Department of Finance
Faculty of Business and Economics

Working Paper Series

The Determinants of Office Rental Yields: The International Evidence

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Working Paper No. 06/20

The Determinants of Office Rental Yields: The International Evidence*

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(Preliminary: please do not distribute)

December 2020

Abstract

We examine commercial office rental yields in 89 large cities in 33 developed and developing countries in the 2000-2019 period. As expected, commercial office yields have declined throughout the world, reflecting a decline in the real rate of interest over this time period. Our cross-city analysis indicates that commercial office yields are lower in cities with growing rental rates and in countries with higher credit ratings and lower inflation rates. Finally, we find that rental yields in suburban office markets are higher than in central business districts, and for a given metropolis, suburban yields are lower in suburbs with better public transport connections to the central business district.

Keywords: Global real estate market, Capitalization rate, Office rental yield, Financial centers, Public Transport
JEL codes: R3, R4

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* We are grateful to Paul Lunn and Raymond Torto for providing us with access to the CBRE ERIX global real estate database. This paper has benefited from the useful comments and suggestions provided by David Ling and participants at the 2018 American Real Estate and Urban Economics Association International conference and the 2018 UNC Real Estate Research Symposium.

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1. Introduction

As an economics discipline, real estate combines insights from both urban economics and finance. Urban economics provides a basis for understanding why rents differ across locations along with the forces that can lead rental rates to increase and decrease over time. Financial economics provides a theory that can map current and expected future rents into property values. Taken together, these disciplines can tell us something about why rental yields, the ratio of rental rates to property values, differ across locations. Specifically, the theory helps us understand why properties in different locations that have similar rents might have very different property values.

In this paper, we examine rental yields of office buildings in 89 major cities in 33 developed and developing countries over the 2000-2019 period. The data set, provided by CBRE, a large international commercial real estate firm, is standardized in the sense that it is based on the rents and values of an identical hypothetical high-rise Class A office property that is located in different cities around the world.[1] Most of the data is for the rental yields of office space located in the cities' central business districts (CBDs), but we also examine a limited amount of data on rental yields in suburban business districts (SBDs) in Europe. We combine this rental yield data with data from additional sources on the size and densities of the cities, their transit infrastructure and various indicators of the cost of capital in the different locations.

Figure 1, which reports the average CBD rental yields by country in both the first half and the second half of our sample, illustrates the substantial cross-sectional as well as time-series variation in rental yields. The lowest rental yields are in relatively wealthy countries that include cities that are financial centers, and the cities with the highest yields tend to be in developing economies. The figure also shows that rental yields are lower in all countries in the second half of

[1] This corresponds closely to the definition of a standardized cap rate, as applied to commercial real estate.

the sample, with the exceptions of Greece, Ireland and Spain, where rental yields increased following the Great Recession.

(Figure 1 about here)

Our empirical tests, which explore this cross-sectional and time-series variation, can be motivated by applying Gordon's Growth Model (1962). Specifically, in a simple setting where both the discount rate, *r*, and the rental income growth rate, *g*, are constant, the rental yield can be expressed as follows:

$$\frac{Rent}{Property\ Value} = r - g \qquad [1]$$

In other words, we expect rental yields to be higher in cities where real discount rates are expected to be high and where rates of rental growth are expected to be low. To explore whether or not this is indeed the case, we test whether observed rental yields are related in both the cross-section and the time series to proxies for discount rates and rental growth rates.

Our proxies for discount rates are relatively straightforward. For example, we consider cross-country and time series differences in inflation rates, which directly affect both nominal discount rates and expected nominal growth rates. In the absence of financial constraints, and assuming the real rate of interest is constant, inflation should not affect rental yields, since the effect of higher inflation on the discount rate should be exactly offset by increases in the nominal growth rate of rents. However, the ability of property owners to borrow money and raise rents may be more constrained in a high inflation environment. Such constraints are likely to lower property

values, leading to higher rental yields. We also try to estimate real rates of interest, which varies across countries as well as across time. Ceteris paribus, declines in real interest rates should result in lower rental yields.

As expected, we find evidence of a positive relationship between discount rates and CBD rental yields. This is clearly true in the time-series, which exhibits declining rental yields around the world corresponding to a decline in real interest rates. The cross-sectional evidence is less clear. We do not observe a significant relation between estimated real rates and rental yields in the cross-section, but we do find a significant relation between country credit ratings and rental yields. Moreover, we find that countries with higher rates of inflation, and hence higher nominal interest rates, tend to have higher rental yields.

Our proxies for expected rental growth rates are much more speculative. We use two approaches -- the first is to simply use the rental growth rate in the past as a proxy for the future expected growth rate -- the second is to use various characteristics that proxy for the future growth rate of cities as well as proxies for constraints on supply. The idea is that rental growth is likely to be highest in growing cities with constraints on the development of new office supply.

Proxies for expected increases in demand for office space include the cities' past population growth rate – our assumption is that population growth is persistent -- and per capita income – we assume that wealthier cities are expected to attract migrants and new businesses. Our proxies for supply constraints are based on the idea that some CBD locations are implicitly constrained because they are difficult to replicate. For example, mid-town Manhattan has extremely expensive real estate and low rental yields in part because proximity to Grand Central Station makes the location accessible to hundreds of thousands of commuters. To generalize this idea we use the

city's public transport capacity as a proxy for supply constraints.[2] It should be noted, however, that public transport capacity can also directly affect the growth rate of a city, since cities with better public transport may be less subject to the traffic congestion that can suppress the growth of car-based cities. We also include the percentage of a city's jobs in the CBD and whether the city is a financial center as proxies for supply constraints. Our intuition is that the CBD locations are more difficult to replicate in cities with more jobs and in cities that host large finance sectors, since finance firms have strong preferences for locating in financial districts where they are within walking distance to both their competitors and service providers.

As it turns out, we are not able to accurately predict rental growth rates. Specifically, we do not find a statistically significant relationship between either past rental rate growth and future growth rates or a relationship between our various proxies for growth and future growth.[3] This is not particularly surprising -- rental growth rates are likely to be difficult to predict. However, the weak relationship between our proxies and future rental growth rates does lead us to be cautious about how we interpret the relationship between these proxies and rental yields.

Nevertheless, we do find relationships between these proxies and observed rental yields that are roughly consistent with the idea that rental yields are lower when future rental growth rates are higher. In particular, we find a significant negative relationship between past rental growth rates and rental yields and that rental yields tend to be lower in larger cities, in richer cities, in cities that host a financial center, in cities that rely more on public transportation and in cities with a greater proportion of jobs located in the CBD.

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[2] Due to data limitations in some of the countries included in our study, we do not include the individual components of public transport – bus, rail and tram.

[3] Results for the regression of observed rental growth rates on our proxies for expected rental growth rates are available on request.

While most of our analysis focuses on CBD rental yields, a comparison of CBD and SBD yields is also of interest. We conjecture that because cities have multiple SBDs, suburban office space is inherently less constrained than CBD office space, which suggests that CBD locations are expected to have lower rental yields. We find that this is indeed the case. We also find that the difference between SBD and CBD rental yields is less for SBDs with shorter travel times between the CBD and SBD and that the difference between SBD and CBD yields is greater in faster growing cities and is less for the few SBDs that are financial centers.

Although we are not the first to consider the determinants of rental yields, most existing studies focus on the determinants of both rental rates and rental yields (or equivalently cap rates) within individual cities and countries.[4] The closest study to ours is Chichernea, Miller, Fisher, Sklarz, and White (2008), which studies 34 U.S. MSAs in 2005. The study documents a negative relationship between cap rates and supply constraints, proxied by an index of the stringency of regulations and a positive relationship with risk, proxied by the standard deviation of population growth, and liquidity, proxied by sales volume. We believe that we are the first to study both time-series and cross-sectional variation in rental yields and we clearly consider a much more varied cross-section as well as a longer time series than past studies. We also consider a much broader set of variables that can plausibly affect rental yields.[5] We also believe that we are the first to explore differences between CBD and SBD rental yields in a cross-country study.

The paper is organized as follows. Our sample is described in Section 2. Section 3 describes the time-series of rental yields. Section 4 presents the cross-sectional univariate analysis

[4] For example, Brueckner and Fansler (1983), Sivitanidou and Sivitanides (1999), Hendershott and MacGregor (2005), Chichernea, Miller, Fisher, Sklarz, M., and White (2008), Piazzi, Torous and Valkonov (2008), Chervachidze, Costello and Wheaton (2009), McDonald and Dermisi (2009) and Chervachidze and Wheaton (2013).

[5] There does exist a small literature that examines the cross-sectional variation in the determinants of cap rates across countries, including, Wit and Dijk (2003) (Europe, Asia and U.S.). These studies include fewer cities and consider fewer explanatory variables.

of the determinants of rental yields. Section 5 presents our regression results and Section 6 draws some conclusions.

2. Data and Sample

2.1 Data on Rental Yields

Our primary data source, the CBRE ERIX database, provides annual rental yields for prime office space in Central Business Districts (CBDs) and some Suburban Business Districts (SBDs) for the period 2000 to 2019.[6] The sample includes CBD prime rental yields for 89 cities across 33 countries, including Europe (both Western and Eastern Europe), Asia/Pacific and North America, with 56 of the cities located in Europe. We also have data on prime office rental yields for 81 SBDs, located in 20 European cities.

The prime rental yield, *Yield*, expressed as a percentage, is defined as the ratio of the annual net rental income (rent minus non-recoverable costs) and the total amount invested (purchase price plus purchasers' on-costs), achievable for a high rise Class A office building of standard size, measured at the end of each year. It is based both on sale and purchase contracts concluded during the survey period. If there are no relevant transactions during the survey period, the rental yields are based on expert opinion of market conditions. For the full sample, the average rental yield for Class A CBD office space is 6.16% with a standard deviation of 1.87%. Rental yields for SBD prime office space averages 5.97% with a standard deviation of 1.26%, which is 1.05% higher than the average rental yield of the CBDs in their respective city.

[6] CBRE ERIX defines sub-centers for given city as parts of city which offers prime office space. Sub-centers as sub-markets of office market for given city may or may not overlap with existing administrative division of the city. Sub-centers are non-CBD office markets and are named after well-established districts in each city.

Table 1 provides a description of the composition of our CBD sample. In half the cases we have just one city per country, but in 16, mostly European countries, we have data on two or more cities. In addition to the full sample, we also analyze the sub-sample of countries with two or more cities and the sub-sample of 56 European cities across 21 countries. Of these European countries 18 (52 cities) are member states of the European Union and 12 countries (34 cities) share a common currency, the Euro.

(Table 1 about here)

Table 1 also provides a description of our sample of 81 SBDs that are located in 20 European cities in 16 countries (both Western and Eastern Europe) -- 16 of the SBDs are located in Germany. With the exception of Switzerland (3 SBDs), all of these countries are member states of the European Union and 10 of these countries (66 SBDs) share a common currency, the Euro. CBD yields are lower than SBD yields in each city and in all years. As we will discuss, there is substantial variation of SBD yields within cities as well as variation in the spread between CBD and SBD yields across cities that we will be studying.

2.2 Proxies for discount rates and rental growth rates.[7]

We proxy for the nominal discount rate using several country-level variables, the *Short real interest* measured in the local currency, as the 3-month nominal interest rate minus the inflation rate, where *Inflation* is measured as the change in the country's CPI index. Both the 3-month nominal interest rate and the change in the CPI are sourced from the World Bank

[7] The set of dependent and independent variables are defined in Appendix A.

Development Indicators. In addition, we include each country's sovereign debt rating as a proxy for political risk. *Rating* is an indicator variable equal to one for countries with a Fitch sovereign debt rating of AAA or AA+ and zero otherwise.

As we mentioned in the introduction, our first proxy for each CBD's expected annual rental growth rate is the *Average rental growth rate* over the previous 3 years. To minimize the potential impact of outliers, we winsorize *Average rental growth rate* at the 2.5 and 97.5th percentiles. We also conjecture that rent is expected to grow faster in cities that are expected to attract new businesses and residents, but have constraints that limit the supply of new office space.

We consider a number of variables that are plausible proxies for cities that are likely to experience constrained growth. We measure the extent to which a city has a large and growing population, *Population* and *Population growth*, which we obtain from the OECD and supplemented with data obtained from each countries' official census website.[8] We also conjecture that wealthier cities are expected to attract new migrants, and collect metropolitan *real GDP per capita* in USD from the same sources. Since office supply may be more constrained in denser cities with more public transportation and with a higher concentration of jobs in the cities' CBDs, we also include the quality of the cities' transport infrastructure, *Transport,* which is the natural logarithm of the number of public transport boardings per capita within the metropolitan area as reported by the International Association of Public Transport (UITP), which is part of the Mobility in Cities Database. The data comes from surveys in 1995, 2002 and 2015.[9] We also collect the proportion of the city's total jobs in the CBD from the Mobility in Cities Database,

[8] Total population estimates for Chinese cities include both registered and unregistered residents.

[9] Public transport boardings per capita within the metropolitan area are measured as the sum of bus boardings, trams/light rail boardings, suburban rail boardings and metropolitan rail boardings. As noted earlier (Footnote 2), due to data limitations in some of the countries included in our study, we cannot identify the individual components of public transport system.

expressed as a percentage, *Jobs*. For each city we set both *Transport* and *Jobs* to zero if the city is missing in the Mobility in Cities Database and include indicator variables for these missing observations (*Transport missing* and *Jobs missing*) in order to control for any effects of this choice.

Using our sample of 81 SBDs and their corresponding CBDs, we also include measures of the road distance and travel times to the city's CBD, taken from Google Maps. *Distance* is measured as the natural logarithm of the road distance between an SBD and its CBD in kilometers. *Travel time – public* is measured as the natural logarithm of the travel time by public transit from an SBD to its CBD at 8:30AM on a working day (Wednesday) in hours. *Travel time – car* is measured as the natural logarithm of the travel time by car from an SBD to its CBD at 8:30AM on the same working day.

We measure financial centers by the number of finance professionals in each city. The variable, *Finance professionals* is measured as the number of finance professionals per capita in each city, as reported by Bloomberg. The number of finance professionals is estimated by Bloomberg as a mix of customers with Bloomberg financial terminal licenses and non-customers who represent high profile finance professionals.[10] *Financial center* is an indicator variable equal to one if the city is a top 20 financial center, defined by the number of financial professionals per capita and zero otherwise. The top 4 financial centers in our sample are New York, London, Hong Kong and Singapore.

In general, the financial district in a city is located in the CBD. However, in four cities – Amsterdam Beijing, Shanghai and Paris – the financial district is located in an SBD. We use a

[10] Bloomberg's detail definition of our variable - *Finance professionals* – is "Bloomberg search for individuals from financial service sector in each city from their sample. Bloomberg tracks a mix of both customers (who have their biography automatically created upon buying a terminal), and non-customers who we add -- mainly high-ranking people or newsworthy people. Location (City) is determined by the organization address for which the individual works for."

number of sources to obtain and verify the exact location of the financial districts. The primary data sources used are the CBRE ERIX database, Bloomberg, the Z/Yen Group's Global Financial Centres Index reports and Ernst Young and the Urban Land Institute's Attractiveness of Global Business Districts reports. We supplement this with data obtained from the Mobility in Cities database, city's official websites and other city-specific data sources. For each CBD and SBD we include the following indicator variables: *Financial CBD,* which is equal to one if the city is a top 20 financial center, defined by the number of financial professionals per capita, and the financial center is located in its CBD and zero otherwise. *Financial SBD*, which is equal to one if the city is a financial center and the financial center is located in the SBD and zero otherwise.

3. A Brief Description of the Time Series

3.1 CBD Rental Yields

We start by briefly describing how prime office rental yields have changed over our 2000 to 2019 sample period. As shown in Figure 3, other than an increase of 78 basis points during the financial crisis, average CBD rental yields declined steadily over this period. On average, CBD rental yields declined by 229 basis points from 6.99% to 4.70%. This decline is a global phenomenon -- we see similar declines for the 8 North American cities, the 21 Asia/Pacific cities and the 56 European cities.

This decline in rental yields is consistent with changes in real short-term interest rates over this time period. To illustrate this, we also plot in Figure 2 the average real short-term interest rate in our sample of countries, measured as the 3-month nominal interest rate minus the inflation rate, where inflation is measured as the change in the country CPI index. Overall real short-term interest

rates declined by 402 basis points from 3.26% to -0.76%, which exceeds the 229 basis points decline in rental yields.

(Figure 2 about here)

The largest declines in rental yields were found in Seoul and second-tier Chinese cities, perhaps reflecting the development of their financial markets over this time period. Rental yields also dropped slightly more in the European Union than in other Western economies during our sample period. This could reflect the introduction of the Euro in 2002, which may have lowered capital costs in some European countries. To briefly consider this possibility, Figure 3 plots the rental yields of those countries adopting the Euro. On average, CBD rental yields declined by 257 basis points from 6.49% to 3.92% in countries adopting the Euro. As the figure reveals, there was, in fact, a convergence in rental yields following the adoption of the Euro. Over the entire sample period, rental yields declined more in countries that had higher pre-2002 rental yields (Belgium, France, Greece and Portugal) relative to the countries with lower pre-2002 rental yields (Austria, Germany, Ireland and Italy), 354 basis points for high yield countries versus 218 basis points for low yield countries.

(Figure 3 about here)

3.2 Suburban versus CBD Rental Yields

To understand how the difference between SBD and CBD rental yields have changed over time, we compute the mean difference between SBD and CBD rental yields each year for the

period from 2000 to 2019. Figure 4 reveals that SBD rental yields are persistently higher than CBD rental yields and that apart from the financial crisis period, this difference increased steadily, by 28 basis points from 0.79% to 1.07% over the sample period. The figure also reveals that these changes in rental yields do not seem to depend on whether the city is in a country that adopted the Euro.

(Figure 4 about here)

4. Cross-sectional Univariate Analysis

4.1 CBD Rental Yields

To better understand the cross-sectional differences in rental yields we start with a series of univariate comparisons that we present in Table 2. The first thing to note is that rental yields are higher in developing economies. This could be due to their higher capital costs -- we find that rental yields are in fact higher in countries with higher rates of inflation and lower sovereign debt ratings. Interestingly, we do not find a material difference in the rental yields in countries with high and low real rates of interest.

The univariate results do not reveal a significant direct link between expected rental growth rates and rental yields. However, other proxies for future rental growth rates are strongly related to rental yields. For example, rental yields are considerably lower in cities with more public transport and in cities that host a financial center. However, our univariate analysis does not reveal a significant relation between rental yields and the proportion of jobs located in the CBD.

(Table 2 about here)

4.2 Suburban versus CBD Rental Yields

As we mentioned previously, suburban business district (SBD) rental yields are significantly higher than CBD rental yields. Table 3 presents mean differences between SBD and CBD rental yields for various subsamples of our data. In all cities and for all SDB and CBD pairings, SBD rental yields are higher than CBD rental yields. The average difference between SBD and CBD rental yields is about 1%, and it tends to be greater in cities with lower CBD rental yields -- the difference is 21 basis points larger in cities with below median CBD rental yields. This evidence is consistent with the idea that SBD yields tend to be more similar across metropolitan areas than CBD yields.

We observe that rental yield differences are larger when the distance and travel time between the CBD and the SBD is longer. SBD rental yields are 131 basis points higher than their respective CBD when the SBD is farther than average from the CBD, but only 78 basis points higher in SBDs when the travel distance is shorter than average. Likewise, the difference between SBD and CBD rental yields is 125 basis points in SBDs with longer travel times by car, and only 84 basis points in cities with shorter travel times.

(Table 3 about here)

5. Regression Results

Our univariate analysis in the last section revealed that rental yields in CBDs in poorer countries tend to be higher. Our conjecture is that this reflects the higher discount rates in these countries, arising from their higher inflation rates and lower credit ratings. We were not able to

find direct evidence that rental growth rates have a material effect on rental yields, but the lower yields in financial centers and in cities with better rail infrastructure provides indirect evidence that in cities with potential supply constraints have lower yields. This section provides a multivariate analysis of CBD rental yields as well as an analysis of the differences between SBD and CBD rental yields.

5.1 CBD Rental Yields

Cross-sectional Analysis

Table 4 reports regressions of rental yields on variables that are likely to be associated with either the discount rate or the rental growth rate in our sample of cities. The regressions include year fixed effects to control for common macro effects, like world-wide changes in real interest rates. We do not impose city fixed effects, because we are primarily interested in explaining cross-city differences, but we cluster our residuals by city to reflect the fact that the rental yields are not independent across years.

Panel A presents regressions for the entire sample of CBDs. Column (1) includes our proxies for the nominal discount rate – real interest rate, inflation and sovereign debt rating – and the average of the city's past 3 years rental growth rate as our proxy for the expected growth rate. The regression estimates are consistent with our hypothesis that yields are higher in CBDs with higher costs of debt and lower in CBDs with higher rental growth rates. An increase of 1% in inflation rates (real interest rate) leads to a 22.5 (10.4) basis point increase in CBD rental yields.[11]

[11] Together with our univariate analysis, these findings reinforce the prior literature on the importance of a city's wealth and GDP, real interest rates, inflation and risk on rental yields (Sivitanidou and Sivitanides (1999), Sivitanides, Southard, Torto and Wheaton (2001), Plazzi, Torous and Valkonov (2008), Chervachidze, Costello and Wheaton (2009), Chervachidze and Wheaton (2011a and b)).

While, an increase of 1% in rental growth rates leads to a 2.9 basis point decrease in CBD rental yields.

Column (2) reports a regression that includes additional proxies for expected rental growth rates – these include measures of the cities' transport infrastructure, job density, agglomeration, size and population growth rate. In columns (3) and (4) we estimate this same regression on data from the first half (2000-2009) and the second half (2010-2019) of our sample. Given that Europe represents a large and relatively homogenous portion of our data we also estimate separate regressions that include only the 56 European cities in our sample.[12] These regressions are reported in Panel B.

The regression estimates for the full sample (Panel A: Column 2) indicate that rental yields are higher in locations with higher real interest rates, higher inflation, lower sovereign debt rating and lower rental growth rates. We also find a strong negative relationship between a city's wealth and rental yields. A doubling of GDP per capita leads to a 76.3 basis point decrease in CBD rental yields. However, we find no support for an association between the size of a city and the rental yields.

We find a strong negative relationship between the size of the city's transport infrastructure and rental yields, rental yields are lower in CBDs with a larger public transport network. A doubling of the frequency of usage of the city's transport network leads to a 66.8 basis point decrease in CBD rental yields.[13] We also find support for an association between the proportion

[12] Our results are substantially unchanged when we account for the influence of a country's legal system by including *common law*, an indicator variable equal to one when a country adopts a common law system and *conflict resolution* which is the natural logarithm of the number of days taken to resolve tenancy disputes through the courts (Titman and Twite 2013).

[13] As previously noted (Footnote 6), public transport boardings per capita within the metropolitan area are defined as the sum of bus boardings, trams/light rail boardings, suburban rail boardings and metropolitan rail boardings. We include bus boardings to reflect the observation that cities within our sample that make extensive use of bus transport provide dedicated bus lanes. While our results remain statistically significance, their economic significance is

of jobs located in the CBD and the rental yields for CBD Class A office space. An increase of 1% in the proportion of jobs located in the CBD leads to a 2.2 basis point decrease in CBD rental yields. In addition, we find that the presence of a financial center is associated with lower rental yields, ceteris paribus, hosting a top 20 financial center decreases a CBD's rental yield by 55 basis points.

There are two key differences in our estimates in the two sub-periods, (Panel A: Columns 3 and 4). The observations that rental yields are lower in wealthier cities only holds during the earlier sub-period. A doubling of GDP per capita is associated with an 86.4 basis point reduction in CBD rental yields in the first sub-period, but is associated with an insignificant 11.5 basis point reduction in CBD rental yields. In addition, the impact of the presence of a financial centre on the rental yields only holds during the later sub-period, being located in a top 20 financial center is associated with a 74 basis point reduction in rental yields in the later period, but only 41 basis points in the earlier period.[14]

We find mixed results for the association between population growth rates and rental yields. While the association is insignificant for the full sample, it is positive in the earlier sub-period and negative in the latter sub-period. The finding of a positive association between population growth rates and rental yields is inconsistent with our expectations and appears to be driven by outliers.[15]

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approximately halved when we substitute an alternative measure, defining public transport boardings per capita within the metropolitan area as the sum of trams/light rail boardings, suburban rail boardings and metropolitan rail boardings.

[14] Our results reported in Table 4 are substantially unchanged when we exclude the 4 cities where the financial center is located in an SBD – Amsterdam Beijing, Shanghai and Paris.

[15] In particular, the high population growth rates and high rental yields of Indian and second-tier Chinese cities in the earlier sub-period generates the positive association between population growth rates and rental yields in the 2000-2009 sub-period. These cities are those that are likely to be unconstrained by factors not captured by our regression. After dropping Indian and second-tier Chinese cities the effect goes away.

Overall, the results are similar for our sample of European cities (Panel B), we find a strong positive relationship between discount rates and rental yields, in particular, rental yields are higher in locations with higher real interest rates, inflation and political risk; and a negative relationship between a city's past rental growth rate and rental yields. In addition, we find a strong negative relationship between a city's wealth, the efficiency of the city's transport infrastructure and rental yields.

There are three key differences between the full sample and the European sub-sample. We find a negative relationship between the city's population and rental yields. In the European cities a doubling of the size of a city is associated with a 29 basis point decrease in CBD rental yields. In contrast to the full sample, we find that rents are lower in wealthier European cities in all three-time period, 2000 to 2019, 2000 to 2009 and 2010 to 2011. Finally, we find no support for an association between either the proportion of jobs located in the CBD, the presence of a financial center or population growth rates and the rental yields for CBD Class A office space.[16]

(Table 4 about here)

Within-country Analysis

This section examines the extent to which we can explain within-country variation in CBD rental yields. By looking at within country variation we are effectively holding the discount rate effects constant and considering only factors that influence rental growth rates. Because these estimates require two or more cities in each country, our sample of cities is reduced to 72, and we lose some

[16] We observe that population, transport infrastructure, jobs, financial centers and GDP per capita are all correlated, which leads us to be cautious in our interpretation of our results. However, our results are substantially unchanged when we estimate separate regressions for our measures of population, transport infrastructure, jobs, financial centers and GDP per capita to mitigate the impact of multi-collinearity. Results for these regressions are available on request.

of the lowest rental yield cities -- Singapore, Hong Kong and Taipei -- as well as some of the highest rental yield cities -- Moscow, Istanbul, Seoul and Tel Aviv. Nevertheless, we do see relatively large cross-city differences in rental yields within countries. For example, France – Paris, Lyon and Nice with average rental yields of 4.46%, 6.15% and 6.94%, respectively; UK – London (4.46%), Edinburgh (5.72%) and Liverpool (6.74%); and China – Shanghai (5.00%), Shenzhen (6.45%), Wuhan (6.74%), Tianjin (7.66%) and Chengdu (9.55%).

Table 5 reports our estimates of these country/year fixed effects regressions. Column 1, which reports the regression for the full sample of multi-city countries, finds a negative relationship between rental growth rates and rental yields, in particular, rental yields are higher in locations with lower past rental growth rates. An increase of 1% in rental growth rates leads to a 2.5 basis point decrease in CBD rental yields. In addition, we find that cities that are larger, wealthier and have a higher proportion of jobs located in the CBD have lower rental yields. A doubling of GDP per capita leads to a 157 basis point decrease in CBD rental yields. While an increase of 1% in the proportion of jobs located in the CBD leads to a 1.4 basis point decrease in CBD rental yields. It should be noted that within a country – the largest city, the wealthiest city or the city with the most jobs in the CBD will have the lowest rental yield, and it mostly the case that the largest city is also the wealthiest and the city with the most jobs in the CBD. As it turns out, in 12 out of 16 countries, the biggest city also has the highest per capita income. In the four countries where the largest city is not the wealthiest, the city with the lowest rental yield is the wealthiest city in one of the countries and is the largest city in three of the countries.

We also find that the city's population growth rate is positively associated with rental yields. This is inconsistent with our expectations and appears to be driven by outliers.[17]

The results for our sample of European countries (Column 2) are almost identical to those estimated for the full sample of multi-city countries.

(Table 5 about here)

5.3 SBD versus CBD Rental Yields

This section examines the rental yields in Suburban Business Districts (SBDs). Specifically, we present regressions that explore the difference between yields in the SBDs and the CBD in the various metropolitan areas in our sample.

Within the context of these regressions, we consider the following questions: First, we ask whether the factors that cause CBD yields to go up and down have parallel effects on the SBDs in the same metro area. For example, if the rental yield in the CBD in city A is 50 basis points greater than the rental yield in city B, do we expect the SBDs in city A to have 50 basis point higher yields than the SBDs in city B. Our conjecture is that because most SBDs are not nearly as supply constrained as the CBDs, that SBD rental yields across cities will not vary as widely as CBD rental yields. As a result, the difference between CBD yields and SBD yields should be negatively related to the CBD yields, i.e., the spread should be greater when the CBD yield is lower. Second, we examine how the cities' transportation infrastructure affects rental yields. Our conjecture is that when the overall transport infrastructure is better, the CBD will be more attractive, and thus more

[17] In particular, the high population growth rates and high rental yields of Indian and second-tier Chinese cities generates the positive association between population growth rates and rental yields. After dropping Indian and second-tier Chinese cities the effect goes away.

constrained, so its rental yield will be lower relative to the SBDs in the same metro area. However, for a given SBD, its rental yield will be lower when the travel time to the CBD is shorter. Finally, we examine whether SBDs that have more finance jobs have lower rental yields.

Table 6 presents the results of the regression of the difference between SBD and CBD rental yields (SBD yield minus CBD yield) on the above described explanatory variables. The first three columns in the table includes all of the explanatory variables along with year fixed effects.

We then make use of the sample of multi-suburb European cities to examine the extent to which within-city variation in our explanatory variables drive our results. We require two or more suburbs in each city, slightly reducing our sample to 77 suburbs in 16 cities, losing Copenhagen, Rotterdam, Utrecht and Warsaw. However, we still observe substantial variation in the spread between SBD and CBD rental yields within the cities that we are examining. For example, in Amsterdam the average spread between SBD and CBD rental yields ranges from 0.19% to 1.05%; Dusseldorf the range is 0.33% to 1.93%; London from 0.51% to 1.31%; and Paris from 0.45% to 1.98%. To estimate the extent to which our results are generated from the within-city variation we re-estimate our regressions including both city/year fixed effects (Columns 4, 5 and 6). The regressions with city/year fixed effects do not include estimates of city specific variables, but other than that, the estimates are almost identical to those estimated without city fixed effects.

We report separate regressions for our measures of distance and travel time to mitigate the impact of multi-collinearity. We include distance (columns 1 and 4), time travelled by public transport (columns 2 and 5) and time travelled by private car (columns 3 and 6).

When considering the cross-sectional differences in SBD and CBD rental yields (Columns 1, 2 and 3), as with CBD rents (Table 4), we find that both the efficiency and usage of the city's

transport infrastructure effects the difference between SBD and CBD rental yields. In particular, we find that both the travel distances and the travel time between the SBD and the CBD affect the difference in rental yields.[18] The difference in rental yields between SBD Class A office space and CBD Class A office space is larger, the longer the distance between SBDs and the CBD and the greater the travel time, both by public transit and private car. For example, a doubling of the travel time by car from an SBD to its CBD leads to a 45.9 basis point increase in the difference between SBD Class A office space rental yields and CBD Class A office space rental yields. While the difference in rental yields between SBD Class A office space and CBD Class A office space is smaller, the greater the utilization of the city's transport infrastructure.

We also find that the difference in rental yields between SBD Class A office space and CBD office space is smaller, the larger is the CBD rental yield. In other words, in cities with very low CBD rental yields, the SBD rental yields are only slightly lower than the rental yields in other cities, reflecting the fact that there are large differences in supply constraints across CBDs, but most SBDs are relatively unconstrained. Finally, we find that SBDs with more finance jobs have lower rental yields, locating financial center in an SBD decreases the difference in rental yields between SBD and CBD office space by 33.8 basis point, while locating a financial center in the CBD has no impact on the difference in rental yields between SBD and CBD office space.

(Table 6 about here)

[18] Examining rental rates rather than rental yields, Sivitanidou (1995) finds that office rental rates are lower in the Los Angeles area, the greater the distance to the CBD or airport, arguing that this distance represents the cost of business trips for face-to-face meetings.

6. Conclusion

Real estate professionals often use rental yields and cap rates to describe cross-city variation in how real estate is priced. In some cities real estate prices are relatively high relative to rental income and in other cities real estate prices are relatively low. Given the importance of this concept, it is somewhat surprising that there is relatively little systematic evidence on how cap rates and rental yields have fluctuated over time, and how they differ across countries, across cities within countries, and across locations within metropolitan regions.

Our research documents a couple of very clear facts from the data. The first is that rental yields declined over our sample period. This is a pervasive result that holds for every city in our sample, i.e., the rental yield in every city in our sample is higher in 2000 than in 2019. While the time-series evidence provides strong support for the idea that real interest rates, which also declined in this period, are an important determinant of rental yields, we do not find support for this relationship in our panel regressions. Indeed, the evidence is consistent with the idea that in the cross-section, nominal interest rates are a more important determinant of rental yields, since countries with higher inflation rates tend to have higher yields.

The second clear fact is that rental yields are lower in central business districts than in suburban business districts. We have data on 81 SBDs in 20 metropolitan regions over a 20 year period and we did not find a single case where the rental yield of a SBD in a metropolis had a lower rental yields that the corresponding CBD. Our conjecture is that the lower rental yields in the CBD reflects the greater constraints in denser urban locations, however, future research that better identifies the causal relation is warranted.

Our analysis of cross-city differences in CBD rental yields is potentially more interesting, but somewhat less definitive. Our description of the cross-section is somewhat looser because we have a number of relatively rough proxies for the relevant concepts, i.e., growth and supply constraints that are the theoretical drivers of cross-city differences in rental yields. We do, however, find that larger and richer cities tend to have lower rental yields, especially, when they are financial centers. Our interpretation is that cities with these characteristics are more likely to experience growing rental rates, but again, we believe additional research is needed to pin down the causal relationships.

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Table 1: Rental Yield Sample

The table presents sample composition over the period between January 2000 and December 2019.

	CBD Rental Yields					SBD Rental Yields	
Country	Number of cities per country	Number of city/years observations	Europe	European Union	Euro	Number of SBDs per country	Number of SBD/years observations
Australia	6	115	0	0	0	0	0
Austria	1	20	1	1	0.86	6	78
Belgium	2	32	1	1	0.91	3	60
Canada	3	54	0	0	0	0	0
China	10	171	0	0	0	0	0
Czech Republic	1	20	1	0.76	0	2	26
Denmark	2	35	1	1	0	1	13
Finland	1	20	1	1	0.86	0	0
France	7	136	1	1	0.86	7	117
Germany	7	140	1	1	0.92	16	160
Greece	1	20	1	1	0.86	2	30
Hong Kong	1	19	0	0	0	0	0
Hungary	1	19	1	0.84	0	0	0
India	2	32	0	0	0	0	0
Ireland	1	20	1	1	0.86	6	102
Israel	1	19	0	0	0	0	0
Italy	2	39	1	1	0.9	7	105
Netherlands	4	80	1	1	0.86	7	110
New Zealand	1	20	0	0	0	0	0
Norway	1	20	1	0	0	0	0
Poland	1	20	1	0.76	0	1	12
Portugal	2	39	1	1	0.86	4	76
Russia	1	19	1	0	0	0	0
Singapore	1	19	0	0	0	0	0
Slovakia	1	16	1	1	0.69	0	0
South Korea	1	19	0	0	0	0	0
Spain	5	88	1	1	0.93	8	113
Sweden	3	60	1	1	0	4	46
Switzerland	2	40	1	0	0	3	57
Taiwan	1	16	0	0	0	0	0
Turkey	1	19	0	0	0	0	0
United Kingdom	10	176	1	1	0	4	80
United States	5	100	0	0	0	0	0
Total	89	1,660	21	18	12	81	1,185

Table 2: CBD Rental Yields

The table presents a comparison of rental yield means partitioned by debt market, cities and the industries characteristics. t-statistics for differences in sample means are shown as ***, **,* denoting 1%, 5% and 10% significance level. All variables are defined in Sections 2.

Variable		Rental Yield (%)		Rental Yield (%)
Transport boardings per capita	Above median	5.49	Below median	6.37***
CBD jobs - proportion	Above median	6.20	Below median	6.05
Financial center	Ranked	5.08	Not ranked	6.48***
Population	Above median	6.23	Below median	6.07
Population growth	Above median	6.36	Below median	5.95***
GDP per capita	Above median	5.57	Below median	6.73***
Average rental growth	Above median	6.08	Below median	6.23*
Short real interest	Above median	6.28	Below median	6.02***
Inflation	Above median	6.56	Below median	5.77***
Rating	AAA or AA+	5.02	No	6.83***
Developed economy	Yes	5.87	No	7.55***
Europe	Yes	5.81	No	6.76***
	Europe			
Transport boardings per capita	Above median	5.39	Below median	5.83***
CBD jobs - proportion	Above median	5.84	Below median	5.73
Financial center	Ranked	4.89	Not ranked	6.07***
Population	Above median	5.60	Below median	5.91**
Population growth	Above median	5.71	Below median	5.87
GDP per capita	Above median	5.08	Below median	6.53***
Average rental growth	Above median	5.71	Below median	5.90*
Short real interest	Above median	5.72	Below median	5.97***
Inflation	Above median	6.21	Below median	5.56***
Rating	AAA or AA+	5.58	No	6.48***

Table 3: Differences Between SBD and CBD Rental Yields

The table presents a comparison of the difference between SBD and CBD rental yield means partitioned by industries characteristics and transport infrastructure. T-statistics for differences in sample means are shown as ***, **,* denoting 1%, 5% and 10% significance level. All variables are defined in Sections 2.

Variable		CBD – SBD Yields (%)		CBD – SBD Yields (%)
CBD rental yield	Above median	0.95	Below median	1.16***
Transport boardings per capita	Above median	1.02	Below median	1.08
Jobs	Above median	1.01	Below median	1.10**
Financial center	Ranked	0.93	Unranked	1.10**
Financial CBD only	Ranked	0.99	Unranked	1.10***
Financial SBD only	Ranked	0.69	Unranked	1.10***
Financial CBD/SBD jointly	Ranked	0.66	Unranked	1.10***
Distance	Above median	1.31	Below median	0.78***
Travel time - car	Above median	1.25	Below median	0.84***
Travel time – public	Above median	1.14	Below median	0.95***
CBD jobs - proportion	Above median	1.01	Below median	1.10**
Population	Above median	1.08	Below median	1.00*
Population growth	Above median	1.01	Below median	1.07
GDP per capita	Above median	1.04	Below median	1.06

Table 4: Determinants of CBD Rental Yields

This table presents the regression of prime yields, *Yield*, on the characteristics of the debt markets, agglomeration, the cities transport infrastructure, and other measures of the size and property of the city, as defined in in Section 2. The sample is split into 3 subsamples (2000–2009, 2010–2019 and European countries). Year fixed effects are included. Standard errors are clustered by city and year. Standard errors are given in parentheses. ***, **,* denotes 1%, 5% and 10% significance level.

	Panel A: Full Sample			
	2000-2019		2000-2009	2010-2019
Variables	(1)	(2)	(3)	(4)
Transport		-0.668***	-0.581**	-0.697***
		(0.223)	(0.228)	(0.214)
Transport missing		2.747**	1.972*	3.132***
		(1.158)	(1.193)	(1.048)
Jobs		-0.0224**	-0.0276**	-0.0171*
		(0.0100)	(0.0124)	(0.00935)
Jobs missing		0.892**	1.165***	0.651
		(0.411)	(0.401)	(0.486)
Financial center		-0.550*	-0.410	-0.740**
		(0.322)	(0.327)	(0.321)
Population		-0.0410	0.170	-0.244*
		(0.149)	(0.163)	(0.139)
Population growth		0.0416	0.150**	-0.116*
		(0.0647)	(0.0697)	(0.0666)
GDP per capita		-0.763***	-0.864***	-0.115
		(0.265)	(0.290)	(0.319)
Average rental growth	-0.0289*	-0.0303***	-0.0217**	-0.0521***
	(0.0158)	(0.0101)	(0.0110)	(0.0106)
Short real interest	0.104**	0.0624	0.0506	0.271***
	(0.0512)	(0.0399)	(0.0649)	(0.0612)
Inflation	0.225***	0.184***	0.165***	0.353***
	(0.0759)	(0.0623)	(0.0559)	(0.0767)
Rating	-0.883**	-0.374	-0.535	-0.401
	(0.345)	(0.366)	(0.504)	(0.308)
Year fixed effects	Yes	Yes	Yes	Yes
Number of obs	1,660	1,660	776	884
R^2	0.379	0.567	0.552	0.568

Table 4: Determinants of CBD Rental Yields (continued)

	Panel B: Europe			
	2000-2019		2000-2009	2010-2019
Variables	(1)	(2)	(3)	(4)
Transport		-0.534***	-0.548**	-0.518***
		(0.153)	(0.258)	(0.166)
Transport missing		2.310***	2.366*	2.098**
		(0.764)	(1.270)	(0.831)
Jobs		0.00699	0.00729	0.00999
		(0.00656)	(0.00793)	(0.00812)
Jobs missing		0.0840	0.349	-0.114
		(0.283)	(0.384)	(0.397)
Financial center		0.240	0.337	0.154
		(0.183)	(0.240)	(0.188)
Population		-0.290***	-0.366***	-0.235**
		(0.109)	(0.132)	(0.103)
Population growth		-0.0567	-0.0722	-0.0779
		(0.0581)	(0.122)	(0.0633)
GDP per capita		-1.571***	-1.581***	-1.537***
		(0.244)	(0.250)	(0.299)
Average rental growth	-0.0337**	-0.0250***	-0.0184**	-0.0354***
	(0.0143)	(0.00514)	(0.00937)	(0.0107)
Short real interest	0.214***	0.238***	0.124*	0.440***
	(0.0579)	(0.0660)	(0.0690)	(0.0783)
Inflation	0.440***	0.405***	0.375***	0.470***
	(0.0757)	(0.0976)	(0.0840)	(0.0579)
Rating	-0.670**	-0.327**	-0.109	-0.354**
	(0.305)	(0.158)	(0.238)	(0.163)
Year fixed effects	Yes	Yes	Yes	Yes
Number of obs	1,059	1,059	499	560
R^2	0.496	0.731	0.652	0.791

Table 5: Within Country Variation in Rental Yields

This table presents the regressions of prime yields, *Yield*. We focus on the sub-sample of countries with two or more cities. Column (1) reports the country/year fixed effects regressions for the full sample of multi-city countries and Column (2) reports the corresponding regression for the sub-sample of European cities. Variables as defined in in Section 2. Standard errors are clustered by city and year. Standard errors are given in parentheses. ***, **,* denotes 1%, 5% and 10% significance level.

	Full Sample	Europe
Variables	(1)	(2)
Transport	-0.00475	0.238
	(0.193)	(0.160)
Transport missing	-0.552	-1.282
	(0.866)	(0.783)
Jobs	-0.0141**	-0.0148*
	(0.00573)	(0.00766)
Jobs missing	0.414*	0.244
	(0.235)	(0.193)
Financial center	-0.194	0.0333
	(0.146)	(0.149)
Population	-0.298***	-0.653***
	(0.104)	(0.0809)
Population growth	0.0780**	-0.00779
	(0.0348)	(0.0300)
GDP per capita	-1.574***	-1.339***
	(0.346)	(0.249)
Average rental growth	-0.0247**	-0.0249***
	(0.00973)	(0.00686)
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Number of obs	1,335	865
R^2	0.737	0.823

Table 6: Difference Between SBD and CBD Rental Yields

This table presents the regression of the difference in rental yields between SBD and CBD office space, *SBD-CBD yield*, on CBD rental yields, the financial centers, efficiency of the city's urban rail network, travel distances and travel times as defined in in Section 2. Columns (1), (2) and (3) reports the cross-sectional regressions, including year fixed effects for the full sample. Columns (4), (5) and (6) reports the within city regressions, including city/year fixed effects for the sample of multi-suburb European cities. Standard errors are clustered by city and time. Standard errors are given in parentheses. ***, **,* denotes 1%, 5% and 10% significance level.

	Cross-section			Within City		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
CBD rental yield	-0.218***	-0.283***	-0.236***			
	(0.0651)	(0.0609)	(0.0631)			
Transport	-0.264**	-0.249**	-0.273***			
	(0.103)	(0.112)	(0.104)			
Financial CBD	-0.0780	-0.143	-0.206*			
	(0.129)	(0.135)	(0.121)			
Financial SBD	-0.338**	-0.410**	-0.474***	-0.241*	-0.317	-0.357*
	(0.141)	(0.198)	(0.157)	(0.132)	(0.195)	(0.187)
Distance	0.390***			0.410***		
	(0.0756)			(0.0989)		
Travel time - public		0.307***			0.395***	
		(0.112)			(0.125)	
Travel time - car			0.459***			0.416***
			(0.139)			(0.146)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effects	No	No	No	Yes	Yes	Yes
Number of obs	1,168	1,168	1,168	1,125	1,125	1,125
R^2	0.294	0.197	0.246	0.387	0.342	0.337

Figure 1: Mean CBD Rental Yields of Sample Countries (2000–2019)

Figure 1 plots the mean CBD rental yield across 33 countries in both the first half (2000-2009) and the second half (2010-2019 of our sample. The CBD rental yield is as defined in Section 2.

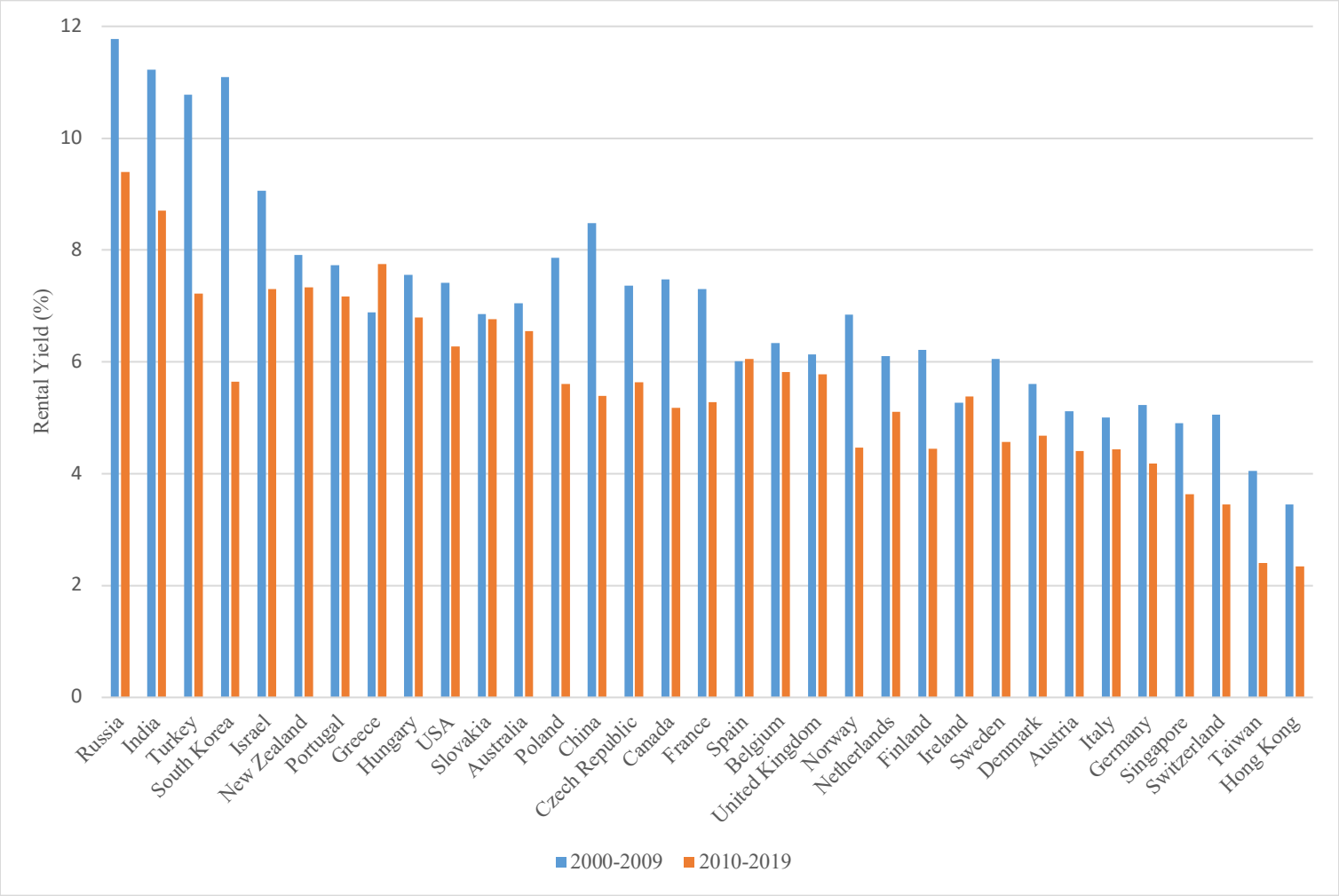

Figure 2: Annual CBD Rental Yields of Sample Countries and Real Interest Rates (2000–2019)

For each year over the period 2000 to 2019, Figure 2 plots the mean CBD rental yield across the full sample of 33 countries, the 21 European countries, 8 Asia/Pacific countries and the 2 North American countries; and the mean real short-term interest rate. The CBD rental yield and real short-term interest rate is as defined in Section 2.

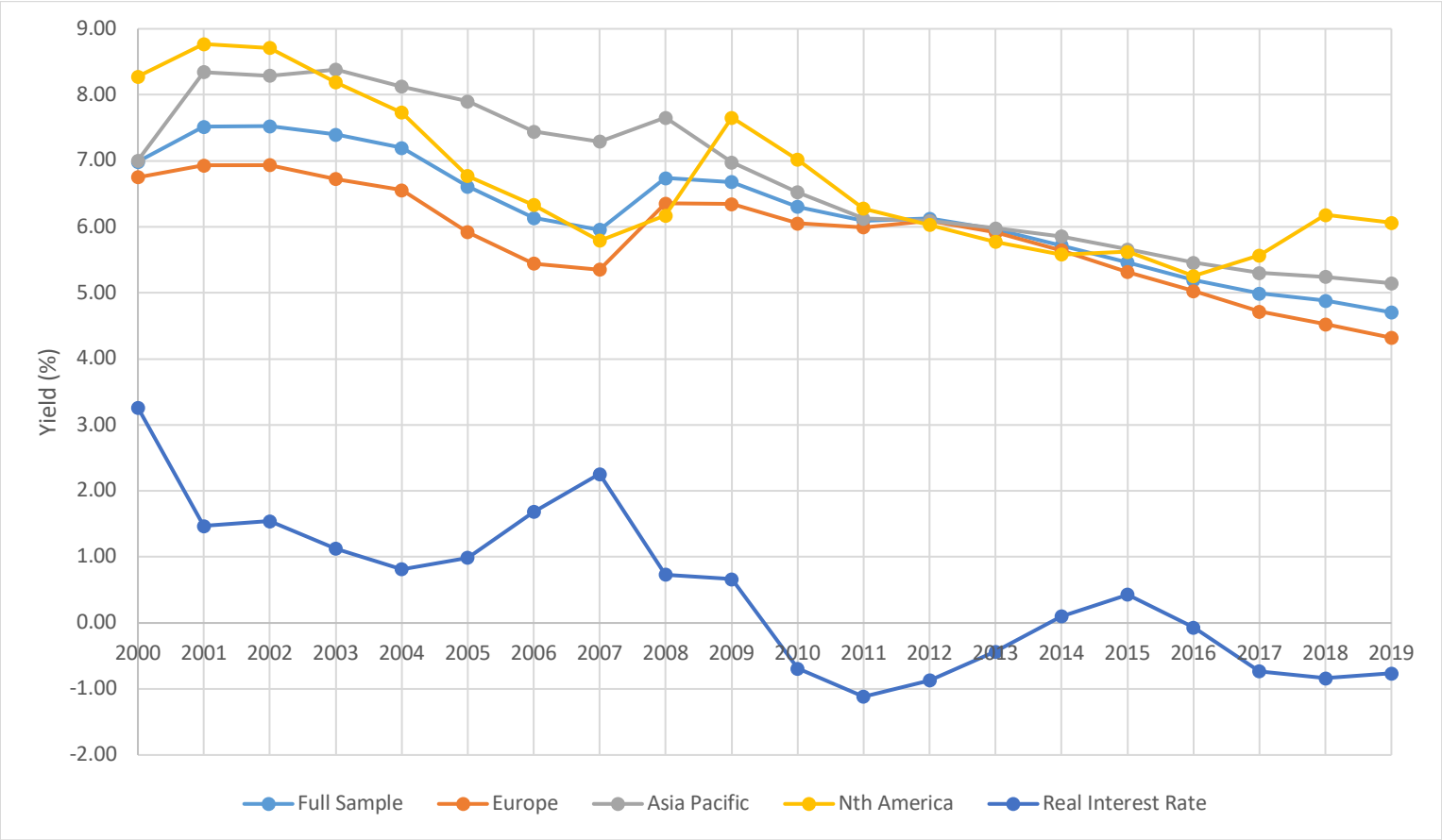

Figure 3: Annual CBD Rental Yields of Euro Adopting Countries (2000–2019)

For each year, Figure 3 plots the mean rental yield across the European countries that adopted the Euro. The CBD rental yield is as defined in Section 2.

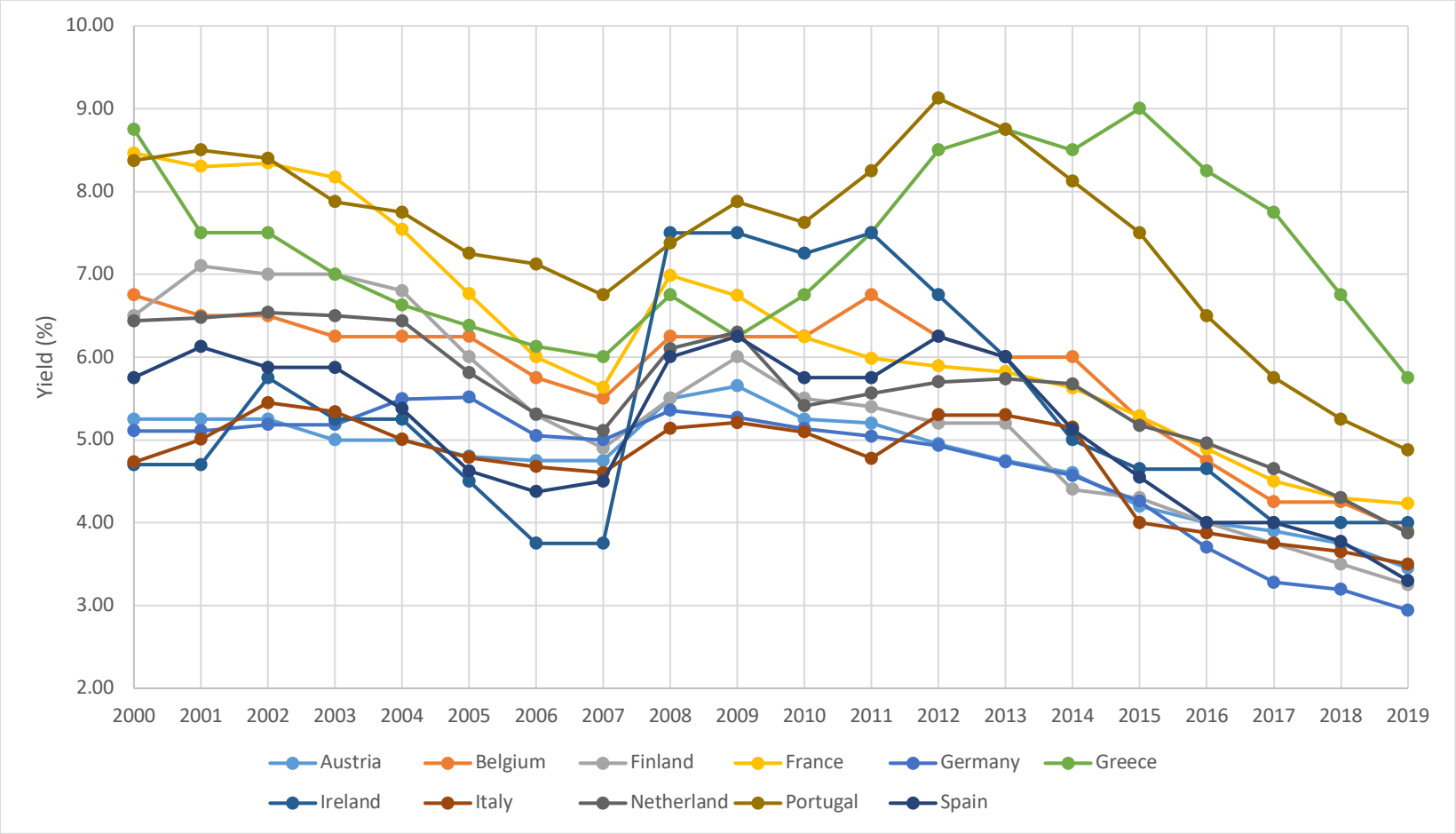

Figure 4: Annual Differences Between SBD and CBD Rental Yields of European Countries (2000–2019)

For each year, Figure 5 plots the mean of the difference in SBD and CBD rental yields across the 16 European countries, 18 European countries that are member states of the European Union, the 12 European countries that adopted the Euro and high and low income countries. The difference in SBD and CBD rental yields is as defined in Section 2.

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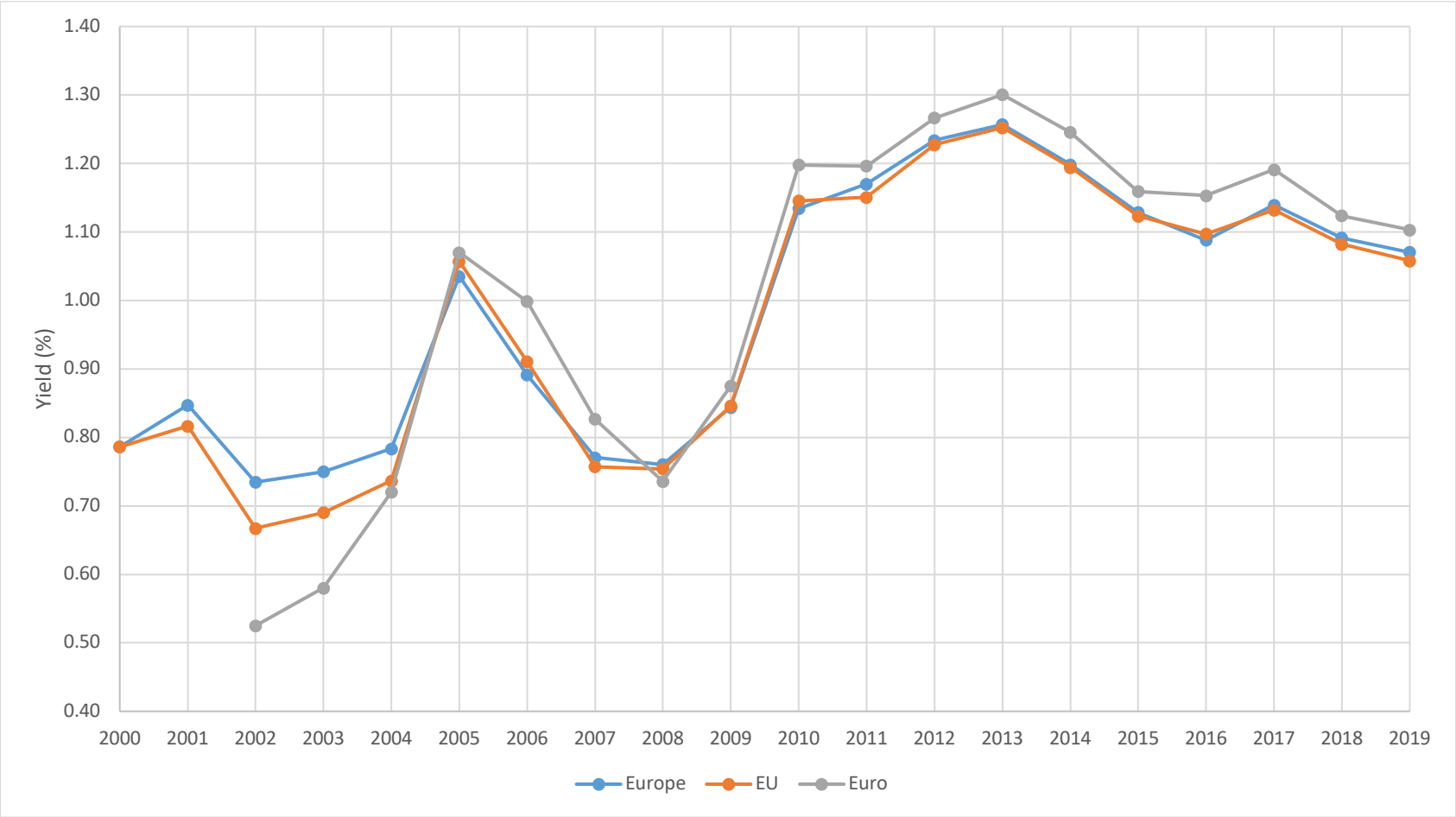

Appendix A: Variable Definitions

Variable	Definition
Yield variables	
Yield	Ratio of the annual net rental income (rent minus non-recoverable costs) and the total amount invested (purchase price plus purchasers' on-costs) for Class A office building, expressed as a percentage.
SBD-CBD yield	Rental yield for suburban business district (SBD) Class A office space minus the rental yield for CBD Class A office space, expressed as a percentage.
City variables	
Transport	Natural logarithm of the number of public transport boardings per capita.
Jobs	The proportion of the city's total jobs located within the CBD, expressed as a percentage.
Finance professionals	The number of finance professionals per capita in each city, as reported by Bloomberg.
Financial center	Indicator variable taking a value one if the city is a top 20 financial center, defined by the number of financial professionals per capita, as reported by Bloomberg, and zero otherwise.
Financial CBD	Indicator variable taking a value of one for CBDs which are a top 20 financial center, defined by the number of financial professionals per capita, as reported by Bloomberg, and zero otherwise.
Financial SBD	Indicator variable taking a value of one for SBDs which are a top 20 financial center, defined by the number of financial professionals per capita, as reported by Bloomberg, and zero otherwise.
Population	Natural logarithm of the metropolitan area population.
Population growth	Annual growth rate of the metropolitan area population, expressed as a percentage.
GDP per capita	Natural logarithm of the metropolitan area real GDP per capita in USD.
Distance	Natural logarithm of the road distance between a suburb and its CBD in kilometers.
Travel time – public	Natural logarithm of the travel time by public transit from a suburb to its CBD at 8:30AM on a working day (Wednesday) in hours.
Travel time – car	Natural logarithm of the travel time by car from a suburb to its CBD at 8:30AM on a working day (Wednesday) in hours.
Rental growth	Annual growth rate of CBD rents for each city, expressed as a percentage.
Average rental growth	The average of the city's past 3 years of rental growth rates expressed as a percentage.
Country variables	
Short real interest	3 month nominal interest rate minus the inflation rate, expressed as a percentage.
Inflation	Change in country's CPI index, expressed as a percentage.
Rating	Indicator variable taking a value of one for countries with a Fitch sovereign debt rating of AAA or AA+ and zero otherwise.

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