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Gedonic Estimation of the Office Real Estate Market Value

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ABSTRACT This study dealt with the identification and evaluation of the key hedonic factors of the office real estate market value in the Vakhitovsky administrative district of Kazan. The study also investigated the composition of hedonic characteristics included in the specification of the model, taking into account the characteristics of the terms of the transaction. Empirical estimates of the specifications presented in the study confirmed the hypothesis of the relationship between the market value of the office and the distance to the nearest public transport stop, the location on the first floor, the class of the office, and the availability of parking. Finally, the results of the empirical estimates confirmed the feasibility of the use of this approach to the evaluation of the market value of the office real estate.

INTRODUCTION

Objects of office real estate can be used as an object of investment, as well as be the object of economic turnover, with respect to which a number of property relations are established. The basis of the comparative approach to the evaluation of the market value is to assess the market value using the analysis of market prices of transactions or proposals for the sale of objects that are comparable with the estimated object and took place in the market of the estimated object before the date of evaluation.

According to the comparative approach, there is also a method of assessing real estate objects using regression analysis. Actually, this method is useful for constructing evaluation models if the number of comparable objects exceeds the number of comparison elements by 5-10 times. Moreover, the comparative approach is actively used for evaluating commercial real estate. Therefore, for the evaluation of office real estate, this approach gives the most objective assessment, taking into account the market situation, but at the same time, it depends on the quality of the data collected. A comparative approach in the presence of a sufficient amount of information allows to obtain reliable and, importantly, easy to explain results of the valuation. With the same limited amount of data, this approach allows one to get the range, in which the cost can be estimated. This type of information is also useful as a test for other assessment approaches (Lieser and Groh 2014; Sun et al. 2015; An et al. 2016; Zhang et al. 2016).

In the researchers' opinion, the regression model of the office property market value can be considered as a hedonic model that links market prices with the value characteristics of offices. The main idea of the hedonic model is that the market value of the office consists of the usefulness of the measured quantitative and qualitative value characteristics of the office as a commodity. The model analyzes the consumer's desire to pay for certain clearly observed characteristics of the office. The coefficients in the hedonic model indicate the implicit price of each characteristic; that is, the value of each characteristic in the total value of the land. The first applications of the hedonic model to the analysis of prices were made in the following publications (Griliches 1971; Rosen 1974; Epple 1987; Ignatenko and Mikhailova 2015; Seo et al. 2019).

However, some studies compared different functional forms of hedonic regression in the problems of variation of office rent prices (Brennan et al. 1984; Frew and Jud 1988; Bollinger et al. 1998; Olszewski et al. 2018). As a rule, authors of works on commercial real estate (Frew and Jud 1988; Shilton and Zaccaria 1994; Sivitanidou 1995; Colwell et al. 1998; Bollinger et al. 1998; Cervero and Duncan 2002) achieved similar results on the impact of the characteristics of the office on the price. In addition, residential real

estate was subjected to a closer analysis of researchers due to both social significance and data availability (Case and Shiller 1987; Arnott 1987; Haurin 1988; Smith and Tesarek 1991; Case and Shiller 1994; Glumac et al. 2019). In Russian practice, there is enough publicly available and detailed data on the real estate market, but few scientific papers have been devoted to this topic. In practice, there is no econometric analysis of the office real estate market, especially assessment of the market value, in the Russian scientific practice.

Objectives

Therefore, this study aims to build a hedonic regression model of the market value of office real estate with a set of variables that can take into account the value characteristics of the office.

METHODOLOGY

With a comparative approach, this study used a statistical method of the cost calculation; that is, regression analysis to calculate the market value of the real estate object to be sold – office space. The method of regression analysis was considered the most appropriate one for calculating the market value of the estimated real estate object or office space, since the number of comparable objects or analogues is large enough. Therefore, in order to construct a linear regression model, a sample of office space was compiled with a total of 50 observations. Offices of classes A and B of Vakhitovsky administrative district of Kazan were included in the sample. Then, characteristics of the objects of comparison were received from an electronic resource "Domofond.ru". The use of regression analysis would reveal the regularity of the influence of the main factors on the studied indicator – the cost of the office property. Finally, the office property subject to sale on the basis of regression analysis was evaluated according to the following sequence of actions:

1. Formation of a homogeneous objects sample of office real estate - analogues and initial information collection,
2. Selection of the main pricing factors affecting the office property cost,
3. Estimation of the regression model on the office real estate sample – analogues,
4. Verification of the model estimates, and
5. Calculation of the office property market value to be sold.

Based on the analysis of the real estate market, the cost of office space per square meter was chosen as the dependent variable in the regression model – Y, the following, available for all objects of comparison, variables were selected as regressors: the distance to the nearest public transport stop (km) – X1, the distance to the nearest metro station (km) – X2, the distance from the city center (from the Kremlin St, d. 1, km) –X3, the floor – X4, office class – X5, the availability of parking – X6, location relative to the 1st line – X7. Thus, the researchers assumed that the selected objects - analogues and the object of evaluation have no significant differences in the variables not included in the model (year of construction and design features of the house, the presence of ennobled areas, etc.) and all the data obtained using information portals are true. It should be noted that variables X1, X2, and X3 are quantitative and can be included into the model without transformations. Moreover, variables X4, X5, X6, and X7 are qualitative. Of course, the researchers used binary variables for their transformations. In fact, variable X4 will take the value 1 if the office is located on the ground floor and the value 0 if the office is not on the ground floor. The variable X5 will be set to 1 if the room is renovated using modern materials according to the European standards corresponding to class A; otherwise, the value will be 0. In addition, the variable X6 will be set to 1 if there is parking and 0 if there is no parking. Finally, the variable X7 will take the value of 1 when the office is located on the 1st line; otherwise, it is 0 on the other line.

It should be noted that the linearized model specifications were analyzed by the usual least squares method in the Gretl Software environment (Greene 2003; Wooldridge 2013; Yakupova et al. 2017). However, the potential impacts of the pricing factors, which compare the office properties, are different in the provided model. The researchers made intuitive examination of the validity of the signs, when the coefficients of the econometric hedonic model conform with the nature of the influence of pricing factors. In

addition, the researchers used the coefficient of determination, average error of approximation, and Fisher's exact test and Student's t-test to verify the quality of the obtained models.

RESULTS AND DISCUSSION

A correlation analysis was performed to determine the presence and strength of the relationship between the variables. Table 1 reports the results of the correlation analysis.

According to the table, there is a moderate feedback of regressors X1, X2, X3 and the dependent variable Y.

The next step was to test for multicollinearity factors, the presence of which could lead to loss of accuracy and reliability of the model parameters, the presence of large standard errors, and misinterpretation of the importance of factors (Ignatenko and Mikhailova 2015). However, as shown by the results in Table 1, it could be said that the regressors X2 and X3 are closely interrelated (correlation coefficient equals 0.7377). Thus, the researchers excluded the X2 regressor and re-constructed the matrix of linear coefficients of pair correlations to eliminate multicollinearity (Table 2).

According to Table 2, regressors are not collinear. Table 3 presents the results of the regression analysis.

According to Table 3, results did not confirm the relationship between the cost of office space per square meter with regressors X3 - distance from the city center- and X7 – location on the first line. This could be explained by the fact that almost all the offices included in the sample were located on the first line, and the X3 regressor was "embedded" in the factor X1 - the distance from the public transport stop. Finally, we excluded insignificant variables from the model, which allowed obtaining the result of regression analysis that is represented in Table 1.

As shown in Table 4, the distance to the nearest public transport stop (X1), the floor on which the office space was located (X4), the office class (X5), and the availability of parking (X6) explain 59 percent of the variation of the dependent variable – the market value of office space per square meter. Other value characteristics explain 41 percent of the variation in the market value of offices. However, results of Fisher's exact test demonstrated rejection of the null hypothesis of the joint equality of regression coefficients to zero at all possible levels of significance (Glumac et

Table 1: Matrix of pair correlation linear coefficients

	x^1	x^2	x^3	x^4	x^5	x^6	x^7	y
x^1	1.0000							
x^2	0.0948	1.0000						
x^3	0.4590	0.7377	1.0000					
x^4	-0.0325	0.1334	0.1295	1.0000				
x^5	-0.0979	-0.2352	-0.2693	0.1909	1.0000			
x^6	0.2080	-0.3075	-0.1215	-0.1667	-0.0174	1.0000		
x^7	-0.4621	-0.4083	-0.3894	-0.0304	0.2777	-0.0456	1.0000	
y	-0.3933	-0.3738	-0.3637	0.3760	0.3918	0.2738	0.1655	1.0000

Source: Obtained by authors in MS Excel

Table 2: Matrix of pair correlation linear coefficients one regressor X2

	x^1	x^2	x^3	x^4	x^5	x^6	x^7	y
x^1	1.0000							
x^3	0.3590	1.0000						
x^4	-0.0325	0.1295	1.0000					
x^5	-0.0979	-0.2693	0.1909	1.0000				
x^6	0.2080	-0.1215	-0.1667	-0.0174	1.0000			
x^7	-0.3621	-0.3894	-0.0304	0.2777	-0.0456	1.0000		
x^y	-0.3933	-0.3637	0.3760	0.3918	0.2738	0.1655	1.0000	

Source: Obtained by authors in MS Excel

Table 3: Regressive analysis results

	Coefficient	*Standard error*	*t-statistics*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	52427.79	9702.20	5.40	0.00	32847.95	72007.63
x^1	-22757.89	14755.79	-1.54	0.01	-52536.27	7020.49
x^3	-2202.88	1928.79	-1.14	0.26	-6095.34	1689.59
x^4	17961.33	4386.79	4.09	0.00	9108.42	26814.24
x^5	14434.22	5737.59	2.52	0.02	2855.30	26013.15
x^6	23842.27	7094.80	3.36	0.00	9524.38	38160.16
x^7	375.25	5434.40	0.07	0.95	-10591.81	11342.31

Source: Obtained by authors in MS Excel

Table 4: Regression analysis results after eliminating redundant variables

Regression statistics	
Multiple R	0.75
R-square	0.59
Normalized R-square	0.51
Observation	50
Analysis of variance	

	df	*SS*	*MS*	*F*	*P-value F*
Regression	5	11047557642.39	2209511528.48	11.28	0.0000005
Residual	44	8621636972.45	195946294.83		
Total	49	19669194614.84			

	Factors	*Standard error*	*t-statistics*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	48534,17	7073,05	6,86	0,000	34279,38	62788,96
õ1	-31716,63	11759,09	-2,70	0,010	-55415,51	-8017,75
õ4	17075,10	4280,88	3,99	0,000	8447,56	25702,63
x5	16573,74	5280,37	3,14	0,003	5931,85	27215,63
õ6	25814,17	6842,66	3,77	0,000	12023,69	39604,66

Source: Obtained by authors in MS Excel

al. 2019). Therefore, the model is statistically significant and reliable. Moreover, student's t-test indicated that regression coefficients for regressors X1, X4, X5, and X6 are statistically significant, which confirms the existence of a linear relationship between these value characteristics and the market value of offices at all possible levels of significance. Hence, using estimates of the linear multiple regression model:

$y = 48534.17 - 31716.63^{*} x_1 + 17075.10^{*} x_4 + 16573.74\, x_5 + 25814.17\, x_6 + \varepsilon$, it is possible to estimate the market value of the office property subject to sale in the Vakhitovsky administrative district of the city of Kazan.

Based on the analysis, the simulation results could be summarized in several conclusions.

Firstly, if the distance to the nearest public transport stop increases, the market value of the land plot decreases by an average of 31716.63 rubles. This is consistent with economic intuition (Yakupova et al. 2017). Secondly, the presence of access roads with hard surface would increase the market value of the land by an average of 31409.44 rubles. Thirdly, the office location on the ground floor increases its market value by an average of 17075.10 rubles, office class enhances its market value by an average of 16573.74 rubles, and the availability of parking would be increased by 25814.17 rubles (Ignatenko and Mikhailova 2015).

However, the relationship between the factors of the market value of office space and the distance from the city center and the location on the first line was not confirmed. This situation could be explained by the fact that the Vakhitovsky administrative district, for which a sam-

ple of observations was formed, was located in the center of the city and dominated by office space in comparison with residential.

CONCLUSION

Currently, the real estate market is one of the most dynamic Russian markets, and thus real estate is an attractive investment. Therefore, a comparative approach to the evaluation of the value of the real estate would be recommended to apply when reliable information is available to analyze the prices and characteristics of the objects-analogues. For real estate objects, for which there is sufficient information about recent sales transactions or existing to date, selling the most effective method of comparing sales would be offered.

According to the analysis of the evaluation features of the office real estate objects, specificity of the evaluation of offices imposes certain restrictions on the choice and application of evaluation approaches and requires careful study of all factors affecting their market value. However, an appropriate method of office space evaluation consists of features related to the quality of offices and economic features that should be based on the principles of the rental economy and the evaluation principles.

RECOMMENDATIONS

Following the completion of the scope of this study, it is recommended to consider these values for estimating the real estate market office value: Production and foreign trade, Key market players, Declarations of market participants, the analysis of public tenders.

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REFERENCES

An X, Deng Y, Fisher JD, Hu MR 2016. Commercial real estate rental index: A dynamic panel data model estimation. *Real Estate Economics*, 44(2): 378-410.

Arnott R 1987. Economic theory and housing. In: ES Mills (Ed.): *Handbook of Regional and Urban Economics*. Chapter 24, Volume 2, 1st Edition. Elsevier, pp. 959-988.

Bollinger CR, Ihlanfeldt KR, Bowes DR 1998. Spatial variation in office rents within the Atlanta region. *Urban Studies*, 35(7): 1097-1118.

Brennan TP Cannaday RE, Colwell PF 1984. Office rent in the Chicago CBD. *Real Estate Economics*, 12(3): 243-260.

Case KE, Shiller RJ 1987. Prices of single family homes since 1970: New indexes for four cities.*New England Economic Review*, 2(1): 45-56.

Case KE, Shiller RJ 1994. A decade of boom and bust in the prices of single-family homes: Boston and Los Angeles, 1983 to 1993. *New England Economic Review*, 3: 40-51.

Cervero R, Duncan M 2002. Benefits of proximity to rail on housing markets: Experiences in Santa Clara County. *Journal of Public Transportation*, 5(1): 3.

Colwell PF, Munneke HJ, Trefzger JW 1998. Chicago's office market: Price indices, location and time. *Real Estate Economics*, 26(1): 83-106.

Epple D 1987. Hedonic prices and implicit markets: Estimating demand and supply functions for differentiated products. *Journal of Political Economy*, 95(1): 59-80.

Frew J, Jud D 1988. The vacancy rate and rent levels in the commercial office market. *Journal of Real Estate Research*, 3(1): 1-8.

Glumac B, Herrera-Gomez M, Licheron J 2019. A hedonic urban land price index. *Land Use Policy*, 81: 802-812.

Greene WH 2003. *Econometric Analysis*. India: Pearson Education.

Griliches Z 1971. *Price Indexes and Quality Change: Studies in New Methods of Measurement*. USA: Harvard University Press.

Haurin D 1988. The duration of marketing time of residential housing. *Real Estate Economics*, 16(4): 396-410.

Ignatenko A, Mikhailova T 2015. Pricing in the office rental market in Moscow: Hedonic analysis. *Economic Policy*, 4: 156-177.

Lieser K, Groh AP 2014. The determinants of international commercial real estate investment. *The Journal of Real Estate Finance and Economics*, 48(4): 611-659.

Olszewski K, Decyk P, Galaszewska K, Jakubowski A, Kulig M, Modzelewska R, Zywiecka H 2018. Hedonic analysis of office and retail rents in three major cities in Poland. *Recent Trends*, 29: 383.

Rosen S 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy*, 82(1): 34-55.

Shilton L, Zaccaria A 1994. The avenue effect, landmark externalities, and cubic transformation: Manhattan office valuation. *The Journal of Real Estate Finance and Economics*, 8(2): 151-165.

Seo K, Salon D, Kuby M, Golub A 2019. Hedonic modeling of commercial property values: distance decay from the links and nodes of rail and highway infrastructure. *Transportation*, 46(3): 859-882.

Sivitanidou R 1995. Urban spatial variations in office-commercial rents: the role of spatial amenities and

commercial zoning. *Journal of Urban Economics*, 38(1): 23-49.
Smith BA, Tesarek WP 1991. House prices and regional real estate cycles: Market adjustments in Houston. *Real Estate Economics*, 19(3): 396-416.
Sun L, Titman SD, Twite GJ 2015. REIT and commercial real estate returns: A postmortem of the financial crisis. *Real Estate Economics*, 43(1): 8-36.
Wooldridge JM 2013. *Introductory Econometrics: A Modern Approach.* 5th Edition. Mason, OH: South-Western.
Yakupova NM, Levachkova SJ, Kadochnikova EI, Beilin IL 2017. Measurement of cost factors: Evidence from trading companies. *International Journal of Economic Perspectives*, 11(4): 794-802.
Zhang D, Zhu P, Ye Y 2016. The effects of E-commerce on the demand for commercial real estate. *Cities*, 51: 106-120.

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