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The influence of non-price factors on the market with new building - Case study for Warsaw and Prague

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Abstract

Purpose of the article The purpose of this article is to identify the factors influencing the number of building permits in the capital city of Warsaw and capital city of Prague. The influence of macroeconomic, microeconomic and demographic factors is examined.

Methodology/methods This study uses secondary data from the Polish Statistical Office and the Polish National Bank. Other data is taken from Czech Statistical Office and EUROSTAT. General scientific methods are Granger causality and multifactor regression.

Scientific aim The global focus of the article is econometric modeling. A particular center uses these models to evaluate the impact of factors for which enough data samples are not established. The evaluation of two distinct regions will estimate the significance of unique factors, their agreement, and possible variations.

Findings A key indicator of market development is the number of building permits. This variable represents the novelty of the approach. Previous approaches have defined this change as marginal; the approach presented here shows the number of building permits concerning other real estate market parameters. This article's findings are primarily relevant for the supply and demand side, i.e., for citizens and building companies. Furthermore, the results show a clear link between the number of building permits and economic growth.

Conclusions GDP growth is a statistically significant factor in the growth in the number of building permits for the capital city of Warsaw and capital city of Prague. GDP is a common factor for both selected cases. A statistically significant factor for the case of Warsaw is the Average Wage Index. These factors are significant at all levels. At lower levels of significance, the Housing Price Index and Number of Inhabitants are significant for Warsaw. In the case of Prague, it is only the Consumer price index. Granger's causality showed that the GDP variable is statistically significant for both the case of Warsaw and the case of Prague. In the case of Prague, this is a dual causality, which has not been confirmed in the case of Warsaw.

Keywords: new residence building; granger causality; determinants; multiple regression; GDP

JEL Classification: C23, R21, R31

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Introduction

Houses are generally taken as a safe investment, not only for the satisfaction of basic needs of life but also as an investment tool. The real estate market for the whole economy is significant. The growth of the real estate market and construction affect economic growth. Over the past few years, however, significantly increased the price of real estate and thus the price of residential housing. The media often refer to "the growth of price bubble." This bubble, in the long run, has a major impact on macroeconomic indicators, namely GDP. Adoniades (Adoniades, 2015) states that the decline reaches up four years, against a decline after the bursting of the "bubble equity" is less than half. For entrepreneurs in the development of construction, it is, therefore, the identification of factors that influence the market necessarily. Most models are built, but that evaluates the development of the market as a whole. Contemporary trends in any market segments, however, are based on the increasing differentiation of the product.

Moreover, it is for housing the pressure on the specific adaptation of housing units. Also, this is only possible with a new housing development. Reconstruction of the existing housing stock is possible. Comparison the reconstruction with the new construction is more expensive, or perhaps it is possible only for a small number of residential units. New residential construction is possible only after legislative approval, which is an indicator of new building permits issued for housing construction. A view of the market development only in terms of non-price factors on the supply side is not too frequent. Therefore, the authors focus on the impact of other factors on the number of building permits issued in the selected location. So it is for housing the pressure on a unique adaptation of housing units. Also, this is only possible with a new housing development.

However, the reconstruction of building units is relatively tricky for their identification. The first problem is that not every reconstruction needs a special building permit. On the other hand, a new building al-ways needs this building permit. The conditions of reconstruction are further determined by the need to pre-serve the historical value of buildings. The second reason can be specific conditions in terms of transaction costs. The last reason for reconstruction is that it always means a highly differentiated product with a high degree of variability in the solution. The new building is more precisely located in terms of the price of input factors, customer requirements, and the final product price. It is a product that is more homogeneous than building reconstruction. For this reason, attention will be focused on building permits for new buildings.

The previous text defined the importance of building permits in the real estate market. However, to demonstrate the possible influences of factors on the supply side, it is necessary to select an appropriate environment where these influences can be identified. The solution is to choose countries that are very close in terms of the effects of development factors. They should, therefore, have at least partially historically joint development. The demo-graphic and economic environment parameters should be similar.

The paper aims to evaluate the influence of macroeconomic and demographic variables on the number of building permits issued. This method is unique in that previous work focused only on several achieved new buildings. The following procedures will fulfill the chosen goal: Performing a literature exploration, constructing a database of selected variables, and building an econometric model and its evaluation. The last section concludes.

1 Literature review

The literary research is thematically divided into two units. The first part defines the starting points based on the study of real estate markets in post-communist countries. This approach is because market mechanisms operate here for the same period. Therefore, the development factors in these markets will be expected. In order to compare and verify this procedure, the second part will also identify the environment of developed markets in West-ern European and Scandinavian countries. This comparison will serve to select suitable indicators for the development model based on generally recommended variables.

Literature focusing on the number of building permits issued is relatively rare. As Strauss (Strauss, 2013) mentions in his publication, it turns out that building permits are, to some extent, influenced by consumer expectations. The consumer throe the building permits de-scribe their forecasting the future business cycle and the consequent impact on their situation. If they expect a decline in income, they usually do not invest in housing or do not want to undergo a credit burden to solve housing transactions. His article focused on US countries, with his analysis focusing on the last three decades. He points out that the development of building permits can more accurately estimate employment and national incomes than other traditional indicators.

The issue of balance or imbalance is addressed from the perspective of the Czech Republic. The comprehensive study compiled in 2010 Hlaváček and Komárek. Their view is slight-ly different from the focus of the article, namely the goal of their research was the discovery of market imbalances in terms of the classical microeconomic model of the balance of sup-ply and demand sides. Article significant market factors development can identify this distinction. For the City of Prague is the price of land, demographic developments in terms of population growth and the latter case, the increasing share of foreign investment. The whole Czech Republic but has a slightly different value. The price of land is not a significant variable but instead appears to be a significant factor in the average monthly wage and interest mortgages. (Hlaváček et al. 2016)

Market situation in Poland, particularly in the Lower Silesia province describes (Brzenicka et al., 2018) Their solution is primarily based on solving the contradiction between sup-ply and demand in the property market in Wroclaw. The authors summarize the factors affecting market development. First, summarize findings similar to the previous case of the Czech Republic, namely that demographic, and economic indicators influence the market trend. However, the results of the article show that a significant factor in the development of the market behavior of participants in both the supply side and the demand side. The results presented analyzes confirm that the information cascade plays a vital role in market pro-cesses. The problem is that the general decision-making actors such schemes. Financial markets are not applicable in this situation. The literature in the Cascades was often providing the context of the capital market, but shares are bought for other purposes than residential property. Information cascades also suggest that market participants act rationally and react to the market situation. However, their behavior undermines the balance of the entire market on a global scale. Behavior that seems irrational in other markets can be considered rational in the property market because the concept of rationality in the housing market is shaped based on a set of other criteria.

Adamuscin et al (2017) made another fascinating contribution within the approach to valuation and subsequent possible decisions on the purchase of the real estate. He tried to describe, define, and analyze the differences in real estate valuation approaches within two EU countries: Poland and Slovakia. It is a critical comparative analysis of the solutions used in the above countries. It is looking for enjoyable, unusual methodological proposals and presenting a current assessment of the assessment methodology applied to real estate. The conclusions of this article can be applied to the Czech Republic as follows: The evaluation principles in these countries are almost identical, with a few minor differences. The main objective is that price factors are very similar. Andrej confirms the fact that individual price levels should not differ fundamentally. However, it always depends on the state of the economy, legislative processes, and other factors. The number of building permits issued is a legislative factor.

Like in Poland and neighboring Lithuania was solved a similar problem real estate bubble. Simanavičiene (2007) for evaluation uses the following variables. GDP, inflation, average wage growth and a rise in real estate prices. Like other variables must be taken into account and the number of "speculators" in the market and further price substitute, i.e., rental housing. Factor that is cited as the least important is the increase in the cost of construction components. In contrast, required more profit owners of construction companies is a crucial factor. The experience of Lithuania and Poland agree in terms of rational behavior of market players, but that, in the long run, leads to growth imbalances.

Oikarinen (2009) evaluates the relationship between real estate prices and household indebtedness. This study of the real estate market from Finland. The model is based on three essential variables: Real housing price, Stock price, and GDP, enhanced by debt-related ratios. The article proves the relationship between the real estate market and GDP. However, a significant relationship between the mortgage market and the Stock price has not been proven.

Philipp (2015) pays attention to the Austrian real estate market. Compared to other countries, Austria differs in a higher proportion of rental housing. The author created a very comprehensive model, which contains a total of 12 variables. These variables can be divided into thematic groups. These are household income and indebtedness, parameters based on capital markets and real estate prices. The results are identical to the previously mentioned conclusions from Poland and Lithuania. The growth of real estate prices is faster than the growth of wages, the availability of housing is decreasing.

Similar research was conducted on the German real estate market. Although Koetter and Poghosyan (2010) focus their study on the stability of the banking market as a whole, they use, like other variants of the classical model of multi-factor regression, for the solution. The basic model defines only two variables: GDP as a macroeconomic

indicator and a demographic indicator of population growth. However, compared to neigh-boring Austria, the authors do not perceive the increase in real estate prices in Germany as drastic.

As previous studies show, the focus on the number of building permits issued is rather exceptional. In the press, however, this issue has been intensively addressed in the coming years. However, it is not yet supported by a corresponding number of scientific articles. One of the biggest problems of the Czech economy is the time required to obtain a building permit, which in some cases can take up to ten years. (ECHO24.cz, 2020) As a result, the Czech Republic ranked 127th out of 185 countries compared in the Doing Business ranking, published by the World Bank, and compares the processing of building permits. If we con-sider only the length of the building permit, Czechia is even in 165th place with 247 days. Of the neighboring countries, Germany is the best (126 days), followed by Poland (153), Austria (222), and Slovakia (286). In the comprehensive ranking, however, Slovakia is 36 places ahead of the Czech Republic. "Year after year, the World Bank confirms to us that the length of building permits is the biggest drag on the Czech economy. Unfortunately, political representation cannot agree on legislative changes that would eliminate this protracted problem," commented Michaela Tomášková, CEO of Central Group. "It is no exception that developers have been waiting for a building permit for five years from the submission of the application." Added Karel Slavíček, sales director and managing director of EDIFICE Construction & Consulting.

2 Research methodology

The research area was chosen for neighboring countries, namely the Czech Republic and Poland. It is for these reasons. Both have a common historical tradition, some voivodships of today's Poland were formerly part of the Czech Kingdom or the Austro-Hungarian monarchy. The Jagiellonian dynasty ruled in the Czech Kingdom in the 15th and 16th centuries. Both states in modern history were established after the First World War. They have a shared history in the period after the Second World War, when they belonged to the East-ern bloc. Both transformed after 1989. In terms of demographic indicators, they have a similar population density, the Czech Republic 131 inhabitants per km2, and Poland 123 inhabitants per km2. The capitals also show similar features; the population density in Prague is 2581 inhabitants per km2, Warsaw has a population density of 3412 inhabitants per km2. In Bratislava, however, the density is only 1169 inhabitants per km2. However, in 2019, Poland showed almost double GDP growth compared to the Czech Republic. If previous data showed the agreement of the selected countries, the GDP growth indicator might have a different effect on the relations examined. A comparison of the number of building permits (Strauss, 2013), (Andrej, 2017) issued in the capital city of Prague and the capital city of Warsaw will be used for the research. The reason for the restriction to the capitals only is as follows: Factors operating in different regions of the country may be different due to their different conditions. However, the factors affecting the capitals are very similar in every economy. Those factors are relevant to the supply and demand side. Specifically, these are real estate prices concerning national prices, higher wage levels, greater competition on the supply and demand side.

This study aims to quantify the effect of non-price factors in the development of new residential housing construction. Only one is chosen market segment and region of the capital city of Warsaw. This choice was made for several reasons. The first is the highest increase in property prices from the perspective of other regions. The second reason is that the capital city has long stable trends than other parts of the state. The capital city generally long retains a similar social structure of the population, which in other parts of the country is not a rule. The last reason is that earlier studies have taken as a reference is always the market situation in the capital. Compared to the traditional concept of factors examined here is the objective of examining the factors not entirely similar conventional models. The determining factor in new construction is just the number of building permits issued.

For the research part formulated the following hypotheses: H1. For growth in the new building permit of residential housing is a statistically significant factor change GDP.

Due to the previous analysis of the literature for further investigation were selected following explanatory variables. Macroeconomic indicators present GDP and Consumer Price Index (Simanavičiene, 2007; Gabrieli, 2018). The demographic factor is the number of inhabitants and unemployment rate (Gabrieli, 2018; Brzenicka et al. 2018; Brzenicka, 2016). The microeconomic factor is represented by the value of the Average Wage Index (Hlaváček and Komárek, 2010) and Housing Prices (Simanavičiene, 2007).

Interval investigation is from 1.1. 2010 to 30. 9. 2018. For the same size input values are converted to values of basic indices, the benchmark is always the average for all four quarters of 2010. The response variable is then the number of building permits granted for residential units.

The reasons for selecting these variables are as follows. GDP is among the frequently selected indicators determining economic development. The Index of Housing Prices is a description of the effects of other non-price factors on selected markets. Consumer Price Index captures both be available balances consumer and partly rational consumer behavior from the perspective of saving, e.g., investment in housing. Population demonstrates the demo-graphic factor. Data for the whole of Poland are selected because the demand for housing in the capital do not include only residents of Warsaw and the surrounding regions, but residents of the country. For the capital city is typical, that the trend increase in the number of inhabitants. For Warsaw, it is since 1990, around 1% per annum. The total number of livings is just one part of the supply side. Increasing of the number of flats is necessary to prepare new building production. And it means new building permits. The saturation of the market development is possible, thanks to the increasing number of residential units.. For the previous variables, similar trends can be documented in both capitals.

To solve these tools were used. Multi-factor linear regression by inspection of the data stationarity, Granger causal relationship autocorrelation, normality test and homoskedasticity test.

3 Materials

The variable number of building permits shows a similar pattern in Warsaw and Prague. The mean shoes, the little differentiation, maximal value are practically the same. High standard deviation describe a strong seasonal effect on this market. The reasons for the selection and variables for the capital city of Prague are identical to the selection of the capital city of Warsaw. The Basic statistical description provides the following tables.

Table 1 The descriptive statistics data file WARSAW

Variable	Descriptive statistics						
	N valid	Mean	Minimum	Maximum	Std. Deviation	Skewness	Kurtosis
Number of building permits	35	529.6571	129.0000	1289.000	309.2588	0.72061	0.11386
GDP	35	12.8600	-7.4000	41.700	11.8447	0.48199	-0.27845
Housing Prices Index	35	10.8018	-1.0014	18.005	5.0786	-1.09141	0.35673
Consumer Price Index	35	7.0778	-0.9534	10.811	3.1322	-1.40820	1.02824
Unemployment rate	35	-16.8514	-60.9529	9.477	23.4681	-0.64159	-1.08491
The Number of Inhabitants	35	-0.1020	-0.2838	0.062	0.1129	-0.06788	-1.53872
Average Wage Index	35	17.1829	-1.1708	41.451	12.1265	0.39036	-0.71844

Source: Own calculations based on https://stat.gov.pl/en/, https://ec.europa.eu/eurostat, 2021

Table 2 The descriptive statistics data file PRAGUE

Variable	Descriptive statistics						
	N valid	Mean	Minimum	Maximum	Std. Deviation	Skewness	Kurtosis
Number of building permits	35	547.6286	94.0000	1390.000	342.6403	0.44464	-0.48356
GDP	35	6.4041	-7.0982	21.495	7.7960	0.33883	-0.61184
Housing Prices Index	35	10.8578	-0.8850	16.513	4.9804	-1.36013	0.53638
Consumer Price Index	35	6.9449	-0.5398	13.962	3.8789	-0.34301	-0.41818
Unemployment rate	35	-25.0349	-68.7973	6.392	24.5340	-0.62705	-1.12798
The Number of Inhabitants	35	0.2115	-0.2832	1.073	0.3675	0.86752	-0.28590
Average Wage Index	35	10.8454	-4.6954	33.564	10.4415	0.72294	-0.28156

Source: Own calculations based on https://www.czso.cz/csu/czso/stavebni-povoleni
https://ec.europa.eu/eurostat, 2021

From the essential statistical files for both capital cities, the following findings can be formulated.

Data are different for macroeconomic variables. The other variables have a very similar structure. The change is only in a different value for GDP and the unemployment rate. Po-land shows a twice faster growth of GDP and practically twice decreasing in the unemployment rate. Unemployment in the Czech Republic is half that in Poland. The Consumer Price Index and population variables are precisely the same. The maximum and minimum values show the same ranges; the development of both countries' population is identical. However, other statistical parameters are comparable; Housing Prices Index shows the same growth in Prague than in Warsaw. A similarly different indicator for both economies is the growth in the average wage. In the Czech Republic, average wage growth is only 1% a year, while in Poland, it is over 3% a year.

4 Statistical evaluation

A necessary condition for creating a model of multi-factor regression is the stationarity of time series. Therefore, the first test will be a stationarity test. For the response, the variable will be used standard Kwiatkowski-Phillips-Schmidt-Shin test. For this test, however, it is necessary to decide on what maximum lag it will be tested. In this case, the number of observations is less than 100. S according to the recommendations in Schwert (2002) the maximum lag can be set to 3. The variable Number of Building Permits will be tested first, as it represents the model's output. Results are as follows:

Table 3 KPSS test for WARSAW

number of observations	35		
Parameter order of delay	3		
test statistics	0.754783		
critical values	10%	5%	1%
	0.122	0.149	0.211
Interpolated p-value	0.01		

Source: Own calculations in GRETL

Table 4 KPSS test for PRAGUE

number of observations	34		
Parameter order of delay	3		
test statistics	0.528124		
critical values	10%	5%	1%
	0.353	0.462	0.715
Interpolated p-value	0.040		

Source: Own calculations in GRETL

The test results show that the data do not meet the stationarity; they contain a trend. The same test performed on the other variables confirms this fact. It is, therefore, necessary to obtain a time series without the existence of a trend. The first step is to calculate the first differences and then retest. In this case, however, the data still does not show stationarity. Therefore, the second difference is used for all variables. Only after this adjustment is the series stationary, the results are shown in the following table.

Table 4 KPSS test for 2nd difference for WARSAW

Variable	KPSS test	
	Test result	p-value
Number of building permits	0.114891	>0.10
GDP	0.1132838	0,.8
Housing Prices Index	0.0770172	>0.10
Consumer Price Index	0.0836356	>0.10
Unemployment rate	0.12226	0.093
The Number of Inhabitants	0.0592241	>0.10
Average Wage Index	0.0878422	>0.10

Source: Own calculations in GRETL

Table 5 KPSS test for 2nd difference for PRAGUE

Variable	KPSS test	
	Test result	p-value
Number of building permits	0.0747861	>0.10
GDP	0.0914743	>0.10
Housing Prices Index	0.0723105	>0.10
Consumer Price Index	0.0716727	>0.10
Unemployment rate	0.108784	>0.10
The Number of Inhabitants	0.058876	>0.10
Average Wage Index	0.0755189	>0.10

Source: Own calculations in GRETL

The next step is to calculate the parameters of the model itself. The general shape of the model is:

$$Y = a + b_1 * X_1 + b_2 * X_2 + \ldots + b_p * X_p \quad (1)$$

The values of each parameter in the following table:

Table 6 Multiple regression result for WARSAW

	b	Std. Deviation b*	t - statistic	p-value
Constant	3.86994	19.6083	0.1974	0.8451
GDP	21.5494	1.09887	19.61	4.21e-017 ***
Housing Prices Index	−67.6705	36.7610	−1.841	0.0771 *
Consumer Price Index	20.2265	29.9301	0.6758	0.5051
Unemployment rate	12.9184	10.1082	1.278	0.2125
The Number of Inhabitants	1721.22	768.887	2.239	0.0340 **
Average Wage Index	−149.902	18.3510	−8.169	1.19e-08 ***
Durbin-Watson statistic	2.123	Critical value	0.8 -1.847	
White test	0.465267	p - value	0.05	
Breusch-Pagan test	0.259175	p- value	0.05	

Source: Own calculations in GRETL

Statistically significant are variables GDP, Average Wage Index and population. GDP and Average Wage Index is statistically significant at both 5% and 1%. The adjusted determination coefficient reaches 96%, which indicates a relatively good model. Durbin-Watson statistics reach 2.134. Critical table values for 35 cases and seven variables are 0.8 - 1.847. The recalculated limits for this case are then 2.153 - 3.2 for the identification of the so-called gray zone. The calculated value lies in the interval 2-2.153, so it is a statistically insignificant negative

autocorrelation. Another test is the heteroskedasticity test for the selected model. White test and Breusch-Pagan test have p values = 0.465267 and 0.259175. P-values are higher than the selected significance level α; it follows that we do not reject H0's hypothesis, and we can say that it is an error term homoskedastic (has constant variance). The last test is the normality test. The chi-square test was used, calculated value p = 0.16379. It is higher than the critical value, so the Chi-square test showed a normal distribution error term.

The same procedure was used to calculate the model in the capital city of Prague. The control parameters of the model are discarded similarly to the Warsaw model. Durbin - Watson statistic = 2.479, Breusch-Pagan test p = 0.615. The adjusted determination coefficient reaches 83%The parameters of the model contain the next table.

Table 7 Multiple regression result for PRAGUE

	b	Std. Deviation b*	t - statistic	p-value
Constant	14.8259	58.6910	0.2526	0.8026
GDP	52.6718	11.7061	4.500	0.0001 ***
Housing Prices Index	56.1733	46.3857	1.211	0.2368
Consumer Price Index	−268.585	106.972	−2.511	0.0186 **
Unemployment rate	−26.0302	24.0775	−1.081	0.2896
The Number of Inhabitants	119.866	579.156	0.2070	0.8376
Average Wage Index	9.12702	11.0364	0.8270	0.4158
Durbin-Watson statistic	2.479	Critical value	0.8 -1.847	
Breusch-Pagan test	0.615	p- value	0.05	

Source: Own calculations in GRETL

In the last part will be tested Granger causality. Granger causality (Granger, 1969) is not causality in the sense of causal dependence. When Granger causality occurs, only one is necessarily satisfied with the assumptions placed on causal causality. This assumption is temporal precedence between X and Y. Granger causality testing is, therefore, only a matter of whether changes to the variable X precede changes to the variable Y. If X conditions the variable Y, the X's delayed values can be significant in the equation for Y. If this is true and not the opposite dependence, there is a one-way causality from X to Y. Causality is based on three axioms:

- AXIOM A: The present and the past can have a causal effect on the future, but the reverse relationship does not apply.
- AXIOM B: No redundant information is included. If a variable is deterministically functionally dependent on one or more variables, then that variable should be removed.
- AXIOM C: All causal relationships, their direction, strength, and delay are constant in time (time-invariant).
- The same data is used for testing as for the previous multi-factor regression model. That is, data transformed using the second difference of the original data. The delay parameter is identical to the previous calculations, so it is a value 3. Only variables marked as statistical-ly significant in previous tests were selected for testing.

The results are shown in Table 7 and Table 7. At the level of significance p = 0.05, none of the variables is statistically significant. Thus, Granger's causality cannot be proved. If the level of significance was reduced to p = 0.1. Granger causality would be demonstrable only for the change in GDP. Here the results for the model of Prague and Warsaw are different. For the Warsaw model, it is possible to prove significance at the level of p = 0.1 in the following relation: At the 10% level of significance, the hypothesis that the variable GDP does not affect the variable Number of building permits in terms of Granger causality was reject. The variable GDP has predictive power for the variable Number of building permits. The results show that the opposite causality is not accepted in terms of statistical significance.

Table 8 Granger causality for WARSAW

Order	relationship variables		p-value	F statistics
Y = f (X)	Number of building permits	GDP	0.0899142001386941	2.44253528725374
X = f (Y)	GDP	Number of building permits	0.334573356858852	1.19258163166872
Y = f (X)	Number of building permits	Housing Prices Index	0.602380752249365	0.631126604627588
X = f (Y)	Housing Prices Index	Number of building permits	0.509798047800755	0.793887372918336
Y = f (X)	Number of building permits	The Number of Inhabitants	0.496635546191577	0.819027615979887
X = f (Y)	The Number of Inhabitants	Number of building permits	0.140073918339674	2.01362966390435
Y = f (X)	Number of building permits	Average Wage Index	0.383756535355958	1.06373043327694
X = f (Y)	Average Wage Index	Number of building permits	0.160620151189409	1.88311884982053

Source: Own calculations in R

The Prague model shows different results. At the significance level p = 0.1, for the variable GDP and the number of building permits, both statistics are lower than the significance level. The test proves the existence of Granger causality at the 10% level of significance. The variable GDP, therefore, has predictive power for the variable number of building permits. However, the inverse relationship holds the same. The number of building permits issued has predictive power for the transformation of GDP.

Table 9 Granger causality for PRAGUE

Order	relationship variables		p-value	F statistics
Y = f (X)	Number of building permits	GDP	0.896800062058317	0.1978118900796
X = f (Y)	GDP	Number of building permits	0.059387374428366	2.85402721141704
Y = f (X)	Number of building permits	Consumer Price Index	0.732871010449693	0.43085258386593
X = f (Y)	Consumer Price Index	Number of building permits	0.198254819768912	1.68379927602407

Source: Own calculations in R

4 Discussion

By evaluating the obtained results, it can be argued that there is an effect of the GDP change on the number of building permits issued. These findings are in line with the results of the research. The construction of econometric models examining the influence of selected variables based on multi-factor regression was performed appropriately. The non-stationarity of the time series was removed using the second difference. There was no crisis in the period under review, which would mean the creation of inconsistent data. The identified variables affecting the change in the number of building permits are different. Only two variables show the same effect. To a greater extent, various factors influence the number of building permits in War-saw than in Prague. This fact is proven by the number of statistically significant variables and the calculation of Granger causality. There is no direct evidence for this explanation. According to the authors, this is be-cause the housing market in War-saw is closer to the competitive environment. Thus, both supply and demand side factors are dynamically adapting to market change. Prague's housing market is rigid, with only demand impulses prevailing here without a corresponding response on the supply side. However, this is a topic for future research for which a different methodology should be used to reveal market mechanisms only on the supply side.

Defined hypotheses have the following evaluation: H1. For growth in the new building permits of residential housing is a statistically significant factor change GDP. The answer must be divided into two parts, as the results for Prague and Warsaw are different.

For Warsaw GDP has the most substantial influence. According to the metric used, 1% of GDP means increase in building permits about 22%. The second statistically significant variable is population growth. The coefficient for this variable is the highest. This is the expected result, as population growth clearly increases the demand side, it represents a positive demand factor. Due to the previous variables, however, there is the smallest change, where the average value reaches 0.1%. Thus, the impact on the change in the number of building permits will be a maximum of hundreds. These factors were among the positive. The negative factor, statistically significant at level 10% is the Housing Price Index. The second factor, statistically significant at the 1%, 5%, and 10% levels, is the Average Wage Index. It has a virtually twofold effect on the resulting variable. The increase in limits is, therefore,

a fact when most consumers are looking for another alternative, which may be the reconstruction of housing, not new housing construction.

For the capital city of Prague, GDP is a statistically significant factor. And at all tested levels of significance. The coefficient is twice as high as in the previous model for the capital Warsaw. In the conditions of the Czech Republic, namely the capital city of Prague, GDP growth is, therefore, an important factor in relation to the growth in the number of building permits. It has a positive effect, as in the case of Warsaw. However, the Consumer Price Index is a statistically significant factor only at the level of significance of 5% and 10%. The rise in the price level on the part of consumers is, therefore, a negative factor in the development of the number of building permits. It represents a negative factor on the demand side. In the Warsaw model, this factor was not statistically significant. There is one fundamental difference in the comparison of the two models. The change in the average wage is statistically significant only for the Warsaw environment; in the Prague model, the coefficient for this variable reaches the lowest value; it is not statistically significant. This fact represents a fundamental difference between customer behaviors in both markets. One possible explanation is that in the Polish environment, consumers are much more motivated and able to carry out reconstructions of housing units. Czech consumers are either not technically capable of this; at the same time, there is probably not a sufficient offer of these services. The last option is different legislation in both countries, which is difficult to capture in the form of a numerical model.

The previous results correspond to the calculation of Granger causality. The change in GDP can be used as a predictive indicator in both models. In the case of Warsaw, a causal relationship between GDP growth and growth in the number of building permits was proved. Granger causality was not demonstrated for other statistically significant variables. The results for the Prague model show causality both in the relationship between GDP and the number of building permits, as well as in the opposite relationship. In this case, it is, therefore, possible to define a strong interconnectedness of these variables, which corresponds to the previous results.

Conclusion

The present models provide a different approach to the assessment of development changes in supply real estate market in Warsaw and Prague. A key variable is selected identification number of building permits. By this process differs from the previously presented model because it describes just a part of the real estate market. However, as shown by the literature search parameters offered new housing units are always an essential factor in the rise in prices on the real estate market. Selected Variables respect the primary division of demographic, macroeconomic and microeconomic.

The evaluation took place in two different locations. The capital cities of Warsaw and Prague show both familiar and different development trends. The Consumer Price Index, Housing Price Index and population variables are precisely the same. Data are different for macroeconomic variables. GDP is growing significantly faster in the Poland; the increase is double that in Czech Republic. However, other statistical parameters are comparable; Unemployment in the Czech Republic is less that in Poland. The dynamics of reducing unemployment in the Czech Republic is almost double. Different indicator for both economies is the growth in the average wage. As with the previous variables, the previously mentioned value of 2 can be used here. The growth of average wages in the Czech Republic is 10%, in Poland it is 17%, which is approximately double.

The paper aimed to evaluate the real estate market factors concerning the number of building permits announced. Selected variables correspond to previously finished studies. However, the discrepancy was that the impact of these variables was assessed only on the building permits issued, not on the final number of housing units. The results confirmed GDP growth in both selected localities as an essential parameter. For the other variables, however, the results were inconsistent. The difference is that Warsaw shows a statistically significant effect of the change in the average wage. In Prague, however, this factor is not statistically significant. It can therefore be defined that the number of building permits in Prague is more affected by the effects of irregular variables, typically speculation and in-vestment, than the market in Warsaw. The presented study, therefore, fulfilled the set scientific goal.

These results encounter several potential limitations. The first of these may be unsatisfactory choice variables. Although previous research work drew on similar indicators, the absence of real causality can never be dismissed. The second problem is the limited number of units of databases. For econometric models, it is useful to have data samples are hundreds of cases. Not all variables used but are measured monthly. For this reason, it had to be used only quarterly frequency. The last limitation is strict application conditions multi-factor regression as indicated in

the previous text. It can be assumed that the existence of monthly data would clarify the calculation procedure. Extending the length of the reference period would probably not lead to an improvement, as the condition of the relative stability of the legislation could be called into question. However, the presented procedure accepted the general conditions for creating an econometric model.

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