International Real Estate Diversification: Empirical

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Abstract

This article is the winner of the International Real Estate Investment/Portfolio Management manuscript prize (sponsored by Jones Lang LaSalle) presented at the 1999 American Real Estate Society Annual Meeting.

This study examines the potential diversification opportunities arising from the extension of real estate portfolios into an international environment. Using data for ten countries, the article compares the diversification benefits obtained from both real estate securities and hedged indices. The hedged indices are constructed in line with the methodology proposed by Giliberto (1993) and are examined as a potential alternative proxy for the direct market. The results indicate that while benefits do arise from international diversification, the results tend to be statistically significant only when local returns are used and no constraints are imposed on the optimal portfolios. In addition, there are concerns over the reliability of the mean return and correlation coefficients obtained using the hedged indices.

Introduction

While large numbers of studies have examined international diversification in the capital markets, the majority of asset allocation studies examining real estate have done so in a domestic setting. This literature has generally argued that the asset justified inclusion in domestic mixed-asset portfolios.[1] In comparison to the wealth of literature examining domestic markets, relatively few studies have broadened the analysis into an international environment, despite the potential benefits of international diversification in the capital markets being long accepted. This empirical evidence has also been consistent irrespective of the various foreign exchange rate systems in place. While the earlier studies such as Grubel (1968) and Solnik (1974) analyzed data within the fixed foreign exchange rate environment of the Bretton Woods agreement, later studies such as Glen and Jorion (1993), who analyzed data from periods of floating rate regimes, have found largely similar results. Eun and Resnick (1985) explore the impact of the foreign

exchange market on the potential for international diversification benefits, finding that the nationality of the investor can dramatically effect the composition of the optimal portfolios, and the corresponding gains.[2]

The studies that have examined real estate in an international context can be broadly divided into three types. The first are those articles that have used the limited data available on international direct markets, while the second classification of study are those that have used real estate securities. Studies such as Ross and Webb (1985), Worzala (1992), Newell and Webb (1996), Goeztmann and Wachter (1996) and Quan and Titman (1997) have all examined the diversification opportunities available from international real estate markets. Eichholtz (1996a, b), Eichholtz and Hartzell (1996), Eichholtz, Huisman, Koedijk and Schuin (1997) and Liu and Mei (1998) all examined the indirect real estate sector.

The final type of study has examined the attractiveness of foreign real estate, concentrating on the issue of foreign exchange exposure and the most appropriate currency hedging technique. These studies have analyzed the use of forwards (Ziobrowski and Ziobrowski, 1995) and option contracts (Ziobrowski and Ziobrowski, 1993), while a number of recent papers have extended the literature by examining the use of swaps in hedging real estate, generally finding that currency swaps are the most suitable hedging instrument available for real estate investors. Examples of such studies include Worzala, Johnson and Lizieri (1997), Lizieri, Worzala and Johnson (1998) and Ziobrowski, Ziobrowski and Rosenberg (1997).

In part, the lack of empirical studies examining international diversification in the real estate sector has been due to two key factors: (1) the relative lack of quality international real estate data and (2) problems in using alternative measures of these markets. With regard to the first point, data is limited in terms of both the historical coverage and the number of markets for which such data are available. While a number of studies have used indirect real estate vehicles such as real estate investments trusts (REITs) and property companies as an alternative proxy of the real estate market, this leads to additional problems due to the influence of the general equity market on indirect vehicles' returns and volatility.

This study extends the work initiated by papers such as Giliberto (1993) in constructing hedged indices of indirect real estate vehicles in an international context and comparing these results to those obtained using unadjusted real estate securities. The use of hedged indices potentially provides a number of advantages over the use of direct market data. First, international coverage can be greatly expanded to include markets that have limited direct market data. Second, the historical coverage and the frequency of the data can also be extended. The final issue is concerned with the problems encountered in measuring risk in the direct market and the fact that it is commonly felt that the variance is downwardly biased. Due to the importance of the variance in asset allocation studies, the uncertainty

regarding the true risk of the asset and whether currently proposed correction models correctly transform the data, the use of hedged indices may provide a viable alternative measure of volatility.

The exact causes of the high levels of autocorrelation and smoothing in index returns remains a controversial issue in the real estate literature, especially with regard to the role of appraisals themselves. Recent studies by Lai and Wang (1998) and Graff and Young (1999) argue that appraisals themselves do not lead to smoothing.[3] However, recent articles by Tarbert and Marney (1998) and Brown and Matysiak (2000), utilizing the finance literature on non-synchronous trading, show that even when appraisals are not smoothed, the impact of cross-autocorrelation can lead to high levels of smoothing at an index level.

A number of studies in recent years have used the hedged index approach as an alternative to either attempting to 'correct' indices of the direct market or using indirect securities such as REITs. In addition to Giliberto's (1993) study, other articles examining the issue include Liang and Webb (1996) who also include international stocks in their analysis, Liang, Chatrath and McIntosh (1996) who apply the methodology to apartment REITs and Liang, Seiler and Chatrath (1998).

This study builds on the previous literature by examining international diversification in real estate using the hedged index approach as a means of adjusting for autocorrelation in measures of the direct market. The study also examines the issue from the perspective of an investor domiciled in each of the ten countries analyzed, thereby allowing an analysis of whether the nationality of the investor impacts the results. Furthermore, this article examines the benefits to be gained from diversifying into international markets. Using the procedure proposed by Jobson and Korkie (1982) and Gibbons, Ross and Stamburgh (1989), we test the statistical significance of the improvement in performance by extending portfolios into an international environment. These tests are conducted on both the original real estate series and the hedged indices. The remainder of the article is laid out as follows. Initially details of the data requirements and the methodological framework adopted in this study are discussed. The following sections present the empirical results, while a final section provides concluding comments.

Data & Methodological Framework

This study examines indirect real estate data from ten countries over the period 1978 to 1997. The countries analyzed are Australia, Belgium, Canada, France, Italy, Japan, the Netherlands, Singapore, the United Kingdom and the United States.[4] All ten markets are analyzed using monthly data on a total return basis, with the Datastream property indices representing each of the markets with the exception of the U.S., where the NAREIT Equity Index was used. The overall NAREIT Index was not used due to the quite different characteristics of mortgage REITs.

The hedged indices are created as follows. The original indirect security indices are adjusted for the influence of their respective equity markets through the use of the following regression model:

$$r_t^p = \alpha + \beta r_t^e + \varepsilon_t, \quad (1)$$

where r_t^p is the unhedged index, r_t^e is the respective equity index, α is the intercept term and β is the estimated beta coefficient. The hedged real estate index can therefore be retrieved as:

$$r_t^{hp} = r_t^p - \beta r_t^e, \quad (2)$$

where r_t^{hp} is the *hedged* index. As the relationship between indirect real estate vehicles and the general equity market may not be stable, the hedged indices are calculated on a forty-eight month rolling basis as in Giliberto (1993) and Liang and Webb (1996).[5] As the total sample covers a period of 259 months, 212 regressions are run for each of the ten markets. Due to the need for forty-eight months of data, while the overall data set starts in 1978, the first hedged index is calculated in 1980. Therefore, the sample for empirical analysis covers the period from 1980 to 1997.

We also compare the summary statistics for the hedged indices against the direct market for the U.K. and the U.S. This part of the analysis was undertaken as the primary aim of this article to see whether the hedged methodology can provide a viable proxy for the direct market, it is therefore of interest to compare the summary statistics of the two series. The choice of the U.S. and the U.K. was determined by the availability of the direct market indices. For the two markets, the NCREIF and Jones Lang LaSalle indices were used respectively. Due to the aforementioned concerns over smoothing in direct market indices, the direct market returns are adjusted for autocorrelation using two alternative methods, namely the model proposed by Geltner (1993) and a simple first order autoregressive (AR1) model.[6] The Geltner model applies a reverse filter to recover the underlying true return, as shown below:

$$r_t^u = \frac{(r_t^* - (1 - a) r_{t-1}^*)}{a}, \quad (3)$$

where r_t^u is the unobserved true return, r_t^* is the observed appraised value and a is a parameter between 0 and 1. If no smoothing is present in the returns, then

a's value is equal to 1. As the value of a cannot be statistically estimated, its value is based on a judgement concerning the degree of smoothing present in the real estate market. For the purposes of this study, a was fixed so that the periodical risk measure for property was half that of the respective equity market. While the choice of the parameter is arbitrary, the use of the restriction chosen was based on survey results such as Giliberto (1992), which suggest that real estate investors view the assets 'true' volatility as being one half of that of equities. It should, however, be acknowledged that the use of different assumptions may result in different results. However, the use of the AR1 as a Full Information Model alternative should provide an adequate alternative figure. The AR1 model assumes that real estate returns follow a first-order autoregressive process, therefore a can be estimated as the β coefficient in the following OLS regression:

$$r_t^* = \alpha + \beta r_{t-1}^*. \tag{4}$$

The underlying corrected return can be retrieved using the following:

$$r_t^u = \frac{r_t^*}{1-a} - \frac{a}{1-a} r_{t-1}^*. \tag{5}$$

To assess the improvement in portfolio performance resulting from the inclusion of international real estate markets, this article follows the approach proposed by Jobson and Korkie (1982) and extended by Gibbons, Ross and Shanken (1989) and Kandel and Stamburgh (1989).[7] The efficiency of the estimated optimal portfolios can be tested using the F-Statistic that relates to the joint hypothesis of zero intercepts in a system of multiple regressions of the returns of the international markets on the relevant domestic market.

$$R_{it}^d = \alpha_i + \sum_{j=1}^{N_t} \beta_{ij} R_{jt}^x + \varepsilon_{it}, \quad i = 1, \ldots, N, \; t = 1, \ldots T. \tag{6}$$

Where T is the number of observations and N_1 is the number of core assets. Additionally, we can define N_2 as the number of total assets. Gibbons, Ross and Shanken (1989) show that this test can be interpreted in terms of the maximum Sharpe ratios obtainable with both N_1 and N_2 assets.

$$F = \frac{\frac{(T - N_2)}{N}(\hat{\theta}_2^2 - \hat{\theta}_2^2)}{(1 + \hat{\theta}_1^2)}, \tag{7}$$

where $\hat{\theta}_1$ is the initial maximum Sharpe ratio, $\hat{\theta}_2$ is the maximum Sharpe ratio from the expanded data set and N can be defined as $N_2 - N_1$. The statistic has a F-distribution with $(T - N_2, N)$ degrees of freedom. It should be noted that this test assumes that the returns are normal i.i.d, however Affleck-Graves and McDonald (1989) find evidence to support the premise that the test statistic is robust to departures from normality.[8]

The procedure detailed above assumes that the short selling of assets can occur. However, while the short selling of real estate securities is possible, it was felt that this assumption was unrealistic for two reasons. First, short selling in the direct market is impossible due to the nature of the asset, and second, a large proportion of investors in the direct market are institutions limited by legislation and regulation as to the degree of short selling they can partake in. The introduction of an assumption prohibiting short selling leads to the *F-S*tatistic shown in Equation (7) having an unknown distribution, thereby requiring the use of simulations to approximate the distribution.

In order to test the degree of performance improvement under the assumption of no short selling, this article follows the procedure adopted by Glen and Jorion (1993). Initially, the historical returns, variances and covariances are calculated, with the returns modified so that the null hypothesis concerning the mean variance efficiency of the initial set of assets is satisfied. The optimal portfolio of N_1 assets that maximizes the Sharpe ratio is calculated, allowing only positive weights. The expected returns on the international markets are then forced to be proportional to their beta relative to this market. This procedure ensures that the optimal portfolio is the same for the sample of N_1 and N_2 assets. T random samples of joint returns are then drawn from a multivariate standard normal distribution with these parameters, providing a set of simulated returns. From these simulations, a new set of means and a new covariance matrix is estimated. The optimization is performed as before and the value of the F-Statistic recorded. The empirical distribution of the statistic is estimated by repeating this process 1,000 times.

Summary Statistics

This section examines the summary statistics of the transformed data and compares them to those of the unhedged indices. Exhibit 1 provides details of the mean and standard deviation of both the hedged and original real estate security series. In addition, the respective equity series are also displayed. It can be seen that for all ten countries the use of the hedged indices results in a substantial reduction in the standard deviation of the series. For example, in the case of the

Exhibit 1 | Annualized Summary Data for 1980–1997

	Real Estate Securities		Hedged Indices		Equities	
Country	Return	Std. Dev.	Return	Std. Dev.	Return	Std. Dev.
Australia	6.50	34.12	3.67	17.79	3.99	27.00
Belgium	4.61	29.63	2.76	19.89	5.26	21.77
Canada	2.68	44.21	3.64	27.23	3.33	18.19
France	2.69	40.73	2.07	25.37	5.15	26.61
Italy	2.85	33.65	0.33	21.75	5.94	32.31
Japan	2.06	40.11	1.65	19.95	2.26	24.96
Netherlands	2.18	14.46	0.30	10.82	6.04	18.96
Singapore	3.52	51.47	1.32	18.50	2.84	31.88
U.K.	4.13	26.16	1.28	15.44	5.84	20.98
U.S.	4.32	13.82	1.38	11.04	5.77	17.90

Notes: The returns and standard deviations are on an annualized basis. The data used consists of the Datastream Property and Maket Indices with the excetion of the U.S. real estate security market, where the NAREIT Equity Index is used. the hedged series are calculated by removing the influence of the general stock market from the real estate securities.

U.K. market, the annualized standard deviation of the hedged series is 15.44%, in comparison to an original figure of 26.16%. In addition, with the exception of Canada, each of the ten markets sees a reduction in the mean annualized return. While in some cases the reduction in return is minimal, for example France, in other cases there is a substantial change, particularly in the case of the Netherlands. The Dutch market seeing a decline in average return from 2.18% to 0.30%. It is also noticeable that in most cases the risk measures for the unhedged securities are higher than those for the respective general equity market, the exceptions being the Netherlands and the U.S. Only the Australian and Singapore real estate markets provided returns higher than equities.

In addition to comparing the hedged returns to the original real estate series, the risk and return figures of the direct markets in the U.K. and the U.S. are also examined. Annualized quarterly risk and return measures were calculated for the direct, indirect and hedged markets for the two countries and are displayed in Exhibit 2. The results show that the standard deviations of the hedged indices are higher than both the smoothed and corrected direct market indices. In the case of the U.S., the hedged index has a standard deviation of 20.70%, compared to 7.09% for the NCREIF Index, while the Geltner and AR1 adjusted series have corresponding figures of 14.78% and 15.22%. The U.K. results are similar with a hedged standard deviation of 31.35% in comparison to 10.31% for the JLW Index, and 21.39% and 29.82% for the Geltner and AR1 series respectively.

Exhibit 2 | Comparison of Annualized Real Estate Returns and Volatility for 1980–1997

	U.K.		U.S.	
Country	Return	Std. Dev.	Return	Std. Dev.
Hedged Real Estate Indices	3.89	31.35	4.18	20.70
Direct Real Estate	10.04	10.31	7.74	7.09
Direct Real Estate (Geltner)	9.93	21.39	7.96	14.78
Direct Real Estate (AR1)	9.86	29.82	7.97	15.22
Real Estate Securities	12.78	50.43	13.38	29.34

Notes: The returns and standard deviations displayed in Exhibit 2 are done so on an annualized basis and are based on quarterly returns. the direct market is proxied by the Jones Lang Wootton index for the U.K. and the NCREIF index for the U.S. The FT-A Property Index and the NAREIT Index measure real estate security performance and are used in the construction of the hedged indices.

Therefore, while the use of the hedged indices does see an increase in the risk measure relative to the smoothed direct market, the figures are higher in each case than those obtained using the conventional correction models.

In addition, and of more concern, is the reduction in the mean return for the hedged indices. The literature would suggest that the primary bias in the performance measurement of real estate occurs with the second moment, with little evidence to suggest that the mean is biased. The results contained in Exhibit 2 would however indicate that while hedged indices perhaps provide a viable alternative risk measure of the real estate market, there may be concerns over the reliability of the return figures. For both the U.K. and U.S. markets, the average return figures obtained from the hedged indices are substantially lower than those for either the direct or indirect markets. In the case of the U.S. market, a hedged index mean of 4.18% compares to corresponding figures of 7.74% and 13.38% for the NCREIF and NAREIT Indices respectively. The figures for the U.K. market follow a similar pattern with returns of 3.89% obtained when the hedged index is analyzed, in comparison to 10.04% for the direct market and 12.78% for property companies.

Influence of Exchange Rate Exposure

The asset allocation tests conducted use both local returns, equivalent to assuming perfect hedging ability, and returns converted at the appropriate spot foreign exchange rates. As the tests in this study take the perspective of investors domiciled in each of the ten countries, we examine the effect of fluctuating currency rates from the viewpoint of each country. Eun and Resnick (1988) show

that the variance of the domestic rate of return for home currency (j) and a given foreign asset (i), can be approximated as follows:

$$Var(r_{ij}) = Var(r_i) + Var(e_i) + 2\ \mathrm{cov}(r_i,e_i), \qquad (8)$$

where r_{ij} is the domestic currency return, r_i is the original local return for the asset and e_i is the rate of appreciation of the assets local currency against the investor's currency. Exhibit 3 provides the results from this decomposition of the currency-adjusted return from the perspective of each of the ten countries. It can be seen that across all assets and each of the ten countries the results are broadly similar, with the largest proportion of volatility being derived from the domestic risk of the asset, with currency risk acting as the second largest component and finally the covariance between the two. The results do however reveal that the division of the source of risk can differ substantially between both the given domestic country and the assets examined. For example, for U.K. investors, the proportion of total risk attributable to currency movement varies from 8.19%, in the case of France, to 46.68% for U.S. assets.[9]

The primary difference between the results for the hedged indices and the unadjusted real estate security series, is that the proportion of total risk that is attributable to domestic factors is generally lower for the hedged indices. Out of a total of ninety decompositions, domestic risk is higher for hedged indices in only three cases. These results would be expected because the results displayed in Exhibit 1 revealed that the risk of the hedged indices was lower than for the original series. Therefore, while the overall risk of the assets will be lower, the currency risk remains constant, naturally leading to the proportion that it accounts for increasing.[10]

Correlational Relationships

Exhibit 4 shows the local return correlations for both the original and hedged series over the overall sample period from 1980 to 1997. The results for the real estate securities, shown in Panel A, conform with previous studies of both real estate and the general equity markets, with low positive coefficients indicating the potential diversification opportunities that can arise from investing internationally. The results obtained using the hedged indices do however show a number of differences, in particular the fact that in every case, the respective hedged coefficient is lower than that obtained using the original data.

These results are highlighted when the significance of the coefficients is examined. In the case of the hedged indices, only four of the coefficients are statistically different from zero at conventional levels. In contrast, however, in the case of the original index series, forty-four of the forty-six correlations are significant. These results would indicate that greater diversification opportunities could be obtained

Exhibit 3 | Decomposition of the Variance of International Real Estate Investment for 1980–1997

	Real Estate Securities			Hedged Real Estate		
	Domestic Risk	Currency Risk	Covariance	Domestic Risk	Currency Risk	Covariance
Panel A: Australian Dollars						
Belgium	76.75	30.85	−3.80	51.32	43.05	2.81
Canada	95.07	8.06	−1.57	86.18	17.42	−1.80
France	88.74	18.84	−3.79	65.12	32.50	1.19
Italy	76.01	22.35	0.82	55.04	35.99	4.48
Japan	76.80	17.09	3.05	51.76	41.20	3.52
Netherlands	55.72	83.28	−19.50	31.44	81.98	−6.71
Singapore	92.09	6.23	0.84	64.99	27.99	3.51
U.K.	78.09	34.11	−6.10	45.41	53.14	0.72
U.S.	56.02	42.18	0.90	45.13	52.28	1.29
Panel B: Belgium Francs						
Australia	63.34	19.72	8.47	42.59	44.04	6.68
Canada	84.21	11.29	2.25	72.22	23.09	2.34
France	98.33	1.12	0.27	97.26	2.60	0.07
Italy	89.10	5.87	2.52	90.65	13.28	−1.96
Japan	81.15	10.06	4.40	68.17	30.21	0.81
Netherlands	94.19	5.24	0.28	88.35	8.57	1.54
Singapore	85.46	6.41	4.06	72.17	34.48	−3.32
U.K.	78.88	15.68	2.72	61.90	32.97	2.57
U.S.	41.17	46.40	6.21	32.21	55.84	5.97

Exhibit 3 | (continued)

Decomposition of the Variance of International Real Estate Investment for 1980–1997

	Real Estate Securities			Hedged Real Estate		
	Domestic Risk	Currency Risk	Covariance	Domestic Risk	Currency Risk	Covariance
Panel C: Canadian Dollars						
Australia	82.33	11.05	3.31	66.82	29.80	1.69
Belgium	92.30	25.30	−8.80	64.20	36.72	−0.46
France	93.42	13.94	−3.68	71.14	24.95	1.96
Italy	84.84	15.83	−0.33	63.80	26.47	4.87
Japan	78.87	13.05	4.04	55.44	32.80	5.88
Netherlands	72.15	73.35	−22.75	40.91	72.56	−6.74
Singapore	98.38	2.33	−0.35	79.56	11.98	4.23
U.K.	82.23	25.11	−3.67	50.17	41.04	4.39
U.S.	92.94	14.13	−3.54	80.07	18.73	0.60
Panel D: French Francs						
Australia	63.83	18.57	8.80	43.47	42.02	7.25
Belgium	99.79	2.01	−0.90	99.36	4.18	−1.77
Canada	84.09	10.86	2.52	72.48	22.32	2.60
Italy	90.80	5.53	1.83	90.96	12.33	−1.65
Japan	80.97	9.76	4.64	68.38	29.49	1.07
Netherlands	93.98	6.23	−0.11	88.43	10.23	0.67
Singapore	85.57	5.89	4.27	71.40	31.28	−1.34
U.K.	80.03	15.43	2.27	63.61	32.87	1.76
U.S.	42.28	44.79	6.47	34.02	55.44	5.27

Exhibit 3 | (continued)

Decomposition of the Variance of International Real Estate Investment for 1980–1997

	Real Estate Securities			Hedged Real Estate		
	Domestic Risk	Currency Risk	Covariance	Domestic Risk	Currency Risk	Covariance
Panel E: Italian Lira						
Australia	65.34	18.73	7.96	44.56	42.43	6.51
Belgium	100.99	8.38	−4.68	95.46	16.52	−5.99
Canada	85.18	9.79	2.52	73.57	20.16	3.13
France	96.05	4.16	0.11	87.15	8.88	1.99
Japan	81.93	12.21	2.93	61.02	32.51	3.24
Netherlands	86.86	25.64	6.25	69.48	35.78	−2.63
Singapore	85.96	5.86	4.09	68.77	29.87	0.68
U.K.	77.16	14.04	4.40	61.05	29.76	4.60
U.S.	42.43	42.73	7.42	34.07	52.78	6.58
Panel F: Japanese Yen						
Australia	66.68	19.80	6.76	43.34	42.75	6.95
Belgium	84.97	18.14	1.56	67.29	29.99	1.36
Canada	86.27	12.03	0.85	71.87	23.90	2.12
France	97.20	11.41	−4.31	79.77	22.01	−0.89
Italy	81.87	16.69	0.72	62.76	28.46	4.39
Netherlands	74.19	55.24	−14.72	52.22	67.83	−10.03
Singapore	87.49	6.12	3.19	70.31	31.32	−0.81
U.K.	83.53	27.23	−5.38	58.21	50.83	−4.52
U.S.	42.50	48.10	4.70	33.83	58.89	3.64

Exhibit 3 | (continued)

Decomposition of the Variance of International Real Estate Investment for 1980–1997

	Real Estate Securities			Hedged Real Estate		
	Domestic Risk	Currency Risk	Covariance	Domestic Risk	Currency Risk	Covariance
Panel G: Dutch Guilders						
Australia	62.69	19.06	9.13	42.79	43.22	7.00
Belgium	101.95	1.49	−1.72	105.04	3.20	−4.12
Canada	82.78	10.81	3.21	71.37	22.23	3.20
France	98.96	0.97	0.03	98.19	2.27	−0.23
Italy	89.79	5.53	2.34	91.70	12.56	−2.13
Japan	82.05	9.31	4.32	69.46	28.20	1.17
Singapore	84.41	5.80	4.90	72.65	31.78	−2.21
U.K.	79.27	14.67	3.03	64.26	31.86	1.94
U.S.	41.49	45.50	6.50	32.93	55.53	5.77
Panel H: Singapore Dollars						
Australia	77.32	10.78	5.95	62.77	29.09	4.07
Belgium	92.70	18.52	−5.61	70.43	29.37	0.10
Canada	92.78	2.86	2.18	88.25	6.48	2.63
France	95.17	9.85	−2.51	77.17	18.78	2.03
Italy	83.87	12.10	2.01	66.96	21.49	5.78
Japan	82.90	8.96	4.07	63.29	24.47	6.12
Netherlands	83.07	57.85	−20.46	51.26	62.28	−6.77
U.K.	83.16	20.84	−2.00	56.28	37.78	2.97
U.S.	78.80	13.46	3.87	74.52	19.57	2.96

Exhibit 3 | (continued)

Decomposition of the Variance of International Real Estate Investment for 1980–1997

	Real Estate Securities			Hedged Real Estate		
	Domestic Risk	Currency Risk	Covariance	Domestic Risk	Currency Risk	Covariance
Panel I: Pounds Sterling						
Australia	70.62	19.02	5.18	48.21	43.14	4.32
Belgium	90.73	14.36	−2.55	76.79	25.37	−1.08
Canada	88.86	10.57	0.29	75.29	21.35	1.70
France	94.39	8.19	−1.29	81.57	16.64	0.89
Italy	89.28	10.27	0.22	77.96	19.95	1.05
Japan	84.56	12.74	1.35	63.88	34.42	0.85
Netherlands	78.40	43.99	−11.20	53.75	52.61	−3.18
Singapore	87.89	6.59	2.76	68.67	32.77	−0.72
U.S.	43.81	46.68	4.75	34.43	56.44	4.56
Panel J: U.S. dollars						
Australia	79.01	11.10	4.94	65.26	30.46	2.14
Belgium	89.89	24.40	−7.15	63.68	36.08	0.12
Canada	94.18	1.69	2.07	91.00	3.89	2.56
France	94.21	13.58	−3.90	73.14	24.79	1.04
Italy	84.13	16.21	−0.17	63.76	27.32	4.46
Japan	76.74	12.14	5.56	54.82	31.02	7.08
Netherlands	71.99	72.40	−22.19	41.56	72.90	−7.23
Singapore	96.62	1.49	0.95	80.97	7.96	5.53
U.K.	77.68	25.04	−1.36	47.36	40.90	5.87

Notes: Exhibit 3 provides a decomposition of the volatility of the international markets examined, into domestic risk, currency risk and the covariance between the relevant return series' and currency. The decomposition is calculated as follows: $Var(r_{ij}) = Var(r_i) + Var(e_i) + 2\ \mathrm{cov}(r_i, e_i)$.

Exhibit 4 | Local Return Correlation Matrices for Period 1980–1997

Country	Local Return Matrices									
Panel A: Original Real Estate Series										
Australia	1.000									
Belgium	0.177***	1.000								
Canada	0.224***	0.092*	1.000							
France	0.275***	0.251***	0.067	1.000						
Italy	0.131**	0.156**	0.161***	0.207***	1.000					
Japan	0.114**	0.138**	0.122**	0.275***	0.008	1.000				
Netherlands	0.278***	0.220***	0.187***	0.164***	0.153**	0.212***	1.000			
Singapore	0.425***	0.176***	0.261***	0.138**	0.106*	0.138**	0.235***	1.000		
U.K.	0.452***	0.250***	0.244***	0.232***	0.133**	0.163***	0.195***	0.416***	1.000	
U.S.	0.461***	0.208***	0.201***	0.235***	0.221***	0.157**	0.295***	0.432***	0.415***	1.000
Panel B: Hedged Real Estate										
Australia	1.000									
Belgium	−0.042	1.000								
Canada	0.031	0.002	1.000							
France	0.086	0.051	−0.089	1.000						
Italy	0.018	0.088	−0.065	0.008	1.000					
Japan	−0.065	−0.072	−0.014	0.189***	−0.115	1.000				
Netherlands	0.128*	0.113	0.046	0.075	0.004	0.006	1.000			
Singapore	−0.053	−0.056	0.068	−0.060	−0.100	0.003	0.003	1.000		
U.K.	0.093	0.011	0.082	−0.044	−0.040	−0.035	−0.019	0.050	1.000	
U.S.	0.178***	−0.032	0.019	0.059	0.039	−0.124*	0.114	−0.098	0.159**	1.000

*The coefficient is significantly different from zero at the 10% level.
**The coefficient is significantly different from zero at the 5% level.
***The coefficient is significantly different from zero at the 1% level.

from the hedged indices than from real estate securities. However, as with some of the results obtained previously, there are concerns as to the accuracy of the results given the methodology used in creating the hedged indices. The correlation coefficients obtained in this study are not only considerably lower than those found using the real estate securities, and in previous studies using similar data, but they are also lower than coefficients found in studies examining the direct market. Quan and Titman (1997) for example, examined both rental income and capital value data for seventeen markets between 1987 and 1994, finding substantially higher coefficients than those found here.

Asset Allocation Tests

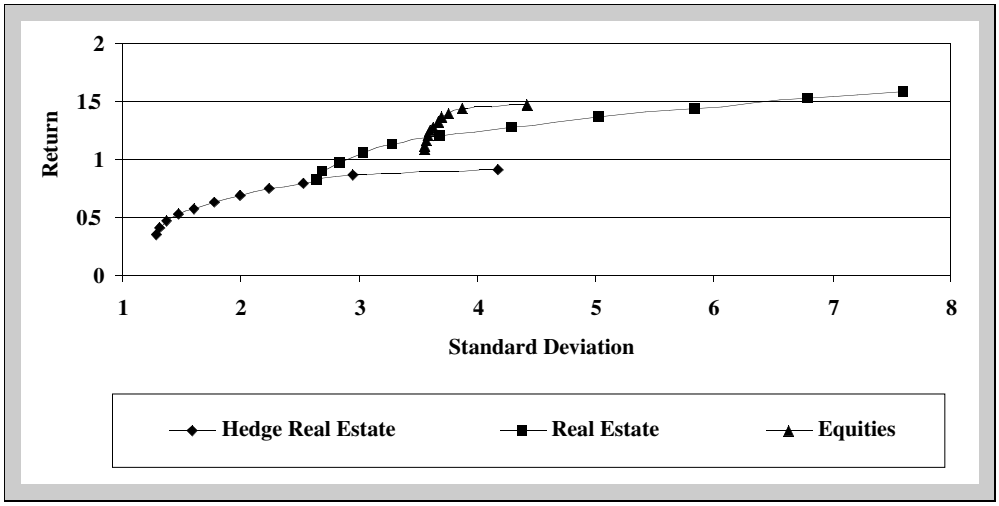
The asset allocation analysis is primarily concerned with the diversification opportunities that can potentially arise from investing in international real estate markets. The tests take the perspective of investors domiciled in each of the ten countries, therefore not only will the tests examine whether diversification opportunities arise, but they will also examine whether these benefits differ between markets. In addition, the optimal portfolios are constructed using both local returns and returns converted at the appropriate spot foreign exchange rates. In all cases, the tests are conducted with the original real estate security data and with the estimated hedged indices, thereby allowing a comparison between the two alternative measures and with previous studies of the indirect market.

Relative Advantages of International Diversification

In order to compare the results with those found by Eichholtz (1996a), we initially examine the respective advantages of diversifying internationally with both the hedged and original real estate series and with equities. Exhibit 5 displays the local return efficient frontiers of real estate securities, the hedged indices and equities, while Exhibits 6 and 7 compare these with combined frontiers of real estate and stocks.

Exhibit 5 shows that the dominant efficient frontier is that of equities, indicating that more benefit can be obtained by diversifying internationally through the general equity market than through either direct or indirect real estate. These findings are contrary to those found by Eichholtz (1996a), who found that property securities offer greater diversification opportunities than equities. Eichholtz examined nine markets from 1985 to 1994 using the LIFE/GPR Indices. While the composition of these indices does differ from those produced by Datastream, it is unlikely that the composition of the index alone would result in differences in the results. Rather, the differences in the findings in this study from those in Eichholtz (1996a) demonstrate the problems in obtaining reliable and stable results in asset allocation studies due to instability in the parameters used. The results contained in Exhibits 6 and 7 do indicate that combinations containing both real estate and equities form the dominant efficient frontier. Therefore, while

Exhibit 5 | Local Return Frontiers



diversification in property alone does not match the diversification benefits obtained from the stock market, the addition of real estate to an optimal stock portfolio does generally result in further increased performance.[11]

This study extends the literature to formally assess the statistical significance of the improvement in performance. Using the methodology outlined, we formally

Exhibit 6 | Real Estate and Equities

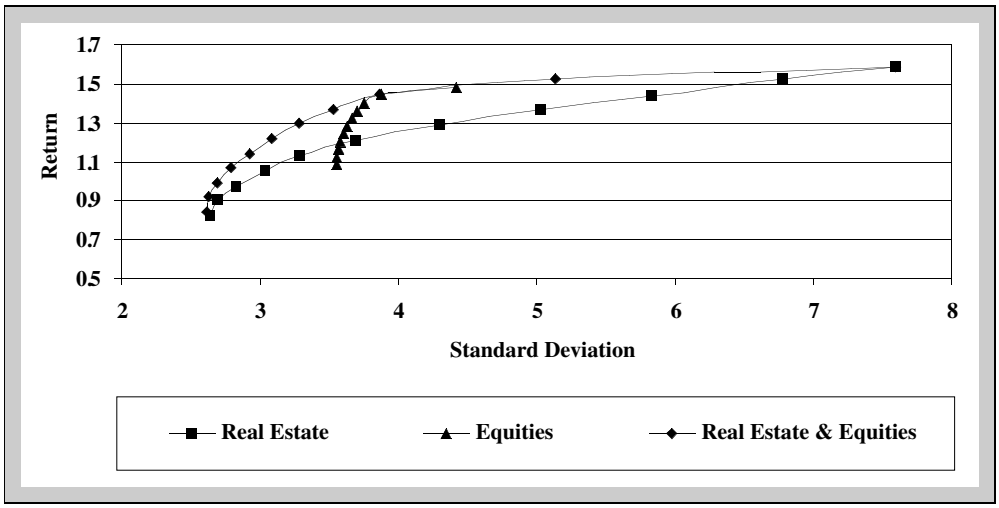
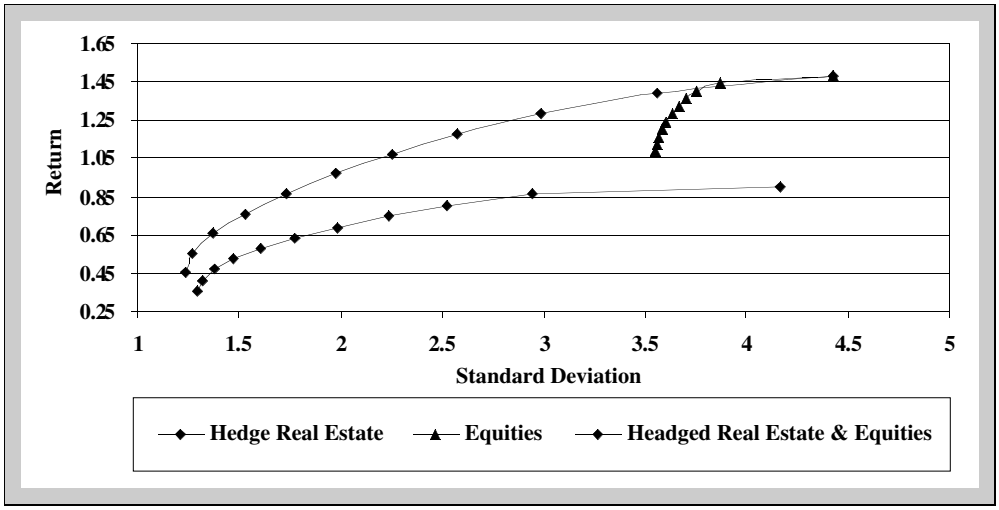


Exhibit 7 | Hedged Real Estate and Equities



assess the difference in performance between the pure equity frontiers and those estimated using the combined data sets.[12] The results of the tests for performance improvement are contained in Exhibit 8, and show that despite the dominance of the combined frontiers, the improvement in portfolio performance is statistically significant in only three cases. All three cases are with the hedged indices and are those frontiers calculated using local returns and those in Dutch Guilders and Singapore Dollars. In all other cases, despite the maximum Sharpe ratio being higher for the combined portfolio, it was not significantly greater than that obtained for the pure equity frontier. Therefore, from an investor's viewpoint, the relative advantages of extending an equity portfolio into either direct or indirect real estate is not as convincing as previous literature may have suggested.

Extending Domestic Real Estate Portfolios

This section examines the diversification benefits that can arise from diversifying a domestic real estate portfolio into international markets. The tests are undertaken under a variety of scenarios using both the hedged indices and the raw real estate security series. The tests are undertaken from the perspective of an investor domiciled in each of the ten countries examined.

Initially, the performance of the respective domestic market is compared to efficient frontiers constructed using both local returns and returns converted at the appropriate spot foreign exchange rate.[13] In addition, the frontiers are re-calculated on a constrained basis. Studies such as Hines (1988), Worzala (1994) and Newell and Worzala (1995) have found that most real estate portfolio managers concentrate in their domestic markets, with a large number having no foreign

Exhibit 8 | *F*-Tests of Performance Improvement for Real Estate Securities for 1980–1997

	Real Estate & Equity Portfolios	
	Real Estate Securities	Hedged Indices
Local Returns	0.30	2.21*
Australian Dollars	0.17	0.72
Belgium Francs	0.16	1.77
Canadian Dollars	0.19	0.87
French Francs	0.13	1.53
Italian Lira	0.07	0.54
Japanese Yen	0.15	0.98
Dutch Guilders	0.23	2.32*
Singapore Dollars	0.46	2.31*
U.K. Sterling	0.07	0.81
U.S. Dollars	0.40	1.63

Notes: Exhibit 5 displays the *F*-Statistic relating to the improvement in portfolio performance. The test examines whether the inclusion of real estate into an equity portfolio results in improved performance.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

holdings. Hines found evidence that most investors who do expand their real estate portfolios into non-domestic markets generally prefer those nations to whom they are geographically close to, or alternatively are culturally similar to. The requirement for more direct and active management of real estate, the in-depth knowledge required of local legislation and the generally high cost of the investment, all further contribute to the small scale of international portfolios.[14] Because of these survey findings, it was felt to be prudent to constrain the maximum allocation in non-domestic markets, therefore an arbitrary upper limit of 20% was imposed.

For illustrative purposes, Exhibits 9 and 10 show the efficient frontiers using both the local and spot rate hedged index returns from the perspective of a U.S. investor. Under both currency scenarios, it can be seen that while diversification benefits do occur under the constrained conditions, the unconstrained efficient frontier is superior.[15] As with the preceding analysis, we examine whether the improvement in portfolio performance is statistically significant, with the results contained in Exhibit 11. It can be seen that on an unconstrained basis using the local returns, the improvement in portfolio performance for the hedged indices is significantly greater than the relevant domestic market in every case with the exception of Australia. In addition, when the real estate securities are examined, Australia and

Exhibit 9 | U.S. Investor Local Return Efficient Frontiers

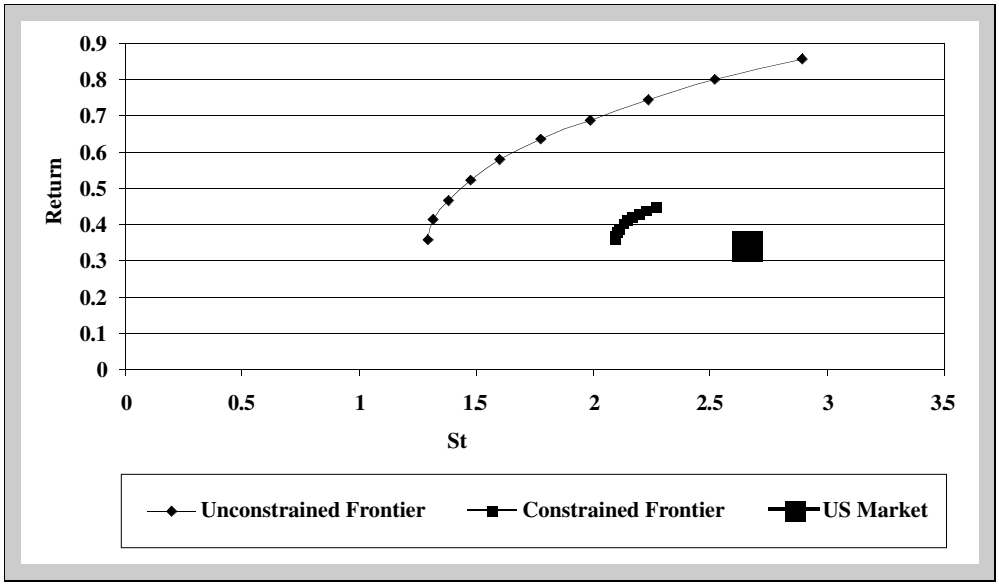


Exhibit 10 | U.S. Investor Spot Rate Return Efficient Frontiers

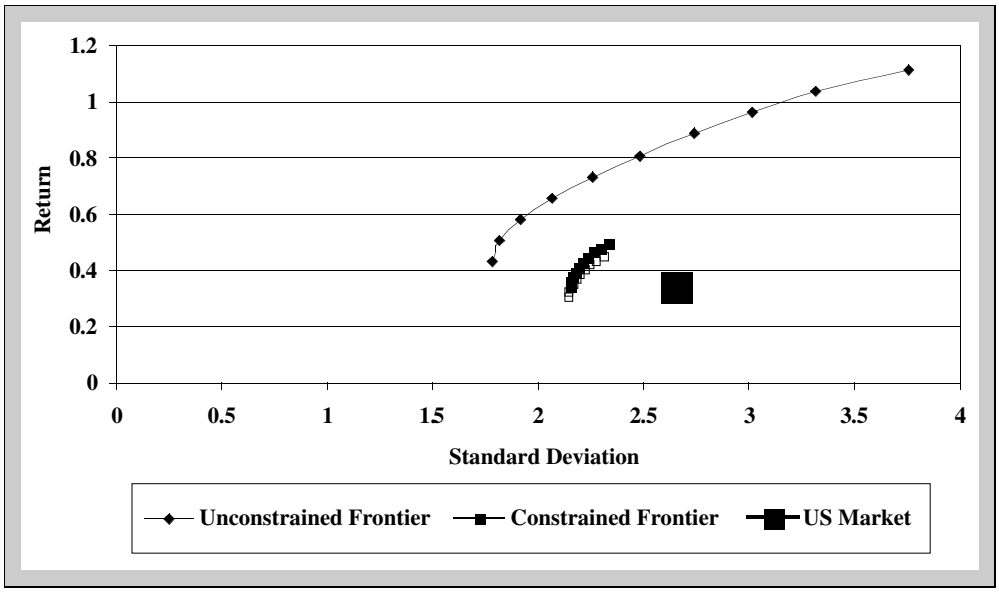


Exhibit 11 | *F*-Test of Performance Improvement for Real Estate Portfolios for 1980–1997

	Unconstrained Real Estate		Unconstrained Real Estate		Constrained Real Estate		Constrained Real Estate	
Home Country	(Local) Real Estate Securities	Hedged Indices	(Spot) Real Estate Securities	Hedged Indices	(Local) Real Estate Securities	Hedged Indices	(Spot) Real Estate Securities	Hedged Indices
Australia	1.96	2.11	0.30	0.32	0.27	0.49	0.27	0.13
Belgium	2.37*	2.82**	1.68	1.31	0.41	0.41	0.43	0.48
Canada	3.05**	2.84**	2.11	1.48	0.16	0.28	0.34	0.19
France	3.03**	3.22**	2.09	1.48	0.18	0.21	0.21	0.20
Italy	2.94**	3.44**	1.24	0.91	0.27	0.09	0.07	0.25
Japan	3.09**	3.22**	3.06**	2.89**	0.17	0.28	0.46	0.24
Netherlands	2.48*	3.43**	2.43*	2.37*	0.60	0.27	0.39	0.89
Singapore	3.01**	3.28**	3.75**	4.0**	0.13	0.27	0.40	0.18
U.K.	2.36*	3.22**	1.06	1.23	0.32	0.33	0.34	0.36
U.S.	0.39	2.96**	0.39	2.32*	0.36	0.57	0.72	0.65

Notes: This exhibit displays the *F*-Statistic relating to the improvement in portfolio performance. The test examines the improvement in performance that results from extending a domestic real estate portfolio into international markets. The tests are conducted twice, first on an unconstrained basis and secondly with a 20% maximum allocation in international markets.

*Significant at the 10% level.

**Significant at the 5% level.

the U.S. are the only home markets not to significantly benefit from diversifying internationally. The probable reason as to why investors in these countries do not significantly benefit is the strong performance of their respective domestic markets. With regard to the original real estate security data, Australian Property Trusts and REITs produce two of the three highest mean returns, while their standard deviations are relatively low. The same is also true for the Australian hedged index. The results do, however, generally confirm the benefits from diversifying real estate portfolios into non-domestic markets.

However, the results under the different scenarios do not support the initial findings to the same extent. When the returns are adjusted for changes in the relevant foreign exchange rate, the number of significant results reduces substantially. With regard to the original series, the only countries that maintain significant diversification benefits are Japan, the Netherlands and Singapore, while for the hedged indices, these three countries together with the U.S. provide significant results. These findings highlight the importance of currency movements and the effect that they can have on the performance of the optimal portfolios. While formal tests were not conducted and costs were not incorporated into the analysis, the results would indicate that adopting a currency hedging strategy would provide enhanced diversification benefits.

These results do, however, have a number of implications for portfolio managers examining the potential benefits to be obtained from international diversification. This can be clearly seen if the constrained results are examined. None of the tests conducted produce significant *F*-Statistics, indicating that while performance is still improved, it is not statistically significant. It would therefore appear that for investors to obtain statistically significant benefits, they must have allocations in international markets in excess of that currently held.

Conclusion

The analysis of international markets is severely limited due to the lack of long-term data, and furthermore the problems over the reliability of measures of the direct real estate market. This study examined international real estate investment through the use of the hedged index methodology proposed by Giliberto (1993). The hedged methodology utilizes the more comprehensive data available for indirect real estate securities and obtains a proxy of the direct market by removing the influence of the general equity market on the real estate security series.

Using hedged indices of indirect real estate securities for ten markets, the potential diversification benefits that could arise are examined and then compared to the results obtained using the unadjusted indices. The results confirm the findings of previous studies regarding the benefits obtained from investing in foreign markets. However, the results indicate that unless a fully-hedged currency strategy is adopted and substantial amounts are allocated in non-domestic markets, the improvement in performance is generally not statistically significant. These findings apply to both the hedged indices and the original real estate security data.

The results also contradict the previous findings of Eichholtz (1996a) with regard to the relative benefits of diversifying internationally in real estate and stocks. While Eichholtz (1996a) found evidence to support the view that real estate provided enhanced benefits, the findings in this study are to the contrary.

While the asset allocation results for the hedged indices do not differ substantially from those for the real estate securities, the summary statistics do reveal that the use of such a methodology on an international scale may be problematic. Of primary concern is the reduction in the means of the hedged indices in comparison to both the indirect and direct sectors. As stated earlier, previous work would suggest that problems in measuring performance in the direct market can lead to bias in the second moment of the returns, however, there is little evidence to support the view that the mean is also biased. In addition, the correlation coefficients between the different markets differ substantially when the two different data sets are analyzed. This problem is highlighted even more as the coefficients between the hedged indices are also substantially lower than those found between direct markets. Therefore, while the hedged indices may provide a means of obtaining an alternative measure of volatility in real estate markets, the potential biases created in both the mean and the correlation and covariance matrices does lead to its wide-spread use being brought into question.

Endnotes

[1] Studies such as Firstenberg, Ross and Zisler (1988), Ross and Zisler (1991) and Kalberg, Liu and Grieg (1996) have all examined the U.S. market, while numerous studies have examined other international markets, such as MacGregor and Nanthakumaran (1992) and Lee, Byrne and French (1996) in the U.K.

[2] Further studies that examine this issue include Jorion (1985), Eun and Resnick (1988), Glen and Jorion (1993) and Levy and Lim (1994).

[3] See also Geltner (1999) for a comment on Lai and Wang (1999).

[4] Hong Kong was initially analyzed, however complications arose due to the prominent role that the sector plays in the general equity market.

[5] While the use of a rolling period should ensure that the majority of the changes in the relationship between real estate securities is captured, there remains the stationarity issue.

[6] The primary difference between the two models is the implicit assumption each makes regarding the efficiency of the real estate market. The AR1 model implicitly assumes perfect market efficiency by assuming that the underlying returns are unpredictable. This form of model can therefore be referred to as a 'full information model.' The Geltner model, however, does not make this implicit assumption, and therefore can be viewed as a 'partial information model.'

[7] Glen and Jorion (1993) applied the same technique with regard to international diversification in the equity and fixed income markets.

[8] MacKinlay and Richardson (1991) show that under less strict assumptions, a Generalized Method of Moments (GMM) Wald test can be calculated as follows:

$$W = ((T - N - 1)(\hat{\alpha}')[D'S^{-1}D]^{-1}\hat{\alpha}).$$

Where $[D'S^{-1}D]$ is the White (1980) heteroskedasticity consistent covariance matrix. The Wald statistic has an asymptotic χ^2 distribution with N degrees of freedom.

[9] There are also differences in the results found in this analysis and results in studies of general equity markets. Studies such as Eun and Resnick (1988) have generally found that the proportion of overall risk that can be attributed to currency movements is larger than that found in this study.

[10] The results contained in Exhibit 3 also highlight the need to examine the asset allocation decision from the perspective of different countries due to the varying impact of currency movements.

[11] The frontiers were also calculated using all ten currencies and are available from the author on request. While the same general pattern is observed there are often quite substantial differences in the risk and return figures obtained under each foreign exchange scenario.

[12] Due to the nature of the tests used, we cannot however compare the pure equity and pure real estate portfolios as both are constructed using the same number of assets. As Equation (8) shows, this would result in a divisor of zero as N is defined as $N_2 - N_1$.

[13] The unconstrained efficient frontier using local returns is obviously identical, irrespective of the assumption regarding the nationality of the investor.

[14] Worzala (1994) surveyed institutional investors from a variety of countries, finding that 15% have no international investments. Newell and Worzala (1995) conducted a similar survey of Asian-Pacific investors and the corresponding figure was 30%.

[15] Similar results were obtained for each of the other home country scenarios. The results for the other countries can be obtained from the author on request.

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The author appreciates the comments made by the anonymous three referees and participants at the 1999 ARES meeting that greatly improved this article.

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