"Diversification Opportunities from Real Estate Investments in Emerging Markets"

Master Thesis

Master of Business Economics

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Summer 2007

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Abstract

In my thesis, I have investigated whether international Real Estate investors can lower the risk of their portfolio through efficent cross-regional diversification in Emerging Markets. Even though Emerging market Real Estate securities underperformed Developed Market Real Estate securities over the course of the last 15 years, I find that investments in specific Emerging Markets yield small diversification opportunities for the international Real Estate investor. Through the analysis of the return distribution, the world and local market integrations and the cross-regional correlations, in my thesis, I investigate and quantify these opportunities.

I would like to thank Erasmo Giambona for being my supervisor from the FEE. I've worked on this thesis during an internship at Kempen & Co, and I enjoyed access to the *Global Property Research* database. I would like to thank Jeroen Vreeker and Bart Bal for all their help and nice Bassie and Adriaan tunes they played for me. Furthermore, I would like to thank Robert Woerdeman for his input and finally Dick Boer, who was kind enough to take me in at Kempen & Co.

Adriaan van Gerrevink,
June 2007

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1. Introduction

In my thesis, I estimate and quantify the diversification opportunities for the Developed market Real Estate investor in Emerging markets.

Many other studies have focussed on this specific subject in recent years. Most of these studies have included all Real Estate related companies in their dataset. The inclusion of development companies, and hybrids[1] results in biased conclusions and no interference can be drawn with respect to the real RE return distribution.

During an internship at Kempen & Co, a Dutch Merchant bank, I had access to the research database of *Global Property Research*. This subsidiary of Kempen & Co builts and maintains a database of all Real Estate companies worldwide. Through the analysis of the constituents of their indices, which I enjoyed exclusive access to and which fulfill strict requirements in terms of free float, market capitalization and turnover derivation, I was able to identifie, for each of the regions in this thesis, which companies are true Real Estate investors. This resulted in a dataset that matches the performance of Real Estate in EM as closely as possible. Development companies as well as hybrids have been omitted from the dataset, where other studies include these companies. These companies show a very differen risk and return structure than pure investors, and should therefore not be part of this study. I believe my results are "cleaner" and more accurate than previous studies, at least in terms of Real Estate returns.

First, I have examined the shape and size of the return distributions and measured liquidity, risk and performance. Even though most EM have underperformed the DM in terms of Sharpe Ratio, I find low correlations between the DM and EM. This could indicate that higher portfolio efficiency can be achieved for a DM RE investor.

[1] Companies like Rodamco Europe for instance, which derive turnover from both development activities as well as rental income

Next, I estimated the diversification potential through some simple regressions, measuring Real Estate market integrations, the integration of equity markets and the integration of local Real Estate markets with world equity markets. I find strong equity market integration, and much smaller integration when it comes to Real Estate markets.

Furthermore, I find deviations from normality in the data, and therefore I employ an alteration to the standard Value at Risk measure, the *Modified VaR*$_s$ for the risk assesment in my thesis. This measure accounts for Skewness and Kurtosis in the data. Minimizing the portfolio MvaR has resulted in smaller diversification opportunities in EM than expected beforehand. However, for any US, UK or Eurozone investor, I show that an improvement in both the Modified Sharpe Ratio and the portfolio risk can be obtained.

In my thesis, I answer the following research question:

"Do Real Estate investments in Emerging markets offer significant diversification opportunities for international RE investors?"

In order to be able to answer this question, I have identified a number of sub questions

How predictable are the returns in emerging markets?
What does the risk-return structure in emerging markets look like?
How can we measure the risk and return structure in emerging markets?
What are the cross-regional correlations of returns, and how do they evolve over time?
How integrated are world equity and Real Estate markets?

Rationale

The Real Estate asset class is becoming increasingly popular among international and institutional investors. Over the last decade, the market capitalization of equities in emerging markets has risen considerably. Amounting less than USD 2 trillion in 1995,

the capitalization is currently exceeding USD 5 trillion.[2] Real Estate securities are gaining interest as well, as the total market capitalisation of developers and pure investors is rapidly rising in recent years. Several characteristics of listed Real Estate securities attribute to the success of these companies, including RE liquidity and limited liability.

Real Estate is viewed as a highly local investment class. As the buildings and land are unmovable, traditionally, extensive local knowledge was the key for success in any RE investment. In the process of globalization in the 1990's, the RE asset class was mostly ignored as part of the worldwide integration of equity and bond markets. However, with the abundance of investment flows worldwide, the increased securitization of RE investment companies, the development of financial instruments and more efficient lending has improved the efficiency of the asset class dramatically.

With the opening up of many formerly closed and restricted economies, investors are now pursuing the cross-border opportunities in RE as well. Furthermore, liberalization of taxations and the stronger enforcement of property and ownership rights in developing economies have entailed stronger investor activity in RE markets globally.

The globalization has an important impact on the demand side as well. Multinational companies, expanding activities worldwide, seek high quality office space across the globe, and consequently, entail construction activity as well as investor interest wherever the companies move. The bull market worldwide at the beginning of the 21st century is continuously sustaining demand for RE.

This globalization rally has enabled international RE investors to diversify not only between asset classes, but geographically as well. Controlling for risk is therefore an important issue in the international RE investment world.

Outlook

This thesis is organized as follows; chapter 2, offers an overview of the recent literature covering the diversification issues, the shape of the return distributions of Real Estate

[2] Standard & Poor's Global Stock Markets Factbook 2005

stocks and a description of current portfolio optimization discussions. Chapter 3 offers an overview of the data and the preliminary results. Chapter 4, presents the methodology for the model building and data selection process for the empirical work in this thesis. Chapter 5 depicts the performance analysis and efficient frontiers for the international RE portfolios. Finally, chapter 6, summarizes and concludes my thesis.

2. Literature Review

The diversification potential op Real Estate in mixed asset portfolios is widely documented. Research has focussed only to a smaller extent on specific Real Estate investments. Some research focuses on the inflation hedging characteristics of Real Estate; others study the correlation of Real Estate investments with equity and fixed income investments. In this chapter, I offer an overview of recent work in this field.

2.1 Emerging markets

An emerging market (EM) is characterized as a country that is restructuring the economy, and has experienced a critical transition from a developing country to an emerging market. Moreover, these economies are in the transition of being a closed to an open economy. An emerging market economy is defined by the International Finance Corporation (IFC) as an economy with low-to-middle per capita income[3]. Currently, according to the World Bank the largest EM markets include China, India, Indonesia, Brazil and Russia.[4]

Harvey (1995)[5] states that equity markets in emerging economies are historically characterized by high average returns and large volatility. Many of these countries are removing protectionist measures and are in the process of (partial) liberalization of markets. Barry et al (1996)[6] suggest that the high population density in combination with high GDP growth rates will provide strong potential for Real Estate investments in these countries.

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[3] Such countries constitute almost 80% of the global population, and represent about 20% of the world's GDP
[4] Other markets included in the Emerging Market Database (EMDB) are Argentina, Chile, Colombia, Mexico, Peru, and Venezuela, South-Korea, Philippines, Taiwan, Malaysia, Pakistan, Sri Lanka, Thailand, Egypt, Israel, Jordan, Morocco, Nigeria, Portugal, Saudi Arabia, Turkey, South-Africa, Zimbabwe and the Central and Eastern European region
[5] "Predictable Risk and Returns in emerging markets"
[6] "Diversification Potential from Real Estate Companies in Emerging Capital Markets" pp 108

Risk in Emerging Markets

Emerging markets (EM) are typically characterized by different risks than Developed Markets (DM). The lack of transparency, the lack of strong property rights, and the liquidity risk are some factors that are commonly associated with investments in EM.

The risk of EM countries is strongly reflected by the high volatility of the stock markets. If markets are fully integrated, volatility is expected to be influenced by world factors, mostly. Bekaert and Harvey (1997)[7] show that volatility is significantly higher in EM than in DM, and that liberalization of the markets reduces volatility, and thus risk.[8]

The diversification benefits occur when markets are less integrated. Harvey (1995) expects emerging markets to be less integrated into world markets, where Real Estate markets are less integrated than equity markets.

Indirect Real Estate investments

The performance of Real Estate is reflected by the returns on direct Real Estate and to a smaller extent by indirect Real Estate returns. However, due to data availability, in academic research, the returns of listed property investment companies are broadly used to evaluate the performance of Real Estate.

Although many academics make use of RE securities to track the performance of RE in a particular region, most studies do not differentiate between development companies, hybrids and pure RE investment companies. Development companies typically show different risk and return characteristics than investment companies, and the latter most closely match the returns of RE. Therefore, some studies employ data from the *Global Property Research* (GPR) database, which exclude property developers and hybrids. Hamelink and Hoesli (2002)[9] use GPR data, as does Eichholtz (1996)[10].

[7] "Emerging equity market volatility"
[8] pp 68
[9] "What Factors Determine International Real Estate Returns"
[10] "Does International Diversification Work Better for Real Estate than for Stocks and Bonds?"

International diversification benefits

At the end of the 1980s, some early research was conducted in the field of international diversification of Real Estate holdings. With the increasing securitization of Real Estate in recent years, more and more studies have focussed on the issue.

Harvey (1995)[11] concentrated on emerging equity markets in his research, and found low correlations with developed equity markets, and concluded that inclusion of emerging markets assets in a mean-variance efficient portfolio could lower volatility and increase the expected return dramatically.

Eichholtz (1996) found that international diversification improves the efficiency of a Real Estate portfolio more than a portfolio of equities or fixed income securities, opting that this is caused by the fact that local factors have stronger influence on the returns of Real Estate securities than on equities or fixed income securities returns.

In contrast, Stevenson (2000)[12] casts doubts on the benefits of holding international RE portfolios. Stevenson examined the potential benefits of international property diversification on both a hedged and an unhedged basis. He used securitised real estate data from 1978 to 1997 across ten countries. The data were obtained from Datastream (with the exception of the US data series, which was the NAREIT index). In contrast to the findings of Eichholtz (1996), Stevenson could not find evidence to support the view that international diversification in real estate stocks provided enhanced benefits in a mixed asset portfolio.

Conover et al (2002)[13] examine the fact that international equity diversification yields less and less possibilities of improving the mean-variance efficiency of a portfolio. In their opinion, this could be the result of integrating international stock markets, where arbitrageurs ensure that similar risk is rewarded the same way. They suggest that this is (less) not the case for Real Estate because strong segmentation in Real Estate markets

[11] pp 773, pp 811
[12] "International Real Estate Diversification: Empirical Tests using Hedged Indices"
[13] "Diversification benefits from foreign Real Estate Investments" pp 18

persists. If true, the addition of foreign Real Estate stocks could enhance the mean-variance efficiency of a portfolio.

Diversification benefits in Emerging markets

Barry et al (1996) analyzed the effect of adding EM RE to a portfolio, in terms minimum variance efficiency. Adding some EM Real Estate to any Real Estate portfolio should reduce the risk of that portfolio in any case. The minimum variance portfolio would require 11% allocation to EM Real Estate. Their results were corrupted due to the lack of data, but offered some guidance for further research.

A few years later, Lu and Mei (1999)[14] found some diversification benefits from emerging market property stocks, but also concluded that these investments were more volatile than the market indices in the country and the US NAREIT index over the same period. Although the diversification benefits are substantial, they found unfavourable correlations during a downfall of the US NAREIT index, i.e. higher correlations during times of market volatility, between the emerging market property indices and the US NAREIT index, meaning that the diversification potential vanished when it was needed the most.

Barry et al (2004)[15], note that little is known about the benefits of investing in emerging markets. They found that RE investments in emerging markets could provide substantial diversification benefits for both equity investors in emerging markets as well as equity and RE investors in developed markets.

Return distributions and Emerging Market characteristics

Two typical measures for non-normality are discussed in this paragraph i.e. Skewness and Kurtosis. Skewness is the measure of (a)symmetry. Positive skewness would indicate higher than average return (and vice versa), compared to a standard normal distribution, and a distribution is said to be *skewed right of the mean* (and vice versa).

[14] "The return distribution of property shares in emerging markets" pp 145
[15] "Risk and return characteristics of property indices in emerging markets" pp 131

Kurtosis captures the degree of 'fat-tails' in a distribution. Alternatively, Kurtosis captures the excess probability of abnormal positive or negative returns. Positive kurtosis indicates a 'peaked' distribution and negative kurtosis indicates a 'flat' distribution.

The need to test for normality is emphasized by the results from Lu and Mei (1999). Through the use of the Anderson-Darling test for normality, they conclude that 4 out of 10 emerging property indices where not normally distributed over the time period examined. Furthermore, they calculated the Skewness and Kurtosis of the returns on the indices, and analyzed the skewness and kurtosis of the data, and found most indices to have positive skewness and kurtosis.

If the returns are normally distributed, the skewness coefficient is close to 0 and the kurtosis coefficients should be close to 3. A typical test to evaluate normality besides the Anderson test is the Berra-Jarque test.

Meyer and Webb (1992)[16] examined the normality, Skewness, Kurtosis and autocorrelation function of REITs. They conclude that most Real Estate indices have "fat tails" and are significantly skewed. They reject the null hypothesis for normality, depending on the test, for all indices.

Young and Graff (1995)[17] analyzed the normality of the Russel-NCREIF combined data base, during the 1980-1992 period. They did not find any of the annual property returns to be normally distributed at any point in time. Moreover, they showed that in every case, the returns were more peaked near the mean than the corresponding normal distribution, that the returns were leptokurtic (i.e. a kurtosis of more than 3) and were negatively skewed.

Equation 1 and 2 show how the skewness and excess kurtosis are computed.

[16] "Return Properties of Equity REITs, Common Stocks and Commercial Real Estate: A comparison." pp 94
[17] "Real estate is not normal: A fresh look at real estate return distributions"

$$S = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{R_t - \overline{R}}{\sigma}\right)^3 \quad (1)$$

$$K = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{R_t - \overline{R}}{\sigma}\right)^4 - 3 \quad (2)$$

Predictability and autocorrelation

A number of studies have focussed on the predictability of returns in emerging markets. Young and Graff (1995)[18] and Harvey (1995) conclude that returns are heteroscedasctic in EM. Harvey also shows that the first-order autocorrelation function for equity returns are higher for the EM than for the DM. He found that 12 out of 20 EM to have autocorrelation coefficients higher than 10%, and 8 of the 20 EM even showed autocorrelation coefficients higher than 20%. Autocorrelations coefficients for DM were less than 1%.

Bekaert and Harvey (1997)[19] find no less than 4 distinguished differences between EM and DM equity returns. Higher sample average returns, low correlations with DM, more predictable returns and higher volatility. Furthermore, they investigate models that specifically account for leptokurtosis and skewness.

2.2 Diversification measurement

The diversification potential is evaluated traditionally through the Markowitz methodology of portfolio optimization. This paragraph offers an overview of the discussion of the Modern Portfolio Theory in the current literature.

Modern portfolio theory

Efficient diversification is traditionally measured through mean-variance portfolio allocation methodologies, commonly known as the Markowitz portfolio selection model.

[18] pp 235
[19] "Emerging equity market volatility" pp 30

In his Nobel price winning paper, Markowitz (1953)[20] first assumed investors want to minimize risk for a certain expected return and vice versa. This results in an efficient frontier, on which lie all the efficient portfolio allocations. Bodie, Kane and Marcus (2005) [21] offer an excellent review of the portfolio selection model.

The risk and return opportunities available to the investor have to be identified first. Once the portfolio is identified and the individual returns are computed, the portfolio return can be calculated from the following formula:

$$E(r_p) = \sum_{i=1}^{n} w_i E(r_i) \qquad (3)$$

The following formula for the portfolio variance:

$$\sigma_P^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_i w_j Cov(r_i r_j) \qquad (4)$$

Where $E(r_p)$ is the expected return of the portfolio, $E(r_i)$ the expected return of the individual stock, and w_i the weight of the individual stock in the portfolio. σ_P^2 equals the portfolio variance, and $Cov(r_i r_j)$ the covariance between the individual stocks (i and j).

In order to achieve a portfolio that lies on the efficient frontier, formula 4 is subject to a typical optimization problem. Lu and Mei (1998)[22] found proof that international Real Estate investments should be added to any portfolio of stocks and bonds.

Modern Portfolio theory issues

The MPT framework assumes that security returns are normally distributed. As described before, academic research has shown that this is not the case for Real Estate

[20] "Harry Markowitz, Portfolio Selection: Efficient Diversification of Investments"
[21] "Investments" 2005 pp 240-241
[22] Lu and Mei calculate efficient frontiers to see whether the inclusion of Real Estate in a mixed asset portfolio of bonds and other equities improves the risk-return characteristics of the portfolio

return distributions. Analogically, higher moments are not accounted for in the MPT framework. Young and Graff (1995)[23] conclude that MPT is not applicable in the current form to Real Estate returns. Furthermore, MPT assumes investors are equally averse to deviations above the mean, which entail gains to the investors, as they are to deviations below the mean, which entail losses. However, many academic researchers still use the MPT framework, even though it is flawed, because of the lack of better easy to interpret alternatives. In recent years, an alternative has gained much popularity: the Value at Risk measure.

Value at Risk and Cornish-Fisher expansion

In recent years, many practioners as well as academics have advocated the use of a different risk measure; Value at Risk instead of the traditional volatility measure for risk. Please find a brief overview of Value at Risk below.

Value at Risk (VaR) has been advocated by professionals because it takes into account the potential loss from extreme negative returns. The popularity of VaR really took off when J.P. Morgan released the RiskMetrics in October 1994. Regulators have started to allow the use of VaR for banks and other financial institutions in recent years.[24]

The traditional VaR approach still assumes a normal distribution. Equation 5 shows how the normal VaR is derived.

$$\Im_{normal} = \mu + z(\alpha)\sigma \qquad (5)$$

Where $\Im_{normal}$ is the VaR, μ and σ are the sample mean and standard deviation respectively and $z(\alpha)$ is the critical value from the normal distribution.

[23] pp 255

[24] The Basle Committee on Banking Supervision and the Federal Reserve decided January 1998 that banks could use the VaR measure to calculate the capital reserves necessary to cover their market risk exposure (Lee 2007)

Lee (2007)[25] explains that the normal VaR isn't applicable when data are skewed and show fat-tails. The Modified VaR (MVaR), based on a Cornish-Fisher expansion specifically accounts for skewness and Kurtosis. Equation 6 shows how it is derived.

$$\Im_{CF}(\alpha) = \mu + \Omega(\alpha)\sigma \qquad (6a)$$

Where $\Omega(\alpha)$

$$\Omega(\alpha) = z_c + \frac{1}{6}(z_c^2 - 1)S + \frac{1}{24}(z_c^3 - 3z_c)K - \frac{1}{36}(2z_c^3 - 5z_c)S^2 \qquad (6b)$$

Where S is the asset skewness, K is the asset kurtosis and z_c is the number of standard deviations at the VaR probability.

Lee sees at least 3 advantages of the VaR incorporating the CF expansion. Firstly, it is based on a realistic view of risk, as sharp downfalls are accounted for, and secondly it accounts for the extreme outcomes from data that are non-normally distributed. Finally, it provides an easy analytical formula for portfolio optimization. For this study, I will employ the MVAR, because it is highly applicable to the portfolio optimization and diversification issue presented in chapter 1.

2.3 Asset pricing and portfolio efficiency

Real Estate is generally believed to have a strong local character. Therefore, many academic papers expect opportunities to emerge from international diversification in RE. Barry et al (2004)[26] show that the average correlation between DM and EM Real Estate indices are significantly lower than the correlation between DM and world RE. Furthermore, they show that EM RE indices have lower correlation with BMI world equity indices. They conclude that diversification opportunities are strong for a DM RE investor.

[25] "Modified VaR and the Allocation to Real Estate in the Mixed-asset Portfolio"
[26] pp 152

Traditional portfolio optimization would yield the minimization of equation (7):

$$MIN\sigma_p = \sqrt{\sigma_P^2} \tag{7}$$

However, equation (7) only includes the traditional standard deviation. Including MVAR in equation (7) yields:

$$MinMVaR = \mu_p + \Omega(\alpha)\sigma_p \tag{8}$$

Where μ_p is the return of the portfolio, and $\Omega(\alpha)$ comes from equation (6b).

Lee (2007) notes that the efficient frontiers that can be drawn from both equation (7) and (8) and the portfolios derived consequently are difficult to compare because they are based upon different risk criteria.

Portfolio performance measurement

The Sharpe ratio ranks the risk/reward characteristics of a portfolio. If a particular portfolio has a higher Sharpe ratio than the benchmark, it is said to outperform the benchmark.

$$SI_p = \frac{(R_p - R_f)}{\sigma_p} \tag{9}$$

Where SI_p is Sharpe ratio for portfolio p, R_p the return on portfolio p, R_f the return on the risk free asset and σ_p the standard deviation.

The modified Sharpe ratio in equation 10 measures the performance in a VaR environment.

$$MS_p = \frac{(R_p - R_f)}{\left|MVAR_p\right|} \tag{10}$$

Where MS_p is the modified Sharpe ratio and $\left|MVAR_p\right|$ is the absolute value of the modified VaR.

Jensen's Alpha measures the abnormal return of a particular asset. Through a simple regression, the performance of a portfolio can be compared to the benchmark.

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_P (R_{Mt} - R_{Ft}) + \varepsilon_{Pt} \tag{11}$$

Where R_{Pt} is the return on the portfolio at time t, R_{Mt} the return on the market portfolio, β_P the sensitivity to the market portfolio and ε_{Pt} the mean zero random error Significant intercepts α would indicate outperformance (or underperformance) of a given portfolio, depending on the sign.

3. Data overview and preliminary results

In chapter 3, I will make a first comparison between EM and DM property securities. In this chapter, I provide summery statistics including market capitalizations and liquidity, I will describe the probability and autocorrelation functions of the dataset, including measures for skewness and kurtosis. The performance is measured through the geometric mean, the standard deviation, the MVaR, Sharpe ratio and the Modified Sharpe Ratio. In conclusion of this chapter, I provide correlation coefficients for the property indices.

3.1 Data characteristics

The dataset consist of 78 publicly listed Real Estate securities with various Emerging Markets investment focus. The main contribution of this dataset is that I have constructed custom indices from the GPR database, which exclude non-investment companies. This results in a much cleaner dataset and hasn't been done before. I strongly favour this approach, where I have consciously chosen a strict selection process for the data. This resulted in a smaller dataset than previous studies.

Table 3.1 provides basic descriptors for the property funds in the dataset. The focus on international Real Estate markets in recent years becomes apparent as the number of funds increases dramatically in recent years. A possible explanation for this is the opening of communist countries Real Estate markets (i.e. China), the renewed trust in Central and Eastern Asia (i.e. after the Asia crisis in 1997) and the overall opportunities and money flows into the Real Estate asset class as a whole. Furthermore, as I left out developers and hybrid Real Estate companies, the lack of listed investment companies in the Middle East and South America is eminent. An explanation for this is that developers still dominate these markets and tax structures are less stringent in these regions when it comes to developers and investors in Real Estate. The opposite is currently taking place in continental Europe, as policymakers are expected to loosen tax exemption criteria for property investors over the next few years.

Table 3.1 also shows how the average market capitalization of property companies has changed over the entire period. A strong rise in recent years is clearly supporting the idea that EM Real Estate is becoming more and more attractive to investors. Total market value of listed property securities investing in EM was USD 6.8bn in May 1992, reaching USD 20bn in the same month in 2007. Furthermore, in recent years many UK listed funds have emerged.

Finally, table 3.1 provides liquidity ratios[27] for the EM securities. Asia shows particularly low liquidity of 3.72% in the first period, and even lower in the second and third period (1.46% and 2.97%).

The Chinese liquidity is unexpectedly high, especially in the first period (16.49%). Liquidity drops in the second and third period, but settles around 9%, which would indicate the Hong Kong stock exchange is quite liquid for RE stocks.

The liquidity for CEE was extremely low in the first period. In latter periods the liquidity for CEE strongly rises, from less than 0.5% in the first period to 32.83% in the second period before settling at around 20% in the final period. This could be a result of the UK listings being more liquid stocks investing in CEE, but certainly has to do with the lack of companies in the first period (as only 1 company was included in the index).

Both South Africa and the Americas show very low trading activity, with liquidity ratios ranging from 0.67% to 3.85% over the three periods. This is typically what you would expect for RE in EM.

DM data are hard to obtain, because the index constituents change over time. However, liquidity ratios of 9.65%, 7.32% and 6.52% over the entire period indicate higher liquidity (on average) than in EM.

[27] There are many approximations for liquidity in the academic literature. In this case, liquidity is calculated by simply multiplying the monthly trading volume by the price of the stock.

Table 3.1: Data overview

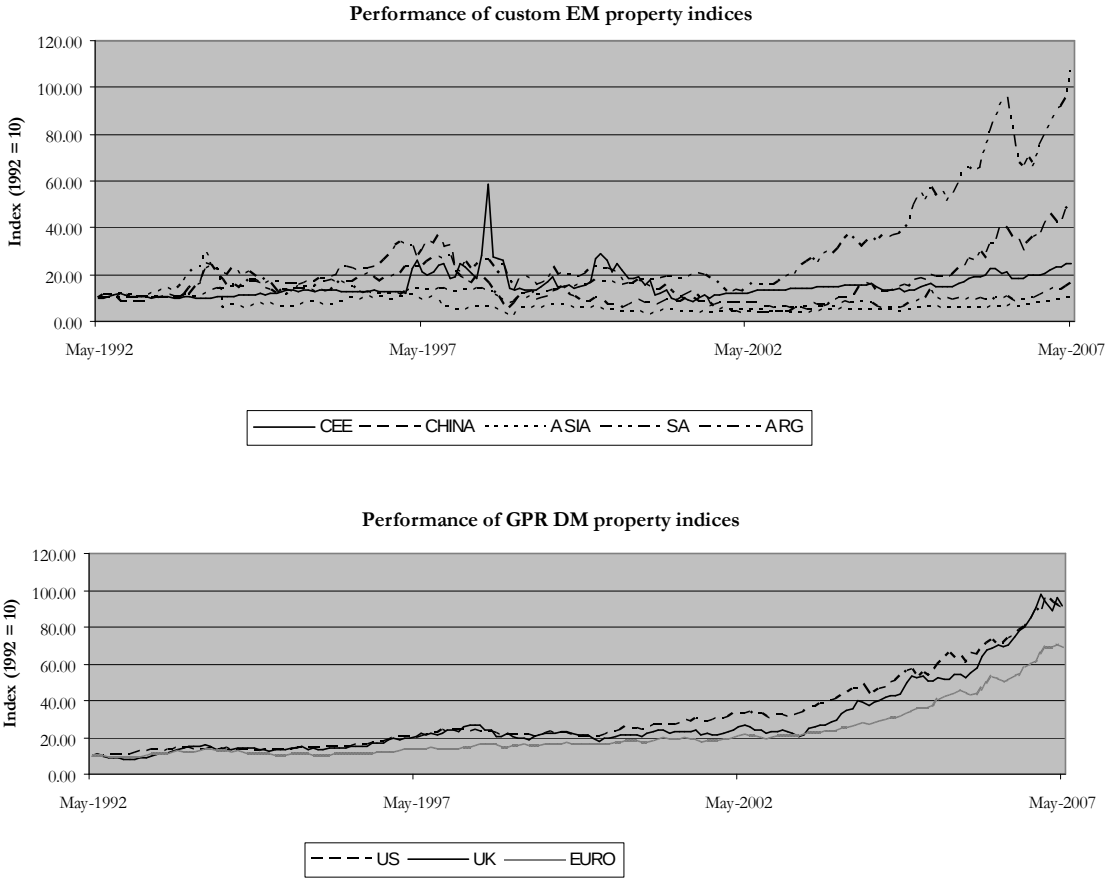
Country Listing	Region focus	Current number of listings	Latest Market Capitalization USDm	Average Market capitalization USDm 1992-2007	Average Market capitalization USDm 1992-1997	Average Market capitalization USDm 1997-2002	Average Market capitalization USDm 2002-2007
Malysia	Asia	11	362		476	162	116
Philippines	Asia	2	3,189		2,644	1,887	1,544
Singapore	Asia	1	100		0	0	88
Thailand	Asia	1	317		0	0	104
UK	Asia	1	114		0	0	28
Argentina	Americas	1	947		214	452	340
Austria	CEE	4	5,099		201	229	1,170
France	CEE	1	1,440		0	41	382
Poland	CEE	1	3,889		0	0	886
Turkey	CEE	9	138		2	47	78
UK	CEE	10	407		0	52	87
Hong Kong	China	17	3,188		495	428	845
China	China	1	312		0	130	159
Singapore	China	1	103		0	0	101
South Africa	S-A	17	607		61	60	243
North America	GPR 250 USA	95	3,101	105,624	21,298	90,697	204,273
UK	GPR 250 UK	23	3,516	28,618	15,813	26,358	43,665
Continental Europe	GPR 250 Euro	35	2,637	24,550	17,483	16,754	39,219

		Current number of listings	Latest Market Capitalization USDm	Average Market capitalization USDm 1992-2007	Average monthly Liquidity 1992-2007	Average monthly Liquidity 1997-2002	Average monthly Liquidity 2002-2007
	Asia	16	4,082	470	3.72%	1.46%	2.97%
	Americas	1	947	335	3.85%	2.77%	0.67%
	CEE	25	10,973	212	0.35%	32.83%	19.80%
	China	19	3,603	240	16.49%	8.36%	9.68%
	South Africa	17	607	121	0.72%	1.69%	2.94%
Total		78	20,213	1,378			
Average EM			4,043	276	5.03%	9.42%	7.21%
Median EM			3,603	240	3.72%	2.77%	2.97%
					DM market liquidity 1992-2007		
	GPR 250 USA				9.65%		
	GPR 250 UK				7.32%		
	GPR 250 Euro				6.52%		

All data are in USD and are extracted from datastream except the GPR indices data, which come from the GPR database. The liquidity ratio is calculated by dividing the average monthly liquidity by the average monthly market capitalization (USD). Please find in the appendix a detailed list of companies included in the indices.

Monthly return analysis

Figure 3.1 and figure 3.2 show the total return indices for each of the EM regions and the three DM regions. Over the course of the years, the South African index has outperformed all other indices in terms of total return.



Figures 3.1 and 3.2 Results for my custom EM indices and GPR DM indices are plotted. Index is 10 at base date 01/05/1992

Table 3.2 summarizes the average monthly USD returns and standard deviations for all regions in the dataset. In the first 5 years (1992-1997), Americas shows the highest Modified Sharpe ratio (MS) within EM of 0.06 with an average monthly return of 1.37%. On average, the EM showed higher risk than DM, with consequent lower returns. All DM outperform the EM in terms of MS, except for the Euro zone. Asia is an underperformer, showing extremely large monthly MVaR of over 40%. Median EM return is 1.26% and median EM MVaR is 17%. Median DM return is 1.18% with DM median MVaR of 6.92%.

For the second period (1997-2002) a number of things are apparent. First of all, all average returns are negative for EM, except for SA, ranging from -2.72% to 0.08%. Furthermore, all MS are negative for EM in this period. For DM, the MVaRs are more or less the same as the first period, with lower returns, indicating a worldwide downfall in the Real Estate sector. MS for DM declined. The Americas region has experienced a dramatic downfall during the Argentinean crisis, in USD terms. Furthermore, the low returns in Asia and China, accompanied by very high volatilities are partly due to the Asian financial crisis.

In the final period (2002-2007) all regions show improved performance. EM returns are up and positive in all regions. The highest average return is found in SA (2.50%), and the highest MS in China (0.11). MVaRs are lower for all EM. Median return for EM is 2.28% and median MVaR of 21.25%. DM MVaR are approximately at the same level as the previous period. These data reflect the worldwide recovery in RE. The results underline the intuition of EM return characteristics; higher returns with higher risk than DM.

If we observe the entire period, we find the strong differences between EM and DM to be even more dramatic. All DM outperform EM in terms of both average return and standard deviation. Median MVaR for EM is 20.63% and median MVaR for DM is 6.29%. Furthermore, median MS is 0.01 for EM and 0.12 for DM.

However, low correlations and low world integration for EM real estate could result in improved minimum variance portfolio characteristics, for an international investor.

Table 3.2: Monthly risk and return

Region	*Geometric return (1992-1997)*	*Standard Deviation (1992-1997)*	*Modified Value at Risk 1992-2007*	*Sharpe ratio (Rf = 3.5%)*	*Modified Sharpe ratio (Rf = 3.5%)*
Asia	1.18%	50.87%	40.09%	0.02	0.02
Americas	1.34%	10.05%	17.04%	0.10	0.06
China	1.87%	12.46%	-42.45%	0.13	0.04
CEE	1.26%	12.36%	20.32%	0.08	0.05
South Africa	0.49%	5.65%	10.35%	0.04	0.02
Average EM	1.23%	18.28%	9.07%	0.07	0.04
Median EM	1.26%	12.36%	17.04%	0.08	0.04
GPR 250 USA	1.15%	3.27%	6.92%	0.26	0.12
GPR 250 UK	1.18%	5.29%	12.63%	0.17	0.07
GPR 250 Euro	0.49%	3.16%	6.47%	0.06	0.03
Region	*Geometric return (1997-2002)*	*Standard Deviation (1997-2002)*	*Modified Value at Risk 1997-2002*	*Sharpe ratio (Rf = 3.5%)*	*Modified Sharpe ratio (Rf = 3.5%)*
Asia	-2.09%	16.39%	20.73%	-0.15	-0.11
Americas	-2.72%	14.79%	25.47%	-0.20	-0.12
China	-2.27%	16.84%	28.76%	-0.15	-0.09
CEE	-0.95%	22.79%	25.13%	-0.05	-0.05
South Africa	0.08%	7.33%	16.25%	-0.03	-0.01
Average EM	-1.59%	15.63%	23.27%	-0.12	-0.08
Median EM	-2.09%	16.39%	25.13%	-0.15	-0.09
GPR 250 USA	0.84%	3.83%	8.03%	0.14	0.07
GPR 250 UK	0.43%	4.97%	10.89%	0.03	0.01
GPR 250 Euro	0.33%	3.64%	7.80%	0.01	0.01
Region	*Geometric return (2002-2007)*	*Standard Deviation (2002-2007)*	*Modified Value at Risk 2002-2007*	*Sharpe ratio (Rf = 3.5%)*	*Modified Sharpe ratio (Rf = 3.5%)*
Asia	2.40%	11.66%	20.20%	0.18	0.10
Americas	2.28%	11.94%	22.94%	0.17	0.09
China	1.92%	13.47%	14.89%	0.12	0.11
CEE	1.63%	5.37%	23.38%	0.25	0.06
South Africa	2.50%	9.28%	21.25%	0.24	0.10
Average EM	2.15%	10.35%	20.53%	0.19	0.09
Median EM	2.28%	11.66%	21.25%	0.18	0.10
GPR 250 USA	1.70%	4.17%	11.93%	0.34	0.12
GPR 250 UK	2.11%	5.12%	11.97%	0.35	0.15
GPR 250 Euro	2.03%	3.23%	9.19%	0.54	0.19
Region	*Geometric return (1992-2007)*	*Standard Deviation (1992-2007)*	*Modified Value at Risk 1992-2007*	*Sharpe ratio (Rf = 3.5%)*	*Modified Sharpe ratio (Rf = 3.5%)*
Asia	0.48%	31.71%	44.98%	0.01	0.00
Americas	0.28%	12.49%	17.50%	0.00	0.00
China	0.49%	14.40%	20.63%	0.01	0.01
CEE	0.64%	15.20%	25.04%	0.02	0.01
South Africa	1.02%	7.61%	11.78%	0.10	0.06
Average EM 15 years	0.58%	16.28%	23.99%	0.03	0.02
Median EM 15 years	0.49%	14.40%	20.63%	0.01	0.01
GPR 250 USA	1.23%	3.77%	6.29%	0.25	0.15
GPR 250 UK	1.24%	5.15%	8.20%	0.18	0.12
GPR 250 Euro	0.95%	3.42%	5.68%	0.19	0.12

All returns are monthly USD returns. The returns are computed with the inclusion of both capital gain and dividend yield. The exchange rates are extracted from datastream. Modified Value at Risk is computed at 0.95 confidence level (Zc = -1.96)

Skewness, Kurtosis and the normality assumption

I will now evaluate the distributional characteristics of the data. The results for the EM and DM RE indices are presented in table 3.3. In the first period, for the EM, only the South

African index normality hypothesis cannot be rejected.[28] Furthermore, the normality hypothesis cannot be rejected for any of the DM.

In the second period, the data show a slightly different result. The hypothesis for the Americas index cannot be rejected (p-value 0.90), but the normality assumption is rejected for South Africa and all other EM.

In the 2002-2007 period, the assumption of normality is rejected for the GPR USA index, and the EM except for Argentina and South Africa.

[28] At a 5% level

Table 3.3: Skewness and Kurtosis and normality for Real Estate indices

Region	*N*	*Skewness 1992-1997*	*Kurtosis 1992-1997*	*Berra Jarque test 1992-1997 (p-value)*	*Normal*
Asia	60	1.93	3.76	58.22	
				(0.00)	FALSE
Americas	60	0.96	2.73	20.69	
				(0.00)	FALSE
China	60	1.10	3.19	28.30	
				(0.00)	FALSE
CEE	60	6.22	45.03	4,310.03	
				(0.00)	FALSE
South Africa	60	0.51	0.97	3.50	
				(0.17)	TRUE
GPR 250 USA	60	0.44	0.62	2.07	
				(0.35)	TRUE
GPR 250 UK	60	-0.43	0.40	1.76	
				(0.41)	TRUE
GPR 250 Euro	60	0.12	-0.11	0.34	
				(0.84)	TRUE
Region	*N*	*Skewness 1997-2002*	*Kurtosis 1997-2002*	*Berra Jarque test 1997-2002 (p-value)*	*Normal*
Asia	60	1.79	10.92	254.78	
				(0.00)	FALSE
Americas	60	0.11	-0.03	0.22	
				(0.90)	TRUE
China	60	0.86	2.67	18.58	
				(0.00)	FALSE
CEE	60	1.70	8.32	155.44	
				(0.00)	FALSE
South Africa	60	-0.21	2.19	8.06	
				(0.02)	FALSE
GPR 250 USA	60	0.16	-0.05	0.39	
				(0.82)	TRUE
GPR 250 UK	60	-0.32	0.10	0.97	
				(0.62)	TRUE
GPR 250 Euro	60	-0.20	0.04	0.43	
				(0.80)	TRUE
Region	*N*	*Skewness 2002-2007*	*Kurtosis 2002-2007*	*Berra Jarque test 2002-2007 (p-value)*	*Normal*
Asia	60	0.80	0.61	6.16	
				(0.05)	FALSE
Americas	60	0.53	0.92	3.52	
				(0.17)	TRUE
China	60	0.80	1.48	8.88	
				(0.01)	FALSE
CEE	60	-1.13	2.32	20.17	
				(0.00)	FALSE
South Africa	60	-0.06	0.49	0.17	
				(0.92)	TRUE
GPR 250 USA	60	-1.12	2.15	18.63	
				(0.00)	FALSE
GPR 250 UK	60	0.07	0.02	0.12	
				(0.94)	TRUE
GPR 250 Euro	60	-0.60	0.37	3.26	
				(0.20)	TRUE

Skewness and kurtosis statistics are calculated based on USD returns for each period for the EM indices. Monthly returns for the GPR indices are extracted from the GPR database. Please find the Berra Jarque test for normality p-value in the parentheses. Critical value for the BJ test is 5.99

Autocorrelation

A market is considered fully efficient if the autocorrelation function (ACF) is (close to) zero (Ramanathan).[29] The results for the data are shown in table 4.4. Except for Asia and CEE, all EM indices show first lag autocorrelation of more than 15%. For the DM, only the US index doesn't show first lag autocorrelation.

These results suggest that the returns of these indices do not follow a random walk. This is in line with previous studies.

Table 3.4: Autocorrelation function output

Region	*Autorrelation function 1992-2007*			
	T - 1	T - 2	T - 3	T - 4
Asia	0.033	0.091	-0.142	-0.032
Americas	0.162	-0.009	0.056	0.091
China	0.155	0.018	-0.242	-0.167
CEE	0.040	-0.275	-0.013	0.065
South Africa	0.160	0.024	0.062	-0.140
GPR 250 USA	-0.063	0.033	-0.015	-0.058
GPR 250 UK	0.123	0.084	0.110	0.006
GPR 250 Euro	0.101	0.130	0.051	0.024

Autocorrelation functions are computed in local currencies. T-1, T-2, T-3 and T -4 are the ACF's for the 1st 2nd 3rd and 4th period lag respectively.

3.2 Cross regional Correlations

Table 3.5, 3.6, 3.7 and 3.8 provide the correlation coefficients for all EM and DM markets in the different periods. The correlations are strengthening over the different periods, as a sign of market integration.

[29] "Introductory Econometrics with Applications" 2002

As expected, the highest correlations are detected between the DM. Many coefficients between DM and EM are close to zero in the first period.

Table 3.5: Correlation matrix 1992-1992

	CEE	CHINA	ASIA	SA	ARG	GPR 250 USA	GPR 250 UK	GPR 250 Euro
CEE	1.000							
CHINA	-0.126	1.000						
ASIA	-0.005	0.332	1.000					
SA	0.281	-0.116	0.250	1.000				
Americas	-0.068	0.447	0.428	0.229	1.000			
GPR 250 USA	-0.011	0.035	-0.004	0.001	0.168	1.000		
GPR 250 UK	0.105	0.365	0.218	-0.066	0.157	0.314	1.000	
GPR 250 Euro	0.125	0.348	0.370	0.123	0.391	0.258	0.436	1.000

The correlation coefficients in this table have been calculated by means of the statistical analysis in excel. These correlation coefficient reflect the *average* correlation over the period described.

As described by Barry et al (2004) and Eichholz (1996b), the low correlation coefficients suggest that international Real Estate investors can realize significant risk reduction by diversifying in EM.

Table 3.6: Correlation matrix 1997-2002

	CEE	CHINA	ASIA	SA	ARG	GPR 250 USA	GPR 250 UK	GPR 250 Euro
CEE	1.000							
CHINA	0.115	1.000						
ASIA	0.032	0.613	1.000					
SA	0.071	0.586	0.381	1.000				
ARG	0.227	0.376	0.314	0.301	1.000			
GPR 250 USA	0.013	0.377	0.175	0.159	0.207	1.000		
GPR 250 UK	-0.012	0.215	0.082	0.190	-0.043	0.347	1.000	
GPR 250 Euro	0.134	0.310	0.401	0.278	0.182	0.260	0.392	1.000

The correlation coefficients in this table have been calculated by means of the statistical analysis in excel. These correlation coefficient reflect the *average* correlation over the period described.

Table 3.7: Correlation matrix 2002-2007

	Cee	China	Asia	SA	Americas	GPR 250 USA	GPR 250 UK	GPR 250 Euro
Cee	1.000							
China	0.099	1.000						
Asia	0.190	0.460	1.000					
SA	0.184	-0.063	-0.120	1.000				
Americas	0.287	-0.123	0.105	0.307	1.000			
GPR 250 USA	0.184	0.361	0.186	0.152	0.030	1.000		
GPR 250 UK	0.242	0.381	0.137	0.121	0.033	0.366	1.000	
GPR 250 Euro	0.259	0.351	0.035	0.190	-0.019	0.404	0.579	1.000

The correlation coefficients in this table have been calculated by means of the statistical analysis in excel. These correlation coefficient reflect the *average* correlation over the period described.

Table 3.8: Correlation matrix 1992-2007

	Cee	China	Asia	SA	Americas	GPR 250 USA	GPR 250 UK	GPR 250 Euro
Cee	1.000							
China	0.050	1.000						
Asia	0.016	0.339	1.000					
SA	0.117	0.181	0.142	1.000				
Americas	0.152	0.256	0.270	0.294	1.000			
GPR 250 USA	0.029	0.288	0.056	0.133	0.144	1.000		
GPR 250 UK	0.053	0.317	0.154	0.109	0.056	0.350	1.000	
GPR 250 Euro	0.132	0.337	0.255	0.227	0.192	0.321	0.477	1.000

The correlation coefficients in this table have been calculated by means of the statistical analysis in excel. These correlation coefficient reflect the *average* correlation over the period described.

Looking at the entire sample correlations, the low correlations persist for a number of regions. Especially the CEE region has low correlations with DM regions (US 0.029, UK 0.053 and Euro 0.132. China has above average EM correlation with DM, with coefficients ranging from 0.288 to 0.337 with DM. Asia shows stronger correlation with Eurozone than with other DM (0.255). All correlations with Eurozone are stronger than those with other EM. Even so, the findings show stronger correlations than in previous studies.

3.3 Conclusion

In this chapter, the basic characteristics of the data are described through some simple analysis. I notice a rapid growth in both the number of listings as well as the total market capitalization. I also found that EM has higher MVaR than DM, at least in earlier periods, and lower returns than DM. This results in lower MS as well. EM indices alone therefore underperformed DM in terms of risk adjusted returns. I could not find significantly stronger autocorrelations in EM than in DM.

EM showed stronger deviations from the normality assumptions, on average, than the DM peers. Except for Argentina and South Africa, the normality assumption was rejected for all indices in all periods. The kurtosis results show that probability of abnormal returns is higher in EM than in DM.

The MS ratio's show that DM generally perform better than their EM peers. In each period, with the exception of the Eurozone in the first period, DM shows higher MS, and consequently higher returns. The cross regional correlations are weak, and sometimes even negative. However, the correlation is strengthening over time. The results are in line with expectations. The low correlations are the basis for the remainder of my thesis.

4. Methodology

In this chapter, I will discuss the source and type of data used in my analysis. In the first paragraph, I offer a broad description of the data, and in the second paragraph, I discuss the controversy in mean calculation, i.e. the geometric mean versus arithmetic mean. Finally, in the last paragraph, I show how the indices for the analysis are derived, for both the EM and the GPR indices.

4.1 Data sources and research horizon

For the research conducted in this thesis, I use data on 78 real estate stocks in emerging markets that qualify as Real Estate investments companies. The emerging markets are subdivided in 5 regions, and for each region, I compute an index with the inclusion of the stocks that qualify as Real Estate investments. In order to be included in the dataset, a company must meet strict requirements. This part offers an overview of the requirements employed by GPR. The time frame for this type of research is typically between 10 and 20 years. The time frame for my research is 15 years.

Emerging markets have gained the interest of international Real Estate investors just in recent years, and a large number of investment companies have only started to focus on the CEE region, for instance, only recently. The same story holds for China, and other Asian EM. The total returns are computed on a monthly basis, because Real Estate securities are typically traded less frequently than other equities. For the analysis, I will therefore use monthly returns in USD terms, for 15 years to date, for the EM regions Asia, Americas, CEE, China and South Africa, and for the DM regions GPR 250 USA index, GPR 250 UK index and the GPR 250 EURO zone index. All EM data are extracted from Datastream, and the DM data from the GPR database.

Arithmetic versus Geometric returns

An ongoing discussion in the investment performance measurement is whether geometric or arithmetic averages should be used. As geometric averages are typically

lower (or equal to) arithmetic averages, the geometric average is a downward biased measure. However, when measuring past performance, the geometric average is better suited, because it provides a constant rate of return over the entire holding period, to match the actual performance of the investment (Bodie, Kane, Marcus)[30]. Furthermore, as time series data are often positively skewed, the impact of extreme values in the computation of the geometric average is lower than when the arithmetic mean is computed.

GPR index inclusion criteria

The database of GPR consists of all RE securities worldwide. It is updated on a daily basis. For a company to be included in a GPR index, the following criteria must be met:

Liquidity:	A minimum free float of 15% of the total market capitalization
Size:	Minimum USD 50m market capitalization for the last 3 months
Turnover:	A minimum of 75% of operational turnover must be derived from rental income

The GPR indices constitute of the most liquid Real Estate companies. Previous studies have included all RE companies in EM including hybrids and development companies. I attempt to follow the GPR criteria in this study as strictly as possible. Consequently, with the exception of a few funds focussing on the Chinese market, all funds in the dataset fulfil all GPR criteria. In this way, the returns in the analysis should reflect the RE returns in these regions as closely as possible.

EM index calculation

The EM index computation is similar to the method for constructing GPR indices. The difference is that GPR indices are *free float* market capitalization based, whereas the EM indices are total capitalization weighted. The EM indices are computed in USD.

[30] "Investments", sixth Edition, 2005, pp 865

In order to obtain the total return of the index, the individual company weights have to be calculated. The weights are computed based on a common currency total market capitalization. USD market capitalization is used to calculate the weight of a typical company in the index. The weight is calculated by dividing the market capitalization of the company by the total market capitalization of all the companies in the index. The level of the index therefore reflects the total market capitalization of the companies in the index, with changing composition over time, compared to the base date. Equation 12 describes the weight calculation of a particular company in the index:

$$W_{i,t_0}^{USD} = \frac{MV_{i,t_0}^{USD}}{\sum_{t=1}^{N_{t=0}} MV_{i,t_0}^{USD}} \tag{12}$$

Where, W_{i,t_0}^{USD} is the weight of company i, at base date $t = 0$ and MV_{i,t_0}^{USD} is the market value of company i.

In order to calculate the total return of the index, the total return of a stock needs to be determined. Total return combines both capital gain on stock price appreciation, as well as the dividend yield. Equation 13 shows the total return formula.

$$R_{i,t} = \frac{P_{i,t_1}^{USD} + D_{i,t_1}^{USD} - P_{i,t_0}^{USD}}{P_{i,t_0}^{USD}} \tag{13}$$

Where, $R_{i,t}$ is the total return R on stock i, in period i, P_{i,t_1}^{USD} the share price of stock i, at time t_1, P_{i,t_1}^{USD} the share price of stock i, at time t_0 D_{i,t_1}^{USD} dividend on share i, at time t_1.

The index computation is quite straightforward from here. The returns of the individual stocks are multiplied by the weights. The base date is set a t_0, and the index base level is set at 10.

A company is included in a country (or region) index if it derives over 75% of the operational turnover from that country (or region). Therefore, listing location might differ from investment focus. For instance, Austrian companies invest considerably in CEE countries. Therefore, many of the constituents of the CEE region in this study are Austrian companies.

The determination of the investment region of a company is deducted from the company's latest annual report. Furthermore, liquidity is an important criterion. The GPR database therefore consists only of the most liquid property companies.

I will derive all indices by means of the USD returns. The horizon of this study is 15 years, starting May 1st 1992 to May 1st 2007.

Following the GPR methodology, the survivorship bias is tackled, as much as possible, with the EM indices. As a company is de-listed, it is removed thereafter on the last trading day of the month. Companies that obtain a listing within the sample period are included at the first trading day of the next month. All companies that match the GPR criteria in EM are included in the sample.

4.2 Market integration regression models

In order to identify the world market integration in terms of both equity markets and RE markets, I will perform a number of regressions. First of all, I perform a simple CAPM regression, in order to determine the RE integration worldwide. Equation 14 shows how the model is defined.

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_{w1}(R_{wt} - R_{Ft}) + \varepsilon_w \qquad (14)$$

Where R_{Pt} is the return on the region's real estate index, R_{wt} is the return on the global GPR 250 index and β_w equals the exposure of the regional index to the world index.

Secondly, I will investigate the exposure of all equity markets to the world equity index. Furthermore, analogous to the Fama-French factor regression, I will include value and growth factors in the model. Equation 15 determines the second model:

$$R_{Pt}^{C} - R_{Ft} = \alpha_P + \beta_{w1}^{C}(R_{wt} - R_{Ft}) + \beta_{w2}(BE/ME) + \beta_{w3}(E/P) + \beta_{w4}(CE/P) + \beta_{w5}(Yld) + \varepsilon_w^{C} \qquad (15)$$

Where R_{Pt}^{C} is the USD weighted return on region P's *equity* index in time period *t* and β_{w1}^{C} equals the sensitivity to the world equity, β_{w2} equals the exposure to the world Fama-French factor (high – low) book equity/market equity, β_{w3} equals the exposure to the Fama-French world factor (high – low) earnings/price, β_{w4} equals the exposure to the Fama-French world factor (high – low) cash earnings/price, β_{w5} equals the exposure to the Fama-French world factor (high – low) yield, and ε_{Pt} are the unexplained residuals. This regression establishes the equity market integration and I expect the outcomes to show strong integration.

The next regression estimates the world RE integration.

$$R_{Pt} - R_{Ft} = \alpha_P + \beta_{w1}^{C}(R_{wt} - R_{Ft}) + \beta_{w2}(BE/ME) + \beta_{w3}(E/P) + \beta_{w4}(CE/P) + \beta_{w5}(Yld) + \varepsilon_{Pt} \quad (16)$$

Where R_{Pt} is the USD weighted return on region P's *Real Estate* index in time period *t* and β_{w1}^{C} equals the sensitivity to the world equity, β_{w2} equals the exposure to the world Fama-French factor (high – low) book equity/market equity, β_{w3} equals the exposure to the Fama-French world factor (high – low) earnings/price, β_{w4} equals the exposure to the Fama-French world factor (high – low) cash earnings/price, β_{w5} equals the exposure to the Fama-French world factor (high – low) yield, and ε_{Pt} are the unexplained residuals. This regression measures the exposure of RE to the world equity index as well as the global Fama-French factors. In addition to these regressions, the liquidity approximation is included for all regressions.[31]

[31] This way, I obtain 4 regressions per region, of which the regressions without the liquidity factor can be found in the appendix

5. Performance analysis

In this chapter, I will perform an in dept analysis of the securities returns. In paragraph 5.1 I will first asses the world integrations, as described in chapter 4. In paragraph 5.2 I will show the results of the efficient MVaR portfolio derivations, and the consequent diversification benefits. Finally, the conclusion of chapter 5 can be found in paragraph 5.3.

5.1 Regression results

In this paragraph, I will first perform a simple CAPM regression, resulting in the data shown in table 5.1.

Global Real Estate regression

All regions have significant exposure to the world Real Estate index, except for the CEE region (p-value of 0.425). Table 1 also shows very low R^2's for the regressions, an indication that the model doesn't fit very well.

4 regions show significant[32] intercepts. South Africa has alpha of 1.1% a month, US, UK show an alpha of 0.7% and 0.8% a month and the Eurozone has a significant intercept of 0.8% a month. All other markets do not show significant intercepts.

The China shows strong reaction to movements in the market index with a beta of 2.112, were the UK and Eurozone show more moderate betas (0.406 and 0.537).

A simple t-test, envisaged to estimate whether beta differs from 1, is rejected for all regions except Americas and Asia.

[32] At a 5 % level

Table 5.1: World Real Estate integration regression output for all regions

Region	N	Intercept (p-value)	Beta (GPR world) (p-value)	R^2	Two sided t-test (H:0 BetaRm = 1)
EM Asia	180	-0.002	1.327	0.178	1.530
		(0.843)	(0.000)		
EM Americas	175	0.001	1.134	0.178	0.599
		(0.876)	(0.000)		
EM CEE	180	0.013	0.231	0.004	-2.665
		(0.259)	(0.425)		
EM China	180	0.001	2.112	0.360	5.273
		(0.898)	(0.000)		
EM South Africa	180	0.011	0.645	0.125	-2.780
		(0.039)	(0.000)		
DM USA	180	0.007	0.776	0.350	-2.825
		(0.020)	(0.000)		
DM UK	180	0.008	0.406	0.256	-11.426
		(0.000)	(0.000)		
DM Euro	180	0.008	0.537	0.324	-7.964
		(0.001)	(0.000)		

The regression results are based on the monthly USD returns for each of the indices for the entire sample period (1992-2007). As a market proxy, the GPR 250 Global index is used. The risk free rate is the US 3 month treasury bill. The p-values indicating significance are displayed in the parentheses.

Global equity regression

The next series of regressions are performed to estimate the effect of the value and growth factors described by FAMA and French.[33] The first step is to identify, for each region, the effect of a world equity portfolio on the regions equity markets. The regions equity markets are regressed on the world equity markets, the global Fama-French value and growth factors and a liquidity factor. The results are shown in table 5.2.

[33] Following the method of FAMA and French, I have included value and growth factors and measures for liquidity in the regression.

Table 5.2: Fama French equity + liquidity regression

Region	N	Intercept	Beta Rm-Rf global	Beta Liquidity factor	R^2	Two sided t-test (H:0 BetaRm = 1)
EM Asia	175	-0.014	1.008	0.519	0.651	0.064
		(0.009)	(0.000)	(0.000)		
EM Americas	175	0.008	-0.118	0.133	0.073	-7.518
		(0.622)	(0.417)	(0.790)		
EM CEE	175	-0.008	1.084	0.063	0.554	0.393
		(0.338)	(0.000)	(0.012)		
EM China	167	0.008	0.965	-0.265	0.429	-0.100
		(0.535)	(0.000)	(0.043)		
EM South Africa	167	-0.001	0.974	0.296	0.039	-0.145
		(0.894)	(0.000)	(0.472)		
DM USA	175	0.001	0.989	n.a.	0.949	-0.077
		(0.287)	(0.000)			
DM UK	175	-0.001	0.950	n.a.	0.911	-0.560
		(0.424)	(0.000)			
DM Euro	119	0.002	1.015	n.a.	0.898	0.310
		(0.370)	(0.000)			

Region	N	Beta High-Low BE/ME	Beta High-Low E/P	Beta High-Low CE/P	Beta High-Low Yld
EM Asia	175	-0.002	0.008	0.001	-0.005
		(0.529)	(0.028)	(0.828)	(0.109)
EM Americas	175	-0.012	-0.010	-0.003	0.020
		(0.090)	(0.207)	(0.709)	(0.006)
EM CEE	175	0.005	-0.001	0.000	-0.005
		(0.171)	(0.848)	(0.908)	(0.199)
EM China	167	0.005	0.012	-0.003	-0.004
		(0.303)	(0.047)	(0.615)	(0.396)
EM South Africa	167	0.002	0.004	0.000	-0.006
		(0.579)	(0.399)	(0.950)	(0.131)
DM USA	175	-0.003	0.000	0.001	0.001
		-(3.157)	(0.239)	(1.277)	(0.717)
DM UK	175	0.002	0.001	-0.002	0.000
		(0.059)	(0.339)	(0.082)	(0.824)
DM Euro	119	0.003	0.001	0.000	-0.003
		(0.135)	(0.487)	(0.901)	(0.038)

The regression results are based on the monthly USD returns for each of the indices for the entire sample period (1992-2007). As a market proxy, the MSCI world index is used. Furthermore, each equity region is defined in a similiar way to the RE regions. The Fama-french international factors are extracted from the Ken French website. BE/ME equals book equity to market equity, E/P equals eanings to price, CE/P equals cash earnings to price and YLD equals the dividend yield. Regressions with local factors and without the liquidity factor can be found in the appendix. The p-values indicating significance are displayed in the parentheses. For the DM, a liquidity proxy cannot be included in this regression.

Most R^2's are above 50%, except for the Americas (R^2 of 0.073) and South Africa regions (R^2 of 0.039). Only Asia shows a significant intercept of -1.4% a month, indicating underperformance. Furthermore, the liquidity factor is significant for Asia (0.519). All world market betas are significant, except for the Americas region (p-value 0.417). In addition, none of these world betas significantly differ from 1 (except for Americas), indicating that all equity markets are strongly integrated.

The Book/Market equity factor is only significant for the Americas and the UK. The Earnings/Price factor is significant for Asia and China and the Cash Earnings/Price factor is not significant in any region. Finally, the Yield factor is significant for Americas and Eurozone.

The strongest model fit (indicated by the R^2) exist within the DM. This result is straightforward, as DM equity markets are strongly integrated internationally. The regression also shows that emerging equity markets are already quite integrated in the world equity market as well. Forging the abnormal result for the Argentinean index, these results indicate that diversifying equity investments globally into EM should not improve the risk return structure significantly, based on these results.

These results merely show that world equity markets are integrated and move together. Furthermore, these results provide a starting point in the analysis of the diversification potential of RE. The next regression will evaluate the Real Estate indices in a similar way.

Real Estate regression including global factors

Table 5.3 shows the results of the third regression, where I investigate the integration of regional EM indices to the world equity MSCI index. The R^2's are quite low, and for all developed markets and CEE even below 10%. The Americas and China alpha's are significant and positive (1.006 and 0.098). All other intercept are not significant. China, South Africa and Eurozone do not have significant market betas. Furthermore, all t-statistics for the market betas reject the null hypothesis, except Asia and China.

The BE/ME Fama-French factor is significant for 3 markets: Americas, US and UK. The E/P factor is significant in 2 regions, Asia and China. The CE/P factor isn't significant in any region at a 5% level. Finally, the Yield factor is significant for the US and UK.

The model fit remains weak, and for CEE and all 3 DM US, UK and Eurozone even extremely poor (0.043, 0.097, 0.034 and 0.017). Moreover, only the Asian RE indices show market betas above 0.5, whereas all other markets show betas near or below zero. These results are in line with academic research, and the weak correlation between equity and RE has been widely documented.

The liquidity factor is significant in two markets, i.e. Asia and CEE (0.128 and 0.115). Furthermore, the BE/ME factor is significant in 3 markets, CEE, USA and UK, and coefficients are close to zero (0.019, -0.012 and -0.005) any market. E/P is significant in Asia and China, and close to zero (0.014, 0.012). CE/P is only significant for CEE (0.033). Finally, two markets have significant Yield factors, USA and UK, with coefficients of 0.017 and 0.012[34]. Very few of the Fama-French factors are significant in this regression. Furthermore, those betas that are significant indicate close to no exposure to the factor. The Fama factors therefore do not seem to have any correlation with the RE markets in.

[34] All significance at a 10% level

Table 5.3: Fama French Real Estate + liquidity regression

Region	N	Intercept	Beta Rm-Rf global	Beta Liquidity factor	R^2	Two sided t-test (H:0 BetaRm = 1)
EM Asia	175	-0.018	1.197	0.655	0.418	1.606
		(0.101)	(0.000)	(0.010)		
EM Americas	175	1.006	-0.857	0.128	0.216	-12.444
		(0.000)	(0.000)	(0.803)		
EM CEE	175	-0.014	-0.187	0.115	0.043	-5.614
		(0.513)	(0.378)	(0.081)		
EM China	167	0.098	0.702	-0.085	0.429	-0.845
		(0.024)	(0.048)	(0.848)		
EM South Africa	167	-0.030	-0.174	1.409	0.542	-6.636
		(0.171)	(0.326)	(0.137)		
DM USA	175	0.002	-0.344	n.a.	0.097	-9.592
		(0.850)	(0.015)			
DM UK	175	0.004	-0.349	n.a.	0.034	-15.212
		(0.844)	-(0.074)			
DM Euro	119	-0.002	0.015	n.a.	0.017	-20.974
		(0.563)	(0.743)			

Region	N	Beta High-Low BE/ME	Beta High-Low E/P	Beta High-Low CE/P	Beta High-Low Yld
EM Asia	175	0.001	0.014	-0.005	-0.006
		(0.931)	(0.034)	(0.480)	(0.301)
EM Americas	175	0.017	0.003	-0.011	-0.011
		(0.019)	(0.714)	(0.181)	(0.146)
EM CEE	175	-0.018	-0.024	0.033	0.005
		(0.307)	(0.214)	(0.071)	(0.756)
EM China	167	0.005	0.012	-0.003	-0.004
		(0.303)	(0.047)	(0.615)	(0.396)
EM South Africa	167	0.013	0.005	-0.007	-0.002
		(0.137)	(0.627)	(0.442)	(0.820)
DM USA	175	-0.012	-0.011	0.000	0.017
		(0.078)	(0.160)	(0.997)	(0.015)
DM UK	175	-0.005	-0.007	-0.008	0.012
		(0.074)	(0.156)	(0.993)	(0.011)
DM Euro	119	0.002	-0.002	0.001	-0.002
		(0.313)	(0.484)	(0.618)	(0.377)

The regression results are based on the monthly USD returns for each of the indices for the entire sample period (1992-2007). As a market proxy, the MSCI world index is used. The Fama-french international factors are extracted from the Ken French website. BE/ME equals book equity to market equity, E/P equals eanings to price, CE/P equals cash earnings to price and YLD equals the dividend yield. Regressions with local factors and without the liquidity factor can be found in the appendix. The p-values indicating significance are displayed in the parentheses. In this regression, a sole factor has been added. For the DM, a liquidity proxy cannot be included in this regression. All input data are the same as in table 5.2

5.2 MVaR minimizations

The next section evaluates the efficient portfolio allocations and consequent risk and return structures. The portfolios are optimized by means of the MVAR measure (equation 8).[35]

Minimum MVAR portfolios 1992-1997

Table 5.4 shows the results for the first 5 year period. Please recall from table 4.2 that the lowest risk in any market was 6.47% in Eurozone, for the first period, with total monthly return of 0.49% and consequent MS of 0.03. The lowest achievable MVAR, when no investments in EM are allowed is 5.47%. Monthly return is 0.79% at this risk level with a consequent MS of 0.09. Furthermore, at a higher risk level, higher MS can be achieved of 0.12.

Table 5.4: Optimal portfolios of Real Estate assets 1992-1997

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Modified Sharpe	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
6.43%	0.50%	0.03	0.00%	0.00%	0.00%	0.00%	0.00%	1.17%	0.00%	98.83%
5.47%	**0.79%**	**0.09**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**44.66%**	**0.00%**	**55.34%**
5.99%	1.00%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	71.50%	5.14%	23.35%
12.63%	1.18%	0.07	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
			II. No restrictions on any assets							
Risk	Return	Modified Sharpe	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
5.83%	0.50%	0.04	0.00%	0.00%	0.00%	0.00%	22.33%	1.13%	0.00%	76.54%
5.10%	**0.75%**	0.09	**0.00%**	**0.00%**	**0.00%**	**0.03%**	**16.65%**	**39.09%**	**0.00%**	**44.22%**
5.57%	1.00%	0.13	0.00%	0.00%	0.00%	5.98%	15.89%	63.24%	1.05%	13.84%
7.00%	1.25%	0.14	0.00%	0.00%	2.00%	13.47%	0.31%	84.22%	0.00%	0.00%
11.76%	1.50%	0.10	0.00%	0.00%	0.00%	48.27%	0.00%	51.73%	0.00%	0.00%
17.62%	1.75%	0.08	0.00%	0.00%	0.00%	83.01%	0.00%	16.99%	0.00%	0.00%
20.32%	1.87%	0.08	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Modified Sharpe	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
5.45%	0.60%	0.06	0.00%	0.00%	0.00%	0.00%	12.50%	16.28%	0.00%	71.22%
5.12%	**0.76%**	**0.09**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**12.50%**	**40.47%**	**0.00%**	**47.03%**
5.58%	1.00%	0.13	0.00%	0.00%	0.00%	5.68%	12.50%	64.28%	0.68%	16.86%
6.58%	1.20%	0.14	0.00%	0.00%	1.36%	11.80%	5.96%	80.88%	0.00%	0.00%
15.98%	1.28%	0.06	12.50%	12.50%	12.50%	12.50%	0.00%	48.90%	1.10%	0.00%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Modified Sharpe	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
13.73%	1.23%	0.07	5.00%	5.00%	5.00%	5.00%	0.00%	0.00%	80.00%	0.00%
5.28%	**0.78%**	**0.09**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**5.00%**	**42.99%**	**0.00%**	**52.01%**
6.45%	1.16%	0.13	0.00%	0.00%	0.25%	4.98%	5.00%	66.16%	0.00%	23.62%
8.66%	1.11%	0.09	0.00%	0.00%	1.13%	5.00%	5.00%	81.97%	6.90%	0.00%

The portfolio allocations presented in table 5.4 are measured in USD terms (5 years). The returns and risk indicators are on a monthly basis. I shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio. The risk measure used in this table is the MVAR.

[35] The standard minimum variance portfolios can be found in the appendix

When investments in EM are allowed freely, a lower risk level of 5.12% can be achieved with a return of 0.76%. In this case, a small fraction is invested in China, 16.65% in SA and 39.09%, 0% and 44.22% in the USA, UK and Eurozone. MS is approximately the same as without the inclusion EM, 0.09. A maximum MS of 0.14 is achieved at MVAR of 7.00% and return of 1.25.

The results only slightly differ when investments in EM are capped at 12.5%. The lowest achievable MVAR is 5.12% with a return and MS of 0.76% and 0.09. In this case, 12.5% is invested in SA, 40.47% in the US and 47.03% in the Eurozone. A maximum MS of 0.14 is achieved at MVAR of 6.58%, return of 1.20.

MVAR increases slightly with EM capping of 5%, i.e. 5.28% with return and MS of 0.78% and 0.09. Highest achievable MS is 0.13, with risk and return 6.45% and 1.16%. Investments in EM are approximately 5% for China, 5% for SA, 66.16% for USA and 23.62% for Eurozone.

In the first period, investments in EM do yield an improvement of the risk and return structure of the international RE portfolio. Even though diversification within DM already results in a lower MVAR as compared to the lowest MVAR in the Eurozone without further diversification, adding a little over 4% of RE investments to SA could improve the portfolio efficiency.

Minimum MVAR portfolios 1997-2002

Table 5.6 shows the MINVAR results for the second period. From table 4.2, we can recapture the lowest MVAR and highest MS. Again, Eurozone has the lowest MVAR (7.8% with return of 0.33% and MS 0.01) but the highest MS was 0.07 for the USA (MVAR 8.03% and return of 0.84%). Furthermore, all EM MS were negative.

Without any allocation to EM investments, the risk of a portfolio of DM can achieve a lower MVAR of 6.36% and MS of 0.04. Again, investing 100% in the USA would result in a higher MS of 0.07.

Table 5.5: Optimal portfolios of Real Estate assets 1997-2002

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
7.80%	0.33%	0.01	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
6.36%	**0.56%**	**0.04**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**43.11%**	**7.71%**	**49.18%**
8.03%	0.84%	0.07	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
			II. No restrictions on any assets							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
6.76%	0.25%	-0.01	2.35%	4.06%	2.24%	0.00%	3.89%	23.75%	15.68%	48.03%
6.29%	**0.52%**	**0.04**	**0.00%**	**0.00%**	**1.48%**	**0.00%**	**4.25%**	**41.79%**	**7.61%**	**44.86%**
7.17%	0.75%	0.06	0.00%	0.00%	0.00%	0.00%	0.00%	81.56%	0.00%	18.44%
8.03%	0.84%	0.07	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
6.76%	0.25%	-0.01	2.24%	4.06%	2.24%	0.00%	3.89%	23.75%	15.68%	48.03%
6.29%	**0.52%**	**0.04**	**0.00%**	**0.00%**	**1.48%**	**0.00%**	**4.25%**	**41.79%**	**7.61%**	**44.86%**
7.17%	0.75%	0.06	0.00%	0.00%	0.00%	0.00%	0.00%	81.56%	0.00%	18.44%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
6.76%	0.25%	-0.01	2.24%	4.06%	2.24%	0.00%	3.89%	23.75%	15.68%	48.03%
6.29%	**0.52%**	**0.04**	**0.00%**	**0.00%**	**1.48%**	**0.00%**	**4.25%**	**41.79%**	**7.61%**	**44.86%**
7.17%	0.75%	0.06	0.00%	0.00%	0.00%	0.00%	0.00%	81.56%	0.00%	18.44%

The portfolio allocations presented in table 5.5 are measured in USD terms (5 years). The returns and risk indicators are on a monthly basis. I shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio. The risk measure used in this table is the MVAR.

A slight improvement can be achieved with the allocation of little over 4% to SA. The allocations to DM in this case differ only slightly from part I of the table. The lower MVAR is now 6.29% with return and MS of 0.52% and 0.04.The results with and without capping are the same as no capping threshold for EM allocations is reached in any case.

As the worldwide downfall in the RE sector during the second period most strongly affected the EM (especially the Asian and Americas regions), the benefit of low correlations with DM faded away during this period. However, risk can still be reduced, even though a higher MS cannot be achieved. The US outperformed all other regions in this period.

Minimum MVAR portfolios 2002-2007

In the final period (2002-2007), we can recall from table 4.2 that the region with the highest MS was Eurozone (0.19). MVAR for this region was 9.19% with return of 2.03%.

Looking at table 5.6, a reduced MVAR of 8.75% can be obtained through diversification in DM. MS remains approximately 0.19.

Table 5.6: Optimal portfolios of Real Estate assets 2002-2007

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Modified Sharpe	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
11.93%	1.70%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
8.75%	**1.95%**	**0.19**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**25.35%**	**6.28%**	**68.37%**
8.87%	2.00%	0.19	0.00%	0.00%	0.00%	0.00%	0.00%	11.26%	12.42%	76.32%
11.97%	2.11%	0.15	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
			II. No restrictions on any assets							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
14.89%	1.63%	0.09	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%
9.37%	1.75%	0.16	0.00%	0.00%	30.30%	0.00%	0.00%	47.52%	0.00%	22.18%
8.37%	**1.96%**	0.20	**4.97%**	**0.00%**	**0.00%**	**11.27%**	**3.87%**	**18.43%**	**2.65%**	**58.81%**
8.40%	2.00%	0.20	6.14%	0.23%	8.41%	8.41%	0.00%	14.00%	4.34%	61.53%
8.70%	2.13%	0.21	9.58%	3.93%	0.00%	0.00%	9.17%	0.00%	10.84%	66.48%
11.87%	2.22%	0.16	39.88%	0.00%	0.00%	0.00%	9.75%	0.00%	0.00%	50.37%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
11.09%	1.69%	0.13	0.00%	0.00%	12.50%	0.00%	0.00%	87.50%	0.00%	0.00%
8.37%	**1.96%**	0.20	**4.97%**	**0.00%**	**11.27%**	**0.00%**	**3.87%**	**18.43%**	**2.65%**	**58.81%**
10.88%	2.03%	0.16	12.50%	12.50%	0.00%	5.05%	12.50%	41.31%	8.91%	7.23%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
11.56%	1.69%	0.12	0.00%	0.00%	5.00%	0.00%	0.00%	95.00%	0.00%	0.00%
8.41%	**1.99%**	**0.20**	**5.00%**	**0.00%**	**5.00%**	**0.00%**	**4.50%**	**19.64%**	**3.63%**	**62.24%**
8.67%	2.09%	0.21	5.00%	5.00%	0.00%	0.00%	5.00%	0.00%	14.44%	70.56%

The portfolio allocations presented in table 5.6 are measured in USD terms (5 years). The returns and risk indicators are on a monthly basis. I shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio. The risk measure used in this table is the MVAR.

Allowing for EM allocations freely, a lower MVAR of 8.37% can be achieved. Furthermore, MS increases to 0.20. Investing over 11% in CEE, approximately 5% in Asia and almost 4% in SA yields an improvement of the portfolio efficiency. DM allocations in this case are 18.43%, 2.65% and 58.81% for the US, UK and Eurozone respectively.

Minimum MVAR remains the same with capping of 12.5%, and with capping of 5% for EM, a lower risk level of 8.41% with return and MS of 1.99% and 0.20 can be achieved.

In the third period, allocations to EM rise, and the efficiency of the portfolio increases in more than without the inclusion of EM.

Minimum MVAR portfolios 1992-2007

Finally, I examine the efficient portfolio allocations for the entire period. Table 5.7 shows the results and allocations.

From table 4.2 we recollect the lowest MVAR for the entire period at 5.68% for Eurozone, with an associated return of 0.95% per month and MS of 0.12. Furthermore,

highest achievable MS for this period was 0.15 for the US (return and MVAR; 1.23% and 6.29%).

Table 5.7: Optimal portfolios of Real Estate assets 1992-2007

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
5.68%	0.95%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
5.03%	**1.07%**	0.15	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**40.06%**	**2.28%**	**57.66%**
5.91%	1.23%	0.16	0.00%	0.00%	0.00%	0.00%	0.00%	72.06%	27.25%	0.69%
8.20%	1.24%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
			II. No restrictions on any assets							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
7.18%	0.75%	0.06	0.00%	23.04%	5.11%	6.15%	0.00%	0.00%	0.00%	65.71%
5.64%	0.90%	0.11	0.00%	8.02%	2.54%	0.00%	3.02%	4.03%	0.00%	82.39%
5.13%	1.00%	0.14	0.00%	1.49%	2.24%	0.00%	5.00%	23.13%	0.00%	68.15%
4.98%	**1.06%**	**0.15**	**0.00%**	**0.00%**	**1.12%**	**0.00%**	**5.49%**	**38.20%**	**2.36%**	**52.83%**
5.24%	1.15%	0.16	0.00%	0.00%	0.00%	0.00%	5.38%	54.70%	15.12%	24.80%
8.20%	1.24%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
8.01%	0.75%	0.06	4.06%	12.50%	12.50%	12.50%	0.00%	0.00%	0.00%	58.44%
4.98%	**1.06%**	**0.15**	**0.00%**	**0.00%**	**1.12%**	**0.00%**	**5.49%**	**38.20%**	**2.36%**	**52.83%**
5.60%	1.20%	0.16	0.00%	0.00%	0.00%	0.00%	5.08%	64.64%	22.79%	7.49%
8.20%	1.24%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Modified Sharpe	Asia	Americas	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
6.78%	0.85%	0.08	5.00%	5.00%	5.00%	5.00%	0.00%	0.00%	0.00%	80.00%
4.98%	1.06%	0.15	0.00%	0.00%	1.14%	0.00%	5.00%	38.35%	2.36%	53.15%
5.27%	1.15%	0.16	0.00%	0.00%	0.00%	0.00%	5.00%	55.76%	15.87%	23.37%
8.20%	1.24%	0.12	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%

The portfolio allocations presented in table 5.7 are measured in USD terms (5 years). The returns and risk indicators are on a monthly basis. I shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio. The risk measure used in this table is the MVAR.

Table 5.7 shows that a slightly higher MS can be achieved in the first scenario. The portfolio with the lowest risk (MVAR of 5.03% and return of 1.07) has MS of 0.15. Maximum achievable average monthly portfolio return over the entire holding period amounted 1.24% (MS 0.12), in which case 100% is allocated to the UK.

Risk can be lowered to 4.98% with the inclusion of EM (return 1.06% and MS 0.15). In this case, 1.5% is allocated to CEE, and 4.25% to SA. DM markets allocations are 41.79%, 7.61% and 44.86% respectively for US, UK and Eurozone. MS can be improved to 0.16, in which case 5% is allocated to SA, and 54.70% to the US, 15.12% to the UK and 24.8% to Eurozone.

5.3 Conclusion

In chapter 5, I analyzed the return drivers for the data more thoroughly. The regressions in the first part were used to determine the type and degree of integration of equity and RE markets. The portfolio optimizations were then used to quantify the allocations for the most efficient portfolio. I will now briefly summarize my findings.

The first regression determined the exposure to the world GPR 250 index for all regions. None of the regions really outperformed the world RE index. The first regression also shows very weak RE integration worldwide. The null hypothesis[36] is rejected for all regions except for the Asia region.

The second and third regressions were merely robustness test. The second regression determined the equity market integration, and I found most regions' equity indices to be integrated with the MSCI world index. The third regression was conducted to test the exposure of the RE indices to the world equity indices and the Fama-French factors and the liquidity of all regions. The results indicate that RE markets are *less* than integrated with the world equity market, compared to the regional equity markets in regression 2.

Finally, I have estimated the efficient *Modified Value at Risk* frontiers for three separate time horizons, and for the entire sample period. The outcomes show that risk reduction in terms of MVAR is definitely rewarding, and a higher *Modified Sharpe Ratio* can be achieved, with the inclusion of EM in the international portfolio. During the worst performing period (1997-2002), the diversification opportunities were smaller, and this would indicate that benefits were smaller when they were needed the most. However, even in the second period, MS can be improved.

Furthermore, allocations to EM increased in the final period, which could indicate that efficiency and the risk and return characteristics in EM are improving. However, over the entire period, the greater part of the risk reduction is achieved by diversifying between the US and the Eurozone.

[36] $H_0: \beta_{REworld} = 1$

6. Conclusions

The main contribution of my thesis is the data selection process. Other studies not applying the same strict thresholds to the stock selection, do not really asses the state of the RE sector and actually cannot draw any inference about the results, because it is not clear what they measure. Therefore I believe the results in my thesis are robust, and I would suggest further research to follow a similar data selection process. Obviously, the difficulty lies in the measurement of RE performance in the first place, and further research could include more sophisticated econometric models and portfolio optimization techniques. In my thesis, I have focused on the international RE investor, omitting other equities and bonds from the analysis. Further research could also include these asset classes.

The evaluation of the diversification opportunities has yielded an unanticipated insight: the reduction of portfolio risk can be merely attributed to the diversification between the US and Eurozone. In each of the periods, as well as for entire period, the addition of EM Real Estate stocks doesn't improve the performance of the portfolio significantly. Taking research cost in consideration for an investor based in the Eurozone for instance, I argue that investing in EM isn't worthwhile at all. The results for the most recent period signal improving risk/return characteristics for EM. The question remains whether this has to do with the worldwide RE boom, or if the rise in efficiency is sustainable.

I evaluated the basic characteristics of the returns. As expected, the Modified Value at Risk was much higher in EM than in DM. The MVaR penalises the EM even more than the standard risk measure, standard deviation. This has affected the final results, but also improved the insights of the study because of the clean RE dataset I have used. Where many other studies find benefits of diversification, these studies are actually unable to accurately measure the RE returns.

Furthermore, I found strong deviations from normality for most EM indices. The result was anticipated beforehand, and therefore I used a different risk measure, that account for skewness and kurtosis, and penalizes large losses.

I also found low correlations between the returns in EM and DM, which could indicate, in the literature, that diversification benefits were available.

I tested for market integrations, both in terms of equity markets, as well as Real Estate markets. As expected, I found strong equity market integration, indicating that cross-regional diversification opportunities are small when it comes to regular stocks. Market integration for Real Estate stocks were much smaller, with only 1 region's world Real Estate beta (close to) 1. With little market integration, efficient cross-regional integration could yield opportunities.

The main conclusion of my thesis comes from the computation of the efficient portfolios. Linking the cross-regional correlations to the MVaR of each region resulted in a minimum MVaR frontier for each period. It is apparent that when DM RE markets are down, the diversification benefit from EM is even smaller than in other periods, which basically indicates that benefits disappear (to some extent) when this is needed the most.

This analysis gave me an insight of how the risk and return structures of the regions interact. Holding a diversified portfolio consisting of US and Eurozone stocks yields strong diversification benefits with strong associated liquidity and market stability. I conclude that the additional benefit of investing in EM is small, in my opinion too small, for any international investor to pursue.

Appendix

Figure A1 to figure A4 shows the MVAR efficient frontier of the three periods and the entire sample[37]

Figure A1: MVAR frontier, first period (1992-1997)

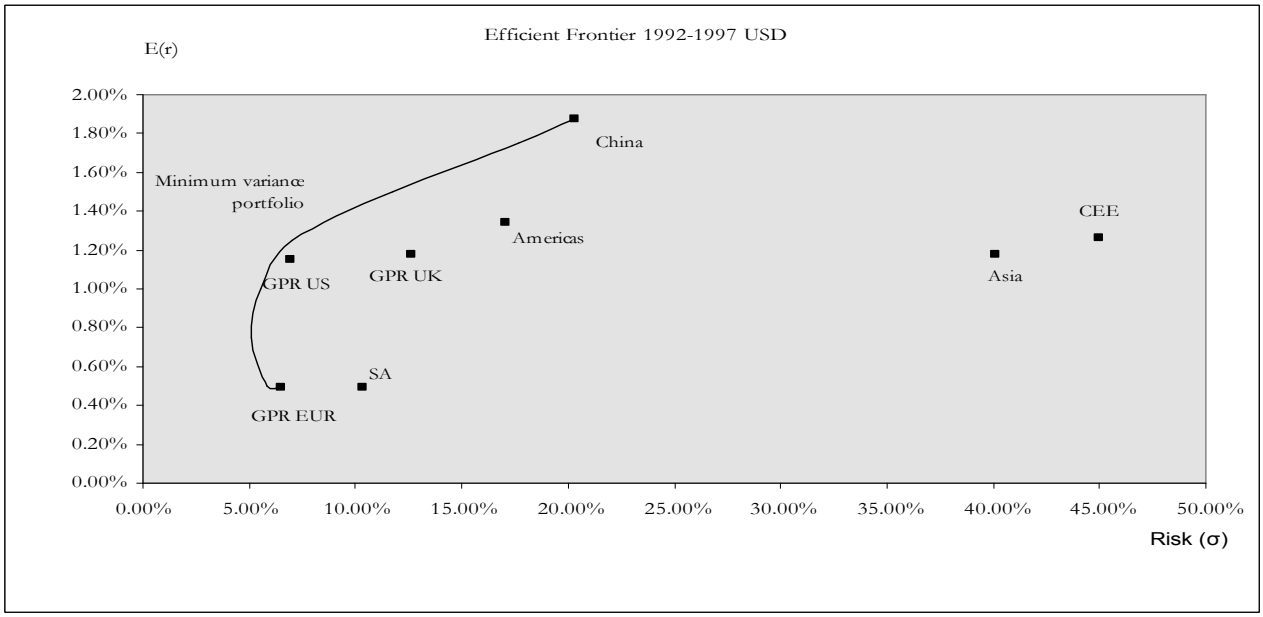
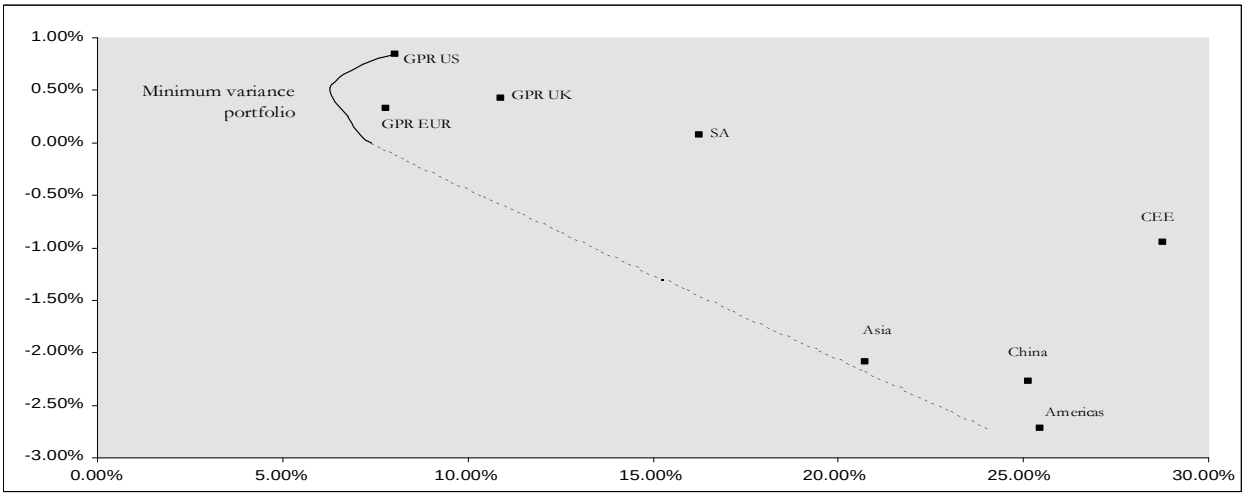


Figure A2: MVAR efficient frontier second period1997-2002



[37] EM investments allowed without restrictions

Figure A3: MVAR efficient frontier third period (2002-2007)

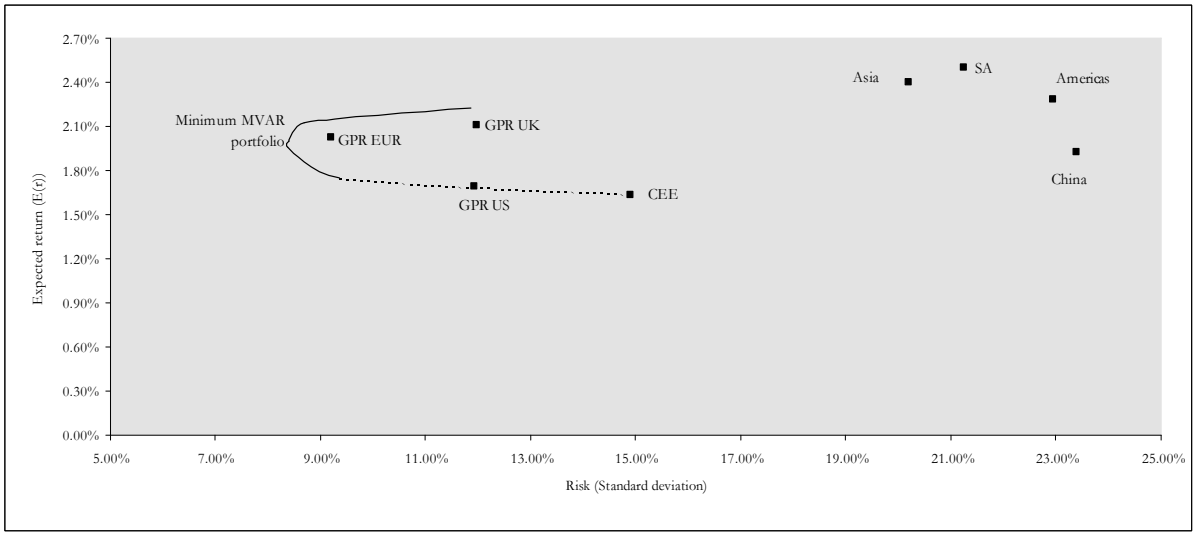


Figure A4: MVAR efficient frontier entire period (1992-2007)

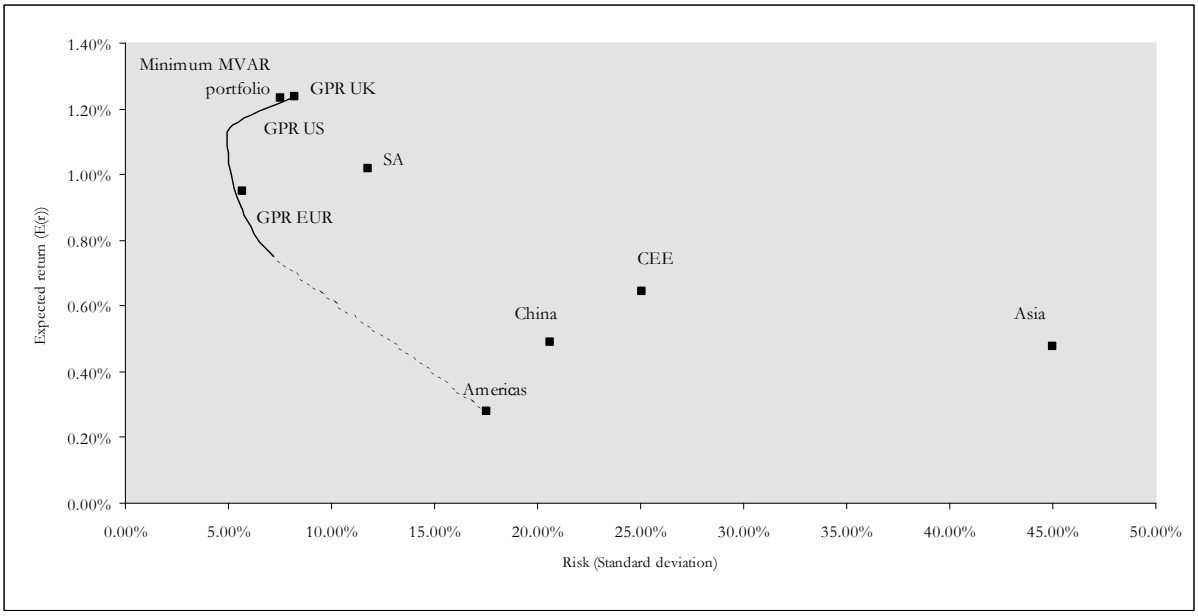


Table A.1: Fama French equity regression

Region	N	Intercept	Beta Rm-Rf global	Liquidity factor	R^2
EM Asia	175	-0.002	1.004	No	0.617
		(0.700)	(0.000)		
EM Americas	175	0.001	1.088	No	0.391
		(0.169)	(0.000)		
EM CEE	175	0.007	1.080	No	0.537
		(0.248)	(0.000)		
EM China	167	-0.013	0.966	No	0.414
		(0.100)	(0.000)		
EM South Africa	167	0.004	0.966	No	0.541
		(0.467)	(0.000)		
DM USA	175	0.001	0.989	No	0.949
		(0.287)	(0.000)		
DM UK	175	-0.001	0.950	No	0.911
		(0.424)	(0.000)		
DM Euro	119	0.002	1.015	No	0.898
		(0.370)	(0.000)		

Region	N	Beta High-Low BE/ME	Beta High-Low E/P	Beta High-Low CE/P	Beta High-Low Yld
EM Asia	175	-0.001	0.007	0.001	-0.006
		(0.706)	(0.063)	(0.684)	(0.088)
EM Americas	175	0.012	0.003	-0.011	-0.003
		(0.029)	(0.573)	(0.050)	(0.646)
EM CEE	175	0.006	-0.001	0.000	-0.006
		(0.142)	(0.910)	(0.963)	(0.143)
EM China	167	0.005	0.012	-0.003	-0.005
		(0.343)	(0.047)	(0.626)	(0.393)
EM South Africa	167	0.002	0.004	0.000	-0.006
		(0.541)	(0.394)	(0.986)	(0.137)
DM USA	175	-0.003	0.000	0.001	0.001
		-(3.157)	(0.239)	(1.277)	(0.717)
DM UK	175	0.002	0.001	-0.002	0.000
		(0.059)	(0.339)	(0.082)	(0.824)
DM Euro	119	0.003	0.001	0.000	-0.003
		(0.135)	(0.487)	(0.901)	(0.038)

The regression results are based on the monthly USD returns for each of the indices for the entire sample period (1992-2007). As a market proxy, the MSCI world index is used. Furthermore, each region's equity regions are defined in a similiar way as the RE regions The Fama-french international factors are extracted from the Ken French website. BE/ME equals book equity to market equity, E/P equals eanings to price, CE/P equals cash earnings to price and YLD equals the dividend yield. Regressions with local factors can be found in the appendix. The p-values indicating significance are displayed in the parentheses. In this regression, a sole factor has been added.

Table A2: Fama French Real Estate regression

Region	N	Intercept	Beta Rm-Rf global	Beta Liquidity factor	R^2
EM Asia	175	-0.002	1.192	No	0.395
		(0.852)	(0.000)		
EM Americas	160	1.009	-0.857	No	0.216
		(0.000)	(0.000)		
EM CEE	175	0.012	-0.193	No	0.025
		(0.416)	(0.365)		
EM China	175	0.091	0.697	No	0.044
		(0.000)	(0.048)		
EM South Africa	175	-0.004	-0.197	No	0.026
		(0.781)	(0.268)		
DM USA	175	0.002	-0.344	No	0.097
		(0.850)	(0.015)		
DM UK	175	0.004	-0.349	No	0.034
		(0.844)	-(0.074)		
DM Euro	175	-0.002	0.015	No	0.017
		(0.563)	(0.743)		

Region	N	Beta High-Low BE/ME	Beta High-Low E/P	Beta High-Low CE/P	Beta High-Low Yld
EM Asia	175	0.001	0.013	-0.004	-0.007
		(0.814)	(0.055)	(0.573)	(0.258)
EM Americas	160	0.017	0.003	-0.011	-0.011
		(0.019)	(0.706)	(0.184)	(0.145)
EM CEE	175	-0.005	-0.014	0.003	0.007
		(0.610)	(0.220)	(0.790)	(0.485)
EM China	175	-0.017	-0.024	0.033	0.006
		(0.307)	(0.209)	(0.071)	(0.747)
EM South Africa	175	0.013	0.006	-0.008	-0.002
		(0.128)	(0.557)	(0.359)	(0.787)
DM USA	175	-0.012	-0.011	0.000	0.017
		(0.078)	(0.160)	(0.997)	(0.015)
DM UK	175	-0.005	-0.007	-0.008	0.012
		(0.074)	(0.156)	(0.993)	(0.011)
DM Euro	175	0.002	-0.002	0.001	-0.002
		(0.313)	(0.484)	(0.618)	(0.377)

The regression results are based on the monthly USD returns for each of the indices for the entire sample period (1992-2007). As a market proxy, the MSCI world index is used. The Fama-french international factors are extracted from the Ken French website. BE/ME equals book equity to market equity, E/P equals eanings to price, CE/P equals cash earnings to price and YLD equals the dividend yield. Regressions with local factors can be found in the appendix. The p-values indicating significance are displayed in the parentheses

Tables A3 to A5 show the minimum variance portfolios for the three periods[38]

Table A3: Optimal portfolios of Real Estate assets 1992-1997

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Sharpe ratio	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
10.94%	6.07%	0.24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
9.93%	8.44%	0.50	0.00%	0.00%	0.00%	0.00%	0.00%	21.79%	6.02%	72.20%
19.94%	15.10%	0.58	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%
			II. No restrictions on any assets							
Risk	Return	Sharpe ratio	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
10.94%	6.07%	0.24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
9.39%	7.00%	0.37	0.00%	0.00%	0.00%	0.00%	19.33%	11.04%	0.00%	69.63%
9.21%	7.95%	0.48	0.00%	0.00%	1.49%	0.27%	17.32%	19.89%	0.00%	61.02%
9.31%	9.00%	0.59	0.00%	0.00%	2.69%	2.30%	15.93%	23.62%	2.86%	52.59%
9.95%	11.00%	0.75	0.00%	0.00%	4.76%	5.70%	12.90%	29.90%	9.93%	36.82%
11.07%	13.00%	0.86	0.00%	0.00%	6.79%	9.05%	9.90%	36.04%	16.87%	21.35%
12.50%	15.00%	0.92	0.00%	0.00%	8.81%	12.36%	6.87%	42.03%	23.72%	6.21%
14.40%	17.00%	0.94	0.00%	0.00%	11.90%	20.04%	0.00%	42.76%	25.30%	0.00%
19.34%	19.00%	0.80	0.00%	0.00%	15.98%	39.82%	0.00%	32.76%	11.44%	0.00%
26.18%	21.00%	0.67	0.00%	0.00%	19.69%	59.27%	0.00%	21.05%	0.00%	0.00%
33.89%	23.00%	0.58	0.00%	0.00%	21.74%	78.26%	0.00%	0.00%	0.00%	0.00%
43.15%	24.93%	0.50	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Sharpe ratio	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
10.94%	6.07%	0.24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
9.50%	7.00%	0.37	0.00%	0.00%	0.12%	0.00%	12.50%	10.91%	0.00%	76.47%
9.26%	8.06%	0.49	0.00%	0.00%	2.17%	0.00%	12.50%	20.36%	0.67%	64.30%
9.57%	10.00%	0.68	0.00%	0.00%	3.91%	3.72%	12.50%	26.65%	6.89%	46.32%
11.07%	13.00%	0.86	0.00%	0.00%	6.79%	9.07%	9.94%	36.04%	16.82%	21.33%
12.50%	15.00%	0.92	0.00%	0.00%	8.81%	12.34%	6.86%	42.04%	23.75%	6.20%
13.32%	16.00%	0.94	0.00%	0.00%	10.13%	12.50%	2.61%	45.60%	29.16%	0.00%
30.90%	16.73%	0.43	12.50%	12.50%	12.50%	12.50%	0.00%	0.00%	50.00%	0.00%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Sharpe ratio	Asia	America	CEE	China	South Africa	GPR USA	GPR UK	GPR EURO
10.94%	6.07%	0.24	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
9.51%	8.48%	0.52	0.00%	0.20%	3.24%	0.00%	5.00%	21.05%	3.24%	67.26%
21.23%	15.75%	0.58	5.00%	5.00%	5.00%	5.00%	0.00%	0.00%	80.00%	0.00%

The portfolio allocations presented in table A3 are measured in USD terms (5 years). It shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio.

[38] Contrary to the minimum MVAR tables, these results are annualized

Table A4: Optimal portfolios of Real Estate assets 1997-2002

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
10.54%	26.06%	2.14	0.00%	0.00%	0.00%	0.00%	0.00%	23.66%	0.00%	76.34%
16.11%	22.36%	1.17	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
10.69%	26.62%	2.16	0.00%	0.00%	0.00%	0.00%	0.00%	13.14%	3.21%	83.64%
			II. No restrictions on any assets							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
18.61%	21.44%	0.96	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%
11.08%	23.00%	1.76	0.00%	0.00%	0.78%	37.04%	0.00%	42.23%	0.00%	19.95%
10.06%	24.00%	2.04	0.00%	0.00%	0.00%	29.39%	0.00%	30.88%	0.00%	39.73%
9.63%	25.46%	2.28	1.65%	0.57%	0.00%	19.40%	1.51%	17.18%	0.00%	59.69%
9.67%	26.00%	2.33	2.96%	0.85%	0.00%	16.63%	3.11%	13.56%	0.00%	62.89%
10.01%	27.21%	2.37	5.90%	1.50%	0.00%	10.37%	6.71%	5.42%	0.00%	70.10%
10.41%	28.00%	2.35	7.80%	1.91%	0.00%	6.36%	9.04%	0.15%	0.00%	74.74%
11.19%	29.00%	2.28	11.08%	2.55%	0.00%	0.00%	11.08%	0.00%	0.23%	71.51%
12.79%	30.00%	2.07	16.10%	2.33%	0.00%	0.00%	24.60%	0.00%	0.57%	56.41%
15.10%	31.00%	1.82	21.08%	2.11%	0.00%	0.00%	34.50%	0.00%	0.91%	41.41%
17.82%	32.00%	1.60	26.04%	1.89%	0.00%	0.00%	44.33%	0.00%	1.24%	26.51%
32.15%	34.53%	0.97	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
14.47%	22.24%	1.30	0.00%	0.00%	0.00%	12.50%	0.00%	87.50%	0.00%	0.00%
10.92%	24.00%	1.88	0.00%	0.00%	1.42%	12.50%	0.00%	50.58%	0.00%	35.50%
9.72%	25.96%	2.31	2.42%	1.38%	0.00%	12.50%	2.17%	17.68%	0.00%	63.86%
9.93%	27.00%	2.37	5.39%	1.38%	0.00%	11.47%	6.09%	6.83%	0.00%	68.84%
10.41%	28.00%	2.35	7.80%	1.91%	0.00%	6.36%	9.04%	0.15%	0.00%	74.74%
11.23%	29.00%	2.27	12.14%	3.84%	0.00%	0.00%	12.50%	0.00%	3.86%	67.67%
15.84%	30.07%	1.68	12.50%	12.50%	0.00%	0.00%	12.50%	0.00%	62.50%	0.00%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
15.41%	22.31%	1.22	0.00%	0.00%	0.00%	5.00%	0.00%	95.00%	0.00%	0.00%
10.53%	25.00%	2.04	0.00%	0.77%	0.39%	5.00%	0.00%	39.87%	0.00%	53.96%
10.00%	26.51%	2.30	3.25%	2.27%	0.00%	5.00%	2.87%	18.21%	0.00%	68.40%
10.13%	27.31%	2.35	5.00%	2.84%	0.00%	5.00%	5.00%	7.45%	0.00%	74.71%
16.25%	29.09%	1.57	5.00%	5.00%	0.00%	0.00%	5.00%	0.00%	85.00%	0.00%

The portfolio allocations presented in table A4 are measured in USD terms (5 years). It shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio

Table A5: Optimal portfolios of Real Estate assets 2002-2007

Portfolio Characteristics			*I. No emerging markets*							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
10.54%	26.06%	2.14	0.00%	0.00%	0.00%	0.00%	0.00%	23.66%	0.00%	76.34%
16.11%	22.36%	1.17	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%
10.69%	26.62%	2.16	0.00%	0.00%	0.00%	0.00%	0.00%	13.14%	3.21%	83.64%
			II. No restrictions on any assets							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
18.61%	21.44%	0.96	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%
11.08%	23.00%	1.76	0.00%	0.00%	0.78%	37.04%	0.00%	42.23%	0.00%	19.95%
10.06%	24.00%	2.04	0.00%	0.00%	0.00%	29.39%	0.00%	30.88%	0.00%	39.73%
9.63%	25.46%	2.28	1.65%	0.57%	0.00%	19.40%	1.51%	17.18%	0.00%	59.69%
9.67%	26.00%	2.33	2.96%	0.85%	0.00%	16.63%	3.11%	13.56%	0.00%	62.89%
10.01%	27.21%	2.37	5.90%	1.50%	0.00%	10.37%	6.71%	5.42%	0.00%	70.10%
10.41%	28.00%	2.35	7.80%	1.91%	0.00%	6.36%	9.04%	0.15%	0.00%	74.74%
11.19%	29.00%	2.28	11.08%	2.55%	0.00%	0.00%	11.08%	0.00%	0.23%	71.51%
12.79%	30.00%	2.07	16.10%	2.33%	0.00%	0.00%	24.60%	0.00%	0.57%	56.41%
15.10%	31.00%	1.82	21.08%	2.11%	0.00%	0.00%	34.50%	0.00%	0.91%	41.41%
17.82%	32.00%	1.60	26.04%	1.89%	0.00%	0.00%	44.33%	0.00%	1.24%	26.51%
32.15%	34.53%	0.97	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%
			II. No capping on DM, 12.5% capping on EM							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
14.47%	22.24%	1.30	0.00%	0.00%	0.00%	12.50%	0.00%	87.50%	0.00%	0.00%
10.92%	24.00%	1.88	0.00%	0.00%	1.42%	12.50%	0.00%	50.58%	0.00%	35.50%
9.72%	25.96%	2.31	2.42%	1.38%	0.00%	12.50%	2.17%	17.68%	0.00%	63.86%
9.93%	27.00%	2.37	5.39%	1.38%	0.00%	11.47%	6.09%	6.83%	0.00%	68.84%
10.41%	28.00%	2.35	7.80%	1.91%	0.00%	6.36%	9.04%	0.15%	0.00%	74.74%
11.23%	29.00%	2.27	12.14%	3.84%	0.00%	0.00%	12.50%	0.00%	3.86%	67.67%
15.84%	30.07%	1.68	12.50%	12.50%	0.00%	0.00%	12.50%	0.00%	62.50%	0.00%
			II. No capping on DM, 5% capping on EM							
Risk	Return	Sharpe ratio	Asia	Americas	China	CEE	South Africa	GPR USA	GPR UK	GPR EURO
15.41%	22.31%	1.22	0.00%	0.00%	0.00%	5.00%	0.00%	95.00%	0.00%	0.00%
10.53%	25.00%	2.04	0.00%	0.77%	0.39%	5.00%	0.00%	39.87%	0.00%	53.96%
10.00%	26.51%	2.30	3.25%	2.27%	0.00%	5.00%	2.87%	18.21%	0.00%	68.40%
10.13%	27.31%	2.35	5.00%	2.84%	0.00%	5.00%	5.00%	7.45%	0.00%	74.71%
16.25%	29.09%	1.57	5.00%	5.00%	0.00%	0.00%	5.00%	0.00%	85.00%	0.00%

The portfolio allocations presented in table A5 are measured in USD terms (5 years). It shows the portfolio allocations without any emerging markets in the portfolio. II shows the portfolio allocation if EM can be freely added to the portfolio. III shows the portfolio allocation if no more than 12.5% of each EM can be added to the portfolio. IV equals III, but with a 5% maximum of each EM added to the portfolio

Table A6: Overview EM property companies included

Company name	Listing date	Region focus	Country listing
GUOCOLAND	<1992	Asia	Malysia
IGB	<1992	Asia	Malysia
WORLDWIDE HOLDINGS	<1992	Asia	Malysia
AYALA LAND	<1992	Asia	Philippines
SM PRIME HOLDINGS	01/08/94	Asia	Philippines
AL-'AQAR KPJ REIT.	01/09/06	Asia	Malysia
HEKTAR REITS	01/01/07	Asia	Malysia
TOWER RLST.INV.TRUST	01/05/06	Asia	Malysia
ASCOTT RESIDENCE TRUST A	01/10/06	Asia	Singapore
AXIS REAL EST.INV.TST.	01/09/05	Asia	Malysia
STARHILL REIT.TST.	01/01/06	Asia	Malysia
UOA REAL ESTATE IT.	01/01/06	Asia	Malysia
CPN RETAIL GROWTH PR.FD.	01/09/05	Asia	Thailand
KLCC PROPERTY HOLDINGS	01/09/04	Asia	Malysia
EREDENE CAPITAL	01/03/05	Asia	UK

Company name	Listing date	Region focus	Country listing
IRSA	01/05/02	Americas	Argentina

Company name	Listing date	Region focus	Country listing
ALARKO GAYRIMENKUL	01/08/97	CEE	Turkey
ATAKULE GMYO	01/03/01	CEE	Turkey
ATLAS ESTATES	01/03/06	CEE	UK
BLACK SEA PROPERTY FUND	01/04/05	CEE	UK
CA IM.ANLAGEN	<1992	CEE	Austria
CA IMMO INTERNATIONAL	01/11/06	CEE	Austia
DAWNAY DAY CARPATHIAN	01/08/05	CEE	UK
DOGUS GE GAYMEN.YATOTA.	01/04/98	CEE	Turkey
EASTERN PROPERTY HDG.	01/01/01	CEE	Switserland
EGS GAYRIMENKUL	01/04/98	CEE	Turkey
EQUEST BALKAN PROPERTIES	01/01/06	CEE	UK
EUROPEAN CVGE.PR.CO.	01/07/05	CEE	UK
GTC	01/06/04	CEE	Poland
IMMOEAST AG	01/01/04	CEE	Austria
IS GAYRIMENKUL	01/02/00	CEE	Turkey
LEWIS CHAS.SOFIA PR.FD.	01/10/05	CEE	UK
MEINL EUROPEAN LAND	01/04/03	CEE	Austria
MID EUROPE REAL ESTATE NV	01/12/03	CEE	Netherlands
NORTH REAL EST.OPPS.FD.	01/09/06	CEE	UK
NORTHERN EUROPEAN PROPS.	01/12/06	CEE	UK
NUROL GMYO	01/01/00	CEE	Turkey
ORCO PROPERTY GROUP	01/01/01	CEE	France
RAVEN RUSSIA	01/08/05	CEE	UK
VAKIF GAYRIMENKUL	01/08/97	CEE	Turkey
Y VE Y GAYRIMENKUL YATOTA.	01/01/00	CEE	Turkey
YAPI KREDI KORAY	01/07/98	CEE	Turkey

Company name	Listing date	Region focus	Country listing
AGILE PROPERTY HDG.	01/01/06	China	Hong Kong
BEIJING NORTH STAR 'H'	01/06/97	China	China
BAOYE GROUP 'H'	01/07/03	China	Hong Kong
CAPITARETAIL CHINA TRUST	01/01/07	China	Singapore
CHINA OS.LD.& INV.	01/09/92	China	Hong Kong
CHINA RESOURCES LAND	01/12/96	China	Hong Kong
CHINESE ESTATES HDG.	01/06/97	China	Hong Kong
GREENTOWN CHINA HDG.	01/08/06	China	Hong Kong
GUANGZHOU R&F PROPS.'H'	01/08/05	China	Hong Kong
GZI REIT.TST.	01/01/06	China	Hong Kong
HOPSON DEVELOPMENT HDG.	01/06/98	China	Hong Kong
NEW WORLD CHINA LD.	01/08/99	China	Hong Kong
NEW WORLD DEV.	<1992	China	Hong Kong
SHANGHAI FORTE LAND 'H'	01/03/04	China	Hong Kong
SHANGHAI REAL ESTATE	01/01/00	China	Hong Kong
SHENZHEN INVESTMENT	01/04/97	China	Hong Kong
SHIMAO PROPERTY HOLDINGS	01/08/06	China	Hong Kong
SHUI ON LAND	01/11/06	China	Hong Kong
SPG LAND HOLDINGS	01/11/06	China	Hong Kong

Company name	Listing date	Region focus	Country listing
ACUCAP PROPERTIES	01/05/02	South Africa	South Africa
ALLAN GRAY PR.TRUST	<1992	South Africa	South Africa
AMBIT PROPERTIES	01/03/04	South Africa	South Africa
ATLAS PROPERTIES	<1992	South Africa	South Africa
CAPITAL PROPERTY FD.	<1992	South Africa	South Africa
CBS PROPERTY PRTF.	01/12/05	South Africa	South Africa
EMIRA PROPERTY FUND	01/01/04	South Africa	South Africa
GROWTHPOINT PROPS.	<1992	South Africa	South Africa
HYPROP INVESTMENTS	<1992	South Africa	South Africa
IFOUR PROPERTIES	01/02/03	South Africa	South Africa
OCTODEC INVESTMENT	<1992	South Africa	South Africa
PANGBOURNE PROPS.	<1992	South Africa	South Africa
PREMIUM PROPERTIES	01/07/95	South Africa	South Africa
RESILIENT PR.FD.	01/01/03	South Africa	South Africa
SA CORPORATE RL.EST.FUND	01/05/96	South Africa	South Africa
SYCOM PROPERTY FUND	<1992	South Africa	South Africa
VUKILE PR.FUND	01/07/04	South Africa	South Africa

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