CAN INVESTORS BENEFIT FROM INTERNATIONAL DIVERSIFICATION WITHOUT TRADING ABROAD

by

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ABSTRACT

This paper examines whether investors can benefit from international diversification without trading abroad.

This study uses monthly return data from 1988 to 2003 for S&P 500 Index, Lehman Brothers U.S. Aggregate Bond Index, MSCI ACWorld ex U.S Index and DJIA Index. The original return correlations, skewness and kurtosis, Sharpe performance measure, and QOS-15 optimization reports provide strong evidence that gains beyond those attainable through homemade diversification have become statistically and economically insignificant. However, the extreme portfolio weights in this optimization indicates that the asset with the higher expected return like the DJIA Index dominates the optimization, and clouds the effect of correlations which are far more relevant to my study. As such, I adopt two corrections that are motivated by a "reverse optimization" approach suggested by Sharpe (2002).

The corrected findings do not support EHH's conclusion, that is, trade abroad is still necessary to gain the benefits of international diversification.

DEDICATION

I would like to dedicate this work to my husband Jun Chang, and to my Parents Ailan Li and Huanwen Gao. Without their love, respect and support this paper would not have been written. I would also like to express a special thanks to my son, Han Gao, for believing in me. Finally, I would like to acknowledge a debt to my Parents- in-law, Fenglian Wang and Yuanhang Chang, for their support, and to my constant friend, Archie Young, for encouraging me and keeping everything in perspective.

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I.
INTRODUCTION

The benefits of international portfolio diversification have been well studied by financial economists. They have shown that investing in foreign indices reduces the volatility of a U.S.-only portfolio, due to the low return correlations between national equity indices. Such investment in foreign indices has traditionally required holding securities that trade abroad, involving additional costs and potential barriers to international investment. Over the past 20 years, an increasing number of country funds and depository receipts have started trading in the U.S. that, along with shares of multinational corporations, may be used to attempt to obtain the benefits from international diversification without owning foreign securities directly.

This study is based mainly on previous work done by Errunza, Hogan, and Hung (1999) (EHH) who studied whether the gains from international diversification can be achieved without trading abroad. In this paper, in order to confirm their findings, I construct two cases using monthly data for each asset class to test whether investors can take advantage of the gains of international diversification by forming a portfolio of securities that trade in the United States.

Case 1 is a truly international portfolio composed of the S&P 500 Index, the Lehman Brothers U.S. Aggregate Bond Index, and the MSCI ACWorld Index ex U.S. Case 2 involves a homemade portfolio which hopefully mimics international diversification by using DJIA' 30s to substitute for the MSCI ACWorld ex U.S. Index.

I optimize the above two cases to compare whether case 2 is better than case 1. I find that this is indeed the case using the unadjusted returns data. In other words, EHH's finding was confirmed by my first original optimization reports which indicate we can use domestic mimicking instruments (i.e. DJIA) to obtain benefits of international index; based on unadjusted returns, investing in assets that only trade abroad appears to be no longer necessary to gain the benefits of international diversification.

However, there are extreme portfolio weights among the three asset classes in the above original optimization results. In order to adjust these extreme positions, I correct the returns data in two ways. These corrections are motivated by the "reverse optimization" approach suggested by Sharpe (2002). The approach adjusts the return so that the correlations become far more relevant to the optimization. Using this corrected data, I find that EHH's conclusion is no longer supported, that is, investing abroad is still necessary to gain the benefits of international diversification.

The paper consists of five additional sections. Section II briefly reviews the theoretical framework on the benefits of international diversification. Section III describes data and portfolio construction. Section IV discusses the empirical methodology used. Section V reports test results for summary statistics and change in Sharpe ratios to assess the ability of domestically traded assets to obtain diversification benefits. Conclusions are presented in Section VI.

II.
LITERATURE REVIEW

The benefits of international diversification have been emphasized over the past 40 years in the financial literature (e.g. Grubel, 1968; Levy and Sarnat, 1970; Solnick, 1974; Errunza, 1997; DeSantis and Gerard, 1997; and Stulz, 1997). According to the mean-variance framework developed by Markowitz (1952, 1959), investors gain from international diversification because stock markets are less than perfectly correlated in different countries. This suggests that the magnitude of gains from international diversification in terms of risk reduction depends on the international correlation structure.

Eun and Resnick (1984) (ER) examine historical correlations from 1973 to 1983 for eight countries. Specifically, ER provides the average pairwise correlations of individual stock returns within each country, and the average pairwise correlations of stock returns between countries. The correlations are in terms of U.S. dollars and computed using weekly return data for the period 1973-1983. The study shows the average intracountry correlation is 0.653 for Germany, 0.416 for Japan, 0.698 for the United Kingdom, and 0.439 for the United States. In contrast, the average intercountry correlation of the United States is 0.170 with Germany, 0.137 with Japan, and 0.279 with the United Kingdom. The average correlation of the United Kingdom, on the other hand, is 0.299 with Germany and 0.209 with Japan. Clearly, stock returns tend to be much less correlated between countries than within a country. The international correlation structure documented in ER suggests international diversification can sharply reduce risk.

According to Solnik (1974), that is indeed the case, too. The Solnik study first shows that as the portfolio holds more and more stocks, the risk of the portfolio steadily declines, and eventually converges to systematic (or nondiversifiable) risk. Systematic risk refers to the risk that remains even after investors fully diversify their portfolio holdings. His study also shows that while a fully diversified U.S. portfolio is about 27 percent as risky as a typical individual stock; a fully diversified international portfolio is only about 12 percent as risky as a typical individual stock. This implies that when fully diversified, an international portfolio can be less than half as risky as a purely U.S. portfolio. This study then illustrates the situation from the Swiss perspective. It finds out that a fully diversified Swiss portfolio is about 44 percent as risky as a typical individual stock. However, this Swiss portfolio is more than three times as risky as a well-diversified international portfolio. This implies that much of the Swiss systematic risk is, in fact, unsystematic (diversifiable) risk when looked at in terms of international investment. In addition, compared with U.S. investors, Swiss investors have a lot more to gain from international diversification. In sum, the Solnik study provides rather striking evidence supporting international, as opposed to purely domestic, diversification.

Traditionally, international diversification has involved foreign assets that only trade abroad. However, over the past 20 years, an increasing number of country funds and depository receipts have started trading in the U.S. that, along with shares of multinational corporations, can be used to gain benefits from international diversification. In other worlds, it is possible to mimic the foreign market index returns with portfolios of domestically traded assets. Currently U.S. investors can achieve international diversification at home simply by investing in U.S.-based international mutual funds,

which now number well over 300. By investing in international mutual funds, investors can (1) save any extra transaction and /or information costs they may have to incur when they attempt to invest directly in foreign markets; (2) circumvent many legal and institutional barriers to direct portfolio investments in foreign markets, and (3) potentially benefit from the expertise of professional fund managers.

ER (2003) examine the risk-return profiles of a sample of U.S.-based international mutual funds that have sufficient track records. Three funds- the ASA (which invests in South African gold-mining stocks), the Canadian Fund, and the Japan Fund–are single-country funds. Other ten funds invest more broadly (including International Investors, Keystone international, Merrill Lynch Pacific, New Perspective, Oppenheimer Global, Putnam International, Scudder International, Sogen International, Templeton Growth, and United International Growth). ER (2003) shows 10 out of 13 international funds outperformed the U.S. stock market index based on the Sharpe measure; only three international funds lie below the U.S. capital market line (CML).

EHH investigate the ability of investors to mimic returns on foreign market indices with domestically traded securities, so that investing in assets that trade only abroad would not be necessary to obtain the benefits from international diversification. They study seven developed markets and nine emerging markets from 1976 to 1993. For each country, they construct diversification portfolios using U.S. market indices, 12 U.S. industry indices, 30 multinational corporations (MNCs) (see Exhibit 4), closed-end country funds (CFs), and American Depository Receipts (ADRs). The main results of the paper indicate as the availability of MNCs, CFs, and ADRs rose, U.S. investors could effectively mimic foreign market returns with domestically traded securities. The mimicking portfolios,

based on U.S. market indices and industry indices, are significantly enhanced by MNCs, CFs, and ADRs. The monthly return correlations of these homemade diversification portfolios with foreign market indices are higher than those with the S&P 500 index. For example, the correlation between the U.S. index and the Mexico index is 0.28, compared with 0.64 between the most augmented ADRs portfolio and the Mexico index. Hence, the index level correlations do not properly take into account the ability of U.S. investors to gain international diversification benefits through homemade international diversification.

III.
CONSTRUCTION OF DIVERSIFICATION PORTFOLIO

I follow ERR and conduct my analysis from the perspective of U.S. investors. In EHH, the homemade diversification portfolio consisted of the three U.S. indices, 12 U.S. value-weighted industry portfolios, and a sample of 30 multinational corporations (MNCs), and ADRs listed on the New York Stock Exchange as the eligible set. The three U.S. indices are the value weighted market return, including dividends, equal-weighted market return, including dividends, and the Standard and Poors 500 composite index. In the international diversification portfolio, they use monthly data from 1976 to 1993 for seven developed and nice emerging market MSCI indices to substitute the MNCs and ADRs.

For this study, I construct corresponding two cases to compare their performance (see Exhibit 1). Case 1 uses international securities to provide international diversification portfolio. The investor chooses among three assets: the S&P500 Index, the Lehman Brothers U.S. Aggregate Bond Index, and the MSCI ACWorld Index ex U.S. Case 2 uses a homemade index which hopefully provides the benefits of international diversification without actually investing internationally. In Case 2, the investor chooses among the S&P500, the U.S. bond index, and DJIA (weighted average 30 MNCs Stock). Here, I use DJIA's 30 MNCs (multinational corporations) to substitute for international diversification based on foreign-traded securities. In this research, I use the monthly returns of 192

observations from January 1988 to December 2003 since the data for MSCI World Index ex US became available in December 1987.

Exhibit 1: Constructed Two Diversification Portfolios

Case1:InternationalDiversification Portfolio	Asset 1	Asset 2	Asset 3
	S&P 500	LB Agg US	MSCI Wld ex US
Case2: Homemade Diversification Portfolio	Asset 1	Asset 2	Asset 3
	S&P500	LB Agg US	DJIA' 30s

I decided to utilize the S&P 500 Index to represent the equity/stock asset class rather than the three indices EHH use. The S&P 500 Index is usually considered one of the best benchmarks available to judge overall U.S. market performance. Standard & Poor's 500 is a basket of 500 stocks that are considered to be widely held. The S&P 500 index is weighted by market value, and its performance is thought to be representative of the stock market as a whole. The S&P 500 index was created in 1957, although it has been extrapolated backwards to several decades earlier for performance comparison purposes. This index provides a broad snapshot of the overall U.S. equity market; in fact, over 70% of all U.S. equity is tracked by the S&P 500. Contrary to a popular misconception, the S&P 500 is not a simple list of the largest 500 companies by market capitalization or by revenues. Rather, it is 500 of the most widely held U.S.-based common stocks, chosen by the S&P Index Committee for market size, liquidity, and sector representation. "Leading companies in leading industries" is the guiding principal for S&P 500 inclusion. Most of the companies in the index are solid mid cap or large cap corporations. Like the Nasdaq Composite, the S&P 500 is a market-weighted index.

I add the Lehman Brothers U.S. Aggregate Bond Index (LB Agg) (an overall bond benchmark) as the benchmark index for fixed-income funds rather than exclusively

focusing on stock market in EHH study. The inclusion of fixed-income assets diversifies the overall portfolio exposure to different classes of asset. The Lehman Brothers U.S. Aggregate Index is an index composed of the Lehman Brothers Government/Credit Bond Index, Mortgage-Backed Securities Index, and Asset-Backed Securities Index. Lehman's U.S. Aggregate Index, thereby covering the U.S. investment-grade quality or better-fixed rate bond market, with components for government and corporate securities, mortgage pass-through and asset-backed securities. It includes only those securities that have at least one year to maturity and must have an outstanding par value of at least $100 million. This particular index also makes regular adjustments by raising the liquidity criteria, with the effect of reducing the number of securities in the index as well as the market value. Moreover, the Lehman Brothers Bond Indices are a widely accepted benchmark within the asset management industry, used by over 90% of U.S. institutional investors; a majority of large European investors and a growing share of Asian investors use their Indices.

I chose the MSCI ACWI (All Country World Index) ex U.S. Index in USD since it covers in a much wider range of country indices than the seven developed emerging market MSCI indices used in EHH's study. The MSCI ACWI ex U.S. Index is a free float-adjusted market capitalization index that is designed to measure equity market performance in the global developed and emerging markets. As of December 2003 the MSCI ACWI consisted of the following 49 developed and emerging market country indices: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Korea, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Russia, Singapore Free,

South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, the United Kingdom, the United States and Venezuela.

An additional difference in my research as opposed to EHH , is that I have not only updated the eligible 30 MNCs' data set (see Exhibits 2 &3) from 1976 to 2003, but have also used the DJIA's 30s as a proxy of the 30 MNCs. In other words, I use the DJAI's 30 as a proxy of homemade mimic diversification. In EHH's paper, they employ multinational corporation (MNC) stocks to substitute for international indices.

The DJIA is an index of 30 "blue-chip" U.S. stocks. As of the end 2003, the Dow Jones Industrial Average consists of the 30 largest MNCs including 10s from the EHH study. The new 20 added companies are either from health care sector like the biggest drugmaker Merk & Company, or leading financial service firms like Citigroup and American Express, etc. The more recent additions of Intel, SBC Communications, Microsoft and Home Depot are a further example of the growing importance of technology and communications and their impact on the economy. Of the four, only Home Depot could not be classified as a technology or telecommunications stock. The new stocks replaced Chevron, Goodyear, Union Carbide and Sears. After this gradual replacement, only a third of the 30 stocks in the Dow is involved in heavy manufacturing or the oil industry.

The international involvement of the 30 MNCs in DJIA index makes these MNCs directly benefit or gain much more through international diversification. And therefore, we can use DJIA' 30s as a better proxy than the 30 MNCs used in EHH (1999) for the exposure to the international market. Exhibit 2 shows the detailed compostion of the DJIA's 30s as of the end of 2003, along with the industry in which the 30 MNcs are.

Exhibit 3 shows the 30 MNCs in EHH (1999), the 30 of the largest U.S. multinational corporations as ranked by 1976 sales report by Fortune magazine.

Exhibit 2: Components of DJIA

DJIA'30 MNCs as of 2003			
M1	3M (materials, electronics)	M16	Home Depot (retail)
M2	Alcoa (aluminum)	M17	Honeywell International (electronics)
M3	**Altria Group (formerly Philip Morris) (tobacco)**	M18	Intel Corp. (microprocessors)
M4	American Express (financial services)	M19	**International Business Machines**
M5	AT&T (telecommunications)	M20	J.P. Morgan Chase and Co (finance)
M6	**Boeing (aviation and aerospace)**	M21	International Paper (paper, packaging)
M7	**Caterpillar Inc (heavy equipment)**	M22	Johnson &Johnson Corp.(pharmaceuticals)
M8	Citigroup (financial services)	M23	McDonald's Corp.(fast food franchise)
M9	Coca-Cola Co. (beverages)	M24	Merck &Company (pharmaceuticals)
M10	**Du Pont (chemicals)**	M25	Microsoft Corp. (software)
M11	**Eastman Kodak (photographic equipment)**	M26	**Procter &Gamble (household supplies)**
M12	**Exxon Mobil Corp. (petroleum)**	M27	SBC Communications (telecom)
M13	**General Electric (electronics, finance)**	M28	United Technologies (aerospace, defense)
M14	**General Motors (automobiles)**	M29	Wal-Mart Stores Inc. (retail)
M15	Hewlett-Packard (computer hardware, printers)	M30	Walt Disney Company (entertainment)

Source: http://www.djindexes.com/jsp/avgFaq.jsp

Exhibit 3: 30 MNCs of EHH (1999)

The 30 of the largest U.S. multinational corporations as ranked by 1976 sales report by Fortune magazine. The in bolded are still in DJIA as of 2003.			
M1	Amerada	M16	Grace W R and Co.
M2	Ashland Oil Inc	M17	**International Business Machines**
M3	Atlantic Richfield Co.	M18	Mobil Corp.
M4	Bethlehem Steel Co.	M19	Monsanto Co. Tr
M5	**Boeing Co.**	M20	Occidental Petroleum Co.
M6	**Caterpillar**	M21	**Phillips Petroleum Corp.**
M7	Chrysler Co.	M22	**Procter and Gamble Co.**
M8	Dow Chemical Co.	M23	Rockwell International Corp.
M9	**Du Pont E 1 De Nemours Co.**	M24	Sun Inc.
M10	**Eastman Kodak Co.**	M25	Tenneco Inc.
M11	**Exxon Corp.**	M26	Texaco Inc.
M12	Ford Motor Co.	M27	Union Carbide Corp.
M13	**General Electric Co.**	M28	United Technologies
M14	**General Motors Corp.**	M29	Westinghouse Electric Corp
M15	Goodyear Tire and Rubber Co.	M30	Xerox Corp

IV.
METHOD

I use monthly return data (192 observations) from 1988 to 2003 for the S&P 500, Lehman Brothers U.S. Aggregate Bond Index, MSCI ACWorld ex U.S. Index, and the DJIA Index. Exhibit 4 shows the return correlations, mean-variance characteristics, skewness and kurtosis, and Sharpe ratio results. In contrast, EHH (1999) used different index databases and asset classes such as the three U.S. indices, 12 U.S. value-weighted industry portfolios, and a sample of 30 multinational corporations (MNCs), and ADRs listed on the New York Stock Exchange as the eligible set.

For the purpose of facilitating the mean-variance efficient optimization process, this study utilized the Quadratic Optimization System-version 15 optimizer, by Financiometrics Inc.

I perform mean-variance optimization using mean, variance, and covariance values obtained from the monthly returns of the S&P 500, Lehman Brothers U.S. Aggregate Bond Index, MSCI ACWorld ex U.S. Index, and DJAI Index. Exhibits 5 & 6 show the correlations between the underlying assets. Then, I use the QOS-15 Quadratic Optimization System that constructs portfolios on the Markowitz mean-variance efficient frontier. QOS-15 is set up for constructing optimal portfolios where risk and reward are measured in terms of total return, as well as for constructing optimal portfolios where risk and reward are measured in terms of active return relative to a benchmark.

To compare case 1 with case 2, I use a given risk tolerance starting at 0.01 and ending at 1. The number of frontier points is 10, but in case 1 the asset allocation does not change after the ninth point; in case 2 the asset allocation does not change after the seventh point. The asset weights have to total 100 percent and no borrowing or lending is allowed. Lower and upper bounds on the asset weights are set as 0 and 1, respectively. No other constraints, transaction costs, or starting asset weights were implied.

The optimization is first done with case 1, the international diversification portfolio including S&P 500 Index, Lehman Brothers U.S. Aggregate Bond Index, and MSCI ACWorld ex U.S. Index. And the optimization is then repeated with case 2, the homemade mimicking diversification portfolio using the DJIA Index to substitute the MSCI ACWorld ex U.S. Index.

After I run the optimizations, the program displays the Efficient Frontier Charts (see Graph 1) and Optimal weights table (see Exhibits 7 & 8), which reports the investment weights of assets in the optimal portfolios at the points on the efficient frontier. In addition, given risk tolerance, optimize portfolio, the QOS-15 reports the Sharpe performance measure, which provides a "risk-adjusted" performance. It represents the excess return (above and beyond the risk-free interest rate) per standard deviation risk. Its formula is:

$$\text{Sharpe Ratio} = (\check{R}_i - R_f)/\sigma_i$$

where $\check{R}_i$ and σ_i are, respectively, the mean and standard deviation of returns, and R_f is the risk-free interest rate.

From the above resulting report, we can see very clearly which case performs better than the other one (see Graph1), i.e., whether EHH's finding can be confirmed or not. I further computed the other two statistics (skewness and kurtosis) using data analysis software under Excel. Skewness is a statistic that provides useful information about the symmetry of a probability distribution. Skewness is equal to zero for all symmetric distribution including the normal. Kurtosis provides a measure of the "thickness" of the tails of a distribution. For a normal distribution kurtosis is equal to 3.

After the above original optimization process using raw data, I further expand my research to examine the results of the optimizations when the returns have been adjusted in a way similar to "reverse optimization" methodology of Sharpe (2002). I make two adjustments to the monthly-expected return in order to study more clearly the effect of international correlation structure. The first correction I have done is a simple approximation of Sharpe's approach. The second correction I have done is much closer to Sharpe' approach. More detailed discussion of the two corrections is in part V- Empirical Results. Then, I optimized based on the adjusted expected return.

V.
EMPIRICAL RESULTS

Exhibit 4 provides summary statistics of the monthly returns, in U.S. dollars, for the underlying four indices during the period 1988-2003. The statistics include the mean, standard deviation, skewness and kurtosis. The mean return per month ranges from 0.411% for MSCI ACWorld ex U.S. Index to 0.9737% for DJIA Index, whereas the standard deviation ranges from 1.1749% for Lehman Brothers U.S. Aggregate Bond Index to 4.8474% for MSCI ACWorld ex U.S. Index. Lastly, Exhibit 4 presents the DJIA Index has the least negative skewness and largest positive kurtosis comparing with the rest three of indices, in particular comparing with World Index ex U.S.

Exhibit 4: Summary Statistics

Summary statistics of the monthly returns, in U.S. dollars, for the underlying four indices during the period 1988-2003.

	Mean	Std. deviation	Skew	Kurtosis
Standard & Poors 500 Index	0.008754	0.042144	-0.45314	0.575342
Lehman Bros. U.S. Agg. Bond Index	0.006766	0.011749	-0.26805	0.245021
MSCI ACWorld ex U.S. Index	0.004110	0.048474	-0.21337	0.32129
DJIA Index	0.009737	0.042909	-0.509668	0.889904

Exhibits 5 & 6 provide the correlation structure for the four assets in two cases I constructed, respectively. The correlation of the S&P 500 with the MSCI World ex U.S. and the DJAI' 30s varies from 0.650394 to 0.9330495. The correlation of the Lehman Agg. with the MSCI World ex US and the DJIA' s 30s varies from -0.00404% to –0.0067597%. In other words, DJAI Index is more correlated with S&P 500, and less correlated with U.S. Bond Index than the World ex US Index.

Exhibit 5: Correlation Matrix for Case 1

Case 1: Correlations for S&P500 Index, Lehman Bro. U.S. Aggregate Bond Index, and MSCI ACWorld ex U.S. Index portfolios, along with their respective Variance-Covariance in parentheses. The bolded figure is the correlation between MSCI ACwolrd ex US Index and DJIA Index			
	S&P500 Index	Lehman Bro. U.S. Aggregate Bond Index	MSCI ACWorld ex US Index
S&P500 Index	1 (0.001776076)		
Lehman Bro. U.S. Aggregate Bond Index	0.20129148 (9.91466E-05)	1 (0.000138032)	
MSCI ACWorld ex US Index	0.650394 (0.001322)	0.071311 (4.04009E-05)	1 (0.002349777)
DJIA Index			**0.64752**

Exhibit 6: Correlation Matrix for Case 2

Case 2: Correlation matrix for S&P500 Index, Lehman Bro. U.S. Aggregate Bond Index, and DJIA Index portfolios, along with their respective Variance-Covariance in parentheses. The bolded figure is the correlation between MSCI ACWolrd ex US Index and DJIA Index			
	S&P500 Index	Lehman Bro. U.S. Aggregate Bond Index	DJIA Index
S&P500 Index	1 (0.001776076)		
Lehman Bro. U.S. Aggregate Bond Index	0.20129148 (9.91466E-05)	1 (0.000138032)	
DJIA Index	0.93304945 (0.00167848)	0.134789914 (6.7597E-05)	1 (0.001841)
MSCI World Index			**0.64752**

More interestingly notice that the correlation between the MSCI ACWorld and DJIA is 0.64752, which is about 44% lower than that between S&P 500 and DJIA (0.93304945), and quite close to the correlation between S&P 500 and MSCI ACWorld (0.650394) - roughly 0.44% lower.

My first optimization is done with the case 1-the international diversification portfolio. Using the historical performance data-mean and correlation structure represented in exhibit 5, I solve for the composition of the optimal international portfolio from the perspective of U.S. investors.

Exhibit 7 illustrates the choice of the optimal international portfolio. Surprisingly, we see that moving upwards along the efficient frontier, on the one hand, results in the S&P 500 component becoming larger and the mean return and standard deviation both rising; on the other hand, the weights on the asset of MSCI ACWorld remain zero except for the first point, on which it has a 1.8775% small weight. In other words, this optimal portfolio excludes the asset of foreign indices. This could imply that investors may not be able to gain from international diversification with trading abroad. Meanwhile, the negative skewness of this portfolio becomes to be smaller, and the positive kurtosis becomes to be bigger. Lastly, exhibit 7 presents the Sharpe performance measure computed over our sample period, 1988-2003, ranges from 0.047351 for point 9 to 1.163385 for point 1. Through the Sharpe ratio, we can see clearly that with increasing risk tolerance, the Sharpe performance goes down about 96% from efficient point 1 to point 9.

Exhibit 7: Optimization Report for Case 1

The optimization system constructs portfolios on the Markowitz mean-variance efficient frontier. For the objective function, I use a given risk tolerance starting at 0.01 and ending at 1. The number of frontier points is 10, but in all cases the asset allocation does not change after the ninth frontier point. The asset weights have to total 100 percent and no borrowing or lending is allowed, and no short sales allowed either. No other constraints, transaction costs, or starting asset weights are used.

S&P 500(%)	LB.Agg. Bond(%)	MSCI ACW ex US (%)	Return	Std. dev.	Skew	Kurtosis	Sharpe Ratio
1.9995	96.1448	1.856	0.006757	0.011634	-0.268823	0.23171	1.16339
16.1725	83.8275	0	0.007088	0.013051	-0.07647	0.09356	0.10876
28.9173	71.0827	0	0.007341	0.016093	-0.10067	0.09639	0.06997
41.6621	58.3379	0	0.007594	0.020085	-0.20158	0.09849	0.05907
54.4070	45.5930	0	0.007848	0.024568	-0.29176	0.13967	0.05460
67.1518	32.8482	0	0.008101	0.029317	-0.35774	0.29607	0.05235
79.8966	20.1034	0	0.008354	0.034222	-0.4045	0.42472	0.05108
92.6415	7.3585	0	0.008608	0.039224	-0.43804	0.52661	0.05029
100	0	0	0.008754	0.042143	-0.45314	0.57534	0.04735

My second optimization is done with case 2-the homemade mimicking diversification portfolio. Similarly, using the historical performance data-mean and correlation structure represented in Exhibit 6. I solve for the composition of the optimal international portfolio from the perspective of U.S. investors. Exhibit 8 illustrates the choice of the optimal international portfolio. Interestingly, we see that there is no weight on the S&P 500 asset along the efficient frontier. Going up along the efficient frontier, on the one hand, results in the DJIA weights becoming larger and the mean return and standard deviation both rising; on the other hand, the weights on the MSCI World ex US component become zero. Meanwhile, the skewness and kurtosis in case 2 comes closer to zero and larger positive value, respectively. The Sharpe performance measure computed over our sample period, 1988-2003, ranges from 0.064040 for point 7 to 1.165419 for point 1

Exhibit 8: Optimization Report for Case 2

The optimization system constructs portfolios on the Markowitz mean-variance efficient frontier. For the objective function, I use a given risk tolerance starting at 0.01 and ending at 1. The number of frontier points is 10, but in all cases the asset allocation does not change after the 7th frontier point. The asset weights have to total 100 percent and no borrowing or lending is allowed, and no short sales allowed either. No other constraints, transaction costs, or starting asset weights are used.

S&P 500 (%)	LB Agg. Bond (%)	DJIA Index (%)	Return	Std. dev.	Skew	Kurtosis	Sharpe Ratio
0	94.5688	5.4312	0.006927	0.011654	-0.22566	0.260768	1.165419
0	76.8456	23.1544	0.007454	0.014293	-0.176585	0.179378	0.119104
0	59.1225	40.8776	0.007981	0.019712	-0.31666	0.110186	0.085706
0	41.3993	58.6007	0.008507	0.026243	-0.417635	0.445284	0.077187
0	23.6761	76.3239	0.009034	0.033237	-0.47243	0.687912	0.073860
0	5.95296	94.0471	0.009560	0.040454	-0.502693	0.848740	0.072240
0	0	100	0.009737	0.042907	-0.509668	0.889904	0.064040

Having obtained optimal portfolios for cases 1 & 2, we now evaluate the gains from holding case1-international diversification portfolio over case2-homemade mimicking diversification portfolio. We measure the gains from holding diversification portfolios in two different ways: (1) the increase in the Sharpe performance measure, and (2) the percentage increase in the Sharpe performance measure relative to that of international portfolio. The increase in the Sharpe performance measure, ΔSHP, is given by the difference in the Sharpe ratio between the optimal international portfolio (OIP) and optimal homemade portfolio (OHP), that is,

$$\Delta SHP = SHP\ (OIP) - SHP\ (OHP)$$

ΔSHP represents the extra return per standard deviation risk accruing from homemade investment. The percentage increase in the Sharpe performance measure relative to that of the international portfolio is Δ%. It can be computed by ΔSHP by [ΔSHP/SHP (case1)]*100.

Graph 1: Comparison of the Original Optimal Portfolios

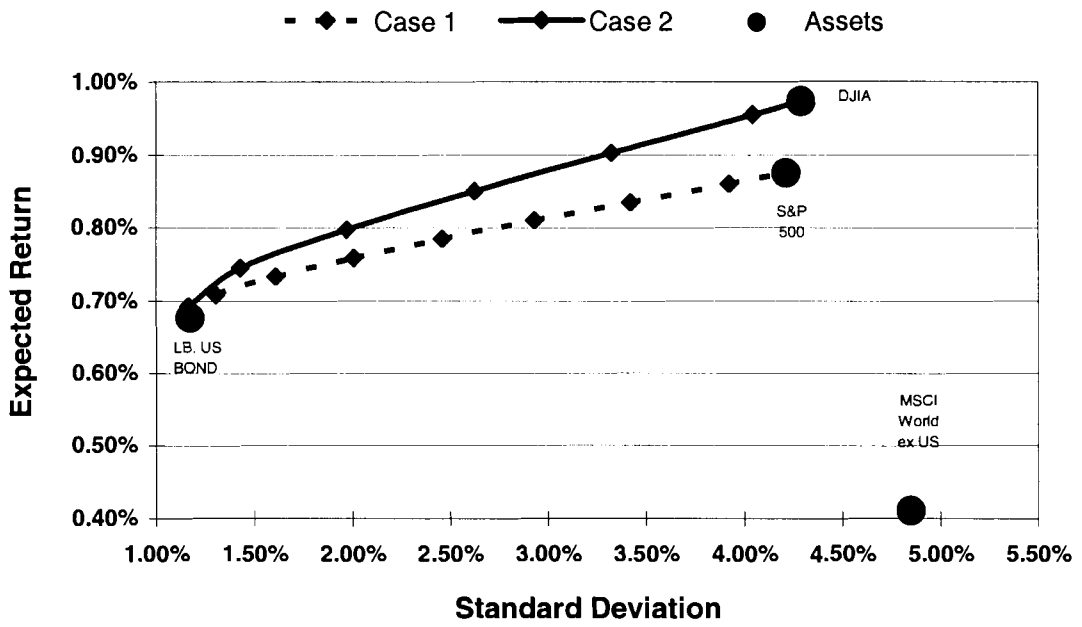


Exhibit 9 presents both the measures of the gains from homemade investment from the perspective of seven efficient frontier points. As a result, the Sharpe performance measure increases from 0.052352 to 0.072240, a 37.9% increase, at the standard deviation of 4.0454 %.

Graph 1 also illustrates the comparison of case 1 and case 2. Using DJIA'30s to substitute for the international index (MSCI ACWorld ex U.S), the case 2 pushes the efficient frontier much higher than that in case1-the international investment. The results strongly suggest that investors can mimic foreign indices by holding domestically traded assets; investing in assets that only trade abroad is no longer necessary to gain the benefits of international diversification. That is, the statement in EHH (1999) appears to be confirmed.

Exhibit 9: Gains from Case1 Comparing with Case 2

Gains from Homemade Diversification Portfolios for different efficient frontier points.								
Efficient Frontier Points	Case 1 Int'l Diversification Portfolio			Case 2 Homemade Diversification			Gains from Case 2	
	Mean	Std, dev.	SHP	Mean	Std. dev.	SHP	ΔSHP	(Δ%)[a]
1	0.006757	0.011634	1.163385	0.006927	0.011654	1.165419	0.002034	0.1748
2	0.007088	0.013051	0.108755	0.007454	0.014293	0.119104	0.010349	9.5159
3	0.007341	0.016093	0.069971	0.007981	0.019712	0.085706	0.015735	22.4879
4	0.007594	0.020085	0.059074	0.008507	0.026243	0.077187	0.018113	30.6615
5	0.007848	0.024568	0.054595	0.009034	0.033237	0.073860	0.019265	35.2871
6	0.008101	0.029317	0.052352	0.009560	0.040454	0.072240	0.019888	37.9890
7	0.008354	0.034222	0.051077	0.009737	0.042907	0.064040	0.012963	25.3793

An interesting observation from Exhibits 7 & 8 is that the weights of DJIA are very large, in contrast, the weights on MSCI ACWorld are very small and even zero after the first efficient point; in addition, the weights on S&P 500 in Case 2 are all zero. These extreme portfolio weights indicate that the asset with much higher expected return like the DJIA Index dominates the optimization. Meanwhile, such return dominance to some extent clouds the effect of correlations which are far more relevant to my study. Looking at the input and Graph 1, obviously that this extreme position incurs when DJIA plots above the US efficient frontier line. Hence, the original optimization results do not properly take into account the ability of U.S. investors to gain international lower correlation benefits through international diversification portfolio.

In order to let the correlations speak more clearly, I use two corrections, which are similar in spirit to Sharpe's discussion in his paper "Budgeting and Monitoring Pension Fund Risk (2002)". To make inputs consistent with other parameters, Sharpe calls this correction process "reverse optimization."

The first correction approach I used is simply to set the returns of MSCI World and DJIA equal to S&P 500.

Graph 2 shows the opposite optimal results to the original one. The Case1-international diversification portfolio performs slightly better than the Case 2 after adjusting the returns of MSCI World and DJAI. In other words, investing MSCI World ex US (foreign indices) reduces the volatility of U.S. market portfolios, with gains attributed to low return correlations between national equity indices. Here, the correlation between MSCI World and S&P 500 is 0.65; while between DJAI and S&P is 0.933.

Graph 2: Comparison of the First Corrected Optimal Portfolio

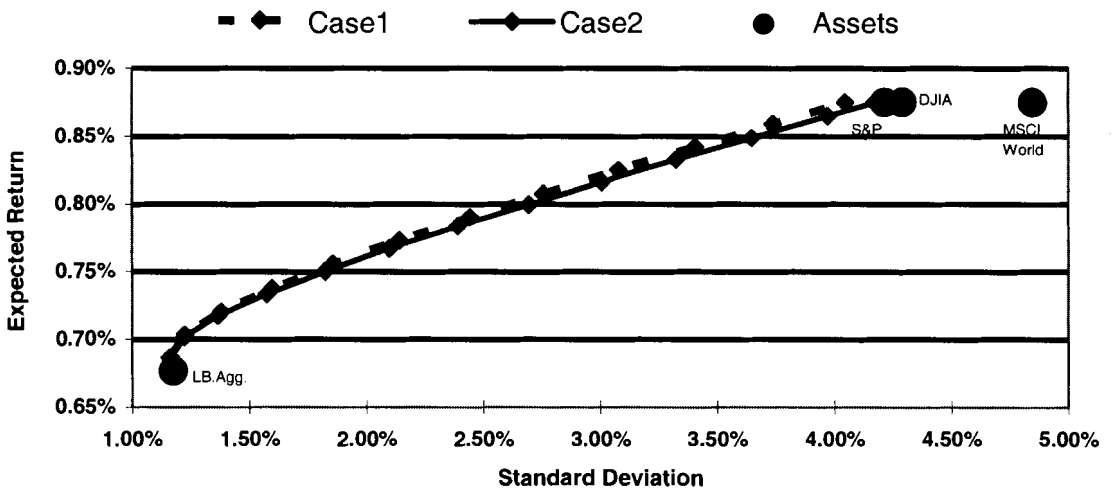


Exhibit 10 shows the weights of the optimal international portfolio. Interestingly, we see that there is increasing weight on the MSCI World and S&P 500 assets along the efficient frontier; on the contrary, the weight on DJIA is decreasing after the return adjustment. Going up along the efficient frontier, other than the first point portfolio, the

rest of portfolios in Case 1- international diversification portfolio gain more than those in Case 2- the homemade diversification portfolios with DJIA Index.

Exhibit 10: Optimal Report after the First Correction

I used a given risk tolerance starting at 0.01 and ending at 1. The number of frontier points is 15, but in case 1 the asset allocation does not change after the 12th frontier point; in case 2 the asset allocation doesn't change after the 13th point. The asset weights have to total 100 percent and no borrowing or lending is allowed, and no short sales allowed either. No other constraints, transaction costs, or starting asset weights are used.

Case 1				Case 2			
S&P 500 (%)	LB. Agg. Bond (%)	MSCI ACW ex US (%)	Sharpe Ratio	S&P 500 (%)	LB. Agg. Bond (%)	DJIA Index (%)	Sharpe Ratio
0	95.1180	4.8820	1.1586	0	95.1018	4.8982	1.1643
5.8296	86.6466	7.5238	0.1517	0	87.4775	12.5225	0.1514
12.2300	77.9176	9.8524	0.0911	3.1496	79.5217	17.3287	0.0901
18.6303	69.1886	12.1811	0.0719	9.3228	71.2476	19.4296	0.0709
25.0306	60.4596	14.5098	0.0634	15.4960	62.9735	21.5305	0.0623
31.4309	51.7306	16.8385	0.0589	21.6992	54.6995	23.6313	0.0577
37.8313	43.0016	19.1671	0.0563	27.8423	46.4254	25.7323	0.0551
44.2316	34.2726	21.4958	0.0546	34.0155	38.1514	27.8331	0.0534
50.6319	25.5436	23.8245	0.0535	40.1887	29.8773	29.9440	0.0522
57.0322	16.8146	26.1532	0.0527	46.3619	21.6032	32.0349	0.0514
63.4325	8.0856	28.4819	0.0521	52.5351	13.3292	34.1357	0.0508
69.3611	0	30.6389	0.0514	58.7083	5.0551	36.2366	0.0504
				62.4798	0	37.5202	0.0486

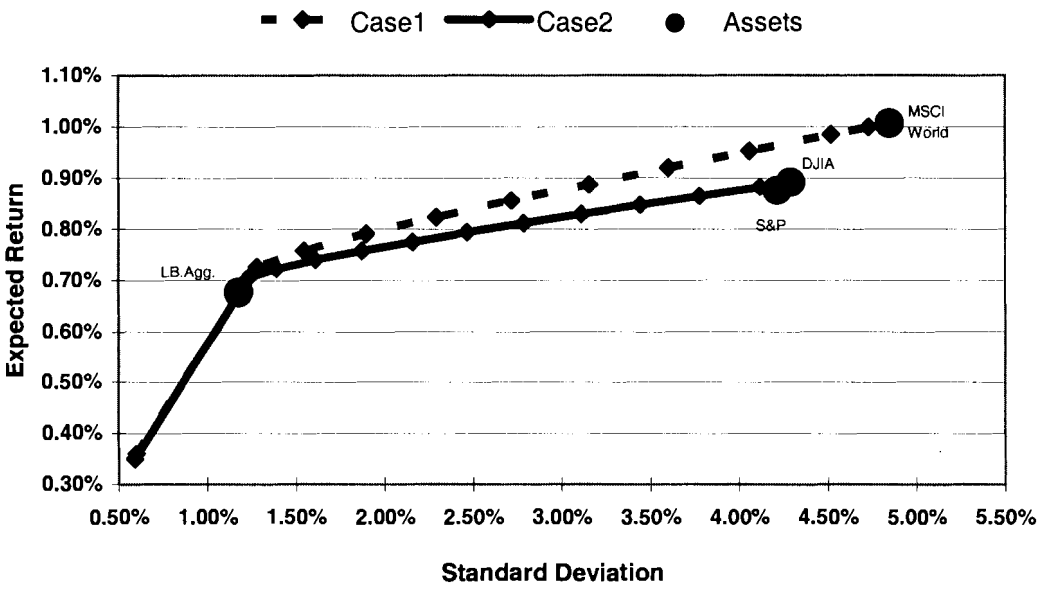
The second correction approach is much closer to Sharpe's "reverse optimization". Rather than simply set the expected return equal to S&P 500, I also take the total risk into account to adjust the expected return (risk-adjusted return) to examine the effect of correlations on the optimization.

The adjustment formula is: $E(R) = Std.dev_{Aseet} * (R_{S\&P}/Std.dev_{S\&P})$.

Therefore, the input for $E(R)_{DJIA} = 0.042909 * (0.008754/0.04214) = 0.008913$;

$$E(R)_{MSCI\ W} = 0.048474 * ((0.008754/0.04214) = 0.010069.$$

Graph 3: Comparison of the Second Corrected Optimal Portfolio



Graph 3 demonstrated that the Case1- international diversification portfolio with MSCI World performs much better than the Case 2 using DJIA as a proxy after inputting the risk-adjusted return. The optimal results from the second correction are all consistent with those from the first simple correction approach, but contradict the results using the raw data. As such, we can say that investing MSCI World ex US (foreign indices) reduces the volatility of U.S. market portfolios, with gains attributed to low return correlations between national equity indices.

Noticeably, Exhibit 11 further illustrates that after the second correction, more and more weight is on the MSCI World Index ranging from 3.4597% to 100%, instead of from 4.8820% to 30.6389 for the first correction, and almost zero weight on the original

optimization using raw data. In addition, another extreme portfolio position- zeros weight on the S&P 500 in case 2 for the original optimization have been improved to average 4% in the adjusted optimization. Sharpe performance measure also indicates that investors can gain more from international diversification only with trading abroad. Using homemade mimicking portfolio, investors can't benefit from international diversification since the correlation between DJIA Index and S&P 500 (0.933) is much higher than that between MSCI ACWorld ex US and S&P 500 (0.65). These results strongly support that investors can reduce portfolio risk by holding securities that are less than perfectly correlated, but they also can get the potential gains from holding optimal international portfolios.

Exhibit 11: Optimal Report after the Second Correction

I used a given risk tolerance starting at 0.01 and ending at 1. The number of frontier points is 15, but in case 1 the asset allocation does not change after the 12th frontier point; in case 2 the asset allocation doesn't change after the 15th point. The asset weights have to total 100 percent and no borrowing or lending is allowed, and no short sales allowed either. No other constraints, transaction costs, or starting asset weights are used.

Case 1				Case 2			
S&P 500 (%)	LB. Agg. Bond (%)	MSCI ACW ex US (%)	Sharpe Ratio	S&P 500 (%)	LB. Agg. Bond (%)	DJIA Index (%)	Sharpe Ratio
0	96.5404	3.4597	0.5997	0	96.9027	3.0973	0.5908
0	84.8680	15.1320	0.1585	0	86.7815	13.2185	0.1526
1.2076	74.6190	24.1734	0.1020	0	78.5473	21.4527	0.0917
2.4628	64.3488	33.1884	0.0853	0	62.0791	37.9209	0.0724
3.7180	54.0785	42.2035	0.0783	0.0899	53.8356	46.0745	0.0639
4.9732	43.8081	51.2187	0.0747	2.0659	45.3935	52.5407	0.0594
6.2284	33.5378	60.2338	0.0726	4.0419	36.9514	59.0067	0.0568
7.4836	23.2675	69.2489	0.0713	6.0179	28.5093	65.4728	0.0551
8.7387	12.9972	78.2641	0.0705	7.9939	20.0672	71.9389	0.0540
9.9939	2.7269	87.2792	0.0699	9.9700	11.6251	78.4049	0.0533
5.7181	0	94.2819	0.0660	11.9460	3.1831	84.8719	0.0527
0	0	100	0.0615	9.9983	0	90.0017	0.0523
				5.6758	0	94.3242	0.0496
				1.3532	0	98.6468	0.0460

VI.
CONCLUSION

This paper reconsiders the results of EHH that the investors are able to mimic returns on foreign market indices with domestically traded securities, so that investing in assets that trade only abroad would not be necessary to obtain the benefits from international diversification. I construct portfolios based on S&P500 Index, Lenman Brothers U.S. Bond index, and DJIA. From 1988 to 2003, the monthly risk-adjusted return of this homemade diversification portfolio using raw data is much higher than that of international diversification portfolio with MSCI ACWorld ex U.S. Index. Based on unadjusted returns data my findings confirmed the statement of EHH, that is, U.S. investors are able to gain international diversification benefits through homemade international diversification.

However, the extreme portfolio weights taken in the original findings would indicate that the asset with the higher expected return like the DJIA Index dominates the optimization. Meanwhile, such return dominance to some extent clouds the effect of correlations which are far more relevant to this study. In order to let correlations speak more clearly or test the role of DJIA's proxy, I use two corrections, which are similar in spirit to Sharpe's discussion in his paper "Budgeting and Monitoring Pension Fund Risk (2002)". To make inputs consistent with other parameters, Sharpe calls this correction process "reverse optimization".

After the two corrections, more and more weights are on the MSCI World Index ranging from 3.4597% to 100%, instead of from 4.8820% to 30.6389 for the first correction, and almost zero weight on the original optimization using raw data. In addition, another extreme situation for S&P 500 in case 2 has been improved a great percentage from zero weight on the original optimization. Sharpe performance measure also indicates that investors can gain more from international diversification only with trading abroad. Using homemade mimicking portfolio, investors can't benefit from international diversification since the correlation between DJIA Index and S&P 500 (0.650) is much higher than that between MSCI ACWorld ex US and S&P 500 (0.933). The Sharpe performance measurement provides strong evidence that investors can reduce portfolio risk by holding securities that are less than perfectly correlated, but they also can get the potential gains from holding optimal international portfolios. On the contrast, 30 MNCs in DJIA Index can't be used as a good proxy to achieve the diversification benefits.

APPENDIX:
LIST OF FOUR UNDERLYING INDICES 1988 - 2003

The table below lists 192 monthly returns used in this research. Standard & Poors' 500(S&P 500) Index gives the investor a point of benchmark for evaluating a fund's performance. The Lehman Brothers U.S. Aggregate Index is an index composed of the Lehman Brothers Government/Credit Bond Index, Mortgage-Backed Securities Index, and Asset-Backed Securities Index. Lehman's U.S. Aggregate Index, thereby covering the U.S. investment-grade quality or better-fixed rate bond market, with components for government and corporate securities, mortgage pass-through and asset-backed securities. MSCI ACWI stands for All Country World Index ex U.S.Index in USD. The MSCI ACWI ex U.S. Index is a free float-adjusted market capitalization index that is designed to measure equity market performance in the global developed and emerging markets. As of December 2003 the MSCI ACWI consisted of the following 49 developed and emerging market country indices. The DJIA's 30s used as a proxy of homemade mimic diversification. The DJIA is an index of 30 "blue-chip" U.S. stocks.

Time	S&P500	US Bond	World ex US	DJIA30
01/1988	0.04039014	0.0352	0.01536	0.010000877
02/1988	0.0418174	0.0119	0.064903089	0.057909734
03/1988	-0.0333433	-0.0094	0.061067643	-0.040335583
04/1988	0.00942485	-0.0054	0.013213747	0.02226794
05/1988	0.00309953	-0.0067	-0.032887436	-0.000595376
06/1988	0.04333562	0.0241	-0.023216096	0.054447792
07/1988	-0.0054479	-0.0053	0.027792955	-0.006060578
08/1988/	-0.0385648	0.0026	-0.065601077	-0.045604656
09/1988	0.03972928	0.0227	0.042101271	0.039997047
10/1988	0.02596447	0.0188	0.080818926	0.01691506
11/1988	-0.0189268	-0.0122	0.054452695	-0.015889047
12/1988	0.01472469	0.0011	0.004982036	0.025566207
01/1989	0.07111479	0.0144	0.018558241	0.080121924

Time	S&P500	US Bond	World ex US	DJIA30
02/1989	-0.0289441	-0.0072	0.003236877	-0.035831996
03/1989	0.02080593	0.0043	-0.018417881	0.015599609
04/1989	0.05008987	0.0209	0.01124699	0.05457748
05/1989	0.03513758	0.0263	-0.052257276	0.025363817
06/1989	-0.0079246	0.0304	-0.020024131	-0.016164345
07/1989	0.08837034	0.0213	0.121857633	0.090407613
08/1989/	0.01551664	-0.0148	-0.042756951	0.028793608
09/1989	-0.0065443	0.0051	0.044815969	-0.016238807
10/1989	-0.0251754	0.0246	-0.037888012	-0.017728626
11/1989	0.01654131	0.0095	0.046793585	0.023133516
12/1989	0.0214168	0.0027	0.036261465	0.017341211
01/1990	-0.0688172	-0.0119	-0.03880223	-0.059080343
02/1990	0.00853896	0.0032	-0.067745561	0.014170791
03/1990	0.02425502	0.0007	-0.1028627	0.030434865
04/1990	-0.0268871	-0.0092	-0.010248233	-0.018635422
05/1990	0.09198912	0.0296	0.109001222	0.082769991
06/1990	-0.0088863	0.0161	-0.009818164	0.00140093
07/1990	-0.0052232	0.0138	0.014374614	0.008508378
08/1990/	-0.0943142	-0.0134	-0.096961867	-0.100110147
09/1990	-0.0511843	0.0083	-0.135149726	-0.061919552
10/1990	-0.0066983	0.0127	0.141433268	-0.004138668
11/1990	0.05993421	0.0215	-0.057460578	0.048036097
12/1990	0.02482776	0.0156	0.016082239	0.028914109
01/1991	0.04151778	0.0124	0.029304552	0.039006554
02/1991	0.06728113	0.0085	0.105512816	0.053278224
03/1991	0.02220285	0.0069	-0.056725132	0.01099168
04/1991	0.00034646	0.0108	0.008937993	-0.00891944
05/1991	0.03857733	0.0058	0.012409369	0.048350514
06/1991	-0.0478927	-0.0005	-0.071225813	-0.039884393
07/1991	0.04485936	0.0139	0.046237102	0.040619248
08/1991/	0.0196488	0.0216	-0.018956753	0.006208634
09/1991	-0.0191437	0.0203	0.049072548	-0.008815219
10/1991	0.01185995	0.0111	0.015789108	0.017346367
11/1991	-0.043928	0.0092	-0.046237983	-0.056830993

Time	S&P500	US Bond	World ex US	DJIA30
12/1991	0.11158787	0.0297	0.050047485	0.094708223
01/1992	-0.0198998	-0.0136	-0.015631399	0.017217711
02/1992	0.00956481	0.0065	-0.032470009	0.01373709
03/1992	-0.0218318	-0.0056	-0.062344341	-0.009854116
04/1992	0.02789269	0.0072	0.001165646	0.038217013
05/1992	0.00096397	0.0189	0.058653433	0.011241039
06/1992	-0.0173589	0.0138	-0.050292524	-0.023068227
07/1992	0.03937374	0.0204	-0.023359784	0.022678785
08/1992/	-0.0239975	0.0101	0.051151218	-0.040200013
09/1992	0.00910562	0.0119	-0.022458716	0.004393142
10/1992	0.00210627	-0.0133	-0.045750769	-0.013870634
11/1992	0.03026178	0.0002	0.003667433	0.024449211
12/1992	0.0101078	0.0159	0.006527879	-0.001225357
01/1993	0.00704597	0.0192	-0.001942719	0.002702121
02/1993	0.01048361	0.0175	0.028804278	0.018362371
03/1993	0.01869728	0.0042	0.080496125	0.019075534
04/1993	-0.0254168	0.007	0.086323237	-0.002200803
05/1993	0.02271746	0.0013	0.020547722	0.029140348
06/1993	0.00075524	0.0181	-0.013568922	-0.00321764
07/1993	-0.0053271	0.0057	0.031627298	0.006652295
08/1993/	0.03443197	0.0175	0.052175276	0.031580999
09/1993	-0.0099879	0.0027	-0.021977858	-0.02632797
10/1993	0.01939294	0.0037	0.034743594	0.035292761
11/1993	-0.0129107	-0.0085	-0.077512018	0.000912897
12/1993	0.01009117	0.0054	0.076507486	0.019039346
01/1994	0.0325008	0.0135	0.08087772	0.059740177
02/1994	-0.0300451	-0.0174	-0.008847433	-0.036784001
03/1994	-0.0457465	-0.0247	-0.047226931	-0.051163616
04/1994	0.01153061	-0.008	0.032391604	0.012577146
05/1994	0.01239715	-0.0001	-0.001167781	0.020827392
06/1994	-0.0267908	-0.0022	0.005599222	-0.035496771
07/1994	0.03148986	0.0199	0.014897149	0.038494218
08/1994/	0.03759874	0.0012	0.032220888	0.039559038
09/1994	-0.0269196	-0.0147	-0.026147418	-0.01794594

Time	S&P500	US Bond	World ex US	DJIA30
10/1994	0.02087791	-0.0009	0.025366597	0.016894819
11/1994	-0.0395046	-0.0022	-0.049672266	-0.043215152
12/1994	0.01229915	0.0069	-0.003769198	0.025462462
01/1995	0.02427766	0.0198	-0.04680174	0.002456682
02/1995	0.03607415	0.0238	-0.007055577	0.043495341
03/1995	0.02732924	0.0061	0.054611614	0.036559006
04/1995	0.0279603	0.014	0.03729498	0.039343963
05/1995	0.03631171	0.0387	-0.006174484	0.033293453
06/1995	0.02127859	0.0073	-0.015559603	0.020371142
07/1995	0.03177604	-0.0022	0.05510992	0.033443076
08/1995/	-0.0003203	0.0121	-0.036225891	-0.020794441
09/1995	0.04009753	0.0097	0.015481258	0.038719808
10/1995	-0.0049794	0.013	-0.028259473	-0.007015961
11/1995	0.04104901	0.015	0.021922288	0.067082608
12/1995	0.01744388	0.014	0.037879716	0.008400844
01/1996	0.03261734	0.0066	0.012272876	0.05436261
02/1996	0.00693374	-0.0174	-0.00154224	0.016740496
03/1996	0.00791656	-0.007	0.016984353	0.018506568
04/1996	0.01343145	-0.0056	0.028538609	-0.003232423
05/1996	0.02285339	-0.002	-0.016659221	0.013305609
06/1996	0.0022567	0.0134	0.003432458	0.002028998
07/1996	-0.045748	0.0027	-0.03485484	-0.022233108
08/1996/	0.01881397	-0.0017	0.004241374	0.015789731
09/1996	0.05417261	0.0174	0.023245253	0.047355779
10/1996	0.02613086	0.0222	-0.011501249	0.025026478
11/1996	0.07337615	0.0171	0.037009005	0.081653503
12/1996	-0.0215054	-0.0093	-0.013100113	-0.011259334
01/1997	0.06131706	0.0031	-0.019798195	0.056576415
02/1997	0.00592755	0.0025	0.016886081	0.009489086
03/1997	-0.042614	-0.0111	-0.003835465	-0.042784403
04/1997	0.05840554	0.015	0.006576954	0.06463299
05/1997	0.05857688	0.0095	0.060009782	0.045948132
06/1997	0.04345263	0.0119	0.053589598	0.046616851
07/1997	0.07812324	0.027	0.018786882	0.071658419

Time	S&P500	US Bond	World ex US	DJIA30
08/1997/	-0.0574459	-0.0085	-0.080000441	-0.072992639
09/1997	0.05315352	0.0148	0.05257199	0.042354003
10/1997	-0.0344777	0.0145	-0.086489594	-0.063330841
11/1997	0.04458682	0.0046	-0.013924193	0.051202083
12/1997	0.01573163	0.0101	0.00988141	0.010880555
01/1998	0.01015014	0.0128	0.028509581	-0.000221288
02/1998	0.07044926	-0.0008	0.065323179	0.080847404
03/1998	0.04994568	0.0034	0.032911378	0.029733013
04/1998	0.00907647	0.0052	0.005655027	0.029950647
05/1998	-0.0188262	0.0095	-0.019766496	-0.018030821
06/1998	0.03943822	0.0085	-0.005198286	0.005850595
07/1998	-0.0116154	0.0021	0.007931184	-0.007677597
08/1998/	-0.1457967	0.0163	-0.142588698	-0.151320063
09/1998	0.06239554	0.0234	-0.022861876	0.040263587
10/1998	0.0802942	-0.0053	0.103092646	0.095565003
11/1998	0.05912603	0.0057	0.052259896	0.061038629
12/1998	0.05637531	0.003	0.032814414	0.007116727
01/1999	0.04100941	0.0071	-0.002422143	0.019321609
02/1999	-0.0322825	-0.0175	-0.023749986	-0.005582963
03/1999	0.03879418	0.0055	0.046700171	0.051531282
04/1999	0.03794398	0.0032	0.048571319	0.10247942
05/1999	-0.0249704	-0.0088	-0.048556232	-0.021253049
06/1999	0.05443833	-0.0032	0.04450236	0.038927095
07/1999	-0.0320461	-0.0042	0.022047492	-0.028771831
08/1999/	-0.0062541	-0.0005	0.00215924	0.016342332
09/1999	-0.0285517	0.0116	0.005404382	-0.045462856
10/1999	0.06253947	0.0037	0.035932259	0.038010245
11/1999	0.01906187	-0.0001	0.038793781	0.013788624
12/1999	0.05784392	-0.0048	0.094159607	0.056933335
01/2000	-0.0509035	-0.0033	-0.055444355	-0.048411254
02/2000	-0.0201081	0.0121	0.025919044	-0.074239548
03/2000	0.0967199	0.0132	0.036404031	0.078355619
04/2000	-0.0307958	-0.0029	-0.056979652	-0.017214006
05/2000	-0.021915	-0.0005	-0.026908716	-0.019711363

Time	S&P500	US Bond	World ex US	DJIA30
06/2000	0.02393355	0.0208	0.04105001	-0.007074479
07/2000	-0.0163413	0.0091	-0.040620917	0.007091384
08/2000/	0.06069904	0.0145	0.01116408	0.065873533
09/2000	-0.0534829	0.0063	-0.05663471	-0.050305392
10/2000	-0.0049495	0.0066	-0.032900211	0.030065008
11/2000	-0.0800686	0.0164	-0.046029621	-0.050737663
12/2000	0.00405339	0.0186	0.032816369	0.035863494
01/2001	0.03463659	0.0163	0.01453559	0.009211169
02/2001	-0.0922907	0.0087	-0.07995905	-0.036012403
03/2001	-0.0642047	0.005	-0.073705014	-0.058740691
04/2001	0.07681436	-0.0042	0.065357837	0.086669609
05/2001	0.0050902	0.006	-0.031156563	0.016485374
06/2001	-0.0250036	0.0038	-0.040229985	-0.037531365
07/2001	-0.0107724	0.0224	-0.022979144	0.001943365
08/2001/	-0.0641084	0.0115	-0.026748997	-0.054458838
09/2001	-0.0817234	0.0116	-0.107665368	-0.110775648
10/2001	0.01735931	0.0209	0.027721688	0.025722346
11/2001	0.07595773	-0.0138	0.044850464	0.085554603
12/2001	0.00757383	-0.0064	0.012500828	0.017257165
01/2002	-0.0155738	0.0081	-0.043415425	-0.010135139
02/2002	-0.0207662	0.0097	0.005906521	0.018763105
03/2002	0.03673886	-0.0166	0.050862087	0.029468253
04/2002	-0.0616617	0.0194	0.003828568	-0.043994871
05/2002	-0.0088237	0.0085	0.006887043	-0.002108339
06/2002	-0.0724647	0.0087	-0.045115428	-0.068712627
07/2002	-0.078995	0.0121	-0.098400531	-0.054815076
08/2002	0.00488142	0.0169	-0.002437719	-0.008365964
09/2002	-0.1100134	0.0162	-0.107648409	-0.123687886
10/2002	0.08644777	-0.0046	0.052832394	0.106046816
11/2002	0.0570577	-0.0003	0.04678715	0.059432919
12/2002	-0.0603326	0.0207	-0.033021977	-0.062326258
01/2003	-0.0274147	0.0009	-0.035794867	-0.034504048
02/2003	-0.0170036	0.0138	-0.0223766	-0.020205344
03/2003	0.00835761	-0.0008	-0.02415206	0.012805598

Time	S&P500	US Bond	World ex US	DJIA30
04/2003	0.08104412	0.0083	0.091291573	0.061055063
05/2003	0.05089866	0.0186	0.059063168	0.043651659
06/2003	0.01133262	-0.002	0.024885411	0.015274128
07/2003	0.01621328	-0.0336	0.025316547	0.027640271
08/2003/	0.01787319	0.0066	0.027159888	0.019712361
09/2003	-0.0119443	0.0265	0.026161818	-0.014949309
10/2003	0.0549615	-0.0093	0.064003194	0.056717692
11/2003	0.00712851	0.0024	0.020171956	-0.001903864
12/2003	0.05076545	0.0102	0.075745782	0.068639177

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