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Estimating Commercial Property Price Misalignment in the CEE Countries

Hana Hejlová, Michal Hlaváček and Blanka Vačkova *

Abstract

In this article, we estimate the misalignment of commercial property prices. To this end, we propose a semi-structural model which imitates the functioning of various segments of the commercial real estate market. To estimate this model, we use a unique set of data on the markets for two property types (office and industrial) in five CEE countries and Germany, provided by JLL. First, we estimate the model for each property type on a panel of countries to capture the international nature of the markets. Secondly, for the example of the Czech Republic we estimate the model on a panel of property types to capture the possible orientation of individual investors towards a certain country. Finally, we compare the outcomes. The results suggest that investors tend to orientate towards certain property types rather than particular countries. It also shows that our approach avoids the end-point bias which can be present when assessing commercial property prices with an HP filter.

Abstrakt

Článek představuje odhad nadhodnocení cen komerčních nemovitostí. Za tímto účelem je navržen semistrukturální model, který zachycuje fungování jednotlivých segmentů na trhu komerčních nemovitostí. K odhadům modelu používáme unikátní soubor dat poskytnutý společností JLL, který pokrývá dva typy nemovitostí (kancelářské a průmyslové) v pěti zemích střední a východní Evropy a v Německu. V prvním kroku odhadujeme model pro každý z typů nemovitostí na panelu zemí, abychom zachytili mezinárodní charakter trhu komerčních nemovitostí. V druhém kroku model odhadujeme na panelu typů nemovitostí na příkladu České republiky s cílem zachytit případnou orientaci investorů na určitou zemi. V posledním kroku obě sady výsledků porovnáváme. Odhady naznačují, že investoři se orientují na určitý typ nemovitostí spíše než na konkrétní zemi. Z výsledků je také patrné, že náš přístup k vyhodnocování cen komerčních nemovitostí omezuje tzv. „end-point bias“, ke kterému může docházet při využití HP filtru.

JEL Codes: C31, E58, R32.
Keywords: Commercial property, misalignment of prices, types of property.

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1. Introduction

Analysis of the financial stability risks related to residential real estate markets has been getting a lot of attention in recent years. However, similar risks may be linked with commercial property markets. There are also several reasons why commercial real estate loans may be even riskier than housing loans. First of all, the existing evidence from advanced countries shows that commercial property prices are more volatile than prices of housing (Fessenden and Muething, 2017). This makes loans secured by property exposed to the risk of a sudden decrease in the value of the collateral, which may leave a part of the loan unsecured. Secondly, the property which serves as collateral on these loans is usually the only source of income used for repaying the loans, which makes the loans sensitive to conditions on the real estate market (Federal Register, 2006). This increases the risk of default when the value of the collateral decreases. Moreover, buyers of commercial real estate may have weaker incentives to avoid default than households, since their loans are usually non-recourse ones (Ellis and Naughtin, 2010).

While the financing of commercial property is highly cross-border in nature, market developments in individual countries may be relevant for both domestic and foreign regulators. Higher demand for commercial property in a particular country may contribute to overvaluation of the property on that market, which increases the collateral risk related to loans secured by property from that country. The higher the exposure of a financial system to the overvalued property markets in the domestic or foreign economies, the bigger the concentration risk. The other source of risk comes from the fact that commercial property loans tend to be concentrated in certain institutions. Disruption of the real estate market can make these institutions less able to lend to other sectors, which may have adverse effects on the real economy with consequences for the financial sector as a whole (Fessenden and Muething, 2017; BdF, 2017). On the one hand, foreign capital may contribute to the boom-bust character of the commercial real estate cycle, as it may first fuel the boom and then flow out when the conditions turn around, causing a protracted downturn. On the other hand, the presence of foreign investors may then help the market recover (Lane, 2014).

Despite these facts, analysis of risks related to commercial real estate exposures has been relatively scarce compared to residential real estate exposures in international practice. One of the main reasons is the limited availability of data on physical commercial real estate markets and their financing (Gyourko, 2009; ESRB, 2019a; ESRB, 2019b). Until now, the existing literature has been limited to estimating the misalignment of commercial property prices as a whole or certain property types separately (see, for example, Hlaváček et al., 2014, and Coffinet and Kintzler, 2019). However, given that various types of commercial property may demonstrate distinct dynamics over time, it is desirable to monitor the risks related to the individual types of commercial property separately (Federal Register, 2006).

This article presents the first attempt to make such estimates. In particular, we present a semi-structural model of the commercial property market which imitates the functioning of various segments of that market and we estimate this model for office and industrial property separately. For this purpose, we use a unique dataset provided by JLL which contains aggregate data for physical market indicators by property type and country, covering five Central and Eastern European (CEE) countries and Germany. As the price variable, we use capital value, which is calculated as the ratio of the rent to the yield expected by investors. We estimate the model on two types of panels, which we label “cross-country” and “cross-property”. For the cross-country panel,

we estimate our model for each type of property on a panel of countries. These results represent the estimated under- or overvaluation of the individual property types from a country comparison. For the cross-property panel, we estimate our model for a selected country, namely the Czech Republic, on a panel of property types. These results represent the estimated under- or overvaluation of the individual property types from a property-type comparison.

The article is structured as follows. Part 2 provides a literature review on the assessment of the commercial property prices and some other related studies. Part 3 describes the structure of the commercial property market. Part 4 presents the proposed model of equilibrium commercial property prices and describes the estimation approach and data. Part 5 provides the results and Part 6 concludes.

2. Literature Review

There are several studies that estimate the price misalignment of a particular type of property or of the commercial market as a whole. Hlaváček et al. (2014) model equilibrium prices of office property in six CEE countries based on their macroeconomic, demographic and structural determinants. Using an error-correction model on a panel of capital cities, the authors demonstrate that both demand factors (GDP and consumer prices) and supply factors (mainly total office space) are statistically significant in determining property price dynamics. In a similar fashion, Coffinet and Kintzler (2019) use a vector error corrections model to model the equilibrium prices of office property in France. They find that property prices depend on GDP and rents and to limited extent also on interest rates. ECB (2011) analyses property price misalignment in the euro countries using selected indicators. In particular, it compares aggregate property prices to macroeconomic variables that determine the demand for property (GDP, private consumption and employment) and variables that affect the future income from the property (rents and initial yields). As a simple measure of the price gap, ECB (2011) also calculates the deviation of property prices from their long-term averages.

Other studies represent more general analyses of the drivers of property prices. Hagen and Hansen (2018) decompose the prices of office property in 58 European cities into rents and yields. They find that while the price peaks before 2003 were mainly driven by the rent component, much of the increases thereafter can be explained by declining yields. Blake et al. (2011) analyse to what extent yields on office, industrial and retail property in the UK and five other developed countries move with inflation and to what extent they are driven by real economic activity. They show that while yields do evolve in line with inflation, the major driver of property returns is GDP growth. Case et al. (2000) decompose prices of office, industrial and retail property in 21 countries into global and domestic factors represented by the respective GDPs. They find that the variation in global GDP explains a substantial part of the co-movement in prices, even though in some countries and episodes local factors were more important. Finally, Davis and Zhu (2011) explore the interaction of commercial property prices and credit cycles. Using a panel error-correction model and Granger causality tests for 17 developed economies, they find a strong mutual relationship between property prices, loan volumes and GDP, the last being considered an indicator of rent prices.

Other studies concentrate on wider topics related to commercial real estate markets and thus contribute to the analysis of commercial real estate prices indirectly. Among these, Bassett and Marsh (2016) explore the effects of regulatory limits on the concentration of commercial real estate

loans in the US on the dynamics of these loans. To this end, they consider a wide range of bank-specific variables as well as domestic and global economic and financial indicators, finding that, for example, stricter monetary policy interest rates and higher market stress tend to affect credit growth negatively. Davis and Zhu (2009) analyse how commercial property prices influence the lending decisions of banks and their performance in terms of profitability and the quality of their credit portfolios. Using microeconomic data for banks in 13 developed countries, they conclude that property prices are negatively associated with banks' bad loan ratios and net interest margins. More generally, Whitley and Windram (2003) present an analytical framework for analysing the financial stability implications of developments in the commercial property market. This framework is structural and includes a model of the real estate sector, a model of borrowing by commercial real estate companies and a model of the probability of default for such companies. Using data from the UK, the authors demonstrate a link between commercial property prices and defaults by non-financial corporations.

3. Structure of the Commercial Property Market

Commercial real estate is a productive asset for its end-users and at the same time an income-producing asset for its owners (DiPasquale and Wheaton, 1992). As a result, the commercial property market is made up of three to some extent separate but interlinked segments.

The rental segment is where the supply of rental space, which is relatively inelastic in the short term, interacts with the demand for such space from end-users. The outcome of this interaction is the net take-up, which is the total volume of new rentals, including expansions and pre-lets, the price of rent and the remaining vacancy rate. While the prices of rent are to some extent governed by shared fundamentals, some of the determinants are specific to individual types of property. The common factors most cited in the literature are GDP growth, which is related to income and spending, and employment, which links to the need for space, especially in the office segment (Coffinet and Kintzler, 2019; ESRB, 2018; Hagen and Hansen, 2018; Bassett and Marsh, 2016; Blake et al., 2011; ECB, 2011). The segment-specific factors include, for example, manufacturing output for logistics property and household consumption for retail property[1] (BdF, 2017).

The investment segment is where transactions in new and existing space take place. An important variable is the prime yield, which is the yield required by investors. In theory, the prime yield consists of the risk-free rate and the risk premium. As such, it may depend on various factors, including yields on alternative assets, interest rates, risks associated with the domestic property market, and the overall economic outlook (Coffinet and Kintzler, 2019; ESRB, 2018; Hagen and Hansen, 2018; BdF, 2017; Bassett and Marsh, 2016). The prime yield, the expected rent and the vacancy rate determine the price which the investor is willing to pay for the property – the "capital value". Counting on the possibility of the property becoming temporarily unoccupied, which is equal to the vacancy rate (see Hlaváček et al., 2014), the capital value may be defined as:

$$\text{capital value} = \frac{\text{rent (1-vacancy)}}{\text{yield}} \tag{1}$$

[1] Apart from these factors, there are also structural factors, for example, the efficiency of use of the space and modes of work for office property, and methods of consumption, which affect the share of warehousing vs. retail merchandising for logistics and retail property (BdF, 2017).

The final segment is the construction segment, where the supply of existing space increases subject to property prices, rents and vacancy rates. The construction segment is influenced by many factors, including the cost of labour, costs of materials, prices of land, profit margins demanded in the construction industry, and urban policies, which are under the control of national or local authorities. Given the mid-term nature of rental contracts[2] and the time delay between deciding to build a property and renting it out, a part of the supply tends to be uncovered and therefore the vacancy rate tends to be positive. The change in the vacancy rate then depends on the difference between the new supply (completions) and the volume of new rentals (net take-up):

$$\Delta\text{vacancy} = \frac{\text{completions} - \text{net take up}}{\text{supply}} \tag{2}$$

Through the change in the vacancy rate, the new supply of space affects the prices of rent (Coffinet and Kintzler, 2019; BdF, 2017). However, the construction segment operates on a rather longer time scale than the rental and investment segments. Some authors argue that construction lags represent a source of increased volatility of the commercial property, since the sources of demand may have gone away by the time the construction is completed. This is one of the reasons why vacancy rates may go up and exert downward pressure on property prices in periods of stress (ESRB, 2018; Hagen and Hansen, 2018; Fessenden and Muething, 2017). In situations where construction is driven by exaggerated or imprudent expectations, over-construction may even be the source of price adjustment (Englund, 1999).

4. Estimating Commercial Property Price Misalignment

4.1 Model

The aim of this paper is to estimate commercial property price misalignment using a model which reflects the structure of the commercial real estate market. To this end, we propose a four-equation model which describes the three segments of the commercial real estate market (rental, investment and construction) and their interlinkages.

The first two equations describe the rental segment. Equation (3) explains net take-up using indicators of real economic activity and thus describes the demand side of the rental segment. Following some previous studies, our explanatory variables are GDP growth and unemployment, which are considered the key drivers of rental markets common to all commercial property. As suggested by BdF (2017), instead of overall GDP we consider some of its sub-components separately, as they may be particularly relevant for individual types of property. Looking for the most parsimonious approach, we decided to include the dynamics of consumption and investment and also the change in exports of goods and services. Consumption describes the situation of households and may affect demand for industrial and logistics premises. Similarly, investment reflects the situation of companies and may affect demand for industrial and logistics space. Finally, some CEE countries are strongly export-oriented. Given that commercial property is an important link in the production and delivery of export articles, we saw a clear reason for including exports of goods and services among the explanatory variables as well. Positive changes in all of these variables except unemployment are indicators of rising demand pressures, which lead to expansion of firms and demand for more space. On the contrary, increasing unemployment may be associated

[2] Lease contracts with end-users of property (tenants) are becoming recently increasingly flexible.

with weakening demand pressures, which may cause firms to shrink and demand for space to diminish. However, the relationship between unemployment and firms' production may not be strictly linear. In a situation of very low unemployment, a further decrease may cause labour shortages with negative impacts on firms' output amid solid and growing demand.

Next, Equation (4) explains the price of rent using net take-up and the vacancy rate and as such describes the meeting of demand and supply in the rental segment. High net take-up and a low vacancy rate indicate a decreasing supply of existing space, and this allows landlords/investors to ask for higher rents.

Equation (5) describes the investment segment. In particular, it explains the capital value of property, which substitutes for information on the price in our analysis, using indicators of aggregate demand, financial conditions and investor appetite. To determine the factors influencing the capital value of property, we consider indicators of global economic activity, risk-free interest rates and global market stress (see Bassett and Marsh, 2016, for a similar set of variables). The same as other authors, we use 10-year government bond yields as a measure of the risk-free interest rate and VIX as a proxy for market stress (see, for example, BdF, 2017, or again Bassett and Marsh, 2016). As a measure of global economic activity we consider GDP growth and 10-year government yields in the Eurozone. We suggest that global economic growth provides incentives for investors to pay higher prices for property. The effect of long-term interest rates, however, is hard to predict. On the one hand, rising rates are usually associated with positive economic development and as such should be associated with increasing demand for commercial property. On the other hand, higher rates imply more elevated costs of debt financing, which may affect demand for property in the opposite way. As regards VIX, periods of market stress should be associated with uncertainty and increased risk aversion, which may negatively affect commercial property transactions (Bassett and Marsh, 2016). However, the overall effect of market stress on the commercial property market may depend on the relative riskiness of commercial property investment as perceived by investors compared to alternative investment opportunities, including government bonds.

Finally, Equation (6) describes the construction segment, where it explains completions using the change in prices of rents and vacancy rates. Growing prices of rent and low vacancy rates provide incentives for property developers to add new space and make higher and more secure profits. While Equations (3)–(5) consider the supply of space as given and therefore describe the short-term dynamics on the market, Equation (6) looks at a longer time scale and assumes that the supply of space may adjust with a lag. Although we present this equation here, and as such it makes our model complete, for the sake of brevity we do not present the results of estimating this equation in the remainder of the paper. One reason for this is the need to account for the lag between completions and the explanatory variables, which would deserve a separate analysis in this particular case.

The whole set of equations is as follows:

$$\text{net take up}_{it} = c + \alpha_1 \text{unemployment}_{it} + \alpha_2 \,\text{dslog consumption}_{it} + \alpha_3 \,\text{dslog investment}_{it} + \alpha_4 \,\text{dslog exports goods}_{it} + \alpha_5 \,\text{dslog exports services}_{it} \quad (3)$$

$$\log \text{rent}_{it} = c + \beta_1 \text{net take up}_{it} + \beta_2 \text{vacancy}_{it} \quad (4)$$

$$\log \text{capital value}_{it} = c + \gamma_1 \log \text{rent}_{it} + \gamma_2 \text{bond yields EUR}_{it} + \gamma_3 \,\text{VIX}_{it} \quad (5)$$

$$\text{completions}_{it} = c + \delta_1 \text{yield}_{it} + \delta_2 \text{vacancy}_{it} \quad (6)$$

where "log" denotes logarithmic transformation, "ds" stands for seasonal differences to capture the yearly dynamics of the variables, and "i" stands for individual countries or property types where the equations are estimated on a panel. Finally, "t" denotes time. "Vacancy" is defined as the vacant or completed space divided by the total space.

Variables defined in percentage points were included as such, while variables in absolute terms were included in logarithms. GDP and its components were included in yearly differences to remove seasonal patterns. Regarding the time pattern of our variables, most of them are trending over the period covered by our sample, but some may be considered mean-reverting over a longer time scale. Some of the mean-reverting variables are flow variables (net take-up), while others are level variables but tend to oscillate within the cycle (yields, vacancy rates, government bond yields and VIX). To control for the levels of the explained variables, we included a constant in each equation.

Finally, we deem it necessary to admit that due to a lack of data, our model is constrained by several omitted variables that may be considered important. These variables include, among others, the variation in the supply of credit over time, the long-term expectations of investors about rental income, and the specific risk premiums required.

4.2 Estimation Approach

Equations (3)–(5) were estimated using a two-stage approach. This means that the explained variables were estimated using fitted values of the variables explained in the previous equations. The results of interest are the residuals from the price equation (5), which provide information about commercial real estate under- or overvaluation.

On the one hand, the dimension of the data set, which includes quite a few cross-section identifiers and a relatively long time span, would suggest using pooled OLS with fixed effects rather than panel regression to estimate the model (see, for example, Cameron, 2007). On the other hand, we were aware that some of the variables in the model include the unit root, so the assumptions of an OLS model would be violated. At the same time, first differencing the unit root variables would lead to losing information about the levels of the variables, which is crucial for calculating the misalignment of property prices. For this reason, we opted for panel regression with fixed effects. When estimating the equations, robust standard errors were used in order to avoid the generated regressors problem.

The property types included are office and industrial property. For retail property, the estimates can only be done for the single price equation, because the other models require data on vacancy rates and net take-up and these data are not available for this type of property. For the sake of brevity, these estimates were excluded from the paper.

The countries included are the Czech Republic, Hungary, Poland, Romania, Slovakia and Germany. In particular, Germany was included due to the important economic interlinkages between this country and the CEE economies, which are important for explaining the property price dynamics in the respective markets.

In addition, the model was estimated on two different types of panels. The first was a "cross-country" panel in which the equations for each type of commercial property were estimated separately on a panel of countries. The results are the estimated under- or overvaluation of individual commercial property in individual countries from a country comparison. We present these results for all the countries in the panel. The second type of panel was a "cross-property" one in which the equations for each type of commercial property in one selected country were estimated on a panel of property types in this country. This may be interpreted as the price misalignment from the point of view of investors looking to purchase a certain property type, whatever the country in the region. The results are the estimated under- or overvaluation of individual commercial property in individual countries from a property type comparison. This, on the other hand, may be interpreted as the price misalignment from the point of view of investors looking to purchase in a particular country, whatever the property type. For the sake of brevity, the estimates on the cross-property panel are presented for the Czech Republic only.

At the same time, the panel-specific constants control for differences in the levels of some of the variables (see also Davis and Zhu, 2011, for a panel model with fixed effects). In particular, the constants in the cross-country panel reflect the heterogeneity of the countries included in the panel, which is reflected in distinct values of the macroeconomic and real estate indicators. In the cross-property panel, the constants account for differences in the values of the nominal variables for the two types of property in the individual countries (for example, higher rent values for office compared to logistics and industrial property). However, the results of the cross-property panel are only presented for the Czech Republic as an example, as we have the most balanced panel of data across property types for this country.

Finally, the estimated misalignment of property prices was obtained as the residuals of Equation (5), in which the logarithmic transformation of the capital price is the explained variable.

4.3 Data

The data on the physical commercial property markets for the individual property types and countries (prime yield, prime rent, stock, completions, vacancy and net take-up) were provided by JLL. In terms of coverage, the dataset refers to modern stock, which means class A and B stock for offices and class A stock for industrial properties. In terms of geography, the office market data and the industrial market data refer to the CEE capital cites (Prague, Warsaw, Bratislava, Budapest and Bucharest). As for Germany, which serves as the benchmark for the CEE markets in this paper, the capital city was replaced by Frankfurt in the dataset. For benchmarking purposes, the Frankfurt office and industrial markets proved to be more stable and less influenced by the post-1990 transformation process than their Berlin counterparts.

The JLL dataset is based on quarterly updates of the respective markets and sectors in the individual countries. The data is aggregated but is based on actual transactions and market development monitored and collected by JLL. The data is collected in line with the JLL property data definitions and methodology, which are common to the entire region, yet some local adjustments are possible within specific markets based on actual market practice and conditions. Definitions of the indicators are provided in Annex A to this paper. Annex B contains charts of the key variables per property type and country, along with summary statistics of the JLL dataset.

The length of data series in the JLL dataset varies depending on the data availability in each market. The longest data series in the subject dataset refer to the office markets in Prague, Warsaw and Frankfurt, where they cover the period from 1996 to the present for all the indicators. The differing data availability is due to the fact that modern real estate markets started to develop later in some countries than in others. The same applies to the industrial sector; the longest time series in the industrial and logistics dataset – starting in 2000/2001 – are available for the Prague, Warsaw and Budapest markets. However, partial coverage (i.e. not including all the indicators) is available since 1997 for the following locations: Prague, Warsaw, Budapest, Bucharest and Frankfurt. As for the individual indicators, vacancy rates in the industrial sector are not available for the German market to the extent they are for the CEE markets. This is because of a lack of transparency. Vacancy rate estimates for the Frankfurt market were therefore used for this purpose.

In CEE, the large majority of the modern office stock of each country is located in the capital city, so focusing on cities instead of countries is justifiable. The German market, though, is different, consisting of several strong office centres which may show slight variability in trends based on local fundamentals. Nevertheless, for the purposes of our comparison, we used data for the city instead of the country. The same is even more true for the industrial sector, which in principle works on a national level, covering entire countries rather than cities. Nevertheless, due to a lack of national-level data in Hungary and Romania, we focused on the industrial sector in the capital cities and Frankfurt instead.

The data on macroeconomic variables (unemployment, the GDP components in the individual countries of the panel, and GDP in the Eurozone and the US) were obtained from Eurostat. The source of the financial market data (10-year government bond yields in the Eurozone and the US, and VIX) is Datastream.

The full dataset which we used for estimating our model covers the period from 1997 to mid-2019 and is quarterly. All nominal variables were converted to real terms using CPI indices. Net take-up, completions and VIX were included as four-quarter averages to reduce the volatility of the observed values. The panel of data is unbalanced.

5. Results

To assess our estimates, we studied the significance and signs of the estimated explanatory variables (in parts 5.1 and 5.2, we only discuss those relationships which are significant at a 90% or higher level of confidence). In particular, we studied all the equations in order to evaluate the specification of the model. First, we analysed the results of the system of equations for the cross-country panel. Then, we compared these results with those for the Czech Republic from the cross-property type panel. Finally, we contrasted the estimates of property price misalignment which we obtained from our model with alternative univariate estimates using an HP filter.

5.1 Estimates on a Cross-Country Panel

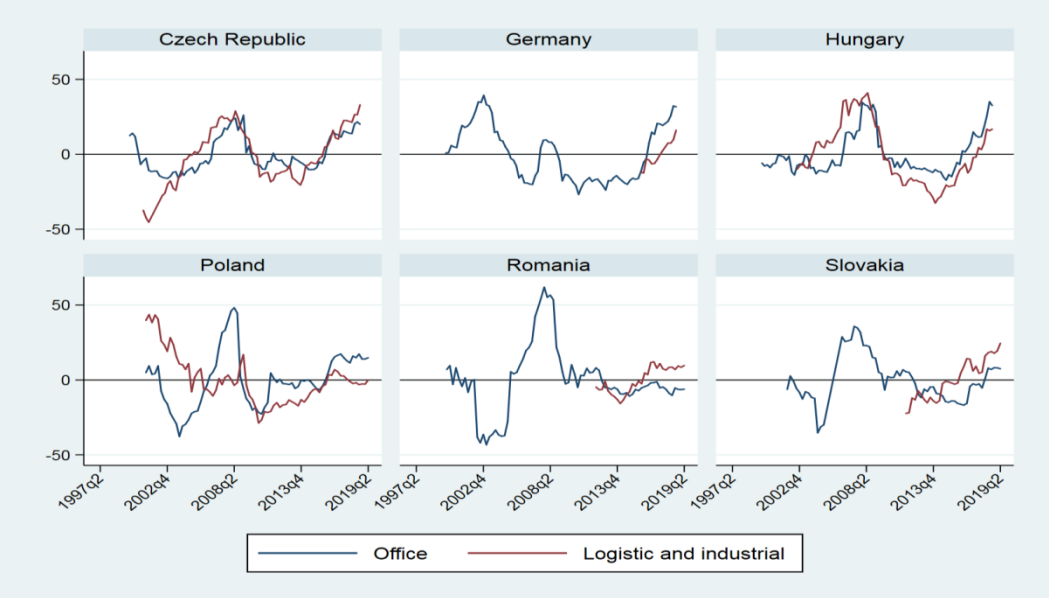
In Equation (3) estimated on a cross-country panel, we found the expected negative relationship between net take-up and unemployment and also the expected positive relationship between net take-up and change in investment. A negative relationship was also estimated between net take-up and change in exports of goods, which is hard to explain on theoretical grounds. These results were

consistent between office and industrial property. The expected positive relationship was also found between net take-up and change in consumption, though for office property only. (For an overview of the estimates see Table C.1 in Appendix C.)

In Equation (4), we found the expected negative relationship between prices of rent and vacancy rates. However, this relationship is only significant for office property. This may be explained by the fact that industrial and logistics property often requires specific characteristics in terms of size and technical equipment. For this reason, new space, especially in light industrial production, is often constructed for new tenants. On the other hand, already existing vacant space may not be an alternative for new tenants, because of either the specification or the location of the space, so the offer of such space does not affect the prices of rents for this property type so significantly. A negative relationship was also estimated between prices of rent and net take-up. This may account for the fact that net take-up is higher when rents are low. (Table C.2 in Appendix C)

In Equation (5), we found the expected positive relationship between capital prices and GDP growth in the Eurozone. A negative relationship was estimated between capital value and Eurozone government bond yields. This may suggest that commercial property in the CEE countries is viewed as an alternative to euro area government bonds. Conversely, VIX was found to affect CEE property prices positively, meaning that investors require higher yields from investment in times of stress. (Table C.3 in Appendix 3)

Figure 1: Property Price Misalignment – Results from the Cross-Country Panel (in %)

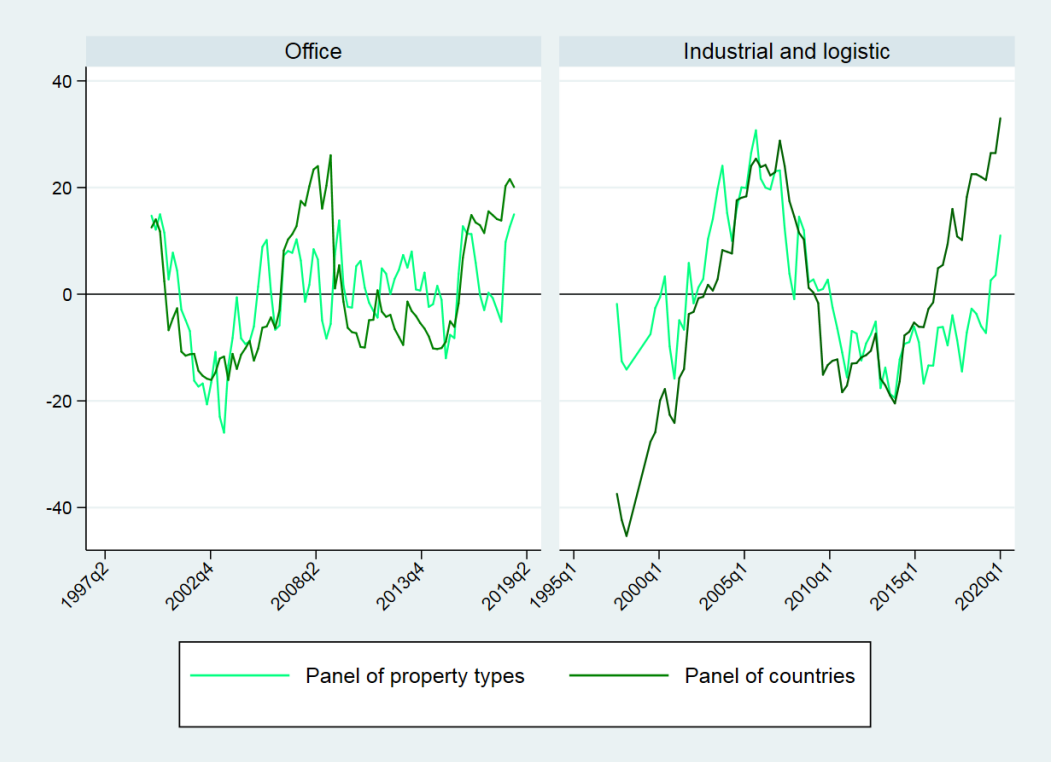


Source: JLL, Datastream, Eurostat, authors' calculations

5.2 Estimates on a Cross-Property Panel

Slightly different estimates were obtained from the cross-property panel estimated for the example of the Czech Republic (for these estimates, see the right-hand columns of Tables B1–B3 in Appendix B). In some cases, the signs of the estimated coefficients were different from those for the country panels and go against the relationship suggested by the theory. Such results may point to misspecification of the panel. This would indicate segmentation of the market by property types rather than countries. In other words, investors may be generally oriented towards particular property types rather than countries. Such interpretation would underline the international character of the commercial real estate market, with investors first choosing the property type they are interested in and only after that choosing the country to invest in.

Figure 2: Property Price Misalignment – Results from the Cross-Property Panel (in %)



Note: The results corresponding to the cross-country panel in this figure are identical to those from Figure 1 for the Czech Republic. They were added for the purposes of comparison with the results corresponding to the panel of property types.

Source: JLL, Datastream, Eurostat, authors' calculations

5.3 Comparison of the Results across Countries and Property Types

A comparison of the results across property types shows that the amplitude of the price misalignment is similar for office and industrial property. A comparison of the results between countries also shows that the price misalignment is correlated for the individual property types (Figure 1). However, the extent of the misalignment in individual countries may differ. For the Czech Republic, for which we estimate our model on the cross-country as well as the cross-property panel, the price misalignment also differs when estimated on these different panels (Figure 2).

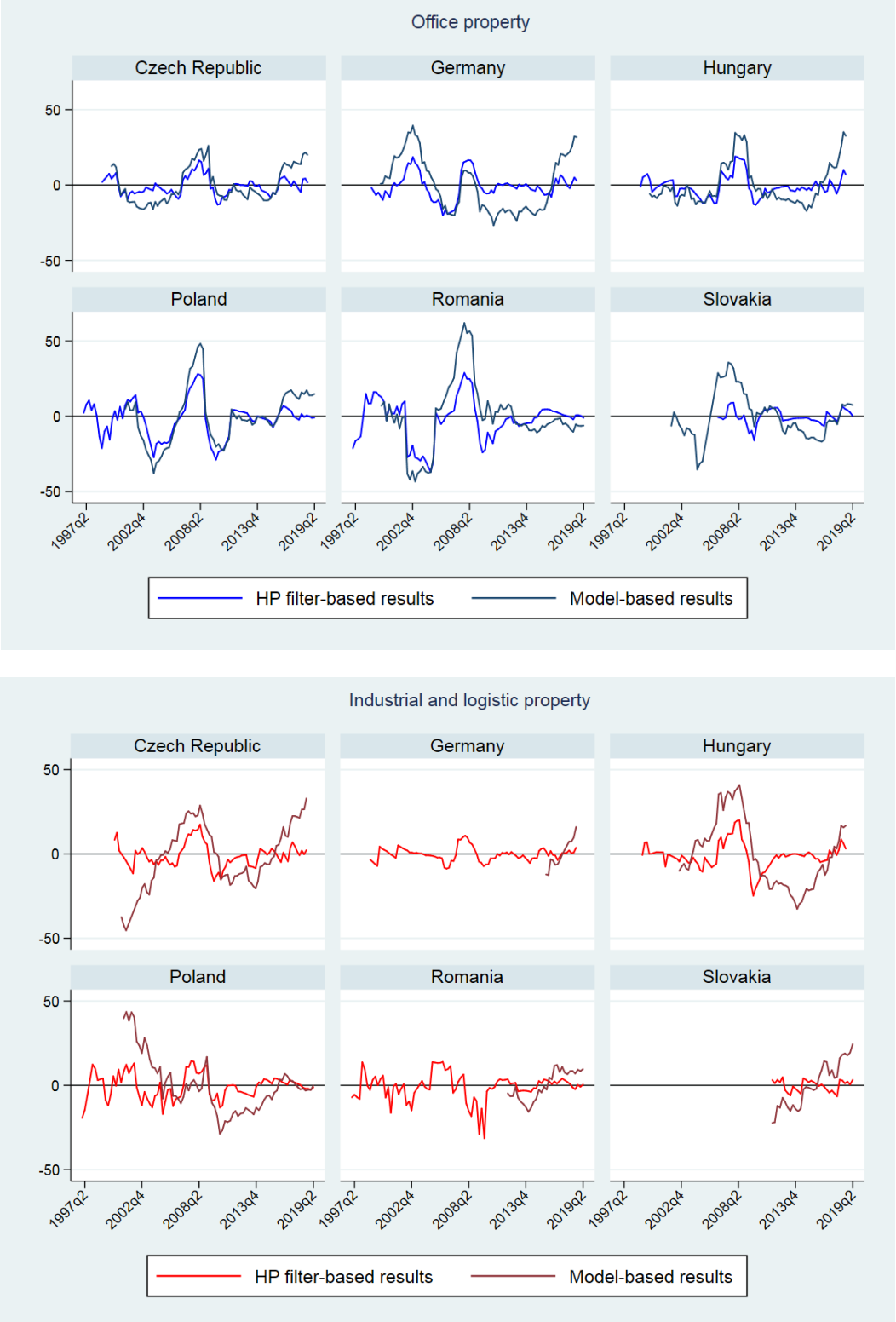
As of 2019Q2, office property shows a varying degree of price misalignment (Figure 1). Such property is estimated as overvalued in the Czech Republic, Germany and Hungary and to a lesser extent also in Poland. On the other hand, the estimates show undervaluation and roughly equilibrium values in Romania and Slovakia respectively. This heterogeneity also applies if we compare the most recent results with those for 2007/2008, when property prices recorded their last cyclical peak in many countries worldwide. In the Czech Republic and Hungary, the current overvaluation of office property is of a comparable extent as in 2007/2008. In Poland, the current overvaluation is lower. Similar results hold for industrial property. The estimated degree of overvaluation of industrial premises is comparable to that of office property in the Czech Republic and Germany. In Hungary, industrial property was found to be less overvalued than offices, and the same holds for Poland.

5.4 Comparison of the Results to those of the HP Filter

To check for the appropriateness of using our semi-structural model, we compared the estimates from the cross-property panel with the results of an HP filter. Specifically, the HP filter was applied to capital value, and the cyclical component was considered as an alternative proxy for property price misalignment. A lambda of 1600, which is the standard value for quarterly data, was used for this purpose.

As can be seen from this comparison, the HP filter may lead to end-point bias (Figure 3). In particular, for the end of our sample the HP filter indicates that capital value is at equilibrium levels for all countries and property types in the panel. In contrast to this, our semi-structural model indicates deviations from the equilibrium values. As such, we believe that our model, which was designed to imitate the structure and functioning of the commercial property market, offers important value added.

Figure 3: Property Price Misalignment – Model-Based Estimates vs. the HP Filter (in %)



Note: For the purposes of comparison with the HP filter-based results, we used the estimates of the model made on the cross-country panel. The model-based results in this figure are therefore identical to those in Figure 1.

Source: JLL, Datastream, Eurostat, authors' calculations

6. Conclusion

In this article we presented a semi-structural model of the commercial property market which imitates the functioning of various segments of that market. Furthermore, we estimated this model separately for two types of property, namely office and industrial. To this end, we used a unique set of data on the markets for the two property types in five CEE countries and Germany, provided by JLL. First, we described the functioning of the commercial real estate market, which consists of three separate but interlinked segments (rental, investment and construction). Then, we proposed a four-equation model which corresponds to these three segments of the commercial real estate market. The interlinkages between these segments are represented by some of the variables which are common to more than one equation.

The model was estimated on two types of panels – cross-country and cross-property. The results from the cross-country panel are the estimated under- or overvaluation of individual commercial property in individual countries from a country comparison. The results from the cross-property type panel are the estimated under- or overvaluation of individual commercial property in individual countries from a property type comparison (this type of panel was only estimated for the Czech Republic as an example). In terms of the significance and expected signs of the estimated coefficients, the estimates on the cross-country panel give more intuitive results than those on the cross-property type panel. Such conclusions also support the market-wide opinion that investors tend to orientate towards certain property types rather than particular countries.

As of mid-2019, the results indicate overvaluation for most of the property types in most of the countries considered. From the historical perspective, office property is the type of commercial real estate with the most volatile prices. Within individual countries, the price dynamics are mostly correlated across property types, although the degree of overvaluation differs.

Using the framework presented in this paper, we can analyse risks to financial stability related to commercial real estate exposures separately for the individual property types. This is especially important since the individual property markets are governed by shared fundamentals but to some extent also depend on different factors. As a result, the various types of commercial property may demonstrate different dynamics, so the potential riskiness of the individual property types with regard to financial stability may differ at certain points in time.

However, the results need to be interpreted with caution. Possible shortcomings of the estimates stem from the limited availability of the data in terms of length. As described by Hagen and Hansen (2018), other potential problems may include structural breaks and omitted variables. Finally, an important disclaimer applies to the interpretation of our results, i.e. the estimated misalignment of property prices. In this respect, misalignment should be regarded as the price gap from investors' point of view and may not reflect the financial stability perspective. This is because, by including market-based variables such as yields among the explanatory variables, we in fact assess the sustainability of property prices using variables which may not be at sustainable levels either. For example, the low yields in the global economy may be perceived by investors as medium or long-term values. This is then reflected in low yields required when purchasing property and, in turn, in higher capital values of property. Finally, if the low-yield environment changes, property prices may undergo a correction that is larger than the overvaluation currently estimated in this paper.

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Appendix A: Description of the JLL Dataset on Commercial Real Estate

A.1 Variable Definitions

Table A1: Variable Definitions

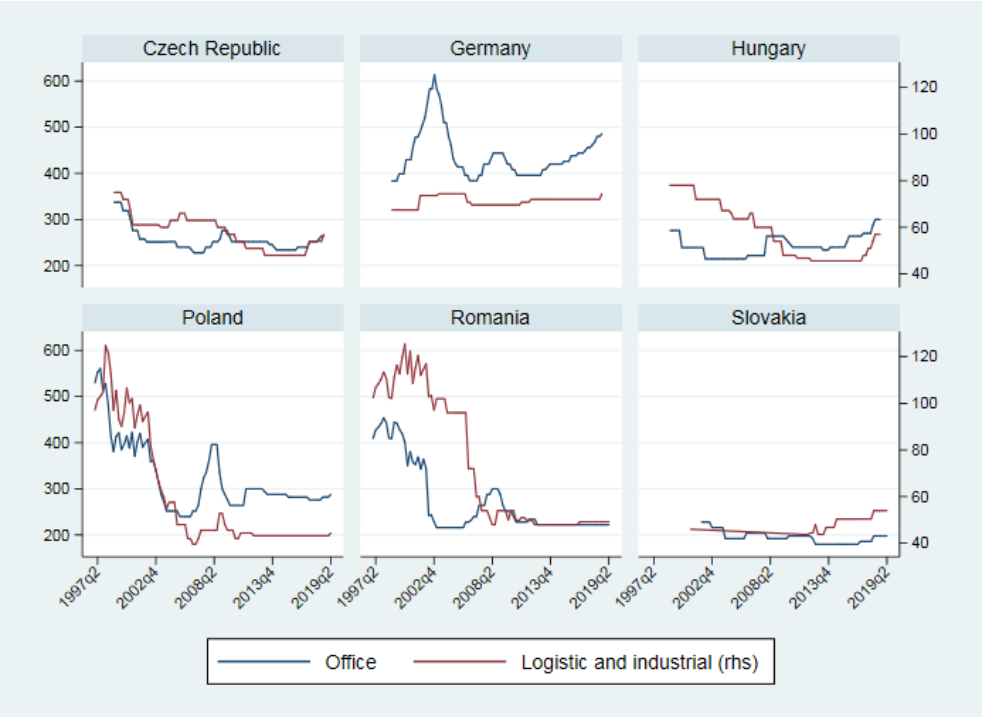
<table>
<tr><th>Variable</th><th colspan="2">Definition</th></tr>
<tr><td rowspan="3">Prime rent</td><td>- For the office market:</td><td>- For the industrial and logistics market:</td></tr>
<tr><td>Represents the top open-market rent that could be expected for a notional office unit of the highest quality and specification in the best location in a market, as at the survey date (normally at the end of each quarter period). The rent quoted normally reflects prime units of over 500 m² of lettable floorspace, which excludes rents that represent a premium level paid for a small quantity of space.</td><td>Represents the top open market rent that could be expected for a notional distribution warehousing unit/notional light industrial unit of the highest quality and specification in the prime location within a market, as at the survey date (normally at the end of each quarter period).
Note:
1) Warehousing properties are defined as property assets dedicated to storage and distribution of goods with a minimum floor-space of 5,000 m² gross internal, with ceiling heights over 8 metres. Warehouse types include storage warehouses, distribution warehouses (freight forwarding), cross-docking warehouses and cold storage warehouses. The office component of warehousing properties is usually between 5–10%.
2) Light Industrial properties are comprised of property assets < 5,000 m² dedicated to the assembly, disassembly, fabrication, finishing, manufacturing, packaging, repairing or processing of materials. The office component of light industrial properties is usually less than 10%.</td></tr>
<tr><td colspan="2">The prime rent reflects an occupational lease that is standard for the local market. It is a face rent that does not reflect the financial impact of tenant incentives, and excludes service charges and local taxes. It represents JLL's market view and is based on an analysis/review of actual transactions for prime office and industrial space, excluding any unrepresentative deals. Where an insufficient number of deals have been made for prime office or industrial space, an assessment of rental value is provided by reference to transactions generally in that market adjusted accordingly to equate to prime.</td></tr>
</table>

Prime yield	Represents the best (i.e. lowest) "rack-rented" yield estimated to be achievable for a notional office and industrial property of the highest quality and specification in the best location in a market, as at the survey date (normally at the end of each quarter period). The property should be let at the prevailing market rent to a first class tenant with an occupational lease that is standard for the local market. The prime initial net yield is quoted, i.e. the initial net income at the date of purchase, expressed as a percentage of the total purchase price, which includes acquisition costs and transfer taxes. The prime yield represents JLL's "market view", based on a combination of market evidence where available and a survey of expert opinion.
Capital values	Represents the top open-market capital value (per square metre) that could be expected for a notional office or industrial building of the highest quality and specification in the best location on the survey date (normally at the end of each quarter period). Prime capital values are derived from prime rents and prime net yields: Capital Value = (Prime Annual Rent/Prime Yield) * 100 This method will provide notional gross capital values, i.e. the purchase price including acquisition costs and transfer taxes.
Take-up	Represents floorspace acquired within a market for occupation during the survey period (normally three-monthly). A unit is registered as taken-up when a legally-binding agreement to acquire the unit has been completed. Take-up includes pre-lettings of floorspace in the course of development or prior to the start of construction. Note: 1) Units that are under offer at the survey date are not included as take-up. Under Offer refers to space where terms have been agreed between parties and legal representatives, but legally binding contracts for letting have yet to be exchanged and/or completed. 2) Net take-up includes new leases, pre-lets and expansions to the existing contracts but excludes renegotiations/reletting of the space.
Vacancy rate	Represents immediately vacant office or industrial floorspace, in all completed buildings within a market as at the survey date (normally at the end of each quarter period), expressed as a percentage of the total stock.

Source: JLL

A.2 Display of the Data

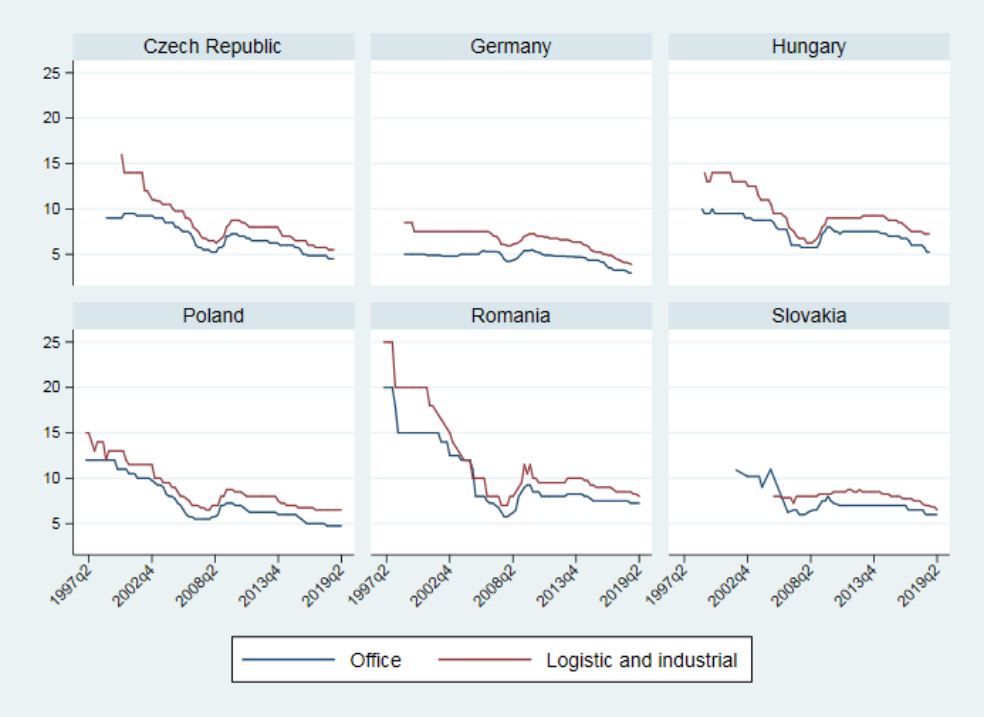
Figure A1: Prime Rent (in EUR/m^2 Per Annum)



Note: Data are displayed in the charts as provided by JLL. For the purposes of the estimates in this paper, the data might have been further transformed.

Source: JLL

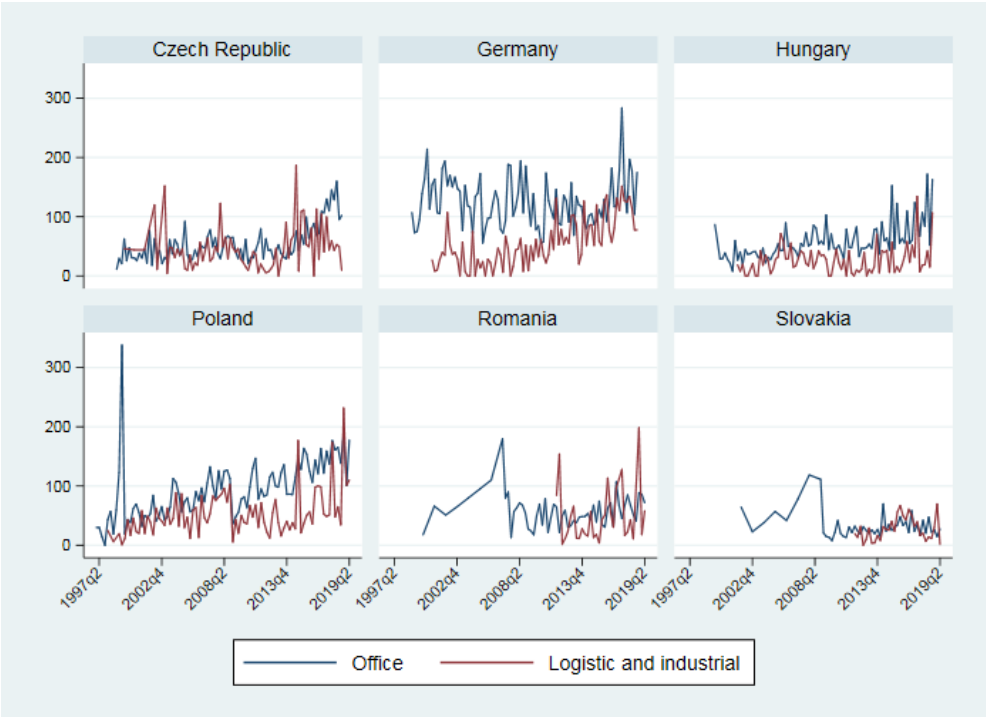
Figure A2: Prime Yield (in %)



Note: Data are displayed in the charts as provided by JLL. For the purposes of the estimates in this paper, the data might have been further transformed.

Source: JLL

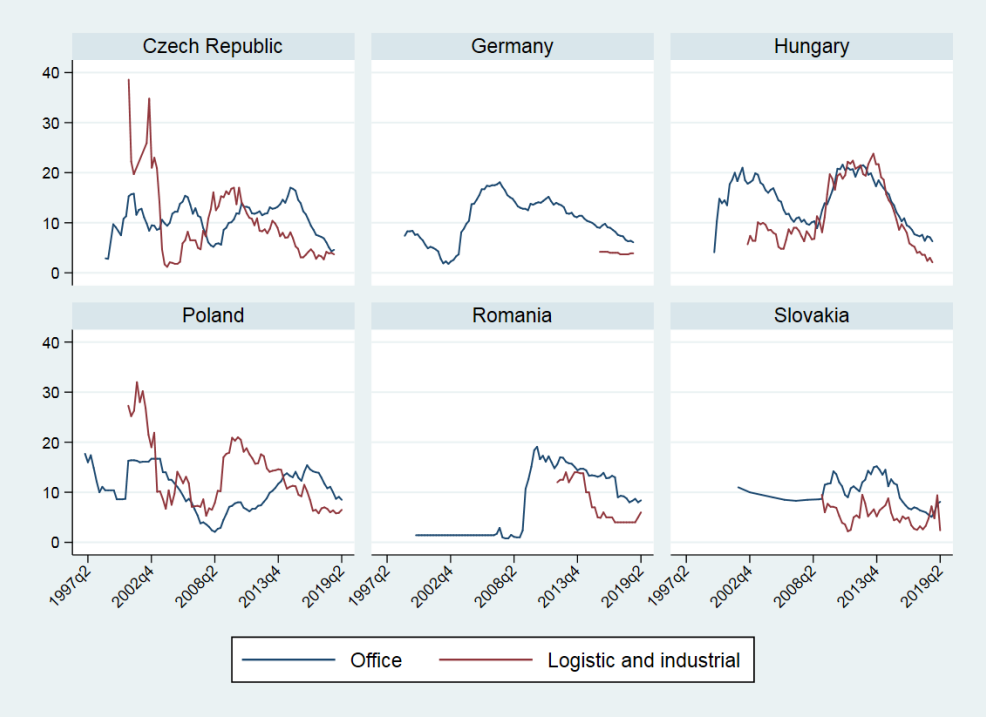
Figure A3: Take-Up (n ths m^2 Per Quarter)



Note: Data are displayed in the charts as provided by JLL. For the purposes of the estimates in this paper, the data might have been further transformed.

Source: JLL

Figure A4: Vacancy Rate (in %)



Note: Data are displayed in the charts as provided by JLL. For the purposes of the estimates in this paper, the data might have been further transformed.

Source: JLL

A.3 Summary Statistics of the Data

Table A2: Summary Statistics of the Data

Prime rent (in EUR/m^2 per annum)								
	Office				**Industrial, logistics**			
	Mean	St. dev.	Min.	Max.	Mean	St. dev.	Min.	Max.
CZ	256	25	228	337	58	7	48	75
DE	441	52	383	614	71	2	67	74
HU	244	24	215	300	58	12	46	78
PL	323	76	240	561	59	24	40	125
RO	272	76	216	454	73	28	48	125
SK	195	13	180	228	50	4	44	59
Prime yield (in %)								
	Office				**Industrial, logistics**			
	Mean	St. dev.	Min.	Max.	Mean	St. dev.	Min.	Max.
CZ	6.9	1.6	4.3	9.5	8.6	2.6	5.5	16.0
DE	4.6	0.7	2.9	5.5	6.6	1.2	3.8	8.5
HU	7.6	1.3	5.3	10.0	9.6	2.3	6.3	14.0
PL	7.5	2.5	4.3	12.0	8.9	2.5	6.0	15.0
RO	10.1	3.8	5.8	20.0	12.1	4.9	7.0	25.0
SK	7.0	1.1	5.3	11.0	8.0	0.6	6.0	8.8
Take-up (in ths m^2)								
	Office				**Industrial, logistics**			
	Mean	St. dev.	Min.	Max.	Mean	St. dev.	Min.	Max.
CZ	55	31	11	160	45	36	0	187
DE	126	42	55	284	55	40	0	152
HU	61	37	8	202	29	28	0	154
PL	95	50	0	338	54	39	1	232
RO	58	28	13	180	54	48	2	199
SK	33	22	8	119	28	20	0	70
Vacancy rate (in %)								
	Office				**Industrial, logistics**			
	Mean	St. dev.	Min.	Max.	Mean	St. dev.	Min.	Max.
CZ	11	3	3	17	10	7	1	39
DE	10	4	2	18	6	2	5	10
HU	14	5	4	22	11	7	2	24
PL	11	4	2	18	13	7	5	32
RO	8	6	1	19	8	4	4	14
SK	10	3	5	15	5	2	2	10

Note: Data are displayed in the table as provided by the JLL. For the purposes of the estimates in this paper, the data might have been further transformed.

Source: JLL

Appendix B: Estimation Details

B.1 Estimation Details

Table B1: Results for Equation (3) Explaining Net Take-Up

	Panel of countries						Panel of property types		
Explained variable:	Office			Industrial, logistics			Czech Republic		
net_take_up	Coef.		St. error	Coef.		St. error	Coef.		St. error
unemployment	-3.258	**	1.311	-2.907	**	1.307	-5.944		5.015
dslog(consumption)	47.216		65.053	6.559		18.127	-22.927		18.112
dslog(investment)	53.193	*	27.413	47.651	*	24.472	111.000		94.231
dslog(exports_goods)	-22.880	***	8.495	-34.250	***	12.236	-38.732		55.260
dslog(exports_services)	1.524		17.251	7.929		21.743	14.747		17.194
FE CZ									
FE DE	76.249	***	1.462	8.032	***	1.140			
FE HU	7.253	***	1.449	-20.220	***	1.124			
FE PL	61.640	***	6.070	18.929	***	6.744			
FE RO	15.152	***	1.998	0.402		2.026			
FE SK	11.262		9.220	-10.858	*	6.422			
c	73.039	***	8.982	69.777	***	8.524	91.698	***	29.979
FE office									
FE industrial							-3.351	***	0.000

Note: "dslog" denotes seasonal logarithmic differences, "FE" means fixed effects. ***, ** and * denote significance at the 0.99, 0.95 and 0.9 level of confidence respectively.

Source: Authors' calculations

Table B2: Results for Equation (3) Explaining Rents

	Panel of countries						Panel of property types		
Explained variable:	Office			Industrial, logistics			Czech Republic		
log(rent)	Coef.		St. error	Coef.		St. error	Coef.		St. error
net_take_up_fitted_value	-0.007	***	0.001	-0.008	***	0.003	-0.005	***	0.001
vacancy	-0.022	***	0.005	-0.001		0.010	0.003		0.008
FE CZ									
FE DE	1.029	***	0.092	0.285	***	0.091			
FE HU	0.057	***	0.021	-0.239	***	0.079			
FE PL	0.412	***	0.056	-0.101	***	0.033			
FE RO	-0.022	***	0.007	-0.219	***	0.021			
FE SK	-0.380	***	0.018	-0.427	***	0.076			
c	6.226	***	0.118	4.547	***	0.165	5.873	***	0.112
FE office									
FE industrial							-1.532	***	0.010

Note: "fitted value" denotes fitted values from the previous regressions, "dslog" denotes seasonal logarithmic differences, "FE" means fixed effects. ***, ** and * denote significance at the 0.99, 0.95 and 0.9 level of confidence respectively.

Source: Authors' calculations

Table B3: Results for Equation (5) Explaining Capital Values

	Panel of countries						Panel of property types		
Explained variable:	Office			Industrial, logistics			Czech Republic		
yield	Coef.		St. error	Coef.		St. error	Coef.		St. error
log(rent)_fitted_value	0.364		0.413	-0.419		0.508	12.331	***	1.310
dslog(gdp_EUR)	1.034	*	0.549	1.318	**	0.635	19.032	***	2.930
bond_yields_EUR	-0.024	*	0.014	0.047	*	0.025	0.296	***	0.075
VIX	0.003	***	0.001	-0.001		0.003	0.071	***	0.014
FE CZ									
FE DE	0.730	***	0.231	0.874	***	0.108			
FE HU	-0.129	***	0.017	-0.158	***	0.026			
FE PL	0.112	**	0.055	-0.193	***	0.071			
FE RO	-0.304	***	0.013	-0.397	***	0.120			
FE SK	-0.284	**	0.118	-0.242	**	0.112			
c	6.308	***	2.295	8.201	***	2.117	-65.338	***	7.345
FE office									
FE industrial							20.191	***	2.031

Note: "fitted value" denotes fitted values from the previous regressions, "dslog" denotes seasonal logarithmic differences, "FE" means fixed effects. ***, ** and * denote significance at the 0.99, 0.95 and 0.9 level of confidence respectively.

Source: Authors' calculations

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