DIVERSIFICATION OF REAL ESTATE INVESTMENT IN THE ASIA-PACIFIC REGION

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Abstract

Studies that hitherto have been done on real estate diversification strategies have given inconclusive results. Therefore this paper is aimed at evaluating the relative merits of three direct real estate investment diversification strategies (i.e. international diversification by sector, diversification across-types-within-nation, and international diversification across types) in the Asia Pacific region. The paper is based on return data for nine countries from 1984 to the fourth quarter of 1996 taken from JLW (now JLL) Asia Pacific Property Digest. Because of the peculiar nature of real estate investment, which precludes short selling and riskless borrowing, Matlab Optimization toolbox (a computer software) is used to construct the optimal portfolio composition from which the efficient frontiers are plotted. Furthermore all returns are denominated in the Singapore dollar to reflect the viewpoint of Singapore investors although analyses based on the currency of any of the sampled countries should produce similar results. Analyses of the return data reveal that international diversification by the retail sector was the best diversification strategy during the period although the choice between the retail and office sectors is a function of the investor's risk aversion vis-à-vis expected quarterly return.

Key Words: Real Estate, Diversification, Strategy, Expected Return, Risk, and Investment

International investments can open up a wider choice of investment opportunities, give improved risk-adjusted returns, reduce volatility and protect investors against the ravages of currency volatility when the investment is in real assets (see Solnik, 1996; Wendt and Wong, 1965; Friedman, 1970 and 1971; Rubens, Bond and Webb, 1989; Fogler, 1984; Irwin and Landa, 1987). These benefits are maximized when there is a low correlation between the markets. Thus, according to Taylor (1995), a well-diversified portfolio would include economies at various stages of development as such economies are lowly correlated. In this regard, the Asia-Pacific region, being at different stages of economic development, should provide many opportunities for real estate investment diversification. This is attested by a study of Seek (1996) in which he concluded that the Asia-Pacific region provides a vast range of different investment opportunities at varying levels of risk and return to satisfy different investment criteria. In other words, the region boasts of a rich diversity of economies to provide avenues for diversification.

Whenever we talk of diversification of investments, we implicitly refer to a body of theories which originate from Markowitz (1952) called the modern portfolio theory (MPT) (see Sharpe, 1963 and 1964; Lintner, 1965; and Mossin, 1966). It must be noted, however, that Fama and French (1992) raise serious questions about the validity of the capital asset pricing model (CAPM) and therefore MPT. Their finding that there is no relationship between the magnitude of a stock's historical beta and the level of its

historical return implies that the risk-return relationship on which MPT is founded may be obscure (see Haugen, 1995; and Chan and Lakonishok, 1993). Furthermore, in the case of real corporate assets like plant and equipment and especially real estate, research thus far has failed to prove the general applicability of CAPM (and therefore MPT) because of indivisibility, relatively large size, limited number of transactions and the absence of efficient markets for such assets (see Gitman, 1994; Liu, Grissom and Hartzell, 1990; Brown, 1991; Sykes, 1983; Baum, 1989; Locke, 1987; Gau, 1985). Even though the applicability of MPT to real estate investment is a polemic issue, MPT provides a useful conceptual framework for evaluating real estate investment to underpin research in the area. However studies, which hitherto have been done on real estate investment diversification strategies, have produced inconclusive results. This paper therefore sets out to evaluate the relative merits of the following three diversification strategies with reference to the Asia-Pacific region in a bid to discover the best strategy: by-nation within-type (i.e. international diversification by sector); by-type within nation (i.e. across-types in a particular country); and international diversification across-types. The countries in the Asia-Pacific region, which are the focus of investigation, are: Singapore, Malaysia, Japan, Hong Kong, New Zealand, Australia and Philippines. The choice of these countries is solely a function of data availability.

Diversification by Sector and By Geographic Region

Conventionally, diversification of real estate investments is by property type and geographic region. Miles and McCue (1982) find that diversification by property type produces higher risk- adjusted returns than geographic diversification. The superiority of diversification by type over geographic diversification is found to be a function of the correlation of returns, which is lower for sectoral diversification than for geographic diversification. Miles and McCue (1984) replicate this conclusion in a later study. However, Hartzell, Hekman and Miles (1986) disagree with Miles and McCue (1982). Hartzell et al (1986) find that the correlation between returns for the four regions (East, Mid-west, West and South – USA) were lower than those for property types. A study by Grissom, Hartzell and Liu (1987), using the standard four regions of East, West, Mid West and South, evidences the existence of regional markets for industrial real estate to suggest the importance of regional diversification. Eichholtz, Hoesli, MacGregor and Nanthakumaran (1995) attempt to surmount the impasse on the relative superiority of diversification by type and by region. Unfortunately, their study concludes with "...there is no simple conclusion applicable to all regions and all sectors in either country" (Eichholtz et al, 1995: 26). Furthermore, researchers in the share market have tried in vain to answer the question on whether diversification should be by type of industry or by country (see Roll, 1992; Heston and Rouwenhorst, 1993). It would appear therefore that there is no consensus on the relative superiority of the two diversification strategies.

Diversification by Economic Region

Several authors (for example Bahl, 1971; and Clemente and Surgis, 1971) have written about segmentation of the market according to economic factors. This is on the assumption that there is more diversification potential across regions with different economic bases than across those with purely political or geographic boundaries. Hartzell, Shulman and Wurtzebach (1987) work with eight regions[1] based on similar underlying economic fundamentals instead of the traditional four regions and find that economic regions provide a wider scope for diversification. Using demand variables for population, income and employment rather than real estate returns, Malizia and Simons (1991) concur with Hartzell et al that the eight-region classification did provide benefits that could not be matched by the traditional approach.

Mueller (1993) compares the appropriateness of using the traditional four-region classification, the eight-region classification suggested by Hartzell et al (1987) and the nine economic categories suggested by Mueller and Ziering (1992) [2]. The results show that the order of preference based on risk-adjusted returns is the pure economic-based strategy, the mixture of economic and geographic strategy (eight-region) and finally, the geographic strategy (four-region)[3].

It would appear that only Miles and McCue (1982) suggest that property type diversification is superior to diversification by region. However, this conclusion may have been caused by the large-scale geographic classification used that might have neutralised the differences between the regions. Furthermore, it should be noted that the above studies compared regions within a single country. This study, however, focuses on some countries in the Asia Pacific region. Given the different stages of growth and the uniqueness of the business climate in each country, the country classification (i.e. by-type within-nation strategy) is seen as a proxy for a mixture of economic and geographic based classification.

Theoretically, it may be argued that since different sectors are influenced by different macro-economic factors, there is justification for diversifying by property type. Given the different phases of growth of the real estate markets in the region, one may argue that there is a potential for diversification by region too. It is, however, hypothesized that more risk reduction (without sacrificing return) could result from diversification by-nation within-type. In other words, international diversification by property type is more beneficial than across-type within-nation, and across-type and nation diversification strategies.

Exchange Rate Volatility and International Investment

Newell and Worzola (1995) identify exchange rate volatility to be the most important risk besetting institutional investors holding a portfolio of overseas investment. This is concurred by Balogh and Sultan (1997) who consider currency risk to be the most common risk of overseas investment. Because of the translation, economic and transaction, exposure which are a corollary of currency risk, it has been suggested by Dawson and Rodney, (1994) that overseas investors who do not engage in currency hedging will be speculating on the
exchange rate movements as well as on their foreign holdings since the return from a foreign investment comprises of the foreign holding's return and an exchange rate return.

Though there are conflicting findings on the impact of currency risk on foreign investments,[4] Exhibit 1 shows that apart from the Japanese yen, the Singapore dollar (SGD) appreciated against the currencies of the countries which are the focus of this paper.[5] Thus, a Singaporean who invested in any of these countries would have suffered a loss by converting the foreign currency return into SGD. Furthermore, the recent currency turmoil in South-east Asia has reminded investors of the ravages of the exchange rate volatility. Therefore, notwithstanding Solnik's (1974) conclusion that international diversification is attractive regardless of the investor's home currency and whether exchange rates are hedged or uncovered, the analyses in this paper will be based on risk-adjusted returns.

Methodology

The paper is based on 'net' market rental and capital values extracted from Jones Lang Wootton (now Jones Lang LaSalle Property Consultants Pte Ltd) Asia Pacific Property Digest. The data cover a thirteen-year period (i.e. 52 quarters) from 1984 to 1996 inclusive. It must be noted, however, that data are not available over the whole period for every country in the sample. As a result of this, analyses are based on 52 (1Q84-4Q96), 40 (1Q87-4Q96) and 16 (1Q93-4Q96) quarters to coincide with data availability for some countries and property types. Furthermore, the rental and capital values are related to prime buildings of similar locational quality in all the sampled countries.

The capital values are quoted on quarterly basis while the rentals are annual figures. Therefore the rental figures have been adjusted accordingly for the computation of quarterly returns for all the statistical analyses. Furthermore, the reader must note that taxes, except property tax, have been ignored because of the assumed quarterly holding period. It would be grotesque to account for taxes over such a short holding period as capital gains tax in particular, which investors may not be liable under normal circumstances, will be extremely
harsh (in countries like Singapore and Malaysia) to grossly distort the returns from reality.

Since the capital and rental value figures are quoted in different currencies, the returns have been denominated in the SGD on the basis of the end-of-period market exchange rates from 1984 to 1996 inclusive which were extracted

from the International Monetary Fund's International Financial Statistics.

An adjusted Markowitz's mean-variance approach is used to construct an optional portfolio. To accommodate the peculiar features of direct real estate investment (e.g. no short selling, no riskless borrowing and lending etc), a quadratic programming tool-kit called Matlab Optimization toolbox is used to calculate the risk and composition of the optimal portfolio. The main concern is creating a portfolio of office properties (from the sampled countries) that maximises return at a given level of risk, or minimises risk at a given level of return without allowing for short selling. The expected return on the portfolio is the weightage average returns of the properties for each country, while the portfolio risk is the weighted average variability and the correlation coefficient of the returns from the sampled countries. Mathematically:

$$\sigma_p^2 = \sum_{i=1}^{n} W_i^2 \sigma_i^2 + 2 \sum_{\substack{i=1 \\ (i \neq j)}}^{n} \sum_{j=1}^{n} W_i W_j \, \rho_{ij} \sigma_i \sigma_j \qquad (1)$$

Subject to $W_i \geq 0$ and $\sum_{i=1}^{n} W_i = 1$

Where σ_p^2 = portfolio variance
σ_i, σ_j = standard deviation of asset i and j respectively
ρ_{ij} = correlation coefficient of asset i and j
W_i, W_j = proportion of asset i and j in portfolio

Equation (1) implies no short selling while the second constraint ensures that the portfolio is fully invested.

After differentiation of Equation (1), the MATLAB Optimisation Toolbox is used to solve the following quadratic programming problem to derive an optimal portfolio composition:

Minimise $\mathbf{1/2x^T Hx + c^T x}$ so that $\mathbf{Ax \leq b}$

where c = (0 0 0 0 0 0 0 0)
x = the optimal portfolio weights
H = a Hesian matrix

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ R_a & R_b & R_c & R_d & R_e & R_f & R_g & R_h \end{bmatrix}$$

$$b = \begin{bmatrix} 1 \\ R_p \end{bmatrix}$$

$R_a \ldots R_p$ = the quarterly property return from respective countries.

Each optimal portfolio minimises the portfolio's risk without allowing for short selling and riskless lending and borrowing (Elton and Gruber, 1994). These constraints are necessary as borrowing and lending for real estate investment are not riskless, while short selling is impossible.

By following the instructions and steps in the toolbox, entering the relevant data, and typing the command: X=qp(H,C,A,b,vlb,vub,xO,neqcstr) – see Matlab Toolbox Manual – the software will compute and give you the optimal portfolio weightages. By typing another command: ½ * χ' * H * χ (see Matlab Toolbox Manual), The portfolio variance for the specific expected return will be given.

Return / Risk

The quarterly returns of the various asset choices are computed before an arithmetic average return is calculated. The quarterly returns can be calculated using the formula given below:

$$R_t = \frac{(C_t - C_{t-1} + D_1)}{C_{t-1}} \qquad (2)$$

where :

R_t is the return on the asset for period t.
C_t is the capital value of the asset at time t
C_{t-1} is the capital value of the asset at time t-1
D_t is the rent received during period t

Thus, the expected quarterly return for each country over the specified investment period can be calculated as follows:

$$R_i = \frac{\sum_{j=1}^{k} R_{it}}{K} \qquad (3)$$

Where

R_i = the expected quarterly rate of return on asset i
R_{it} = the quarterly rate of return for asset i in period t
K = number of periods

In relation to international diversification across types, R_{it} in equation (3) is the quarterly rate of return for country i in period t. Because of the dearth of data, the quarterly return for each country is simply the arithmetic mean returns for the respective sectors which are: office, residential and retail. The choice of these property types is, once again, predicated upon the availability of data.

The expected quarterly unadjusted and currency-risk-adjusted returns and the associated risks have been computed and presented in Exhibit 2. It could be seen that the figures in Exhibits 2-4 do not always conform to the conventional dictum that return is directly related to risk. For example, during the 1Q1984-4Q1996 period, Japan, with a risk of 0.105 produced a return of 0.027 while Singapore provided a return of 0.033 with a risk of 0.064. Similarly Hong Kong and New Zealand recorded higher returns vis-à-vis lower risk than Japan. Exhibits 2 to 4 are replete with similar contradiction of the conventional dictum.

One may argue that these anomalous results for Japan is a function of the overly optimistic sentiment for Japanese property over part of that period by both Japanese and US investors.

It must be noted, however, that Japan recorded similar anomalous results for the 1Q1993-4Q1996 period when optimism had been superceded by pessimism to result in capital flight from Japan's property market. For example, New Zealand, Malaysia, Australia, Singapore, Indonesia and Thailand recorded higher returns (with lower risk) than Japan during the period (see Exhibit 2, Office Sector). This could also be controverted on the premise that the results for 1Q1993-4Q1996 were the aftermath of the earlier over-investment in the property market vis-à-vis the stock market crash of 19 October, 1987 and the resultant lingering depression of Japan's economy, especially the property market. A careful examination of Exhibits 2 – 4 would reveal, however, that the problem of anomalous results is not peculiar to Japan.

Therefore one may contend that the anomaly is attributable to other factors than the special circumstances peculiar to Japan during the period. Thus, it would appear that a plausible explanation to the odd risk-return outcome could be market distortions as a corollary of restrictive property investment laws in the sampled countries. Unfortunately, however, the anomaly exists even in Hong Kong (see Exhibit 2, 1Q1993-4Q1996 [Office & Retail sectors]; and Exhibits 3 & 4), which is an open market. It would appear therefore that the sampled countries' foreign property investment regimes might not be a credible explanation for the anomalous results. Once again, it could be argued that Hong Kong's results are a function of the uncertainties during the period immediately preceding the handing over of the island to China in 1997. Whatever be the reason(s) for the anomaly, it is worth noting that the anomaly did occur, and it is likely to be replicated in the future because of the imperfect and irrational political, economic and investment milieu that we have to deal with. Furthermore, the odd risk-return outcomes concur with Haugen (1995) that risk and return are not always positively related.

Exhibit 2 shows that apart from the period 1Q1993-4Q1996 where the residential sector out-performed the other two sectors, the retail sector performed better than the residential and office sectors over the thirteen and ten-year periods (i.e. 1Q84-4Q96 and 1Q87-4Q96). Furthermore the retail sector appears to be the least risky as measured by the coefficient of variation. However, Exhibits 2 to 4 do not give any indication of the relative risk reduction merits of the three sectors. Since the opportunity for risk reduction in investment portfolios is inversely related to the correlation of the asset returns (Markowitz, 1952 and 1959), the correlation matrices for the three strategies are presented in Exhibits 5 to 7.

CORRELATIONS BETWEEN CURRENCY-ADJUSTED RETURNS

International Diversification within Type

The correlation matrices (Exhibit 5a-c) reveal that each of the three property types offers tremendous opportunities for international diversification within property type.

Over he thirteen-year period (i.e. 1Q84-4Q96, Table 5a), the correlation coefficients between the currency-adjusted office sector returns of the respective countries were either negative or low. The positive correlation coefficients are below 0.5 to imply that diversification could lead to considerable reduction in risk – All the correlation coefficients are not statistically significant at both 1% and 5% level of significance. Similarly, the limited data on the retail sector indicate a negative correlation between Malaysia and New Zealand (-0.03) and a relatively low positive correlation between Singapore and New Zealand. However, these figures are so low that one could safely conclude that the returns are uncorrelated.

The story is almost the same for the ten-year period (Exhibit 5b) and the four-year period (Exhibit 5c). Furthermore the correlation coefficient for the adjusted residential, and retail, sectors returns for the respective countries are either relatively low (i.e. below 0.5) or negative. The only statistically significant correlation (at 5% level of significance) in Exhibit 5b is between Singapore and Australia (0.59). Similarly, it is evident from Exhibit 5c that apart from Hong Kong-New Zealand (0.61), Philippines-Australia (0.72) and Thailand-Malaysia (0.63) (office sector), the positive currency-adjusted correlation figures are below 0.5 – about 89% of the adjusted correlation coefficients are not statistically significant at the 1% and 5% levels of significance. Furthermore it may be noted that one of the few statistically significant correlation coefficients (i.e. Singapore-Hong Kong) is negative to imply that diversification of real estate investment in these two countries is particularly beneficial.

Exhibit 2: Variability of (Adjusted) and Unadjusted Returns – International Diversification Within Type

OFFICE SECTOR

1Q 1984 – 4Q 1996

COUNTRY	Expected Return	Standard deviation	Coefficient of Variation
New Zealand	0.038 (0.034)	0.074 (0.100)	1.94 (2.96)
Hong Kong	0.069 (0.062)	0.096 (0.096)	1.38 (1.55)
Malaysia	0.021 (0.013)	0.059 (0.062)	2.79 (4.89)
Australia	0.027 (0.018)	0.418 (0.067)	1.57 (3.84)
Singapore	0.033	0.064	1.97
Japan	0.020 (0.027)	0.071 (0.105)	3.53 (3.86)
Philippines	NA	NA	NA
Indonesia	NA	NA	NA
Thailand	NA	NA	NA

RESIDENTIAL SECTOR

Hong Kong	NA	NA	NA
Singapore	NA	NA	NA
Malaysia	NA	NA	NA
Indonesia	NA	NA	NA
Thailand	NA	NA	NA

RETAIL SECTOR

Singapore	0.025	0.040	1.60
New Zealand	0.113 (0.109)	0.045 (0.071)	0.40 (0.65)
Malaysia	0.087 (0.078)	0.057 (0.062)	0.66 (0.79)
Hong Kong	NA	NA	NA
Thailand	NA	NA	NA
Indonesia	NA	NA	NA

Source: Authors' computation

Exhibit 3: Variability of Returns – Diversification by Types within Nation

Country	1Q1987 – 4Q1996		1Q1993 – 4Q1996	
	Average Return	Std. Deviation	Average Return	Std. Deviation
New Zealand				
- Office	0.017	0.088	0.056	0.030
- Retail	0.100	0.054	0.087	0.026
Singapore				
- Office	0.047	0.055	0.050	0.058
- Residential	0.053	0.039	0.072	0.039
- Retail	0.040	0.031	0.028	0.010
Hong Kong				
- Office	0.062	0.107	0.045	0.129
- Residential	0.062	0.095	0.071	0.114
- Retail	0.042	0.079	0.011	0.058
Malaysia				
- Office			0.009	0.035
- Residential			0.035	0.056
- Retail			0.087	0.039
Indonesia				
- Office			0.005	0.031
- Residential			0.050	0.022
- Retail			0.026	0.021
Thailand				
- Office			0.006	0.027
- Residential			0.010	0.019
- Retail			0.016	0.022

Source: Authors' computation

Exhibit 4: Variability of Returns – International Diversification Across Types

Country	1Q1987 – 4Q1996		1Q1993 – 4Q1996	
	Expected Return	Std. Deviation	Expected Return	Std. Deviation
New Zealand	0.058	0.063	0.072	0.026
Hong Kong	0.055	0.082	0.042	0.094
Singapore	0.047	0.030	0.050	0.025
Indonesia			0.027	0.019
Thailand			0.032	0.048
Malaysia			0.044	0.033

Source: Authors' computation

Exhibit 5a: Correlation Coefficients of Returns (1Q1984 to 4Q1996)
International Diversification Within Type

Office Sector

	NZ	HK	Msia	Aust	Sg	Jap
NZ	1					
HK	0.11 (0.18)	1				
Msia	-0.58 (-0.49)	-0.01 (0.06)	1			
Aust	0.34 (0.39)	0.21 (0.16)	-0.22 (-0.22)	1		
Sg	-0.04 (0.05)	-0.06 (-0.11)	0.16 (0.11)	0.44 (0.41)	1	
Jap	0.34 (0.31)	0.10 (0.08)	-0.25 (-0.39)	0.28 (0.01)	-0.30 (-0.29)	1

Residential Sector

N.A.

Retail Sector

	Sg	NZ	Msia
SG	1		
NZ	0.14 (0.001)	1	
Msia	0.73 (0.65)	0.09 (-0.03)	1

Source: Authors

Note: Figures in brackets are based on currency risk adjusted returns
NZ = New Zealand, HK = Hong Kong, Msia = Malaysia, Aust = Australia
Sg = Singapore, Jap = Japan

Exhibit 5b: Correlation Coefficients of Returns (1Q1987 to 4Q1996)
International Diversification Within Type

	NZ	HK	Msia	Aust	Sg	Jap	Phi
NZ	1						
HK	0.11 (0.13)	1					
Msia	-0.49 (-0.49)	-0.02 (0.07)	1				
Aust	0.29 (0.36)	0.24 (0.19)	-0.15 (-0.23)	1			
Sg	0.14 (0.21)	-0.11 (-0.14)	-0.06 (-0.14)	0.70 (0.59)	1		
Jap	-0.12 (-0.15)	0.18 (0.06)	0.22 (-0.13)	0.22 (-0.12)	0.17 (0.09)	1	
Phi	0.09 (0.15)	0.14 (0.50)	0.35 (0.26)	0.48 (0.40)	0.29 (0.24)	0.28 (-0.21)	1

Residential Sector

	HK	Sg
HK	1	
Sg	-0.09 (-0.13)	1

Retail Sector

	SG	NZ	Msia	HK
SG	1			
NZ	0.66 (0.47)	1		
Msia	0.58 (0.49)	0.38 (0.07)	1	
HK	0.21 (0.23)	0.35 (0.31)	0.06 (0.12)	1

Source: Authors

Note: Figures in brackets are based on currency risk adjusted returns

Exhibit 5c: Correlation Coefficients of Returns (1Q1993 to 4Q1996)
International Diversification Within Type

Office Sector

	NZ	HK	Msia	Aust	Sg	Jap	Ph	Ind	Thai
NZ	1								
HK	0.61+ (0.61)+	1							
Msia	-0.44 (0.06)	-0.06 (0.18)	1						
Aust	-0.28 (0.18)	0.10 (0.15)	0.76* (0.31)	1					
Sg	-0.49 (-0.34)	-0.53+ (-0.57)+	0.47 (0.25)	0.55 (0.29)	1				
Jap	0.18 (0.43)	0.16 (0.18)	0.49+ (0.32)	0.26 (-0.44)	-0.03 (-0.04)	1			
Phi	0.12 (0.32)	0.52+ (0.39)	0.21 (0.07)	0.59 (0.72)*	-0.05 (0.07)	-0.02 (-0.11)	1		
Indo	0.28 (0.34)	0.33 (0.35)	-0.47 (-0.20)	-0.23 (0.37)	-0.37 (-0.39)	-0.15 (-0.40)	-0.02 (0.28)	1	
Thai	-0.23 (-0.22)	0.01 (0.08)	0.57+ (0.63)*	0.43 (0.24)	0.23 (0.06)	-0.07 (-0.13)	0.16 (-0.10)	-0.57 (00.21)	1

Residential Sector

	HK	Sg	Msia	Indo	Thai
HK	1				
Sg	-0.24 (-0.29)	1			
Msia	-0.23 –0.06)	0.05 (-0.05)	1		
Indo	0.22 (0.23)	0.51 (0.20)	0.23 (0.32)	1	
Thai	0.13 (0.20)	0.10 (-0.05)	-0.38 (-0.44)	-0.19 (-0.27)	1

Retail Sector

	Sg	NZ	Msia	HK	Thai	Ind
Sg	1					
NZ	0.04 (0.21)	1				
Msia	-0.38 (-0.30)	0.09 (-0.17)	1			
HK	-0.25 (-0.21)	0.29 (0.34)	0.03 (0.18)	1		
Thai	-0.04 (-0.01)	0.13 (-0.08)	-0.46 (-0.31)	0.28 (0.26)	1	
Indo	0.52 (0.51)	0.39 (0.30)	-0.20 (0.07)	-0.34 (-0.12)	-0.30 (-0.39)	1

Source: Authors

Note: Figures in brackets are based on currency-risk adjusted returns
Ind = Indonesia, Thai = Thailand
** Correlation is significant at 1% level of significance*
+ Correlation is significant at 5% level of significance

Diversification by Type within Nation

Our main concern under this section is to examine the relative advantage(s) of each of the sampled nations if the investment strategy during the periods was across-type diversification within a country. Because of the dearth of data, the analysis is restricted to six countries: New Zealand, Singapore, Hong Kong, Malaysia, Indonesia and Thailand; and to two periods: 1Q87 to 4Q96 and 1Q93 to 4Q96. The currency risk adjusted quarterly returns (Exhibit 3) have been utilised to compute the correlation matrices (Exhibit 6a-f).

The sectors for all the countries were positively correlated, as expected, during the 1Q87 to 4Q96 period. Apart from Hong Kong, the correlations were relatively low. It is worth noting that the residential and retail sectors of Singapore were not correlated during the period. Furthermore the retail sector (Singapore) was negatively correlated to the office and residential sectors during the 1Q93 – 4Q96 period. Once again, Hong Kong had the highest correlation between its sectors

International Portfolio Access Types

We have used the figures in Exhibit 4 to compute and present the correlation between the returns of the various countries in Exhibit 7.

Exhibit 7 shows that the correlations between the countries were generally either positive, albeit very low, or negative. However, it would appear that returns for Malaysia and Hong Kong, Malaysia and Singapore, and Malaysia and Thailand are not correlated (Exhibit 7b). It is somewhat paradoxical that the returns for Malaysia and Singapore were not correlated as the two countries are closely linked by bi-lateral trade agreements. The uncorrelation of returns could be a function of the ravages of exchange rate volatility as the analysis are based on risk adjusted returns which were about 35% lower than the unadjusted returns for Malaysia.

Overview

All the correlation matrices indicate that each of the three diversification strategies could provide considerable risk reduction benefits. It is, however, not easy to rank these diversification strategies in an order of preference as it is extremely difficult, on inspection, to determine which of the matrices have the lowest correlation. Unfortunately, it is not possible to resort to the formal and straight forward approach developed by Jenrich (1970) [6] to resolve the problem simply because Jennrich's model is applicable to correlation matrices of equal dimension while our matrices are of different dimensions. We therefore resort to efficient frontiers to determine the relative merits of the diversification strategies.

Exhibit 6: Correlation Matrices

(a) New Zealand

1Q1987 to 4Q1996			1Q1993 to 4Q1996		
	Office	Retail	Office		Retail
Office	1		Office	1	
Retail	0.55	1	Retail	0.72*	1

(b) Singapore

1Q19987 to 4Q1996				1Q1993 to 4Q1996			
	Office	Residential	Retail		Office	Residential	Retail
Office	1			Office	1		
Residential	0.30	1		Residential	0.31	1	
Retail	0.38	0.0002	1	Retail	-0.17	-0.60^{+}	1

(c) Hong Kong

1Q1987 to 4Q1996				1Q1993 to 4Q1996			
	Office	Residential	Retail		Office	Residential	Retail
Office	1			Office	1		
Residential	0.71*	1		Residential	0.81*	1	
Retail	0.62^{+}	0.60^{+}	1	Retail	0.78*	0.81*	1

(d) Malaysia

1Q1993 to 4Q1996			
	Office	Residential	Retail
Office	1		
Residential	0.53	1	
Retail	0.25	0.31	1

(e) Indonesia

1Q1993 to 4Q1996			
	Office	Residential	Retail
Office	1		
Residential	0.42	1	
Retail	0.49	0.02	1

(f) Thailand

1Q1993 to 4Q1996			
	Office	Residential	Retail
Office	1		
Residential	0.21	1	
Retail	0.32	0.14	1

Source: Authors

*Note: * Correlation is significant at 1% level of significance*
+Correlation is significant at 5% level of significance

Exhibit 7: Correlation of Returns – International Diversification Across Type

(a) 1Q1987 to 4Q1996

	NZ	HK	Sg
NZ	1		
HK	0.20	1	
Sg	0.32	-0.13	1

(b) 1Q1993 to 4Q1996

	NZ	HK	Sg	Indo	Thai	Msia
NZ	1					
HK	0.50	1				
Sg	-0.17	-0.61	1			
Indo	0.32	0.24	-0.36	1		
Thai	-0.09	0.35	-0.29	-0.05	1	
Msia	-0.19	0.0004	0.01	0.10	-0.03	1

Source: Authors

EFFICIENT FRONTIERS

While the correlation matrices (Exhibits 5-7) clearly demonstrate the great opportunities for risk reduction through diversification of investments, they do not deal with the asset risks, which, together with the correlation, are functions of the portfolio risk (see Eichholtz et al, 1995). Furthermore, correlation matrices do not give any indication of the risk-return trade-off. This implies that the relationship between an investor's risk aversion and an optimal diversification strategy cannot be deduced from correlation matrices. This vital link can, however, be seen from the comparison of the efficient frontiers for the different diversification strategies. Furthermore, efficient frontiers will enable us to determine the relative merits of both the different possible diversification permutations within each strategy, and the diversification strategies themselves. Matlab has been utilised, subject to a constraint of no short-selling, to produce the efficient frontiers (Exhibits 8-10) for the three property-types.

Diversification by Nation within Type

Exhibit 8 shows that the office sector is preferable to the retail sector for quarterly returns of up to 4% after which the retail sector efficient frontier dominates that for the office sector. Over the ten-year period from 1Q87 to 4Q96 (Exhibit 9), international diversification within the residential sector was quite risky as depicted by an almost flat efficient frontier. International diversification within the office sector was better, during the period, for quarterly returns of up to 4.0%. The residential sector efficient frontier dominated the other frontiers over a narrow

quarterly return range between 5.4% and 5.6% after which international diversification within the retail sector was the preferred option. It would appear therefore that the preferred property-type for international diversification during the period depended on the expected quarterly return. However, it may be cautioned that an expected quarterly return of above 5% (i.e. 27.6% p.a. for ten to thirteen years) would appear somewhat optimistic. This implies that diversifying international investment within the office sector would appear to have been the most realistic and best diversification strategy over the two periods.

The situation is, however, different for the four-year period spanning from 1Q93 to 4Q96. It could be seen from Exhibit 10 that the retail sector was the choicest property type for international diversification.

Diversification by Type within Nation

It is evident from Exhibit 11a and b that the efficient frontier for Singapore dominated the frontiers for the other countries during the ten-year and four-year period except for expected quarterly returns in excess of 6% where New Zealand was superior. This implies that as far as diversification across-types within-a-nation strategy is concerned, Singapore is the choicest country. This is consistent with the international assessment of business in Singapore.

Which Diversification Strategy?

The three strategies for the four-year period are evaluated together under this section in an attempt to discover the best diversification strategy. This is done for the four-year period as this is the only period in which there is sufficient data for the three strategies. The thirteen and ten-year periods are omitted in the analyses because of inadequate data. This does not prejudice the findings of the study as the results for the four-year period are relatively consistent with the results for the thirteen and ten-year periods.

The analysis is done by superimposing the best efficient frontier(s) for each strategy on the same risk-return axis (see Exhibit 12). Thus, efficient frontiers for the office and retail sectors are chosen to represent the international diversification within type strategy as the choice between the two sectors depends on the expected return. Similarly, Singapore, being the best choice for across-type within-nation strategy, is chosen to represent this particular strategy.

An examination of Exhibit 12 reveals that the across nations retail sector efficient frontier dominated the frontiers for international diversification within the office sector, and for the remaining two diversification strategies during the period. It is worth noting the congruity of the frontiers for sectoral international real estate diversification (as represented by the retail sector) and by-type-within-nation diversification (as represented by Singapore) over a very narrow range of quarterly returns (Exhibit 12).

Furthermore Exhibit 12 clearly shows that sectoral international diversification within the retail sector was preferable to diversification within the office sector. It must be cautioned that Exhibit 12 is based on a four-year period (1Q93 – 4Q96). In the longer term (i.e. not less than ten years), the choice between the office and the retail sectors would depend on the investor's expected return vis-à-vis his / her risk aversion (see Exhibits 8 and 9). In addition, the dearth of data precluded the industrial and hotel sectors from the analyses. Whether the inclusion of these sectors would have affected the relative merits of the sectors is any body's guess.

Another question that must be addressed is whether the inter-country and the inter-sectoral correlations are stable over time to justify any conclusion derived from the resultant efficient frontiers. The figures in Exhibits 13a and b demonstrate that apart from Malaysia-Singapore and Singapore-Thailand (Retail), Australia-Philippines (office) and Indonesia-Thailand (office, and across-type-and-nations) the various correlations were stable over the four-year period. Thus any conclusion based on Exhibit 12 is reliable.

Conclusion

The congruence of the frontiers for sectoral international diversification (retail sector) and by-type-within-nation (in Singapore) over a very narrow range of quarterly returns (between 3.5% and 3.7%) implies that the two strategies are equally beneficial over that range of expected quarterly return. However,

the general conclusion that can be drawn from the above analyses is that diversifying real estate investment internationally (i.e. in relation to the sampled countries) by type is a better diversification strategy than by-type-within-nation, and across-types and nations strategies. In the longer term, the choice between international diversification by retail or office sector depends on each investor's expected return-risk trade-off. It would appear, however, that diversifying real estate investment internationally by the retail sector is preferable to, and therefore more beneficial than, the office sector. It is hoped that notwithstanding the caveats that are highlighted in the above discussion, the study has offered some insights into the relative merits of the three diversification strategies in the sampled countries

END NOTES

1. The eight regions are: New England, Mid-Atlantic Corridor, Old South, Industrial Midwest, Farm Belt, Mineral Extraction Area, Southern California and Northern California – USA.
2. The nine economic categories are: mining, government, manufacturing, finance, insurance and real estate, services, transportation, military, farm and diversified.
3. Readers may refer to D'Arcy and Lee (1998) for further discussion on the issue.
4. Ziobrowski and Curcio (1991) find that currency conversion consistently amplified risk, in some cases, by over 600%. Radcliffe (1994) replicated this conclusion. Similarly Worzola (1995) find that when currency fluctuations were considered for UK real estate, risk increased by about 145% while returns slightly decreased. Notwithstanding the above findings Jorion (1990) indicates that from an investor's stand point, exchange rate exposure would be important only if it represented a systematic component of an asset's riskiness. This implies that currency risk may be diversifiable through broad country diversification (see Soenen, 1985 and 1986). Addae-Dapaah and Choo (1996) confirm the insignificance of currency risk to a fully diversified portfolio in a study on ' International Diversification of Property Stock. Solnik (1996) argues that exchange rate volatility has never been the major component of total return on a diversified portfolio over a long period of time because the depreciation of one currency is often offset by the appreciation of another. Solnik's (1996) conclusion supports Biger (1979) who suggests that exchange rates volatility is insignificant in a portfolio.
5. In spite of the appreciation of the Singapore dollar against the relevant currencies over the period, a recent study by Addae-Dapaah and Goh (1998) conclude that exchange rate volatility does not have a significant impact on the returns from a fully diversified portfolio of international office investments.
6. The Jennrich (1970) chi-square test statistic for equality tests of correlation matrices has p(p-1)/2 degrees of freedom, where p is the dimension of the correlation matrix. The statistic is:

$$\text{Chi square} = 0.5 * \text{tr}(Z^2) - \text{diag}'(Z)S^{-1}\,\text{diag}(Z).$$

$$\text{Here: } Z = c^{1/2}R^{-1}(R_1 - R_2)$$

[in which:

$$R = (n_1R_1 + n_2R_2)/(n_1 + n_2)$$

$$C = n_1n_2/(n_1 + n_2)$$

With R_1 and R_2 the correlation matrices to be compared, and n_1 and n_2 the number of observations on which they are based].

$S = (\text{delta}_{ij} + r_{ij}\,r^{ij})$, with delta_{ij} the Kronecker delta, r_{ij} the elements of R, and r^{ij} the elements of R^{-1}.

Exhibit 13a: Test Statistics for Inter-Temporal Stability

1Q1993 to 4Q1996

	Office	Retail	Across Type and Nations
NZ-HK	0.31	-0.58	0.26
NZ-Msia	0.91	0.25	0.44
NZ-Aust	-0.64		
NZ-Sg	-0.50	0.98	-0.68
NZ-Jap	0.95		
HK-Msia	1.37	1.19	1.03
HK-aust	-0.06		
HK-Sg	0.59	-0.16	1.22
HK-Jap	0.69		
Msia-Aust	-0.77		
Msia-Sg	-0.93	2.72*	-0.81
Msia-Jap	0.28		
Aust-Sg	-0.61		
Aust-Jap	-0.81		
Sg-Jap	-0.87		
NZ-Phi	0.007		
HK-Phi	0.32		
Msia-Phi	0.59		
Aust-Phi	-2.27*		
Sg-Phi	-1.23		
Jap-Phi	1.39		
NZ-Indo	-0.79	1.19	-0.75
NZ-Thai	1.68	-1.00	0.73
HK-Indo	1.09	0.82	0.64
HK-Thai	1.10	-0.75	-0.11
Msia-Indo	1.82	0.92	1.29
Msia-Thai	0.07	0.42	-0.15
Aust-Indo	1.15		
Aust-Thai	1.00		
Sg-Indo	0.06	0.69	-0.17
Sg-Thai	-0.43	-2.30*	0.53
Jap-Indo	0.25		
Jap-Thai	0.03		
Phi-Indo	0.12		
Phi-Thai	1.36		
Indo-Thai	2.93*	0.33	2.06*

Exhibit 13b: Test Statistics for Inter-Temporal Stability – 1Q1993 to 4Q1997 By-Type-Within-Nation (Singapore)

Office-Residential	0.33
Office-Retail	-1.80
Residential-Retail	-2.58*

*Statistically significant at 5% level of significance

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