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The Determinants of Office Cap Rates: The International Evidence

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Abstract: We examine commercial office cap rates in 89 large cities in 33 developed and developing countries in the 2000-2019 period. We find that cap rates decline throughout the world over this period, reflecting a corresponding decline in the real rate of interest. In the cross-city analysis our most robust findings are that office cap rates are lower in wealthier cities, especially those that are either considered gateway cities or financial centers. In addition, cap rates tend to be higher in countries with lower credit ratings and higher inflation rates. We find that cap rates in suburban office markets are higher than in central business districts, and for a given metropolis, suburban cap rates are lower in suburbs with better public transport connections to the central business district. Finally, evidence from regressions with city fixed effects reveal that cap rates rise as the discount rate and vacancy rates increase and fall as cities get wealthier.

Keywords: Global real estate market, Capitalization rate, Office cap rates, Financial centers, Public Transport

JEL Classifications: R3, R4

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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 the current net income generated by properties into property values. Taken together, these disciplines can tell us something about why capitalization (cap) rates, the ratio of net income 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 the *standardized* cap rates of office buildings in 89 major cities in 33 developed and developing countries over the 2000-2019 period. The cap rate data, provided by CBRE, a large international commercial real estate firm, is standardized in the sense that in each city, it is based on the rents and values of an identical quality hypothetical high-rise Class A office property.[1] Most of our focus is on the cap rates of office space located in the cities' central business districts (CBDs), but we also examine a limited amount of data on cap rates in suburban business districts (SBDs) in Europe. We combine this 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 percentage CBD cap rates 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 cap rates. The lowest cap rates are in relatively wealthy cities that are financial centers and/or gateway cities and the cities with the highest cap rates tend to be in developing

[1] The typical age and quality of office building do differ across cities, but our data for each city represent cap rates on newly built or renovated buildings in each city.

economies. The figure also shows that cap rates are lower in all countries in the second half of the sample, with the exceptions of Greece, Ireland and Spain, where cap rates increased following the 2008 financial crisis.

(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, the cap rate can be expressed as an increasing function of the nominal discount rate and a decreasing function of the expected growth rate of the net cash flows generated by the properties. Based on this, our analysis examines the extent to which proxies for discount rates and growth rates explain differences in cap rates, both around the world and over time.

Discount rates reflect real risk-free rates along with return premia that can reflect risk, liquidity considerations and financing constraints. To capture these determinants of discount rates, which vary both over time and across cities, our analysis includes country bond ratings, that provide a measure of risk, inflation rates, that are likely to affect financing constraints, and various city specific characteristics that may be related to risk, the liquidity of the property markets as well as the availability of capital in our sample of cities.

To measure the relation between cap rates and expected net income growth we use two approaches. The first approach assumes that growth rates are persistent and uses the past rate of growth as a proxy for the expected future rate. The second approach looks more closely at the city fundamentals – specifically, we measure the growth rate of the city's population along with the extent to which the growth in prime office space is constrained. The idea is that growth rates are likely to be the highest in growing cities with constrained office space.

Our analysis of the time-series provides strong evidence of a link between real interest rates and cap rates. Over our sample period, real interest rates dropped throughout the world, and cap rates also dropped. Our cross-country analysis finds that cap rates are higher in cities with higher inflation rates, which is consistent with the idea that capital is either more constrained or is riskier in cities with higher inflation rates. Our cross-sectional analysis also detects a relationship between cap rates and proxies for potential risk and liquidity differences. Most notably, cap rates are significantly lower in countries with better credit ratings and they are particularly low in cities that are financial centers or are considered gateway cities, which tend to have more liquid real estate markets. Finally, in our analysis that take out city fixed effects, we find that for a given city, cap rates tend to be higher when the vacancy rates in the city are higher and tend to decrease when the city becomes more prosperous.

The low cap rates observed in the gateway/financial centers could also reflect the possibility that these highly visible and wealthy cities are expected to continue to grow. However, our evidence of a more general link between expected growth rates and cap rates is relatively weak and is subject to interpretation. Specifically, we do not find a strong relationship between the past growth rate of rental incomes and cap rates and the cities that experience the highest population growth tend to have slightly higher rather than lower cap rates, which is inconsistent with expected rental growth being higher in growing cities. We do find that the more constrained cities have lower cap rates, which supports the link between cap rates and expected growth rates, and cap rates are 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.

Our analysis of the cap rates of suburban office buildings in European cities is also of interest. We find that in almost all European metropolitan areas the suburban cap rates are higher than the CBD cap rate, which we conjecture reflects that fact that suburban areas are almost always less constrained. We also find that the difference between SBD and CBD cap rates is less for SBDs with shorter travel times between the CBD and SBD and for the few SBDs that are financial centers.

Although we are not the first to empirically examine the determinants of cap rates, most existing studies examine individual cities and countries.[2] 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. Unfortunately, we do not have data on the stringency of regulation for our international sample, but our study complements this study by including both a long time-series and a very diverse cross-section.[3] Plazzi, Torous and Valkonov (2010) examine time-series variation in the determinants of cap rates across 53 U.S. metropolitan areas over the period 1994 to 2003 for apartments, retail properties, industrial properties, and office space. The study documents that the significance of the times-series variability of expected return and expected rent growth rate in explaining the variability of realized rent growth rates. Also, the result is strongest in metropolitan areas characterised by higher population density and stringent land-use restrictions. Finally, a recent paper, Fisher, Steiner,

[2] For example, Brueckner and Fansler (1983), Sivitanidou and Sivitanides (1999), Hendershott and MacGregor (2005), Plazzi, Torous and Valkonov (2008), Chervachidze, Costello and Wheaton (2009), McDonald and Dermisi (2009), Nichols and Elliehausen (2012) and Chervachidze and Wheaton (2013).

[3] 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.) and Lieser and Groh (2014) (country-level real estate investment over 47 countries. These studies include fewer cities, consider fewer explanatory variables or examine country-level data).

Titman and Viswanathan (2021), use REIT data to infer the cap rates in different U.S. locations, and find that cap rates are higher in less dense locations, which is consistent with our finding that suburban cap rates are higher than CBD cap rates.

While there is a lot of discussion of cap rates in the real estate literature, we are unaware of existing studies that go beyond the observation that a property's cap rate is determined by the expected growth in the property's net operating income and the appropriate rate for discounting those cash flows. However, the analysis in this paper also draws on the urban economics literature that emphasizes the importance of a property's proximity to transportation, and the advantages of locations that allow workers to benefit from spill overs that can arise from proximity to other knowledge workers.[4] Our evidence of a link between cap rates and both transportation infrastructure and the presence of finance professionals, who tend to benefit from locating in tight proximity, suggest that in our sample period cap rates reflect higher expected growth rates in cities with these characteristics.[5] We conjecture that the higher expected growth rates in financial centers and CBDs with good rail transit reflect supply constraints, e.g., there is a limited amount of buildable space close to rail stations.

The paper is organized as follows. Our sample is described in Section 2. Section 3 describes the time-series of cap rates. Section 4 presents the cross-sectional univariate analysis of the determinants of cap rates. Section 5 presents our cross-sectional regression results, Section 6 presents panel regressions with city fixed effects, which provides evidence of time-series effects within cities and Section 7 draws some conclusions.

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[4] See McMillen (2006) and Duranton and Puga (2014, 2015) for a review of both the recent theoretical and empirical literature.

[5] While we are not aware of research that directly examines the link between rail transit and cap rates, Drennan and Brecher (2012) find that office rental rates are higher in major US urbanized areas with greater use of public transport. Likewise, 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.

2. Data and Sample

2.1 Data on Cap Rates

Our primary data source, the CBRE ERIX database, provides on standardized capitalization rates for prime office space in Central Business Districts (CBDs) and some Suburban Business Districts (SBDs) for the period 2000 to 2019.[6] The sample is measure as at the fourth quarter of each year and includes data 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 and 81 SBDs, located in 20 European cities.

The standardized prime capitalization rate, *Cap Rate*, 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, assumed to be either newly built or recently renovated, with vacancy rates that are representative of Class A office space within the city. It is based both on sale and purchase contracts during the quarter. If there are no relevant transactions during the quarter, cap rates are based on local brokers' opinions of market conditions.[7]

Table 1 provides a description of the composition of our CBD sample. About half the data come from countries with just one city in the sample, 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.

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[6] CBRE ERIX defines sub-centers as locations in metropolitan areas that are not part of the CBD but have prime office space.

[7] From discussions with members of the CBRE research team, and we learned that most cap rates are based on transactions and that the opinions of local brokers are sometimes used to determine the reported cap rates for tier 2 and 3 cities. As our sample covers mostly tier 1 cities, we do not expect that cap rates based on these opinions will significantly influence our results.

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. For the full sample, the average cap rate for Class A CBD office space is 6.16% with a standard deviation of 1.87%.

(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 cap rates are lower than SBD cap rates in each city and in all years. As we will discuss, there is substantial variation of SBD cap rates within cities as well as variation in the spread between CBD and SBD capitalization rates across cities that we will be studying. Cap rates for SBD prime office space averages 5.97% with a standard deviation of 1.26%, which is 1.05% higher than the average cap rate of the CBDs in their respective city.

2.2 Proxies for discount rates and rental growth rates.

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

$$Property\ Value = \frac{NOI}{r - g}$$

Rearranging the preceding equation, we can specify the cap rate as:

$$Cap\ rate = \frac{NOI}{Property\ Value} = r - g$$

Recognizing that the discount rate is determined by the real risk-free interest rate, r_f, inflation rate, i, and a return premium that can reflect either risk or liquidity considerations, λ, then $r = r_f + i + \lambda$, and:

$$Cap\ rate = \frac{NOI}{Property\ Value} = (r_f + i + \lambda) - g \qquad [1]$$

It should be emphasized that g, the nominal growth rate in rental income, can be characterized as a real growth rate plus the inflation rate. What this means, is that if inflation is neutral, i.e., the real growth rate, the real risk-free rate, and the return premium are unaffected by the rate of inflation, that the inflation terms in the discount rate and the growth rate cancel out, which implies that the cap rate is unaffected by the rate of inflation. We have reason to believe, however, that inflation is not neutral – in particular, we expect that borrowers will be more constrained when the inflation rate is higher -- and as a result, cap rates may be higher when inflation is higher.

Our analysis uses the 10-year nominal interest rate minus the inflation rate (*Inflation*) measured as the percentage change in the country's CPI index, as our measure of the real rate expressed as a percentage (*Long real interest*). Both the 10-year nominal interest rate and the change in the CPI are sourced from the World Bank Development Indicators. To proxy for risk, we include each country's sovereign debt rating as a proxy for risk. *Rating* is an indicator variable equal to one for countries with a Fitch sovereign debt rating of AAA or AA+ and zero otherwise. We will also recognise that the liquidity of a city's property market, may also affect the required rate of return in their property markets. To proxy for liquidity, we include each country's restrictions on purchase of real estate by nonresidents, measured as an indicator equal to one if the purchase of real estate by non-residents is allowed at the country-level, and zero otherwise, *Foreign investment*, sourced from Fernández, Klein, Rebucc, Schindler, and Uribe (2016) updated 2017.[8] We conjecture that foreign access to the domestic real estate market will leads to a more liquid market, a lower liquidity premium and a lower discount rate.

We employ two different approaches for estimating the expected rental growth rate in a city. The first is a backward-looking approach, which assumes that rental growth rates tend to be persistent. Specifically, we proxy for each CBD's expected annual rental growth rate as the average CBD rental growth rate over the previous 3 years, lagged one year, expressed as a percentage (*Average rental growth rate*). To minimize the potential impact of outliers, we winsorize *Average rental growth rate* at the 2.5 and 97.5th percentiles. The second approach is a fundamentals-based forward-looking approach, which is based on the idea 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 begin this second approach by identifying proxies that measure whether a city is growing, with higher rental rates associated with increases in demand for office space. We measure the extent to which a city has a large and growing population as the natural logarithm of the metropolitan area population (*Population*) and the annual growth rate of the metropolitan area

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[8] The purchase of real estate by non-residents is allowed in most EU countries to the extent that the European Commission prevents member states from restricting cross-border trade within the EU, weakening the power of this proxy within the subsample of European cities.

population, expressed as a percentage (*Population growth*), which we obtain from the OECD and supplemented with data obtained from each countries' official census website.[9] We also conjecture that wealthier cities are expected to attract new migrants, and collect the natural logarithm of metropolitan real GDP per capita in USD from the same sources (*GDP per capita*).

Following Sivitanidou and Sivitanides (1999) we also include the current stock of prime office space as an alternative measure of size. We measure the city's current prime office supply as the natural logarithm of the metropolitan area's total stock of office space (sq ft) over the size of the metropolitan area, *Total stock density*. For each city we set *Total stock density* to zero if missing and include indicator variables for missing city observations (*Total stock density missing*) in order to control for any effects of this choice. We obtain our measure from the CBRE ERIX database, supplemented with data obtained from city's official websites and other city-specific data sources.

We next identify proxies that measure whether the CBD is constrained. Our conjecture is that rental growth rates will be higher in constrained cities. 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 cap rates 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. Specifically, we define the variable, *Transport,* 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). We obtain this data from the Mobility

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

in Cities Database, which comes from surveys in 1995, 2002 and 2015.[10] We also include both the proportion of the city's total jobs based in the CBD, *CBD jobs*, as reported by the Mobility in Cities Database, expressed as a percentage. Our intuition is that the CBD locations are more difficult to replicate in cities with more jobs. For each city we set both *Transport* and *CBD jobs* to zero if the city is missing in the Mobility in Cities Database or Moody's and include indicator variables for missing city observations (*Transport missing* and *CBD jobs missing*) in order to control for any effects of this choice.

We also include the vacancy rate for office space within the metropolitan area expressed as a percentage, *Vacancy rate*. Some have argued that CBDs with higher vacancy rates are less constrained, and should experience lower rental growth rates (Sivitanidou and Sivitanides (1999)). For each city we set *Vacancy rate* to zero if missing and include indicator variables for missing city observations (*Vacancy rate missing*) in order to control for any effects of this choice. We obtain our measure from the CBRE ERIX database, supplemented with data obtained from the city's official websites and other city-specific data sources.

Finally, we identify proxies that measure whether the location hosts industries in which proximity is highly valued, i.e., do the businesses value being in the CBD, or are they willing to move to SBDs if the CBD is too constrained. Our intuition is that the CBD locations are more difficult to replicate for industries in which proximity is highly valued. For example, cities that host large finance sectors, since finance firms have strong preferences for locating in financial districts, because they value being within walking distance to both their competitors and service providers.

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[10] 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. Due to data limitations in some of the countries included in our study, we cannot identify the individual components of public transport system.

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.[11] The top 4 financial centers in our sample are New York, London, Hong Kong and Singapore.

Following Glaeser, Kolko and Saiz (2001), we recognise that gateway cities have grown faster than other cities, as the amenities they provide are valuable and firms have strong preferences for locating in these cities, attracting investors resulting in a more liquid real estate market with more access to capital. We follow CBRE Research, Global Gateway Cities database, which define gateway cities as large cities with a rich variety of services and consumer goods (e.g. restaurants and theatres), pleasant physical environment (e.g. weather), good public services, an efficient transport system, a strong corporate presence, and are often financial centers. Our sample of 89 cities comprises 33 financial centers and 21 gateway cities; 19 of these cities are both financial centers and gateway cities. As there is substantial overlap between cities that are classified as gateway cities and financial centers our regressions include an indicator variable, equal to one if the city is either a top 20 financial center, defined by the number of financial professionals per capita or a gateway city, and zero otherwise, *Financial/gateway.*

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

[11] 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.

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. Our conjecture is that if the transit time between the CBD and the SBD is shorter, the SBD location is a better substitute for the CBD location. Hence, the difference between CBD and SBD cap rates are lower when the travel distance (time) is shorter or the city's financial center is located in the SBD rather than the CBD.

Table 2 listed our set of proxies and identifies the direction of their relationship to cap rates, categorizing them as discount rate or rental growth rate proxies, and which determinant of rental growth they proxy for. All variables are defined in Appendix A, along with their data sources.

(Table 2 about here)

3. A Description of the Time Series

3.1 CBD Cap Rates

We start by briefly describing how prime office cap rates have changed over our 2000 to 2019 sample period. As shown in Figure 2, other than an increase of 78 basis points during the financial crisis, average CBD cap rates declined steadily over this period. On average, CBD cap rates 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. The decline was temporarily halted during the years surrounding the financial crisis. Indeed, North American cities' cap rates increased in this period; increasing, on average, from 5.79% at the end of 2007 to a high of 7.65% at the end of 2009. An interesting observation from this Figure is that cap rates tended to converge around the world after the financial crisis, but in the most recent years, European cap rates are once again significantly lower than North American cap rates.

This decline in cap rates 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 change in each country's 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 cap rates.

(Figure 2 about here)

The largest declines in cap rates were found in Seoul and second-tier Chinese cities, perhaps reflecting the development of their financial markets over this time period. We also observe that cap rates fell in European cities following 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 cap rates in those countries adopting the Euro. On average, CBD cap rates 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 cap rates following the adoption of the Euro. Over the entire sample period, cap rates declined more in countries that had higher pre-2002 cap rates (Belgium, France, Greece and Portugal) relative to the countries with lower pre-2002 cap rates (Austria, Germany, Ireland and Italy), 354 basis points for high cap rate countries versus 218 basis points for low cap rate countries.

(Figure 3 about here)

3.2 Suburban versus CBD Cap rates

To understand how the difference between SBD and CBD cap rates have changed over time, we compute the mean difference between SBD and CBD cap rates each year for the period from 2000 to 2019. Figure 4 reveals that SBD cap rates are persistently higher than CBD cap rates 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 cap rates 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 Cap rates

To better understand the cross-sectional differences in cap rates we start with a series of univariate comparisons of all variables of interest that we present in Table 3. The first thing to note is that cap rates are higher in developing economies. This could be due to their higher capital costs -- we find that cap rates are in fact higher in countries with higher interest rates, higher rates of inflation, lower liquidity and lower sovereign debt ratings.

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

(Table 3 about here)

4.2 Suburban versus CBD Cap rates

As we mentioned previously, suburban business district (SBD) cap rates are significantly higher than CBD cap rates. Table 4 presents mean differences between SBD and CBD cap rates for various subsamples of our data. In all cities and for all SDB and CBD pairings, SBD cap rates are higher than CBD cap rates. The average difference between SBD and CBD cap rates is about 1%, and it tends to be greater in cities with lower CBD cap rates -- the difference is 21 basis points larger in cities with below median CBD cap rates. This evidence is consistent with the idea that SBD cap rates tend to be more similar across metropolitan areas than CBD cap rates.

We observe that cap rate differences are smaller in cities that host a financial center, with the effect being greater in cities where the financial center is located in the SBD. SBD cap rates are 31 basis points smaller than their respective CBD when the SBD is a financial center, but only 14 basis points smaller when the financial center is located in the CBD.

Finally, we observe that cap rate differences are larger when the distance and travel time between the CBD and the SBD is longer. For example, SBD cap rates 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.

(Table 4 about here)

5. Cross-sectional Regression Results

One of our most salient observations from our univariate analysis is that cap rates 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 cap rates, but the lower cap rates in financial centers and in cities with better rail infrastructure provides indirect evidence that cities with potential supply constraints have lower cap rates. This section considers these possibilities within the context of a multivariate analysis of CBD cap rates as well as an analysis of the differences between SBD and CBD cap rates. In all cross-sectional regressions reported in Section 5, we cluster our residuals by country and year to account for the fact that there are common world-wide as well as country-wide factors generating rents in any given year.

5.1 CBD Cap Rates

Table 5 reports regressions of cap rates on variables that are likely to be associated with either the discount rate or the rental growth rate in our sample of cities. We include variables where we expect most of the identification comes from the cross-section, including, the following city-level variables: utilisation of public transport (*Transport*), Jobs within the CBD (*CBD jobs*), whether the city hosts a financial center or is a gateway city (Financial/gateway), *Population*, *GDP per capita* and average rental growth rate (*Average rental growth*).[12] At the country-level we include long-term real government bond rate (*Long real interest*), inflation rate (*Inflation*), sovereign debt rating (*Rating*) and whether the purchase of real estate by non-residents is allowed (*Foreign investment*). The regressions include year fixed effects to control for common macro effects, like world-wide changes in real interest rates. These regressions do not include city fixed effects, because we are primarily interested in explaining cross-city differences, but as noted above we cluster our residuals by country and year to account for correlation in errors across cities in a given country and year.[13]

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.

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[12] In unreported regressions, we also include the average cap rates of the firms headquartered in the cities, defined as the firm's EBITDA over its enterprise value, as an independent variable. This variable was not statistically significant and its inclusion did not have a meaningful effect on other estimated coefficients in any of our specifications.

[13] We also re-estimated our regressions to account for the fact that the regression residuals are heteroskedastic and serially correlated across city level observations, estimating Newey-West standard errors assuming an AR(1) process. The results are robust to this alternative specification.

The regression estimates are consistent with our hypothesis that cap rates are higher in riskier CBDs with higher costs of debt and higher inflation. An increase of 1% in long-term interest rates (inflation rates) lead to a 23.1 (28) basis point increase in CBD cap rates.[14] In addition, being located in an economy with a credit rating below AA+ is associated with a 79 basis point increase in cap rates.[15] However, we find no support for an association between past rental growth rates and cap rates.

Column (2) reports a regression that includes additional proxies for expected rental growth rates – these include measures of the cities' size, population growth rate, transport infrastructure, job density, vacancy rates and agglomeration. 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.[16] These regressions are reported in Panel B.

The first thing to note from these regressions is that the coefficient of country credit ratings is no longer significant in the regressions that include other country variables. We suspect that this is due to the fact that per capita income is strongly negatively related to cap rates, and the

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[14] 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 cap rates (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)).

[15] We conjecture that access to capital is likely to be more hindered, and risk is likely to be higher, in economies with more inflation. We re-estimated the regression including just one indicator variables equal to one for countries with a Fitch sovereign debt rating below AA+ and a higher than median inflation rate, and zero otherwise. We find that being located in a high inflation, low credit rating city is associated with a 118.4 basis point increase in cap rates. Results for this regression is presented in Appendix B Column (1).

[16] 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).

effect of credit ratings and per capita income capture similar economic characteristics.[17] In addition, we find cap rates are lower in CBDs with a larger public transport network. For example, a doubling of the frequency of usage of the city's transport network leads to a 60 basis point decrease in CBD cap rates.[18] In addition, we find that the presence of a financial center or a gateway city is associated with lower cap rates -- ceteris paribus, hosting a top 20 financial center or being a gateway city decreases a CBD's cap rates by 57.8 basis points.[19] However, we find no support for an association between the size of a city, its growth rate, vacancy rates nor its stock of office space and cap rates.

There are three key differences in our estimates in the two sub-periods, (Panel A: Columns 3 and 4). The observations that cap rates are lower in wealthier cities only holds during the earlier sub-period. We find mixed results for the association between population growth rates and cap rates. While the association is insignificant for the full sample, it is positive in the earlier sub-period, which is inconsistent with our priors. A closer examination of the data reveals that the positive relation between population growth and cap rates is driven by fast growing second-tier Chinese cities that had both high cap rates and high population and rental growth rates during the earlier sub-period.

[17] The result that cap rates are lower in wealthier cities may be attributable to liquidity, these markets are more liquid markets attracting international institutions with lower funding costs. Our results reported in Panel A; Column 2 are substantially unchanged when we re-estimated our regression including an indicator variable equal to one if the city has above median GDP per capita and purchase of real estate by non-residents are allowed at the country-level, and zero otherwise. We find that the association between GDP and cap rates is significantly weakened under this specification. Results for this regression is presented in Appendix B Columns (2).

[18] As previously noted (Footnote 10), 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 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.

[19] Our results reported in Table 5 are substantially unchanged when we exclude the 4 cities where the financial center is located in an SBD – Amsterdam Beijing, Shanghai and Paris.

Overall, the results are similar for our sample of European cities (Panel B). We find a strong positive relationship between discount rates and cap rates, in particular, cap rates are higher in locations with higher real interest rates and higher inflation rates. We do find a negative relationship between past rental growth rates and cap rates in our regression over the entire sample period, but the effect is weak, and is not significant in either of the subperiods. There are three key differences between the full sample and the European sub-sample. In contrast to the full sample, we find strong support for the observation that cap rates are lower in larger and wealthier European cities. However, we find only weak support for an association between the efficiency of the city's transport infrastructure and cap rates and no association between cap rates and both the proportion of jobs located in the CBD, and the presence of a financial center or gateway city.[20]

(Table 5 about here)

5.2 Within-country Analysis

This section examines the extent to which we can explain within-country variation in CBD cap rates for a sub-sample of countries with two or more cities. These regressions include country and year fixed effects, and we cluster residuals by country and year to account for correlation in errors across cities in a given country and year. The regressions include variables where we observe significant variation at the city-level. These variables include: utilisation of public transport (*Transport*), Jobs within the CBD (*CBD jobs*), whether the city hosts a financial center or is a gateway city (Financial/gateway), *Population*, *Population growth, GDP per capita,* vacancy

[20] 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.

rates for office space (*Vacancy rate*), total stock of office space (*Total stock density*) and average rental growth rate (*Average rental growth*). By looking at within country variation we are effectively holding the macro effects fixed, e.g., the risk-free rate and the inflation rate.

Because these regressions require two or more cities in each country, our sample of cities is reduced to 72, and we lose some of the lowest cap rate cities -- Singapore, Hong Kong and Taipei -- as well as some of the highest cap rate cities -- Moscow, Istanbul, Seoul and Tel Aviv. Nevertheless, we do see relatively large cross-city differences in cap rates within countries. For example, in France – Paris, Lyon and Nice have average cap rates of 4.46%, 6.15% and 6.94%, respectively; in the UK – London (4.46%), Edinburgh (5.72%) and Liverpool (6.74%); and in China – Shanghai (5.00%), Shenzhen (6.45%), Wuhan (6.74%), Tianjin (7.66%) and Chengdu (9.55%).

Table 6 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 strong relationship between cap rates and the extent to which a city is growing. In particular, cap rates are lower in larger, wealthier cities with a larger current stock of prime office space. It should be noted that within a country – the largest city and the wealthiest city tend to have the lowest cap rate, and 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 cap rate is the wealthiest city in one of the countries and is the largest city in the other three countries. We also find a strong relationship between cap rates and the extent to which the growth in a city's prime office space is constrained. In particular, cap rates are lower in cities with lower vacancy rates, a decrease of 1% in vacancy rates lead to a 4 basis point decrease in CBD cap rates.

Again we find that the presence of a financial center or a gateway city is associated with lower cap rates -- hosting a top 20 financial center or being a gateway city decreases a CBD's cap rates by 30 basis points. However, we find no support for an association between the usage of the city's transport network, CBD jobs, past rental growth rates and within-country variation in CBD cap rates. Finally, we again observe a positive association between population growth rates and cap rates and we again find that this observation is driven by fast growing second-tier Chinese cities that had both high cap rates and high population growth rates. The results for European cities (Column 2) are similar and reveal that large wealthy cities with low vacancy rates have lower cap rates.

(Table 6 about here)

5.3 SBD versus CBD Cap Rates

This section examines the cap rates in Suburban Business Districts (SBDs). Specifically, we present regressions that explore the difference between cap rates in the SBDs and in 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 cap rates to go up and down have parallel effects on the SBDs in the same metro area. For example, if the cap rate in the CBD in city A is 50 basis points greater than the cap rate in city B, do we expect the SBDs in city A to have 50 basis point higher cap rates than the SBDs in city B. Our conjecture is that because most SBDs are not nearly as supply constrained as the CBDs, that SBD cap rates across cities will not vary as widely as CBD cap rates. If this is indeed the case, then the difference between CBD cap rates and SBD cap rates should be negatively related to the CBD cap rates, i.e., the spread should be greater when the CBD cap rate is lower. Second, we examine how the cities' transportation infrastructure affects cap rates. Our conjecture is that when the overall transport infrastructure is better, the CBD will be more attractive, and thus more constrained, so its cap rate will be lower relative to the SBDs in the same metro area. However, for a given SBD, its cap rate will be lower when the travel time to the CBD is shorter. Finally, we examine whether SBDs with more finance jobs have lower cap rates.

Table 7 presents the results of the regression of the difference between SBD and CBD cap rates (SBD cap rate minus CBD cap rate) on the following city-level variables: *CBD cap rate*, utilisation of public transport (*Transport*), Jobs within the CBD (*CBD jobs*), whether the city CBD or SBD hosts a financial center (*Financial CBD; Financial SBD*), road distance between a suburb and its CBD (*Distance*), travel time by public transit from a suburb to its CBD (*Travel time – public*) and travel time by car from a suburb to its CBD (*Travel time – car*).

All regression residuals are clustered by country and year to account for correlation in errors across firms in a given country and year. The first three columns in Table 7 include all of the explanatory variables along with year 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). The last three columns examine the extent to which we can explain within-city variation in SBD cap rates and thus includes city and year fixed effects, and excludes the CBD variables that are subsumed by the city dummies. These latter regressions 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 cap rates within the cities that we are examining.

For example, in Amsterdam the average spread between SBD and CBD cap rates 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%.

From the first three columns we learn that the CBD cap rate is an important predictor of the differences in the cap rates of the CBD and the SBD, reflecting the fact that CBD cap rates vary more across cities than do the SBD cap rates. We also find that the difference is greater in cities with better transportation infrastructure, and that SBDs that are financial centers have considerably lower cap rates. Finally, we find that both the travel distances and the travel time between the SBD and the CBD affect the difference in cap rates.[21] The difference in cap rates 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. While the difference in cap rates between SBD Class A office space and CBD Class A office space is smaller, the greater the utilization of the city's transport infrastructure.

Columns (4), (5) and (6) reports our estimates of the city and year fixed effects regressions. Within a city the difference in cap rates between SBD and CBD office is smaller if the CBD rather than the SBD hosts a financial center and consistent with prior evidence, larger the longer the distance and the greater the travel time between an SBD and its respective CBD.

(Table 7 about here)

6. Time-series Regression Results

[21] Examining rental rates rather than cap rates, 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.

Up to this point our emphasis has been on the cross-sectional variation in cap rates. In this section we run similar regressions that also include city fixed effects. These regressions reveal the extent to which the year-to-year variation in the CBD cap rates within cities reflect the year-to-year changes in our explanatory variables. For example, our univariate analysis in Section 3 indicated that in the aggregate, declines in CBD cap rates were associated with corresponding declines in real interest rates. Our regressions that include city and year fixed effects provide additional evidence on the time series effects of discount rates as well as several city specific variables. We include city-level variables where we expect a significant amount of the identification to come from the time series. These include, *Population*, *Population growth, GDP per capita,* vacancy rates for office space (*Vacancy rate*), total stock of office space (*Total stock density*) and average rental growth rate (*Average rental growth*). At the country-level we include the long-term real government bond rate (*Long real interest*) and the inflation rate (*Inflation*). Because we wanted to limit this regression to cities without missing observations in both vacancy rates and total stock of office space, these regressions include only 46 cities in 24 countries.

The regression estimates for the full sample Column (1) indicate a strong relationship between cap rates, discount rates, vacancy rates and GDP. In particular, the evidence suggests that cap rates rise as vacancy rates increase and decline as cities get wealthier. Consistent with our earlier time series analysis, cap rates increase with both real interest rates and inflation rates.

(Table 8 about here)

7. Conclusion

Real estate professionals often use cap rates to describe cross-city variation in how real estate is priced. In some cities real estate prices are 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 have fluctuated over time, and how they differ across countries, across cities within countries, and across locations within metropolitan regions.

We document a number of links between proxies for discount rates and cap rates. Our proxies for discount rates are intuitive and our results on this aspect of cap rates are strong and convincing. The first clear observation is that cap rates throughout the world declined over our sample period along with the decline in the real rate of interest. The decline is pervasive -- for every city in our sample, the cap rate is higher in 2000 than in 2019.

We also find that the availability of credit affects cap rates. In particular, two very intuitive indicators of borrowing constraints, country credit ratings and inflation rates, are positively related to cap rates. Moreover, cities that are financial centers or Gateway cities, which are likely to have more liquid real estate and debt markets, have lower cap rates.

We document a number of other observations, which we think supports the idea that cap rates are related to the expected rental growth rates. However, the connection between these proxies and the rental growth rate is less intuitive, so the interpretation of these results are more speculative. For example, we observe that cap rates 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 cap rate of a SBD in a metropolis had a lower cap rates that the corresponding CBD. Our conjecture is that the lower cap rates 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 cap rates is potentially more interesting, but somewhat less definitive. This is partly because many of our proxies have multiple interpretations. For example, as we just mentioned, financial centers and gateway cities are likely to have better access to financial markets, and thus lower discount rates. However, some authors have argued that these cities also experienced higher growth rates.

Another robust finding is that larger and richer cities tend to have lower cap rates. One interpretation is that these cities, especially when they are gateway or financial centers, are more likely to attract new businesses and experience growing rental rates, but we cannot rule out the possibility that real estate in these markets sell for a premium because they are more liquid markets that attract international institutions with lower funding costs. At this point, we have not identified an approach that allows us to cleanly distinguish between plausible alternative explanations but look forward to future research that can clarify these relationships. Hopefully, future researchers will make progress along these lines.

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Table 1: Sample

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

	CBD Capitalization Rate					SBD Capitalization Rates	
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: Alternative Proxies

The table presents the expected sign of the relationship between CBD cap rates and discount rate components and alternative proxies for rental growth rates. All variables are defined in Sections 2.

Proxy	Nominal discount rate	Rental growth rate		
		Growing city	Constrained CBD	Proximity
Short real interest rate	+			
Long real interest rate	+			
Inflation	+			
Rating	-			
Foreign investment	-			
Average rental growth		-		
Population		-		
Population growth		-		
GDP per capita		-		
Total stock density		-		
Vacancy rate			+	
Transport boardings per capita			-	
CBD jobs			-	
Financial/gateway				-
Distance				+
Travel time – public				+
Travel time – car				+

Table 3: CBD Cap Rates

The table presents a comparison of cap rates 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		Cap Rate (%)		Cap Rate (%)
Long real interest	Above median	6.70	Below median	5.59***
Inflation	Above median	6.56	Below median	5.77***
Rating	AAA or AA+	5.02	No	6.83***
Foreign investment	Yes	5.92	No	6.41***
Average rental growth	Above median	6.08	Below median	6.23*
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***
Vacancy rate	Above median	6.45	Below median	5.54***
Total stock density	Above median	5.77	Below median	6.83***
Transport boardings per capita	Above median	5.49	Below median	6.37***
CBD jobs	Above median	6.20	Below median	6.05
Financial/gateway	yes	5.32	No	6.60***
Developed economy	Yes	5.87	No	7.55***
Europe	Yes	5.81	No	6.76***
	Europe			
Long real rate	Above median	6.32	Below median	5.37***
Inflation	Above median	6.21	Below median	5.56***
Rating	AAA or AA+	5.58	No	6.48***
Foreign investment	Yes	5.69	No	5.84
Average rental growth	Above median	5.71	Below median	5.90*
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***
Vacancy rate	Above median	6.07	Below median	5.16***
Total stock density	Above median	5.55	Below median	6.19***
Transport boardings per capita	Above median	5.39	Below median	5.83***
CBD jobs	Above median	5.84	Below median	5.73
Financial/gateway	Yes	4.86	No	6.18***

Table 4: Differences Between SBD and CBD Cap Rates

The table presents a comparison of the difference between SBD and CBD cap rates 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 Cap Rates (%)		CBD – SBD Cap Rates (%)
CBD cap rate	Above median	0.95	Below median	1.16***
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
Transport boardings per capita	Above median	1.02	Below median	1.08
CBD jobs	Above median	1.01	Below median	1.10**
Financial CBD	Ranked	0.96	Unranked	1.10***
Financial SBD	Ranked	0.67	Unranked	1.08***
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***

Table 5: Determinants of CBD Cap Rates

This table presents the regression of prime CBD cap rates, *Cap Rate*, 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. Year fixed effects are included as we focus on cross-city differences. Standard errors are clustered by country 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		-0.602**	-0.618***	-0.574***
		(0.234)	(0.229)	(0.215)
Transport missing		2.266*	2.312*	2.148**
		(1.211)	(1.186)	(1.089)
CBD jobs		-0.0200**	-0.0253**	-0.0131*
		(0.00985)	(0.0121)	(0.00680)
Jobs missing		0.963**	1.054***	0.769**
		(0.400)	(0.388)	(0.339)
Financial/gateway		-0.533*	-0.354	-0.667**
		(0.284)	(0.271)	(0.262)
Population		-0.0126	0.155	-0.171
		(0.184)	(0.170)	(0.159)
GDP per capita		-0.802***	-0.945***	-0.224
		(0.297)	(0.281)	(0.308)
Average rental growth	-0.0214	-0.0192**	-0.0108	-0.0246***
	(0.0150)	(0.00848)	(0.0113)	(0.00628)
Long real interest	0.229**	0.217***	0.0796	0.412***
	(0.0915)	(0.0660)	(0.119)	(0.0947)
Inflation	0.275***	0.234***	0.184***	0.419***
	(0.106)	(0.0827)	(0.0663)	(0.0849)
Rating	-0.752*	-0.219	-0.557	0.00999
	(0.393)	(0.416)	(0.588)	(0.310)
Foreign investment	0.191	0.0544	-0.0648	0.0748
	(0.303)	(0.213)	(0.269)	(0.186)
Year fixed effects	Yes	Yes	Yes	Yes
Number of obs	1,660	1,660	776	884
R^2 adj	0.402	0.591	0.548	0.665

Table 5: Determinants of CBD Cap Rates (continued)

Panel B: Europe				
	2000-2019		2000-2009	2010-2019
Variables	(1)	(2)	(3)	(4)
Transport		-0.252	-0.482*	-0.0967
		(0.158)	(0.278)	(0.115)
Transport missing		0.832	1.971	0.0845
		(0.777)	(1.326)	(0.645)
CBD jobs		0.000108	0.00758	-0.00345
		(0.00596)	(0.00722)	(0.00755)
Jobs missing		0.220	0.471	-0.0719
		(0.216)	(0.318)	(0.289)
Financial/gateway		-0.129	-0.0151	-0.209
		(0.153)	(0.209)	(0.181)
Population		-0.357***	-0.425***	-0.291**
		(0.116)	(0.144)	(0.137)
GDP per capita		-1.277***	-1.323***	-1.203***
		(0.240)	(0.284)	(0.323)
Average rental growth	-0.0215	-0.0153*	-0.0134	-0.0109
	(0.0145)	(0.00785)	(0.00994)	(0.01000)
Long real interest	0.374***	0.333***	0.465***	0.320***
	(0.0767)	(0.0808)	(0.148)	(0.0849)
Inflation	0.567***	0.495***	0.592***	0.463***
	(0.0789)	(0.105)	(0.116)	(0.0960)
Rating	-0.294	-0.0228	0.000287	-0.0539
	(0.380)	(0.213)	(0.322)	(0.239)
Year fixed effects	Yes	Yes	Yes	Yes
Number of obs	1,059	1,059	499	560
R^2 adj	0.559	0.764	0.678	0.808

Table 6: Within Country Variation in Cap Rates

This table presents the regressions of prime cap rates, *Cap Rate*. We focus on the sub-sample of countries with two or more cities. Variables as defined in in Section 2. Country and year fixed effects are included. Standard errors are clustered by country and year. ***, **,* denotes 1%, 5% and 10% significance level.

	Full Sample	Europe
Variables	(1)	(2)
Transport	0.139	0.194
	(0.152)	(0.149)
Transport missing	-1.196*	-1.075
	(0.681)	(0.738)
CBD jobs	-0.0101	-0.0181*
	(0.00720)	(0.0108)
Jobs missing	0.447*	0.479***
	(0.238)	(0.162)
Financial/gateway	-0.301*	0.0130
	(0.154)	(0.181)
Population	-0.320**	-0.629***
	(0.152)	(0.141)
Population growth	0.112***	0.00594
	(0.0427)	(0.0408)
GDP per capita	-1.422***	-1.065***
	(0.313)	(0.197)
Vacancy rate	0.0408***	0.0178**
	(0.0107)	(0.00716)
Vacancy rate missing	-0.482***	-0.322***
	(0.139)	(0.118)
Total stock density	-0.0480*	-0.0896***
	(0.0273)	(0.0240)
Total stock density missing	0.172**	0.480***
	(0.0848)	(0.165)
Average rental growth	-0.0166	-0.0241***
	(0.0120)	(0.00806)
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Number of obs	1,335	865
R^2 adj	0.763	0.839

Table 7: Difference Between SBD and CBD Cap Rates

This table presents the regression of the difference in cap rates between SBD and CBD office space, *SBD-CBD cap rate*, on CBD cap rates, 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 for the full sample and includes year fixed effects. Columns (4), (5) and (6) reports the within city regressions, including city and year fixed effects for the sample of multi-suburb European cities. Standard errors are clustered by country 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 cap rate	-0.242***	-0.286***	-0.260***			
	(0.0561)	(0.0581)	(0.0556)			
Transport	-0.264*	-0.294**	-0.279**			
	(0.145)	(0.141)	(0.133)			
CBD jobs	0.00592	0.00119	0.00576			
	(0.00742)	(0.00843)	(0.00696)			
Jobs missing	-0.152	0.0780	-0.131			
	(0.202)	(0.257)	(0.200)			
Financial CBD	-0.0527	-0.107	-0.183	-0.390***	-0.260***	-0.365**
	(0.189)	(0.207)	(0.175)	(0.112)	(0.0753)	(0.152)
Financial SBD	-0.330**	-0.402**	-0.473***	-0.241*	-0.317	-0.357*
	(0.143)	(0.197)	(0.152)	(0.133)	(0.196)	(0.188)
Distance	0.408***			0.410***		
	(0.0816)			(0.106)		
Travel time - public		0.314***			0.395***	
		(0.0984)			(0.126)	
Travel time - car			0.488***			0.416***
			(0.139)			(0.147)
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 adj	0.299	0.196	0.250	0.387	0.342	0.337

Table 8: Time-series variation in CBD Cap Rates

This table presents regressions of prime CBD cap rates, *Cap Rate*, on the characteristics of the debt markets, agglomeration, measures of the size and property of the city, as defined in in Section 2. We omit missing values in all explanatory variables. City and year fixed effects are included. Standard errors are clustered by country and year. Standard errors are given in parentheses. ***, **,* denotes 1%, 5% and 10% significance level.

	Full Sample	Europe
	(1)	(2)
Population	1.434	0.628
	(1.749)	(1.985)
Population growth	0.0326	-0.0448
	(0.0451)	(0.0418)
GDP per capita	-0.933**	-1.236**
	(0.410)	(0.546)
Vacancy rate	0.0250**	0.0110
	(0.0121)	(0.00928)
Total stock density	-0.766	-0.492
	(0.503)	(0.685)
Average rental growth	-0.000836	-0.00251
	(0.00640)	(0.00662)
Long real interest	0.240***	0.260***
	(0.0641)	(0.0571)
Inflation	0.167**	0.170**
	(0.0653)	(0.0678)
Number of obs	1,088	614
R^2 adj	0.839	0.908

Figure 1: Mean CBD Cap Rates of Sample Countries (2000–2019)

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

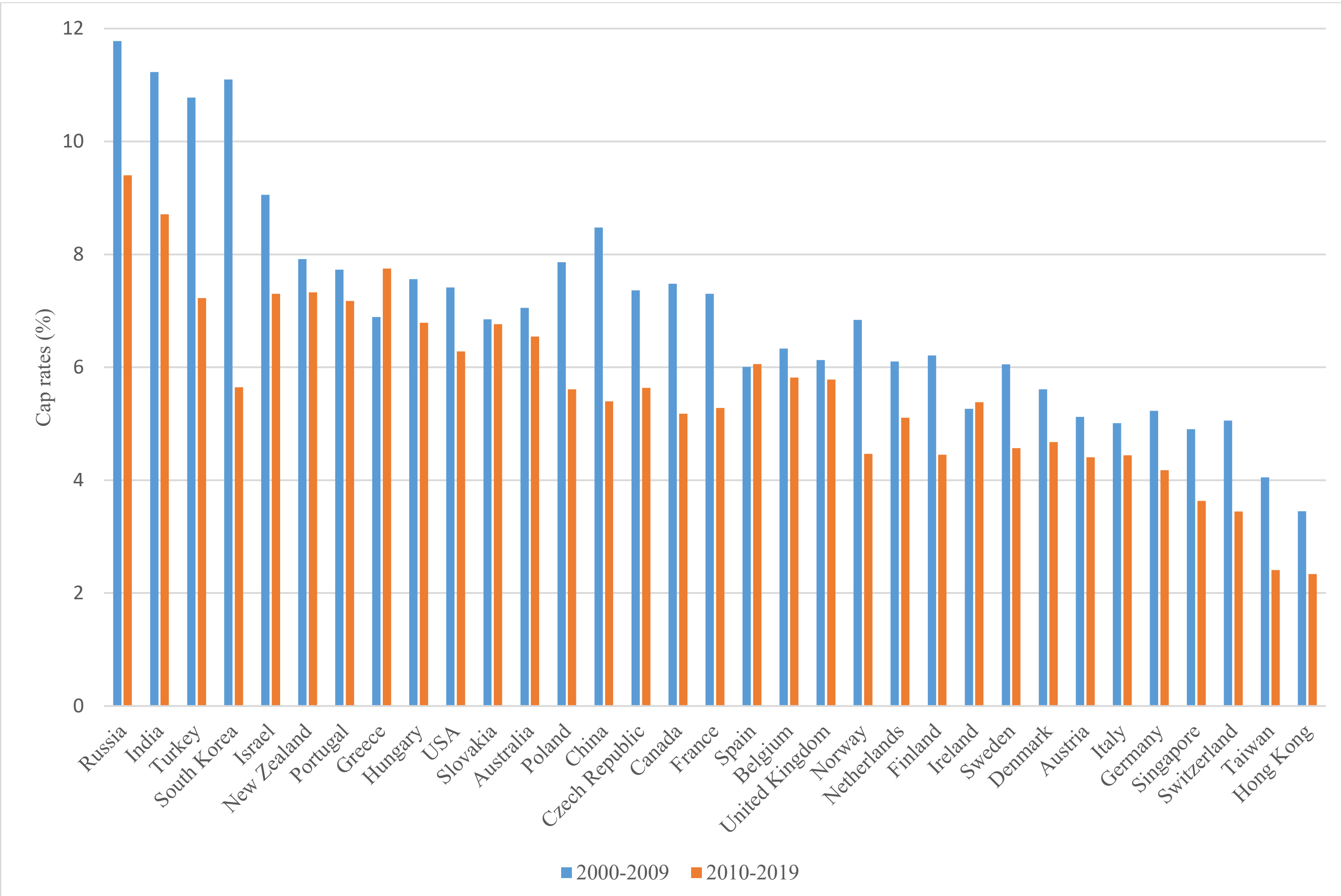

Figure 2: Annual CBD Cap Rates of Sample Countries and Real Interest Rates (2000–2019)

For each year over the period 2000 to 2019, Figure 2 plots the mean CBD cap rate 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 cap rate and real short-term interest rate is as defined in Section 2.

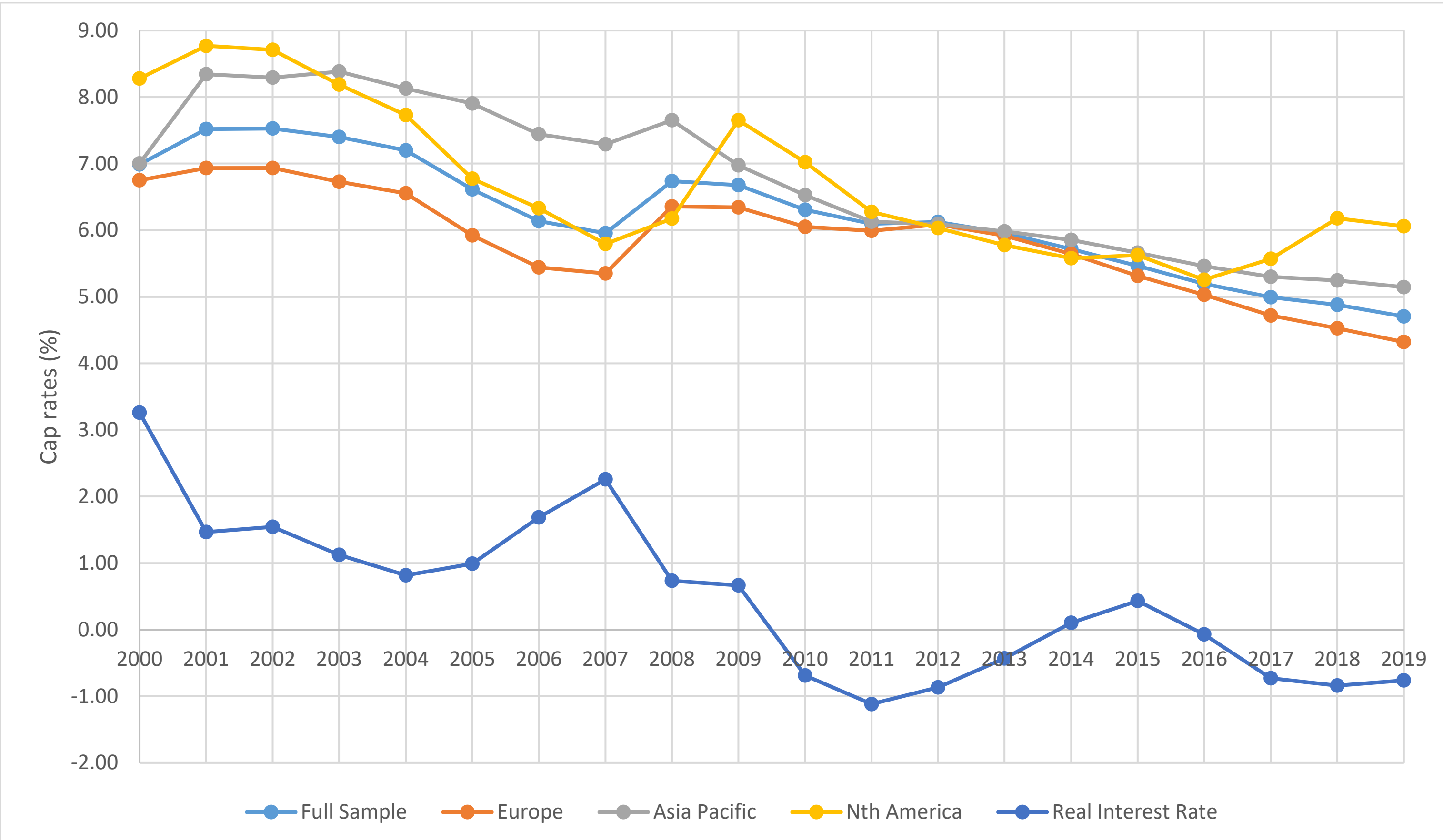

Figure 3: Annual CBD Cap Rates of Euro Adopting Countries (2000–2019)

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

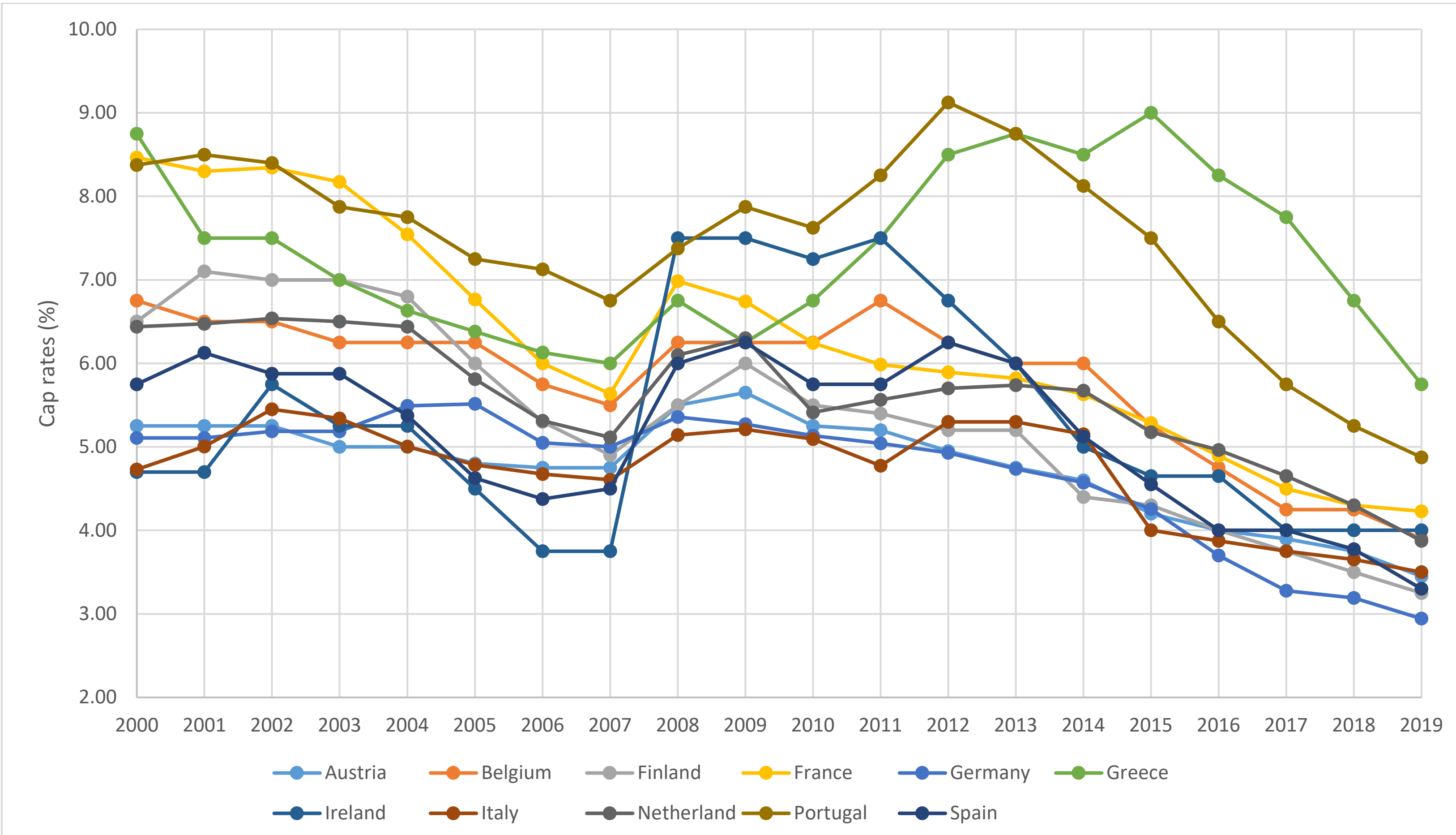

Figure 4: Annual Differences Between SBD and CBD Cap Rates of European Countries (2000–2019)

For each year, Figure 5 plots the mean of the difference in SBD and CBD cap rates 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 cap rates is as defined in Section 2.

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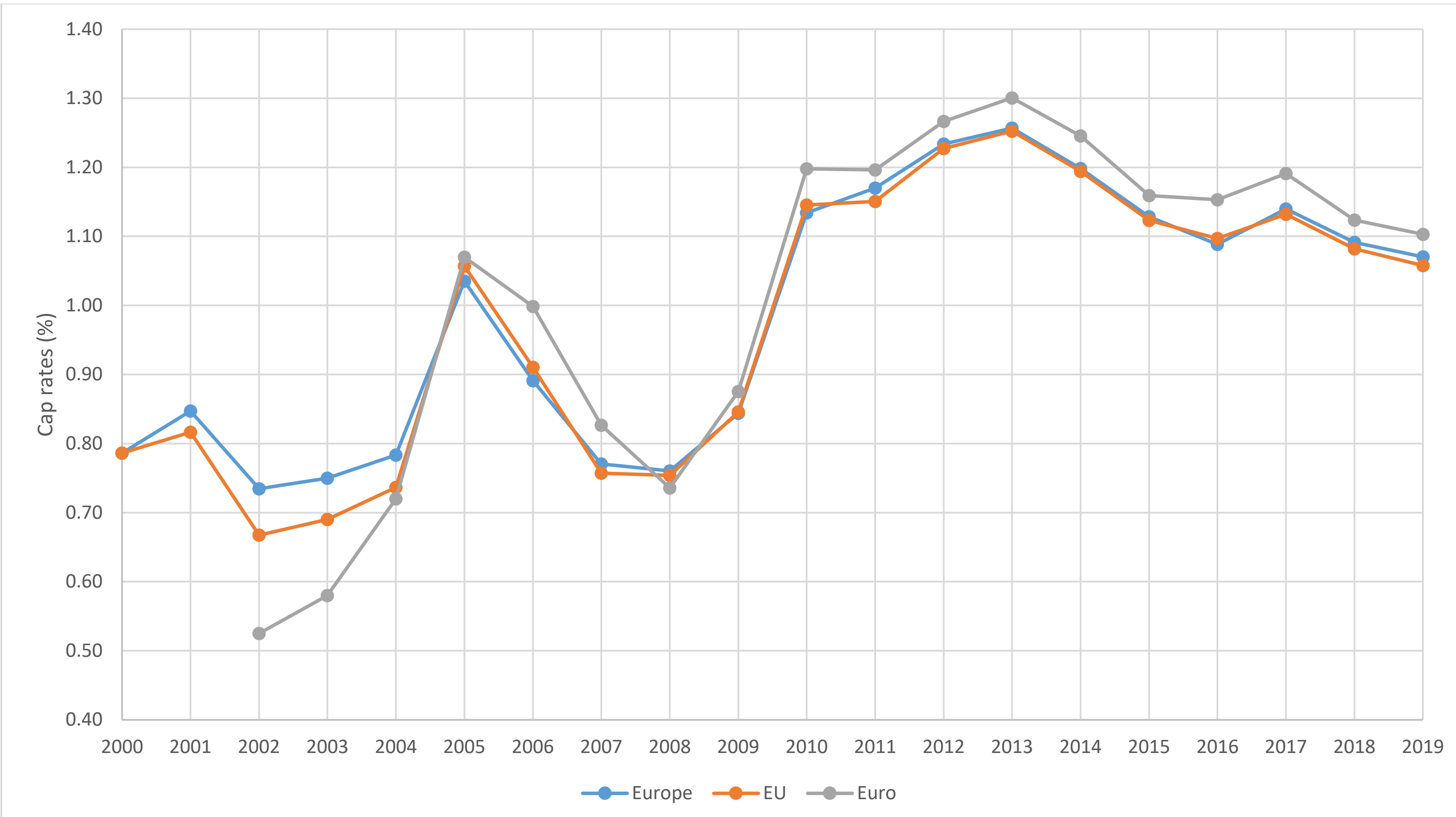

Appendix A: Variable Definitions

Variable	Definition	Source
Capitalization rate variables		
Cap rate	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.	CBRE ERIX
SBD-CBD cap rate	Cap rate for suburban business district (SBD) Class A office space cap rate minus cap rate for CBD Class A office space, expressed as a percentage.	CBRE ERIX
Country variables: Discount rate		
Long real interest	10-year nominal interest rate minus the inflation rate, expressed as a percentage.	World Bank Development Indicators
Inflation	Change in country's CPI index, expressed as a percentage.	World Bank Development Indicators
Rating	Indicator variable taking a value of one for countries with a Fitch sovereign debt rating of AAA or AA+ and zero otherwise.	Fitch
Foreign investment	Indicator variable taking a value of one if the purchase of real estate by non-residents is allowed at the country-level and zero otherwise.	Fernández, Klein, Rebucc, Schindler, and Uribe (2016) updated 2017
City variables: Expected rental growth		
Average rental growth	The average of the city's past 3 years of CBD rental growth rates expressed as a percentage.	
Population	Natural logarithm of the metropolitan area population.	OECD
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.	OECD
Transport	Natural logarithm of the number of public transport boardings per capita.	International Association of Public Transport, Mobility in Cities Database
CBD jobs	The proportion of the city's total jobs located within the CBD, expressed as a percentage.	International Association of Public Transport, Mobility in Cities Database
Total stock density	Natural logarithm of total stock of office space (sq ft) over the size of the metropolitan area.	CBRE ERIX

Appendix A: Variable Definitions (continued)

Variable	Definition	Source
Vacancy rate	Vacancy rate for office space within the metropolitan area, expressed as a percentage.	CBRE ERIX
Finance professionals	The number of finance professionals per capita in each city.	Bloomberg
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, and zero otherwise.	CBRE ERIX Bloomberg Z/Yen Group's Global Financial Centres Index reports
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, and zero otherwise.	CBRE ERIX Bloomberg Z/Yen Group's Global Financial Centres Index reports
Gateway city	Indicator variable taking a value of one for a gateway city defined to be large cities with a rich variety of services and consumer goods, pleasant physical environment, good public services, an efficient transport system, and a strong corporate presence and real estate investment flow, and zero otherwise.	CBRE Research, Global Gateway Cities
Financial/gateway	Indicator variable taking a value of one if the city is a top 20 financial center or a gateway city, and zero otherwise.	
Foreign investment	Indicator variable taking a value of one if the purchase of real estate by non-residents is allowed at the country-level, and zero otherwise.	Fernández, Klein, Rebucc, Schindler, and Uribe (2016) updated 2017
Corporate cap rate	Mean each year of the "cap rate" for firms headquartered in the city, where we measure firm level "cap rates" as EBITDA over enterprise value.	Compustat Global
Distance	Natural logarithm of the road distance between a suburb and its CBD in kilometers.	Google Maps
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.	Google Maps
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.	Google Maps

Appendix B: Alternative Proxies

This table presents from Table 5 (Columns 1 and 2) the regression of prime CBD cap rates, *Cap Rate*, 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 Appendix A. 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.

	(1)	(2)
Transport		-0.555***
		(0.207)
Transport missing		2.014*
		(1.093)
CBD jobs		-0.0163*
		(0.00964)
Jobs missing		0.755*
		(0.394)
Financial/gateway		-0.817***
		(0.250)
Population		0.194
		(0.156)
Population growth		0.0712
		(0.0610)
Vacancy rate		0.0167
		(0.0138)
Vacancy rate missing		-0.255
		(0.260)
Total stock density		-0.0437
		(0.0577)
Total stock density missing		0.0708
		(0.457)
High GDP/Foreign investment		-0.280**
		(0.127)
Average rental growth	-0.0218	-0.0271**
	(0.0181)	(0.0119)
Long real interest	0.140*	0.189***
	(0.0787)	(0.0702)
Inflation		0.238***
		(0.0896)
Rating		-0.639*
		(0.361)
High inflation/Low rating	1.184***	
	(0.365)	
Year fixed effects	Yes	Yes
Number of obs	1660	1660
R^2 adj	0.246	0.560