Development of the Office Space Prices on the Czech Market

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Abstract

The price developments in the commercial real estate market can affect the financial stability of countries, particularly through the level of lending by companies operating in this area. In the literature, research can be found dealing mainly with residential real estate, while commercial real estate stands rather in the background. The aim of this paper is to analyse the price development of the office space (CRECVI index) in the Czech market between years 2005 to 2022.

As part of the cointegration analysis, an ADL model is constructed to describe how commercial real estate prices respond to changes in selected macroeconomic indicators. The results of the analysis show that office space prices are mainly influenced by the evolution of gross domestic product, unemployment and the level of inflation and interest rates.

Key Words

Cointegration analysis, CRECVI index, ADL model, commercial real estate

JEL Classification: C51, F63

Introduction

The property market has been going through major fluctuations in recent years, first brought about by the COVID-19 pandemic, followed by a sharp rise in property prices, which was quickly replaced by a period of high interest rates and recession. High inflation rates are also causing rising construction and energy costs. For many companies in need of warehouses, office space or production halls, it may be more profitable to lease these spaces on a long-term basis. The commercial property market is therefore currently stagnant, and investors are waiting for commercial property prices to fall.

The description and modelling of office space real estate prices can be a useful tool to understand the dynamics of this market. The real estate transactions monitored focus on the main sector of the market, which represents only the most lucrative properties. Thus, the rest of the market, which does not meet the standard of prime real estate, is not included in the analysis. However, the advantage of looking only at prime property is comparability with other countries. These analyses therefore include mainly capital cities and other large cities.

1. Development of the Prague office market

The COVID-19 pandemic has caused hard times for the office market. However, this market soon stabilized and vacancy rates began to slowly decline. At the end of 2022, the vacancy rate in Prague will reach 7.7%, equivalent to 293,600 sqm. In Q1 2023, the Prague office vacancy rate decreased to 7.5%, the lowest since the end of 2020. By district, the

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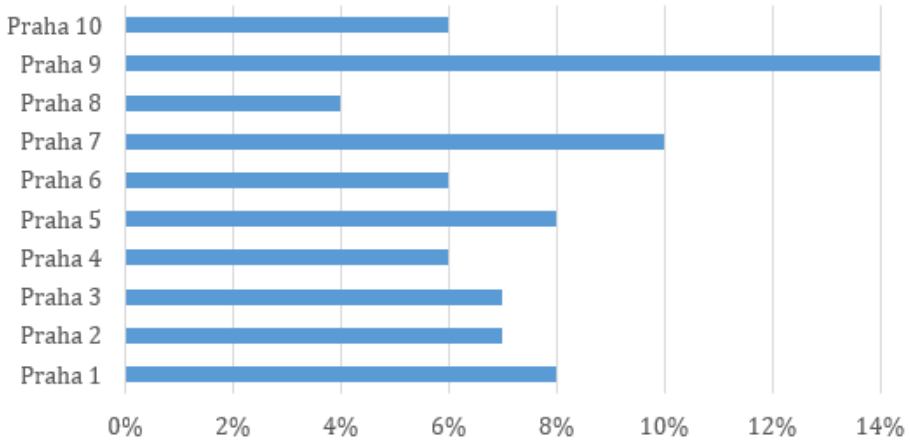
highest vacancy rates were in Prague 4 (56,400 sqm) and Prague 5 (52,100 sqm). By the end of 2022, vacancy rates in Prague 4 and Prague 9 decreased significantly. On the other hand, Prague 7 and Prague 1 recorded the largest increase, mainly due to new speculative construction. The vacancy rates in each urban area are shown in Figure 1.

Fig. 1: Vacancy rate in Prague as of Q1/2023



Source: authors' own calculations, data from (JLL, 2023)

The total volume of modern office space in Prague reached more than 3.85 million sqm as of Q1 2023, with four office buildings completed in two projects - Port7 in Prague 7 and Red Court in Prague 8. Savills Research (2023)

Since the second half of 2022, no construction of office buildings has started in Prague, and the area of offices under construction is thus decreasing. At the end of the first quarter of 2023, a total of 15 projects with a leasable area of around 145,000 sqm were under construction, of which 45% were already contracted. (JLL, 2023)

Information on individual properties is presented in Table 1.

Tab. 1: Basic statistic characteristics in the sample of nominal and real NDHI

Property	Completion	Size (sq m)
Hagibor	Q1 2024	28 900
Metalica & Legatica	Q3 2023	27 300
Masaryčka	Q3 2023	22 100
Roztyly Plaza	Q4 2023	21 700
E-Factory (1st phase)	Q1 2024	10 000

Source: authors' calculations, data from (JLL, 2023)

2. Methods of Research

For the purposes of this analysis, commercial real estate is defined as real estate that is used exclusively for business purposes. The commercial real estate market consists primarily of the following segments: office buildings, industrial and warehouse buildings, retail space and hotels. The cointegration analysis in this article will focus specifically on the office market.

As stated by Arlt (2007), cointegration is one way of classifying economic time series, where time series are divided into short memory and long memory series. Time series cointegration was first studied in the early 1980s. C. W. J. Granger.

This method is based on the problem of integrated processes, which was already addressed by G. Box and G. Jenkins.

According to Arlt (2003), when modeling multivariate economic time series, it is useful to distinguish between short-run and long-run relationships, because short-run relationships between time series exist only in a relatively short peri-period and weaken over time. These short-term relationships occur in non-stationary time series that are characterized by short memory. The second type of relationships are long-term in nature and persist over time.

Long-term relationships between time series are closely related to the concept of equilibrium, which can be understood as a steady state. The system is continuously attracted to this equilibrium state. However, the system is subject to shocks and is never directly in equilibrium, but may be in a long-term equilibrium towards which it converges over time. A time series is in long-run equilibrium if there is no divergence in the long run. Therefore, an analysis of the long-run relationship between time series can only be performed for non-stationary time series that share a common stochastic trend. These time series are then considered to be cointegrated. Arlt (2002)

According to Brooks (2008), when time series have different trend directions, a condition known as apparent regression arises in the analysis of the relationship. Apparent regression is considered to be a situation where there are time series that are unrelated. However, using the least squares method, it is possible to obtain statistically significant estimates of the parameters of the regression function. Thus, the index of determination, t-tests and F-test will indicate the appropriateness of using the model. Thus, the time series cointegration test also serves as an indicator of true and apparent regression.

Testing for cointegration in univariate models can be based on testing the stationarity of the residuals. The residuals required for testing are estimated by the least squares method, where one series is treated as the explanatory variable and the other series as the explained variables. This is based on a regression model of the form:

$$Y_t = \beta X_t + a_t \tag{1}$$

For this testing, mainly the Augmented Dickey-Fuller test (ADF test) is used. It tests the hypothesis that time series are not cointegrated, i.e. that the unsystematic component is of type I(1). In this case, it is an apparent regression. If the ADF test shows that the residuals are stationary, this is a true cointegrating regression.

If the non-systematic component of the model represents white noise, a simple linear regression is sufficient to capture the relationships. If autocorrelation of the non-systematic component is evident, a lagged explanatory variable model, the autoregressive distributed lag (ADL) model, is used.

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In the diagnostic check of the model, according to Arlt (2002), it is necessary to test whether the nonsystematic component exhibits normality, homoskedasticity, and is autocorrelated.

To assess the normality of the unsystematic component, the Jarque-Bera test is used, which is based on simultaneous testing of skewness and bias of the unsystematic component. The ARCH ("AutoRegressive Conditional Heteroskedasticity") effect is tested to test the homoskedasticity of the unsystematic component of the model. This test consists in creating an artificial regression where the explanatory variable is the square of the residuals and the explanatory variable is the square of the residuals in lag q.

According to Pagan (2009), the Breusch-Godfrey LM test can be used to assess the autocorrelation of the unsystematic component. This test verifies the serial dependence of the random components in the model, with the null hypothesis stating that there is no autocorrelation in the model. The test consists of creating an artificial variable where the explanatory variable is at, the explanatory variables are *at-1, ..., at-p* and the explanatory variables of the model are $y = ßX + a_t$.

After identifying the cointegrated relationship between the variables, we can use the Autoregressive Distributed Lag (ADL) model. Pagan (2009). The model has the form ADL(1,1)

$$Y_t = c + a_1 Y_{t-1} + \beta 1 X_t + \beta 2 X_{t-1} + a_t \quad (2)$$

3. Data

CRECVI data are not publicly available. For the purposes of this analysis, they were provided by the consultancy Cushman & Wakefield. Other selected indicators were obtained from the Czech Statistical Office and the Czech National Bank's time series database.

The C&W CRECVI (Commercial Real Estate Capital Value Index) is compiled by the consultancy Cushman & Wakefield. The index is limited to the Czech Republic and shows year-on-year changes in the capital value of a commercial real estate portfolio (prime Prague offices, shopping centres and logistics parks). The index is based on quarterly "prime rents" and "prime yields" for selected commercial real estate markets and starts in 2005. The index starts from Q1 2015 (i.e. Q1 2015 = 100). The resulting index is then the average of the index values across sectors and locations. Development of the office space index is provided in Figure 2.

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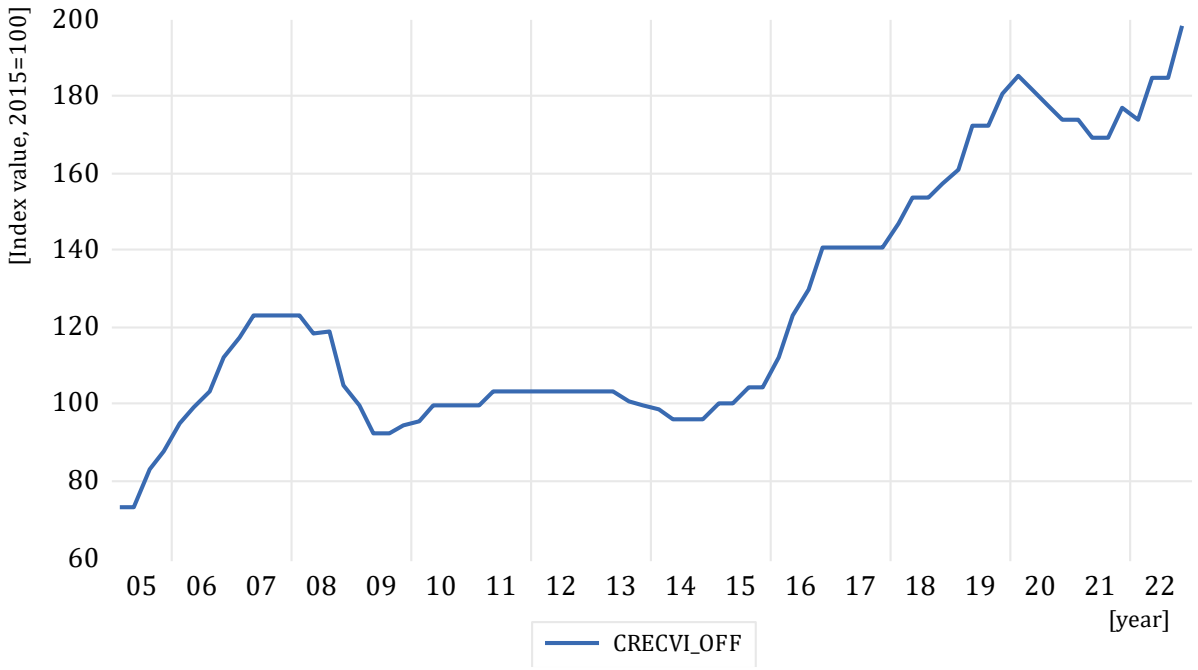
Fig. 2: Development of the CRECVI – office space, 2005-2022.



Source: authors' calculations in EViews 13, data from Cushman & Wakefield

The cointegration analysis is based on quarterly data for the period I/2005 - IV/2022 of the CRECVI index for office space. In addition to the CRECVI index, it also includes the macroeconomic variables listed below:

- GDP (GDP);

- Consumer Price Index (CPI);

- Interest rate for commercial real estate (INTRST_RATE);

- unemployment (UNEMPL).

These variables were used to model the short- and long-term effects on the commercial real estate capital value index, which is the explanatory variable.

4. Results of the Research

Time series modelling was performed in EViews 13. With the exception of the explanatory variable CRECVI, all time series showed seasonality. The C-X13 ARIMA method was chosen to identify the seasonal component and then to adjust the time series. After seasonal adjustment, the time series are denoted by the ending SA in the analysis.

Based on the results of the augmented Dickey-Fuller unit root test, the time series are non-stationary, type I(1). The model residuals obtained from the linear regression are stationary. The unit root test confirmed that the time series are cointegrated.

The statistically significant ADL model is presented in Table 2.

Tab. 2: ADL model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CRECVI_OFF(-1)	0,859156	0,043733	19,64552	0,0000
CPI_SA	-0,826541	0,175878	-4,699511	0,0000
GDP_SA	7,62E-05	1,44E-05	5,311782	0,0000
INTRST_RATE_SA(-1)	0,985431	0,392263	2,512168	0,0145
UNEMPL_SA(-2)	1,944811	0,519196	3,745812	0,0004

Source: authors' calculations in EViews 13

After fitting the ADL model, diagnostic tests were performed and the results are presented in Table 3.

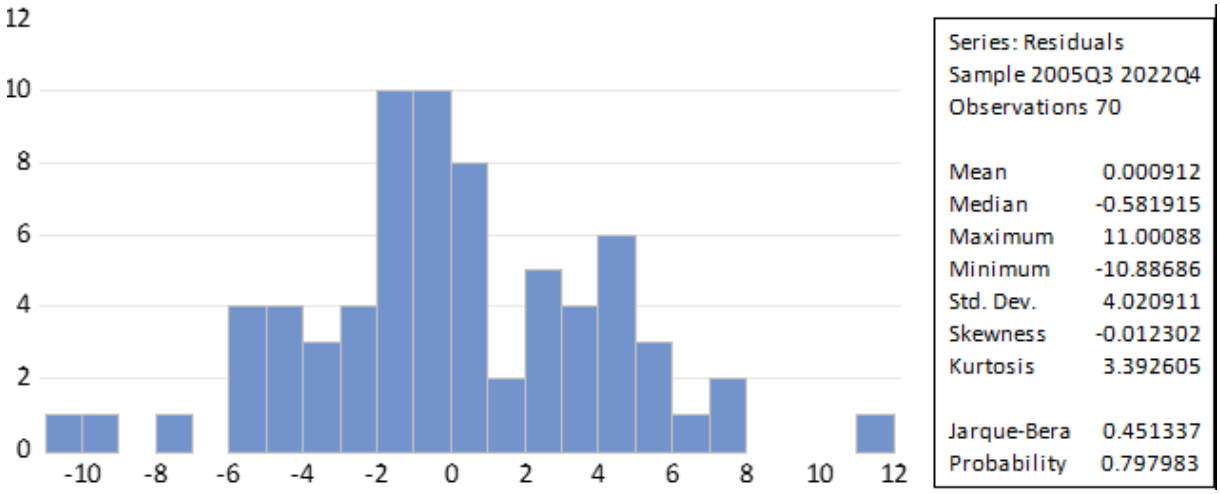
Tab. 3: Diagnostic tests

Model diagnostics	Stat.	Prob.
R^2	0,984715	-
Durbin-Watson Stat.	1,960565	-
Breusch-Godfrey	1,690213	0,2548
Jarque-Bera	0,451337	0,7979
ARCH	0,360880	0,5500

Source: authors' calculations in EViews 13

A correlogram was used to show the progression of ACF and PACF, which did not show autocorrelation. The ARCH test shows that the non-systematic component of the model is homoskedastic. Furthermore, in validating the fit of the model, the Breusch-Godfrey test was performed, which shows that the non-systematic component of the model is not autocorrelated. To test the normality of the model, the Jarque-Bera test was used, according to which the non-systematic component of the model is normally distributed. Detailed statistical testing information is provided in Figure 3.

Fig. 3: The Jarque-Bera normality test of the unsystematic component.



Source: authors' calculations in EViews 13

The resulting ADL model passed the diagnostic check and can be written as follows:

$$\widehat{CRECVI\_OFF_t} = 0{,}859156\ CRECVI\_OFF_{t-1} - 0{,}826541\ CPI\_SA_t + 7{,}62E-05\ GDP\_SA_t + 0{,}985431\ INTRST\_RATE\_SA_{t-1} + 1{,}944811\ UNEMPL\_SA_{t-2} \quad (3)$$

According to the resulting model, the commercial real estate index at time t depends on its value at time t-1. The equation shows that at time t, office prices are influenced by the consumer price index and gross domestic product. The interest rate variable then depends on the commercial real estate price of office space at time *t-1* and the unemployment rate at time *t-2*.

According to the model, gross domestic product has an inversely proportional effect on commercial real estate prices for office space. With lag t-1, real estate prices are directly proportionally affected by interest rates on commercial real estate mortgage loans. The consumer price index came out statistically significant with an inversely proportional effect, suggesting that mortgage interest rates fall as inflation falls. Low interest rates increase the demand for real estate, which leads to rising house prices in the absence of supply. Unemployment rates affect commercial office property prices with a *t-2* lag and this effect is directly proportional.

Conclusion

The paper analyses the cointegration relationship between the office space prices on the Czech market and selected macroeconomic aggregates. An ADL model is constructed to describe how office space prices react to changes in the economy. The results of the analysis show that office prices are mainly influenced by changes in gross domestic product, unemployment, and the level of inflation and interest rates.

Further research in this area could focus on analysis during the COVID pandemic. A further extension of this research could also be building an error correction model or comparison the evolution of the commercial real estate index across EU countries.

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