

# Risk Diversification In World Stock Markets

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## ABSTRACT

*The benefit of risk diversification refers to the reduction in the portfolio risk when different stocks are combined into a portfolio. This risk reduction benefit exists because not all stocks are moving together through time; this is presumably true for stocks from different countries. The smaller the degree of co-movements in the world stock markets (i.e., the less the correlation between the markets), the greater is the risk reduction effect. Thus, it makes sense for a US investor to invest globally as long as the foreign stock markets are not highly correlated with the U.S. market. Nevertheless, recent evidence shows that the correlations between the U.S. and various foreign stock markets are evolving through time due to the integration of world capital markets and international capital flows. Now that we witness the increased interdependence of the world stock markets, does it still make sense to diversify globally? In this paper, we address the question of global risk diversification from the US perspective.*

## INTRODUCTION

The benefit of risk diversification refers to the reduction in the portfolio risk when different stocks are combined into a portfolio. This risk diversification concept was originally introduced by Markowitz. In an article published in *Journal of Finance*, Markowitz (1952) established that this diversification benefit exists because not all stocks are moving exactly together and that the less the two stocks are correlated the greater the benefit of risk reduction. Portfolio managers seeking for risk diversification no longer focus on stocks in one national market. International diversification is achieved by combining stocks from different countries. The smaller the degree of co-movements in the world stock markets (i.e., the less the correlation between the markets), the greater is the risk reduction effect. Thus, it makes sense for an US investor to invest globally as long as the foreign stock markets are not highly correlated with the U.S. market. Nevertheless, recent evidence shows that the correlations between the U.S. and various foreign stock markets are evolving through time due to the integration of world capital markets. For example, Longin and Solnik (1995) found rising international correlations between various markets over the years from 1960 to 1999. Campbell, Koedijk and Kofman (2002) presented evidence of increased correlation in international equity returns in bear markets during 1990-1999. Butler and Joaquin (2002) reported that observed correlations between national markets during bear markets are significantly higher than predicted during the 1970-2000 period. Forbes and Rigobon (2002) reported high level of national market co-movements during the 1997 Asian crisis, 1994 Mexican devaluation and 1987 US market crash. Hon, Strauss and Yong (2004) found that international stock markets, particularly those in Europe, responded more closely to US stock market shocks in the three to six months after the September 11 crisis than before. Now that we witness the increased interdependence of the world stock markets, especially during the times of financial crisis and bear markets, does it still make sense to diversify globally? In this paper, we address the question of global risk diversification covering the period 1999-2004 from the US perspective. Our study period covers bull markets (up to March 2000), bear markets (after March 2000) and financial market crisis (briefly after the attack of September 11, 2001).

## DATA AND ANALYSIS

The study focuses on nine major world indices: US (S&P 500), Australia (All Ordinaries), China (Shanghai Composite), France (CAC 40), Germany (DAX), Hong Kong (Hang Seng), Japan (Nikkei 225), Switzerland (Swiss Market) and United Kingdom (FTSE 100). The end of month index price and foreign exchange (US dollar per unit of foreign currency) data for all indices/countries are collected over the period December 1998 through November 2004 from the database compiled by Commodity Systems, Inc. The monthly closing prices used in the study are the prices

adjusted for dividends and stock splits. Table 1 Panel A (B) shows the summary statistics of the stock market index price in local currency (in US dollar). Table 2 presents the descriptive statistics of various stock market monthly returns, computed as the sum of dividend yield and capital gain (or loss). It is clear that the returns in US dollar shown in Panel B are very different from those in local currency in Panel A for all countries except for China and Hong Kong markets. This is because the exchange rate between US dollar and Chinese Yuan (Hong Kong dollar) is constant (stable), while all other foreign currencies fluctuated widely against the US dollar over the study period. The return on a foreign investment depends in part on what happens to the exchange rate; as the foreign currency becomes stronger relative to US dollar, the return in US dollar is greater than that in local currency and vice versa. Due to the weak US dollar in recent years, the returns in US dollar are generally higher than those in local currency as depicted in Table 2. Since our study is to examine the benefits of global risk diversification from the U.S. perspective, the analysis focuses on the returns in US dollar.

Table 2 also presents the Pearson correlations between the U.S. and various world markets, computed using the stock market monthly returns time series over the entire study period from January 1999 to November 2004. It is interesting to point out that China has the least correlation (less than 0.06) while the European markets have the highest correlations (higher than 0.59) with the U.S. market during the sampling period. Unfortunately, as the correlations between two world markets vary over time, the correlations determined over the entire 71-month study period may not be meaningful. To get a better look at the co-movements between the U.S. and various world markets through time, we compute the 36-month rolling correlations, employed in Solnik, Bourcille and Fur (1996). That is, at the end of each month from December 2001 through November 2004, the correlations between two world markets are derived based on the two markets' time-series returns for the previous 36 months. For example, in December 2001, the correlation is computed according to the two markets' pair-returns from January 1999 to December 2001; in January 2002, the correlation is computed according to the pair-returns from February 1999 to January 2002; and so on. The resulting 36-month rolling correlations between the U.S. and various stock markets are plotted against time from December 2001 to November 2004 in Figure 1 Panel A. The line of best fit is inserted for each pair of world markets in the Figure to depict the trend of the co-movements between the two markets. The slopes of the trend lines are presented in Table 3 along with the descriptive statistics of the 36-month rolling correlations between the U.S. and various world markets from December 2001 to November 2004. It is evident that Australia, France, Germany, Hong Kong, Switzerland and U.K. are becoming more correlated with the U.S. over the months; the slopes of the trend lines are all positive and statistically significant. For these six pair-markets, the average correlations are relatively high, the smallest correlation is 0.6159 for Switzerland and the largest is 0.8308 for U.K., and they are evolving through time. The results are not good for risk diversification. On the other hand, Japan and China are becoming less correlated with the U.S. Specifically, the slope for Japan is  $-0.000286$  and is significant at .001 level, i.e., the average monthly decrease in correlation between Japan and US is  $.0286\%$ . This is good news for global risk diversification. Moreover, the trend line for China is flat which means that the correlation between the U.S. and China remains relatively stable across time; there's neither increase nor decrease in the correlations between the two markets through time. Furthermore, the rolling correlations between the two markets are very low, varying from  $-0.0989$  to  $0.134$  over the study period. This suggests that China is a good candidate for US investors searching for the benefit of global risk diversification.

An investor holding S&P 500 index is considered well diversified in the U.S. market as the 500 stocks in the index are selected from different industry sectors. In fact, the index is used as a benchmark portfolio by most professionals in the investment community. In this study, we adopt the index as our base portfolio when examining the effect of global diversification. We also follow Solnik, Bourcille and Fur (1996) 36-month rolling procedure in computing the variance risk and mean returns of various portfolios. Thus, at the end of each month from January 1999 to November 2004, we construct global portfolios<sup>1</sup> consisting of 60% US and 40% foreign stocks, and each portfolio's mean returns and variances are computed on the basis of previous 36 months returns. The resulting 36-month rolling variances (mean returns) of the global portfolios are plotted against S&P 500 variances (mean returns) across time in Figure 1 Panel B (Figure 2). Figure 2 shows that with the exception of Australia and China, the various global portfolio returns are very similar to the S&P returns ranging from  $-1.4\%$  to  $0.29\%$  over the study period. For Australia, the global portfolio consistently outperformed the S&P index over the entire study period; for China, the global portfolio outperformed the S&P index up till September 2003. The evidence suggests that global portfolio returns are comparable to S&P returns, if not better.

Given that the portfolio return is not sacrificed, we now focus solely on portfolio risk. Figure 1 Panel B depicts that the benefit of risk diversification existed throughout the study period for Australia, China, Switzerland and UK; the global portfolio variances are below those of S&P 500 at all times. But the spread between the two variances is diminishing over time and the diversification benefit became nil in recent months for Switzerland and U.K. Furthermore, Panel B of Figure 1 shows that the risk reduction benefit for Japan, albeit small, appeared only after October 2002. In contrast, it reveals that not only there's no diversification benefit for Hong Kong, France and Germany but there's amplified portfolio risk when diversifying globally in these markets.

So far our global portfolios are composed of two world stock markets: the U.S. and one foreign market. In practice, US investors may be interested in investing in more than one foreign market. In this section, we combine US with three foreign markets and introduce three new global portfolios. They are: Global Europe consisting of 60% US, 10% UK, 10% Switzerland, 10% France & 10% Germany, Global Asia/Pacific consisting of 60% US, 10% Japan, 10% China, 10% Hong Kong & 10% Australia and Global World consisting of 60% US, 10% Switzerland, 10% Australia, 10% Japan & 10% China. Table 4 presents the summary statistics of 36-month rolling portfolio returns and variances over the study period. The variance risk and mean returns of various global portfolios are plotted against those of S&P 500 in Figure 3 from December 2001 to November 2004. It is clear that Global World and Global Asia/Pacific outperformed S&P 500 in terms of both risk and return through time; the two global portfolios' variances are lower and returns are slightly higher as compared to those of S&P 500 at any given month during the study period. The benefit of risk diversification is evident throughout our study period for the two global portfolios. However, this is not the case for Global Europe though. Figure 3 shows that Global Europe is riskier than S&P 500 after March 2003 and it is less profitable than S&P 500 from December 2001 to September 2003. Not a good global portfolio to invest in!

Finally, Table 4 presents the summary statistics of the 36-month rolling returns and variances of all portfolios constructed in this study. As a result of the recent long lasting bear markets during our study period, it is not surprising that the mean returns of the portfolios are all negative. The risk-return profiles of the S&P 500 and various global portfolios are presented in Figure 4. Table 4 and Figure 4 clearly depict that Global Australia and Global China are mean-variance dominant; that is; these two portfolios provided the highest possible mean return given the variance risk level and/or the lowest possible variance risk given the amount of mean return. Global World is less profitable but safer than is Global Australia, and it is very close to Global China in terms of risk and return measures. When Global World is compared to S&P 500, it is a clear winner; i.e., more return and less risk. Moreover, Global World is superior to all the other global portfolios, including Global Asia/Pacific, Global Europe and Global Switzerland. Regardless of the bear markets (started in March of 2000) and the financial market crisis (as a result of the attack of September 911) during our study period, Global World looks very attractive to a US investor searching for risk diversification globally.

#### FOOTNOTE

1. The 60% US stocks and 40% foreign stocks weighting of the global portfolios is adopted for illustration purpose only; it is by no means the optimal portfolio mix between US and foreign stocks. Depending on the investment goals, different weights are allocated to foreign stocks by mutual fund managers, e.g., TIAA-CREF Growth Equity Fund consists of up to 20% in foreign stocks and its International Equity Fund consists of at least 80% in foreign stocks.

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**Table 1. Summary Statistics of Stock Market Index Price, Monthly Data from 12/1998 to 11/2004**

<b>Panel A. Stock Market Index Price in Local Currency</b>						
<b>Stock Market</b>	<b>Market Index</b>	<b>Mean</b>	<b>Variance</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Count</b>
Australia	All Ordinaries	3183	51751	2778	3943	72
China	Shanghai Composite	1618	74028	1090	2218	72
France	CAC 40	4416	1276871	2618	6625	72
Germany	DAX	4903	1981014	2424	7645	72
Hong Kong	Hang Seng	12409	5471564	8634	17407	72
Japan	Nikkei 225	12771	11422362	7831	20337	72
Switzerland	Swiss Market	6328	1261365	4086	8220	72
United Kingdom	FTSE 100	5234	939826	3567	6930	72
United States	S&P 500 Index	1171	33424	815	1518	72
<b>Panel B. Stock Market Index Price in US Dollar</b>						
<b>Stock Market</b>	<b>Market Index</b>	<b>Mean</b>	<b>Variance</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Count</b>
Australia	All Ordinaries	1947	114046	1475	3059	72
China	Shanghai Composite	195	1080	132	268	72
France	CAC 40	4465	745689	2745	6180	72
Germany	DAX	4951	1293316	2645	7360	72
Hong Kong	Hang Seng	1593	90330	1107	2235	72
Japan	Nikkei 225	112	1193	66	197	72
Switzerland	Swiss Market	4193	277420	3023	5214	72
United Kingdom	FTSE 100	8268	2003120	5712	11169	72
United States	S&P 500 Index	1171	33424	815	1518	72

Note: Stock market index price is the end of month close price adjusted for dividends and splits.

**Table 2. Summary Statistics of Various Stock Market Monthly Returns from 01/1999 to 11/2004**

<b>Panel A. Monthly Rate of Return in Local Currency</b>						
<b>Stock Market</b>	<b>Mean</b>	<b>Variance</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Correlation with US</b>	<b>Count</b>
Australia	0.52%	0.09%	-7.14%	7.14%	0.6424	71
China	0.44%	0.47%	-13.42%	32.06%	0.0577	71
France	0.11%	0.35%	-17.49%	13.41%	0.8246	71
Germany	0.04%	0.61%	-25.42%	21.38%	0.8045	71
Hong Kong	0.72%	0.50%	-13.71%	21.85%	0.6593	71
Japan	-0.19%	0.41%	-11.62%	10.22%	0.4981	71
Switzerland	-0.29%	0.19%	-13.09%	11.19%	0.7494	71
United Kingdom	-0.22%	0.18%	-11.96%	8.65%	0.8429	71
United States	0.04%	0.21%	-11.00%	9.67%	1.0000	71

Panel B. Monthly Rate of Return in US Dollar						
Stock Market	Mean	Variance	Minimum	Maximum	Correlation with US	Count
Australia	0.94%	0.27%	-12.88%	12.75%	0.6586	71
China	0.44%	0.47%	-13.42%	32.06%	0.0577	71
France	0.28%	0.36%	-16.86%	15.37%	0.7911	71
Germany	0.21%	0.61%	-24.85%	24.14%	0.7884	71
Hong Kong	0.71%	0.50%	-13.71%	21.85%	0.6578	71
Japan	0.00%	0.41%	-15.27%	12.07%	0.4979	71
Switzerland	-0.02%	0.21%	-12.73%	10.80%	0.5929	71
United Kingdom	-0.03%	0.19%	-10.50%	9.86%	0.8082	71
United States	0.04%	0.21%	-11.00%	9.67%	1.0000	71

Note: Rate of return is the sum of dividend yield and capital gain or loss.

**Table 3. Summary Statistics of 36-Month Rolling Correlations between US and Various Stock Markets from 12/2001 to 11/2004 (t-Statistics in parentheses)**

Stock Markets	Mean	Median	Minimum	Maximum	Count	Slope <sup>a</sup>
Australia & US	0.6905	0.7109	0.5709	0.7882	36	0.000212*** (13.575)
China & US	0.0247	0.0168	-0.0989	0.134	36	-0.000003 (-0.103)
France & US	0.8014	0.827	0.6779	0.899	36	0.000232*** (18.518)
Germany & US	0.8237	0.8551	0.6953	0.9063	36	0.000232*** (16.787)
Hong Kong & US	0.7266	0.7312	0.6658	0.7855	36	0.000048* (2.615)
Japan & US	0.4528	0.4467	0.2753	0.6418	36	0.000285*** (-15.177)
Switzerland & US	0.6159	0.6235	0.4452	0.7437	36	0.000286*** (19.263)
United Kingdom & US	0.8308	0.8369	0.7792	0.8617	36	0.000041*** (4.396)

<sup>a</sup> Slope of the time series fitted trend line of 36-month rolling stock market correlations from December 2001 to November 2004.

\* Significant at .05 level. \*\*\* Significant at .001 level

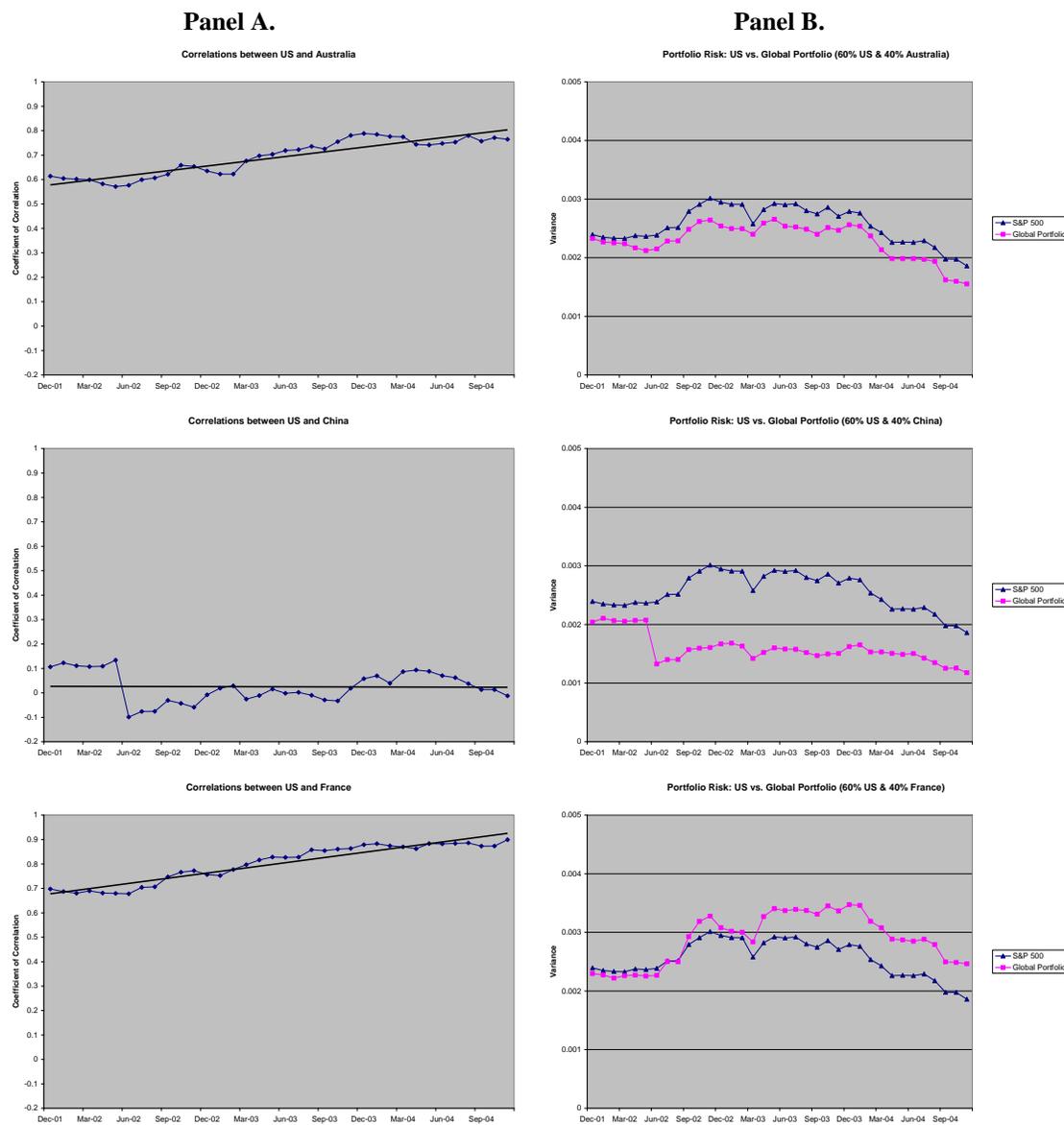
**Table 4. Summary Statistics of 36-Month Rolling Portfolio Returns and Variances from 12/2001 to 11/2004**

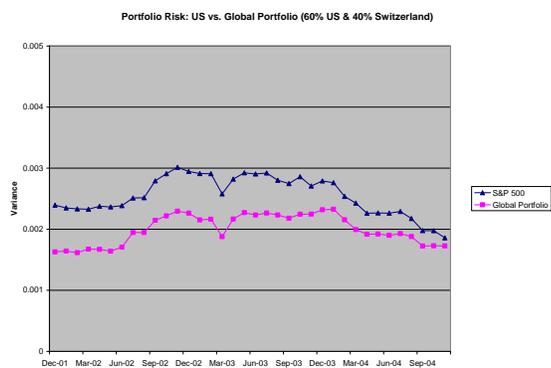
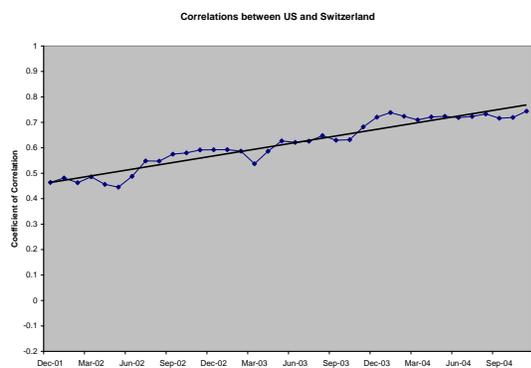
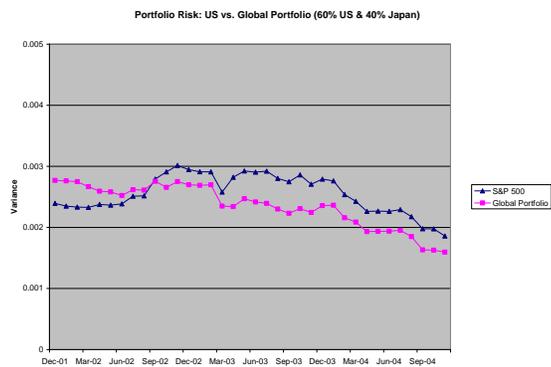
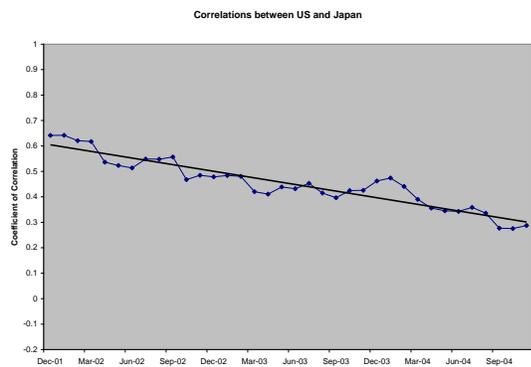
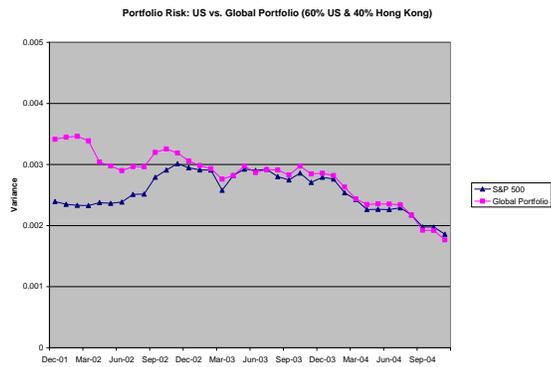
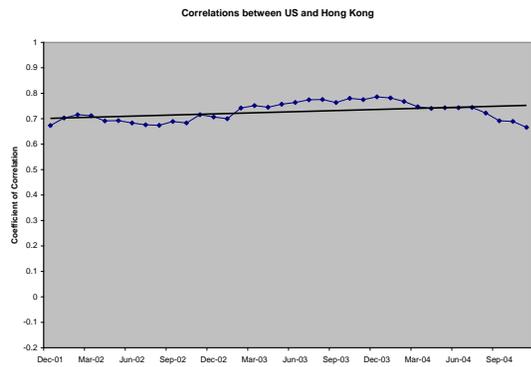
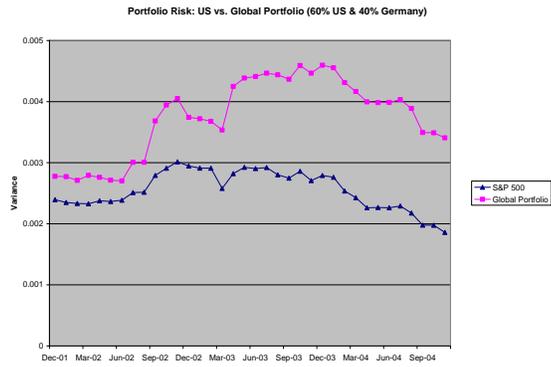
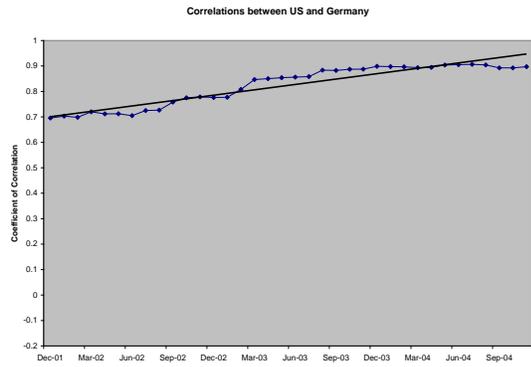
Panel A. Portfolio Returns					
Portfolio	Mean	Median	Minimum	Maximum	Count
Global Europe	-0.00534	-0.00435	-0.01549	0.00443	36
Global Asia/Pacific	-0.00425	-0.00328	-0.01356	0.00455	36
Global World	-0.00420	-0.00342	-0.01280	0.00419	36
S&P 500	-0.00557	-0.00475	-0.01442	0.00287	36

Panel B. Portfolio Variances					
Portfolio	Mean	Median	Minimum	Maximum	Count
Global Europe	0.00258	0.00262	0.00200	0.00309	36
Global Asia/Pacific	0.00194	0.00203	0.00127	0.00220	36
Global World	0.00176	0.00179	0.00128	0.00199	36
S&P 500	0.00255	0.00253	0.00186	0.00301	36

Notes: Global Europe is composed of 60% US, 10% UK, 10% Switzerland, 10% France & 10% Germany.  
 Global Asia/Pacific is composed of 60% US, 10% Japan, 10% China, 10% Hong Kong & 10% Australia.  
 Global World is composed of 60% US, 10% Switzerland, 10% Australia, 10% Japan & 10% China.

Figure 1. Stock Market Correlations and Portfolio Monthly Return Variances





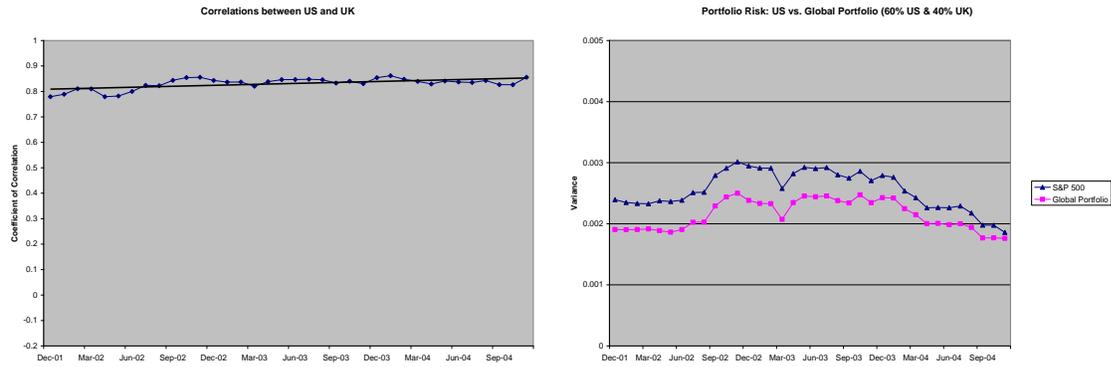


Figure 2. S&P 500 and Global Portfolio Monthly Returns



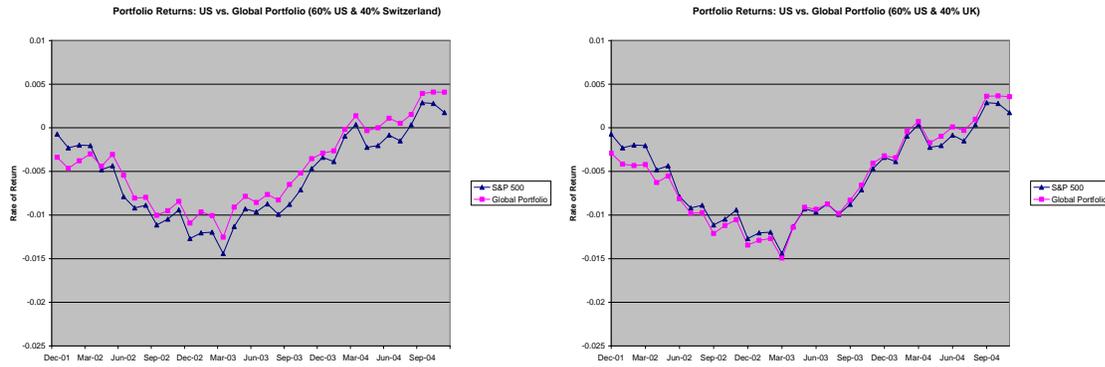
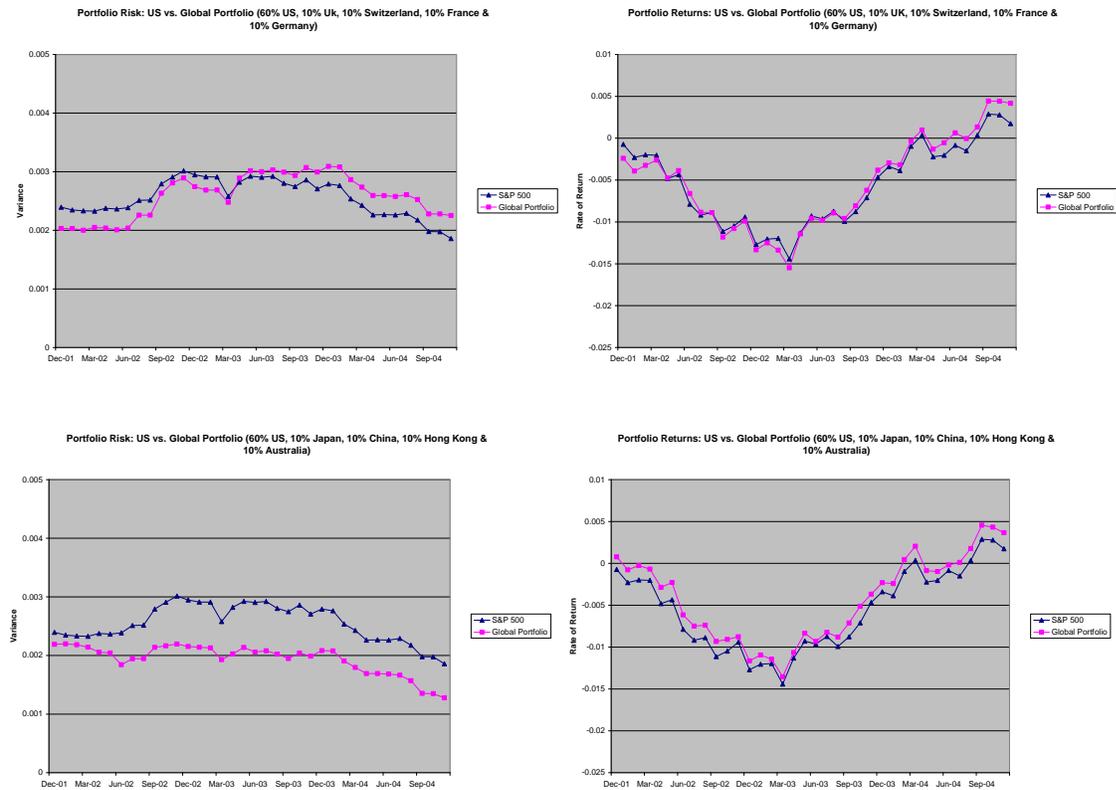


Figure 3. Portfolio Risk and Returns: S&P 500 vs. Global Portfolios

Panel A.

Panel B.



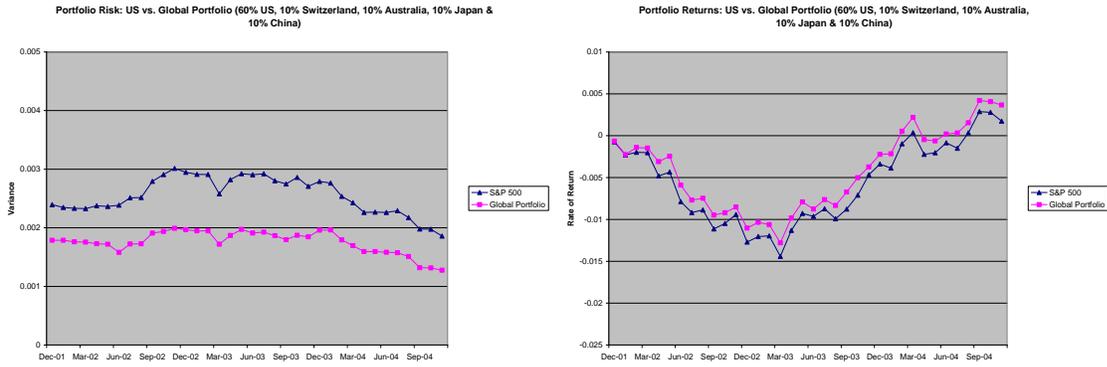


Figure 4. Risk-Return Profiles of Various Global Portfolios and S&P 500

