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Exchange rate risk and internationally diversified portfolios

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Foreign diversification has long been accepted as a means of improving portfolio efficiency through risk reduction. Yet surprising little is known about proper international portfolio construction in terms of how much should be invested in foreign countries, which countries should be targeted and in what types of assets. This paper attempts to partially address this need by examining the impact of systematic exchange risk and systematic national risk on foreign asset performance. Specifically, it is hypothesized that when exchange rates are very volatile, multiple acquisitions in the same foreign country do not significantly improve the efficiency of a portfolio. The results of empirical tests in support of this hypothesis are presented. (JEL G11, F31).

Beginning with the work of Grubel (1968), numerous studies (see, *e.g.*, Levy and Sarnat, 190; Ripley, 1973; Solnik, 1974) have empirically demonstrated the low correlation between US assets and foreign assets. This phenomenon was conceptualized by Solnik (1974) as a reflection of the lack of correlation between various national economies. Thus, the acquisition of a single foreign asset by a US investor holding only US assets should provide diversification gains through portfolio risk reduction. What is far less certain, however, are the benefits of more extensive foreign diversification through the acquisition of (1) multiple assets in the same foreign country or (2) assets in several (or many) different foreign countries.

With respect to the holding of multiple assets in the same foreign country, modern portfolio theory would clearly suggest that, to some degree, the returns from all these assets would logically be systematized by a common response to the same domestic market. Additionally, exchange rate fluctuations can further synchronize the returns of assets from the same foreign country when the returns

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are received in dollars. And to the extent that the returns are positively correlated by these two sources of systematic risk, the benefits of diversifying with multiple assets from the same foreign country will obviously diminish.

Consider that the dollar denominated rate of return on a foreign asset i based in country j, $R_{ig\$}$, can be written

$$\langle 1 \rangle \qquad R_{ij\$} = (1 + R_{ij})(1 + X_{j\$}) - 1,$$

where

R_{ij} = rate of return on asset i in the local currency of country j
$X_{j\$}$ = rate of appreciation (or depreciation) of the local currency against the US dollar

When the cross-product term, which is normally small, is omitted, the dollar rate of return can be closely approximated by

$$\langle 2 \rangle \qquad R_{ij\$} = R_{ij} + X_{j\$}.$$

It can also be demonstrated that the covariance of the dollar denominated returns of any two assets from the same foreign country, $\text{cov}(R_{1j\$}, R_{2j\$})$ may be expressed:

$$\langle 3 \rangle \quad \text{cov}(R_{1j\$}, R_{2j\$}) = \text{cov}(R_{1j}, R_{2j}) + \text{cov}(R_{1j}, X_{j\$}) + \text{cov}(R_{2j}, X_{j\$}) + \text{var}(X_{j\$}).$$

Equation $\langle 3 \rangle$ shows that when the rate of currency appreciation (or depreciation) is stable, (*i.e.*, $X_{j\$}$ relatively constant), the covariance between the dollar denominated returns of these assets depends primarily on the covariance of asset returns denominated in the local currency, $\text{cov}(R_{1j}, R_{2j})$. However, when exchange rates are volatile, currency translation has a significant impact on asset covariance. The variance of $X_{j\$}$, in particular, can potentially be very large and will always be positive. Thus, the greater the exchange rate volatility, the stronger the positive correlation among returns from assets of the same foreign country.

As few would deny, since 1973 exchange rates have been less than stable. Eun and Resnik (1988) found that during the period 1980 to 1985, exchange rate volatility accounted for about 50 percent of the total volatility of dollar returns from investment in the stock markets of such major countries as Germany, Japan and the UK. As will be shown later, the exchange rate volatility accounts for even higher percentages of total dollar return variation in other classes of assets.

The positive correlation among assets from the same foreign country may also be enhanced by the common response of these assets to the same national economy. Using a single index model, the rate of return on asset i, denominated in the local currency of country j may be related to the local economy with

$$\langle 4 \rangle \qquad R_{ij} = \alpha_{ij} + \beta_{ij} R_{mj} + \varepsilon_{ij},$$

where

R_{mj} = domestic market index for country j,
α_{ij} = return on asset i which is independent of the domestic market index,

β_{ij} = a measure of the responsiveness of returns from asset i to changes in the domestic market index,

ε_i = an error term with a mean of zero and variance $\sigma^2_{\varepsilon ij}$.

Substituting equation ⟨4⟩ into equation ⟨2⟩ yields

$$\langle 5 \rangle \qquad R_{ij\$} = \alpha_{ij} + \beta_{ij} R_{mj} + X_{j\$} + \varepsilon_{ij\$}.$$

This equation shows that except in the rare cases where an asset's return is completely independent of the domestic economy ($\beta_{ij} = 0$) or negatively related to the performance of the domestic economy ($\beta_{ij} < 0$), national systematic risk will typically cause additional positive correlation of dollar denominated returns among assets of the same country.

It is, therefore, logical to hypothesize that an investor would obtain the majority of all diversification benefits available in a foreign country from his/her first acquisition in that country when exchange rates are volatile. By comparison, any subsequent acquisitions in this country should yield very limited gains because of high positive asset correlation. In fact, it is conceivable that the positive correlation among these assets is so high that, for purposes of portfolio risk reduction, all assets from the same foreign country may be viewed as essentially the same asset. Under such conditions, the acquisition of multiple foreign assets in a single foreign country cannot be regarded as risk diversification. Rather, it is simply a shift in the current asset mix.

One might conclude from this analysis that the investor could overcome this foreign country-specific risk by targeting assets in new foreign countries. However, such an observation may be oversimplistic. Eun and Resnik (1988) also observed that changes in exchange rates *vis-à-vis* the US dollar are highly correlated across the currencies of the developed countries. When the US dollar strengthens (or weakens), it tends to strengthen (or weaken) against all the major currencies of the world simultaneously. This, of course, suggests that exchange risk is largely non-diversifiable through acquisitions in other developed countries. Furthermore, Errunza (1977, 1983) has found that, although correlations among the various national markets of developed countries are not very high, over time they have increased as a result of greater economic synchronization. Thus, from the perspective of the US investor, substantial positive correlation may potentially be expected among all asset returns of all foreign developed countries. Expansion into a different developed country may, therefore, provide some diversification benefits, but such gains could be highly restricted.

This paper focuses on these issues by empirically examining the diversification gains available to US investors from five very different types of British assets and five different types of Japanese assets during the period 1973 to 1991. Particular attention is given to the correlation of returns within and between the assets of the countries and the role played by exchange rate fluctuations in these relationships. Admittedly, as with any study involving *ex post* data, the results of this study cover a limited time frame and thus it is acknowledged that they may be time specific. Furthermore, only the assets of two foreign countries (albeit very major countries) were considered and therefore it may be argued that the results are country-specific. Readers should bear both of these limitations in mind when making investment decisions based on these results.

I. Methodology and data

I.A. Construction of efficient frontiers

Using the portfolio optimization technique developed by Elton *et al.* (1976), a series of efficient investment frontiers were generated based on the annual dollar denominated returns from US, British and Japanese common stock, long-term bonds, treasury bills,[1] farm real estate, and commercial real estate during the period 1973–91. These groups of assets were chosen because, when returns are denominated in their respective domestic currencies, they represent a very broad range of foreign asset return patterns with widely varying degrees of intercorrelation.[2]

As a reference point, an efficient frontier was constructed composed of only US assets. To estimate the diversification gains from the investor's first foreign acquisition, two additional efficient frontiers were produced. In one case, British common stock[3] alone was added to the opportunity set of all US assets. In the second case, only Japanese common stock was added to the US assets.

The basic hypothesis of this study was tested when an efficient frontier was generated from an opportunity set which included British government bonds, treasury bills, farm real estate and commercial real estate in addition to the British common stock and all six US assets. By direct comparison of this efficient frontier with the frontier generated from only British common stock and US assets, it was possible to estimate the additional gains to a US investor provided by multiple British acquisitions. This procedure was repeated for an opportunity set including all five Japanese assets and all six US assets to estimate the additional gains available to a US investor from multiple Japanese acquisitions.

To provide additional insight, another efficient frontier was constructed from the opportunity set including all six US assets, British common stock and Japanese common stock. This frontier permitted comparison of multicountry diversification gains versus those achievable through single country diversification. As further confirmation of our results, an additional frontier was produced which included all assets from all three countries.

I.B. Sample and data description

US annual returns were obtained from the time series data originally presented in Ibbotson and Fall (1979), Ibbotson and Siegel (1983, 1984) and Ibbotson and Sinquefield (1982).

For data on UK investments, annual returns on all UK financial assets (stocks, bonds and bills) were provided by Barclays de Zoete Wedd of London, England. Annual returns on British farmland were obtained from the British real estate investment firm Savills. Savills, in cooperation with the Investment Property Databank (IPD), holds the investment details of approximately 80 percent of the institutionally-owned agricultural property in the UK. Returns on British commercial real estate came from two sources. For the period 1973–80, the data used in the analysis were provided by the British real estate investment firm, Jones, Lang and Wooton Consulting and Research (JLW). The data employed

for the period 1981–91 were obtained from a pooling of the data from JLW's clients and those of other British firms including Healey and Baker, Hillier Parker and Richard Ellis. These pooled data provided a very broad representation of the British commercial real estate market.

Data on Japanese investments were also obtained from a variety of sources. Calculation of annual returns and standard deviations on Japanese financial assets were secured from Hamao (1989). Hamao's procedure for tabulating return data is essentially identical to that used by Ibbotson and Sinquefield (1982). Japanese real estate capital gains were provided by the Japanese Real Estate Institute (JREI), a non-profit independent real estate research organization. JREI measures the time series movement of commercial property prices in 140 cities

TABLE 1. Mean annual rates of return and standard deviations from all US and foreign assets when returns were received in US dollars[a] years 1973–1991.

Asset	Mean annual return (%)	Standard deviation (%)	Return/risk ratio
US Stocks	13.00	17.94	0.72
US Corporate Bonds	10.82	12.89	0.84
US Gov. L-T Bonds	9.81	12.56	0.78
US T-Bills	7.95	2.51	3.17
US Comm. R.E.	9.33	6.13	1.52
US Resid. R.E.	8.60	4.71	1.83
UK Stocks	19.22	37.17	0.52
	(20.59)	(39.38)	(0.52)
UK Gov. L-T Bonds	12.65	22.42	0.56
	(13.89)	(18.65)	(0.74)
UK T-Bills	11.54	16.63	0.69
	(11.75)	(2.40)	(4.90)
UK Farm R.E.	6.69	24.41	0.27
	(7.07)	(18.95)	(0.37)
UK Comm. R.E.	11.90	20.16	0.59
	(12.07)	(10.33)	(1.17)
Japanese Stocks	17.98	29.08	0.62
	(11.39)	(20.31)	(0.56)
Japanese LT Gov. Bonds	14.59	19.85	0.74
	(8.01)	(6.57)	(1.22)
Japanese ST Int. Rts.	12.87	15.61	0.82
	(6.96)	(2.44)	(2.85)
Japanese Farm R.E.[b]	13.33	16.81	0.82
	(7.28)	(5.63)	(1.29)
Japanese Comm. R.E.[b]	13.91	17.09	0.81
	(7.74)	(5.57)	(1.39)

[a] Values in parenthesis are mean annual rates of return and standard deviations from foreign assets when returns were received in their respective domestic currencies.

[b] Japanese real estate returns include an assumed operating income of 2% (in yen) for all years 1973–91.

throughout Japan. They also track agricultural land prices in approximately 1600 Japanese cities, towns and villages. One deficiency in the data is that reliable estimates of operating income rates of return for Japanese real estate were not available. To overcome this shortcoming, an annual operating income rate of 2 percent[4] was assumed. The annual rates of return and the associated standard deviations for all the assets considered in the analysis are presented in Table 1.

It should be noted that no short selling nor currency risk hedging were permitted in this analysis. The impact of taxes and transaction costs are also not included in this study.

II. Empirical results

II.A. Correlation matrix

Table 2 is the correlation matrix of the annual dollar denominated returns for all US, British and Japanese assets included in the study. Overall, the correlation between all US asset returns and all foreign asset returns was very low. The average correlation coefficient among all US/British asset pairs was −0.08. Among the US/Japanese asset pairs the average correlation coefficient was −0.11. These results are consistent with the findings of earlier researchers.

In contrast, the correlations between all pairs of British assets were very high. The average coefficient within this group was 0.56. The correlations among Japanese asset returns denominated in dollars were even higher with an average correlation coefficient between Japanese asset pairs of 0.77. Consistent with the hypothesis, this suggests that the potential for portfolio risk reduction through multiple acquisition in either country alone is very limited.

Finally, significant positive return correlation was found between virtually all British and Japanese assets. The average correlation coefficient among the different British/Japanese asset pairs was 0.44. To put this value in perspective, the correlation coefficient between US common stock and US government bonds was determined to be 0.44 over the same period.

II.B. Efficient frontiers

The compositions of all optimum portfolios used to construct the efficient frontiers are available from the authors.

Figure 1 shows a comparison of the efficient frontiers generated with (1) US assets only, (2) US assets plus British common stock and (3) US assets with all five British assets. British common stock alone improves the efficiency of the US asset portfolio at all risk levels. The gains are small at the low levels, increasing proportionately with risk. However, as predicted by the model, including the additional four British assets raises the efficient frontier only slightly at the very lowest risk levels. At the moderate and upper risk levels there is no improvement in efficiency. British bonds, bills and real estate collectively never occupy more than 4 percent of the optimum portfolio composition.

Figure 2 provides a comparison of the same efficient frontiers using Japanese assets in lieu of British assets. Like British common stock, adding only Japanese

TABLE 2. Correlation coefficients between the annual dollar denominated rates of return from all US, British and Japanese assets.*

	USCS	USCB	USGB	USTB	USCRE	USRRE	BCS	BGB	BTB	BFRE	BCRE	JCS	JGB	JSTIR	JFRE	JCRE
US Stocks (USCS)	1.00															
US Corp. Bonds (USCB)	0.51	1.00														
US Gov. LT Bonds (USGB)	0.44	0.97	1.00													
US T-Bills (USTB)	−0.07	−0.12	−0.06	1.00												
US Comm. R.E. (USCRE)	−0.04	−0.36	−0.35	0.64	1.00											
US Resid. R.E. (USRRE)	−0.03	−0.28	−0.25	0.18	0.66	1.00										
UK Stocks (BCS)	0.53	0.13	0.01	−0.26	−0.02	0.20	1.00 (1.00)									
UK Gov. LT Bonds (BGB)	0.21	0.12	0.03	−0.34	−0.17	0.09	0.68 (0.69)	1.00 (1.00)								
UK T-Bills (BTB)	−0.10	−0.26	−0.23	−0.24	−0.10	0.09	0.25 (−0.07)	0.68 (−0.03)	1.00 (1.00)							
UK Farm R.E. (BFRE)	−0.09	−0.35	−0.42	−0.31	0.12	0.19	0.30 (0.12)	0.55 (0.20)	0.53 (−0.26)	1.00 (1.00)						
UK Comm. R.E. (BCRE)	−0.02	−0.33	−0.36	−0.31	0.16	0.22	0.39 (0.25)	0.68 (0.19)	0.79 (−0.32)	0.76 (0.64)	1.00 (1.00)					
Japanese Stocks (JCS)	0.36	0.17	0.17	−0.27	0.11	0.01	0.35	0.20	0.06	0.50	0.37	1.00 (1.00)				
Japanese Gov LT Bonds (JGB)	0.02	0.06	0.01	−0.43	−0.19	−0.21	0.41	0.62	0.44	0.34	0.54	0.67 (0.29)	1.00 (1.00)			
Japanese ST Int. Bonds (JSTIR)	0.00	−0.04	−0.09	−0.45	−0.19	−0.10	0.36	0.60	0.58	0.32	0.58	0.61 (−0.31)	0.94 (0.01)	1.00 (1.00)		
Japanese Farm R.E. (JFRE)	−0.15	−0.17	−0.23	−0.44	−0.08	0.00	0.25	0.48	0.52	0.40	0.57	0.50 (−0.40)	0.86 (−0.28)	0.94 (0.49)	1.00 (1.00)	
Japanese Comm. R.E. (JCRE)	−0.10	−0.10	−0.15	−0.42	−0.22	−0.21	0.23	0.54	0.64	0.41	0.65	0.49 (−0.43)	0.82 (−0.57)	0.91 (−0.30)	0.91 (0.24)	1.00 (1.00)

* The values in parentheses ( ) are the correlation coefficients between foreign asset rates of return when returns are denominated in the local currency, i.e. UK asset returns denominated in pounds and Japanese asset returns denominated in Yen.

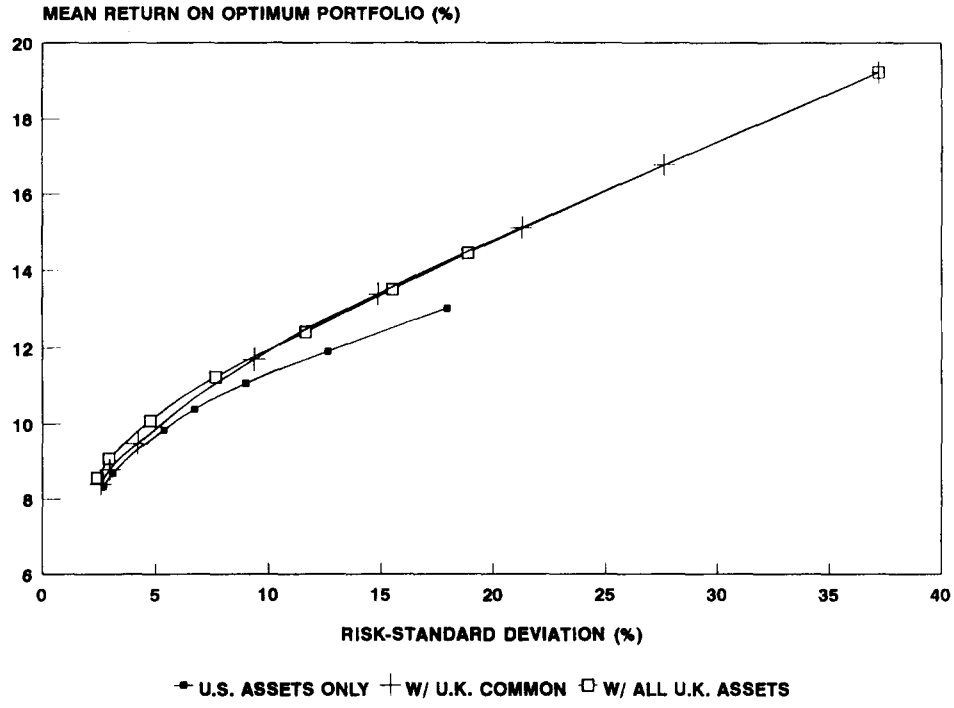

FIGURE 1. Comparison of US asset-based efficient frontiers diversified with British assets only.

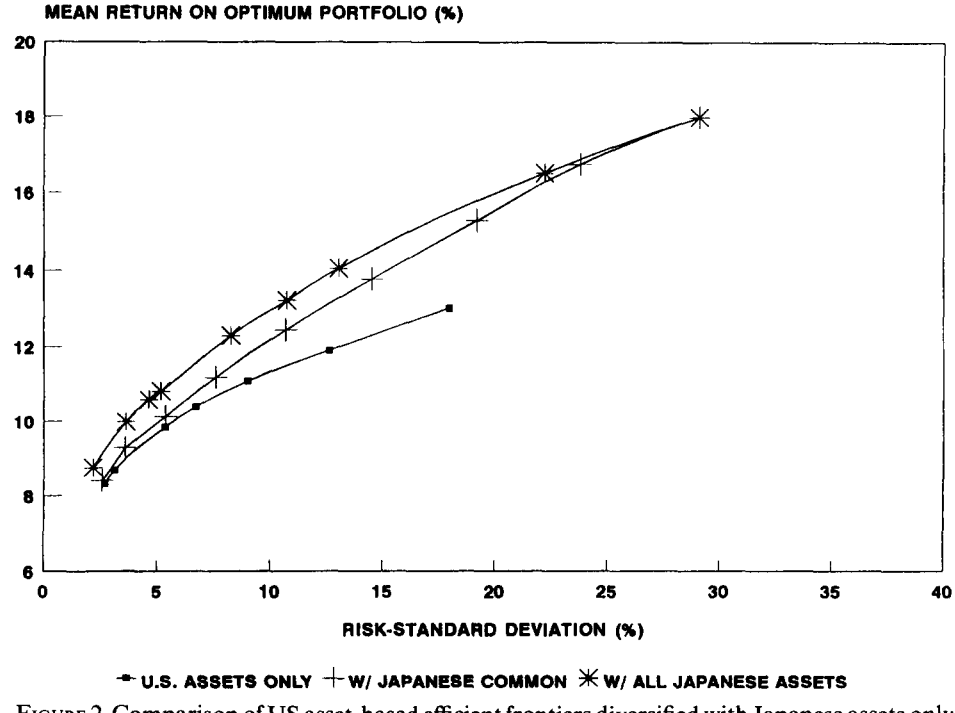

FIGURE 2. Comparison of US asset-based efficient frontiers diversified with Japanese assets only.

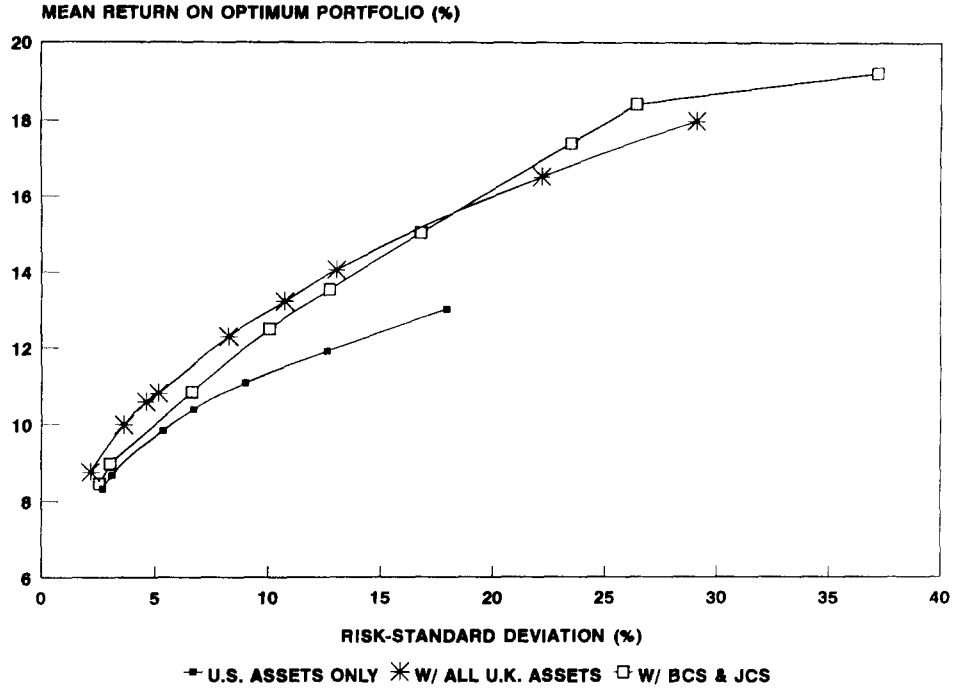

FIGURE 3. US asset-based efficient frontiers diversified with UK assets only versus expansion into Japan.

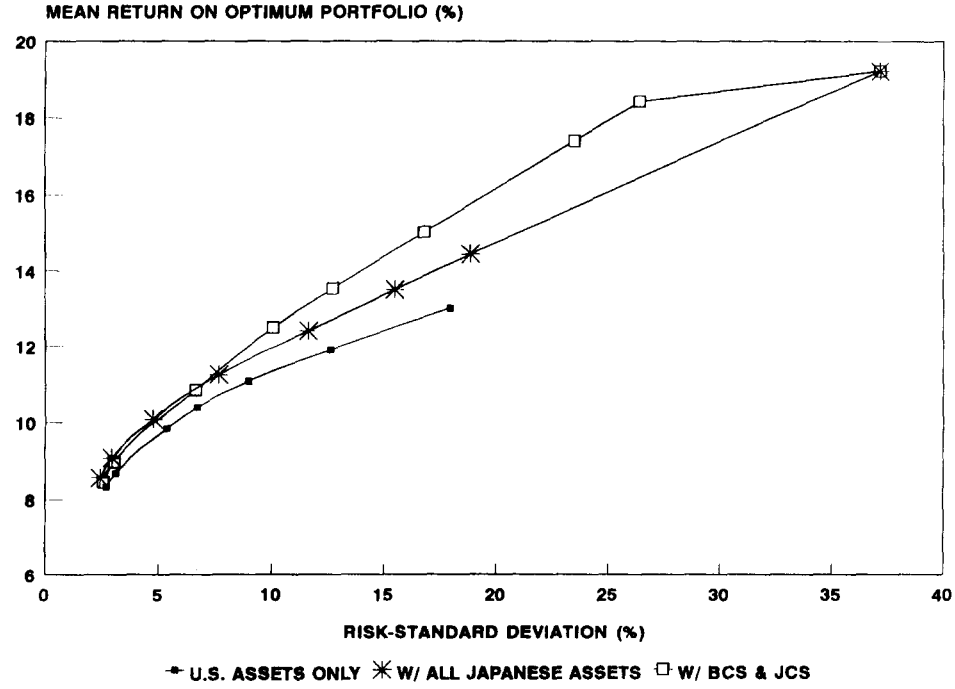

FIGURE 4. US asset-based efficient frontiers diversified with Japanese assets versus expansion into the UK.

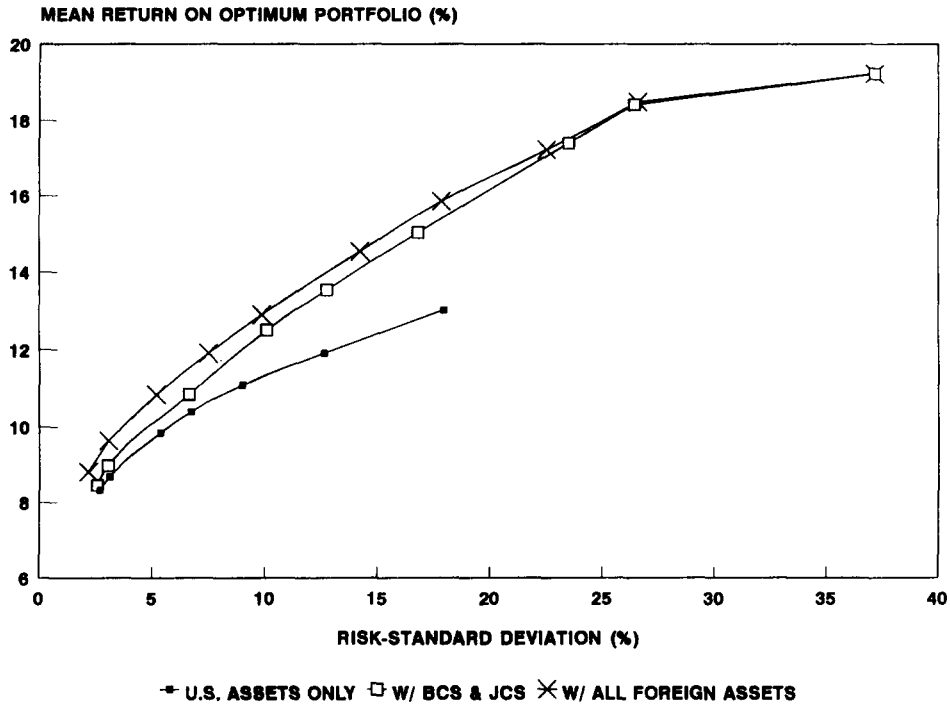

FIGURE 5. US asset-based efficient frontiers diversified with foreign common stock only versus all types of foreign assets.

common stock to the US assets also provides gains at all risk levels. Again these gains are small at the low end of the risk spectrum and increase substantially with risk. However, when Japanese bonds, bill equivalents and real estate are included in the opportunity set, they fare somewhat better than their British counterparts. These assets yield some gains above those available from Japanese common stock only, at all but the highest risk level. The benefits were highest at the low and moderate portfolio risk levels, tapering off as risk increased. At one point along the efficient frontier, Japanese bonds and real estate constitute nearly half of the optimum portfolio.

Figure 3 presents a comparison of the efficient frontier constructed with all US assets and all five British assets versus an efficient frontier constructed with all US assets, British common stock and Japanese common stock. For the US investor holding British common stock, it seems clear that the acquisition of Japanese common stock provides substantially greater benefits when compared with the acquisition of additional British assets. This was uniformly true everywhere across the efficient frontier except at the very lowest levels where British assets outperformed the Japanese common stock by a slim margin.

A similar pattern is seen for the US investor holding Japanese common stock who further diversifies into other Japanese assets versus diversification into British common stock (Figure 4). At the low risk end of the efficient frontier, the additional Japanese assets dominate the British common stock. But as risk increases, the

benefits associated with the British common stock gradually overtake and eventually surpass the gains available from broad Japanese diversification.

Finally, a comparison of the diversification benefits from British and Japanese common stock to the gains available from all ten British and Japanese assets is shown in Figure 5. The larger foreign opportunity set (all ten foreign assets) outperform the foreign common stock by a modest amount in low risk portfolios. However, the gap quickly narrows in the intermediate risk range and disappears completely for the most risky portfolios.

Overall, we find these results to be generally supportive of the hypothesis. Under ideal conditions, the marginal gains associated with multiple acquisitions in both foreign countries versus the gains available from the acquisition of only foreign common stock is relatively small or non-existent for all but those US investors with a low tolerance for risk. Furthermore, for small investors with a low risk tolerance this type of broad diversification may be problematic in practical terms. The findings clearly indicate that low risk US investors should hold the large majority of their funds in US assets, leaving little available to 'spread around' among many different foreign assets.

II.C. Regression analysis

To obtain additional evidence on the impact of systematic exchange risk and systematic national risk on portfolio performance, the following regression model was estimated:

$$\langle 6 \rangle \qquad R_{ij\$} = a_0 + a_2 R_{mj} + a_2 X_{j\$} + e_{ij\$},$$

where $R_{ij\$}$ is the dollar denominated rate of return on asset i based in country j, R_{mj} is an equal weighted market index estimated from the local currency denominated returns of all assets based in country j and $X_{j\$}$ is the return on a dollar investment in the currency of country j.

Table 3 reports the results of this regression analysis for all foreign assets used in the study. Clearly, the model has extremely strong explanatory power (9 out of 10 regressions have F-statistics significant at the 0.001 level). Furthermore, it explains over 75 percent of the total dollar denominated return variation for every asset except British farm real estate for which it explains 52 percent of the variation. Exchange rates are highly significant for every foreign asset, in all cases at the 0.01 level. The domestic market index was significant for all British assets except the British T-Bill. However, for Japanese assets, the domestic market index was only significant for stocks.

To investigate the sources of positive correlation between the dollar denominated returns of British and Japanese assets, another regression model was constructed of the form:

$$\langle 7 \rangle \qquad R_{ij\$} = a_0 + a_1 R_{mk} + a_2 X_{k\$} + e_{ij\$},$$

where $R_{ij\$}$ is the dollar denominated return on asset i based in foreign country j, R_{mk} is an equal weighted market index estimated from the local currency denominated returns of all assets based in a different foreign country k, and $X_{k\$}$ is the return on the dollar investment in the currency of country k. Thus, the

TABLE 3. Estimated coefficients and *t*-statistics (in parentheses) from regressing the annual dollar denominated rates of return from foreign assets, *i* based in country *j*, $R_{ij\$}$, on the local market return index, R_{mj}[a], and the local exchange rate, $X_{j\$}$[b].

Years 1973–91

$$R_{ij\$} = a_0 + a_1 R_{mj} + a_2 X_{j\$} + e_{ij\$}$$

Regression	a_0	a_1	a_2	N	R squared (%)	F	Significance of F (%)
			British Assets				
BCS	−14.196**	2.605***	1.031***	19	83.1	39.276	<0.1
	(−2.615)	(8.486)	(3.881)				
BGB	−0.560	1.042***	1.205***	19	81.1	34.419	<0.1
	(−0.162)	(5.332)	(7.128)				
BTB	12.161***	−0.030	1.123***	19	97.7	340.798	<0.1
	(13.600)	(−0.603)	(25.668)				
BFRE	−4.269	0.866**	1.082***	19	52.6	8.863	0.3
	(−0.715)	(2.566)	(3.705)				
BCRE	5.654*	0.503**	1.226***	19	79.6	31.257	<0.1
	(1.750)	(2.754)	(7.756)				
			Japanese Assets				
JACS	−33.447***	5.488***	1.048***	19	89.2	65.736	<0.1
	(−5.704)	(8.333)	(6.447)				
JAGB	2.434	0.608	1.243***	19	91.80	90.082	<0.1
	(0.701)	(1.559)	(12.913)				
JASTIR	7.778***	−0.079	1.030***	19	97.50	316.879	<0.1
	(5.219)	(−0.473)	(24.924)				
JAFRE	8.482**	−0.116	1.013***	19	86.4	51.032	<0.1
	(2.326)	(−0.284)	(10.015)				
JACRE	12.400***	−0.578	1.097***	19	89.5	68.161	<0.1
	(3.657)	(−1.517)	(11.670)				

[a] R_{mj} = equal-weighted local market index based on the annual local currency denominated rates of return from all assets based in country *j*.

[b] $X_{j\$}$ = annual rate of return from a US dollar investment in the local currency of country *j*.

* = Significant at the 0.10 level.

** = Significant at the 0.05 level.

*** = Significant at the 0.01 level.

dollar denominated returns on British assets were regressed against the Japanese domestic market index and the yen/dollar exchange rate. Conversely, Japanese asset dollar denominated returns were regressed against the British domestic market index and the pound/dollar exchange rate.

The results of this analysis are shown in Table 4. Although the model expressed in equation ⟨7⟩ is far less powerful than the model expressed in equation ⟨6⟩, it is still relatively strong. In 8 out of 10 cases, the *F*-statistic is significant to the 0.05 level or better. The exchange rate is significant for 8 foreign assets,

TABLE 4. Estimated coefficients and *t*-statistics (in parenthesis) from regressing the annual dollar denominated rates of return from foreign assets, *i* based in country *j*,[a] $R_{ij\$}$, on the local market return index of a different foreign country *k*, R_{mk},[b] and the local exchange rate for the country *k*, $X_{k\$}$.[c]

Years 1973–91

$$R_{ij\$} = a_0 + a_1 R_{mk} + a_2 X_{k\$} + e_{ij\$}$$

Regression	a_0	a_1	a_2	N	R squared (%)	F	Significance of F (%)
			British assets				
BCS	7.437	0.822	0.868	19	13.7	1.270	30.80
	(0.352)	(0.346)	(1.480)				
BGB	24.961**	−2.186*	1.006***	19	50.1	8.018	0.4
	(0.020)	(0.062)	(0.002)				
BTB	29.513***	−2.703***	0.766***	19	69.9	18.562	<0.1
	(5.282)	(−4.306)	(4.942)				
BFRE	21.948	−2.355	0.738*	19	27.8	3.087	7.3
	(1.729)	(−1.652)	(2.096)				
BCRE	14.890	−0.988	0.904***	19	44.2	6.333	0.9
	(1.615)	(−0.954)	(3.537)				
			Japanese assets				
JACS	9.686	0.648	0.337	19	9.2	0.815	46.0
	(0.985)	(1.165)	(0.700)				
JAGB	9.197	0.430	0.759**	19	33.7	4.057	3.8
	(1.602)	(1.325)	(2.701)				
JASTIR	10.688**	0.193	0.702***	19	42.7	5.964	1.2
	(2.564)	(0.817)	(3.443)				
JAFRE	11.660**	0.140	0.665***	19	35.1	4.320	3.2
	(2.519)	(0.534)	(2.939)				
JACRE	13.180***	0.070	0.819***	19	48.0	7.380	0.5
	(3.013)	(0.281)	(3.827)				

[a] k = Japan when country j is the UK. When j is Japan, country k is the UK.
[b] R_{mk} = equal-weighted local market index based on the annual local currency denominated rates of return from all assets based in country k.
[c] $X_{k\$}$ = annual rate of return from a US dollar investment in the local currency of country k.
* = Significant at the 0.10 level.
** = Significant at the 0.05 level.
*** = Significant at the 0.01 level.

demonstrating the high correlation between the yen and pound versus the dollar. Dollar denominated returns on Japanese assets exhibited very little relationship to the British domestic market index. However, two British assets showed a significant and surprisingly large negative relation to the Japanese market index.

The fact that equation ⟨7⟩ failed to significantly explain the dollar denominated returns of British and Japanese stocks may be explained by the riskiness of these

assets in their respective domestic contexts. Because these assets are so risky in the domestic market, the additional risk imparted by exchange rate volatility contributes a smaller percentage of the total dollar denominated variability when compared with assets with smaller domestic risk such as T-Bills. For example, exchange rate volatility changed the standard deviation on Japanese common stock from 20.31 percent in yen to 29.08 percent in dollars, an increase of 43 percent. However, during the same period, the standard deviation on Japanese short-term interest rates (STIR) went from 2.44 percent in yen to 15.61 percent in dollars, an increase of 540 percent. Thus, assets with low domestic risk seem far more susceptible to positive international exchange rate correlation than are assets with high domestic risk. In essence, when an investor diversifies with the assets of a new foreign country it appears to be relatively easy to escape the national systematic risk elements which are more prominent in assets such as common stock. It is far more difficult to escape the international systematic exchange risk. Foreign common stock therefore not only provides US investors with the highest rates of return available in their respective countries. Foreign common stock is also the asset least affected by exchange rate volatility in terms of correlation characteristics. This combination of benefits suggests that, from a mean-variance perspective, foreign common stock is the most desirable type of foreign asset for a US investor to hold in his or her portfolio.

These findings also provide evidence supporting the view that the dollar denominated returns from all assets based in a given foreign country are likely to exhibit high positive correlation when exchange rates are volatile. This high correlation stems primarily from systematic exchange risk and systematic national risk. The results further demonstrate that the dollar denominated returns of assets from different developed countries are less positively correlated because of the elimination of systematic national risk. However, the returns of assets from developed countries remain strongly correlated by international systematic exchange risk.

Although these results are significant it is critical that they should not be misinterpreted. For example, the findings do not suggest that US investors should put all their Japanese-designated funds into a single Japanese asset such as the common stock of one Japanese company (*e.g.* Hitachi). Such a strategy would clearly expose those funds to far too much non-systematic or company-specific risk. However, the results do indicate that by investing in a single, well diversified foreign country fund (*e.g.* Japan OTC or the Korea Fund), one obtains the largest portion of all the diversification benefits available from that nation. This information is especially significant to the small investor who has limited funds available for diversification purposes.

Also of special interest to the small investor is the recognition of the high positive correlation among the returns from assets of all developed foreign countries. Errunza (1977, 1983) has argued that the markets of the less developed countries are generally much less correlated with those of the USA and other developed countries. More significantly, the currencies of LDCs demonstrate far less dependence on the movements of the major currencies. This lack of both exchange rate correlation and national market correlation may translate into a greater potential for portfolio risk reduction. Thus, investors who have relatively

small portfolios may consider diversifying with the country-funds of LDCs (*e.g.* Brazil, China and Spain) rather than those of developed nations to achieve the greatest diversification 'bang for the buck'. However, it must be acknowledged that the support for this hypothesis is primarily speculative in nature requiring far more empirical evaluation.

Further investigation of these results is important for other reasons as well. In recent years a seemingly endless number of international mutual funds have sprung up which supposedly offer global diversification. However, logic suggests that some types of foreign acquisitions should be more mean-variance efficient than others. At the current time there are no empirically verified guidelines for the proper construction of an efficient global portfolio nor is it clear how many foreign assets the typical US investor should hold or from what countries they should come.

These results should also be of interest to the managers of multinational corporations. A recent study by Doukas and Travlos (1988) empirically examined the impact of foreign expansion by US corporations through acquisition on market share price. Among their findings, it was observed that (1) when a purely domestic US firm expands internationally for the first time, shareholders experience insignificant positive abnormal returns at the announcement of the acquisition; (2) from multinational corporations (MNCs) already operating in the target firm's base country, the acquisition announcement results in insignificant negative valuation effects on share price; (3) acquisitions by multinational corporations of firms in countries where operations do not exist yield positive and statistically significant abnormal returns, and (4) the largest positive abnormal returns occur when the target firm is based in a less developed country. The results of this study are certainly consistent with their findings and therefore the systematic risk induced by exchange rate volatility may serve as a partial explanation for their observations.

As a final cautionary note, this study should not be viewed as an indictment of the floating rate exchange system versus pegged rates. The volatility of floating exchange rates is a problem, but floating exchange rates may still be more efficient than pegged rates that change infrequently and by large amounts (see Jackson and Lothian, 1994).

III. Summary and conclusions

This study investigates the effect of exchange rate risk on internationally diversified portfolios. In particular, the study provides evidence on the diversification gains associated with multiple assets in a single foreign country. For the cases examined, it was found that except for investors with a low-risk tolerance the acquisition of a single asset in a foreign country provided the vast majority of all gains available in that country. Additional gains from more acquisitions were minimal because of high positive asset return correlation among all assets of the same country when returns were denominated in dollars. This high positive asset correlation was found to be directly related to the systematic exchange rate risk and systematic national risk inherent in all foreign assets. It

was further determined that expansion into a new foreign country reduced positive correlation through elimination of national risk elements and thus increased the potential for portfolio risk reduction. However, these gains were limited by the systematic exchange risk which transcends international borders.

US investors with a low risk preference benefited most by keeping nearly all their funds in US assets. Exchange rate volatility made all foreign assets very risky. Thus, it is not surprising that the optimum level of foreign investment varied directly with the investor's willingness to accept risk.

Finally, the results suggest that common stock may be the most desirable type of foreign asset to hold from the perspective of effective foreign diversification. Foreign common stock not only provided the highest rates of return available in other countries, but perhaps more significantly it appears that exchange rate fluctuations have less influence on the correlation characteristics of common stock in comparison to other types of assets. This is important since currency risk tends to systematize (positively correlate) the returns of assets from different foreign countries.

However, it should be noted that a great deal more work is required in this area. Although it is generally accepted that an investor benefits from some international diversification, relatively little is known about how much should be invested overseas or where. This is not only true for the individual investors but it is true for the managers of global mutual funds and multinational corporations as well.

Notes

1. The Japanese government does not offer a security which is comparable to the US Treasury Bill. As a substitute, Hamao's (1989) Japanese Short Term Interest Rate (STIR) was used in this study. The STIR is based on the interest rate applied to bond repurchase agreements which, as in the US are essentially collateralized loans. The agreement period varies from one month to three months and the market is open to financial institutions, corporations, government pension funds and non-residents.
2. As an example, when returns are received in British pounds sterling, the British T-Bill shows virtually no correlation with British common stock (correlation coefficient -0.07). Similarly, when returns are received in Japanese yen, Japanese farm real estate shows strong negative correlation with Japanese common stock (correlation coefficient -0.40).
3. Common stock was selected because it provided the US investor with the highest mean annual return available in both foreign countries. This insured that any subsequent improvements in the efficient frontier (when bonds, bills or real estate were added to the opportunity set) were a result of portfolio risk reduction, not higher asset return.
4. This rate is generally consistent with those reported by Hines (1987) who has done extensive research on Japanese real estate. Admittedly, this assumption introduces several potential biases. Obviously, variations in total annual returns due to variations in operating income will not be captured in the data. Also, this assumption ignores the possibility that different types of Japanese real estate may yield different rates of operating income. Finally, the 2 percent rate assumption may understate or overstate the true rate. However, given the objective of this study, these deficiencies are unlikely to have any substantial impact on the results or conclusions.

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