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Office Property Pricing and Macroeconomic Shocks: European Regions through the Real Estate Cycle

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We study the relation between European office prices and their fundamentals by using a panel dataset of 29 major European cities over 25 years. We control for the dotcom crisis, global financial crisis (GFC), and sovereign debt crisis to analyze the varying impact of our variables. We find real estate variables such as rent and vacancies to be the most important factors in explaining for office values. For the European Monetary Union, we find monetary policy measures played a considerable role only during the GFC. For Europe as a whole, monetary policy variables are less important. We document a strong negative linkage of the risk premium of investors to office prices during crisis times, but not in normal times. The dotcom crisis left European office prices almost unaffected. The German and Swiss office markets exhibit safe haven characteristics.

Keywords

European office properties, real estate cycle, crisis analysis, macroeconomic shocks

JEL: G11; G12; G14; G15

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1. Introduction

Real estate markets are heterogeneous and differ by a wide range of country- and city-specific factors, such as currencies, policies, business habits, and regulations. In this study, we examine the European office markets.[1] The vast majority of the academic literature has focused on North American and Asian office markets. Most of the European studies examine the United Kingdom (UK), especially the office market in London (e.g. Dobson and Goddard, 1992; Hendershott et al., 1999; Lizieri et al., 2000; d'Amato and Amoruso, 2018), due to more data availability. Despite the empirical work by Giussani et al. (1993), D'Arcy et al. (1997), and McAllister and Nanda (2016), the literature on continental European office markets remains scarce.

We analyze the continental European office markets by using a comprehensive panel dataset of 29 major cities across 17 European countries that covers the period of 1995Q1–2020Q1. Our variable of interest is the growth rate of the office capital value, which we relate to microeconomic variables (e.g., rent) that vary across cities and macroeconomic variables (e.g., 10-year government bond yields) that vary across countries.

We contribute to the literature in several ways. First, we extend previous empirical studies by using both a longer time frame and a larger cross-sectional country dimension, which allows us to examine office price developments across multiple regions. Second, the longer period enables us to cover entire up and down cycles over the past 25 years of major events such as the dotcom crisis (DCC) of the early 2000s, global financial crisis (GFC) of 2007/2008, as well as European sovereign debt crisis (ESDC), which we empirically analyze. This setting enables a comparative view of price movements during all major crisis events. We distinguish between real estate markets that are members of the European Monetary Union (EMU) and European real estate markets as a whole. We further explicitly examine the safe haven characteristics of the German and Swiss office markets. Overall, we add to the very limited literature on European commercial real estate markets.

We find that in general, real estate variables such as rent and vacancy rates are the most important in explaining for office prices. For the EMU, we find that monetary policy measures such as money supply and interest rates played a considerable role only during the GFC, since the EMU is steered by a single central bank. For our full European sample, monetary policy variables are less important. We also examine crisis effects. We document a strong negative relation of the risk premium of investors to office capital values in times of crisis, but not in normal times. Furthermore, we find that the DCC left European

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[1]The European commercial real estate market has an estimated value of 8.0 trillion USD in 2020 compared to the North American market with an estimated value of 10.0 trillion USD (www.statista.de).

office markets almost unaffected, since this was solely a stock market crisis that did not spread to the real estate markets. Finally, we identify safe haven characteristics in the European office markets for Germany and Switzerland, as indicated by the strong positive effects on capital value during the GFC and ESDC. The regions in Eastern, Western, and Southern Europe, however, were hit hard by the crises, which led to decreasing office values.

The remainder of this paper is organized as follows. Section 2 reviews the literature. In Section 3, we describe our sample and explain our panel data methodology. Section 4 presents our empirical results. Finally, Section 5 concludes the paper.

2. Literature Review

Pricing is a common topic in real estate finance. Our study focuses on office property prices, since commercial real estate is typically more closely tied to the underlying economic conditions of a certain location than residential real estate.

Traditionally, returns from direct office investments are studied by modeling rents. Early empirical studies can be traced back to Rosen (1984), who estimates demand and supply models for the San Francisco office market. He shows that rents are inversely related to vacancy rates. In a similar study for the North American market, Hekman (1985) also includes the vacancy rate as an indicator for supply- and demand-side conditions within the office sector to explain for rents. He reports a negative effect of vacancy on rents and also finds that the gross domestic product (GDP) significantly and positively influences rents, while local unemployment has no significant impact on the rent level. Dobson and Goddard (1992) document a positive relation between real interest rates and rental prices for four commercial markets in the UK. In the case of office properties, they find that employment is not significant. Giussani et al. (1993) carry out one of the first pan-European studies on the determinants of office rents. For 10 European cities, they find that rents are determined by demand-side variables, as do Hekman (1985) and Dobson and Goddard (1992), where the GDP is the most important variable. However, they do not find any significance for unemployment or interest rates in rental prices. D’Arcy et al. (1997) extend previous studies by analyzing the influence of national economic conditions, market size, and economic growth effects on office rents for 22 European cities. They show that the GDP and real interest rates are significantly related to rents, whereas market size and city growth effects are not significant. Some studies also include economic fundamentals in determining both rental values and capital values. For example, Quan and Titman (1999) analyze 17 global markets. In their study, rents and capital values are significantly related to the economic variables, especially the GDP. For the London office market, Hendershott et al. (1999) use supply and demand relations to link vacancies and rents to employment growth and real interest rates. They show that real effective rents have a mean-reverting price pattern.

Another strand in the real estate literature focuses on the yield (rent standardized by office value) of direct office investments rather than solely the rent. For example, Sivitanides and Sivitanidou (1999) explore factors that influence the office capitalization rate for a dataset of 17 US cities. To analyze time trends and the impact of local and national market components of capitalization rates, the authors split their analysis into three parts: fixed-location time-invariant office markets, time-variant local office markets, and time-variant national capital markets. They conclude that local office market characteristics such as vacancy rates, employment growth, and lagged rental growth have a larger effect on capitalization rates than national capital markets. For a dataset of major cities in Asia, Europe and the US, De Wit and Van Dijk (2003) examine the determinants of office returns by using a dynamic panel data model. Their findings show that GDP and inflation positively affect changes in prices, while prices are negatively affected by changes in unemployment and vacancy. They further report that changes in office values are strongly related to value changes of the previous quarter, while rental changes are also strongly related to rental changes in previous quarters. Similarly, Sivitanides et al. (2001) examine the yield determinants of four property types, including offices, for metropolitan areas in the US. They find that yield movements are shaped by the time path of local rental growth and national factors such as interest rates and the consumer price index (CPI). Notably, inflation (CPI) has only half of the effect one might expect. Clayton et al. (2009) additionally include an indicator for investor sentiment on commercial cap rates, which they find to be significant. Similar to Sivitanides and Sivitanidou (1999), they emphasize the pivotal role of real estate fundamentals in cap rate formation. In a global study of 33 cities across 16 countries for the period 2007–2015, Devaney et al. (2019) explore variations in the transaction activity and pricing of international office markets with a standard panel framework to model the capitalization rates. Consistent with previous research, their paper underpins the importance of drivers such as government bond yields, yield spreads, and rents. Furthermore, they argue that larger and more mature markets tend to have lower cap rates and, in turn, higher asset values, and vice versa. Duca and Ling (2020) model the short- and long-run relations between capitalization rates and risk premiums for office buildings and apartments and the required rates of return of investors and their assessment of capital availability. In accordance with previous studies in the literature, both expected rental growth and capital availability have a significantly negative effect on the cap rate.

Since the GFC, many scholars have argued that central bank activities such as the expansion of the monetary base and declining interest rates cause real estate prices to rise as financing conditions become more favorable and opportunity costs decrease. Thus, a growing strand of the literature has addressed the nexus of liquidity and real estate values or capitalization rates. Several studies build on the work of Chervachidze et al. (2009), who examine office properties by means of a panel analysis of 30 US metropolitan regions over the period 1980–2007. They incorporate total net borrowing and lending over the nominal GDP as a measure of liquidity and a general corporate risk premium. They find that higher liquidity decreases yields and hence raises property values. Chervachidze and Wheaton (2013) extend the work of Chervachidze et al. (2009) by using the ratio of the annual growth of total debt outstanding to the GDP (debt availability) as a proxy for liquidity. Their results are in line with those of Chervachidze et al. (2009); however, they argue that this variable better explains the strong relation between debt and asset prices. They conclude that local rents could be just a small part of the explanation and that other (unobserved) systematic factors between markets which contribute to the understanding of cap rates need to be considered. In a later study, Hahn et al. (2016) analyze the response of office rents and capital values to macroeconomic shocks for the German market. They proxy for liquidity by the growth rate of the M3 money supply, and their results show a positive influence of the money supply and government bond yield on office performance. Kim et al. (2019) model the relation between liquidity and office yields for six Asian markets. They measure liquidity as both M2 and excess liquidity, and calculate excess liquidity as the gap between M2 and GDP growth. Their findings suggest that excess liquidity tends to temper office yields due to the positive effect on property value. Therefore, they conclude that increasing excess liquidity leads to the overvaluation of office markets.

Other studies explore the impact of economic events on office property cycles in the European markets, such as the introduction of the Euro or the GCF, rather than merely looking at variable effects. For example, Lizieri et al. (2000) and d'Amato and Amoruso (2018) examine the cyclical nature of the London office market. Lizieri et al. (2000) find that the London market is highly volatile compared to other UK markets, due to large international capital inflows, which make the market more prone to shocks in international financial markets, thus increasing systematic risk. In addition, d'Amato and Amoruso (2018) have developed a cyclical capitalization model that is based on the income approach and a time series analysis. They find that their model is particularly useful in the valuation process of income-producing properties that are affected by frequent up- and downturns of the market cycle. Very few studies also cover the continental European market. Srivatsa and Lee (2012) analyze the extent of convergence in rents and yields in seven European office markets during the period of 1982–2009. They find evidence that the implementation of a single currency in January 1999 led to increasing signs of convergence, particularly in Continental Europe. However, their results show that European office markets are not fully integrated, thus implying that diversification across Europe is still a reasonable investment strategy.[2]

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[2]Lee et al. (2014) focus on the European real estate future securities market. As in our study, they distinguish between pan-European future markets and the future markets of

Several studies focus on the repercussions of the GFC (e.g., Gupta et al., 2015; McAllister and Nanda, 2016). They all find that German markets evince more stable characteristics during crisis times from the perspective of an investor. In their paper on house price co-movements in the euro area, Gupta et al. (2015) detect strongly positive correlations between prices within European countries, except for Germany. This result is consistent with the fact that real estate prices rose since 2008 in Germany but stagnated or declined in the rest of the euro area. Gupta et al. (2015) argue that Germany is seen as a safe haven and the country has thus witnessed a large capital influx from the peripheral European regions. McAllister and Nanda (2016) extend previous models by examining the impact of foreign real estate investment on office capitalization rates for 28 key European markets over the period of 1999–2013. They show that foreign investment significantly led to yield compression due to increased competition intensity. Furthermore, their dataset from the DTZ Research Institute illustrates that cap rates fell significantly in Europe in the boom phase from 2005 to 2007 which preceded the GFC. During the GFC, however, cap rates increased, substantially peaked in 2009, and asset values thus experienced sharp declines. Compared to other European cities that had high cap rates and high volatilities in the sample period, German cities exhibited low cap rates and remained relatively stable. More recently, Coffinet and Kitzler (2019) assess whether the French office market is overvalued due to office supply constraints and low interest rates. According to their study, office prices in France were only slightly overvalued in 2017Q4, since the deviation between prices from their fundamentals was only between 0% and 10%, thus suggesting that the prices were close to fair value.

Most European studies have focused solely on the UK market, especially the London city office market. The research coverage of continental European office markets overall is scant. The vast majority of articles use pooled models and, hence, draw more general inferences on the European market as a whole.

3. Data and Methodology

We use a commercial property panel dataset that covers 29 European cities from 17 countries, as listed in Table 1. The dataset was provided by CoStar and is based on average real estate data. Due to a few missing data points, our panel structure is unbalanced.

the Eurozone only. Their focus, however, is on the link between the futures and the underlying markets. To the best of our knowledge, aside from our study, this is the only paper that distinguishes between these two markets.

Table 1 Country and City Dimensions

Country	City
Austria	Vienna
Belgium	Brussels
Czech Republic*	Prague
Denmark*	Copenhagen
Finland	Helsinki
France	Lyon, Paris
Germany	Berlin, Cologne, Duesseldorf, Frankfurt, Hamburg, Munich, Stuttgart
Greece	Athens
Hungary*	Budapest
Ireland	Dublin
Italy	Milan, Rome
Netherlands	Amsterdam
Norway*	Oslo
Poland*	Warsaw
Spain	Barcelona, Madrid
Sweden*	Gothenburg, Malmö, Stockholm
Switzerland*	Geneva, Zurich

Note: Countries denoted with an asterisk (*) are not members of the EMU.

Our dataset spans the period from 1995Q1 to 2020Q1. The dataset covers the introduction of the Euro in 1999, DCC of the early 2000s, GFC of 2007/2008, as well as the subsequent ESDC. Overall, our sample size comprises 2779 observations. The choice of cities is governed by the availability and reliability of the data and the economic importance of the cities.

Our dependent variable is the growth rate of the average capital value index, which is indexed to 100 for 1995Q1. This index is transaction based and measures office capital values on the basis of rents and cap rates:

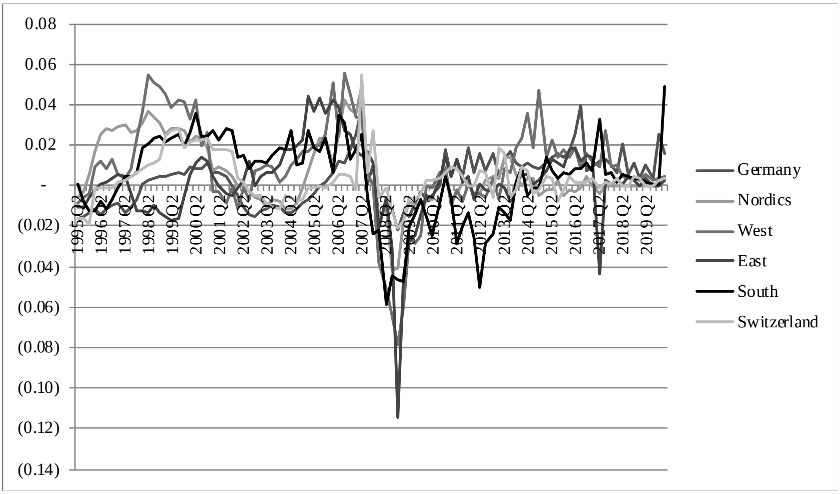
$$CV_t = \sum_{t=1}^{T} \frac{R_t}{(1+i)^t} + \frac{R_t}{(1+i)^T + (c - g)} \quad (1)$$

where R_t represents the net rental income in period t, discounted by the discount rate i. In the terminal period T, R_t is capitalized by a cap rate c minus the expected growth rate of cash flow g. However, we are interested in the changes of the capital value. Thus, we transform our dependent variable into growth rates:

$$CVGrowth_t = \frac{CV_t}{CV_{t-1}} - 1 \quad (2)$$

Figure 1 shows the capital value growth rates of different regional office markets over the sample period. We clearly observe price reactions during the boom phases that preceded the dotcom bubble in the early 2000s and a small decline in the DCC, whereas we see the most severe price declines during the GFC in 2007/2008. During the ensuing ESDC, prices appear quite volatile across countries. In particular, Southern and Eastern Europe were negatively affected during and after the GFC, while German and Swiss office prices appeared more stable over time.

Figure 1 Capital Value Growth Across European Regions



Notes: This figure plots the growth rates of the capital value index (1995Q1=100) over the sample period from 1995Q1 to 2020Q1. The data are provided by CoStar.

As for the independent variables, we use a set of macroeconomic variables to proxy for the demand factors and microeconomic variables to capture the supply factors. Our two main microeconomic variables of interest are the growth rate of the average asking rent measured in Euros per square meter, which represents the income stream of an office property, and the vacancy rate, as a measure of the general attractiveness of an office building. Our macroeconomic control variables are the growth rate of the GDP, as a measure of the business cycle and income of a country; the growth rate of the CPI, since real estate is often considered as a hedge against inflation (e.g., Hoesli et al., 2008); and the unemployment rate, as a gauge of economic activity and the labor market development of a country (e.g., De Wit and Van Dijk, 2003). We include 10-year government bond yields as a proxy for both long-term interest rates and direct competitors of office investments.[3] As a measure of monetary policy and liquidity, we use the growth rate of the money supply (M3; see, e.g., Belke et al., 2008; Kim et al., 2019). Additionally, a country-specific spread is included which serves as a proxy for the market risk premium. We calculate the spread as the difference between short-term interest rates and 10-year government bond yields.[4]

We obtain the data for the GDP, CPI, unemployment, and short rate from the Organisation for Economic Cooperation and Development (OECD) database; the 10-year government bond and M3 data are from the Federal Reserve Economic Data; and real estate data, such as vacancy, rent, and capital values, are provided by CoStar.[5] Real estate variables are available at the city level, and macroeconomic variables are available at the country level. Data for M3 and the short rate (central bank base rates) are the same for all countries in the EMU, due to their common monetary policy; otherwise they are country-specific.

Table 2 presents the descriptive statistics of the dependent and independent variables.[6]

We estimate two different models. Since we are interested in the main determinants of office property values during the DCC, GFC, and ESDC, our first model takes the following form:

$$CVGrowth_{i,t} = \alpha_0 + \beta_1 RE_{i,t} + \beta_2 Macro_{i,t} + \beta_3 \delta_{i,t} + \beta_4 \gamma_{i,t} + \beta_5 \rho_{i,t} + \mu_i + \varepsilon_{i,t} \quad (3)$$

where $CVGrowth_{i,t}$ denotes the growth rate of the capital value in city i and period t. β_k is the parameter to be estimated; $RE_{i,t}$ is a vector of our real estate controls; and $Macro_{i,t}$ is a vector of our macro controls. δ denotes a vector of the interaction terms between the respective independent control variables and a dummy that indicates the period during the DCC, which is one for the period from 2001Q1 to 2003Q1 and zero otherwise. γ denotes a vector of the interaction terms between the respective independent control variable and a dummy that indicates the period during the GFC, which is one for the period

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[3]The choice of the 10-year government bond duration is in line with, for example, the works of Clayton et al. (2009), Hahn et al. (2016), McAllister and Nanda (2016), Kim et al. (2019), and Devaney et al. (2019). The government bond yields in our study are country-specific.

[4]An earlier version of our model also included the short rate instead of the spread, since short-term interest rates are closely linked to central bank base rates and, in turn, financing costs. Due to multicollinearity issues between the short rate and the 10-year government bond yield, we only employ the market risk premium.

[5]The OECD data are available at https://stats.oecd.org, FRED data at https://fred.stlouisfed.org, and CoStar data at https://www.costar.com.

[6]The highest correlation is found between the GDP and vacancy (0.355), thus implying that multicollinearity is not an issue.

from 2007Q1 to 2009Q4 and zero otherwise. ρ denotes a vector of the interaction terms between the respective independent control variable and a dummy that indicates the period during the ESDC, which is one for the period from 2010Q1 to 2020Q1 and zero otherwise. Finally, μ refers to the city fixed effects to capture city-specific factors, and ε is the error term.[7]

Table 2 Descriptive Statistics

	Mean	Median	Max.	Min.	Std. Dev.	Obs.
CV Growth	89.074	90.512	221.172	23.446	23.928	2901
Rent Growth	405.312	194.663	2455.454	85.167	472.152	2926
Vacancy	9.327	8.683	25.474	0.628	4.580	2929
GBond10	3.654	3.886	25.400	-0.776	2.412	2861
Spread	-1.273	-1.167	9.256	-24.357	1.709	2861
M3 Growth	6.037	5.443	28.104	0.081	4.208	2929
CPI Growth	88.786	90.927	112.015	23.532	12.572	2929
GDP Growth	1.985	1.958	28.960	-10.294	2.671	2921
Unemplmt	8.221	7.800	27.833	1.966	4.071	2917

Notes: This table reports the descriptive statistics of our quarterly variables for the full sample period. The sample period is from 1995Q1 to 2020Q1.

In our second model, we analyze different regions with similar features to test for safe haven characteristics. Hence, we integrate city clusters into our model, so that it takes the following form:

$$CVGrowth_{i,t} = \alpha_0 + \beta_1 Control_{i,t} + \beta_2 \varphi_{i,t} + \beta_3 \tau_{i,t} + \beta_4 \vartheta_{i,t} + \beta_5 \lambda_{i,t} + \varepsilon_{i,t} \tag{4}$$

where $Control_{i,t}$ is a vector of both our real estate and macro variables used in Equation (3), with and without crisis interaction controls; φ represents a vector of dummy variables that include clusters of European cities according to their geographical location; τ denotes a vector of the interaction terms between the respective cluster dummy and a dummy that indicates the period during the DCC, which is one for the period from 2001Q1 to 2003Q1 and zero otherwise. ϑ denotes a vector of the interaction terms between the cluster dummy and a dummy that indicates the period during the GFC, which is one for the period from 2007Q1 to 2009Q4 and zero otherwise. Finally, λ denotes a vector of the interaction terms between the cluster dummy and a dummy that indicates the period during the ESDC, which is one for the period from 2010Q1 to 2020Q1

[7]The national macroeconomic variables are the same for each cross-sectional unit. The variables for rent and vacancy are the only two that allow for full cross-sectional as well as temporal variation. This prevents us from including time fixed effects in our models, since these would absorb the impact of the national macroeconomic variables. We add additional quarterly dummies to all our models to account for time-specific factors. Since the results do not improve, we adhere to the models without time dummies.

and zero otherwise. Due to multicollinearity between the dummy variables, Equation (4) can only be estimated in the pooled cross section.

All of the macroeconomic variables except for the 10-year government bond (GBond10) and the short rate are seasonally adjusted. To address non-stationarity, all of the variables, with the exception of GBond10 and the spread, are transformed into growth rates. For vacancy and unemployment, we use first differences.[8]

Furthermore, we account for heteroskedasticity issues by clustering standard errors at the city level. Our standard errors are explicitly not clustered at the country or regional level, since many countries are only represented by a single city.

4. Results

Table 3 shows our estimates for Equation (3). We measure two different models: Model (1) observes Europe as a whole and therefore includes our full cross-sectional country dimension, while Model (2) merely considers the EMU; that is, non-member states of the EMU, such as the Czech Republic, Denmark, Hungary, Norway, Poland, Sweden, and Switzerland, are excluded.[9] Although the EMU model has fewer observations, it exhibits a higher R^2 value than the full European model due to the larger homogeneity of the EMU member countries, which share the same monetary policy (a single central bank, the same interest rates, and same monetary base). Both models are structured as follows. First, we measure our full sample period to examine the overall effects of our variables on the growth of capital value. Second, we include dummy variables to control for the additional effects of our variables during the DCC, GFC, and ESDC.

For our full sample period, rent and vacancy are highly significant in both models and show the expected signs, which are in line with the literature (Chervachidze et al., 2009; Chervachidze and Wheaton, 2013; Devaney et al., 2019; De Wit and Van Dijk, 2003; Duca and Ling, 2020; McAllister and Nanda, 2016). As expected, rent and vacancy have the largest impact on office prices. The signs and significance are also as expected for long-term government bond yields, M3 and GDP growth, and unemployment, and are in line with the literature (e.g., Chervachidze et al., 2009; Chervachidze and Wheaton, 2013; De Wit and Van Dijk, 2003; Kim et al., 2019; McAllister and

[8]The results of common panel unit root tests (the Im–Pesaran–Shin and Levin–Lin–Chu tests) indicate that all variables become stationary with a growth rate or first difference transformation.
[9]See Table 1 for a more detailed view of the member states and cities of the EMU compared to our full European sample.

Nanda, 2016; Quan and Titman, 1999; Tsolacos et al., 1998). Inflation (CPI growth), however, is only significant in the European model, but, as for Sivitanides et al. (2001), its impact on office prices is rather weak. Contrary to our expectations that expansionary monetary policy drives up real estate values, the inflation variable is not significant for the EMU in the full sample period. For the period of the DCC, the additional effects of our variables are either not significant or the significance appears to be rather weak in both models. Similarly, the crisis dummy DCC for this period is not significant in both models, thus indicating that the DCC left office markets unaffected in both Europe as a whole and the EMU region. This underpins that the DCC was a crisis that was induced by the bursting of a stock market bubble and not by a bubble in physical real asset markets.

Table 3 Regression Results, Basis Models

	Europe		EMU	
	Model (1)		**Model (2)**	
Dependent Variable	CV Growth		CV Growth	
Full period: 1995q1–2020q1				
Rent Growth	0.608***	(0.06)	0.605***	(0.07)
Vacancy	-1.637***	(0.20)	-1.300***	(0.30)
Spread	-0.001	(0.06)	-0.025	(0.08)
GBond10	-0.344***	(0.06)	-0.436***	(0.07)
M3 Growth	0.120***	(0.03)	0.143***	(0.05)
CPI Growth	0.186**	(0.08)	0.131	(0.08)
GDP Growth	0.182***	(0.04)	0.192***	(0.05)
Unemplmt	-0.181**	(0.08)	-0.814***	(0.26)
Dotcom crisis: 2001q1–2003q1				
Rent Growth*DCC	-0.099	(0.10)	-0.043	(0.13)
Vacancy*DCC	0.573**	(0.29)	-0.074	(0.42)
Spread*DCC	-0.094	(0.12)	-0.629**	(0.27)
GBond10*DCC	0.159	(0.13)	-0.201	(0.35)
M3 Growth*DCC	-0.141***	(0.05)	-0.108	(0.09)
CPI Growth*DCC	-0.090	(0.13)	0.176	(0.14)
GDP Growth*DCC	-0.104	(0.07)	-0.001	(0.09)
Unemplmt*DCC	0.385*	(0.20)	1.283**	(0.54)
DCC	-0.496	(0.74)	0.327	(1.43)
GFC: 2007q1–2009q4				
Rent Growth*GFC	-0.296***	(0.10)	-0.307***	(0.11)
Vacancy*GFC	0.039	(0.34)	-0.724	(0.47)
Spread*GFC	-0.960***	(0.18)	-1.808***	(0.24)
GBond10*GFC	-0.278	(0.21)	-1.584***	(0.44)
M3 Growth*GFC	-0.034	(0.13)	0.906***	(0.20)
CPI Growth*GFC	-0.035	(0.20)	-0.341	(0.23)
GDP Growth*GFC	0.065	(0.08)	0.135	(0.09)
Unemplmt*GFC	-1.177***	(0.38)	-0.894*	(0.53)
GFC	-0.655	(0.98)	2.761*	Q

(Continued…)

(Table 3 Continued)

European sovereign debt crisis: 20101–2020Q1				
Rent Growth*ESDC	-0.136**	(0.06)	-0.147*	(0.08)
Vacancy*ESDC	0.250	(0.27)	-0.195	(0.41)
Spread*ESDC	-0.007	(0.10)	0.054	(0.24)
GBond10*ESDC	0.134	(0.09)	0.235	(0.20)
M3 Growth*ESDC	-0.156**	(0.06)	-0.182*	(0.10)
CPI Growth*ESDC	-0.324***	(0.10)	-0.206	(0.12)
GDP Growth*ESDC	-0.179***	(0.05)	-0.175***	(0.06)
Unemplmt*ESDC	-0.104	(0.18)	0.435	(0.39)
ESDC	-0.895**	(0.40)	-1.093**	(0.45)
C	1.608***	(0.38)	1.873***	(0.43)
Cross-sectional fixed effects	Yes		Yes	
R^2	0.526		0.573	
Adj. R^2	0.515		0.561	
Obs.	2808		1864	

Notes: This table shows the results of our panel regressions with city fixed effects. Except for GBond10 and Spread, all of the variables are expressed as growth rates, where first differences are used for Vacancy and Unemplmt. The dummy variables DCC, GFC, and ESDC equal one during the periods for the DCC (2001Q1–2003Q1), GFC (2007q1–2009q4), and ESDC (2010Q1–2020Q1), respectively, and zero otherwise. Heteroskedasticity- and autocorrelation-corrected standard errors are presented in parentheses. *** p-value < 0.01, ** p-value < 0.05, and * p-value < 0.10.

During the period of the GFC, the significance of the additional variable effects increases substantially, since this crisis had its roots in the US housing market bubble and then spread to Europe as economies became more globally intertwined. The additional effect of rent on the growth of capital value is highly significant and negative, while the effect of vacancy is nonsignificant in either model, thus implying that other factors gained more importance than real estate fundamentals in explaining for office prices during the GFC period. The size of the coefficient for spread is negative and becomes highly significant in both models, which could be related to increased investor risk sensitivity during the GFC, thus resulting in declining office values. The additional effects of unemployment are also negative and significant in both models during the GFC, since the financial troubles of enterprises (or office tenants) facilitated occupational redundancies and insolvencies at the time. While the additional effects of liquidity (M3) and long-term government bond yields are not significant in the full European model, they are highly significant in the EMU model and show the expected signs. This result can be related to the single monetary policy of the European central bank, which started to gradually reduce interest rates and inundated the markets with liquidity to stimulate the economy during the GFC. Despite these central bank measures, other than those expected, inflation does not show significant additional effects during the GFC. This finding contradicts the inflation hedging theory of real estate in crisis times.

For the period of the ESDC, for both of our models, again, the additional effect for rent is significant and negative and vacancy is not significant. The following two findings are contrary to our expectations, however. First, the effects of long-term government bond yields are not significant, whereas M3 growth shows an additional negative and significant effect on office value in both models. We expect positive and significant additional effects of both variables, since the central banks decreased interest rates to zero and continued their bond purchasing programs, thus resulting in market liquidity reaching unprecedented high levels during this time. Second, the coefficient of inflation has a negative and significant effect on office prices in the European model, but is not significant in the EMU model. The GDP has a significant and negative additional impact on office value due to the predominance of economies in our sample that were hit hard by the crisis.[10]

Table 4 shows the results of the pooled panel regional model of Equation (4). To test whether the hypothesis that Germany is a safe haven holds true, we form regional clusters, namely, the variables CH, GER, EAST, NORDIC, WEST, and SOUTH, whereby NORDIC serves as the basis in this regression and is thus not shown.[11] Each cluster represents the aggregated growth rate of the office capital value for the respective region and period. We define a safe haven market as a market that exhibits high resilience during crisis periods. This resilience is indicated by stable or rising property prices, whereas prices decline in non–safe haven markets due to the crisis effect. Again, we present estimates for the European model, Equation (3) and an EMU model, Equation (4). As before, the EMU model has fewer observations, since non-EMU member states are excluded, but higher R^2 values. The control variables included are the same as those in Models (1) and (2). The signs, size, and significance of the controls are the same as those in Models (1) and (2).

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[10]Additionally, we test all our models with a time trend to capture the dynamics of technical innovations over time. However, the time trend is not significant, and improves the explanatory power of our models only marginally, and the overall results remained unchanged.

[11]We tested several variants of basis dummies a priori. We choose the NORDIC regional dummy as the basis, since it appeared fairly neutral to the crisis shocks. The cluster dummy CH (Switzerland) equals one for the cities of Geneva and Zurich and zero otherwise; GER (Germany) is equal to one for Berlin, Cologne, Duesseldorf, Frankfurt, Hamburg, Munich, and Stuttgart and zero otherwise; EAST equals one for Budapest, Prague, Vienna, and Warsaw and zero otherwise; WEST equals one for Amsterdam, Brussels, Dublin, Lyon, and Paris and zero otherwise; and SOUTH equals one for Athens, Barcelona, Madrid, Milan, and Rome and zero otherwise. The basis of this panel model is NORDICS, a cluster dummy that equals one for Copenhagen, Gothenburg, Helsinki, Malmo, Oslo, and Stockholm and zero otherwise.

Table 4 Regression Results, Regional Models

	Europe		EMU	
	Model (3)		**Model (4)**	
Dependent Variable	CV Growth		CV Growth	
Full period: 1995q1–2020q1				
CH	-1.073***	(0.38)		
GER	-0.731***	(0.26)	-0.575	(0.35)
EAST	0.486	(0.34)	-0.868*	(0.47)
WEST	0.261	(0.27)	0.411	(0.34)
SOUTH	-0.057	(0.27)	0.227	(0.35)
Dotcom crisis: 2001q1–2003q1				
CH*DCC	0.859	(0.62)		
GER*DCC	-0.098	(0.40)	-0.036	(0.76)
EAST*DCC	-0.714	(0.49)	0.719	(0.98)
WEST*DCC	-0.619	(0.42)	-0.631	(0.74)
SOUTH*DCC	0.748	(0.45)	0.489	(0.78)
DCC	-0.823	(0.81)	-0.097	(1.58)
GFC: 2007q1–2009q4				
CH*GFC	1.375*	(0.84)		
GER*GFC	1.135*	(0.56)	0.561*	(0.72)
EAST*GFC	-2.253***	(0.74)	-0.548	(0.97)
WEST*GFC	-1.488**	(0.59)	-1.538**	(0.73)
SOUTH*GFC	-1.142*	(0.60)	-0.917*	(0.76)
GFC	-3.676***	(1.08)	0.531	(1.75)
European sovereign debt crisis: 2010Q1–2020Q1				
CH*ESDC	1.198***	(0.44)		
GER*ESDC	1.326***	(0.30)	1.647***	(0.41)
EAST*ESDC	-0.167	(0.39)	-1.754***	(0.56)
WEST*ESDC	0.171	(0.31)	0.471	(0.41)
SOUTH*ESDC	0.426	(0.33)	0.544	(0.44)
ESDC	-1.981***	(0.46)	-2.571***	(0.56)
C	2.162***	(0.43)	2.263***	(0.52)
Cross-sectional fixed effects	No		No	
R^2	0.539		0.584	
Adj. R^2	0.530		0.572	
Obs.	2808		1864	

Notes: This table shows the results of the panel regression as a pooled setup. The control variables are the common macroeconomic and real estate variables used in this study. The cluster dummy CH (Switzerland) equals one for the cities Geneva and Zurich and zero otherwise; GER (Germany) equals one for Berlin, Cologne, Duesseldorf, Frankfurt, Hamburg, Munich, and Stuttgart and zero otherwise; EAST equals one for Budapest, Prague, Vienna, and Warsaw and zero otherwise; WEST equals one for Amsterdam, Brussels, Dublin, Lyon, and Paris and zero otherwise; and SOUTH equals one for Athens, Barcelona, Madrid, Milan, and

Rome and zero otherwise. The basis of this panel model is NORDICS, a cluster dummy that equals one for Copenhagen, Gothenburg, Helsinki, Malmö, Oslo, and Stockholm and zero otherwise. The dummy variables DCC, GFC, and ESDC are described in Table 3. Heteroskedasticity- and autocorrelation-corrected standard errors are presented in parentheses. *** p-value < 0.01, ** p-value < 0.05, and * p-value < 0.10.

For the full sample period, CH and GER are the only two clusters that exhibit significant coefficients. In both clusters, we see falling office prices over the entire time span for the European model.[12] For the EMU model, only EAST exhibits a significant and negative coefficient. For the period of the DCC, as expected, none of the coefficients in either model is significant, since the DCC, which was a stock market crisis, was isolated from the real estate markets. However, for the period of the GFC, which was a real estate cycle bust, our regional cluster coefficients have high significance in both models. The additional effects of CH and GER are strongly positive. They outweigh the negative effects of office price growth of the full period. By contrast, all the other regions—namely, EAST, WEST, and SOUTH—show strong negative effects, thus indicating that these regions were hit hard by the financial crisis.

During the ESDC, CH and GER still exhibit significant growth rates in positive office value in both models, whereas those for WEST and SOUTH are not significant. In the EMU model, EAST is highly significant and strongly negative. Again, the positive effects of CH and GER outweigh the negative effects for the full period, such that we find strongly positive overall price effects. Since the office market in Germany performed very well in all of the crisis periods under study, we can support the hypothesis that Germany is perceived as a safe haven market. Furthermore, this result underlines the strong market fundamentals of Germany in both real estate markets and the economy as a whole. Since the same characteristics are observed for Switzerland, our findings further suggest that Switzerland is perceived as a safe haven market within the European context as well.[13]

Overall our results for real estate and macroeconomic variables are in line with the literature. We find real estate variables such as rent and vacancy play the most important role in explaining for the office capital value. Furthermore, we find crisis effects. First, the DCC, which was essentially a stock market crisis, had no significant effects on office prices. Second, the GFC and the ESDC had strong significant effects on office prices. However, the results for the monetary

[12]This effect is also documented in the literature (e.g., Gupta et al., 2015; McAllister and Nanda, 2016).

[13]Typically, safe haven characteristics are related to a robust (or less volatile) economic development, but also to political stability or predictability (such as a well-developed social security and healthcare system). In Germany, the unemployment rate from 2010-2020 was on average below 5% and even lower in Switzerland. In the Eurozone, it averaged around 8%.

policy variables, such as liquidity, interest rate, and inflation, are mixed. The signs, size, and significance of monetary policy on office values are overall different from those one would expect. Finally, Germany and Switzerland are found to be safe haven markets, as indicated by the strong positive and significant capital value growth during the crisis periods, while all the other regions show negative signs.

5. Conclusion

In this paper, we analyze the empirical interrelations between European office capital values and their fundamentals. We thereby focus on crisis events such as the DCC, GFC, and ESDC, which are only barely covered in the literature. We account for different European office markets via cluster dummies. This setting also enables us to examine the safe haven characteristics of the German and Swiss office markets.

We generally find that real estate variables, such as rent and vacancy, are the most important determinants in explaining for office prices. For the EMU, our findings suggest that monetary policy measures, such as the growth rate of the money supply and interest rates, played a considerable role only during the GFC, since the EMU is steered by a single central bank. For Europe as a whole, monetary policy variables are less important. We also observe different crisis effects. The risk premiums of investors do not play a role in the entire sample period, but significantly reduce office values in the GFC period. Furthermore, we find that the DCC left European office markets almost unaffected, since this was solely a stock market crisis that did not spread to real estate markets. Finally, we identify safe haven effects in the office markets for Germany and Switzerland, as indicated by the strong positive effects on capital value during the GFC and ESDC. By contrast, the regions in Eastern, Western, and Southern Europe were hit hard by the crises, as indicated by decreasing office values. This heterogeneity of the European office market also offers diversification potential for investors.

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