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International Diversification Strategies for Direct Real Estate

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Abstract This paper will disentangle the performance of international real estate into property type performance and region selection. This helps to create an international diversification strategy for direct real estate. We use constrained cross-section regression with dummy variables for regions and property types to measure the best risk reducer. We analyze the impact of currency changes on total returns by looking at a hedged and un-hedged portfolio, both stock and equally weighted. The findings show that geographic factors have the largest influence on the volatility of international real estate returns. The average variance of the regional effects is higher than the property type effects and therefore the regional effects have a higher influence on the variation of the total portfolio. However, the regional effects are less stable through time, compared with the variance and correlation of the property type effects. Also the property type effect seems to become a more important factor for the return over time, especially when the return is expressed in local currency.

Keywords International direct real estate · Diversification · Property type

Introduction

Traditionally, investment managers in direct real estate have focused on a single geographical region. To achieve diversification, they have invested across different property types, in assets with different characteristics, or by selecting assets in targeted areas within that region. Achieving diversification through international investment - common in other asset classes - has not been considered as attractive for direct real estate because real estate markets are less transparent and there are

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higher risks and costs involved. This could be a disadvantage for the international real estate investor versus the domestic investor. A study by Eichholtz et al. (2001) finds that international companies underperform domestic companies and that the underperformance is not the result of transaction costs, leverage or currency. Size appears to be the only factor that improves the performance of international companies.

The size of a real estate investment company relative to its home market also seems to be an important reason why we have seen international expansion by institutional investors over the past few years. The international expansion is mainly driven by the relatively small size of their home market and the shortage of investment products. For example ING Real Estate started its international expansion in 1998 because of the relatively small size of the home market. It transformed its business from a mainly local Dutch real estate company with Euro 6 billion of assets under management (AuM) to one of the largest property investors with more than Euro 50 billion AuM in 14 countries. To achieve this expansion together with good investment performance requires a strong focus on high quality and consistent information data to create a global direct real estate investment strategy. Information about performance, market rents, and capital value has recently become available through international expansion of Investment Property Databank (IPD) and Jones Lang LaSalle (JLL). With this newly collected information, it is possible to demonstrate whether the additional risk of international investment is offset by higher returns and to determine which investment strategy - portfolio diversification by region or property type - is more effective in reducing the volatility of real estate returns.

The literature has already devoted much attention to the benefits of international diversification using real estate equities (see Worzala and Sirmans 2003). For example, Eichholtz (1997) examines international diversification by looking at investing in different regions versus different property types. Studies of non-listed real estate or direct real estate also discuss the diversification benefits of international investment (see Sirmans and Worzala 2003). However, most of the studies advocate the inclusion of international real estate based on a mean-variance analysis, where applying the modern portfolio theory to direct real estate has some disadvantages. An alternative model developed by Heston and Rouwenhorst (1995) measures country and industry effects and provides a quantitative framework for analyzing portfolio selection. A recent paper by Hamelink and Hoesli (2004) applies this model to listed real estate securities and disentangles the effects of country, property type, size, and value/growth factors. In this paper, we apply this model for the first time to international non-listed real estate data. This allows us to disentangle the property-type performance and regional influences on international real estate returns. The rationale is the need for international real estate research for the investment industry as it moves towards market globalization.

For most asset classes, where the information has been available for some time, the question of investing internationally has been addressed extensively. For equities, Solnik (1974) looks at the advantages of international investment by measuring the reduction in variability of the total portfolio as a result of including foreign securities. He concludes that there is a large risk reduction for US and foreign investors who invest internationally. This risk reduction is achieved with relatively

few investments. Since then there have been several studies on the diversification benefits of international investment. For the purpose of this paper we focus on a group of studies that decompose international equity data to identify the effect that is most important for international stock returns. Heston and Rouwenhorst (1995) develop a model to measure country and industry effects, providing a quantitative framework for analyzing portfolio selection. They find that country effects are greater than industry effects, which implies that diversification by country reduces risk more. A paper by Griffin and Karolyi (1998) extends the Heston and Rouwenhorst model by including a weighting for the relative market value of the equity market for a country or industry. They confirm the original results and also reveal the differences in the proportion of variation that is captured by country and industry. A paper by Van Dijk and Keijzer (2004) decomposes the importance of region, industry sector, size, and value/growth allocation for global equity portfolios. They find that the combination of region and industry sector is more important than style tilts towards value/growth and size. In addition they show that, over their sample period of January 1987 through March 2002, the relative importance of region and industry-sector changes. In the first half of the sample period regional allocation is the more important, while in the second half this is industry-sector allocation.

For this study, we would like to focus on diversification effects within a real estate strategy. A literature review on investing in international listed real estate by Worzala and Sirmans (2003) shows the benefits of international diversification using real estate equities. Giliberto (1990) was among the first to analyze international diversification for a portfolio consisting only of listed real estate companies. Eichholtz (1997) examines international diversification by looking at investing in different regions versus different property types. This is a similar analysis to the one we make in this paper, where we focus on direct real estate investments. Eichholtz concludes that regional diversification is more beneficial than property type diversification. This is also the conclusion of Eichholtz et al. (1995), who use the Jennrich test to measure the stability of correlations and find that the benefits from international investment versus property type diversification differ by region. Another study by Eichholtz (1996) finds that correlation between national real estate returns are significantly lower than similar correlations for stocks and bonds. This implies that international diversification reduces risk in a real estate portfolio more than it does in common stock and bond portfolios. In addition, Eichholtz et al. (1993) examines continental factors by using a principal component analysis. The findings show that countries within continents move together. The implication is that investors cannot realize optimal diversification by investing in one continent alone and need to diversify across multiple regions for optimal international diversification. Eichholtz et al. (1998) re-examine continental factors and find that real estate returns in Europe depend positively and significantly on returns in other European countries. They further conclude that European and North American investors can achieve diversification benefits specifically by investing in Asia Pacific real estate. Ling and Naranjo (2002) find evidence of a world-wide systematic factor influencing listed real estate returns. However, country-specific factors are more significant in many countries, demonstrating the advantages of international investment in real estate stocks. A recent paper by Hamelink and Hoesli (2004) disentangles the effects

of country, property type, size, and value/growth factors on listed real estate securities, based on the model applied in Heston and Rouwenhorst (1995). In their study the identification of 'pure' factors is very important. Returns on country (or property type) factors are adjusted to the difference in the property type (or country), size and value/growth composition of the country markets. The study concludes that country factors are more important than property type, size and value/growth factors.

One of the earlier papers looking at international diversification for non-listed or direct real estate is from Sweeney (1988, 1989). Sweeney (1988) looks at rental value growth rate for 16 countries from 1970 to 1986. This study finds support for international diversification and concludes that an investor would have achieved a superior return if a global investment strategy had been implemented. The benefit achieved from international diversification depends on the home country of the investor. Sweeney (1989) adds the modern portfolio theory to the previous study and finds that a minimum risk portfolio allocates investments to 7 out of 11 countries. The conclusions remain the same as Sweeney (1988), that diversification benefits can be achieved by investing internationally. Gordon (1991) looks at mean returns, standard deviations and correlations for all asset classes. In his study he analyses real estate data from 1970-1990 for the US (combination of EAI survey and NCREIF index) and for the UK (combination of JLL property index and IPD index) and finds gains from international diversification. An overview of studies about diversification benefits of international direct real estate investment is discussed in a literature review by Sirmans and Worzala (2003). Looking at the literature on international investment within a real estate asset class portfolio, they conclude that most of the studies advocate the inclusion of international real estate in a mean-variance analysis. Furthermore, they conclude that both property type and regional diversification is important, but regional diversification appears to be more important. However, most studies are based on mean-variance analysis using the modern portfolio theory of 1959. As most real estate data are appraisal based and therefore do not reflect the true volatility, applying the MPT theory has some disadvantages, especially when comparing real estate to other asset classes. Goetzmann and Wachter (2001) use a cluster analysis and bootstrapping technique alongside the MPT model to demonstrate the potential benefits of international diversification. Case et al. (1999) find support for increasing globalization of property markets, with cross-border correlations depending in part on the exposure to fluctuations in the global economy. However, the analysis of international diversification also suggests that portfolio volatility is reduced by cross-border property investment.

In this paper, we examine the potential for diversification in the international direct real estate market. Since real estate returns are believed to be strongly influenced by geographical and property type effects, it is key to be able to disentangle those effects from one another. In particular, differences between regional returns may simply reflect differences in the property type allocation in the regions, which clearly makes it difficult to disassociate the two effects. For international real estate investors, it is crucial to identify which factor offers the highest diversification benefits and return potential. We apply a multi-factor approach to estimate 'pure' regional and property type factors. The diversification benefits are tested using a unique database of 200 city/MSA and property type

combinations from the first quarter of 1988 through the last quarter of 2003. Through a restricted cross-sectional regression analysis, we separate the effects that property type and region have on the variance (and therefore the diversification) of international real estate investment and determine that the impact of different geographical regions is much more substantial than that of different property types. Therefore, we will show that by investing in different geographical areas, a real estate investor is able to increase diversification benefits compared with investing solely across property types.

This paper is organized as follows. In section 2 (Data) we describe the data and provide summary statistics for total returns for the regions and property types; section 3 (Methodology) provides the methodology. Section 4 (Results) discusses the results and interprets the findings. Section 5 (Conclusions) gives the conclusions for this paper.

Data

In this paper, we analyze total return data for five regions to compare international real estate markets (see Appendix A). The data sources are selected to create a dataset that has a sufficiently long history. The cross-sectional analysis is only possible if every region is represented by at least one city, in other words the shortest time-series meeting this condition becomes the limiting factor. As a result the database starts in the first quarter of 1988 because that is when we have at least one data-point for every region. Furthermore, the dataset should contain enough cities/MSAs to provide a good representation of the performance of real estate in a particular region. For Asia and Continental Europe, the source is market information from Jones Lang LaSalle (JLL). Data for Australia are provided by the Property Council of Australia (PCA) investment performance index, the return data for the U.K. are extracted from the monthly database of Investment Property Databank (IPD), and for the U.S. we use the total return series from the National Council of Real Estate Investment Fiduciaries (NCREIF) index. The data have been selected on the basis of quality and availability.

For the 30 cities in Asia and Continental Europe, the JLL[1] total return index is based on rents, yields, and capital values (or price). The city selection is based on data availability and institutional activity in a real estate market. The data are proxies of average effective rents and yields for institutional quality real estate in a specific market. For the office sector, the market information focuses on class A office space in the Central Business District (CBD). Residential property is represented by high-rise buildings in the inner city area of the best quality for the renters market. Retail space is represented by shopping center space and high-street retail in the main shopping locations of the cities. Industrial real estate is logistic warehouse space in the immediate area around the city. Based on rent (D_{it}) per quarter per square meter,

[1] The JLL data series are used in various international direct real estate diversification studies, for example Newell and Webb (1996), Quan and Titman (1997 and 1999), Stevenson (1998), Addae-Dapaah and Young (1998), Chau (1997).

yield, and price (P_{it}) per square meter we created a total return series (R_{it}) on a quarterly basis from the first quarter of 1988 through the last quarter of 2003, where the total return is the sum of capital appreciation and the net rent generated by the property.

For Australia, we used total return series provided by the Property Council Investment Performance Index in Australia. As of December 2003, the PCA index included 470 properties with a total market value of 43.2 billion Australian dollars. The index comprises three property types: industrial (4.6%), office (44.5%), and retail (50.9%). The PCA index breaks the data down into sub-categories. In our database we included CBD office total returns for 5 cities, industrial total returns for Sydney, Melbourne, and Brisbane. For retail, Sydney represents the performance of retail in metropolitan New South Wales, Melbourne retail performance in metropolitan Victoria, Brisbane in metropolitan Queensland, and Perth in metropolitan Western Australia.

For the U.K., IPD published an annual and monthly index from the first quarter of 1988 through the last quarter of 2003. To make the time series consistent with other regions, the quarterly total returns are calculated from the monthly IPD index for the cities. The monthly index at year-end 2003 covered about 16% of the annual index, with a slightly different composition. The annual index comprises 15.7% industrial, 29.7% office, 51.6% retail, and 3.0% other. Our dataset has a higher allocation to office (50.1%) and a lower allocation to industrial (14.8%) and retail (35.1%) as a result of city selection and use of the monthly index.

For the U.S., the data selection is compiled from the appraisal-based direct real estate index from NCREIF. As of year-end 2003, the NCREIF index included 4,060 properties with a total market value of 132.4 billion USD. The NCREIF index breaks down into five property types: apartments (19.21% of the index), hotels (1.66%), industrial (19.50%), office (38.96%), and retail (20.67%). NCREIF provides return data if there are four or more property investments in an MSA, which results in 49 MSAs for industrial real estate, 47 MSAs for office, 49 MSAs for residential, and 36 MSAs for retail. This gives the index a wide geographical spread. However, for a global analysis we would need comparable cities on an international scale. We therefore select only the top 20 MSAs by market value for the four main property types: industrial, office, residential, and retail. By selecting the top 20 markets we cover 81.2% of the industrial market value, 84.4% of the office market value, 74.9% of residential, and 88.2% of the retail market value in the NCREIF index.

Table 1 shows the key statistics of the total returns in local currency by region and by property type. The region returns are calculated on a quarterly basis from the city/MSA data as shown in Appendix A. The total number of observations is 9933, with the majority of the observations in the U.S. and Continental Europe. The average return and risk is highest for Asia. The average return for all regions (9.3%) is higher than the average return for the U.S. and Australia. Moreover, the risk for all regions combined (2.9%) is lower than the risk for any individual region. This already indicates potential for diversification. If we look at the key property type statistics we can see that the office property type has the lowest return, but also the highest risk. Residential real estate has the highest average return and slightly higher risk than the average of all property types. Retail property has a higher return than the mean of all property types, but a lower risk (2.8% vs. 2.9%).

Table 1 Summary statistics for equally weighted total returns in local currency

Region	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Asia	1094	14.5%	8.8%	-7.4%	21.5%
Australia	691	8.9%	3.7%	-1.6%	6.7%
Continental Europe	2669	11.9%	5.0%	-3.8%	9.5%
United Kingdom	1113	10.8%	5.4%	-2.4%	11.1%
United States	4366	7.3%	3.2%	-4.4%	5.2%
All regions	9933	9.3%	2.9%	-1.6%	5.1%
Property type	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Industrial	2499	9.7%	3.1%	-1.6%	4.7%
Office	3389	8.0%	4.1%	-2.7%	5.9%
Residential	1288	10.6%	3.0%	-1.2%	10.0%
Retail	2757	9.6%	2.8%	-0.7%	5.7%
All property types	9933	9.3%	2.9%	-1.6%	5.1%

The table contains the number of observations, average annual equally weighted mean in local currency, and standard deviations of the annualized return variables in our study. The minimum and maximum observations are the minimum and maximum average value of the time-series for a region or property type in a quarter. The statistics were obtained after pooling all observations over the whole time-series. The period ranges from 1Q1988 to 4Q2003

Appendix B gives the weight for each region or property type for every quarter between 1Q1988 through 4Q2003. The weight for each region/property type depends on the number of cities and the market value (size of the real estate market times the price per square meter in US dollars). The weights change gradually through time as cities are added to the database and market values change; the number of cities included in the database appears to be large enough to avoid large fluctuations from adding cities. The region weights are most impacted by the increase in weight of Europe over the time period, as a result of including Central European cities in the database. The increasing number of European cities in the database is also the main reason for the decrease in relative weight of the U.S.

All results presented so far are in local currency. However, currency risk can have an impact on the diversification potential of international real estate investment (see Liu and Mei 1998). In order to measure the influence of currency risk, we have calculated the total return for each quarter between 1Q1988-4Q2003, to include the change in local currency versus the US dollar.

Methodology

Our objective is to determine which investment strategy - portfolio diversification by region or by property type - is more effective in reducing the volatility of a direct real estate portfolio. The model should therefore decompose the city/MSA direct real estate return into a geographic or property type effect.

To isolate the regional effect from property type factors it is crucial not only to separate the two influences on the return but also eliminate the interaction between

them. The goal is not reached when region indices are used as a proxy for region factors, and property type indices for property type factors. If the allocation of property type differs across regions, than the region indices contain a property type effect and the property type indices contain a regional effect. That is why we apply a multi-factor approach to city or MSA direct real estate returns. Region and property type effects can be more easily separated by using individual city or MSA returns rather than indices and by simultaneously estimating 'pure' factor returns through a regression technique. With this methodology, the region effect of for example Asia can be interpreted as the outperformance of a property type diversified Asian portfolio relative to the global portfolio. By 'property type diversified', we mean that the Asian portfolio has the same property type composition as the global return index. This is to compensate for the lack of industrial real estate data in our database for Asia. Similarly, for example, the residential effect is the outperformance of a geographically diversified residential portfolio relative to the global return index, this is to compensate for the lack of residential data in Australia, Europe, and the U.K.

This type of model is proposed for the global equity market in a paper by Heston and Rouwenhorst (1995) and later re-examined by Griffin and Karolyi (1998). The model is based on the assumption that the return on an individual asset depends on a common factor (the market movement) and loading factors. In their paper, this approach assumes that equity returns are a function of market movements and industry and country effects. If we replace the industry effect by property type effect we can assume that: the direct real estate return for a city or MSA i is the result of market movements, plus property type effects, and region effects.[2] Therefore, every return i should belong to a property type j and a region k.

$$R_{it} = \alpha_t + \beta_{jt} + \gamma_{kt} + e_{it} \tag{1}$$

where α is the common factor, β_j is the property type effect for property type j, γ_k is the region effect for region k and e_i is a city or MSA specific component of the return period t.

For each quarter we estimate α, β, and γ by running a cross-section regression of the total returns of 74 cities or MSAs in our data set on a set of property types and region dummies:

$$R_i = \alpha + \beta_1 P_{i1} + \ldots + \beta_4 P_{i4} + \gamma_1 G_{i1} + \ldots + \gamma_5 G_{i5} + e_i \tag{2}$$

where P_{ij}=1 if a city or MSA i belongs to property type j (otherwise zero), and G_{ik}=1 if a city or MSA belongs to geographic region k (otherwise zero). Running the cross-sectional analysis will result in a time-series for each of the estimated parameters for property type and region.

However, applying this model creates an identification problem because every return belongs to both a property type and a region. To solve this we could eliminate one property type dummy and one region dummy. The eliminated dummies would then become the benchmark. To avoid this interpretation problem of an arbitrary

[2] Property type effect and region effect are tested for listed property by Hamelink and Hoesli (2004).

benchmark, we can impose the constraint that, for a value weighted portfolio, the sum of the property type value weighted coefficients equals zero and the sum of the region value weighted coefficients equals zero, as proposed by Kennedy (1986).

$$\sum_{j=1}^{4} w_j \beta_j = 0 \tag{3a}$$

$$\sum_{k=1}^{5} v_k \gamma_k = 0 \tag{3b}$$

where w_j and v_k are value weighted (see Appendix B) by property type j and region k in the total aggregate portfolio. The least-square estimate of α is the return on the value-weighted total aggregate portfolio. With these constrains, a portfolio replicating a global index has zero exposure to the two factors. By construction, the common factor equals the global real estate index return.[3]

For every quarter we calculate the weighted least square (WLS) using Eq. 2 subject to restriction 3a and 3b. This will result in time-series of the intercepts and coefficients by property type and geographic region. Coefficient $\hat{\beta}$ estimates the 'pure' property type effect and coefficient $\hat{\gamma}$ measures the 'pure' region effect. The variation of the time-series indicates the better diversification strategy to reduce risk.

Results

Property Type and Region Effect

Table 2 shows the annualized mean and standard deviation in local currency by region and property type. The common factor is equal to the global index or equal to the average of all regions in Table 1. The mean for the individual regions indicates over or underperformance relative to the common factor or global index given a property type diversified portfolio for the 'pure' region effects and a regionally diversified portfolio for the 'pure' property type effects. For example, Asia has outperformed the common factor or market by 510 basis points during the selected period, given a diversified portfolio with the same property type allocation (see Appendix B) as the global portfolio. Since the common effect is the global total return performance, all regions except the U.S. outperform. Asia, Australia, Europe and the U.K. show a positive 'pure' effect, demonstrating that these regions, with the same allocation to property type as the global allocation, outperform the global total return. Residential real estate has the highest outperformance, followed by industrial, and retail, given the same regional allocation as the global portfolio. Only office real estate underperforms. By carrying out this analysis, we separate the region effect from the property type effect and eliminate their interaction.

[3] Griffin and Karolyi (1998) for further information.

Table 2 'Pure' effects in local currency

	Mean 'pure' effect	Standard deviation
Common Factor	9.3%	2.9%
Asia	5.1%	8.1%
Australia	0.3%	2.1%
Continental Europe	3.0%	3.3%
United Kingdom	2.0%	4.2%
United States	-2.3%	2.3%
Average Absolute Value	2.6%	4.0%
Industrial	1.1%	0.9%
Office	-1.9%	1.4%
Residential	2.2%	2.4%
Retail	0.4%	1.6%
Average Absolute Value	1.4%	1.6%

The table contains the results for the mean and variance by region and property type in local currency. Mean 'pure' effect and standard deviation are annualized

The results in Table 2 also show that the average absolute value for the regional effect is higher than the average absolute value for the property type effect, demonstrating that the average returns over this time period for the property type stay closer together than the average returns between regions. It appears that average regional effect volatility is more than twice the property type volatility. This shows that returns for regions are more volatile than returns for property types. It is clear that Asia has the highest variance and therefore has a big influence on portfolio diversification. However, excluding Asia from the average absolute value will lead to the same conclusion, because the average volatility of the remaining regions is still higher than the average volatility of the property types. The higher average absolute volatility of the region effects makes it a more important determinant of the variation in international returns.

Figure 1 shows the index of the common factor or global index for the total return in local currency and US dollars. The currency effect over the whole period is very small, with the exception of the period after the Asian crisis, when the global total return index in US dollars is below the global total return index in local currency.

Table 3 gives the results for the common factor, the mean 'pure' effect, and standard deviation in US dollars by region and property type. Converting the returns into US dollars reduces the outperformance of Asia and increases the outperformance of Australia, Continental Europe, and the U.K., relative to the global portfolio. Figure 1 shows the global total return index in local currency and after converting into US dollars. Converting to US dollars also increases the volatility of the common factor or global total return, as shown in Fig. 2 The increase in volatility of the global total return leads to an increase in volatility of the 'pure' effects, because the 'pure' effect is a relative measure to the global portfolio. The analysis of the returns in US dollars results in the same conclusion as the local currency analysis. International diversification has a larger influence on the overall variation of the portfolio than property type diversification.

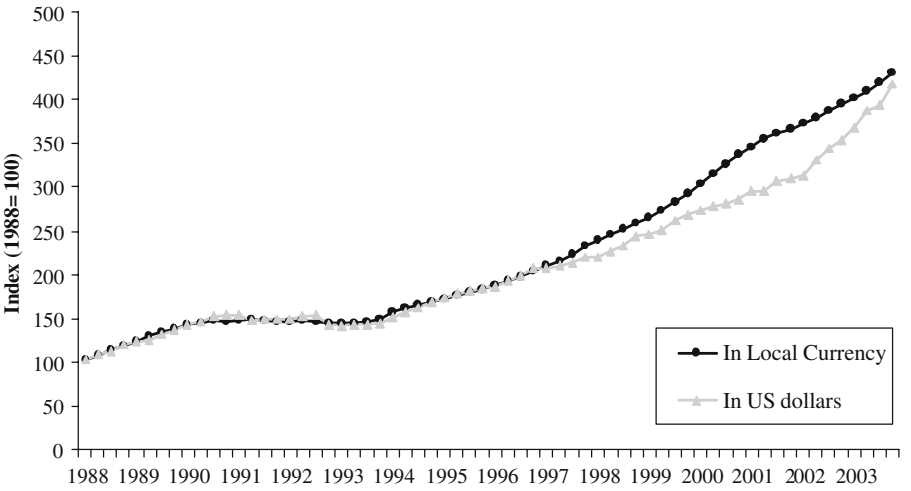


Fig. 1 Global total return index in local currency and US dollars. This figure shows the index of the common factor or global total return index, both in local currency and US dollars. The values of the indices are set equal to 100 in the base year

To analyze whether the importance of the pure effect for the regions changes over time, we calculate the moving average absolute return by property type and region relative to the sum of the absolute returns. Figure 3 shows that the region has the most influence on the return. However, the influence of the property type is higher in the last 2 years, when expressing the returns in local currency. Figure 4 analyzes the average standard deviation of the region versus the average standard deviation of the

Table 3 'Pure' effects in US dollars

	Mean'pure' effect	Standard deviation
Common Factor	9.1%	4.5%
Asia	2.1%	9.3%
Australia	1.1%	7.9%
Continental Europe	3.3%	6.7%
United Kingdom	2.2%	6.8%
United States	-2.2%	4.2%
Average Absolute Value	2.2%	7.0%
Industrial	1.1%	0.9%
Office	-1.9%	1.4%
Residential	2.1%	2.3%
Retail	0.4%	1.6%
Average Absolute Value	1.4%	1.6%

The table contains the results for the mean and variance by region and property type in US dollars. Mean 'pure' effect and standard deviation are annualized

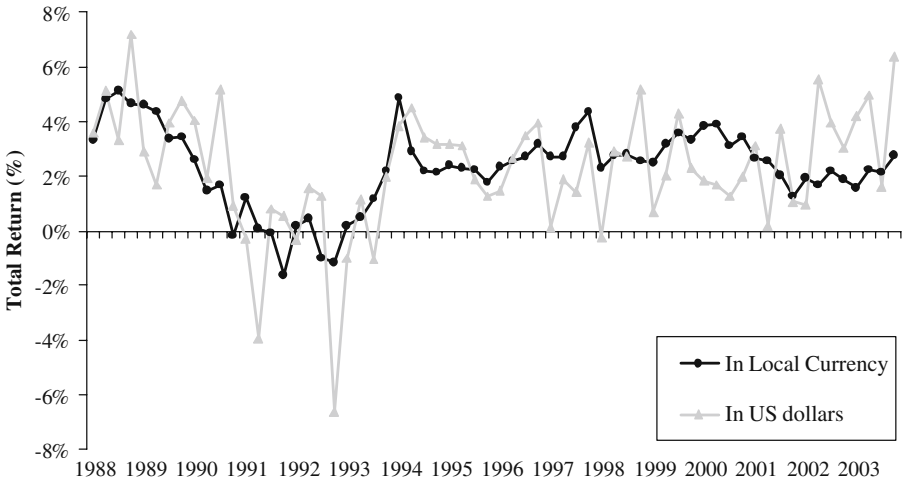


Fig. 2 Quarterly global total return in local currency and US dollars. This figure shows the quarterly common factor or global total return, both in local currency and US dollars

property type. We conclude that the average region standard deviation is higher than the property type standard deviation, for every time period. However, similarly to the absolute average return analysis, the average standard deviation for the property type effect becomes relatively more important in the most recent years, when expressed in local currency. Van Dijk and Keijzer (2004) find similar results for the equity markets. Over the period January 1987 through March 2002, they show that there is

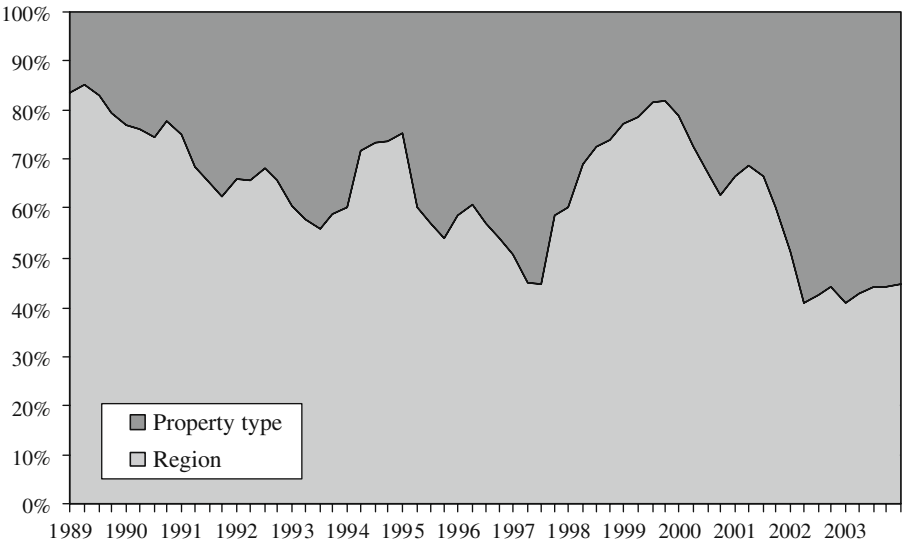


Fig. 3 Moving average absolute return. This figure shows the moving average 4 quarter absolute returns for the property types and region effect in local currency as a percentage of the sum of the absolute returns

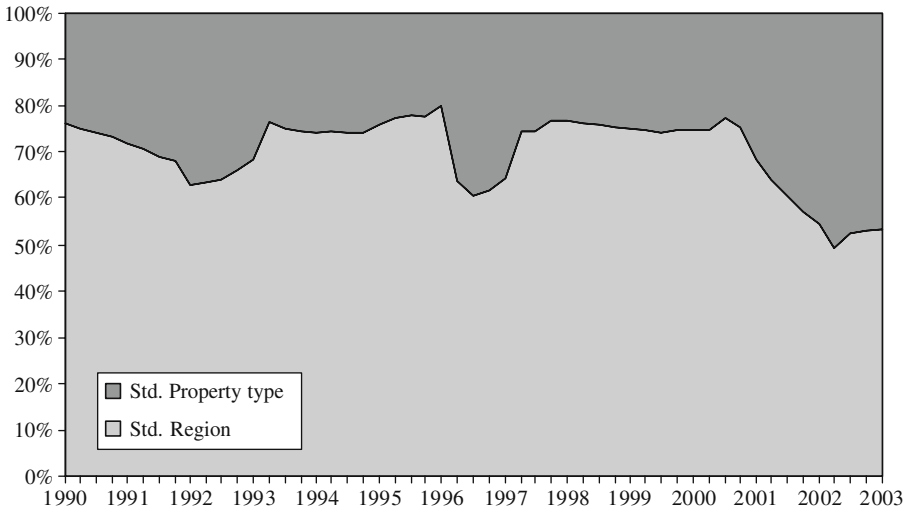


Fig. 4 Moving average standard deviation. This figure shows the moving average 12 quarter standard deviation for the property types and region effect in local currency as a percentage of the sum of the standard deviations

a shift in the relative importance from region to industry-sector effect. In the first half of the sample period, region allocation is most important. However, over the second half of the sample period the region allocation becomes less important, while the industry-sector allocation becomes the most important.

Table 4 gives the correlations between the common factor, the pure region effect, and the pure property type effect, in both local currency and US dollars. As expected, the correlation coefficients between the regions and property type are very

Table 4 Correlations between the common factor and mean 'pure' effects in local currency

	Common Factor	Asia	Australia	Europe	U.K.	U.S.	Industrial	Office	Residential
Asia	0.106	1							
Australia	-0.075	0.131	1						
Cont. Europe	0.177	-0.183	0.041	1					
U.K.	0.082	0.399[c]	0.275[a]	-0.112	1				
U.S.	-0.168	-0.758[c]	-0.250[a]	-0.354[c]	-0.544[c]	1			
Industrial	0.105	0.239[a]	0.178	0.153	-0.023	-0.228[a]	1		
Office	0.618[c]	-0.253[b]	-0.297[a]	0.149	-0.159	0.250[b]	0.108	1	
Residential	-0.629[c]	0.100	-0.079	-0.182	0.158	-0.127	-0.258[b]	-0.565[c]	1
Retail	-0.406[c]	0.124	0.218	-0.095	0.081	-0.111	-0.445[c]	-0.810[c]	0.184

This table contains correlations of the common factor, pure effect by region, and pure effect by property type in local currency between 1Q1988-4Q2003. The symbols [a, b, c] indicate that a correlation is significant from zero at the 10%, 5%, 1% levels, respectively

low and mostly not significant. This demonstrates the disentanglement of the region effect versus the property type effect when compared to the correlation coefficients of the region and property type indices. The correlation coefficients between the outperformance of regional effects and outperformance of property type effects are, as stated above, generally not significantly different from zero (with the exception of office and Asia, Australia, and the U.S. in local currency, and office and Asia in US dollars). Looking at the correlations between the pure region effects, the U.S. is significantly negatively different from the other regions, except for Continental Europe when expressed in local currency. Overall, we conclude from Table 4 that from a region perspective there are diversification benefits to be achieved because the correlation coefficients between the regions are not close to one. In the case of Continental Europe and the U.S. the correlation coefficients are in most cases negative. This would indicate that adding a region to an investment portfolio will reduce the risk more than the outperformance. Converting total returns in local currency to US dollars has less of an influence on the correlations between the pure effects of the property types. Industrial and office are both significantly negatively different from retail and residential (industrial and residential in US dollars are significantly different at a 10 percent level). This indicates that there is good diversification potential from adding industrial or office to a portfolio of residential or retail real estate.

Disentangling the Performance of the Region

The results of the models can be used to explain the performance of a region. The individual return by region on an equally weighted market of region k is the sum of three components: the common factor, the weighted average of the property type effect, and the region effect.

$$R_k^{ew} = \underbrace{\widehat{\alpha}}_{\text{Common effect}} + \underbrace{\sum_{j=1}^{4} x_{k,j}\widehat{\beta}_j P_{k,j}}_{\text{Property type effect}} + \underbrace{\widehat{\gamma}_k}_{\text{Region effect}}, \tag{4}$$

where $x_{k,j}$ is the weight of the property type in region k compared to the aggregate of the property type for all regions. All regions have the same common factor ($\widehat{\alpha}$); the difference between the performance of the regions is therefore the result of two effects: the property type effect and the region effect. The first factor is an adjustment for property types that are under-represented or not represented in the performance of a region. This under representation is the result of data, but also indicates the relative (in)activity of institutional investors in a certain property type. The attribution of the property type selection to the return performance is given in the second part of Eq. 4. For example, there is very little consistent data available for institutional residential real estate investment in Australia, Continental Europe, and the U.K. (this does not mean that this market is not important to institutional investors, but that they rely on local information for specific markets). As a result, there are no available observations in our database for residential real estate in Australia, Continental Europe, and the U.K. Therefore, property returns, in these

regions, do not reflect the performance of residential real estate and can be interpreted as a negative bet against residential real estate. The second driver of return is the regional effect, represented by the last term in Eq. 4. It measures the performance of cities/MSA in a region relative to cities/MSAs in other regions. It controls for the fact that a region is relatively over or under represented by a property type.

Tables 5 and 6 show the sum of the equally weighted performance of the regions in local currency and US dollars. Australia, Continental Europe, and the U.K. are negatively impacted because there is no residential data in the performance. For Australia, the property type effect is also negative because there is an under-allocation in the industrial sector, which has an outperforming property type effect.

Disentangling the Performance of the Property Type

To disentangle the performance for the individual property type on an equally weighted basis, we have to correct for the different weightings of property types within regions. The individual return by property type on an equally weighted market within property type j is the sum of three components: the common factor, the property type effect, and the weighted average region effect.

$$R_j^{ew} = \underbrace{\widehat{\alpha}}_{\text{Common effect}} + \underbrace{\widehat{\beta}_j}_{\text{Property type effect}} + \underbrace{\sum_{k=1}^{5} \phi_{j,k}\widehat{\gamma}_k G_{j,k}}_{\text{Region effect}} \tag{5}$$

where $\phi_{j,k}$ is the weight of the property type within a region compared to the aggregate of the property type for all regions. All property types have the same common effect. The property type effect is the pure property effect given in Tables 2 and 3. The region effect shows whether a region is under- or overweighted for a certain property type and the impact on the overall return for a property type.

Table 5 Component analysis for regional return in local currency

	Common effect	Property type effect	Region effect	Equally-weighted regional performance
Asia	9.3%	0.1%	5.1%	14.5%
Australia	9.3%	-0.6%	0.3%	9.0%
Continental Europe	9.3%	-0.4%	3.0%	11.9%
United Kingdom	9.3%	-0.5%	2.0%	10.8%
United States	9.3%	0.4%	-2.3%	7.4%

The table contains the results for the common effect, property type effect, and region effect by region. All effects are annualized

Table 6 Component analysis for regional return in US dollars

	Common effect	Property type effect	Region effect	Equally-weighted regional performance
Asia	9.1%	0.0%	2.1%	11.2%
Australia	9.1%	-0.6%	1.1%	9.6%
Continental Europe	9.1%	-0.4%	3.3%	12.0%
United Kingdom	9.1%	-0.5%	2.2%	10.8%
United States	9.1%	0.4%	-2.2%	7.3%

The table contains the results for the common effect, property type effect, and region effect by region. All effects are annualized

Tables 7 and 8 show the results for the equally weighted property type performance. The underweight of industrial in Asia has impacted the overall return for industrial in a negative way, because Asia was an outperforming region. The overweight of office in Asia was a positive bet and has a positive influence on the return. The underweight for residential in Continental Europe and the U.K. has a negative impact on the overall performance for residential, because Continental Europe and the U.K. have an above average performance. Retail seems to be more balanced with returns across all regions. Looking at the differences in performance between local currency and US dollars, we can see that the region effect for industrial and office becomes smaller. This is the result of a lower return for Asia when converting from local currency to US dollars. The performance of residential becomes more negative as the underweight is in regions (Continental Europe and the U.K.) with additional currency gains between 1983-2003.

Cumulative Effects

Figures 5 and 6 show the cumulative return of the 'pure' effect by region and property type. An index value of more than 100 in 4Q2003 indicates that

Table 7 Component analysis for property type return in local currency

	Common effect	Property type effect	Region effect	Equally-weighted property type performance
Industrial	9.3%	1.1%	-0.6%	9.8%
Office	9.3%	-1.9%	0.7%	8.1%
Residential	9.3%	2.2%	-0.8%	10.7%
Retail	9.3%	0.4%	-0.1%	9.6%

The table contains the results for the common effect, property type effect, region effect by property type. All effects are annualized

Table 8 Component analysis for property type return in US dollars

	Common effect	Property type effect	Region effect	Equally-weighted property type performance
Industrial	9.1%	1.1%	-0.1%	10.1%
Office	9.1%	-1.9%	0.5%	7.7%
Residential	9.1%	2.1%	-1.7%	9.5%
Retail	9.1%	0.4%	0.1%	9.6%

The table contains the results for the common effect, property type effect, region effect by property type. All effects are annualized

outperformance was achieved between 1Q1988-4Q2003 for the region with the same property type allocation as the global index. Similarly for the property type cumulative return indices, a value higher than 100 in 4Q2003 indicates outperformance. This represents the property type outperformance given a geographically diversified portfolio equal to the global portfolio. The differences across regions have a bigger impact on the return than the differences between property types, as the cumulative returns deviate much more between regions than between property types. The influence of the Asian crisis becomes apparent from Fig. 5.

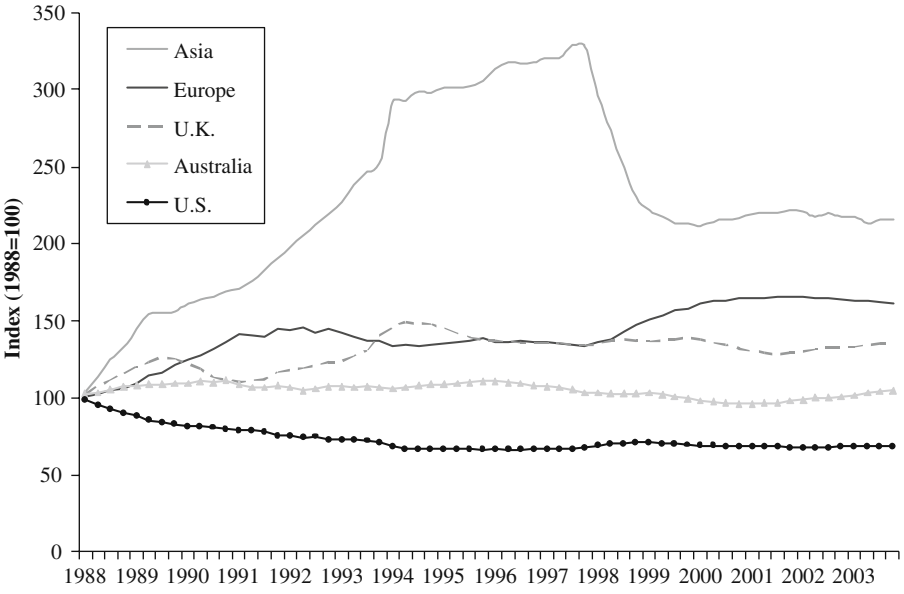


Fig. 5 Index of cumulative returns on the pure effect for the regions. This figure shows the index of cumulative returns on the pure effect for the regions in local currency. The values of the indices are set equal to 100 in the base year

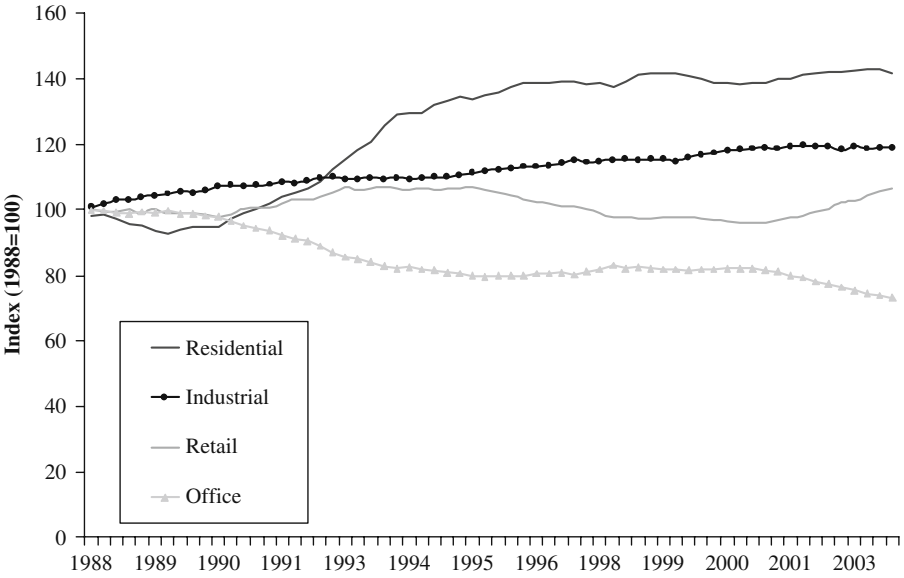


Fig. 6 Index of cumulative returns on the pure effect for the property types. This Figure shows the index of cumulative returns on the pure effect for the property types in local currency. The values of the indices are set equal to 100 in the base year

Conclusions

This paper examines whether investing across regions or property types can lead to higher diversification gains. To analyze this, we created a unique data set for direct real estate covering 25 countries in 5 regions for 4 different property types. Our study confirms the previous findings of Hamelink and Hoesli (2004) for listed real estate securities. They found that geographic factors still have the biggest influence on the volatility of international real estate security returns. The average variance of the regional effects is higher than that of the property type effects and therefore the regional effects have a bigger influence on the variation of the total portfolio. Because of the stronger influence on the total risk of the portfolio, investing in assets across regions will result in the highest diversification benefits. However, the regional effects are less stable through time, compared with the variance and correlation of the property type effects. Also the property type effect seems to become a more important factor for the return, especially when the return is expressed in local currency. This is similar to findings in the equity markets for this period, where the region allocation becomes less important and the industry-sector allocation becomes more important. With respect to the 'pure' factor for the region we conclude that over the time period 1Q1988-4Q2003 Asia, Australia, Continental Europe, and the U.K. outperform based on the same property type allocation as the global index. For the property type 'pure' factor we conclude that during the selected time period industrial, residential, and retail outperform given the regional allocation of the global index. The regional outperformance in particular depends on the selected time period and the impact of the Asian crisis.

Appendix A. Average total return analysis by city and property type.

Region/Country	City/MSA	Industrial			Office			Residential			Retail		
		Total Return	σ Total Return		Total Return	σ Total Return		Total Return	σ Total Return		Total Return	σ Total Return	
Asia													
China	Beijing				22.1%	20.1%	[48]	18.0%	17.9%	[56]	-1.2%	14.9%	[32]
	Shanghai				13.3%	19.9%	[41]	19.8%	19.9%	[40]	15.4%	17.0%	[40]
	Hong Kong				9.9%	19.9%	[64]	17.6%	19.6%	[64]	1.6%	13.9%	[24]
Indonesia	Jakarta				24.3%	27.3%	[64]	25.1%	27.2%	[28]	21.6%	29.4%	[44]
Japan	Tokyo				-6.8%	7.7%	[64]						
Malaysia	Kuala Lumpur				7.1%	4.1%	[48]	11.7%	7.1%	[48]	4.0%	11.6%	[24]
Philippines	Manila				3.3%	5.7%	[31]	0.4%	7.9%	[32]	4.5%	5.7%	[24]
Singapore	Singapore				1.0%	12.8%	[49]	10.2%	10.2%	[60]	1.6%	13.5%	[49]
Thailand	Bangkok				6.2%	10.4%	[40]	6.5%	5.5%	[44]	8.2%	13.7%	[36]
Australia													
Australia	Brisbane	12.3%	2.9%	[40]	6.5%	3.6%	[64]				10.7%	2.4%	[40]
	Canberra				8.0%	5.2%	[64]						
	Melbourne	12.1%	2.4%	[35]	5.2%	6.1%	[64]				11.0%	3.4%	[64]
	Perth				5.3%	7.3%	[64]				13.0%	4.0%	[64]
	Sydney	10.5%	4.6%	[64]	5.9%	6.8%	[64]				12.0%	3.3%	[64]
Continental Europe													
Belgium	Antwerp	12.1%	9.6%	[58]	10.7%	6.5%	[58]				11.2%	8.0%	[64]
	Brussels	11.5%	10.5%	[58]	10.4%	8.2%	[64]				11.7%	8.3%	[64]
Czech	Prague	15.0%	6.5%	[28]	8.4%	9.4%	[46]				22.5%	12.9%	[16]

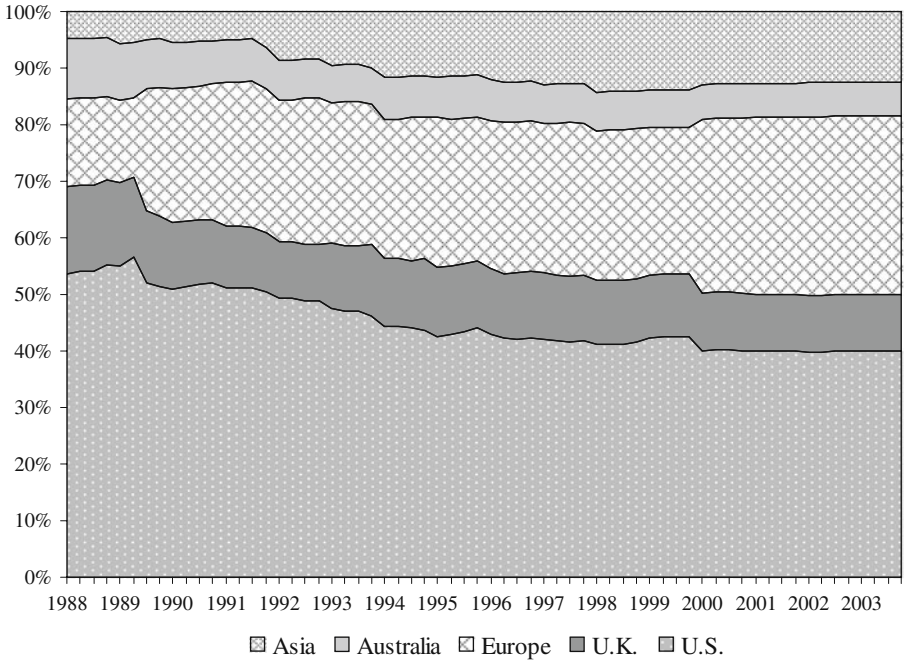
Region/Country	City/MSA	Industrial			Office			Residential			Retail		
		Total Return	σ Total Return		Total Return	σ Total Return		Total Return	σ Total Return		Total Return	σ Total Return	
Republic													
Denmark	Copenhagen	12.3%	6.6%	[12]	9.6%	3.7%	[16]				6.6%	8.1%	[16]
Finland	Helsinki	12.1%	9.7%	[16]	7.3%	7.4%	[16]				7.2%	6.8%	[16]
France	Lyon	16.0%	8.8%	[36]	10.3%	8.8%	[52]				30.7%	15.5%	[38]
	Paris	8.7%	10.5%	[58]	3.9%	10.0%	[54]				20.2%	13.1%	[38]
Germany	Berlin	5.6%	10.1%	[29]	2.0%	13.4%	[53]				7.2%	9.5%	[64]
	Frankfurt	7.5%	7.0%	[43]	7.5%	10.6%	[64]				7.3%	10.0%	[64]
	Munich	9.3%	6.7%	[16]	7.2%	9.6%	[64]				8.1%	10.5%	[64]
Hungary	Budapest	11.1%	8.9%	[26]	9.9%	8.5%	[46]				15.9%	6.5%	[8]
Ireland	Dublin	14.1%	10.2%	[56]	11.7%	12.0%	[57]				19.0%	12.4%	[16]
Italy	Milan	14.5%	10.6%	[36]	7.5%	11.4%	[52]				14.1%	9.2%	[32]
Luxembourg	Luxembourg	13.9%	7.2%	[50]	6.9%	8.5%	[52]				11.7%	6.9%	[16]
Netherlands	Amsterdam	13.5%	9.6%	[58]	11.8%	9.5%	[64]				13.0%	7.5%	[64]
	The Hague	10.7%	10.0%	[58]	9.6%	6.1%	[64]				9.8%	8.1%	[58]
Norway	Oslo	12.6%	10.3%	[13]	4.8%	17.5%	[16]				6.4%	6.2%	[16]
Poland	Warsaw	13.5%	13.4%	[31]	7.3%	9.5%	[31]				19.5%	10.6%	[16]
Spain	Barcelona	15.0%	14.3%	[58]	8.3%	14.0%	[56]				14.8%	16.2%	[57]
	Madrid	12.4%	10.1%	[58]	10.7%	18.1%	[64]				17.6%	14.9%	[64]
Sweden	Stockholm	12.8%	14.5%	[36]	14.8%	13.1%	[40]				-0.7%	8.9%	[15]
United Kingdom													
United Kingdom	Birmingham	10.2%	4.3%	[30]	10.4%	5.6%	[64]				12.1%	4.6%	[41]

	Bristol	12.4%	6.2%	[64]	11.4%	8.6%	[64]				9.5%	4.8%	[64]
	Edinburgh				10.0%	9.7%	[64]				9.6%	6.0%	[64]
	Leeds	14.7%	8.5%	[64]	11.1%	7.1%	[64]				11.9%	5.6%	[44]
	London	12.4%	5.5%	[64]	7.9%	6.6%	[64]				9.7%	4.4%	[64]
	Manchester	10.8%	3.3%	[37]	13.6%	7.7%	[64]				11.8%	5.1%	[44]
	Reading	7.9%	4.5%	[41]	6.3%	6.0%	[64]				11.2%	4.9%	[44]
United States													
United States	Atlanta	6.5%	4.1%	[64]	4.2%	5.7%	[64]	7.7%	4.5%	[64]	8.1%	3.7%	[64]
	Austin							8.0%	3.3%	[35]			
	Baltimore	9.7%	3.5%	[64]							5.7%	4.7%	[56]
	Boston	8.3%	6.0%	[64]	5.9%	8.6%	[64]	11.8%	5.7%	[53]	9.9%	3.6%	[38]
	Chicago	7.7%	3.3%	[64]	4.6%	6.5%	[64]	11.3%	3.2%	[35]	7.3%	3.5%	[64]
	Dallas	6.1%	3.9%	[64]	5.3%	6.2%	[64]	6.6%	4.2%	[64]	6.3%	4.7%	[64]
	Denver				4.2%	6.7%	[64]	13.0%	3.7%	[46]	6.0%	5.2%	[64]
	Fort Lauderdale							8.0%	3.3%	[59]			
	Houston				4.1%	6.8%	[64]	6.9%	5.0%	[64]	4.5%	8.1%	[64]
	Indianapolis	6.7%	3.1%	[53]									
	Las Vegas							7.6%	2.8%	[59]			
	Los Angeles	8.7%	5.0%	[64]	4.3%	6.4%	[64]	13.3%	4.4%	[23]	9.7%	5.8%	[64]
	Memphis	7.1%	4.5%	[64]									
	Miami				10.5%	4.1%	[33]				5.5%	3.8%	[21]
	Middlesex	6.2%	4.5%	[52]	8.7%	2.3%	[20]						
	Minneapolis	7.3%	4.1%	[64]	1.4%	6.3%	[64]				9.0%	2.7%	[33]
	New Haven				9.0%	16.5%	[54]						
	New York				6.4%	7.1%	[64]	8.0%	3.6%	[15]			
	Oakland	8.4%	6.0%	[64]	6.9%	6.8%	[64]				7.6%	3.6%	[64]
	Orange County	8.6%	5.5%	[64]	6.8%	8.9%	[64]				6.4%	5.3%	[59]

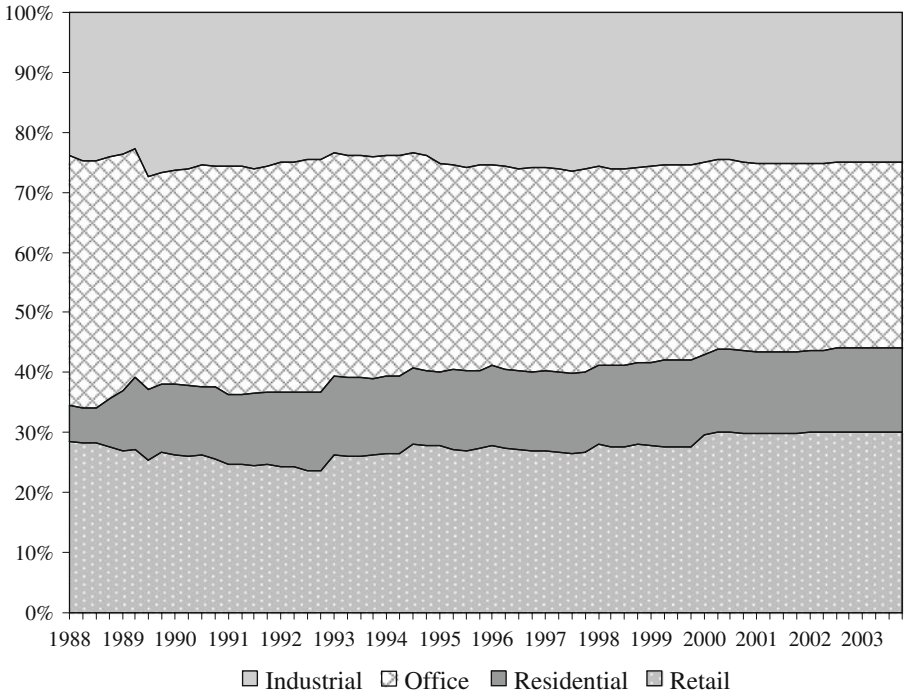
Region/Country	City/MSA	Industrial			Office			Residential			Retail		
		Total Return	σ Total Return		Total Return	σ Total Return		Total Return	σ Total Return		Total Return	σ Total Return	
	Orlando	7.4%	6.4%	[64]				7.6%	3.7%	[58]			
	Philadelphia							11.0%	7.5%	[60]	7.5%	5.3%	[44]
	Phoenix	6.3%	5.6%	[64]	8.8%	4.3%	[29]	9.0%	3.7%	[61]	8.4%	7.0%	[64]
	Portland	12.4%	3.5%	[34]									
	Riverside	8.7%	5.1%	[63]				17.0%	3.6%	[20]			
	San Antonio										11.3%	5.2%	[15]
	San Diego	8.5%	4.9%	[64]	6.4%	8.3%	[64]	15.0%	3.4%	[19]	6.8%	5.6%	[64]
	San Francisco				5.7%	8.2%	[64]	5.0%	1.5%	[6]	8.4%	5.4%	[54]
	San Jose	9.6%	8.8%	[64]	8.6%	11.9%	[55]				8.6%	6.5%	[64]
	Seattle	8.9%	3.2%	[64]	8.1%	8.1%	[56]	9.5%	4.8%	[61]	9.4%	3.7%	[57]
	Washington	8.0%	5.4%	[64]	7.1%	3.6%	[64]	10.1%	3.7%	[64]	7.1%	5.2%	[64]
	West Palm Beach							8.7%	3.3%	[50]			

This appendix shows the average annual total return in local currency and standard deviation for every city/MSA included in our database. If there is a value, it means that there is a time-series available, no value means no time-series included in the database. The number of available quarters is given in brackets.

Appendix B. Relative weight of regions and property type



This figure shows the relative weight of regions in the dataset between 1Q1988-4Q2003. The weight depends on the number of cities and the market value in US dollars.



This figure shows the relative weight of property types in the dataset between 1Q1988-4Q2003. The weight depends on the number of cities and the market value in US dollars.

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