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The Predictability of International Real Estate Markets, Exchange Rate Risks and Diversification Consequences

Crocker H. Liu* and Jianping Mei**

International real estate related securities are investigated to see whether they offer any incremental diversification benefits over foreign stocks using mean-variance analysis together with a multifactor latent variable model. Diversification benefits are found to be primarily driven by unanticipated returns which are partially driven by changes in exchange rate risk. Although exchange rate risk accounts for a larger portion of the return fluctuation in real estate related securities relative to common stocks, international real estate securities provide some incremental diversification benefits over common stocks even if currency risks are hedged.

Recent evidence suggests that returns for United States real estate securities and stocks are not only predictable but also that these returns tend to move in tandem.[1] While some controversy exists on whether these findings are also applicable on an international basis for stock returns, little (if any) research exists on either the predictability or co-movement of international real estate related securities.[2] The purpose of this study is to investigate the degree to which returns on international stocks and real estate related securities are predictable and exhibit systematic co-movement. The role of

*New York University, New York, NY 10012-1126 or cliu@stern.nyu.edu.
**New York University, New York, NY 10012-1126 or jmei@stern.nyu.edu.

[1] See, for example, Fama and Schwert (1977), Chen, Roll and Ross (1986), Keim and Stambaugh (1986), Campbell (1987), Fama, French (1988, 1989) and Campbell and Hamao (1992). These studies find that the dividend yield on the stock market, the January effect, the return on Treasury bills and the long-term yield spread are useful in predicting excess stock returns among other variables. Liu and Mei (1992, 1993) also find these factors in addition to the cap rate can help predict excess real estate returns. Liu and Mei further find that excess returns on real estate are more predictable than stocks.

[2] Both Stehle (1977) and Errunza and Losq (1985) cannot reject the proposition that a common factor(s) affects returns on international stocks. Jorion and Schwartz (1986) in contrast, find that different factors may impact on different stock markets as a result of statutory investment barriers. Recently, Campbell and Hamao (1992) find that common factors influence returns on U.S. and Japanese stocks and that these returns are predictable.

this co-movement on international portfolio diversification is then assessed. If returns are fairly predictable and is the result of the integration of returns on stock and real estate related securities among markets where integration is evidenced by common factors that are responsible for the systematic co-movement of returns, then the construction of efficient portfolios is affected.

A related issue is whether it pays to use international real estate related securities if a portfolio already includes international stocks of each country and if all the markets for stocks and real estate securities are integrated. The extent to which own country real estate related securities offer incremental benefits over and above that of stocks in each country has not been studied. Some diversification studies involving international real estate have used returns on direct real estate investment which have different characteristics from that of real estate related securities. Alternatively, other studies have used an international real estate index which provides few insights on portfolio construction from a micro-perspective (*e.g.*, mixed asset), inter-country portfolio construction. Of the few papers on international real estate diversification, Ziobrowski and Curcio (1991) find that U.S. real estate did not offer U.K. and Japanese investors any significant incremental diversification advantages over own country real estate due to higher riskiness of U.S. real estate when returns are denominated in foreign currency. In contrast to this, Asabere, Kleiman and McGowan (1991) conclude that international real estate should improve portfolio efficiency for U.S. investors given a weak positive correlation with U.S. real estate investment trust (REIT) returns. Asabere et al. further find that international real estate equity securities have a higher risk and return relative to U.S. REITs. A partial reason for the conflicting results is that the former study employs direct real estate investment whereas the latter study uses the Morgan-Stanley index of international real estate securities. In addition, different methodologies are also used. In exploring this issue, the impact of exchange rate risk is also considered since prior studies have shown that currency risk is a dominant factor. Consideration is also given to whether the results here are robust to hedged versus unhedged returns. However, settlement costs and other transaction costs are not included in the analysis of hedging currency risk although the consequences of these costs on portfolio risk and return are discussed.[3]

[3] Most studies on international stocks and real estate either ignore exchange rate fluctuations or alternatively adjust returns for currency on a periodic basis. Moreover, Worzala (1995) observes in a survey of institutional investors with respect to international investments that "...few of these international investors indicate hedging as one of their basic strategies." As such, this study is guilty of the same sins of omission.

This study has several distinguishing features. First, monthly returns on real estate related securities for six countries are used. Returns on foreign property trusts are utilized for a more direct comparison with portfolio diversification studies involving U.S. REITs except where no trusts exist. In these cases, property companies are employed to get some sense of incremental diversification benefits. Second, only one factor is necessary in accounting for the time-variation of expected returns across different countries. This implies that international real estate securities are integrated with international stocks because one factor can account for the movement of the expected returns of all assets. This result holds regardless of whether exchange risk is hedged. However, the unexpected portion of returns is quite large and accounts for most of the diversification benefits. Also, changes in currency risk account in part for movements in unanticipated returns. This phenomenon is more pronounced for real estate related securities relative to stocks for most countries. Moreover, evidence indicates that real estate securities of some countries (but not others) do add incremental diversification benefits, even if stocks of that country are already included in an international portfolio.

The remainder of the paper is organized as follows. Section two describes the data set while the analytical framework is contained in section three. The existence of predictable excess real estate returns is documented in section four together with the extent that international real estate markets are integrated. Section five is the conclusion.

The Data

Monthly returns on property trusts, and/or property-related securities, as well as capital market indices are obtained for Australia, France, Japan, South Africa, the U.K. and the U.S. The Australian Stock Exchange provided a market capitalization weighted index of listed property trusts. The Interactive Data Corporation (IDC), which is also the source of the CRSP data, furnished returns on individual property trusts in France from which a property trust return series inclusive of dividends is constructed.[4] For Japan, returns on property companies are taken from the Nikkei Telecom News Retrieval system which reports Japanese value-weighted stock price indices

[4] The total number of shares outstanding was unavailable for each property trust and a value weighted index was not constructed. The return data are adjusted for stock splits in an identical manner to that in the CRSP database. The stocks included in our index include Cofimeg, Cogifi, Foncina, GFII, Sefimeg, Simco and Socim which are SIIs, in addition to Codetel, Immoffice, Locindus and Unibail which are all Sicomis.

by industry for the first section of the Tokyo Stock Exchange. B.O.E. Properties (Transvaal) Limited provided the value-weighted South Africa property unit trust index inclusive of dividends for the Johannesburg Stock Exchange. The Financial Times value weighted property index, which consists of property-related companies including a few developers, is used for the U.K. For U.S. real estate, the value weighted monthly index of equity real estate investment trusts (EREITs) inclusive of dividends from the National Association of Real Estate Investment Trusts (NAREIT), is used.[5]

Information on stock market returns, short-term government yields, long-term government yields, consumer price indices and exchange rates are obtained from Ibbotson and Associates IDEAS database for each of the six countries.[6] The Morgan Stanley Capital International Indices cum dividend is used as the proxy for capital market returns.[7] All monthly return data for each country start in February 1980 and end in March 1991.

All of the return series are converted into U.S. returns to facilitate cross-country comparisons. As such, the perspective of the U.S. investor is assumed in this study. The formula used to translate returns on foreign assets into dollar terms is as follows:

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[5] An adjustment was made to the NAREIT index since the dividend yield in the NAREIT index is calculated using current price (t) rather than the price at the beginning of the period ($t - 1$). The index consists of all tax-qualified REITs listed on the New York Stock Exchange, the American Stock Exchange and the NASDAQ. Prior to 1987, REITs were included in the index for the January following their listing. After 1987, REITs were added to the index in the month that their shares were issued. The beginning of the month is used in calculating the value-weighted total return with only REITs listed for the entire period included in the index for that month.

[6] Ibbotson and Associates repackage data from several sources. For government yields and consumer price indices, the data is either from the International Monetary Fund's publication *International Financial Statistics* or the publications of the Organization of Economic Cooperation and Development (OECD) including *Main Economic Indicators* and *Financial Statistics: Part I*. Exchange rates until 1987 are from OECD, *Main Economic Indicators: Historical Statistics* and after this date, *The Wall Street Journal* is used. Short-term government yields are derived from government instruments with less than three months to maturity or from an official discount rate. Long-term government yields, in contrast, assume that a single bond with a maturity of between 7.5 to 20 years is bought at par at the beginning of each period and then sold at the end of the period (*e.g.*, a month at the then-prevailing market yield). The inflation rate is calculated as the change in the consumer price index from the beginning to the end of the month for each country. For Australia, however, the Producer Price Index taken from the I.M.F. *International Financial Statistics* is used as the proxy for inflation since the CPI is unavailable.

[7] The Financial Times stock index for South Africa was used as no Morgan Stanley Capital International Index exists.

$$\tilde{R}_{i\$} = (1 + \tilde{R}_i)(1 + \tilde{R}_{ei}) - 1 \tag{1}$$

where the tilde "~" represents a random variable, $\tilde{R}_{i\$}$ is the dollar rate of return on an unhedged investment in the i^{th} foreign market, $\tilde{R}_i$ is the rate of return stated in local currency and $\tilde{R}_{ei}$ is the rate of appreciation of the local currency relative to the dollar. The framework of Eun and Resnick (1988) is used to compute returns using a hedged strategy using a foreign exchange forward contract, and alternatively, an unhedged strategy with respect to currency risk. This, in turn, permits determination of the benefits from international diversification.[8] If currency risk is not hedged, then the expected rate of return, the actual rate of return, the variance of that return and the covariance of returns in terms of dollars are as follows:

Expected Return: $E(\tilde{R}_{i\$}) = (1 + E(\tilde{R}_i))(1 + E(\tilde{R}_{ei})) - 1$ (2)

Actual Return:[9] $\tilde{R}_{i\$} = (1 + \tilde{R}_i)(1 - \tilde{R}_{ei}) - 1 \approx \tilde{R}_i + \tilde{R}_{ei}$ (3)

Variance of Returns: $var(\tilde{R}_{i\$}) \approx var(\tilde{R}_i) + var(\tilde{R}_{ei}) + 2cov(\tilde{R}_i,\tilde{R}_{ei})$ (4)

Covariance: $cov(\tilde{R}_{i\$},\tilde{R}_{j\$}) \approx cov(\tilde{R}_i,\tilde{R}_j) + cov(\tilde{R}_{ei},\tilde{R}_{ej}) + cov(\tilde{R}_i,\tilde{R}_{ej}) + cov(\tilde{R}_j,\tilde{R}_{ei})$ (5)

where "≈" denotes an approximation and E is the expectations operator. If a U.S. investor decides to hedge currency risk through a forward contract, Eun and Resnick (1988) show that the expected rate of return, the actual rate of return, the variance of that return and the covariance of returns in terms of dollars are as follows:

Expected Return: $E(\tilde{R}^H_{i\$}) = (1 + E(\tilde{R}_i))(1 + f_i) - 1$ (6)

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[8] Eun and Resnick (1988) show that exchange rate fluctuations add to foreign investment risk by way of its own variance and also through its "positive" correlations with returns in the local stock market. In fact, a sizable portion of dollar stock volatility arises from exchange rate risk in developed countries. Hauser, Marcus and Yaari (1994) however, find that this phenomenon does not necessarily hold for stocks in emerging markets.

[9] The actual return on an international investment in dollar terms actually consists of three components: the return on the asset (R_i), the return on the currency (R_{ei}), and the interaction between the return on the investment and the return on the currency (R_iR_{ei}). Since the interaction term is small, it is omitted in all subsequent calculations.

$$\text{Actual Return:} \quad \tilde{R}^H_{i\$} = (1 + E(\tilde{R}_i))(1 + f_i) + (\tilde{R}_i - E(\tilde{R}_i)(1 + \tilde{R}_{ei}) - 1 \approx \tilde{R}_i + f_i \tag{7}$$

$$\text{Variance of Returns:} \quad var(\tilde{R}^H_{i\$}) \approx var(\tilde{R}_i) \tag{8}$$

$$\text{Covariance:} \quad cov(\tilde{R}^H_{i\$}, \tilde{R}^H_{j\$}) \approx cov(\tilde{R}_i, \tilde{R}_j) \tag{9}$$

where superscript H denotes the rate of return under the hedged strategy, f_i is the relative forward exchange premium or discount and subscript j refers to an asset j which is different from asset i. To calculate the relative foreign exchange premium/discount the interest rate parity is assumed to hold[10] so that

$$\frac{1 + r_\$}{1 + r_i} = 1 + f_i \tag{10}$$

where $r_\$$ represents the U.S. risk-free rate and r_i is the risk-free interest rate in the i^{th} foreign country.

A comparison of Equations (4) and (8) reveals that if the covariance between return on the asset and return arising from currency fluctuations is positive, e.g., $cov(\tilde{R}_i, \tilde{R}_{ei}) > 0$, then the variance of the unhedged returns exceeds that of the hedged returns. Consequently, hedging currency risk is a superior strategy in this situation.[11] If $cov(\tilde{R}_i, \tilde{R}_{ei}) < 0$ however, the hedged currency strategy is not necessarily superior to that of an unhedged strategy. Moreover, strategy to hedge currency risk is dependent on the extent to which currency risk contributes to the overall volatility. To further explore the contribution of currency risk to overall volatility of returns stated in dollar terms, the variance of returns in Equation (4) are decomposed into two components: (1) the portion of the variance associated with own country variance (V_1); and (2) the portion of the variance due to exchange rate risk (V_2) as follows:

$$1 = V_1 + V_2 = \left[\frac{var(\tilde{R}_i)}{var(\tilde{R}_{i\$})}\right] + \left[\frac{var(\tilde{R}_{ei}) + 2cov(\tilde{R}_i, \tilde{R}_{ei})}{var(\tilde{R}_{i\$})}\right] \tag{11}$$

[10] Frenkel and Levich (1977) among other others provide evidence supporting this assumption.

[11] This presumes that no settlement or transactions costs exist.

Characteristics of Foreign Property Trusts

This study uses property trusts (except for Japan and the U.K. where property companies are employed) to increase the comparability of investing in real estate securities similar to that of U.S. property trusts. Foreign property trusts share many features with U.S. REITs. For one, shares of a property trust are traded on a stock exchange. Another similarity to REITs is that foreign property trusts are taxed only at the investor level. To qualify for tax exemption at the firm level, property trusts are required to distribute a certain percentage of net earnings, are subject to certain asset restrictions and are typically prohibited from engaging in certain real estate related activities. Most property trusts tend to have portfolios consisting of offices, retail and/or industrial properties. Some differences do exist, however, in that some foreign property trusts are limited in the amount of leverage they can use to purchase property. The leverage is typically much lower than that for U.S. REITs. In addition, while the U.S. has at least seven times more property trusts relative to other countries, the aggregate market capitalization of foreign property trusts (in U.S. dollars) is less than two times that of U.S. REITs. Table 1 provides detailed information on property trusts in various countries.

While this study searched for property trusts in all countries for which data was available, property companies had to be used for Japan and the U.K. There were no property trusts available for Japan. Although property unit trusts do exist in the U.K., their characteristics are more similar to that of U.S. commingled real estate funds (CREFs) than REITs. Admittedly, the use of property companies does create a comparability problem. In particular, property companies, in contrast to property trusts, take a more active role in real estate development since there are no prohibitions on certain real estate activities like those that exist for property trusts. As such, property companies tend to exhibit greater price volatility relative to property trusts in general. Also, property companies pay taxes at the firm level. However, they do not have any distribution requirements as is the case with property trusts. While this may be a potential problem, it is not unrealistic to assume that if an investor wishes to participate in real estate-related securities, that investor will invest in property companies to get some exposure in a particular market if no property trusts are available. This study includes as many countries as possible in examining whether there are any incremental diversification advantages to investing in publicly traded real estate-related interests (preferably property trusts) over that of foreign stocks.

Table 1 ■ Characteristics of international property trusts.

	Australia	France	South Africa	U.S.
Number (1990)	14	11	16	119
Market Capitalization				
Local Currency (1990)	A$6.904 billion	Francs 26 billion[a]	R3.400 billion	$8.737 billion
U.S. Currency (1990)	$5.352 billion	$5.108 billion	$.999 billion	$8.737 billion
Minimum Percentage of Assets in Direct Property	20[b]	n.a.	n.a.	75
Taxation at Firm Level	No	No	No	No
Distribution Requirement	n.a.	85% of net earnings	n.a.	95% of Taxable Income
Borrowing Restrictions	20% of gross assets[c]	n.a.	No borrowing	Depends on REIT declaration/charter
Other Characteristics	Largest group of net funds invested in property 1985–1989 (29%). Larger trusts own CBD offices & retail. Smaller trusts own suburban offices, retail and industrial.	Sicomis represented 65% of commercial real estate financings in 1990. Sicomis lease commercial & industrial properties and are prohibited from residential rental activities. SIIs invest in residential properties.	Pension funds invest up to 30% in property trusts. Portfolios contain industrial, office and/or retail properties.	Not more than 30% of gross income can be from sale of properties held for less than four years.

[a]Approximate market cap at year end 1991. The market cap is approximated using Ducrozant (1992).
[b]Most trusts invest 80%–85%.
[c]Trusts, on average, use 7.5% of assets.

The Analytical Framework

To investigate whether international stock markets and markets for real estate related securities are integrated, both ordinary least square (OLS) regressions as well as the asset pricing framework described in Liu and Mei (1992) are used. First, OLS regressions of asset returns are performed for each country against own country state variables.[12] The state variables used are a dummy variable for the January effect, the lagged short-term rate, the lagged spread in that country and lagged market returns. Lagged market returns are used to proxy for the dividend yield of an equally weighted portfolio because the latter is not available for many countries. This set of regressions gives an indication of the level of predictability of returns based on the own country information set. Next, excess asset returns are regressed (OLS) against common state variables where "common" is defined in terms of U.S. variables. The rationale for using U.S. variables is that international markets are studied from a U.S. investor's perspective.[13] The common, economic state variables used are a January dummy, the T-bill, the spread between the long-term and short-term rate and the dividend yield of an equally weighted portfolio. These regressions offer a partial test of international market integration. If a common set of U.S. variables can explain or predict the time-varying risk premiums for all assets across countries, then there is a strong indication of international market integration.

The forecasting variables chosen reflect those widely used in previous stock return and real estate securities studies (see Keim and Stambaugh 1986; Campbell 1987; Fama and French 1989; Ferson and Harvey 1991; Liu and Mei 1992; and Mei and Saunders 1995, among others). These studies have consistently shown that these variables are capable of explaining the time variation of expected returns over different sample periods and their use also conforms to asset pricing theories. These variables are also expected to act as important variables in this study. The January dummy captures the persistence in the positive rate of return during January. This effect has been

[12] This study is conducted from a U.S. investor's perspective. For a U.S. investor, only the currency adjusted return (unhedged) or the hedged return is available. Thus, this study focuses on currency adjusted returns (unhedged) and the hedged returns.

[13] There are two other reasons for using only the U.S. variables. First, the latent variable model could treat "omitted variables" as random errors. As such, the model is still well-specified even if variables of some other country(ies) are left out. Thus, the test still holds with only U.S. variables. Second, was the need to be careful with degree of freedom restrictions. If variables are included from all countries, there will be spuriously high R^2s but meaningless results.

found to be present for U.S. stocks during the 1970s.[14] The January dummy is included to see if this seasonal effect is present in other security markets as well. The treasury bill rate proxies for the level of interest rates. A high relative bill rate is consistent with a sudden increase in the short-term interest rates in the economy and increased inflationary expectations, which could adversely impact the pay-off on real estate assets—especially those assets with relatively fixed nominal rental incomes—see Miles, Webb and Guilkey (1991). Thus, in periods when interest rates are higher (or lower) than "normal" a change might be expected in the interest-rate risk premium to be impounded in real estate security returns. The spread between the yield on long-term government bonds and the treasury bill rate proxies for the slope of the yield curve. A widening of the spread reflects investors' expectations of increased long-term inflation risk and thus may impact the present value of real estate assets, which are sensitive to long-term inflation. The dividend yield on equally-weighted stock portfolios seeks to capture changing expectations regarding expected future returns in the security markets. An increase in the risk (or perception) of security investment will increase the required rate of return on stocks and thus lower the market value of stocks. This, in turn, will result in an increase in the dividend yield. On the other hand, an unexpected increase in the future cash flows (dividends) to stocks will result in a higher dividend yield. A higher dividend yield makes stocks look more attractive to investors in terms of higher expected future returns.

One question which arises is the extent to which the forecasting variables, denominated in own country currency, are correlated. Table 2 reveals that the state variables for a country exhibit only a modest correlation with the same state variables for another country in general. In fact, only eight of the correlation coefficients equal or exceed 0.5 between state variables of different countries. All of these eight correlations are statistically significant. Consequently, the majority of the correlations are low even though most are statistically significant due to the number of time periods used. While low correlations might suggest that segmentation exists since these variables might be expected to fluctuate together in an integrated market, Adler and Dumas (1983) point out that this rationale is misguided given that national random factors, such as politics, are reflected in these state variables. Thus, small correlations among national stock market indices, for example, are generally consistent with perfect capital market integration.

[14] Recent studies however have noted that the January effect was nonexistent in the late 1980s (*e.g.*, Malkiel 1990).

Table 2 ■ Correlation of economic state variables.

	AUS ST	AUS SP	AUS M	FR ST	FR SP	FR M	JP ST	JP SP	JP M	SAF ST	SAF SP	SAF M	UK ST	UK SP	UK M	US ST	US SP	US M	US DY
AUS ST	1																		
AUS SP	−.6*	1																	
AUS M	−.1	.0	1																
FR ST	.2	.0	−.2	1															
FR SP	−.2	.4	.1	−.3	1														
FR M	.3	−.1	.0	.0	−.1	1													
JP ST	.1	.0	−.1	.6*	.1	.1	1												
JP SP	−.2	.3	−.1	.0	.0	−.2	−.5*	1											
JP M	.1	.0	.3	−.1	.0	.1	.0	−.1	1										
SAF ST	.2	−.2	−.1	.2	−.2	.1	.1	.0	.0	1									
SAF SP	.2	−.2	.1	−.2	.3	.0	.1	−.3	.1	−.4	1								
SAF M	.1	−.2	.3	.0	−.1	.1	.1	−.2	.2	.5*	.1	1							
UK ST	.3	−.3	−.1	.5*	−.2	.1	.5*	−.4	−.1	.2	.1	.1	1						
UK SP	−.3	.7*	.0	.1	.4	−.1	.0	.5*	.0	−.2	.0	−.2	−.5*	1					
UK M	−.1	−.1	.5*	−.2	.0	.0	.0	−.1	.4	.1	.0	.3	−.1	−.1	1				
US ST	−.1	.2	−.2	.3	−.2	−.1	.2	.1	−.2	−.1	−.2	−.2	.0	.3	−.1	1			
US SP	−.4	.5*	−.1	.3	.1	−.1	.1	.3	−.1	.0	−.4	−.2	−.2	.6*	−.1	.7*	1		
US M	.1	−.1	.1	−.1	.0	.5*	.0	−.2	−.1	−.1	.0	.2	.0	−.1	.0	−.1	−.2	1	
US DY	−.1	.2	−.1	.3	−.1	−.1	.3	−.2	−.2	−.1	−.2	−.1	.1	.2	.0	.7*	.7*	.1	1

All variables are in own country currency. AUS = Australia, FR = France, JP = Japan, SAF = South Africa, UK = United Kingdom, US = United States, ST = short term rate, SP = spread of the long term rate over the short term rate, M = lag of market return and DY = equally weighted dividend yield. All correlation coefficients with an asterisk(*) are statistically significant at the 5% level. The statistic used in calculating whether a correlation is significant is $S = \frac{c}{\sqrt{|c|(1-|c|)}} * \sqrt{T}$ where c is the correlation coefficient, $|c|$ is the absolute value of the correlation coefficient and T is the number of time periods. A correlation is significant, given the number of time periods, if $|S| \geq 2$.

In addition to OLS regressions, Hansen's Generalized Method of Moments (GMM) is also used in conjunction with the asset pricing framework set forth in Liu and Mei (1992) as a more rigorous test of international market integration. The asset pricing test not only imposes the restriction that the expected returns of all assets must be explained by a common set of state variables, but their movement must also satisfy some linear pricing restrictions outlined in the Appendix. It also has the advantage of being robust to heteroskedasticity in excess returns. More specifically, asset expected returns are fit using a latent variable model. If the international markets are integrated, then as Campbell and Hamao (1992) point out, the time-variation of risk premiums across different countries should satisfy the linear pricing restrictions determined by some systematic factors. A chi-squared test is used to examine the linear pricing restrictions imposed by the latent variable model. Initially the sample is divided into two markets, real estate related securities and stocks, due to the limited number of time series observations. Next, a chi-square test is conducted on each of the two separate samples to determine if the securitized property market is integrated, and alternatively, the stock market is integrated. If each respective market is integrated, an equally weighted international market index is constructed for real estate and stock, respectively, to see whether the international real estate market is integrated with the international stock market. The rationale for "collapsing" the seven countries into an international category is to circumvent the ranking (dimensionality) problem which arises from the limited number of time periods. The Appendix contains a more detailed discussion of the latent variable model and the associated test of linear pricing restrictions.

After examining whether international real estate markets are integrated, the issue of what is the optimal holdings of international assets from the perspective of a U.S. investor is explored. To do this, the mean-variance efficient portfolios is calculated for real estate, stocks and the combination real estate and stocks, respectively, assuming that no short sales are allowed.[15]

[15] Mathematically,

$$\min x'\Sigma x$$
$$\text{s.t. } x'\iota = 1$$
$$x'\mu = R_p$$
$$x \geq 0$$

where x is the vector of weights, Σ is the variance-covariance matrix of returns, ι is the unity vector and μ is the vector of mean returns.

Empirical Results

Table 3 shows the average dollar return and the accompanying standard deviation for stocks and real estate-related securities in each country. Return and risk are reported on an unhedged and hedged currency basis together with the decomposition of volatility on unhedged returns. In terms of returns, Japanese stocks and property companies have the highest average monthly returns over the sample period regardless of whether currency risk is hedged. South African stocks and property trusts, in contrast, exhibit the lowest relative returns from both a hedged and unhedged perspective. South African stocks and property trusts also display the highest relative volatility in terms of unhedged returns. When currency risk is hedged, however, Australian stocks and Japanese property companies have the highest inter-country risk. Not surprisingly, U.S. stocks and property trusts have the lowest standard deviation.[16] Interestingly, no linear risk-return tradeoff appears to exist regardless of whether currency risk is hedged. More specifically, both stocks and real estate related securities with relatively higher average returns do not necessarily have correspondingly higher standard deviations.

When the volatility of unhedged returns is partitioned, the exchange rate risk of the countries accounts for a sizable portion of the dollar return volatility for both stocks and real estate related securities. This evidence is consistent with prior studies on international stock diversification in developed markets. Consequently, hedging currency risk may be a desirable investment strategy.[17] The impact of currency risk on stocks and property related securities differs depending on the country in question. For South Africa, exchange rate risk accounts for most of the variation in both returns on stocks and property trusts with the impact relatively larger for stocks. This situation also holds for Japan. In all other countries, however, currency risk accounts for a larger portion of the fluctuations in returns on property trusts/companies compared to stock returns in that country.

Table 4 presents the inter-country correlations and accompanying t-Statistics from an unhedged return perspective. Table 5 presents the same information when currency fluctuations are hedged. The correlations in both tables are relatively low across countries between different asset types indicating that

[16] These returns are not adjusted for currency fluctuations.

[17] The degree to which hedging currency risk is desirable depends in part on the magnitude of settlement and other transaction costs which is not recognized here. See Worzala (1995) for details on how transaction costs can increase the variability of the portfolio.

Table 3 ■ Decomposition of the volatility of the monthly rate of return: February 1980–March 1991.

	Unhedged Returns		Fraction (%) of Volatility		Hedged Returns	
Country	$E(R_{i\$})$	$\sigma(R_{i\$})$	V_1	V_2	$E(\tilde{R}^H_{i\$})$	$\sigma(\tilde{R}^H_{i\$})$
Panel A: Stocks						
Australia	0.01	0.08	67.1	32.9	0.01	0.07
France	0.02	0.07	76.5	23.5	0.02	0.06
Japan	0.02	0.07	54.7	45.3	0.02	0.05
South Africa	−0.001	0.09	38.0	62.0	0.01	0.06
U.K.	0.02	0.07	71.7	28.3	0.02	0.06
U.S.	0.01	0.05	100.0	0.0	0.01	0.05
Average	0.01	0.07	68.0	32.0	0.01	0.06
Panel B: Real Estate Related Securities						
Australia	0.01	0.05	54.4	45.6	0.01	0.04
France	0.01	0.05	54.3	45.7	0.01	0.04
Japan	0.02	0.08	60.1	39.9	0.02	0.06
South Africa	0.01	0.09	45.5	54.5	0.01	0.06
U.K.	0.01	0.07	68.5	31.5	0.01	0.06
U.S.	0.01	0.03	100.0	0.0	0.01	0.03
Average	0.01	0.06	63.8	36.2	0.01	0.05

Note: $V_1 = var(\tilde{R}_i)/var(\tilde{R}_{i\$})$ = volatility due to own country risk and $V_2 = (var(\tilde{R}_{ei}) + 2cov(\tilde{R}_i,\tilde{R}_{ei}))/var(\tilde{R}_{i\$})$ = volatility due to currency risk.

gains are possible from international diversification in general. More specifically, the degree of co-movement in the international property trust markets is low with an average inter-country correlation coefficient of .26 (.19) if returns are unhedged (if currency risk is hedged). Similarly, the average inter-country correlation coefficient between international stocks is .34 and .36 for unhedged and hedged returns, respectively. While both sets of intra-asset correlations are low, returns tend to move more closely in international stock markets relative to the international property trust markets. This suggests larger diversification benefits are possible for a property trust portfolio relative to a stock portfolio if portfolio diversification is on an intra-asset basis. The degree of co-movement between stocks in one country, and real estate-related securities in a different country, is also low in general. In particular, the average inter-country correlation is .29 for unhedged returns and .26 for hedged returns. However, the intra-country correlations between stocks and property trusts/companies in both tables are moderate to high ranging from .62 to .80 if returns are unhedged and from

Table 4 ■ Unhedged correlations [$Corr(\tilde{R}_{i\$},\tilde{R}_{j\$})$] (February 1980–March 1991).

	AUS RE	AUS Stk	FR RE	FR Stk	JP RE	JP Stk	SAF RE	SAF Stk	UK RE	UK Stk	US RE	US Stk
AUS RE	1.00											
AUS Stk	0.80 (14.8)[a]	1.00										
FR RE	0.51 (6.6)[a]	0.53 (6.9)[a]	1.00									
FR Stk	0.54 (7.1)[a]	0.55 (7.2)[a]	0.64 (9.2)[a]	1.00								
JP RE	0.20 (2.3)[a]	0.22 (2.5)[a]	0.24 (2.7)[a]	0.29 (3.4)[a]	1.00							
JP Stk	0.24 (2.8)[a]	0.29 (3.3)[a]	0.22 (2.5)[a]	0.31 (3.6)[a]	0.70 (11.0)[a]	1.00						
SAF RE	0.23 (2.6)[a]	0.29 (3.4)[a]	0.21 (2.4)[a]	0.21 (2.3)[a]	0.14 (1.7)[b]	0.26 (3.0)[a]	1.00					
SAF Stk	0.16 (1.8)[a]	0.20 (2.2)[a]	0.04 (0.4)	0.14 (1.6)[b]	0.21 (2.4)[a]	0.28 (3.3)[a]	0.79 (14.2)[a]	1.00				
UK RE	0.50 (6.4)[a]	0.51 (6.6)[a]	0.32 (3.7)[a]	0.36 (4.3)[a]	0.30 (3.5)[a]	0.37 (4.5)[a]	0.13 (1.5)	0.09 (1.0)	1.00			
UK Stk	0.45 (5.5)[a]	0.55 (7.2)[a]	0.33 (3.9)[a]	0.47 (5.9)[a]	0.32 (3.7)[a]	0.41 (4.9)[a]	0.23 (2.6)[a]	0.16 (1.8)[a]	0.82 (15.7)[a]	1.00		
US RE	0.30 (3.5)[a]	0.38 (4.6)[a]	0.13 (1.4)	0.35 (4.1)[a]	0.11 (1.2)	0.24 (2.8)[a]	0.15 (1.7)[a]	0.12 (1.3)	0.38 (4.6)[a]	0.52 (6.8)[a]	1.00	
US Stk	0.30 (3.5)[a]	0.44 (5.4)[a]	0.19 (2.2)[a]	0.47 (6.0)[a]	0.09 (1.0)	0.25 (2.8)[a]	0.15 (1.7)[a]	0.10 (1.1)	0.38 (4.5)[a]	0.55 (7.4)[a]	0.62 (8.8)[a]	1.00

AUS = Australia, FR = France, JP = Japan, SAF = South Africa, UK = United Kingdom, US = United States, Stk = stock and RE = real estate. Significance levels are calculated by treating $(N - 2)^{1/2}\rho/(1 - \rho^2)^{1/2}$ as coming from a t-distribution with $N - 2$ degrees of freedom, where N is the appropriate sample size (134 in this study) and ρ is the Pearson correlation coefficient. t-Statistics are in parenthesis. Subscripts i and j associated with R refer to the return (R) on asset i and asset j, respectively, where $i \neq j$.

[a]Significant at the 5% level.
[b]Significant at the 10% level.

Table 5 ■ Hedged correlations [$Corr(\tilde{R}^H_{i\$},\tilde{R}^H_{j\$})$] (February 1980–March 1991).

	AUS RE	AUS Stk	FR RE	FR Stk	JP RE	JP Stk	SAF RE	SAF Stk	UK RE	UK Stk	US RE	US Stk
AUS RE	1.00											
AUS Stk	0.65 (9.5)[a]	1.00										
FR RE	0.09 (1.0)	0.19 (2.2)[a]	1.00									
FR Stk	0.32 (3.7)[a]	0.35 (4.1)[a]	0.48 (6.0)[a]	1.00								
JP RE	0.11 (1.2)	0.13 (1.4)	0.09 (1.0)	0.25 (2.8)[a]	1.00							
JP Stk	0.27 (3.1)[a]	0.27 (3.2)[a]	0.11 (1.2)	0.32 (3.7)[a]	0.47 (6.0)[a]	1.00						
SAF RE	0.23 (2.7)[a]	0.34 (4.0)[a]	0.16 (1.8)[a]	0.16 (1.8)[a]	0.01 (0.2)	0.16 (1.8)[a]	1.00					
SAF Stk	0.22 (2.5)[a]	0.26 (3.0)[a]	−0.07 (−0.8)	0.15 (1.7)[a]	0.16 (1.8)[a]	0.24 (2.8)[a]	0.49 (6.2)[a]	1.00				
UK RE	0.51 (6.5)[a]	0.46 (5.7)[a]	0.07 (0.8)	0.27 (3.1)[a]	0.08 (0.9)	0.27 (3.1)[a]	0.18 (2.0)[a]	0.14 (1.6)[b]	1.00			
UK Stk	0.46 (5.8)[a]	0.52 (6.7)[a]	0.14 (1.6)[b]	0.45 (5.5)[a]	0.14 (1.6)[b]	0.39 (4.7)[a]	0.33 (3.9)[a]	0.25 (2.9)[a]	0.73 (11.8)[a]	1.00		
US RE	0.38 (4.5)[a]	0.46 (5.7)[a]	0.15 (1.6)[b]	0.38 (4.5)[a]	0.17 (1.9)[a]	0.37 (4.4)[a]	0.23 (2.6)[a]	0.20 (2.3)[a]	0.46 (5.8)[a]	0.62 (8.7)[a]	1.00	
US Stk	0.33 (3.8)[a]	0.49 (6.3)[a]	0.18 (2.1)[a]	0.49 (6.3)[a]	0.13 (1.4)	0.35 (4.1)[a]	0.30 (3.5)[a]	0.24 (2.7)[a]	0.47 (5.9)[a]	0.67 (10.1)[a]	0.62 (8.8)[a]	1.00

AUS = Australia, FR = France, JP = Japan, SAF = South Africa, UK = United Kingdom, US = United States, Stk = stock and RE = real estate. Significance levels are calculated by treating $(N - 2)^{1/2}\rho/(1 - \rho^2)^{1/2}$ as coming from a t-distribution with $N - 2$ degrees of freedom, where N is the appropriate sample size (134 in this study) and ρ is the Pearson correlation coefficient. t-Statistics are in parenthesis. Subscripts i and j associated with R refer to the return (R) on asset i and asset j, respectively, where $i \neq j$.

[a]Significant at the 5% level.
[b]Significant at the 10% level.

.47 to .73 if currency risk is hedged.[18] This suggests that while some incremental benefits do exist from adding international real estate securities to a portfolio of international stocks, the gain might be modest.

Some differences also exist when the unhedged and hedged correlation structures are compared. For one, the intra-country correlations between stocks and property trusts/companies appear to be relatively lower when currency risk is hedged. This indicates that potentially larger gains from diversifying with international real estate securities exist if a U.S. investor hedges currency risk through a forward transaction. Secondly, the unhedged correlations do differ from the hedged correlations, although no clear pattern is evident as to the direction of the difference.

To determine the role that hedging exchange rate risk has on expected returns and in turn, the impact that fluctuations in expected returns have on the movement of actual returns, a series of regressions is performed. The results for the first set of OLS regressions, which explores the question of how predictable returns are for each country using own country state variables as the relevant information set, are reported in Table 6. These variables are in local currency since the intuition is to proxy for each country's economic condition. The results for the second set of OLS regressions, reported in Table 7, examine the related question of how predictable returns are for each country. Table 7, in contrast to Table 6, uses a set of common U.S. state variables in lieu of own country economic variables. The U.S. variables are in U.S. currency since: (1) this provides evidence of whether U.S. variables are more important relative to own country economic variables in predicting returns; (2) this gives an indication of whether international markets are integrated; and (3) international markets are studied from a U.S. investor's perspective.

Table 6 illustrates that own country state variables account for a portion of the variation in the expected rates of return in some countries but not in others. Own country variables for Japan and South Africa play a significant role in predicting returns on real estate securities in both countries regardless of whether exchange rate risk is hedged. This is also the case, to a weaker extent, for unhedged U.S. property returns. For expected returns on Japanese property companies, hedging exchange rate risk reduces the role of own country variables. The converse is true for expected returns on South African

[18] Intra-country correlations between stocks and property trusts/companies are higher if returns are unhedged than if currency risk is hedged since both own-country returns are adjusted by the same currency factor each month in the former case. The authors thank an anonymous reviewer for this point.

Table 6 ■ Regression of asset returns against own country state variables.

	Property							Stocks						
	Constant	January	ST Rate	Spread	Mk_{t-1}	F-Stat	Adj. R^2	Constant	January	ST Rate	Spread	Mk_{t-1}	F-Stat	Adj. R^2
Panel A: Unhedged														
Australia	0.00	0.02	0.06	−0.03	0.01	0.4	−0.02	0.03	0.00	−0.13	−0.38	0.02	0.2	−0.03
	(0.1)	(1.1)	(0.3)	(−0.1)	(0.2)			(0.8)	(0.0)	(−0.5)	(−0.9)	(0.1)		
France	0.03	−0.02	−0.01	−0.45	0.09	1.1	0.00	0.02	0.01	−0.05	−0.52	0.05	0.3	−0.02
	(2.1)[a]	(−0.9)	(−1.1)	(−0.9)	(1.4)			(1.2)	(0.6)	(−0.3)	(−0.8)	(0.5)		
Japan	0.03	−0.06	−0.26	−1.17	0.54	6.6[a]	0.15	0.02	−0.01	−0.01	−0.52	0.11	0.6	−0.01
	(2.2)[a]	(−2.1)[a]	(−1.3)	(−1.6)[b]	(4.2)[a]			(1.5)	(−0.2)	(−0.1)	(−0.8)	(0.9)		
South Africa	0.06	0.02	−0.37	−0.47	0.32	1.8[b]	0.03	0.05	0.05	−0.39	−0.30	0.48	4.5[a]	0.10
	(2.3)[a]	(0.7)	(−2.2)[a]	(−1.8)[b]	(2.4)[a]			(1.9)[a]	(1.7)[b]	(−2.4)[a]	(−1.2)	(3.7)[a]		
U.K.	0.01	0.00	0.05	−0.43	−0.19	1.0	0.00	−0.01	0.02	0.19	−0.46	−0.20	2.0[b]	0.03
	(0.4)	(0.0)	(0.3)	(−1.0)	(−1.6)			(−0.3)	(1.0)	(1.2)	(−1.3)	(−1.9)[a]		
U.S.	−0.01	0.02	−3.75	0.42	0.10	2.2[b]	0.04	0.03	0.01	−0.17	−0.01	0.01	0.4	−0.02
	(−0.4)	(1.4)	(−2.1)[a]	(1.8)[b]	(1.5)			(1.0)	(0.8)	(−0.7)	(−0.0)	(0.1)		

Table 6 ■ (continued)

	Property							Stocks						
	Constant	January	ST Rate	Spread	Mk_{t-1}	F-Stat	Adj. R^2	Constant	January	ST Rate	Spread	Mk_{t-1}	F-Stat	Adj. R^2
Panel B: Hedged														
Australia	0.04	0.02	−0.09	−0.34	0.02	0.2	−0.03	0.06	−0.00	−0.28	0.68	0.03	0.2	−0.03
	(0.8)	(0.5)	(−0.3)	(−0.6)	(0.3)			(1.1)	(−0.0)	(−0.6)	(−0.9)	(0.3)		
France	0.05	−0.01	−0.11	−0.97	0.09	0.8	−0.01	0.04	0.02	−0.04	−1.04	0.07	0.4	−0.02
	(1.8)[b]	(−0.2)	(−0.5)	(−1.1)	(1.3)			(1.1)	(0.6)	(−0.1)	(−0.8)	(0.7)		
Japan	0.03	−0.04	−0.02	−1.04	0.31	3.8[a]	0.08	0.03	0.01	0.08	−0.58	0.08	0.5	−0.02
	(1.5)	(−1.1)	(−0.1)	(−1.0)	(3.2)[a]			(1.3)	(0.2)	(0.3)	(−0.5)	(0.8)		
South Africa	0.05	0.03	−0.31	−0.44	0.32	3.1[a]	0.06	0.04	0.06	−0.28	−0.22	0.41	4.9[a]	0.11
	(1.9)[a]	(0.8)	(−1.7)[b]	(−1.3)	(3.3)[a]			(1.3)	(1.4)	(−1.4)	(−0.6)	(3.9)[a]		
U.K.	0.02	0.04	0.12	−0.41	−0.17	1.1	0.00	0.01	0.06	0.25	−0.44	−0.17	1.7	0.02
	(0.6)	(0.9)	(0.5)	(−0.6)	(−1.8)[b]			(0.2)	(1.5)	(1.0)	(−0.7)	(1.8)[b]		
U.S.	0.02	0.03	−5.41	0.41	0.06	1.0	0.00	0.05	0.03	−3.33	−0.02	0.01	0.4	−0.02
	(0.5)	(1.2)	(−1.4)	(0.8)	(0.8)			(1.0)	(0.8)	(−0.7)	(−0.0)	(0.1)		

Degrees of freedom for the F-Statistic are F(4,120). t-Statistics are in parenthesis.

[a]Significant at 5% level.
[b]Significant at 10% level.

Table 7 ■ Regression of asset returns against common U.S. state variables.

	Property							Stocks						
	Constant	January	T-bill	Spread	DivYld	F-Stat	Adj. R^2	Constant	January	T-bill	Spread	DivYld	F-Stat	Adj. R^2
Panel A: Unhedged														
Australia	0.05	0.02	−0.00	−0.00	−0.01	1.2	0.01	0.09	−0.01	−0.01	−0.01	0.01	2.0[b]	0.03
	(1.9)[b]	(1.0)	(−1.1)	(−1.3)	(−0.5)			(2.3)[a]	(−0.3)	(−2.3)[a]	(−1.3)	(0.2)		
France	0.05	−0.02	−0.00	−0.00	0.00	1.2	0.01	0.06	0.01	−0.00	−0.00	−0.01	0.7	0.00
	(2.0)[a]	(−1.3)	(−1.6)	(−1.0)	(0.1)			(1.7)[b]	(0.4)	(−1.0)	(−0.9)	(−0.3)		
Japan	0.10	−0.04	−0.00	−0.00	−0.02	2.0[b]	0.03	0.08	−0.00	−0.00	−0.00	−0.02	1.4	0.01
	(2.5)[a]	(−1.5)	(−0.8)	(−0.6)	(−1.2)			(2.6)[a]	(−0.1)	(−0.9)	(−1.0)	(−1.1)		
South Africa	0.06	0.02	−0.01	−0.01	0.02	1.9[b]	0.03	0.09	0.05	−0.01	−0.01	0.00	3.0[a]	0.06
	(1.5)	(0.6)	(−2.2)[a]	(−2.2)[a]	(0.9)			(2.3)[a]	(1.5)	(−2.2)[a]	(−2.0)[a]	(0.0)		
U.K.	0.06	−0.01	−0.01	−0.00	0.01	1.9[b]	0.03	0.05	0.01	−0.01	−0.00	0.02	2.7[a]	0.05
	(1.8)	(−0.4)	(−2.2)[a]	(−0.4)	(0.6)			(1.7)[b]	(0.5)	(−3.0)[a]	(−0.9)	(1.6)[b]		
U.S.	−0.00	0.01	−0.01	0.00	0.02	4.5[a]	0.10	0.02	0.01	−0.01	−0.00	0.03	2.8[a]	0.06
	(−0.3)	(1.0)	(−2.7)[a]	(1.3)	(2.6)[a]			(0.7)	(0.4)	(−3.0)[a]	(−0.3)	(2.4)[a]		

Table 7 ■ (continued)

	Property							Stocks						
	Constant	January	T-bill	Spread	DivYld	F-Stat	Adj. R^2	Constant	January	T-bill	Spread	DivYld	F-Stat	Adj. R^2
Panel B: Hedged														
Australia	0.12	0.01	−0.01	−0.01	0.00	1.3	0.01	0.16	−0.02	−0.02	−0.01	0.01	1.8	0.02
	(2.2)[a]	(0.2)	(−1.7)[b]	(−1.1)	(0.0)			(2.2)[a]	(−0.4)	(−2.2)[a]	(−1.0)	(0.3)		
France	0.08	−0.01	−0.01	−0.00	−0.03	0.6	0.00	0.09	0.02	−0.01	−0.00	−0.01	0.4	0.00
	(1.8)[b]	(−0.4)	(−1.1)	(−0.6)	(−0.1)			(1.4)	(0.4)	(−0.7)	(−0.5)	(−0.2)		
Japan	0.15	−0.03	−0.01	−0.01	−0.03	1.6	0.02	0.13	0.01	−0.00	−0.01	−0.03	1.2	0.01
	(2.8)[b]	(−0.7)	(−0.8)	(−0.8)	(−1.3)			(2.5)[a]	(0.3)	(−0.7)	(−1.0)	(−1.1)		
South Africa	0.12	0.03	−0.02	−0.01	0.02	2.1[b]	0.04	0.15	0.06	−0.02	−0.01	0.00	2.7[a]	0.05
	(2.1)[a]	(0.7)	(−2.4)[a]	(−2.0)[a]	(0.7)			(2.4)[a]	(1.3)	(−2.2)[a]	(−1.7)[b]	(0.0)		
U.K.	0.08	0.02	−0.01	−0.00	0.03	1.8	0.03	0.07	0.04	−0.02	−0.00	0.05	2.4[a]	0.04
	(1.4)	(0.5)	(−2.3)[a]	(−0.5)	(1.2)			(1.2)	(1.0)	(−2.6)[a]	(−0.7)	(1.8)[b]		
U.S.	0.01	0.02	−0.01	0.00	0.05	3.7[a]	0.08	0.03	0.01	−0.01	−0.00	0.05	2.5[a]	0.05
	(0.4)	(0.7)	(−3.0)[a]	(−0.4)	(2.8)[a]			(0.7)	(0.4)	(−2.8)[a]	(−0.3)	(2.4)[a]		

Degrees of freedom for the F-Statistic are F(4,120). t-Statistics are in parenthesis.

[a]Significant at 5% level.
[b]Significant at 10% level.

property trusts. Own country variables for South Africa are also important in accounting for the variation in South African stock returns regardless of whether exchange rate risk is hedged. For Japan, in contrast, own country variables are not influential with respect to stock returns on either an unhedged or hedged basis. Own country variables are also related to movements in unhedged U.K. stock returns although to a more limited extent relative to South Africa. While the preceding evidence indicates that own country economic variables as well as exchange rate risk do influence expected returns, this evidence is relatively weak as reflected in the relatively low F-Statistics and adjusted R^2s. In general, only minor differences exist between using an unhedged or hedged strategy with respect to capturing *expected* rates of return. Consistent with Liu and Mei (1992), short-term rates and the spreads are negatively related to expected asset returns in general.

Table 7 reveals a similar story to Table 6. While some differences are present with respect to which U.S. common variables are useful in predicting returns due to currency hedging, this difference is not significant. Stated differently, only minor differences exist between using an unhedged or hedged strategy, in general, with respect to capturing expected rates of return when U.S. economic variables are substituted for own country state variables. However, some conflicting evidence exists as to which information set is more useful in predicting returns. A comparison of Tables 7 and 6 reveals that U.S. economic variables appear to be better predictors of individual country returns on both stocks and real estate securities. The F-Statistics are significant and the adjusted R^2s are slightly higher when the set of U.S. economic variables is used relative to own country economic variables for more countries. However, own country economic variables have more explanatory power based on the adjusted R^2s for unhedged and hedged returns on Japanese property companies and also South African stocks. South African economic variables also account for more of the variation in hedged returns on South African property trusts relative to U.S. economic variables. In all other cases, however, U.S. economic variables are slightly better predictors of individual country returns on both stocks and real estate securities relative to own country variables. The adjusted R^2s in Table 7 also suggest that U.S. real estate securities are more predictable relative to other U.S. stocks. This is consistent with the findings of Liu and Mei (1992). Returns on foreign stocks are relatively more predictable relative to the returns on foreign real estate securities in general. Another interesting observation is that the January effect is insignificant in all countries and for all assets except for South African stocks.

A plausible explanation as to why U.S. economic variables better predict returns relative to own country economic variables is that the former information set includes equally weighted dividend yields. The latter information set, in comparison, uses lagged market returns as a proxy for equally weighted dividend yields since this information was unavailable in most countries. The equally weighted dividend yield does slightly better than the lag of market return in predicting asset returns because the dividend yield consists of two components—the lag of price and dividends. The lag of market returns in contrast, provides information about past performance but not about the value of stocks with respect to dividends.

To formerly address the issue of market integration, Hansen's GMM methodology is used in conjunction with the asset pricing framework described in Liu and Mei (1992) to test whether a one factor model is effective in accounting for movements in the expected rate of return (the null hypothesis) and to also test whether the linear pricing relationship of an integrated world market holds. The alternative hypothesis is that a one-factor cannot capture the time-variation of risk premiums across different countries. The GMM results, reported in Table 8, show no evidence to reject the null hypothesis.[19] Consequently, one latent factor is capable of capturing the time-variation of expected returns across different countries regardless of whether returns are hedged or unhedged. This implies that international real estate securities are integrated with international stocks. Given the findings of Tables 6, 7 and 8, it can be seen that the predicted part of the returns are extremely small and the expected returns have a tendency to move together. This is because a one factor model is capable of explaining the movement of all expected returns. However, the unanticipated part of the returns is fairly large. Consequently, the benefits of diversification come primarily from the unexpected portion of returns. These results, read in conjunction with Table 3, imply that movements in unanticipated returns are due, in part, to changes in currency risk.

Given that international real estate securities are integrated with international stocks regardless of whether returns are hedged, the question of whether it

[19] The chi-square on the linear pricing restrictions imposed by the latent variable model in Table 8 is not significant at either the 5% or 10% level. Although the GMM test offers a more rigorous test of international market integration by imposing the restriction that the expected returns of all assets must satisfy some linear pricing restrictions, it may lack statistical power in *small* samples due to the fact it puts much less restrictions on the data. For example, it does not require that the residual returns follow i.i.d. normal distributions. As a result, it may be more robust but it also sacrifices the efficiency associated with the OLS tests under i.i.d. normal distributions.

Table 8 ■ Estimation of the Latent Variable model with the rank restriction of equation imposed.

	Unhedged Returns				Hedged Returns			
	Property Trust		Stocks		Property Trust		Stocks	
	β_i	Std. Dev.	β_i	Std. Dev.	β_i	Std. Dev.	β_i	Std. Dev.
Australia	0.08	0.23	1.43	0.41	0.90	0.23	1.17	0.29
France	0.59	0.30	0.87	0.35	0.63	0.23	0.78	0.25
Japan	0.55	0.37	0.14	0.27	0.26	0.19	0.36	0.18
South Africa	−0.58	−1.00	1.94	0.64	0.74	0.35	1.15	0.37
U.K.	1.20	0.36	1.45	0.31	1.18	0.20	1.23	0.21
U.S.	1.00		1.00		1.00		1.00	
χ^2		22.5		20.5		20.2		21.5
Significance		.31		.43		.45		.37
Degrees of Freedom		20		20		20		20
EW Stocks	1.00				1.00			
EW Property	0.74	0.11			0.90	0.07		
χ^2		4.47					5.36	
Significance		.35					.25	
Degrees of Freedom		4					4	

The null hypothesis (H_0) is whether a one factor model explains the movement in the expected rate of returns. The alternative hypothesis (H_A) is if more than one factor is needed to account for variations in the expected rate of return. The significance level is the level required to reject the null hypothesis *e.g.*, a $P = .31$ means that H_0 is rejected if a 31% significance level is used. The k-factor model that is assumed to generate asset returns is

$$\tilde{r}_{i,t+1} = E_t[\tilde{r}_{i,t+1}] + \sum_{k=1}^{K} \beta_{ik} \tilde{f}_{k,t+1} + \tilde{\varepsilon}_{i,t+1}$$

Here $\tilde{r}_{i,t-1}$ is the return on asset i in excess of the riskfree rate held from time t to time $t + 1$, $E_t[\tilde{r}_{i,t-1}]$ is the conditional expected excess return on asset i which is allowed to vary through time, $\tilde{f}_{k,t+1}$ are the factor realizations, β_{ik} are the time-invariant factor loadings and the idiosyncratic error is $\tilde{e}_{i,t+1}$. If certain restrictions are imposed on this return generating model then the preceding equation can be rewritten as

$$E_t[\tilde{r}_{i,t+1}] = \sum_{k=1}^{K} \beta_{ik} \sum_{n=1}^{L} \theta_{kn} X_{nt} = \sum_{n=1}^{L} \alpha_{in} X_{nt}$$

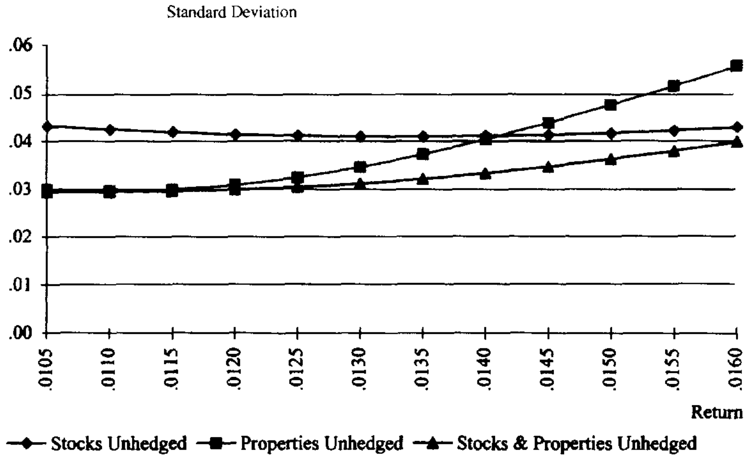
The combination of these two equations represent a multi-factor "Latent-Variable" model.

pays to use international real estate related securities if a portfolio already includes international stocks of each country is now explored. In other words, do own country real estate related securities offer incremental risk/ return advantages to a portfolio over and above that of stocks in each country?

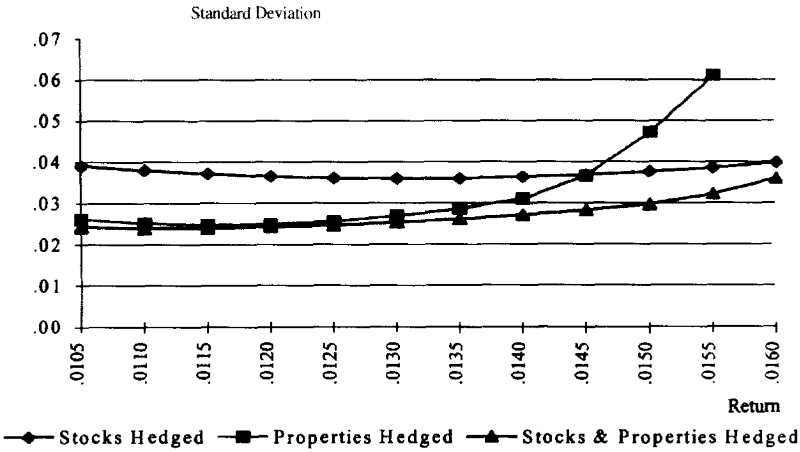
Figure 1 reports the mean-variance frontiers calculated from three sets of assets: (1) all six property trusts; (2) all six stocks; and (3) both the property trusts and the stocks assuming that returns are unhedged (Figure 1a) and alternatively assuming that currency risk is hedged (Figure 1b). Regardless of whether currency risk is hedged, the combination of international stock and real estate securities provides less risk at all levels of return relative to either an all real estate portfolio or a portfolio consisting only of stocks. However, the incremental reduction in risk is small at low and high levels of portfolio return. At low levels of return, the risk of an efficient, mixed asset portfolio is similar to an efficient portfolio consisting solely of international, real estate related securities. At high levels of return, the risk on an efficient, mixed asset portfolio is similar (albeit lower than) to an efficient portfolio comprised only of international stocks. Table 9 also reveals that investing in an international portfolio of stocks and real estate securities reduces the risk of a portfolio consisting solely of U.S. stocks and U.S. property trusts at all levels of return. In particular, portfolio risk is reduced between 15%–27% (31%–40%) on monthly returns of 1.1%–1.3% respectively, when foreign currency is not hedged (is hedged). Table 9 also shows that incremental reduction in risk is small at low levels of portfolio return because international real estate securities represent between 86%–88% of the efficient portfolio when the portfolio return equals 1.1% per month. Conversely, the incremental reduction in risk is also small at high levels of portfolio return since international stocks account for 71%–74% of the efficient portfolio when the portfolio return equals 1.6% per month. Although the aggregate inter-asset weights for real estate and stocks are similar for the efficient portfolio at low and high levels of returns regardless of whether returns are hedged, there are differences in intra-asset allocations. These differences depend on whether currency risk is hedged. U.S. real estate securities dominate efficient portfolios with low returns (and risk) when returns are unhedged. When returns are hedged, however, non-U.S. real estate related securities comprise the majority of the efficient portfolio at low levels of portfolio risk and return. At the highest levels of portfolio risk and return, the weight for U.S. stocks is almost equal to (but a little less than) the weight on international stocks when returns are unhedged. However, only international stocks are included in the efficient portfolio when currency risk is hedged. In fact, only international stocks and

Figure 1 ■ Efficient mixed asset frontiers.

a. Efficient frontier assuming currency risk is not hedged.



b. Efficient frontier assuming currency risk is hedged.



international real estate comprise the efficient portfolio if an investor hedges foreign exchange risk and desires at least a 1.6% portfolio return per month.

Consequently, the investment implications are that if an investor is risk averse and desires a yearly portfolio return of 12% then the investor should hold a portfolio that has 86%–88% weight in real estate related securities

Table 9 ■ Returns, standard deviations and portfolio allocations (February 1980–March 1991).

Panel A: Common Stocks and Property Stocks (U.S. only)*						
Return	0.01	0.01	0.01			
Standard Deviation	0.03	0.04	0.04			
Allocations						
U.S. Real Estate	0.69	0.44	0.18			
U.S. Stocks	0.31	0.56	0.82			
Panel B: Common Stocks and Property Stocks Unhedged						
Return	0.01	0.01	0.01	0.01	0.02	0.02
Standard Deviation	0.03	0.03	0.03	0.03	0.04	0.04
Allocations						
U.S. Real Estate	0.60	0.54	0.42	0.27	0.12	0.00
Intl Real Estate	0.29	0.29	0.29	0.29	0.29	0.26
U.S. Stocks	0.05	0.09	0.16	0.23	0.31	0.34
Intl Stocks	0.07	0.08	0.14	0.21	0.28	0.39
Aggregate Weights						
Real Estate	0.88	0.82	0.71	0.56	0.41	0.26
Stocks	0.12	0.18	0.29	0.44	0.59	0.74
Panel C: Common Stocks and Property Stocks Hedged						
Return	0.01	0.01	0.01	0.01	0.02	0.02
Standard Deviation	0.02	0.02	0.03	0.03	0.03	0.04
Allocations						
U.S. Real Estate	0.30	0.24	0.17	0.07	0.00	0.00
Intl Real Estate	0.56	0.59	0.61	0.61	0.54	0.29
U.S. Stocks	0.00	0.00	0.05	0.09	0.06	0.00
Intl Stocks	0.14	0.16	0.17	0.23	0.40	0.71
Aggregate Weights						
Real Estate	0.86	0.83	0.78	0.68	0.54	0.29
Stocks	0.14	0.17	0.22	0.32	0.46	0.71

*The return on the efficient portfolio consisting of stocks and property trusts of the U.S. does not equal or exceed 1.4% since the return on U.S. stocks is 1.37% while the return on U.S. property trusts is 0.98%.

and a 12%–14% weight in stocks to achieve the lowest risk. The intra-asset composition of this portfolio will depend on whether that investor wishes to hedge currency risk. If currency risk is hedged then the investor should invest primarily in international real estate securities. On the other hand, if the return is unhedged then U.S. REITs should comprise the majority of the investor's portfolio. If the investor desires higher returns, say 19% per year, then he or she should invest primarily in stocks (71%–74%) with not more than 26%–29% in real estate securities. Furthermore, this portfolio should consist of only international assets if currency risk is hedged. Conversely, a 34% exposure in U.S. stocks in addition to international assets is warranted if portfolio returns are unhedged. Regardless of whether currency risk is hedged however, the inclusion of international stocks and real estate securities in a portfolio does reduce the incremental risk for any given level of return relative to a portfolio consisting solely of U.S. stocks and U.S. property trusts.

While it is unlikely that any investor would hold at least 25% (90%) in real estate securities to obtain a 19% (12%) annual return, what this finding suggests is that real estate securities do provide diversification benefits. Furthermore, some real estate exposure is warranted even if the investor desires a high level of return. Another implication is that international real estate securities provide more diversification benefits relative to U.S. REITs, the higher the portfolio return if currency risk is hedged. Even if currency risk is not hedged, an investor still derives an advantage to having some exposure in foreign real estate securities.

Although it might appear from a comparison of Figure 1a to Figure 1b that an investor benefits from hedging currency risk[20] *e.g.*, portfolio risk is reduced, this finding ignores settlement costs and other transaction costs of the hedge. Worzala (1995) argues that if settlement costs are explicitly recognized in the hedging process, then not only will the portfolio return decrease but also the portfolio risk will increase. Thus, settlement costs might completely offset any advantage to hedging currency risk.

A finer delineation of the composition of the optimal mixed asset portfolio into the stocks and real estate securities of various countries reveals that when currency risk is not hedged, U.S. REITs comprise 60% of the efficient portfolio while French property trusts represent an additional 23% when the portfolio return desired is equal to 1.1% a month (13.2% per year) as shown in Figure 2a. Japanese property companies and Australian property trusts round out the real estate portion of this portfolio with weights of 4.4% and 1.4%, respectively. Consequently, real estate securities comprise approximately 89% of the efficient portfolio when risk and return are relatively low and currency risk is unhedged. The remaining 11% of the portfolio consists of stocks of the U.S. (5%), South Africa (4%), and Japan

[20] This is not surprising given that the variance of unhedged returns will exceed that of hedged returns when a positive covariance exists between the return on the asset and currency returns.

Figure 2 ■ Optimal portfolio of stocks and real estate.

a. Optimal portfolio of stocks and real estate assuming currency risk is not hedged.

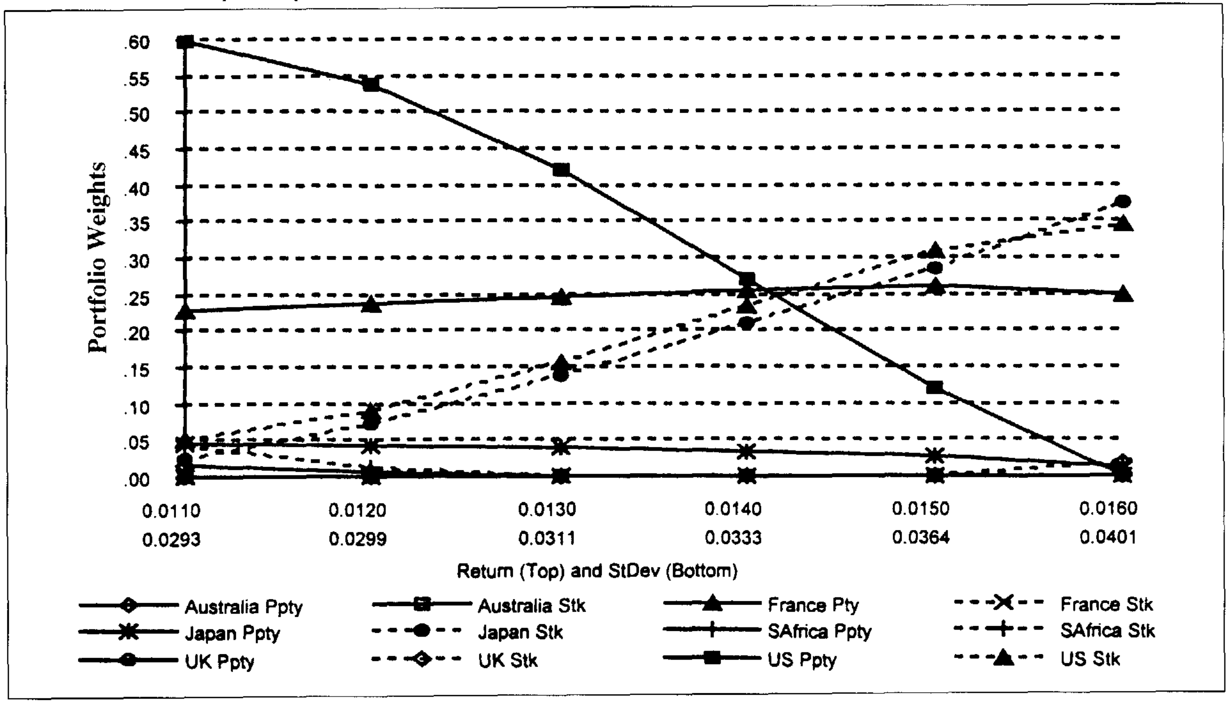
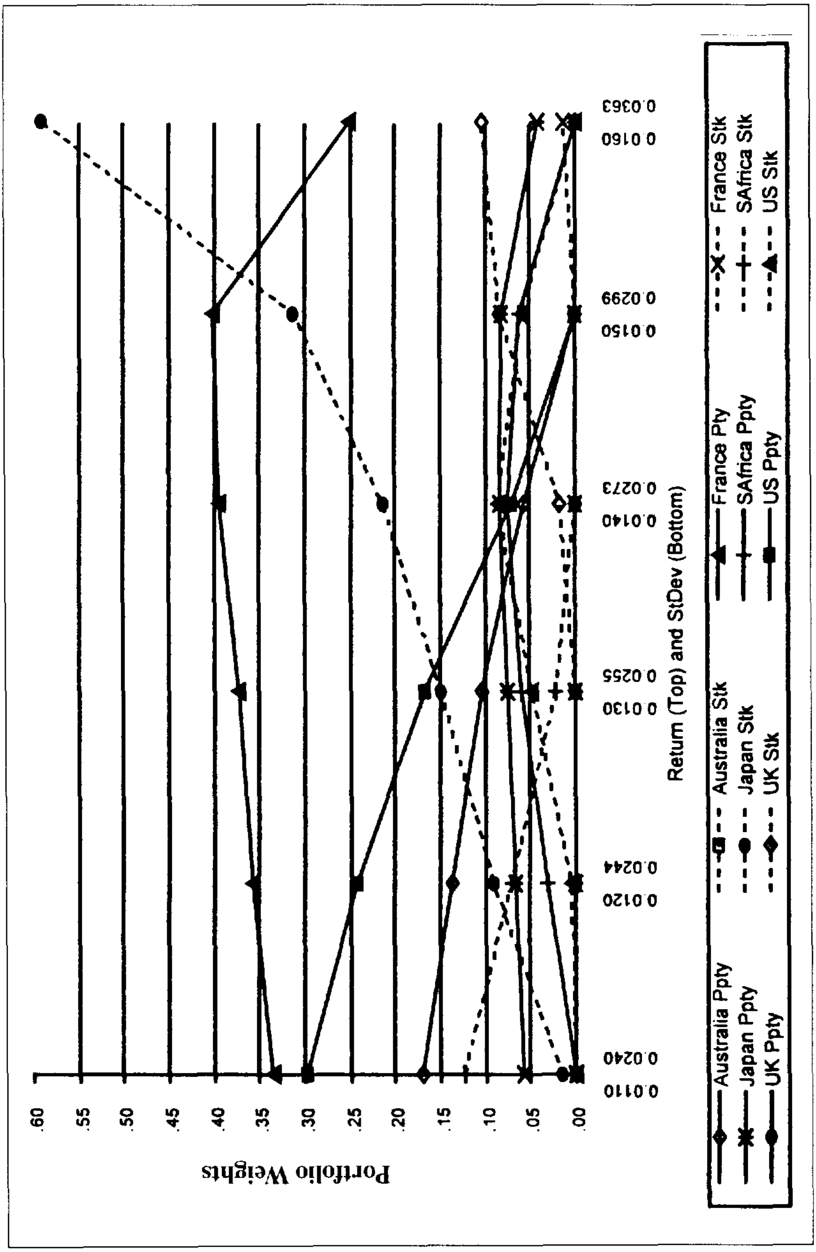


Figure 2 ■ (continued)

b. Optimal portfolio of stocks and real estate assuming currency risk is hedged.



(2%). Figure 2b shows that when currency risk is hedged and the return on the efficient portfolio remains at 1.1% a month, the majority of the portfolio is still weighted towards real estate securities. However, French property trusts now constitute the largest portion of the optimal portfolio with a weight of 33.6% followed by U.S. and Australian property trusts with weights of 30% and 17%, respectively.[21] Japanese property companies round out the list of real estate related securities, representing about 5% of the efficient portfolio. The only stocks included in this portfolio are those from South Africa (12%) and Japan (1.5%). Thus, the real estate securities and stocks that comprise the efficient portfolio at a return of 1.1% are similar on average, albeit the weights differ, regardless of whether currency risk is hedged.

As the return on the efficient portfolio increases to 1.5% per month (18% per year), the weights associated with property trusts/companies of various countries decrease when currency risk is not hedged. The only exception to this are French property trusts whose portfolio weight remains relatively constant at 24%–26%. Moreover, only the real estate securities of three countries, France (26%), U.S. (12%) and Japan (2.6%), remain in the efficient portfolio when the return is at 18% per year. In contrast, the weights associated with U.S. and Japanese stocks continue to increase as the risk and return on the efficient portfolio increase. In fact, U.S. and Japanese stocks dominate the portfolio (with weights of 31% and 28%, respectively) when returns reach 18% per year. At no time do South African property trusts, UK property companies, Australian stocks, French stocks or U.K. stocks enter into the efficient portfolio over this region of portfolio return.

A slightly different perspective obtains when currency risk is hedged. Both the allocation to French property trusts and Japan property companies increase, in general, until returns reach 1.5% per month (18% per year). South African property trusts also begin to enter into the mixed asset portfolio. In contrast, the weight given to U.S. REITs and Australian property trusts decrease as portfolio returns increase while U.K. property companies do not enter the optimal portfolio at any level of risk and return. In terms of international stocks, Japanese stocks are the dominant asset (with a weight of 59%) in the optimal portfolio as returns exceed 1.5%. An inverse relationship appears to exist, in general, between the weights for real estate related securities and stocks of a given country. For example, exposure to U.S. stocks increase while the weight on U.S. REITs decrease as the risk/

[21] Detailed tables on which Figure 2a and Figure 2b are based are available from the authors.

return on an efficient portfolio increases. Further, French stocks start to enter into the efficient portfolio only after French property trusts exit from the portfolio. The only exception to this inverse tendency is with respect to Japanese assets. Australian stocks never enter into the efficient portfolio.

At the highest level of monthly portfolio return shown, 1.6% (19.2% per year), Japanese stocks represent 37% of the portfolio while U.S. stocks closely follow with a weight of 34% when currency risk is unhedged. French property trusts comprise another 25% of this portfolio while Japanese property companies (1%) and U.K. stocks (2%) have a minor contribution. When currency risk is hedged, Japanese stocks comprise 59% of the portfolio followed by French property trusts and U.K stocks with a 25% and 10% weight, respectively. Japanese property companies and French stocks make up the remaining assets in this portfolio.

In summary, real estate related securities from at least one country are included in the optimal mixed asset portfolio, except at extremely high levels of return when currency risk is hedged. When currency risk is not hedged, in contrast, real estate securities of South Africa and the U.K are not included in any efficient portfolio. In terms of real estate related securities included in the optimal portfolio, U.S. property trusts and French property trusts have the largest weights regardless of whether currency risk is hedged. The incremental risk/return influence of U.S. property trusts decreases while that of French property trusts increases at higher levels of portfolio risk and return. However, not all of the property securities of each country are included in an efficient portfolio. Does the fact that U.K. and Japanese property companies have different characteristics (*e.g.*, development opportunities) relative to the rest of the real estate securities in the sample impact on the optimal portfolio? Interestingly, the results show that Japanese and U.K. property companies have a minor influence, if any, on the composition of the efficient portfolio regardless of whether currency risk is hedged. More specifically, Japanese property companies comprise 2.6% (4.4%–5.0%) of the optimal portfolio when portfolio returns are high (low). At no time do U.K. property companies, in contrast, enter into the efficient portfolio. These results are invariant to whether currency risks are hedged.

Conclusion

This study examines the extent to which returns on stocks and real estate related securities are predictable in six countries in an attempt to discover which portion of the return is responsible for international diversification benefits. Both a hedged strategy for exchange rate risk and an alternative unhedged strategy are considered. A group of own country economic variables and a set of U.S. economic variables are alternatively used as the relevant information set to predict hedged and unhedged returns. The predicted portion of the returns on both stocks and real estate securities are small and tend to move in tandem. This common co-movement of expected returns arises because these capital markets are integrated and a one-factor model is sufficient in capturing the time-variation of risk premiums across different countries. Further, regardless of which information set is used, the expected portion of returns for portfolios consisting of both unhedged and hedged returns are quite small. This suggests that diversification benefits arise primarily from the unexpected portion of returns. Changes in currency risk account, in part, for movements in unanticipated returns. The most distinguishing result is the finding that investing in international real estate related securities provides additional (incremental) diversification benefits over and above that associated with international stocks. These benefits are relatively more pronounced at lower risk-return levels of the optimal portfolio and are present regardless of whether currency risks are hedged. Thus, U.S. investors should consider including international real estate securities in their portfolios.

It is worth noting that the results are based on historical returns from the sample period of 1980–1991. The optimal portfolio weights derived here, therefore, may not be applicable to future asset allocations if the underlying economic conditions have changed. However, this study has at least demonstrated the benefits of international diversification and the role of real estate securities. Furthermore, the approaches developed are certainly useful for portfolio managers in solving their asset allocation problems.

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Appendix

Detailed Description of the Latent Variable Model

Basically, the asset pricing framework used in this study is identical to that of Liu and Mei (1992) and assumes that the following K-factor model generates asset returns:

$$\tilde{r}_{i,t+1} = E_t[\tilde{r}_{i,t-1}] + \sum_{k=1}^{K} \beta_{ik}\tilde{f}_{k,t+1} + \tilde{\varepsilon}_{i,t+1} \quad \text{(A.1)}$$

Here $\tilde{r}_{i,t+1}$ is the return on asset i in excess of the riskfree rate held from time t to time $t + 1$, $E_t[\tilde{r}_{i,t+1}]$ is the conditional expected excess return on asset i which is allowed to vary through time,[22] $\tilde{f}_{k,t+1}$ are the factor realizations, β_{ik} are the time-invariant factor loadings and the idiosyncratic error is $\tilde{e}_{i,t+1}$. If certain restrictions are imposed on this return generating model then Equation (A.1) is rewritten as:[23]

[22] Evidence on time-varying risk premiums is reported in Campbell (1987), Fama and French (1989) and Ferson, Kandel and Stambaugh (1987), among others.

[23] These restrictions are that (1) the conditional expected rate of return is a linear function of the factor risk premiums, with the coefficients equal to the betas of each asset or mathematically:

$$E_t[\tilde{r}_{i,t+1}] = \sum_{k=1}^{K} \beta_{ik}\lambda_{ik}$$

where λ_{kt} is the "market price of risk" for the k^{th} factor at time t. There are a number of intertemporal asset pricing models which can generate this type of linear pricing relationship, under either a no arbitrage opportunity condition or through a general equilibrium framework (see, for example, Ross 1976; Campbell 1993; and Connor and Korajczyk 1988), and (2) the conditional expectations are a linear function of L forecasting variables X_{nt}, $n = 1,\ldots,L$ (where X_{1t} is a constant) which represent the information set at time t, so λ_{kt} is written as

$$\lambda_{kt} = \sum_{n=1}^{L} \Theta_{kn}X_{nt}$$

$$E_t[\tilde{r}_{i,t+1}] = \sum_{k=1}^{K} \beta_{ik} \sum_{n=1}^{L} \theta_{kn} X_{nt} = \sum_{n=1}^{L} \alpha_{in} X_{nt} \tag{A.2}$$

The combination of Equations (A.1) and (A.2) represent a multi-factor "latent-variable" model.[24] The model implies that expected excess returns are time-varying and can be predicted by the forecasting variables (X_{nt}) in the information set. The forecasting variables used are the common, economic state variables discussed earlier.[25] The model puts some restrictions on the coefficients of Equation (A.2), namely

$$\alpha_{ij} = \sum_{k=1}^{K} \beta_{ik} \theta_{kj} \tag{A.3}$$

Here, β_{ik} and θ_{kj} are free parameters. To test the restriction in Equation (A.3), the model is first renormalized by setting the factor loadings of the first K assets as follows: $\beta_{ij} = 1$ (if $j = i$) and $\beta_{ij} = 0$ (if $j \neq i$) for $1 \leq i \leq K$. If the linear pricing relationship holds, that implies that the data should not be able to reject the null hypothesis of Equation (A.3) H_0: $\sigma = \Theta B$ in the following regression in Equation (A.4),

$$\begin{aligned} R_1 &= X\Theta + \mu_1 \\ R_2 &= X\alpha + \mu_2 \end{aligned} \tag{A.4}$$

where B is a matrix of β_{ij} elements and $R = (R_1, R_2)$ is the excess returns matrix. Here R_1 is a TxK matrix of excess returns of the first K assets and R_2 is a $Tx(N - K)$ matrix of excess returns on the rest of the assets. The regression system in Equation (A.4) is used to see to what extent the forecasting variables, X, predict excess returns of all assets and to test the linear pricing restriction of Equation (A.3). If the linear pricing restriction is not rejected by the data, then there is evidence of market integration, since

[24] For more details on this model, see Gibbons and Ferson (1985), Campbell (1987) and Ferson and Harvey (1990).

[25] Keim and Stambaugh (1986), Campbell (1987), Fama and French (1988, 1989), Ferson (1989), Ferson and Harvey (1990), Campbell and Hamao (1992) and Liu and Mei (1992, 1994) have used these variables among others. Fama and French (1989) also uses the spread between yields of a low grade long-term corporate bond and a long-term treasury bond to capture the default risk in the financial market. But they find the variable to be capturing the same information as the dividend yield. Thus, only dividend yield is included here.

the variations in asset expected returns can be explained by the variation of some systematic factors, $f_{k,t+1}$.

The regression system of Equation (A.4), given the restriction in Equation (A.3), is estimated and tested using Hansen's GMM. A chi-square test is performed to see if the data rejects the restricted regression system in Equation (A.4).