International Diversification During the 1990s

Ahmet Tezel and Ginette McManus

This paper re-examines whether international diversification provided the expected benefits during the 1990s using ex-ante optimized portfolio procedures and the MSCI developed country stock indices. Our results show that only constrained efficient portfolios provide the best diversification benefits. Their performances, however, are inferior to that of the U.S. domestic portfolio. In addition, portfolios formed using data excluding the 1987 crash period are slightly riskier portfolios, but they outperform those formed using data including the crash. Finally, the results support that hedging away currency risk reduces portfolio performance.

I. INTRODUCTION

Adding foreign stocks to a US domestic portfolio would be attractive if the globally diversified portfolio either decreases overall risk without decreasing expected return or increases expected return without increasing risk. Previous studies showed that the low correlations among stock returns of various foreign countries are a source of beneficial diversification to investors (see Elton and Gruber [5], Solnik [29], Hunter and Coggin [15], and Eun and Resnick [7]). Furthermore, using data from the period 1970-1990, mean-variance efficient international portfolios dominated U.S. domestic portfolios on both risk and return characteristics (see Solnik [29]). Radcliffe [23] (p. 613) reports "that in the 1990s, limiting portfolio investments to securities in the United States is akin to limiting portfolio investments in the 1890s to securities of, say, the state of Pennsylvania. It excludes many potential profitable markets and limits portfolio diversification."

The purpose of this paper is to re-examine whether international diversification provided the expected potential benefits during the 1990s using ex-ante mean-variance optimization procedures. This paper is motivated by the presumption that the importance of international diversification during the 1990s is reduced. First, stock returns of developed equity markets are often assumed to be more highly correlated with increased economic integration

Ahmet Tezel and **Ginette McManus**, Saint Joseph's University, Philadelphia, PA 19131.

during the 1990s (see Shapiro [27] (p. 479) and Elton and Gruber [5] (p. 274)). Second, the empirical evidence for the 1970-1994 period in Sinquefield [28] does not support the claim that international stock portfolios reliably outperform U.S. stock portfolios. Results show that foreign equity portfolios do not materially increase expected returns and that their variances and correlations with the United States are too high to make them risk reducers for U.S. equity portfolios. Third, previous studies based on ex-post return data (Ibbotson, Siegel, and Love [16] and Solnik and Noetzlin [30]) and those more realistically based on ex-ante data (Grauer and Hakansson [11] and Jorion [18]) demonstrate that the advantage of international diversification may overstate the potential gains from international investment. Foreign markets (especially Japan) outperformed the U.S. market during the time of both Grauer and Hackansson [11] and Jorion [18] studies. However, during the 1990s, the U.S. market has outperformed the Japanese and European markets. Fourth, correlations among foreign stock markets appear to increase with increases in market volatility (see Odier and Solnik [22]). Taken together, these changes from the 1980s should diminish the risk-return benefits of international investing during the 1990s.

Our results indicate that ex-ante mean-variance Markowitz optimized international stock portfolios did not provided any diversification benefits during the 1990-1995 period. More specifically, all ex-ante unconstrained international portfolios of stocks traded in 18 developed countries achieved a lower risk-adjusted performance, using Sharpe ratios, than a U.S. domestic stock portfolio. Only ex-ante constrained international equity portfolios are better diversified with risk closer to that of the U.S. domestic portfolio. Their performances, while inferior to that of the of U.S. domestic stock portfolio, provide the best diversification benefits during the 1990-1995 period. Results also indicate that international portfolios formed with data excluding the 1987 crash period generally outperform those formed with data including the crash period. Furthermore, unhedged international portfolios outperform hedged portfolios during the 1990-1995 period.

The rest of the paper is organized as follows: Section II provides the data source and summary statistics. Section III describes the methodologies that investors might use to construct ex-ante mean-variance portfolios. Section IV reports the results for both unconstrained and constrained portfolios, and Section V concludes.

II. DATA AND SUMMARY STATISTICS

The obvious strategy for investors deciding to diversify internationally is to hold an international index fund. Therefore, the data in this study are drawn from the 22 developed country stock indices produced by Morgan Stanley Capital International (MSCI) Perspective. Each MSCI index is calculated using monthly data (with dividends reinvested) and is value-weighted. Nearly all the stocks included in the MSCI indices for equity markets can be purchased by foreign investors.[1]

Average monthly returns, standard deviations, and correlation coefficients are calculated for each of the 18 country stock indices for which data are available during the 1985-1990 and 1990-1995 periods.[2] These investment parameters for unhedged currency positions are converted to U.S. dollars at prevailing exchange rates and are shown in Tables 1 and 2, respectively. Table 3 presents average monthly returns, standard deviations, and correlation coefficients among country stock indices for hedged currency positions over the 1985-1990 and 1990-1995 periods. In addition, average values of these parameters excluding the 1987 crash period are presented in Tables 1 and 3.

Table 1 reports that, over the 1985-1990 period, average monthly returns ranged from as low as 0.90 percent for Canada to as high as 4.0 percent for Austria. Standard deviations ranged from 5.1 percent for the United States to 8.8 percent for Hong Kong. Austria has the highest average monthly return and almost the highest volatility (8.7 percent) while the United States has one of the lowest average monthly returns (1.1 percent) and the lowest volatility. Correlation coefficients vary somewhat across countries but are overall surprisingly low. The average monthly correlation coefficient of all 18 countries is less than 50 percent.

Table 1
Average monthly correlation coefficients: 1985-1990

Table 2
Average monthly correlation coefficients: 1990-1995

For the 1990-1995 period, Table 2 shows that all countries (with the exception of Hong Kong, Japan, and Sweden) experienced lower average monthly returns and standard deviations than for the 1985-1990 period. Hong Kong's returns are identical (1.8 percent) in both time periods while Japan and Sweden have higher risks. Average monthly correlations among all 18 countries were 47.7 percent and 45.3 percent over the 1985-1990 and 1990-1995 periods, respectively.

Table 3
Average monthly parameters among stock indices: 1985-1995

A. Average monthly parameters among stock indices: 1985-1990

	Including Crash	Excluding Crash	Including Crash	Excluding Crash
Average Monthly Return	.023	.028	.016	.022
Average Monthly Standard Deviation	.073	.062	.068	.055
Average Monthly Correlation Coefficient	.477	.281	.415	.195

B. Average monthly parameters among stock indices: 1990 - 1995

	Unhedged[*]	Hedged
Average Monthly Return	.004	.004
Average Monthly Standard Deviation	.057	.056
Average Monthly Correlation Coefficient	.453	.440

*Unhedged: Currency risk is fully borne.

Unhedged international portfolios include not only domestic returns and risks but also currency returns and risks. Results in Table 3 support the theory that international portfolios may have lower risks if currency risk is hedged away (see Elton and Gruber [5] p. 276). For the 1985-1990 period, the average standard deviation is 6.8 percent when currency risk is hedged away for the 18 countries shown in Table 1. This contrasts with 7.3 percent when currency risk is fully borne. Similarly, an average correlation coefficient is found to be 41.5 percent when currency risk is fully hedged and 47.7 percent when the effect of exchange risk is included. Risk differentials between hedged and unhedged international portfolios are much smaller for the 1990-1995 period.

Some studies on domestic stock markets include the 1987 crash period in evaluating different investment strategies (see Fama and French [8]). However, the crash of October 1987 produced excessive volatilities in foreign stock markets for several months and the effect of the crash differed significantly among countries, (see Lau and McInish [19] and Roll [24]). Therefore, results in this study both include and exclude the 1987 crash period, defined as October, November, and December 1987. Results in Tables 1 and 3 indicate that correlations for both hedged and unhedged international portfolios are significantly lower when the 1987 crash period is excluded. The average correlation coefficient for hedged (unhedged) international portfolios is 41.5 (47.7) percent when data including the 1987 crash period are considered. When the 1987 crash period is excluded, hedged and unhedged international portfolios have an average correlation coefficient of 19.5 and 28.1 percent, respectively. Our results support the finding that correlations increase when stock markets become more volatile (see Odier and Solnik [22]). The stock market crash of 1987 appears to have led to a permanent increase in correlations of both hedged and unhedged international portfolios. As mentioned previously, increased correlations during the 1990s reduce the benefits of international diversification for U.S. investors.

III. METHODOLOGY

Using the mean-variance optimization model of Markowitz, efficient portfolios are formed every quarter over the 1990-1995 period and their performances are examined in the subsequent quarter. Thus, investors' holding period spans 20 quarters, beginning at the end of January 1990 and ending at the end of January 1995. Portfolios formed at the end of, say, January 1990 are based on 60-

months' trailing return data, from the beginning of January 1985 to the beginning of January 1990. These portfolios are held until the following quarter (end of April 1990) when new mean-variance efficient portfolios are formed again based on the previous 60-months' trailing return data (from the beginning of April 1985 to the beginning of April 1990). No short sales are allowed.

Markowitz's mean-variance approach assumes that investors aim to maximize expected return for a given level of risk (subject, in most cases, to a number of constraints). The potential reduction in risk from international diversification is due to lower correlations among stock prices of many foreign countries than correlations among U.S. stock prices. Like in studies by Grauer and Hakansson [11] and Jorion [18], ex-ante return data are utilized in this study to implement modern portfolio theory. More specifically, stock data from the 1985-1990 period are used to form expectations about mean returns, variances, and covariances for foreign markets. Optimal portfolios are then formed and their performances during the 1990-1995 period are examined.

Two portfolio selection models or approaches that investors might use to construct ex-ante optimal mean-variance portfolios are employed. The two approaches are: (1) Historical portfolio, and (2) Minimum risk portfolio.

The historical portfolio approach assumes that a country's expected returns are equal to the average of its historical returns. Under this method, portfolios are formed over the 1990-1995 period by using as investment inputs each country's mean returns, standard deviations, and correlation coefficients calculated from the 1985-1990 estimation period (as explained above). The compositions of ex-ante tangency portfolios associated with the risk-free rate are found and their ex-post performances are measured (on a quarterly basis).[3]

Previous studies report that historical portfolios exhibit the worst ex-post performance and are generally poorly diversified (see Green and Hollifield [12] and Best and Grauer [1]). To cope with estimation risk or measurement error in expected returns, the minimum risk portfolio approach assumes that a country's expected returns are equal to the average (grand mean) of historical mean returns across countries. Therefore, minimum risk portfolios in this study are equivalent to those of Jobson and Korkie [17], which use a James-Stein estimator. Under the minimum risk portfolio method, portfolios are formed over the 1990-1995 period by using as investment inputs the grand means of all countries' mean returns as each country's mean returns, each country's standard deviations and correlation coefficients calculated from the 1985-1990 estimation period. The compositions of portfolios having the minimum risk

(bullet portfolios) are then found and their ex-post performances are measured on a quarterly basis. Minimum risk portfolios should provide superior ex-post performances and be better diversified than historical portfolios. In addition to historical and minimum risk portfolio approaches, a naive strategy of investing equally in each of the 18 developed countries is also considered in this study. Equally-weighted portfolios are formed and their ex-post performances are measured on a quarterly basis.

A potentially interesting method to cope with estimation risk is to employ shrinkage estimators procedures to estimate sample parameters. Therefore, portfolios under both the historical and the minimum risk approaches are also formed using shrinkage estimates. To implement this adjustment strategy, the distribution of means is shrunk by truncating the standardized values of inputs. Specifically, if a country's mean return is, say, 1.7 standard deviation above the grand mean of all 18 countries' mean returns in one quarter, its mean return in the next quarter is estimated to be 1.0 standard deviation above the grand mean. Similarly, if a country's mean return is, say, 0.6 standard deviation below the grand mean in one quarter, the next quarter's mean is set equal to the grand mean. In short, five values are estimated (grand mean and four others with plus and minus 1.0 and 2.0 standard deviations around the mean). Similar quarterly adjustments are made to both standard deviations and correlation coefficients. This adjustment strategy is based on the assumption that when returns, standard deviations, and correlation coefficients move away from their long-term mean values, equilibrating forces in markets will tend to push them back.

In an effort to avoid tilting international portfolios toward foreign countries, portfolios under both the historical and the minimum risk models (with and without using shrinkage estimators) are constrained by imposing the strategic target of investing no less than 10 percent but no more than 30 percent in foreign stocks as well as some additional specific requirements.[4] Given the large size of the Japanese market, portfolios may contain up to a 20 percent investment in Japan.[5] Total investments in two risky Asian countries (Hong Kong and Singapore) is limited to 10 percent or less of the portfolio.[6] On the other hand, investments in three major European countries (France, Germany, and United Kingdom) must be at least 10 percent of the portfolio.[7] Finally, it is required that, with the exception of Japan and the United States, no single country constitutes more than 10 percent of the portfolio. Constrained equally-weighted portfolios consist of 70 percent invested in the United States and 30 percent invested equally in the remaining 17 countries.

IV. RESULTS

Means, standard deviations, and Sharpe ratios of both unconstrained and constrained efficient portfolios obtained under each portfolio selection model including and excluding the 1987 crash period are reported in Table 4. Tables 5 and 6 present the compositions of some of these efficient portfolios for each of the 18 countries.

Unconstrained Mean-Variance Approach to International Diversification

As found in previous studies, historical or past information provides a poor guide to future performance. Among the nine stock portfolios reported in Table 4, the unhedged, unadjusted, and unconstrained historical portfolio, P0, has the worst ex-post performance, in terms of Sharpe ratio of -20.0 percent, during the 1990-1995 period. This portfolio never invests in the United States and invests unreasonably large amounts in markets with high mean returns such as Hong Kong. More than 95 percent of portfolio P0 is invested in three countries (Austria, Denmark, and Japan) on January 1990 while only two countries (Hong Kong and Switzerland) constitute mostly the portfolio on October 1994. These results support Jorion [18] who reported "that whether imprecision in measuring averages or time-varying expected returns, changing differential returns lead to a significant shift in portfolio weights and assign the large percentage to foreign stocks."

Table 4
Portfolios performances based upon quarterly results: 1990 - 1995

A. Unconstrained Portfolios

	Mean %	Standard Deviation %	Sharpe Ratio %
1. Unhedged Portfolios			
Historical (P0)	-0.77	10.10	-20.00
Minimum Risk (P1)	0.62	6.18	-10.11
Minimum Risk, excl. crash (P1)	0.98	6.50	-4.16
Equal - Weighted (P5)	1.26	6.40	0.17
U.S.A. (P9)	2.13	5.60	15.77
2. Hedged Portfolios			
Minimum Risk (P2)	-0.10	7.21	-18.69
Minimum Risk, excl. crash (P2)	0.53	7.39	-9.69
Equal - Weighted (P6)	1.20	7.82	-0.61

B. Constrained Portfolios

	Mean %	Standard Deviation %	Sharpe Ratio %
1. Unhedged Portfolios			
Historical (P0)	1.62	5.81	6.38
Minimum Risk (P3)	1.87	5.58	11.17
Minimum Risk, excl. crash (P3)	1.62	5.73	6.54
Equal - Weighted (P7)	1.85	5.27	11.49
2. Hedged Portfolios			
Minimum Risk (P4)	1.44	5.80	3.28
Minimum Risk, excl. crash (P4)	1.55	5.94	5.16
Equal - Weighted (P8)	1.83	5.73	10.26

P0: Unhedged (currency risk is fully borne) historical portfolio; P1 (P2): Unconstrained and unhedged (hedged) minimum risk portfolio; P3 (P4): Constrained and unhedged (hedged) minimum risk portfolio; P5 (P6): Unconstrained and unhedged (hedged) equally-weighted portfolio; P7 (P8): Constrained and unhedged (hedged) equally-weighted portfoliol; P9: Unconstrained and unhedged U.S. domestic portfolio.

Historical portfolio: Tangency portfolio using Treasury Bill rate

Minimum risk portfolio: Country return = grand mean of all countries' mean returns

Excl. crash: Excluding the 1987 crash period (October, November, and December of 1987)

Constraints: 0.9 >= U.S. >= 0.7; France + Germany + United Kingdom >= 0.1; Japan <= 0.2; Hong Kong + Singapore <= 0.1; Each country (except Japan and U.S.) <= 0.1

Table 5
Unconstrained Minimum Risk Portfolio Compositions by Country

	Unhedged			Hedged		
	P1	P1 (ex)	P1	P2	P2 (ex)	P2
	Jan-90	Jan-90	Oct-94	Jan-90	Jan-90	Oct-94
Australia	0.00%	13.26%	13.76%	0.00%	10.82%	17.51%
Austria	17.28%	13.75%	0.35%	18.27%	11.70%	1.43%
Belgium	0.00%	0.00%	0.00%	0.00%	0.00%	0.80%
Canada	2.39%	0.00%	26.44%	0.00%	0.00%	38.73%
Denmark	24.99%	13.51%	10.94%	34.84%	21.09%	9.57%
France	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Germany	0.00%	1.05%	0.00%	0.00%	0.00%	0.00%
Hong Kong	0.00%	0.50%	0.00%	0.00%	3.33%	0.00%
Italy	0.00%	0.00%	1.68%	0.00%	0.00%	0.12%
Japan	20.56%	17.64%	0.00%	33.72%	28.04%	1.25%
Netherlands	0.00%	0.00%	10.05%	0.00%	0.00%	0.00%
Norway	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Singapore	0.00%	14.63%	0.00%	0.00%	9.66%	0.00%
Spain	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sweden	5.01%	3.17%	0.00%	7.77%	7.17%	0.00%
Switzerland	0.00%	0.00%	0.00%	0.00%	7.07%	0.00%
United Kingdom	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
United States	29.78%	22.49%	36.78%	5.39%	1.12%	30.60%

P1: Unconstrained and unhedged (currency risk is fully borne) minimum risk portfolio.
P1 (ex): Unconstrained and unhedged minimum risk portfolio, excluding the 1987 crash period.
P2: Unconstrained and hedged minimum risk portfolio.
P2 (ex): Unconstrained and hedged minimum risk portfolio, excluding the 1987 crash period.
Minimum risk portfolio: Country return = grand mean of all countries' mean returns.
1987 crash period: October, November, and December 1987.

The performance of the unhedged, unadjusted, and unconstrained minimum risk portfolio, P1, is also much worse than the performance of the equivalent U.S. domestic portfolio, P9. In Table 4, portfolio P1 has a Sharpe ratio of -10.1 percent. In addition, its standard deviation of 6.2 percent is slightly higher than the standard deviation of 5.6 percent for the U.S. domestic portfolio. In Table 5, portfolio P1 invests 20.6 percent in Japan on January 1990 but 0 percent on October 1994. Similarly, 0 percent is invested in Australia on January 1990 while 14.0 percent is invested in this country later. About one-third of portfolio P1 is invested in the United States in almost every quarter. The performances of both the unhedged and unconstrained historical portfolio and minimum risk portfolio with shrinkage estimators are inferior to the performances of portfolios P0 and P1 and are not reported.[8]

Unconstrained minimum risk portfolios excluding the 1987 crash period have higher returns and slightly higher risks than those including the crash period. Mean returns are 0.98 percent versus 0.62 percent and 0.53 percent versus -0.10 percent for unhedged and hedged positions, respectively. Similarly, standard deviations are 6.50 percent versus 6.18 percent for unhedged minimum risk portfolios and 7.39 percent versus 7.21 percent for hedged ones. As a result, unconstrained minimum risk portfolios using data that exclude the 1987 crash period have less risk per unit of return and superior ex-post performances during the 1990-1995 period.

Unhedged portfolios excluding the 1987 crash period outperform similar hedged portfolios. This result holds for minimum risk portfolios and equally-weighted portfolios, irrespective of whether they are constrained or not. In general, the compositions of unhedged and hedged portfolios are somewhat similar. In Table 5, in October 1994, the unhedged minimum risk portfolio, P1, invests 36.78 percent in the United States, 10.05 percent in the Netherlands, 1.68 percent in Italy, 10.94 percent in Denmark, 26.44 percent in Canada, 0.35 percent in Belgium, and 13.76 percent in Australia. On October 1994, the hedged minimum risk portfolio, P2, invests 30.6 percent in the United States, 1.25 percent in Japan, 0.12 percent in Italy, 9.57 percent in Denmark, 38.73 percent in Canada, 0.80 percent in Belgium, 1.43 percent in Austria, and 17.51 percent in Australia.

Markowitz's minimum risk portfolios, P1 and P2, have lower risks and returns than equally-weighted portfolios, P5 and P6, during the 1990-1995 period. While minimum risk portfolios have inferior performances to equally-weighted portfolios, minimum risk portfolios have lower risks and, thus, may

be preferable to equally-weighted portfolios for many investors. Overall, the U.S. domestic portfolio, P9, dominates all portfolios in terms of Sharpe performance measures. The higher return (2.13 percent) and the lower risk (5.60 percent) of the U.S. domestic portfolio makes it more attractive than internationally diversified portfolios to U.S. investors.

Constrained Mean-Variance Approach to International Diversification

Table 4 confirms that the performances of constrained international portfolios are more similar to that of the U.S. domestic portfolio since at least 70.0 percent of the portfolios must consist of U.S. stocks. In addition to 70.0 percent investment in the United States, Table 6 reports that the unhedged (hedged) minimum risk portfolio, P3 (P4), invests 1.17 (0.98) percent in Italy, 8.33 (10.0) percent in Germany, 1.67 (0.0) percent in France, 3.88 (1.67) percent in Denmark, 4.95 (7.35) percent in Canada, and 10.0 (10.0) percent in Australia on October 1994. As expected, constrained portfolios are better diversified among foreign stocks and the compositions of unhedged and hedged constrained portfolios are very similar. Constrained portfolios, while inferior to the U.S. domestic portfolio, may well provide satisfactory diversification benefits in the future.

With the exception of unhedged portfolios, constrained minimum risk portfolios excluding the 1987 crash period also outperform those including the crash. Therefore, excluding very large changes in international markets when estimating parameter values may improve the relative future performance of minimum risk portfolios. As mentioned previously, unhedged minimum risk portfolios excluding the 1987 crash period as well as equally-weighted portfolios outperform similar hedged portfolios. Observed smaller standard deviations and larger returns of unhedged portfolios during the 1990-1995 period provide some support for not hedging away the currency risk of internationally diversified portfolios. The results support the theory that currency risk gets diversified away in international portfolios and optimal currency hedging never implies fully hedged positions (see Gastineau [10] and Black [2]).

Table 6
Constrained Minimum Risk Portfolio Compositions by Country

	Unhedged			Hedged		
	P3	P3 (ex)	P3	P4	P4 (ex)	P4
	Jan-90	Jan-90	Oct-94	Jan-90	Jan-90	Oct-94
Australia	0.00%	8.26%	10.00%	0.00%	8.26%	10.00%
Austria	7.20%	4.76%	0.00%	5.79%	4.76%	0.00%
Belgium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Canada	0.00%	0.00%	4.95%	0.00%	0.00%	7.35%
Denmark	5.99%	0.00%	3.88%	5.95%	0.00%	1.67%
France	0.00%	0.00%	1.67%	0.00%	0.00%	0.00%
Germany	7.67%	9.70%	8.33%	8.93%	9.70%	10.00%
Hong Kong	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Italy	0.00%	0.00%	1.17%	0.00%	0.00%	0.98%
Japan	6.81%	4.95%	0.00%	8.27%	4.95%	0.00%
Netherlands	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Norway	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Singapore	0.00%	2.03%	0.00%	0.00%	2.03%	0.00%
Spain	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sweden	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Switzerland	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
United Kingdom	2.33%	0.30%	0.00%	1.07%	0.30%	0.00%
United States	70.00%	70.00%	70.00%	70.00%	70.00%	70.00%

P3: Constrained and unhedged (currency risk is fully borne) minimum risk portfolio.
P3 (ex): Constrained and unhedged minimum risk portfolio, excluding the 1987 crash period.
P4: Constrained and hedged minimum risk portfolio.
P4 (ex): Constrained and hedged minimum risk portfolio, excluding the 1987 crash period.
Minimum risk portfolio: Country return = grand mean of all countries' mean returns.
1987 crash period: October, November, and December 1987.
Constraints: 0.9 >= United States >= 0.7; France + Germany + United Kingdom >= 0.1; Japan <= 0.2; Hong Kong + Singapore <= 0.1; Each country (except Japan and United States) <= 0.1

During this study period, international volatilities and correlations have not been stable enough to provide any predictive value for managing the future risk of the portfolio. Meric and Meric [21] found international correlation matrices to be relatively stable over consecutive five-year periods while Eun and Resnick [6] found a size-industry model to be the best forecasting approach to estimate correlations in the United States. In Tables 1 and 2, for example, the correlation coefficient between Hong Kong and the United States is 56 percent over the 1985-1990 period and 34 percent over the 1990-1995 period. Elton and Gruber [5] (p. 267) report a correlation coefficient between these two countries of 32 percent over the 1980-1993 period. Solnik [29] (p. 45) reports a correlation coefficient of 28 percent over the 1971-1988 period. Over five-year periods, correlations change sufficiently to have a significant impact on the portfolio compositions.

V.   CONCLUSIONS

The low correlations of stock prices among many countries are usually presumed to be a source of beneficial diversification to investors. Using data from the 1970-1990 period, empirical studies found that mean-variance efficient international portfolios dominated U.S. domestic portfolios on both risk and return characteristics. However, these studies may overstate the potential gain from international diversification.   While foreign markets outperformed the U.S. market before the 1990s, the U.S. market outperformed both the Japanese and European markets during the 1990s. Furthermore, recent evidence in Sinquefield [28] does not support the claim that international stock portfolios outperformed U.S. ones. In addition, stock returns of developed equity markets are often assumed to be more highly correlated with increased economic integration during the 1990s. These changes from the 1970-90 period should reduce the risk-return benefits of international investing during the 1990s.

Unconstrained ex-ante efficient international mean-variance portfolios constructed over the 1990-1995 period are poorly diversified and are not less risky than a U.S. domestic portfolio. Only constrained ex-ante efficient international portfolios are better diversified and have risk closer to that of the U.S. domestic portfolio. By forcing diversification among foreign countries and a 70 percent investment in the United States, constrained portfolios are

more realistic. Their performances, while inferior to that of the U.S. domestic portfolio, provide the best diversification benefits during the 1990-1995 period.

The results also indicate that unhedged portfolios dominate hedged portfolios. Hedging away currency risk reduces portfolio performance. In addition, portfolios formed using data excluding the 1987 crash period are slightly riskier portfolios but they outperform portfolios formed using data including the crash. Similarly, equally-weighted portfolios are riskier but superior, in terms of Sharpe performance measures, to Markowitz's minimum risk portfolios, irrespective of whether currency risk is hedged away or not.

NOTES

1. In practice, however, investors may find it very costly or sometimes impossible to invest directly in some foreign stock markets. Foreign investors are often prohibited and/or limited from directly purchasing stocks in many emerging markets (see Chang et al. [3]). For this reason and for comparability purposes with previous studies, we do not include the MSCI indices for the emerging equity markets in this study. See Harvey [14] for a discussion of the MSCI country stock indices and Roll [25] for an explanation of the structure of country correlation.
2. Specifically, the two time periods cover the beginning of January 1985 to the beginning of January 1990 and the end of January 1990 to the end of January 1995, respectively.
3. The risk-free rate used is the three-month Treasury bill rate at the beginning of the portfolio formation date.
4. No less than 70 percent but no more than 90 percent of the portfolios can be invested in U.S. stocks given that an investment of about 20 percent in foreign stocks appears to be reasonable as theoretical analyses suggest (see Chang et al. [3], Wilcox [31], Leibowitz and Kogelman [20], and Halpern [13]). However, according to surveys by Greenwitch Associates, U.S. pension funds still have much less international exposure.
5. Flanders [9] reports that during the 1990s, U.S. investors have claimed the lion's share of international investments due largely to the desire of pension funds managers to increase their international stock ownership. It is estimated that U.S. pension assets invested in foreign equities will increase to 20-25 percent of total assets by the year 2000 (see also Sesit [26]).

6. On December 1994, the United States was the largest equity market, which represented about 35 percent of the world portfolio. The second largest market was Japan with about 25 percent of the world market. All of the European markets combined accounted for about 25 percent of the world market (see Shapiro [27] p. 473).

7. Divecha et al. [4] consider Hong Kong and Singapore the two most developed of the emerging markets. Emerging markets are small markets, representing in the aggregate less than 10 percent of the world portfolio.

8. See note 5.

9. The performances of most portfolios with shrinkage estimators were found inferior and are not reported. Their results, however, are available from the authors upon request.

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