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REGRESSION ANALYSIS OF SELECTED TECHNICAL AND ECONOMIC PARAMETERS OF THE RESIDENTIAL MARKET IN THE CZECH REPUBLIC

Abstract:

Currently, there is an increasing interest in the real estate market and many small and large investors regularly monitor real estate prices and price trends at the national and regional level. The covid-19 pandemic has caused a change in long-term trends in the real estate market. The paper deals with a regression analysis of selected technical and economic parameters that affect the real estate market in the Czech Republic. Specifically, these parameters are: the relationship between the average mortgage rate and the price of an apartment for sale, the relationship between the average mortgage rate and the number of properties offered for sale and the influence of the existence of a terrace, balcony or loggia on the unit price of the apartment. The results of the work are based on the EVAL software, which collects data on real estate advertising in the Czech Republic.

Keywords:

Real estate market, EVAL software, regression analysis

JEL Classification: C13, C35, R31

1 Introduction

Investments in the real estate market today can represent an interesting appreciation of money and at the same time support the growth of the national economy and GDP. It is therefore useful to examine the key parameters that affect the market value of real estate and its future development.

The article examines the dependencies between several technical and economic parameters of the real estate market in the Czech Republic. The residential market for the sale and rental of apartments and the return on investment are examined. The calculation includes input data for the period January 2018 to June 2021.

Input data from the EVAL software, which the author of the paper has been developing for a long time, are used. The EVAL software database contains a huge number of investigated technical and economic parameters, for which it is possible to perform a regression analysis and examine the value of the correlation coefficient. This article selects some of these parameters that may be of interest to the professional public.

Many authors around the world are researching the development of the real estate market. For example, the paper [1] evaluates the impact of the COVID-19 epidemic on the real estate market using a community-level panel dataset of 34 major cities in China. It was founded that the average housing price in communities with COVID-19 infections decreases by approximately 1.3% compared to communities with no confirmed cases.

In the Czech Republic, a paper [2] deals with a similar topic. The paper aims to find links between selected demand and supply determinants based on a panel regression of regional data during 2000-2017 and to contribute to further discussion of the role of these determinants. The main output of the paper is the identification of regional differences in the direction and strength of the influence of individual determinants on the flat price.

The impact on the price level of real estate is also significantly influenced by spatial development plans. The paper [3] analyses the impact of the current local spatial development plans on the activity of investor on the Polish residential real estate market. Four selected cities located in different parts of Poland were analysed. The authors proposed determining the investor activity indicator as a measure of this impact.

The paper [4] contains a revised valuation framework based on the life cycle cost (LCC) of residential properties, focusing on the operation phase. This research also benefitted from the 5D BIM model with a level of development (LOD) of 300 to increase the transparency and validity of valuation.

Real estate ownership also has a significant link to the age of buyers. The paper [5] identifies and analyses the key determinants of the housing tenure regime and residential independence of young adults in Spain. There is used a multilevel strategy that allows to take into account the heterogeneity amongst regions in both homeownership rate and residential independence rate.

The market value of real estate is also affected by its total life cycle cost (LCC) and the method and intensity of property maintenance. Some potential property buyers do not realize that the

operating costs over the life of the property will exceed the original cost of construction. These issues are addressed, for example, here [6, 7, 8].

The paper [9] sets out to explore the strength of the relationship between the proximity of a property to the city centre and its price. It was determined how much does a one minute of commuting time influence the price of an apartment in Prague. It was found that on average, every minute of commuting time closer to the city centre corresponds to an additional cost of CZK 43,390.45 for an average sized apartment in Prague.

2 Methodology

Regression analysis is a statistical method that allows us to examine the relationship between two variables - the independent variable (X - we call the regresand, the target variable) and the dependent variable (Y - we also call the regressor). The analysis helps us to understand how the value of a dependent variable changes following a change in one of the independent variables while the other independent variables remain constant. The final estimate is based on the so-called regression function.

We express linear regression as follows

$$y = b_1 x + b_2, \tag{1}$$

where optimal values are found for coefficients b_1 and b_2.

Logarithmic regression is a specific case of linear regression where the data set is prolonged by logarithmic function:

$$y = b_1 ln(x) + b_2 \tag{2}$$

Input data from EVAL software are used to process correlation and regression analysis. The EVAL software processes data contained in real estate advertising in the Czech Republic on a regular basis. The database includes all cities in the Czech Republic. The data used are adjusted for errors occurring in real estate advertising and possibly for manipulative techniques by real estate agencies. There is an effort to remove duplicate ads in real estate advertising.

3 Results and discussion

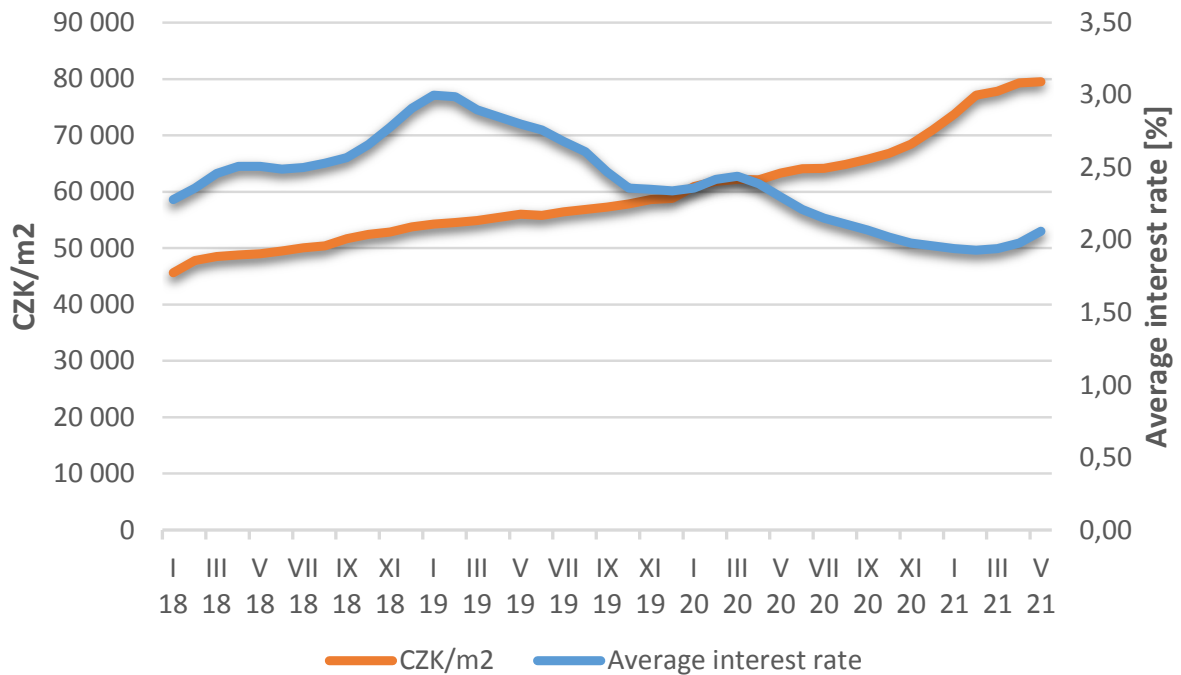### 3.1 The relationship between the average mortgage rate and the price of an apartment for sale

Figure 1 shows the relationship between the average mortgage interest rate in the Czech Republic and the average price of an apartment for sale. The analysis includes flats from all regions of the Czech Republic. Average mortgage interest rates are based on the Fincentrum Hypoindex indicator (https://www.hypoindex.cz/).

Hypoindex is the weighted average interest rate at which new mortgage loans for individuals are provided in a given calendar month. The weights are the volumes of loans provided. The input

data for the calculations are provided by the following banks: Air Bank, Česká spořitelna, ČSOB, Equa Bank, Moneta Money Bank, Hypoteční banka, Komerční banka, Raiffeisenbank, Sberbank CZ and UniCredit Bank.

It was found that the lower the interest rate, the higher the unit price of the apartment for sale. A lower average interest rate allows more people to get a mortgage loan. At the same time, however, this fact causes the demand for real estate to grow, and thus the price per square meter also increases. The value of the correlation coefficient is -0,725. The regression function has the form:

$$y = -52731*ln(x) + 105538 \qquad (1)$$

Figure 1 The relationship between the average mortgage rate and the average offer price for sale of an apartment per 1 square meter of floor space (the Czech Republic, time period January 2018 to May 2021)
Source: Software EVAL, https://www.hypoindex.cz/

3.2 The relationship between the average mortgage rate and the number of properties offered for sale
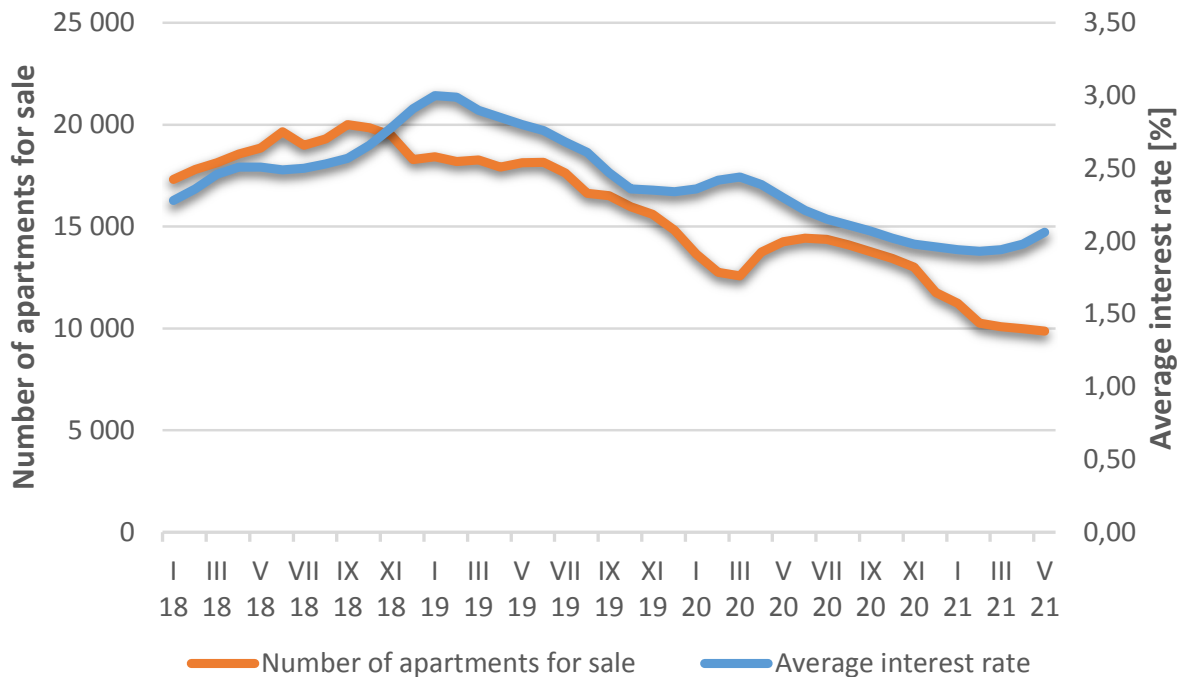
Figure 2 shows the relationship between the average mortgage rate and the number of ads that EVAL recorded in its database in a given month. Low interest rates cause great interest in acquiring all types of real estate in the Czech Republic. This fact leads to a decrease in the availability of owner-occupied housing because the average amount of the mortgage has increased significantly, and especially young people will be forced to live in long-term rent. This fact will cause an increase in social tension in society.

Currently, it is very difficult to find a suitable property to buy on the real estate market because the market is practically sold out. This fact is influenced not only by low interest rates but also by a

number of other factors (large savings of part of the household that were not financially affected by the covid-19 pandemic, dysfunctional pension reform, fear of inflation and others).

In the following period, the current situation will definitely not improve because there are restrictions in construction production. There is a significant increase in the price of building materials, building materials are often completely inaccessible (especially steel, insulation materials, wood) and there is a lack of foreign labour, which formed a significant part of workers in construction companies, especially in the manual professions. The value of the correlation coefficient is 0,808. The regression function has the form:

$$y = 19582*ln(x) - 1338,1 \qquad (2)$$

Figure 2 The relationship between the average mortgage rate and the number of ads that EVAL recorded in its database in a given month (the Czech Republic, time period January 2018 to May 2021)
*Source: Software EVAL, https://www.hypoindex.cz/*

3.3 The influence of the existence of a terrace, balcony or loggia on the unit price of the apartment

In the media, we encounter the opinion of some experts that the price of apartments has risen if they contain a terrace, balcony or loggia, especially during the covid-19 pandemic. This view was therefore examined using EVAL software data. Figure 3 shows the relationship between the average offer price for sale of an apartment per 1 square meter of floor space and the existence of a terrace, balcony or loggia. Input data for the years 2018 to 2021 were used for the analysis. However, the results obtained are in conflict with the general opinion of the professional public.

It was found that in 2018 apartments that contained a terrace, balcony or loggia were on average seven percent more expensive than average apartments without distinguishing these

accessories. In the following years, however, this deviation decreased evenly. In 2021, this deviation was only 4%.

A closer examination of the data revealed that the largest difference in the unit price is when the apartment contains a terrace. It has the least effect on the price if the apartment contains a loggia.
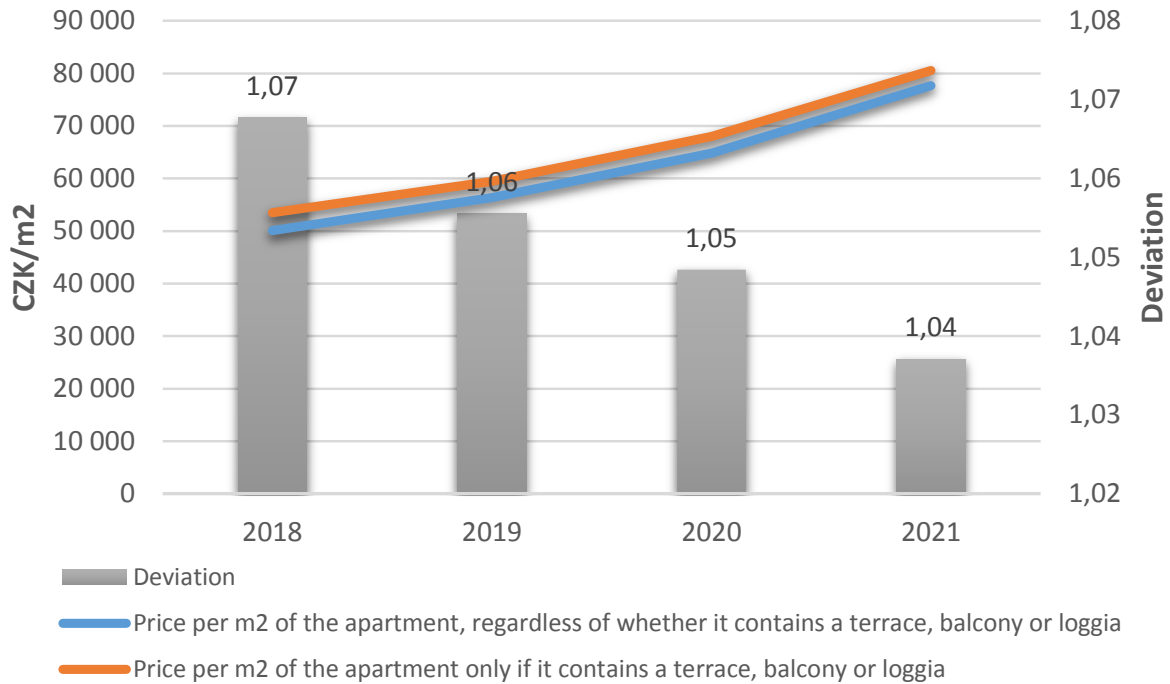
Figure 3 The relationship between the average offer price for sale of an apartment per 1 square meter of floor space and the existence of a terrace, balcony or loggia (the Czech Republic, time period January 2018 to June 2021)
*Source: Software EVAL*

In the case of renting an apartment, the situation on the real estate market develops differently than in the case of selling an apartment. The results are significantly affected by the covid-19 pandemic, as rental housing prices fell between 2020 and 2021.

In 2018 and 2019, a deviation of 3% was found if the apartment contained a terrace, balcony or loggia. However, no statistically significant deviation was observed in 2020 and 2021. Apartments for rent are offered for the same price, whether they include a terrace, balcony or loggia, or this apartment does not include these accessories.

The most significant reason will probably be the fact that in the Czech Republic there is currently a surplus of apartments offered for rent and many landlords and owners offer apartments at dumped prices. They are based on the situation that it is better to rent an apartment for a low price than to have an empty apartment. This situation is likely to be only temporary and, once the pandemic measures have subsided, the real estate market will gradually return to its original

state. However, it should be noted that changes in the real estate market take place with some time lag.

A closer examination of the data revealed that the existence of the terrace had the most significant effect on the demand. As with apartment sales, the existence of a loggia has the least effect on the rental demand.
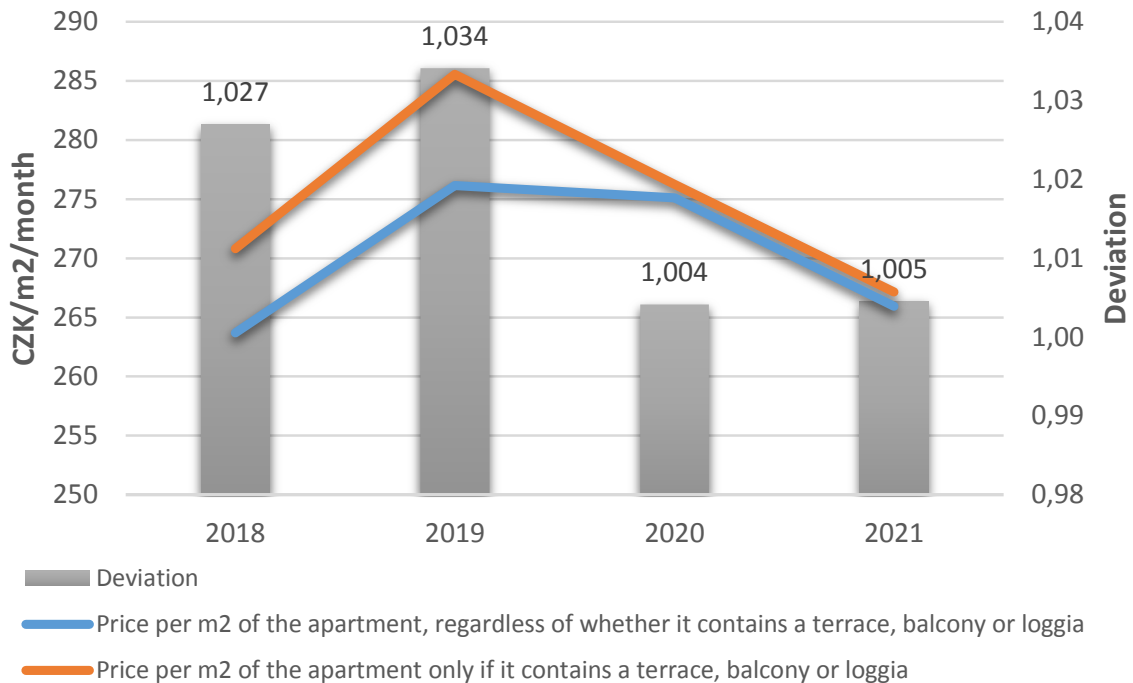
Figure 4 The relationship between the average offer price for rent of an apartment per 1 square meter of floor space per month and the existence of a terrace, balcony or loggia (the Czech Republic, time period January 2018 to June 2021)
Source: Software EVAL

4   Conclusion

The paper presents an analysis of selected technical and economic parameters that affect the demand and supply of real estate in the Czech Republic. It was found that the low average interest rate on mortgages has a significant impact on interest in acquiring all types of real estate. Due to the effects of the covid-19 pandemic, it is difficult for the central bank to return interest rates to standard levels, as many economic sectors would be damaged at the same time. However, a negative side effect is the rapid rise in real estate prices, and a significant reduction in the supply of real estate for sale will lead to a further reduction in the availability of owner-occupied housing in the future, which will be paid for, especially by young people.

Part of the professional public expresses the opinion that there is an increased demand for apartments, which also include a terrace, balcony or loggia. Increased interest in this type of real estate has been identified, however, there is no significant impact on the price level. In the housing rental market in particular, no dependency has been identified. If in the future the restrictions caused by the covid-19 pandemic are reduced, it can be assumed that the public's interest in purchasing apartments containing a balcony, loggia or terrace and the interest in purchasing holiday cottages will decrease compared to the current situation.

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