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MEAN-VARIANCE PORTFOLIO OPTIMIZATION:  
A GLOBAL EQUITY APPROACH FOR THE AMERICAN INVESTOR

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## **ABSTRACT**

Investing in international equity has become a popular and effective way to achieve portfolio diversification, yet the average American investor still does not take full advantage of the diversification power that international equity offers. I use Markowitz modern portfolio theory to construct a mean-variance portfolio optimization model to quantify the diversification benefits of adding international equity to a domestic stock portfolio. I find that combining international equity with United States equity results in more efficient portfolios than investing in the United States equity market alone. The diversification benefit is most pronounced when adding emerging market equity to United States equity.

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# **I. Introduction**

## ***Thesis Question***

This study seeks to quantify the benefits of diversification to a portfolio of domestic equities by adding regional and country-based equity index funds to the domestic stock portfolio. In my study I construct efficient portfolios using regional and country indices to determine the benefit from adding international equity to a domestic stock portfolio. I consider scenarios where short selling is restricted and where a fixed percentage of the portfolio is invested in United States equities. I also offer insight into existing research in three popular areas relating to international equity investing. This paper is organized as following: Section 1 introduces my study and findings. Section 2 examines existing research on the home-country bias, changes in stock market correlations over time, international equity portfolio strategies, and the impact of currency fluctuations on returns. Section 3 presents my study in full, including my data, methodology, statistics, and results. Finally, in section 4 I briefly describe how my study could be expanded and other future research opportunities related to my study.

## ***Motivation for Study***

Research indicates that the majority of American investors hold a tiny fraction of their equity portfolio in international equities. Some estimates indicate that as much as ninety percent of assets in an American's portfolio are invested domestically (Woolley, 2009). This phenomenon is commonly referred to as home-country bias, and is typical of investors not just in the United States, but worldwide. The home-country bias is pervasive in countries with small domestic markets, such as Greece and Sweden (Zweig, 2006).

A home-country bias can be detrimental to investors for several reasons. Investors who exhibit a home-country bias forego the opportunity to diversify away idiosyncratic risk in their stock portfolio. These investors are not exposed to a substantial part of the world's equity market, especially if their domestic market is small. Investors who exhibit home-country biases also incur significant losses when there is a shock specific to their domestic equity market. Bearing the full brunt of the shock can be avoided by diversifying across geographical borders.

Adding international equity to a stock portfolio was once a tedious and expensive process, which in today's world can be accomplished with a click of a button. Liberalization of capital markets and rapid advances in technology have played pivotal roles in this marked change in equity investing. Markets as a whole have become more open in that more people worldwide have access to them. Investors are also able to invest in more markets than ever before. The easing of political tensions throughout the world has led to the integration of numerous previously inaccessible markets. Political and economic integration in Europe has tightly linked the markets of Western Europe through the adoption of the Euro currency. American investors now have the ability to invest through a variety of means in countries such as Brazil, China, India, and Russia. This was not possible several decades earlier. For example, prior to economic reform in 1992, it

was not possible for foreign investors to invest in India, or for Indian companies to hold stock offerings in international equity markets.

Technology has also played an important role in the integration of markets worldwide. The advent of the internet has enabled increased flow of information available to the average investor. The widespread use of online brokerage accounts has enabled investment in foreign owned assets and asset classes once reserved only for large institutional investors and Wall Street traders. Coupled with the enormous popularity of low cost ETFs (exchange traded funds), it is now possible to diversify a portfolio into low cost and highly traded funds that grant the investor exposure to a vast spectrum of assets. Investors can easily invest in ETFs and gain exposure to different countries, industries, sub-industries, commodities, bonds, and government securities. It is even possible to be long an ETF that takes only leveraged short positions.

The opening of capital markets has had a pronounced effect on the availability of non-domestic equities. It has long been possible for American investors to invest foreign securities through conventional means such as American Depositary Receipts and globally oriented mutual funds. The widespread adoption of ETFs, which unlike mutual funds are exchange traded like regular stocks, not subject to minimum investments, and designed to track specific indices versus outperforming them (as many mutual funds attempt to do) has created four distinct ways to globalize an otherwise domestic equity portfolio. The first method is through investing in regional and country funds that give exposure to a certain geographic area such as Asia or the Euro-zone. The second is through funds that offer exposure to an assortment of foreign companies based on fundamental factors such as global value funds, growth funds, dividend funds, and small cap funds. Thirdly, ETFs are offered with increasing frequency at a global industry level and even at an industry level within certain foreign countries. Finally, investors can also invest in GDP weighted funds, as opposed to the traditional market cap weighted fund.

Despite all of the advances enabling American investors to add international equity to their stock portfolios, using international equity to further diversify stock portfolios remains an underutilized investment strategy. In spite of the increase in availability of international funds and the ease of investing in them, American investors still shy away from adding international stocks to their portfolios.

The majority of existing research indicates that adding international stocks to an otherwise domestic stock portfolio can improve portfolio performance. American investors can achieve a greater level of return for less risk by augmenting their stock portfolio with international stocks. The key driver behind better portfolio performance is that international stock returns' are less correlated to the returns of United States stocks. For example, the performance of United States equities have little relation to the performance of European utilities' or Chinese banks' stocks. During a bull market in the United States, many United States equity returns might outpace equities in the rest of the world; however during a recession in the United States, the majority United States equities would likely offer poor returns. International equities not affected by a recession

in the United States thus serve to offset the weak performance of domestic stocks affected by the recession.

International equities with low correlation to the United States offer high portfolio diversification potential. A simple and low cost way to efficiently exploit this diversification potential is through use of ETFs that track regional and country stock markets. Emerging market countries' stock markets tend to be least correlated with the United States stock market, while highly industrialized and developed countries, such as the G7 countries, tend to be the most correlated to the United States.

I find that American investors achieve the highest levels of portfolio diversification when investing in so called "emerging market" countries. I construct efficient portfolios using regional and country indices in combination with the United States index. I do this at three different levels, combining the United States index with the G7 countries, followed by a collection of developed market countries, and finally with emerging market countries. I conduct my study in two different time periods, 1988-2010 and 1993-2010. Investing in emerging market equities alone offers the investor the highest Sharpe ratio; however my model also shows this portfolio construct has high risk, as measured by the standard deviation of returns. The Sharpe ratio measures the amount of excess return achieved by an asset or portfolio per unit of risk.

I then combine emerging market equity with United States equity using predetermined weights for the United States and show that the ensuing portfolio offers better diversification than investing just in the United States. Furthermore, I show that creating efficient portfolios weighted by economic factors such as GDP have the potential to offer significantly more diversification than the traditional market cap weighting approach.

## II. Issues Confronting the International Investor

The use of international equities to diversify a portfolio is a well-researched and documented area of study. In this section I present other researchers' relevant studies and findings to aid the reader in further understanding this topic. This review is meant to further educate the reader in key issues the investor is confronted with when creating international stock portfolios and key findings that will guide investors in their decisions.

This section examines four widely explored areas of research. The first section further discusses research on the home-country bias. Next, I take a look at the importance of stocks' correlations in creating a well-diversified portfolio. I offer a comparison between different portfolio strategies as they relate to investing in international equity and conclude by briefly addressing the impact of foreign currency fluctuations on an international stock portfolio.

### *Home-Country Bias*

Regardless of what portfolio theory or security analysis is used, the overwhelming majority of studies acknowledge the benefits of international stock portfolio diversification. Literature ranging from academic studies to articles in widely read publications has examined the home-country bias, with little success in explaining this tendency. Home-country bias exists in almost all equity markets, small and large.

To what extent does the home-country bias exist in the United States? An easy and unbiased way to measure the size of global equity markets is their share of global market capitalization. A significant holding in domestic equity in excess of the equity's share of global market capitalization is a simple way measure home-country bias.

A study done by Kai Li (2004), *Confidence in the Familiar: An International Perspective*, states that in 1990, the domestic ownership of the United States equities is as high as 92.2% The United States' equity market capitalization is far from this figure. Rather, "Stocks traded outside the United States are worth \$14 trillion, or 59% of total value of global shares. Yet the average American has only 11% of his stock holdings abroad" (Woolley, 2009).

American equity investors have a large variety of domestic stocks to choose from. The wide variety of stocks available to American investors and the low risk profile of the United States (the United States stock market historically has the lowest risk of all the countries in this study) make investing in the United States a highly lucrative option. Yet investors from countries with much smaller equity markets (as measured by their share of global market capitalization) exhibit strikingly similar behavior to United States investors. A 2007 *Money Magazine* article illustrates this point: "Greeks, whose stock market accounts for 1% of the world's capitalization, keep 75% of their money at home" (Zweig, 2007, p. 66). I.e. 75% of Greek investors' equity allocations are in Greek stocks.



A great deal of academic literature also strives to explain and clarify the rationale behind the home-country bias. *Going Global: The Changing Pattern of U.S. Investment Abroad* (Aurelio, 2006) examines in detail the change in U.S. investors' home-country bias. Overall, the study notes that while the home-country bias still persists, it has declined during the last decade (1995-2005). The value of foreign investments made by the U.S. increased from 40% of GDP in 1990 to 89% in 2005. Aurelio shows that while a substantial portion of the increase in foreign investment is attributable to the appreciation in stock values and depreciation of the dollar relative to other currencies, the valuation adjusted value of foreign investments still rose from 40% of GDP in 1990 to over 60% in 2005.

United States investors are not investing uniformly across the world; rather U.S. investors prefer to invest in certain regions and countries. One area where the home-country bias has shrunk is in major industrial countries. These include countries in Western Europe such as France and Germany, as well as major Asian economies such as Japan. Americans also have reduced their bias against emerging market countries in Asia. Yet according to Aurelio's study (2006), American's country bias increases against emerging markets in Latin America and Eastern Europe.

That Americans prefer to invest much more in other major foreign industrial countries is somewhat surprising because these developed and industrialized countries tend to have highly correlated returns to the U.S. stock market. The United States' correlation with four of the other six G7 countries is over eighty percent during the last ten years (Table 1). Over short periods of time, investing in G7 countries and other developed markets might offer solid diversification benefits, but in the long run, these country's stock markets move increasingly in tandem.

On the other hand, emerging market countries tend to be less correlated to the United States and stand to better diversify a portfolio than their developed market counterparts. Aurelio (2006) finds that increasing the international component of an equity portfolio up to approximately 40% can result in diversification benefits that not only increase the expected return of the portfolio, but results in lower risk as well (p. 15).

If foreign equity is riskier than equity available in the domestic stock market, should investors favor their own country's stocks? *Confidence in the Familiar* (Li, 2004) debunks this idea and shows using CAPM (Capital Asset Pricing Model) investors must perceive international equities to be riskier than the model predicts in order to exhibit a home bias. The study constructs an optimal portfolio for each of the G7 countries. Each country compares the stock returns of the other countries to its own domestic index using a CAPM model.

In all cases, the model demonstrates that investors need to perceive foreign equity riskier than the prediction of the model used in the study. In other words, investors tend to believe foreign equities are riskier than conventional models and actual historical returns bear out. The aptly named article allows the reader to conclude that investors have more confidence in the risk-return (mean-variance) profile of stocks they are familiar with.

Despite the best efforts of the media and academic research, explaining American investors' home-country bias remains a vexing puzzle. In fact, the answer to this question might have more to do with basic psychology than economics. "At the University of Münster in Germany, neuroscientist Peter Kenning found that when people considered buying a mutual fund that invested overseas, an alarm went off inside the amygdala, a structure that functions as one of the fear centers in the brain," (Zweig, 2007, p. 66).

### ***Correlation Coefficients***

Modern portfolio theory is based on the principle that

non-perfectly correlated assets combined into a portfolio of assets can reduce the risk of the ensuing portfolio. Risk is commonly measured by the standard deviation of assets' historical returns. An asset can reduce the standard deviation of a portfolio even if it has a standard deviation higher than the assets already in the portfolio. This is counterintuitive, but is explained by the relationship between the assets' correlation coefficients and standard deviations.

#### **Equation 1 Correlation Coefficient:**

$$\rho_{x,y} = \text{corr}(x,y) = \frac{[\text{cov}(x,y)]}{(\sigma_x \cdot \sigma_y)} = \frac{(E[(x - \mu_x) \cdot (y - \mu_y)])}{(\sigma_x \cdot \sigma_y)}$$

The correlation coefficient measures the strength of two asset return's relationship. The coefficient ranges from [-1, 1]. A value of 1 (-1) means that the two assets have a perfectly positive (negative) linear relationship, and a value of zero indicates there is no linear relationship between the two assets. In the above equation, two asset returns are denoted by  $x$  and  $y$ .  $\mu_x$  and  $\mu_y$  represent the expected return of asset  $x$  and  $y$ , while  $\sigma_x$  and  $\sigma_y$  represent asset  $x$  and  $y$ 's standard deviations.

Countries with small or negative correlation coefficients work wonders in lowering the risk of a portfolio. This is because a decline in the value of one asset can be offset by the gain in another. Generally speaking, the less correlated the assets, the greater the diversification benefit to the portfolio. Due to this straightforward relationship between returns and correlation coefficients, correlations are of high relevance to any investor looking to diversify their portfolio. It was this relationship that opened the eyes of investors to the benefits of diversifying their portfolios with international equities in the first place.

In 1969, Morgan Stanley Capital International (MSCI) introduced country indices that tracked stock returns in various countries and regions. Since the inception of these indices, it has become easier to track the risk-return characteristics of stocks around the world. The indices also spurred the creation of mutual funds and investments designed to track the various MSCI global indices. Investors quickly caught on to the trend that international stocks tended to have higher returns, albeit higher standard deviations than their domestic equity counterparts. Furthermore, correlation coefficients were extremely low between different countries' stock returns. Low and even negative correlations

between foreign equities and United States indices made investing abroad highly attractive, especially at a regional and country level.

Through the 1980s, low correlations made adding international equities to a portfolio highly enticing and relatively straightforward. The savvy international investor encountered several difficult limiting factors that play a much smaller role in today's times, namely significant investment costs, and a smaller pool of assets to choose from.

Since the end of the 1980s and in more recent years, there has been an observed increase in correlation between international stocks returns, especially in developed markets such as the G7 countries. An outpouring of research is dedicated towards quantifying stock market correlations at the "country level" as well as looking at how these relationships have evolved over time. Research has focused on topics ranging from the convergence and unification of world equity markets over time, regional, country, and industry correlations, and to the relationship between standard deviation and correlations.

One relevant question to investors is to ask how correlations between countries have changed over time. MSCI data is available for G7 countries and several other developed and industrialized countries beginning in 1969, though some studies have analyzed time periods prior to 1969.

Table 1 provides insight into how correlations between major developed countries have changed since 1970, as well as why the observed change in correlation matters. Observing the "USA" row over each time period, the correlation between the United States and The World Index, as well as the other G7 countries increased in each time period for every country. Much of the increase in correlation has occurred in the past decade. This suggests that at a country level, investors must broaden their search beyond "safer" highly industrialized, developed countries if they seek to reap the diversification benefits of international equity.

As major developed countries' stock markets become more correlated to the United States' stock market, these countries offer less diversification power to the American investor. Assets highly correlated to the United States stock market do little to reduce the risk of a portfolio concentrated in United States stocks and offer virtually no upside when the United States stock market falls in value. Thus, the American investor can achieve greater diversification benefits by investing in assets with lower correlations to the United States stock market relative to the G7 countries and other highly developed countries.

**Table 1**

***G7 COUNTRY CORRELATIONS TO WORLD INDEX, 1970-2010***

	UNITED							
<i>1970-1990</i>	<i>WORLD</i>	<i>CANADA</i>	<i>FRANCE</i>	<i>GERMANY</i>	<i>ITALY</i>	<i>JAPAN</i>	<i>KINGDOM</i>	<i>USA</i>
<i>WORLD</i>	1.0000	0.7333	0.6113	0.5450	0.4151	0.6374	0.6731	0.8617
<i>CANADA</i>	0.7333	1.0000	0.4350	0.2902	0.2737	0.2714	0.5201	0.7109
<i>FRANCE</i>	0.6113	0.4350	1.0000	0.5820	0.4483	0.4057	0.5224	0.4189
<i>GERMANY</i>	0.5450	0.2902	0.5820	1.0000	0.3649	0.4073	0.3966	0.3356
<i>ITALY</i>	0.4151	0.2737	0.4483	0.3649	1.0000	0.3731	0.3487	0.2182
<i>JAPAN</i>	0.6374	0.2714	0.4057	0.4073	0.3731	1.0000	0.3517	0.2779
<i>UNITED KINGDOM</i>	0.6731	0.5201	0.5224	0.3966	0.3487	0.3517	1.0000	0.4902
<i>USA</i>	0.8617	0.7109	0.4189	0.3356	0.2182	0.2779	0.4902	1.0000

	UNITED							
<i>1990-2010</i>	<i>WORLD</i>	<i>CANADA</i>	<i>FRANCE</i>	<i>GERMANY</i>	<i>ITALY</i>	<i>JAPAN</i>	<i>KINGDOM</i>	<i>USA</i>
<i>WORLD</i>	1.0000	0.7870	0.8438	0.8083	0.6758	0.7065	0.8564	0.8959
<i>CANADA</i>	0.7870	1.0000	0.6539	0.6329	0.5444	0.4614	0.6629	0.7652
<i>FRANCE</i>	0.8438	0.6539	1.0000	0.8694	0.7017	0.4699	0.7905	0.7292
<i>GERMANY</i>	0.8083	0.6329	0.8694	1.0000	0.6815	0.3932	0.7377	0.7170
<i>ITALY</i>	0.6758	0.5444	0.7017	0.6815	1.0000	0.4134	0.5812	0.5434
<i>JAPAN</i>	0.7065	0.4614	0.4699	0.3932	0.4134	1.0000	0.5137	0.4276
<i>UNITED KINGDOM</i>	0.8564	0.6629	0.7905	0.7377	0.5812	0.5137	1.0000	0.7399
<i>USA</i>	0.8959	0.7652	0.7292	0.7170	0.5434	0.4276	0.7399	1.0000

	UNITED							
<i>2000-2010</i>	<i>WORLD</i>	<i>CANADA</i>	<i>FRANCE</i>	<i>GERMANY</i>	<i>ITALY</i>	<i>JAPAN</i>	<i>KINGDOM</i>	<i>USA</i>
<i>WORLD</i>	1.0000	0.8564	0.9226	0.9011	0.8479	0.6964	0.9191	0.9677
<i>CANADA</i>	0.8564	1.0000	0.7607	0.7179	0.7109	0.6340	0.7848	0.8075
<i>FRANCE</i>	0.9226	0.7607	1.0000	0.9486	0.9243	0.5635	0.8851	0.8393
<i>GERMANY</i>	0.9011	0.7179	0.9486	1.0000	0.8725	0.5206	0.8298	0.8365
<i>ITALY</i>	0.8479	0.7109	0.9243	0.8725	1.0000	0.5466	0.8240	0.7454
<i>JAPAN</i>	0.6964	0.6340	0.5635	0.5206	0.5466	1.0000	0.5999	0.6016
<i>UNITED KINGDOM</i>	0.9191	0.7848	0.8851	0.8298	0.8240	0.5999	1.0000	0.8446
<i>USA</i>	0.9677	0.8075	0.8393	0.8365	0.7454	0.6016	0.8446	1.0000

Academic research has also focused on the increase of countries' stock market correlations over time. Solnik, Boucrelle, and Le Fur (1996) analyze correlations using monthly data beginning in 1960. They find the correlations between the United States and France, Germany, Japan, and the United Kingdom increase between 1962 and 1995. The study also notes that European markets become increasingly correlated over time. The study cautions that these positive trends do not hold over all periods of time and are indicative of the trend over the entire time period only.

The increase in European stock correlations should hardly be a surprise. *Economic Integration and Country Allocation in Europe* (Freimann, 1998) finds that equity market

correlations in Europe have tripled in the 1990s compared to the 1970s. Peripheral European countries such as Sweden and Italy at one time had zero to little correlation to other major European countries. Freimann finds that Sweden and Italy have correlations in excess of 50% to most major European countries. This paper was written before the implementation of the European Monetary Union, which has led to even more economic integration in Europe. France and Germany's correlation, as seen in Table 1, increased from .5820 in the 1970-1990 period to .8694 in the 1990-2010 period.

Many developed countries' stock markets have become increasingly correlated over time. At the same time, many of the emerging market countries have become increasingly modern. Do emerging market stock markets also exhibit an increase in correlation?

This is the focus of *Are Emerging Market Equities a Separate Asset Class?* (Saunders and Walter, 2002). Saunders and Walter analyze correlation coefficients for developed and emerging market countries between 1989 and 1999, using two sub-periods 1989-1993, and 1994-1999. Their results show that most correlation coefficients between emerging market and developed market countries increase when looking at the second sub-period compared to the first. One-third of the increases are statistically significant. (Saunders and Walter, 2002, p.3) Using the same investment strategy in one period versus the other would yield much less diversification in the second time period than the first.

An increase in correlations and integration of world equity markets over time means that it has become significantly more difficult to reap the benefits of diversification through investing in international equity.

Investing in international equity through the use of regional and country index funds remains the most convenient way to invest in global equities. Does investing at a country level offer more diversification than investing at a regional level, or is the answer to invest globally at an industry level? This question is subject to a large and still ongoing debate.

One of the first studies to look at international equity return effects at the industry level was the 1994 Heston Rouwenhorst model. The Heston Rouwenhorst model is a four factor model that includes a base return, industry effect, country effect, and firm specific disturbance (Heston and Rouwenhorst, 1994, p. 8). At the time (1994), Heston and Rouwenhorst conclude that diversifying internationally across countries versus industries is a more effective diversification strategy (p. 18). Many papers have furthered the efforts of Heston Rouwenhorst in attempts to quantify country and industry effects with an up to date time period, as well as to show that industry effects are now more beneficial to international equity diversification than country effects.

Brooks and Del Negro (2005) add a fifth component to the Heston Rouwenhorst model, a region specific effect, in *Country versus Region Effects in International Stock Returns*. They find that region effects "explain half of the return variation accounted for by country effects" (Brooks and Del Negro, 2005, p. 5). This study suggests that in addition

to diversifying across industries and countries as done in the Heston Rouwenhorst model, it is of equal importance to diversify across regions as countries.

Combining the logic of Freimann (1998) and Brooks and Del Negro (2005), an American investor choosing to invest internationally in Europe alone would not only face higher correlations, but the returns in particular countries would increasingly be influenced by regional factors. Spreading one's money across countries in different regions would likely offer better portfolio diversification.

Ferreira and Gama (2005) decompose international equity return volatility into industry, country, and regional effects to re-evaluate the assertion of the Heston Rouwenhorst model. Their paper, *Have World, Country, and Industry Risks Changed Over Time*, seeks to answer among other things, has the relative importance of world, country, and local industry risks changed over time (p. 3)?

An important finding of the study is that during the last time period of the study (1996-2001), local risk, as measured by within country industry risk rises significantly. Ultimately the study finds that world and country risk are fairly stable over the time period of the study (1974-2001), while industry risk rises during the time period, particularly in the late 1990s (p. 27). Ultimately, Ferreira and Gama find in contrast to Heston and Rouwenhorst (1994), that industry risk offers the most diversification efficiency (p. 27).

*Sector Effects in Developed vs. Emerging Markets* (Chen, Bennett, and Zheng, 2006) also examines the industry versus country effect over time, however the authors seek to discern if there is a different pattern when looking at developed markets and emerging markets. The authors and Ferreira and Gama (2005) both conclude that country volatility reaches a peak during the year 2000. This leads them to conclude that up to the end of the century the country effect dominates the industry effect, though industry effects are at least as important or more important than country effects going forward (Chen, Bennett, and Zheng, 2006, p.9). Chen, Bennett, and Zheng assert that the increase in sector importance is confined to the developed markets only. The country effect is still more dominant in emerging market equity. According to the study, country based portfolios have returns 50% higher than industry based portfolios (p. 10). Finally, they suggest that the uptick in sector volatility seen by Ferreira and Gama (2005) and Brooks and Del Negro (2005) is a product of the information technology bubble (p.10).

Thus far, I have focused on how correlations and risk have changed in international equity over time and which sub-level of international equity offers the best portfolio diversification. While correlations often provide a good benchmark for how asset's returns will be related, they do not tell the whole story.

Correlations are unfortunately somewhat misleading. Solnik, Broucelle, and Le Fur (1996) summarize the greatest problem with correlations as such:

Volatility appears to be contagious across markets. In addition, international correlation increases in periods of high market volatility.... The link between correlation and market volatility is bad news for money managers because when the domestic market is subject to a strong negative shock is when the benefits of international risk diversification are needed most. (p.1)

A common source of frustration for investors is that correlations tend to increase during down markets. Several academic papers discuss the sharp spike in volatility surrounding the October 1987 market crash. During extreme adverse market shocks, correlations need not spike for long periods of time to wreak havoc on a well-diversified portfolio. The most recent market panic surrounding the collapse of Lehman Brothers in October 2008 serves as a prime and painful example of this. In the October 2008 market crash, nearly all major world stock indices experienced double digit percentage declines, erasing years of gains.

The connection between standard deviation, correlations, and their impacts on equity returns is the focus of Statman and Scheid (2008). They assert,

Correlation is the common indicator of the benefits of diversification, but it is not a good indicator for two reasons. First, the benefits of diversification depend not only on the correlation between returns, but also on the standard deviation of returns. Second, correlation does not provide an intuitive measure of the benefits of diversification. The return gap, the difference between the returns of two assets, is a better indicator. (p.8)

The paper offers a poignant example of return gaps' power in both up and down markets. Using 60 month correlations leading up to January 2007, Statman and Scheid (2008) show that despite the .86 correlation coefficient between the S&P 500 Index and the MSCI EAFE Index, the return gap is 78.81%, in favor of the international index. Absent in the seemingly high correlation coefficient is the magnitude of difference between the returns actually realized (p.1). Similarly, the paper shows that a significant market drop at the end of February 2007, during which time the correlation between the United States and foreign equities spikes to a value of 0.95, still offers diversification benefits when return gaps were used (p.6).

Having explored the use and practical implications of assets' correlations in international equity investing, there are several key trends to keep in mind when making investment decisions. Research indicates that correlations between the United States and the rest of the world, especially the developed markets have increased over time. There is a large debate surrounding whether diversifying across global industries or countries offers better diversification benefits. It appears diversifying across industries is gaining more traction, though diversifying across countries still is an effective strategy, especially in emerging markets. Finally, research has also indicated there are some flaws in using correlations to measure diversification benefits. Forecasting return gaps can reveal further benefits to diversifying with international equities not readily evident from observing correlations.

## ***Strategies and Models for International Equity Investing***

### **Mean Variance Portfolio Theory**

My study uses mean-variance portfolio theory to construct a model that creates efficient portfolios. There is a great deal of research on using portfolio theory to create international equity models. In my study, I assume a passive portfolio management strategy that is based on expected returns derived from historical data. Global optimal portfolios are created by maximizing the Sharpe ratio subject to a specified set of constraints. Mean-variance portfolio optimization requires making assumptions about the risk and return profiles of assets. Some studies, such as this one, rely on historical averages, while others use formulas of higher complexity to construct forecasts for expected returns. In this section, I will present several different studies and strategies, as alternatives to the investment strategy used in this paper.

Several studies such as *Global Portfolio Optimization* (Black and Litterman, 1992) make use of a global CAPM model to forecast expected returns. They also discuss some of the frustrating and unexpected results of using mean-variance optimization in conjunction with historical average returns. For example, when constructing unconstrained portfolios (portfolios where short selling is allowed), the model often yields erratic results that suggest taking extremely large long and short positions. To construct such a portfolio would require a significant amount of leverage and capital.

Both institutional asset managers and especially individual investors may face short sale restrictions. Constructing such a portfolio may simply not be permitted for institutional investors. For some highly skilled investors with deep pockets, it may be possible to construct an unconstrained portfolio, however many investors lack the knowledge or capital to construct this kind of portfolio. They may also be risk averse to taking short positions, especially in a retirement account.

Black and Litterman's (1992) paper tackles the issue of "cornering" that the mean-variance model imposes when short sales are not permitted. "When constraints rule out short positions, the models often prescribe "corner" solutions with zero weights in many assets, as well as unreasonably large weights in assets with small market capitalizations" (Black and Litterman, 1992, p.1). I also encountered this problem when constructing my efficient portfolios.

### **GDP and Equal Weighted Stock Portfolios**

Two easily implementable international equity investment strategies are proposed by Umstead (1990) in *Selecting a Benchmark for International Investment*. The first strategy focuses on an index based on countries' market capitalization. Umstead proposes using the market capitalization index as a benchmark, while allowing the investor to go "overweight" or "underweight" on assets within the benchmark index. This is especially useful when the investor has strong preferences for certain assets.



Another even simpler portfolio construct is an equal weighted portfolio, where all assets have the same weight in the portfolio at the beginning of the investment period. The logic behind this portfolio is that “managers are not likely to be able to forecast returns in large markets any better than they can in small markets” (Umstead, 1990 p. 2). Umstead also suggests a portfolio weighted based on countries’ proportions of GDP. I create a GDP based portfolio in my study to compare its return potential to my mean-variance portfolios.

Which of the above strategies performs the best over time? Choueifaty and Coignard (2008) explore similar investment strategies in *Toward Maximum Diversification*. They find that the mean-variance portfolio outperforms both the equal weighted portfolio and the market capitalization weighted portfolio over the long run, while the equal weight portfolio outperforms the market capitalization portfolio. The mean-variance portfolios have higher Sharpe ratios with higher returns and lower volatility than the other portfolios (p.12).

### **Fundamental Analysis**

Another tool available to global investors is the use of fundamental analysis. Fundamental analysis involves valuing an asset based on its characteristics such as sales, dividend growth, cash flows, etc.

Estrada (2008) presents the concept of fundamental indexing for international equities as an alternative to active market capitalization based strategies. His study *Fundamental Indexation and International Diversification* concludes that a fundamental indexation strategy based on dividend per-share data could out perform a global market capitalization index in absolute and risk adjusted returns. Likewise, a portfolio allocated across international markets based on weighing dividend yields could outperform an equally weighted index (p.11). The equal weight index and dividend yield index approaches both outperform the dividend-per share model.

Do certain strategies work better for developed market countries versus emerging market countries? In *Emerging Markets: When Are They Worth It?* (Conover, Jensen, and Johnson, 2002), U.S. monetary policy is a critical factor in determining returns between developed and emerging markets. Specifically, the study finds that during times of U.S. expansionary monetary policy, the addition of emerging market securities versus developed market stocks provides little additional benefit. However, during times of restrictive monetary policy by the United States, the addition of emerging market securities could provide an increase in return over four percent per annum (p.7). The study also finds that adding emerging market stocks to a portfolio of U.S. stocks would add one and a half to two additional percentage points of return per year, irrespective of the United States’ monetary policy (p.1).

More complicated investment strategies exist for investing in international equity. These include using Fama-French factor considerations, such as country specific book-to-price levels, using multiple regimes (normal and bear market states) to construct portfolios, and

even options pricing models to construct efficient portfolios. These strategies are beyond the scope of this paper.

### ***Currency Fluctuations and Implications***

Up to this point, I have ignored the impact of foreign currency fluctuations on portfolio returns. When investing in international stocks, the investor stands to gain or lose from the movement of foreign currencies. Diermeier and Solnik's (2001) research indicates that many global publically traded firms engage in of currency hedging. Depending on the extent of a firm's currency hedging, the firms can be more or less sensitive to foreign exchange risks. Thus when firms engage in currency hedging, the stock price impact is at first ambiguous. Diermeier and Solnik (2001) conclude that in aggregate, firms over-hedge. Solnik (1995) sums up the risks and rewards to foreign currency risk as such:

As can be expected, the risk of a portfolio unprotected against exchange risk is larger than for a covered portfolio. However, its total risk is still much smaller than for a comparable domestic portfolio. It is obvious, for example, that holders of foreign stocks have greatly benefited from the dollar devaluation. An uncovered international portfolio is certainly a good hedge against devaluations of the dollar. (p.5)

Having explored several key issues and areas of research related to international equity investment, I now present my data, study, and findings.

### III. Data

#### *Description of Data*

To construct the efficient global portfolios and perform mean-variance analysis, I collected data from MSCI's website. MSCI provides a variety of indices which track global and domestic equities. Data is available on a regional, country, and industry level for a variety of portfolio constructs, such as large cap, small cap, value, growth, and equal weighted portfolios. I conducted my study using MSCI's Global Standard Indices.

According to MSCI's website:

The MSCI Global Standard Indices are divided into large and mid-cap segments and provide exhaustive coverage of these size segments by targeting a coverage range around 85% of free float-adjusted market capitalization in each market. (MSCI Index Definitions).

The global standard indices are available at three levels of aggregation: regional, country, and sector level. The regional indices are an aggregation of the country indices. I use regional and country indices in my study.

The regional and country indices are organized into three tiers: developed markets (DM), emerging markets (EM), and frontier markets. I collected data from the first data available for each index through August 31, 2010. The data lists index prices at monthly intervals and is denominated in United States Dollars (USD).

To ensure a sufficient number of monthly observations, country indices with inception dates after 1993 were not included in the study. The study focuses on the use of DM and EM countries, thus frontier market indices were excluded. Few investment funds are dedicated to tracking MSCI's frontier markets and few investors are willing to bear the costs and risks associated with investing in these countries.

The following two tables show the specific indices used in this study and the earliest year data is available for each index. Table 20 contains the regional indices, year of inception, and their components. Table 21 lists the country indices I used in my analysis as well as the first year data is available for each country.

To analyze the country funds' return in a portfolio setting, a riskless asset is needed. I pick a risk free rate and corresponding security available to most American investors, the three month United States Government Treasury Bill (3 month T-Bill). Historical 3 month T-Bill returns are available on the Federal Reserve's website. This study uses monthly 3 month T-Bill returns. The monthly 3 month T-Bill returns are provided on a 360 day annual basis and therefore needed to be converted to monthly returns to match the MSCI data set. This was done by dividing the 3 month T-Bill returns by twelve.

To construct a portfolio based on economic output, I collected data from the World Bank's website. The World Bank offers a variety of economic data related to countries' output, one of which is Gross National Income (GNI). This figure was developed by the World Bank to replace Gross National Product (GNP). The exact data set I used is called the GNI (Current US\$).

### ***Time Periods***

Due to the nature of the data used in this study, data is analyzed in two different time periods. The first time period is 1988-2010 and the second is 1993-2010. For the American investor, the world changed drastically between 1988 and 1993. During this time the cold war ended, Germany reunified, and India implemented major economic reforms.

MSCI data for highly developed and industrialized countries, such as the G7 countries, is available dating as far back as 1970; however MSCI emerging market data is not available until 1988. There is also a substantial and important amount of emerging market data available beginning in 1993. The new data available beginning in 1993 includes new emerging market countries such as India and China. These two countries represent two major world economies with which the United States has major ties. Investing in Chinese and Indian stocks is very popular with American investors. This is especially true for China, for which ETFs are available at the sector level.

Since investing in emerging market equity is a critical component of my findings, I believe it is important to include in my study the country indices that become available in 1993. For this reason, and the reasons outlined above, I chose to use the two different time periods. Furthermore, as my results will demonstrate, using different time periods in conjunction with the mean variance model used in my study results in significantly different portfolio outcomes. The investor should be aware that the time period chosen can play just as large a role in the model's outcome as any other factor.

The World Bank GNI data is available for countries such as the United States and United Kingdom beginning in the 1960s. Occasionally for some countries, GNI data was not available in years when MSCI country data was available. In these circumstances, that particular country was omitted from the study until the first year GNI data became available. I analyze G7 country, DM, and EM GNI portfolios from 1988-2008 and 1993-2008.

## Methodology

All models used in my analysis were created using Microsoft Excel. The models I use can easily be replicated and customized to meet the user's specifications. An extremely useful reference for creating financial models in Microsoft Excel is Benninga's *Financial Modeling*, 3<sup>rd</sup> Edition.

### ***Mean-Variance Optimization Model***

A mean-variance optimization problem, such as the one conducted in my study, requires several statistical inputs. As the name suggests, the model's two primary inputs are the expected return and risk of the assets which will comprise the portfolio. The model is designed to maximize the expected excess return of the portfolio while minimizing the portfolio's risk. This is accomplished by using the Sharpe ratio.

#### **Equation 2: Sharpe Ratio**

$$(\mu - r_f) / \sigma$$

In the Sharpe Ratio,  $\mu$  is the expected return of the portfolio,  $r_f$  denotes a riskless asset, and  $\sigma$  the standard deviation of the portfolio. Maximizing the Sharpe ratio provides the highest expected return in excess of a riskless asset per unit of risk.

In my study I rely on the use of historical data to create assets' risk-return characteristics. The data I obtained from MSCI is given as a series of monthly prices. In order to analyze how the country and regional indices have performed over time, I converted the time series of prices into returns. Returns are calculated as:

#### **Equation 3: Two Period Return**

$$\frac{(X_1 - X_0)}{X_0}$$

$X_1$  is the current time period and  $X_0$  the previous time period.

The expected return of a given asset in the portfolio is measured by the assets' arithmetic mean.

#### **Equation 4: Expected Return of an Asset**

$$M = 1/n \cdot \sum_{i=1}^n X_i$$

The measure used to quantify risk is the given asset's standard deviation from the mean.

#### **Equation 5: Standard Deviation of an Asset**

$$\sigma = \sqrt{\left(1/n \cdot \sum_{i=1}^n (X_i - \mu)^2\right)}$$

The mean-variance model assigns weights to assets in order to maximize the Sharpe ratio. In all cases, the weights in a portfolio must add up to one. Positive weights indicate taking a long position in a given asset, while negative weights are short positions. Short sales are both costly for the investor, as well as extremely risky investments. Few individual investors have the capital or risk tolerance for short-selling. Therefore, assets' weights are restricted to being positive and summing to one.

The portfolio's return is the weighted average of the assets' expected returns and respective weights. The portfolio's standard deviation is also a weighted average of the asset's standard deviations. In practice, this is achieved by using a covariance matrix. Like the expected returns and standard deviations, covariance is calculated using assets returns.

#### **Equation 6: Covariance Between Two Assets:**

$$\begin{aligned} \text{Cov}(X, Y) &= E(X - E(X)) \cdot (Y - E(Y)) \\ \text{Cov}\left(\sum_{i=1}^n x_i, \sum_{j=1}^m Y_j\right) &= \sum_{i=1}^n \sum_{j=1}^m (X_i, Y_j) \end{aligned}$$

By using the covariance matrix and the assets' weights, the standard deviation of a portfolio is calculated using Equation 7, below:

#### **Equation 7: Matrix Algebra to Compute Portfolio Standard Deviation**

$$\sqrt{[A'] \cdot \Omega \cdot [A]}$$

Here A represents the vector column of n assets in the portfolio. The term A' is the transpose of this vector.  $\Omega$  (Omega) represents the covariance matrix.

Once the model described above is constructed, the Sharpe ratio can be maximized by using Microsoft Excel's solver function.

**Figure 1: Mean-Variance Optimization Model**

*1970-2010 G7 Efficient Portfolio*

	Weight	Return	Risk
3 mo. T Bill (rf)		0.46%	-
CANADA	30%	0.73%	5.79%
FRANCE	1%	0.74%	6.56%
GERMANY	18%	0.74%	6.33%
ITALY	0%	0.49%	7.38%
JAPAN	51%	0.83%	6.30%
UNITED KINGDOM	0%	0.67%	6.48%
USA	0%	0.58%	4.51%
<b>Portfolio</b>	<b>100%</b>	<b>0.78%</b>	<b>4.88%</b>

$\leftarrow = (MMULT(MMULT(TRANSPOSE(weights), Cov\_Mat), weights))^0.5$   
 $\leftarrow = SUMPRODUCT(Asset\_Ret, weights)$   
 $\leftarrow = (Portfolio\_Ret - rf) / Portfolio\_Risk$

<b>Sharpe Ratio</b>	<b>0.065034</b>
---------------------	-----------------

	UNITED						
Covariance	CANADA	FRANCE	GERMANY	ITALY	JAPAN	KINGDOM	USA
CANADA	0.0033	0.0020	0.0017	0.0017	0.0013	0.0021	0.0019
FRANCE	0.0020	0.0043	0.0029	0.0027	0.0018	0.0026	0.0016
GERMANY	0.0017	0.0029	0.0040	0.0024	0.0016	0.0021	0.0015
ITALY	0.0017	0.0027	0.0024	0.0054	0.0018	0.0020	0.0012
JAPAN	0.0013	0.0018	0.0016	0.0018	0.0040	0.0016	0.0010
UNITED KINGDOM	0.0021	0.0026	0.0021	0.0020	0.0016	0.0042	0.0017
USA	0.0019	0.0016	0.0015	0.0012	0.0010	0.0017	0.0020

Figure 1 is a representation of the Microsoft Excel model I used to create efficient portfolios. The equations used to manipulate the portfolio return, standard deviation and Sharpe ratio can be seen in the above figure.

The model provides the combination of assets that create the highest Sharpe ratio. It is possible to graph an efficient frontier by graphing the series of points that minimize the portfolio's standard deviation. This process can be automated by writing a Macro using Microsoft Excel's Visual Basic Editor.

It is also possible to impose other restraints on the model. For instance, one solution, albeit not the most efficient way, to eliminating the cornering effects of the model is to require that each asset in the portfolio has some specified minimum weight such as five or ten percent. The model then over-weights the assets it would normally select. Likewise, it is possible to hand select specific weights for each asset. In the results section, I will blend EM country indices together with the United States index to form portfolios. I specify a weighting for the United States (in this study the value used is 60%) and allow the model to select assets for the remaining unallocated weights.

### GNI Portfolio Model

The GNI portfolio model is a combination of MSCI country data and World Bank GNI data. I constructed three separate portfolios: a G7, DM, and EM portfolio. The DM portfolio includes the DM countries used in my mean-variance optimization model, excluding the G7 countries. Likewise the EM portfolio includes the EM countries from

the mean-variance optimization model, except Taiwan, for which no GNI data was available.

I first calculated each country's share proportion of world GNI on an annual basis. For each of the three portfolios, the "world GNI" was the sum of those countries' GNI. Next, using the MSCI monthly returns I calculated each country's raw realized return on an annual basis. Since returns were given on a monthly basis, I converted each month's return to  $(1 + \text{observed monthly return})$ . The country's annual return is therefore given by the product of the monthly returns minus one:

**Equation 8: Annual Return in GNI Model**

$$\text{Annual Return} = [(1 + \text{Jan. Observed}) \cdot (1 + \text{Feb. Observed}) \cdot \dots \cdot (1 + \text{Dec. Observed})] - 1$$

Finally, I obtained the portfolio returns by multiplying each country's return by its GNI weight. GNI weights were applied to the subsequent return period. i.e. the 1995 GNI weights multiplied against the observed returns in 1996, the 1996 GNI weights were multiplied against the 1997 observed returns, etc. Here the logic is that an investor would not know the actual GNI or GDP figure for the current period until after the period was over. The investor therefore relies on the most recently available period's GNI data or must forecast the value himself.

Once I obtained the annual returns, I created efficient portfolios over the 1988-2010 and 1993-2010 time periods. I used the same methodology as described in the mean-variance section above, except that I used annual versus monthly returns in constructing the GNI efficient portfolios.



## **Summary Statistics**

As outlined in the methodology section, my model uses several statistical measures to create efficient portfolios. The summary statistics for the mean variance model are located in Appendix A. In Appendix A, the statistics are organized into two categories: regional and country level portfolios. The regional and country portfolios are further classified by market group (G7, DM, and EM), then by year. For each category, four statistics are presented: the historical return, standard deviation, covariance matrix, and correlation matrix. I also present a covariance and correlation matrix between the DM and EM countries for both time periods of the study.

For the GNI weighted portfolios, I used MSCI monthly returns for each country index. I also calculated the yearly portfolio weights for each country. These figures, as well as the raw GNI data are located in Appendix B.

## **Results and Analysis**

I present my results in the following format:

I first examine the results of the mean-variance portfolio model, followed by the results of the GNI weighted model. The mean-variance portfolio model results are organized first by the level of index aggregation: region and country.

In the regional results and analysis, I first present and discuss the scenario where the only restraint on the model is no short sales. I perform this analysis for both time periods, and then add an additional restraint to the model by requiring at least sixty percent of the portfolio to be invested in the United States.

I follow a similar organization for the country portfolios. They are organized first by country designation (G7, DM, and EM), then by time period. As in the regional index results and analysis, the base state for the model is to create portfolios with a short sale restriction. After performing this analysis as described above, I then require that the United States' weight in the portfolio is sixty percent. At the country level, I perform the second scenario by combining the United States index with emerging market indices.

### **No Short Sales**

#### ***Regional Index Results***

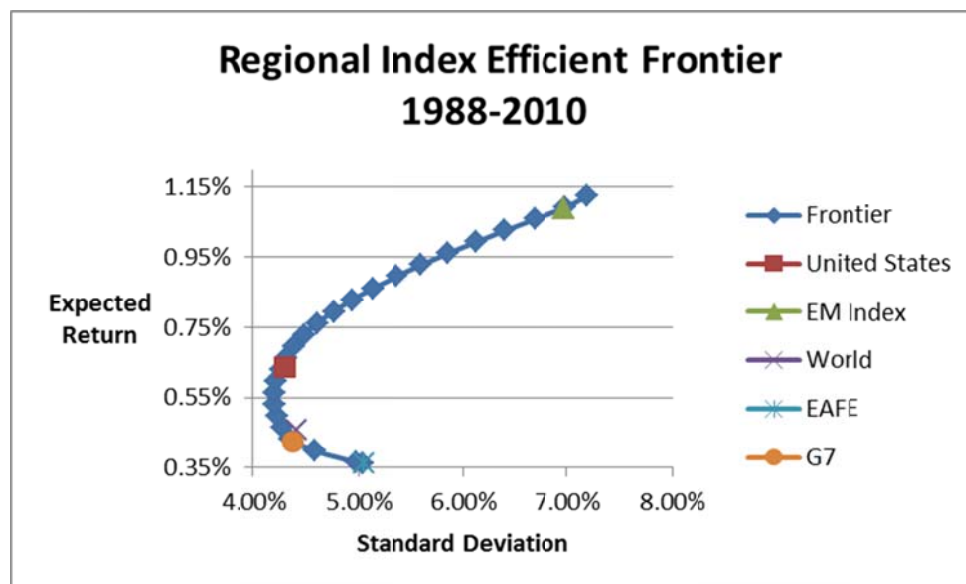
##### **1988-2010 Results**

The first efficient portfolio sets four regional level indices against the United States. The result immediately resembles the “corner effect” discussed by Black and Litterman (1992). Given this set of historical returns, the entire portfolio is placed in the emerging market index. This is because for the 1988-2010 time period, the EM index has a superior risk return profile to the other asset choices.

**Table 2: Efficient Portfolio**

Regional Efficient Portfolio 1988-2010			
	Weight	Return	Risk
3 mo. T Bill (rf)		0.33%	-
USA	0.00%	0.64%	4.31%
WORLD	0.00%	0.46%	4.41%
EAFE	0.00%	0.36%	5.05%
G7	0.00%	0.43%	4.38%
EM	100.00%	1.09%	6.97%
<b>Portfolio</b>	<b>100.00%</b>	<b>1.09%</b>	<b>6.96%</b>
<b>Sharpe Ratio</b>	<b>0.1087</b>		
*no Short Sales			

**Figure 2: Efficient Frontier**



### 1993-2010 Results

Using the 1993-2010 time frame results in a portfolio heavily skewed toward the EM index, however it also includes United States equity. In comparing the 1988-2010

portfolio to the 1993-2010 portfolio, note that the latter portfolio has a higher Sharpe ratio, although the Sharpe ratio in the earlier time period is just the Sharpe ratio of investing in the EM index. While the former portfolio has a higher expected return, the latter portfolio has less risk.

Combining the United States index with the emerging market index is a logical outcome in these portfolios since the United States has superior risk return characteristics to all of the DM regional indices in 1988 and superior returns in 1993 with nearly identical risk. During both time periods the EM index has the highest risk and return.

Taking a look at the correlation matrix for these time periods (Tables 22 and 23, Appendix A), correlations between all the funds in the portfolio increased. Several correlations are noteworthy: In both 1988 and 1993, the correlation between the G7 and World index is nearly one (.9968 and .9966). This is because the MSCI standard indices at the regional level are market capitalization weighted. Since the G7 countries are components of The World Index and make up a substantial proportion of the World Index's total market capitalization, the indices move virtually in lock step with one another.

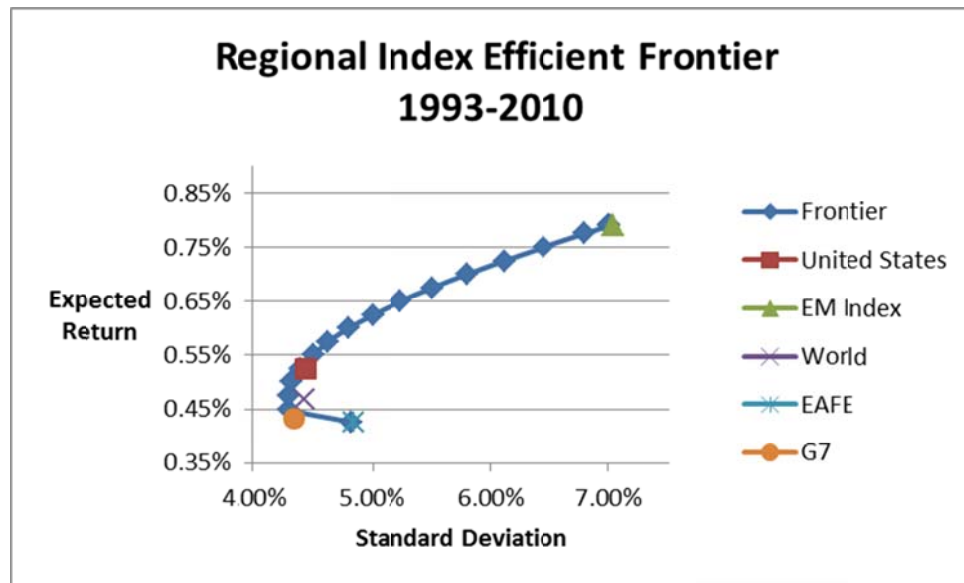
The correlation between the United States and the EM index also increased over this time period. In the 1988-2010 time period the correlation was .6549, and rose to .7197 in the second time period. The United States was least correlated to the EM index in both time periods. Likewise, the EM index was least correlated with the United States in both time periods. (Table 22 and 23, Appendix A)

Looking at diversification benefits at the regional level does not offer much insight, as the non-EM indices are nearly identical in their performance characteristics as well as highly correlated.

**Table 3: Efficient Portfolio**

<i>Regional Efficient Portfolio</i> 1993-2010			
	Weight	Return	Risk
3 mo. T Bill (rf)		0.28%	-
USA	13.74%	0.52%	4.44%
WORLD	0.00%	0.47%	4.43%
EAFE	0.00%	0.43%	4.84%
G7	0.00%	0.43%	4.35%
EM	86.26%	0.79%	7.04%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.75%</b>	<b>6.49%</b>
Sharpe Ratio			
	<b>0.1204</b>		
*no Short Sales			

**Figure 3: Efficient Frontier**



## *Country Index Results*

### **G7 Country Portfolios**

#### *1970-2010 G7 Results*

Comparing just the components of the G7 index and using the longest time period available, the mean-variance model does a better job diversifying into more assets than at the regional level, however at the cost of a much lower Sharpe ratio. This is most likely because the historical risk free rate for this time period is high (.46%) compared to the 1988 and 1993 time periods (.33% and .28%).

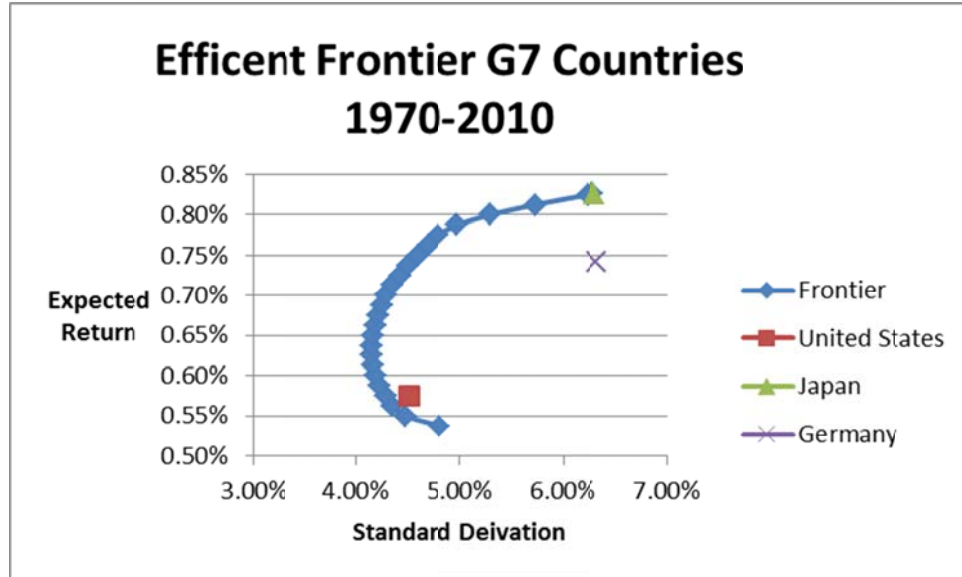
Correlations among G7 countries are lowest during this time period. Italy (.3710) and Japan (.3505) in particular have very low correlations to the United States (Table 24, Appendix A). In fact, referring back to Table 1, one can see how both of these country's correlations to the United States have increased drastically.

**Table 4: Efficient Portfolio**

#### *G7 Country Efficient Portfolio 1970-2010*

	<b>Weight</b>	<b>Return</b>	<b>Risk</b>
<i>3 mo. T Bill (rf)</i>		0.46%	-
<i>CANADA</i>	30.40%	0.73%	5.79%
<i>FRANCE</i>	0.75%	0.74%	6.56%
<i>GERMANY</i>	18.23%	0.74%	6.33%
<i>ITALY</i>	0.00%	0.49%	7.38%
<i>JAPAN</i>	50.62%	0.83%	6.30%
<i>UNITED KINGDOM</i>	0.00%	0.67%	6.48%
<i>USA</i>	0.00%	0.58%	4.51%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.78%</b>	<b>4.88%</b>
<b>Sharpe Ratio</b>	<b>0.0650</b>		
<i>*no Short Sales</i>			

**Figure 4: Efficient Frontier**



#### ***1988-2010 G7 Returns***

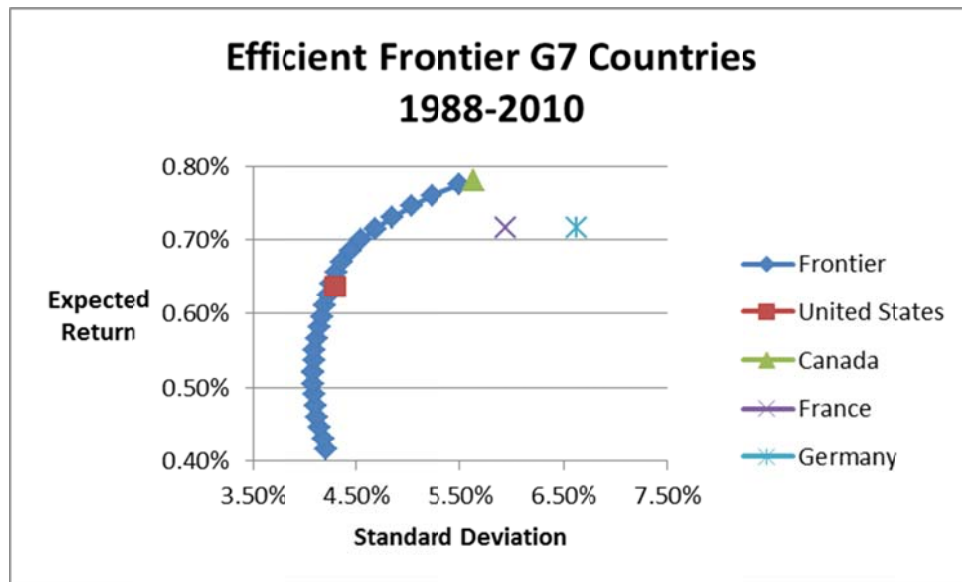
Using the 1988-2010 time period results in a slightly higher Sharpe ratio than the 1970-2010 time period. The model weights the majority of the portfolio in the United States, which had the lowest risk over the time period. In fact, the United States nearly lies on the efficient frontier. Note that France and Germany have the exact same return, but German equity is riskier. Thus, using this model and time period, France will always be preferred to Germany. In this time period, Canada enjoyed the highest return while Japan's return was nearly zero. This is a sharp contrast to the 1970-2010 return of Japan, which is the highest at .83% monthly. This serves as a reminder that historical averages are not always good indicators of future performance.

**Table 5: Efficient Portfolio**

*G7 Country Efficient Portfolio  
1988-2010*

	Weight	Return	Risk
3 mo. T Bill (rf)		0.33%	-
CANADA	27.40%	0.78%	5.64%
FRANCE	11.70%	0.72%	5.95%
GERMANY	0.00%	0.72%	6.62%
ITALY	0.00%	0.38%	6.92%
JAPAN	0.00%	0.07%	6.35%
UNITED KINGDOM	0.00%	0.45%	4.87%
USA	60.90%	0.64%	4.30%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.68%</b>	<b>4.44%</b>
<b>Sharpe Ratio</b>	<b>0.0794</b>		
<i>*no Short Sales</i>			

**Figure 5: Efficient Frontier**



**1993-2010 G7 Results**

The 1993-2010 data series yields a portfolio that is weighted entirely in Canadian equity. Canada's return over this time period is .94% per month. Combined with a lower risk free rate than in the 1970 and 1988 portfolios, Canada's high returns over this time period result in the highest Sharpe ratio of the G7 optimal portfolios.

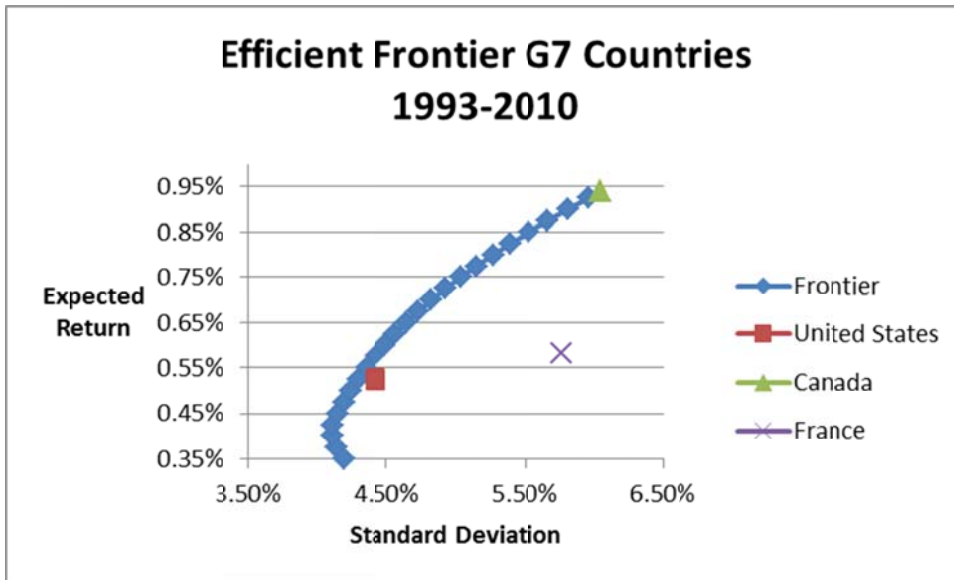


**Table 6: Efficient Portfolio**

*G7 Country Efficient Portfolio  
1993-2010*

	Weight	Return	Risk
3 mo. T Bill (rf)		0.28%	-
CANADA	100.00%	0.94%	6.05%
FRANCE	0.00%	0.58%	5.77%
GERMANY	0.00%	0.69%	6.54%
ITALY	0.00%	0.56%	6.96%
JAPAN	0.00%	0.15%	5.78%
UNITED KINGDOM	0.00%	0.40%	4.55%
USA	0.00%	0.52%	4.42%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.94%</b>	<b>6.05%</b>
<b>Sharpe Ratio</b>	<b>0.1090</b>		
<i>*no Short Sales</i>			

**Figure 6: Efficient Frontier**



**DM Country Portfolios**

In this section, I combine the G7 countries with the rest of the DM countries and re-run the mean-variance model used in the G7 country section for the time periods 1988-2010 and 1993-2010. Interestingly, the short sale restriction in the DM country scenario results

in portfolios that strictly exclude G7 countries. For visual ease, I do not list the G7 countries in the efficient portfolios since they have zero weights. The risk return profile for the G7 countries is the same as in Table 5 and 6 in the previous section. I find that using this set of countries, the model prefers in all cases, smaller economies, whose historical performance in these time periods were exceptionally strong.

### ***1988-2010 DM Results***

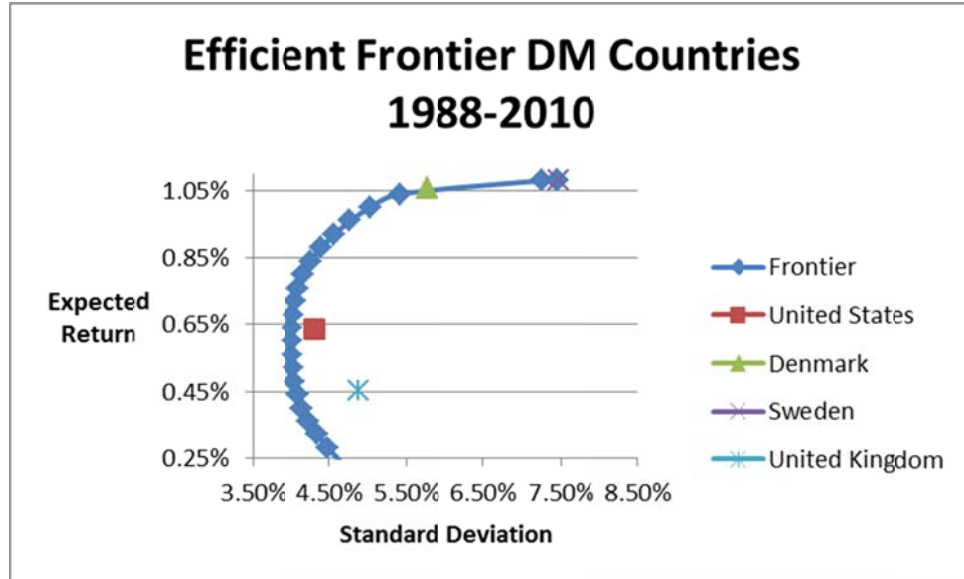
Again, none of the G7 countries receive weights in this time period and scenario. The Sharpe ratio of this portfolio is higher than the corresponding Sharpe ratio from investing just in the G7 countries over the same time period.

**Table 7: Efficient Portfolio**

#### ***G7 and DM Country Efficient Portfolio 1988-2010***

	<b>Weight</b>	<b>Return</b>	<b>Risk</b>
<i>3 mo. T Bill (rf)</i>	-	0.33%	-
<i>AUSTRALIA</i>	0.00%	0.72%	5.99%
<i>AUSTRIA</i>	0.00%	0.62%	7.61%
<i>BELGIUM</i>	0.00%	0.53%	6.03%
<i>DENMARK</i>	56.87%	1.06%	5.76%
<i>FINLAND</i>	0.00%	0.94%	9.35%
<i>GREECE</i>	0.00%	0.88%	10.68%
<i>HONG KONG</i>	13.54%	0.97%	7.65%
<i>IRELAND</i>	0.00%	0.20%	6.54%
<i>NETHERLANDS</i>	0.00%	0.66%	5.48%
<i>NEW ZEALAND</i>	0.00%	0.17%	6.79%
<i>NORWAY</i>	0.00%	0.90%	7.60%
<i>PORTUGAL</i>	0.00%	0.27%	6.65%
<i>SINGAPORE</i>	0.00%	0.86%	7.28%
<i>SPAIN</i>	0.00%	0.71%	6.71%
<i>SWEDEN</i>	4.01%	1.08%	7.48%
<i>SWITZERLAND</i>	25.58%	0.86%	5.02%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.99%</b>	<b>4.98%</b>
<b>Sharpe Ratio</b>	<b>0.1329</b>		
<i>*No Short Sales</i>			

**Figure 7: Efficient Frontier**



***1993-2010 DM Results***

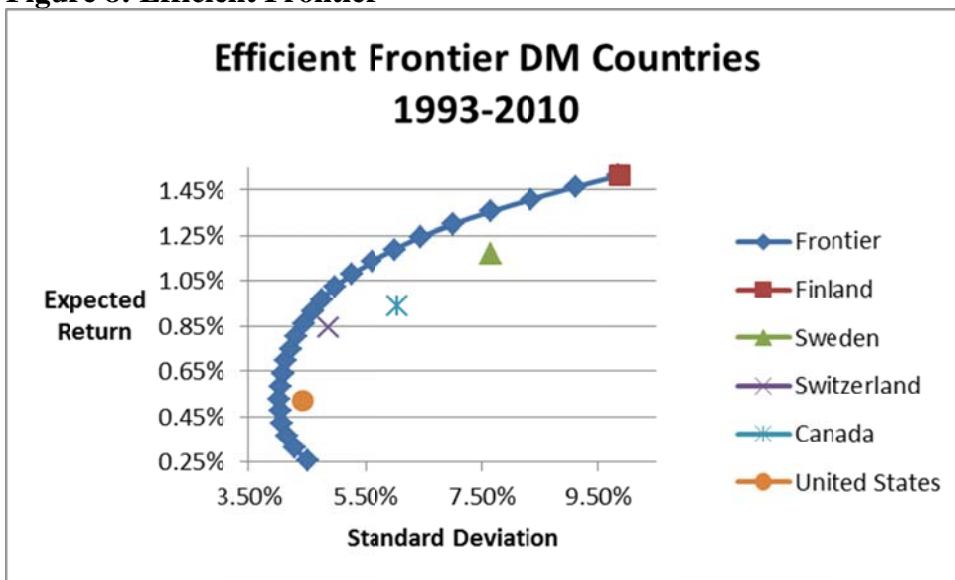
Here again the model corners into a portfolio consisting of only three countries: Finland, Switzerland and Denmark. The Sharpe ratio is .1525, higher than the 1988-2010 DM Sharpe ratio. Interestingly, had investors actually invested in this portfolio, the risk of their portfolio would have been less than the G7 portfolio over the same time period. Recall however, that the mean-variance model assigned the entire portfolio's weight to Canada in the 1993-2010 scenario.

**Table 8: Efficient Portfolio**

*G7 and DM Country Efficient Portfolio  
1993-2010*

	Weight	Return	Risk
3 mo. T Bill ( <i>rf</i> )	-	0.28%	-
AUSTRALIA	0.00%	0.77%	6.03%
AUSTRIA	0.00%	0.45%	7.10%
BELGIUM	0.00%	0.44%	6.13%
DENMARK	50.82%	1.05%	5.69%
FINLAND	25.08%	1.51%	9.87%
GREECE	0.00%	0.64%	9.25%
HONG KONG	0.00%	0.76%	7.92%
IRELAND	0.00%	0.12%	6.44%
NETHERLANDS	0.00%	0.63%	5.83%
NEW ZEALAND	0.00%	0.41%	6.57%
NORWAY	0.00%	0.97%	7.65%
PORTUGAL	0.00%	0.60%	6.45%
SINGAPORE	0.00%	0.73%	7.75%
SPAIN	0.00%	0.95%	6.82%
SWEDEN	0.00%	1.17%	7.66%
SWITZERLAND	24.10%	0.84%	4.85%
<b>Portfolio</b>	<b>100.00%</b>	<b>1.12%</b>	<b>5.49%</b>
<b>Sharpe Ratio</b>	<b>0.1525</b>		
<i>*No Short Sales</i>			

**Figure 8: Efficient Frontier**



## **EM Country Portfolios**

In this section, I combine the G7 countries with the EM countries. I perform the same analysis and scenarios in the DM country section. Again, the G7 countries are assigned zero weights in the base scenario and are thus not depicted in the efficient portfolio data. The risk return profile for the G7 countries is the same as in Table 5 and 6 in the G7 country index section.

The return potential for EM countries is immediately apparent. Many of the country indices had annual returns in excess of 10% per annum. This is impressive considering the annual return on the United States index over this period was 7.68% ( $.64 \times 12$ ). In fact, the only G7 country that achieves a return in excess of 10% per annum is Canada from 1993-2010. France and Germany come closest to this mark over the 1988-2010 time period with annual returns of 8.6%. Brazil's annual return of 30% over the 1988-2010 time period out-paced all other EM indices.

While achieving an annual return of 30% over a timespan of twenty-two years is an undeniably incredible feat, investors should not and cannot ignore the steep price that comes with this incredible return. That is, of course, the standard deviation of Brazil's returns, which over the same time period and annualized were 184%. Investors chasing highly lucrative returns in emerging markets must be wary of the additional risks that come packaged with super-sized returns. Risks that could disrupt emerging market stock returns include political, socio-economic, and inflationary risk, as well as the risk of corruption, unfavorable currency market interventions, tariffs, and other policies that disrupt and distort the free flow of goods and money in emerging country markets.

### ***1988-2010 EM Results***

The model heavily weights Latin American countries in this scenario, especially Mexico and Chile. An American investor would most likely not hold a portfolio such as the one above for two key reasons: the home-country bias dictates that few American investors invest their entire stock portfolio in EM countries. Secondly, Aurelio (2006) shows in his study that American investors have actually increased their bias against Latin American emerging market stocks. American investors have demonstrated that they prefer emerging market countries in the Far East.

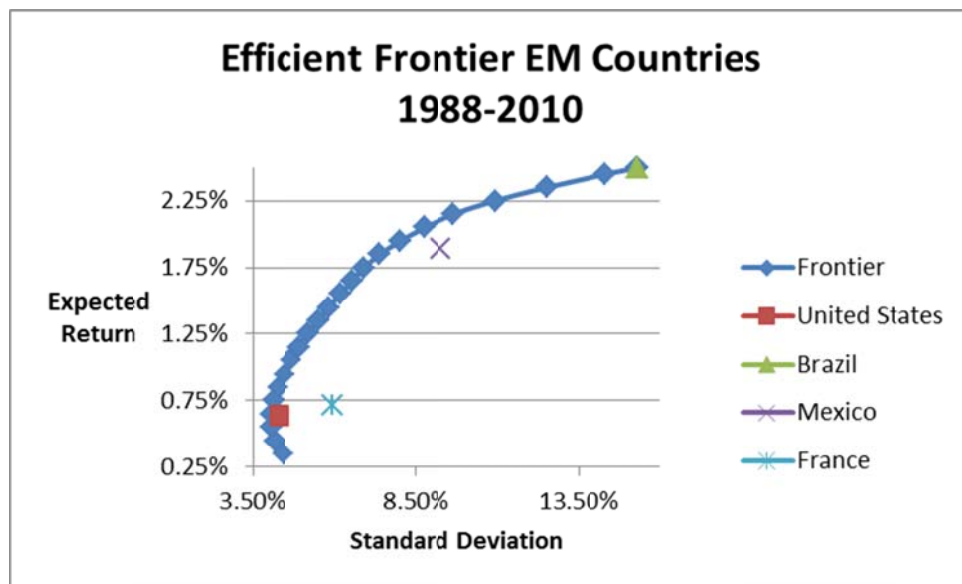
Despite the unlikelihood of an investor actually creating this portfolio, it does command a Sharpe ratio significantly larger than the G7 and DM portfolios.

**Table 9: Efficient Portfolio**

*G7 and EM Country Efficient Portfolio  
1988-2010*

	Weight	Return	Risk
3 mo. T Bill ( <i>rf</i> )	-	0.33%	-
BRAZIL	13.78%	2.50%	15.34%
CHILE	37.00%	1.44%	7.09%
INDONESIA	6.13%	1.74%	14.88%
KOREA	0.00%	1.03%	11.26%
MALAYSIA	0.00%	0.88%	8.57%
MEXICO	37.07%	1.89%	9.28%
PHILIPPINES	0.00%	0.83%	9.25%
TAIWAN	0.00%	0.90%	10.84%
THAILAND	0.00%	1.02%	11.27%
TURKEY	6.02%	2.03%	17.03%
<b>Portfolio</b>	<b>100.00%</b>	<b>1.81%</b>	<b>7.18%</b>
<b>Sharpe Ratio</b>	<b>0.2056</b>		
<i>*No Short Sales</i>			

**Figure 9: Efficient Frontier**



### 1993-2010 EM Results

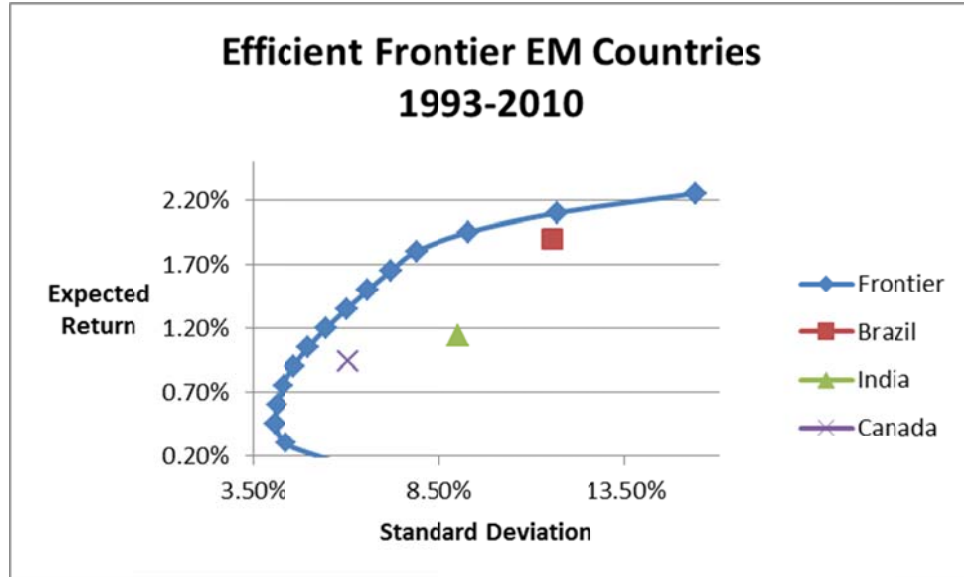
While the G7 and DM 1993-2010 portfolios both had higher Sharpe ratios than their 1988-2010 counterparts, the Sharpe ratio actually decreases slightly from (.2056 to .1932) for the 1993-2010 EM portfolio. Several additional countries are introduced to the data set for the 1993 EM portfolio including India and China. The lower Sharpe ratio could be due to the different country mix in this portfolio versus the countries used in the previous time period.

**Table 10: Efficient Portfolio**

#### *G7 and EM Country Efficient Portfolio 1993-2010*

	Weight	Return	Risk
<i>3 mo. T Bill (rf)</i>	-	0.28%	-
<i>BRAZIL</i>	8.10%	1.90%	11.54%
<i>CHINA</i>	0.00%	0.33%	10.78%
<i>INDIA</i>	0.00%	1.14%	9.01%
<i>CHILE</i>	0.00%	0.99%	6.90%
<i>COLUMBIA</i>	30.79%	1.58%	9.45%
<i>INDONESIA</i>	0.00%	1.33%	13.64%
<i>KOREA</i>	0.00%	1.15%	11.82%
<i>MALAYSIA</i>	0.00%	0.74%	9.13%
<i>MEXICO</i>	0.00%	1.04%	8.89%
<i>PERU</i>	35.42%	1.71%	9.51%
<i>PHILIPPINES</i>	0.00%	0.44%	9.37%
<i>POLAND</i>	12.23%	1.94%	14.61%
<i>SOUTH AFRICA</i>	0.00%	1.07%	8.06%
<i>TAIWAN</i>	0.00%	0.65%	9.40%
<i>THAILAND</i>	0.00%	0.66%	11.90%
<i>TURKEY</i>	13.46%	2.28%	16.31%
<b>Portfolio</b>	<b>100.00%</b>	<b>1.79%</b>	<b>7.83%</b>
<b>Sharpe Ratio</b>	<b>0.1932</b>		
<i>*No Short Sales</i>			

**Figure 10: Efficient Frontier**



### No Short Sale Model Results

Table 11 below summarizes the risk, return and Sharpe ratios for each portfolio construct. The diversification benefits of this portion of my study are somewhat misleading, as several of the portfolios were weighted solely in one index. The results were also highly sensitive to the risk premium. For lower expected portfolio returns or lower risk free rates, the model favored less risky countries, especially the United States. The data points along the lower portion of the minimum variance frontier were often heavily weighted in the United States and other G7 countries. The upper bounds of the frontier were heavily weighted in EM countries.

The EM portfolios have much higher Sharpe ratios than the DM and G7 country portfolios. These higher returns do not come without a steep price: The annualized standard deviation of the 1993-2010 EM portfolios would be an astounding 93.9%. Such a high standard deviation offers little confidence in the likelihood of achieving the tantalizing 21% annualized return advertised by the model.

**Table 11:**

<i>Portfolio Characteristics</i>					
Level	Portfolio	Year	Risk	Return	Sharpe Ratio
Regional	Regional	1988	6.96%	1.09%	0.1087
Regional	Regional	1993	6.49%	0.75%	0.0729
Country	G7	1970	4.88%	0.78%	0.0665
Country	G7	1988	4.94%	0.74%	0.0826
Country	G7	1993	6.05%	0.94%	0.1089
Country	G7 & DM	1988	4.98%	0.99%	0.1334
Country	G7 & DM	1993	5.50%	1.12%	0.1524
<b>Country</b>	<b>G7 &amp; EM</b>	<b>1988</b>	<b>7.18%</b>	<b>1.81%</b>	<b>0.2058</b>
Country	G7 & EM	1988	7.83%	1.79%	0.1931



## **Additional Model Constraints**

In the previous exercises, the mean-variance model was restricted only by allowing it to take long positions. This resulted in portfolios that often invested in the riskiest assets and predicted exceptional returns, but at risk levels far too high for most investors. The portfolios in the previous section also showed that investing in emerging market countries offered investors the highest Sharpe ratio, a measure of risk-return efficiency.

Equipped with the knowledge that many American investors exhibit a home-country bias in their equity portfolios, I impose an additional constraint on the mean-variance model to accommodate for the home-country bias. Recall that the market capitalization of United States stocks accounts for approximately forty percent of the world's total market capitalization. I thus allow for a modest home-country bias by requiring that the model assign a weight of sixty percent to the United States index. The model then freely allocates the remaining forty percent of the portfolio across the other indices.

Using this restriction, in all cases where the model can allocate the remaining forty percent across any country index used in the study (G7, DM, and EM), the model allocates the remaining portfolio weights exclusively to emerging market countries. I therefore show only the results of this additional model constraint for both time periods, using the United States index and the EM index, followed by the United States index and the EM country indices.

### ***Regional Index Results***

#### ***1988-2010 Results***

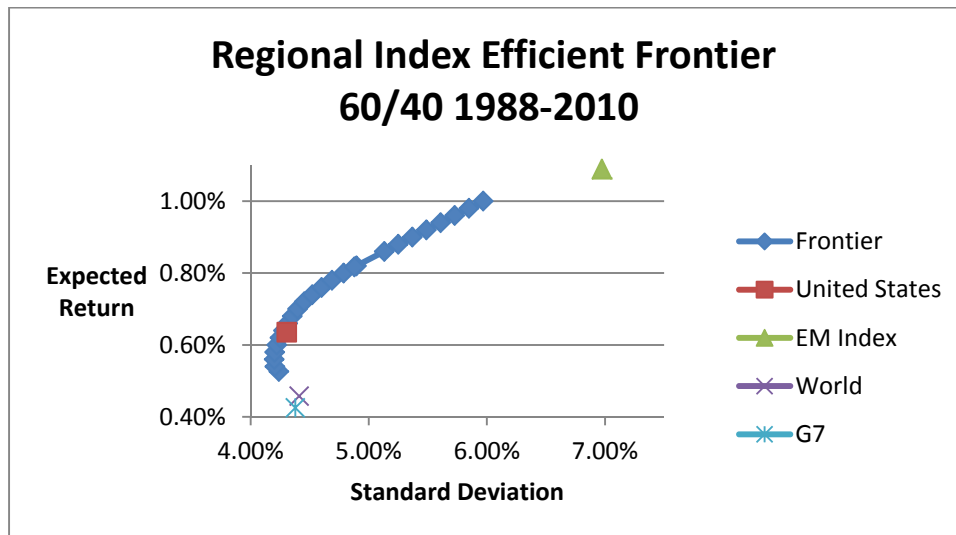
At the regional level, both the 1988-2010 and 1993-2010 portfolios are weighted sixty percent in the United States index and forty percent in the EM index. In the previous exercise at the regional level, both portfolios were weighed heavily in the EM index. In fact the 1988-2010 regional efficient portfolio was completely weighted in the EM index. This automatically implies that adding any of the regional indices in the data set to the EM index will lower the portfolio's Sharpe ratio.

**Table 12: Efficient Portfolio**

*Regional Efficient Portfolio*  
**60/40 1988-2010**

	Weight	Return	Risk
3 mo. T Bill (rf)		0.33%	-
USA	60.00%	0.64%	4.31%
WORLD	0.00%	0.46%	4.41%
EAFE	0.00%	0.36%	5.05%
G7	0.00%	0.43%	4.38%
EM	40.00%	1.09%	6.97%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.82%</b>	<b>4.88%</b>
<b>Sharpe Ratio</b>	<b>0.0994</b>		
<i>*no Short Sales</i>			

**Figure 11: Efficient Frontier**



## 1998-2010 Results

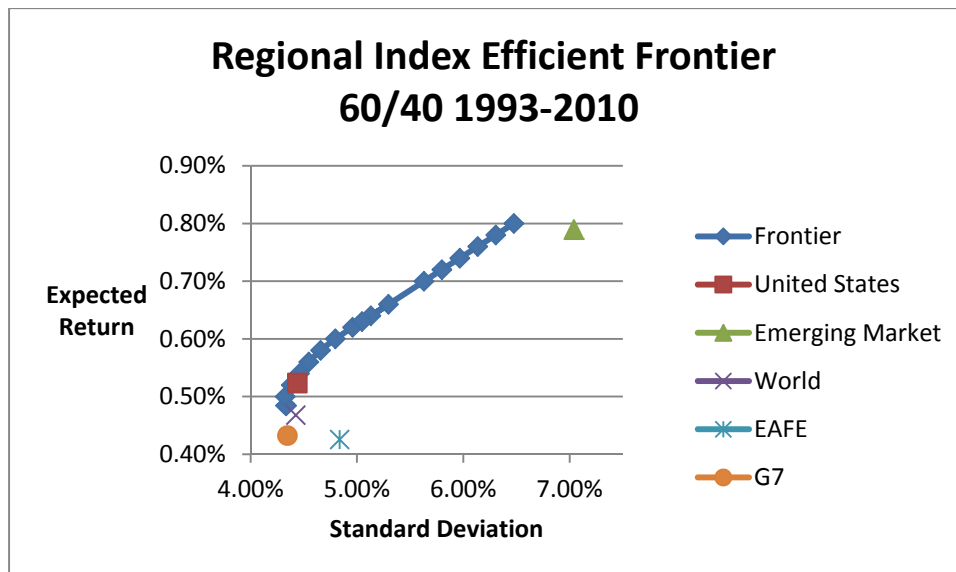
**Table 13: Efficient Portfolio**

### Regional Efficient Portfolio

60/40 1993-2010

	Weight	Return	Risk
3 mo. T Bill (rf)		0.28%	-
USA	60.00%	0.52%	4.44%
WORLD	0.00%	0.47%	4.43%
EAFE	0.00%	0.43%	4.84%
G7	0.00%	0.43%	4.35%
EM	40.00%	0.79%	7.04%
<b>Portfolio</b>	<b>100.00%</b>	<b>0.63%</b>	<b>5.05%</b>
<b>Sharpe Ratio</b>	<b>0.0694</b>		
*no Short Sales			

**Figure 12: Efficient Frontier**



### *Country Index Results*

The 60/40 weighted portfolios perform much better at the country level than at the regional level. Over the two time periods, the country level portfolios have nearly identical Sharpe ratios. This outcome makes sense because the regional level EM index is weighted based on market cap, and is in itself not mean-variance efficient. The country indices are also weighted by market cap within their respective countries. Selecting at the country level allows the investor to be more mean-variance efficient than at a regional level. One drawback not considered here, however, is that investing at the country level will incur more costs than at the regional level.

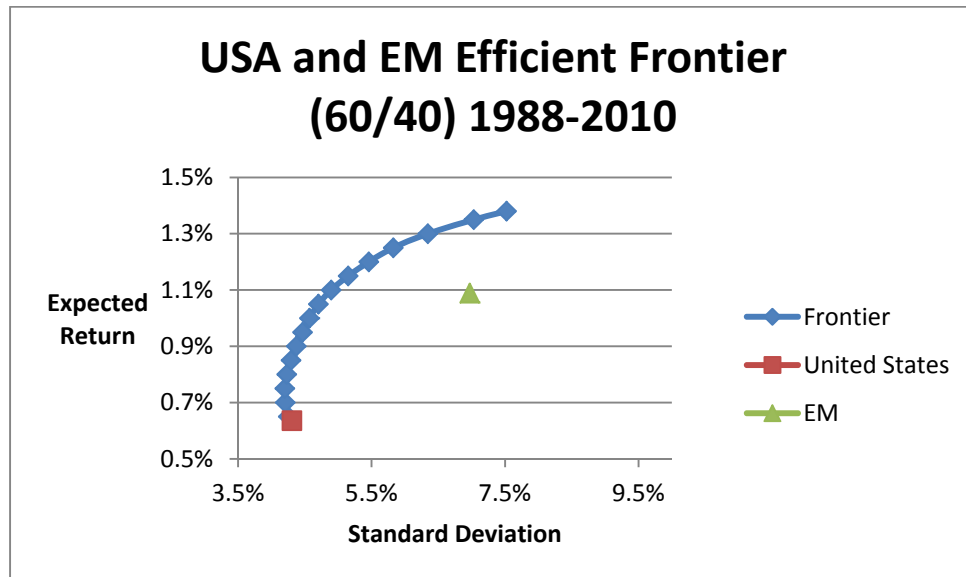
### *1988-2010 Results*

**Table 14: Efficient Portfolio**

#### *G7 and EM Country Efficient Portfolio 60/40 1988-2010*

	<b>Weight</b>	<b>Return</b>	<b>Risk</b>
<i>3 mo. T Bill (rf)</i>	-	0.33%	-
<i>USA</i>	60.00%	0.64%	4.31%
<i>BRAZIL</i>	11.67%	2.50%	15.34%
<i>CHILE</i>	6.89%	1.44%	7.09%
<i>INDONESIA</i>	2.08%	1.74%	14.88%
<i>KOREA</i>	0.00%	1.03%	11.26%
<i>MALAYSIA</i>	0.00%	0.88%	8.57%
<i>MEXICO</i>	16.11%	1.89%	9.28%
<i>PHILIPPINES</i>	0.00%	0.83%	9.25%
<i>TAIWAN</i>	0.00%	0.90%	10.84%
<i>THAILAND</i>	0.00%	1.02%	11.27%
<i>TURKEY</i>	3.26%	2.03%	17.03%
<b>Portfolio</b>	<b>100.00%</b>	<b>1.18%</b>	<b>5.32%</b>
<b>Sharpe Ratio</b>	<b>0.1591</b>		
<i>*No Short Sales</i>			

**Figure 13: Efficient Frontier**



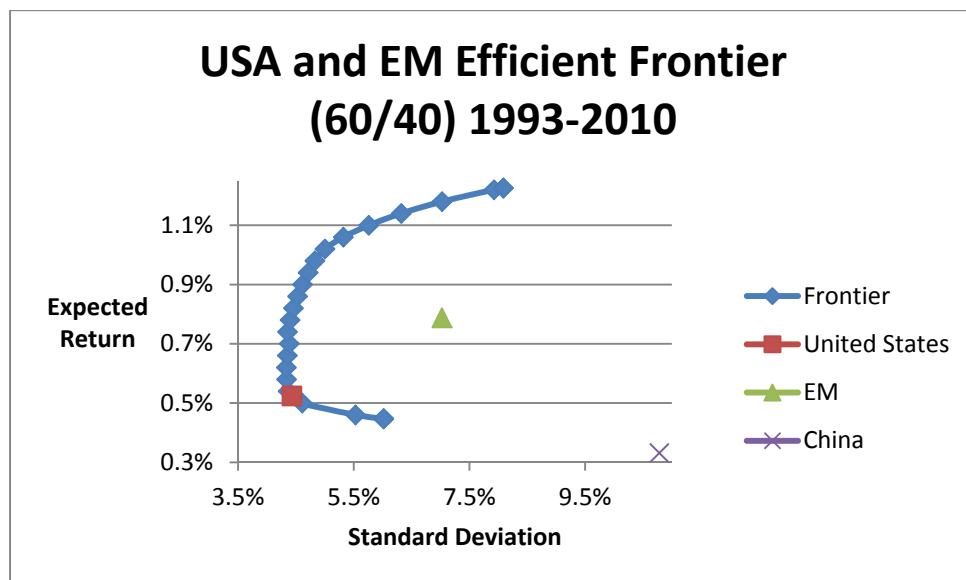
## 1993-2010 Results

**Table 15: Efficient Portfolio**

*G7 and EM Country Efficient Portfolio  
60/40 1993-2010*

	Weight	Return	Risk
3 mo. T Bill (rf)	-	0.28%	-
USA	60.00%	0.52%	4.43%
BRAZIL	0.00%	1.90%	11.54%
CHINA	0.00%	0.33%	10.78%
INDIA	0.00%	1.14%	9.01%
CHILE	0.00%	0.99%	6.90%
COLUMBIA	12.37%	1.58%	9.45%
INDONESIA	0.00%	1.33%	13.64%
KOREA	0.00%	1.15%	11.82%
MALAYSIA	0.00%	0.74%	9.13%
MEXICO	0.00%	1.04%	8.89%
PERU	17.83%	1.71%	9.51%
PHILIPPINES	0.00%	0.44%	9.37%
POLAND	3.71%	1.94%	14.61%
SOUTH AFRICA	0.00%	1.07%	8.06%
TAIWAN	0.00%	0.65%	9.40%
THAILAND	0.00%	0.66%	11.90%
TURKEY	6.09%	2.28%	16.31%
<b>Portfolio</b>	<b>100.00%</b>	<b>1.03%</b>	<b>5.04%</b>
<b>Sharpe Ratio</b>	<b>0.1481</b>		
<i>*No Short Sales</i>			

**Figure 14: Efficient Frontier**



## 60/40 Portfolio Results

Investing sixty percent of a portfolio in the United States in combination with emerging market equity will result in better behaved portfolios than investing in the emerging markets alone. Table 16 below summarizes the portfolio characteristics of these portfolios.

The results of this exercise again make a very strong case for the diversification benefits of emerging market equity. In comparing the 1988 USA and EM portfolio to the portfolios in Table 11, the former portfolio actually outperforms the DM portfolio over the same time period. The 1993 USA and EM portfolio performs very closely to the DM portfolio over the 1993-2010 time period. On a risk basis alone, it actually outperforms the DM portfolio by nearly half a percent per month.

While the additional constraint of pegging a certain percentage of the portfolio to the United States index is in no way mean-variance efficient, it still is a viable alternative for the United States investor. This mechanism can be used to control the portfolio's exposure to emerging market stocks, while still augmenting the portfolio's performance over investing just in the United States index or a combination of the United States and developed market countries.

**Table 16:**

<b><i>Portfolio Characteristics- 60/40 Allocations</i></b>					
<b>Level</b>	<b>Portfolio</b>	<b>Year</b>	<b>Risk</b>	<b>Return</b>	<b>Sharpe Ratio</b>
Regional	Regional 60/40	1988	4.88%	0.82%	0.0994
Regional	Regional 60/40	1993	5.05%	0.63%	0.0694
<b>Country</b>	<b>USA &amp; EM 60/40</b>	<b>1988</b>	<b>5.32%</b>	<b>1.18%</b>	<b>0.1591</b>
Country	USA & EM 60/40	1993	5.04%	1.03%	0.1481

### ***GNI Portfolio Results***

In this section I present the results of my GNI weighted index model. The time period for this model is 1988-2008, the last year that GNI data was available. I first examine the performance of a portfolio invested in the G7 countries, followed by investing in the non-G7 DM countries, and finally the EM countries. I present graphs and show how if constructed, these portfolios would have performed over time. My findings indicate that the EM index would have performed best, followed by the United States, DM, and G7 indices.

For the GNI data, annual portfolio weights, and individual portfolio data, please refer to Appendix B.

I also used the portfolios' annual returns to construct an efficient portfolio based on the different GNI indices. Using the Sharpe ratio, this efficient portfolio can be compared to the efficient portfolios in the mean-variance section. The GNI weighted portfolio has several intrinsic advantages to the investor than the mean-variance efficient portfolios. Firstly, it offers a high level of diversification. Market cap based indices are often skewed heavily to large developed countries such as the United States and United Kingdom. The GNI weighted index includes a much larger proportion of other large economies, such as China and India. The GNI weighted index is also much more cost efficient. The investor gains exposure to a higher level of countries with the GNI index versus having to buy each country index.

### **GNI Efficient Portfolio Results**

Both GNI efficient portfolios have higher Sharpe ratios than any mean-variance efficient portfolio in my study. The 1988-2010 GNI efficient portfolio is invested fifty-three percent in the United States and forty-seven percent in the emerging market GNI index. Meanwhile from 1993-2010, the GNI efficient portfolio was weighted eighty-five percent in developed market equity and only fifteen percent in emerging market equity. Figure 17 below shows that the DM index outperformed the EM index for much of the 1990s through 2006. During this second time period the DM index outperformed the United States index by an average of 3.72 percent annually. Based on these efficient portfolios, it appears that indexing based on economic output can result in more efficient international stock portfolios.

While more research needs to be done on this topic, it is clear that allocating capital in this fashion can deliver robust portfolio diversification. Referring to Tables 36 and 37 in Appendix B, the emerging market index is even less correlated to the United States index when using the GNI approach. From 1988 to 2010 the GNI United States- EM correlation is .4039, compared to .6549 over the same time period using the EM market cap weighted index. The effect is even more pronounced from 1993-2010, where the GNI based correlations are .3470 against .7134. During the second time period, the correlations actually diverge from one another.



Unfortunately, there are few opportunities for retail investors to actually invest in economic output based international funds. Currently, the only such index fund available to investors is MSCI's ACWI (All Country World Index), a GDP weighted ETF, though according to an August 2010 ETFdb article, two more GDP weighted ETFs may hit the market soon. One would be solely comprised of emerging market countries (ETFdb, 2010).

As a final note, I chose to leave the final year of the model as 2008 in order to show both the magnitude in return gap at the peak in 2007, as well as the ensuing market crash in 2008. Figure 17 shows that between 2007 and 2008, the DM index and United States actually switch places in cumulative return ranking. The United States ends up with a slightly higher cumulative return (3.74) than the DM index (3.39), whereas the cumulative return was in favor of the DM index (7.18 versus 6.09) in 2007.

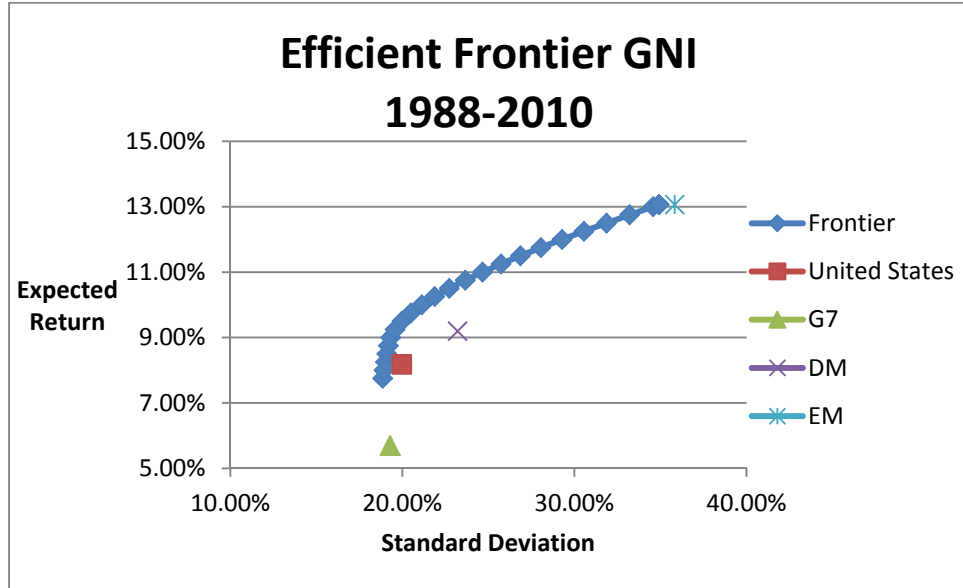
Furthermore, the impact of the .com boom can easily be seen in Figure 17. A spike is seen in all the indices during this time, but it is by far most pronounced in the United States. The results of the housing boom are nearly the reverse, where the impact is felt most severely in the EM and DM index. From 1996 through 2006 the United States outperforms all of the GNI indices. From 2003 on, the G7 index is the worst performing index. Much of the G7's lagging performance toward the end of the model can be attributed to the United States, who's GNI makes up anywhere from 45% to 48% of the G7's total GNI from 2003 on. That the other six G7 countries do little to offset the United States sluggish equity performance is an alarming concern regarding the G7 country's diversification abilities.

### ***1988-2010 Results***

**Table 17: Efficient Portfolio**

<i>GNI Efficient Portfolio 1988-2008</i>			
	<b>Weight</b>	<b>Mean</b>	<b>Risk</b>
<i>3 mo. T Bill (rf)</i>		3.98%	-
<i>USA</i>	53%	8.18%	19.97%
<i>G7</i>	0%	5.70%	19.29%
<i>DM</i>	0%	9.19%	23.21%
<i>EM</i>	47%	13.06%	35.83%
<b>Portfolio</b>	<b>100%</b>	<b>10.45%</b>	<b>22.57%</b>
<b>Sharpe Ratio</b>	<b>0.2867</b>		
<i>*no Short Sales</i>			

**Figure 15: Efficient Frontier**



**1993-2010 Results**

**Table 18: Efficient Portfolio**

*GNI Efficient Portfolio 1993-2008*

	Weight	Return	Risk
3 mo. T Bill ( <i>rf</i> )		3.35%	-
USA	0%	6.93%	21.03%
G7	0%	6.13%	20.17%
DM	85%	10.65%	24.57%
EM	15%	12.89%	38.40%
<b>Portfolio</b>	<b>100%</b>	<b>10.99%</b>	<b>24.58%</b>
<b>Sharpe Ratio</b>	<b>0.3106</b>		
<i>*no Short Sales</i>			

Figure 16: Efficient Frontier

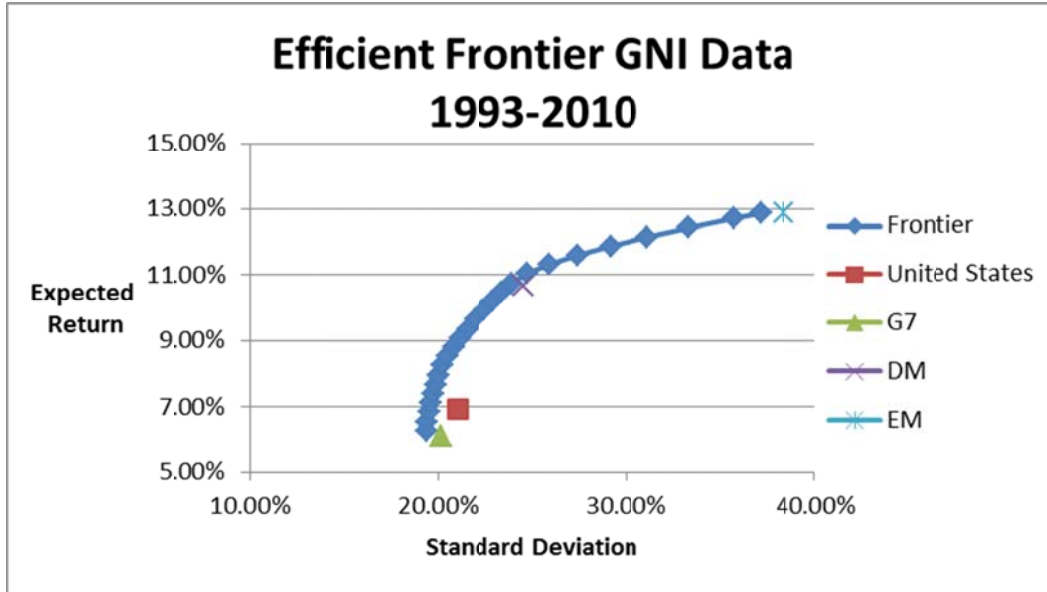


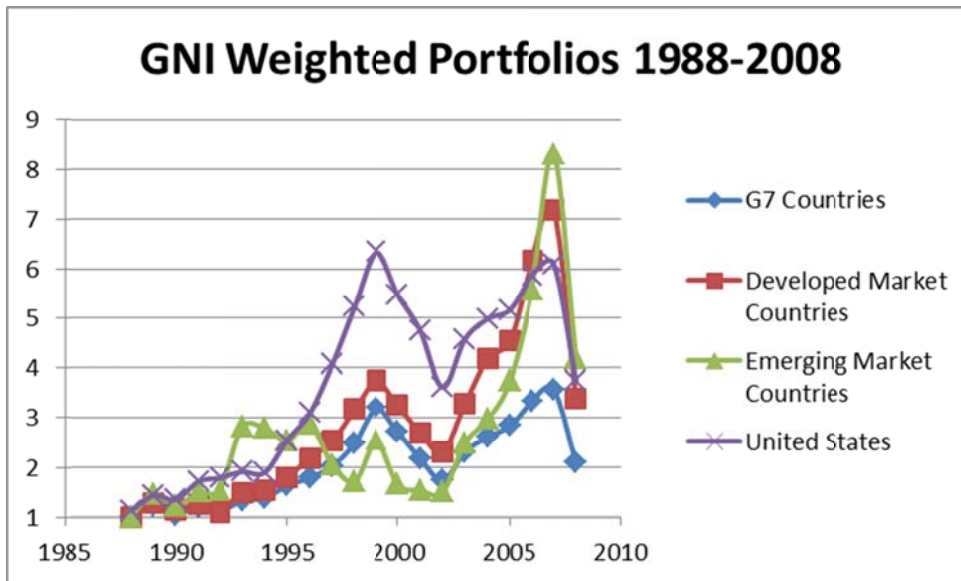
Table 19:

*GNI Portfolio Returns 1988-2008\**

Year	USA	G7	DM	EM
1988	1.00	1.00	1.00	1.00
1989	1.27	1.22	1.26	1.47
1990	1.20	1.04	1.14	1.21
1991	1.52	1.21	1.25	1.49
1992	1.59	1.12	1.09	1.53
1993	1.70	1.32	1.48	2.82
1994	1.68	1.38	1.54	2.79
1995	2.27	1.63	1.80	2.54
1996	2.75	1.79	2.18	2.87
1997	3.63	2.02	2.53	2.05
1998	4.67	2.49	3.17	1.72
1999	5.65	3.20	0.50	2.55
2000	4.88	2.71	3.25	1.66
2001	4.23	2.18	2.70	1.53
2002	3.22	1.73	2.31	1.50
2003	4.08	2.31	3.29	2.49
2004	4.44	2.61	4.19	2.96
2005	4.61	2.84	4.55	3.76
2006	5.22	3.33	6.16	5.58
2007	5.43	3.56	7.18	8.31
2008	3.34	2.10	3.39	4.19

\*Value of \$1 invested in base year

**Figure 17: G7, DM and EM combined with U.S. index**



## IV. Conclusion

In summary, I find that emerging markets offer the American investor the best opportunity to reap the benefits of global equity diversification. My study indicates that while historically highly volatile, emerging market countries can augment the risk and return performance of a solely domestic stock portfolio. At the country level, emerging market indices remain less correlated with the United States index, though the trend has been for correlations to increase over the time period of the study.

Research indicates that to achieve the maximum benefits of diversification, the American investor should hold approximately a 60/40 split of domestic and foreign equity in their portfolio. While this strategy is not as mean-variance efficient as investing just in emerging market equity, it is still a viable option for many American investors. Investing the forty percent allocation in emerging markets offers comparable diversification to investing in developed market countries alone, and easily outpaces investing in G7 countries. Overweighting the United States index relative to its world market capitalization is also consistent with American investors' home-country bias.

I find that in all scenarios, investing in the G7 countries offers dismal diversification benefits. The G7 index is heavily weighted in the United States and therefore highly correlated. Of all the G7 countries, the United States' equity market is historically the least volatile and makes for the most attractive investment of these seven countries.

Finally, I also find that economic output weighted indices have the potential to offer significantly better diversification than market weighted indices. The GNI indices, and especially the emerging market index, appear to be significantly less correlated than the market weighted indices' correlations.

American investors accomplish the most efficient diversification when choosing assets that are least correlated to the United States stock market. Historically, emerging market equities have consistently offered the best returns combined with the lowest correlations.

Today's investor is presented with a plethora of international equity investment opportunities. While the sheer number of investment options can be overwhelming, adding international-fueled portfolio diversification to a domestic stock portfolio is in the age of the Internet as simple as a click of a button.

### ***Further Studies***

This study could be furthered and improved upon in several ways. A CAPM pricing model could be used to forecast expected returns to input in the mean-variance model. Likewise, a variety of techniques such as option pricing models or GARCH models could be used to forecast standard deviation. Additionally, further studies could use more recent time periods to include additional countries, particularly in emerging markets, in the dataset.

The notion to invest using GDP, market capitalization, and equal weighted portfolios has existed for well over twenty years, as evidenced by Umstead (1990). Including an equal weighted portfolio would also augment this study by providing the reader and investor with more investment strategies and results.

A more recent development in finance has been the use of momentum based strategies. The logic behind this strategy is that “hot” or well performing stocks in one period tend to continue to perform well in the next period. Certainly a study which applied a momentum strategy on a global region, country, or industry level would be a compelling study.

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# Appendix A

List of MSCI Regional and Country indices used in study

Mean-variance portfolio model Inputs

The following tables are organized into two categories: regional and country level portfolios.

The regional and country portfolios are further classified by market group (G7, DM, and EM), then by year. Finally, all country indices are combined and displayed by year. For each category, four statistics are presented: the historical average return, standard deviation, covariance matrix, and correlation matrix.

**Table 20**

***MSCI Regional Indices included in Data***

The World Index (1970)

Australia  
Austria  
Belgium  
Canada  
Denmark  
Finland  
France  
Germany  
Greece  
Hong Kong  
Ireland  
Israel  
Italy  
Japan  
Netherlands  
New Zealand  
Norway  
Portugal  
Singapore  
Spain  
Sweden  
Switzerland  
United Kingdom  
United States of America

EAFE Index (1970)

Includes all countries in The World Index less the United States of America and Canada

G7 Index (1977)

Canada  
France  
Germany  
Italy  
Japan  
United Kingdom  
United States of America

Emerging Markets Index (1988)

Brazil  
Chile  
China  
Columbia  
Czech Republic  
Egypt  
Hungary  
India  
Indonesia  
Korea  
Malaysia  
Mexico  
Morocco  
Peru  
Philippines  
Poland  
Russia  
South Africa  
Taiwan  
Thailand  
Turkey

**Table 21**

***MSCI Country Indices included in Data***

Developed Market

G7 Countries

United States (1969)  
Canada (1969)  
France (1969)  
Germany (1969)  
Italy (1969)  
Japan (1969)  
United Kingdom (1969)

Asia & Oceania

Australia (1969)  
Hong Kong (1969)  
New Zealand (1988)  
Singapore (1969)

Europe

Austria (1969)  
Belgium (1969)  
Denmark (1969)  
Finland (1988)  
Greece (1988)  
Ireland (1988)  
Netherlands (1969)  
Norway (1969)  
Portugal (1988)  
Spain (1969)  
Sweden (1969)  
Switzerland (1969)

Emerging Market

Asia

China (1993)  
India (1993)  
Indonesia (1988)  
Korea (1988)  
Malaysia (1988)  
Philippines (1988)  
Taiwan (1988)  
Thailand (1988)

Europe, Middle East & Africa

Poland (1993)  
South Africa (1993)  
Turkey (1988)

Latin America

Brazil (1988)  
Chile (1988)  
Columbia (1993)  
Mexico (1988)  
Peru (1993)

**Table 22: Regional Indices Summary Statistics 1988-2010**

	Return	Risk
<i>3 mo. T Bill (rf)</i>	0.33%	-
<i>USA</i>	0.64%	4.31%
<i>WORLD</i>	0.46%	4.41%
<i>EAFE</i>	0.36%	5.05%
<i>G7</i>	0.43%	4.38%
<i>EM</i>	1.09%	6.97%

<b>Correlation</b>	<i>USA</i>	<i>WORLD</i>	<i>EAFE</i>	<i>G7</i>	<i>EM</i>
<i>USA</i>	1.0000	0.8788	0.6988	0.8824	0.6549
<i>WORLD</i>	0.8788	1.0000	0.9521	0.9968	0.7197
<i>EAFE</i>	0.6988	0.9521	1.0000	0.9419	0.6777
<i>G7</i>	0.8824	0.9968	0.9419	1.0000	0.6960
<i>EM</i>	0.6549	0.7197	0.6777	0.6960	1.0000

<b>Covariance</b>	<i>USA</i>	<i>WORLD</i>	<i>EAFE</i>	<i>G7</i>	<i>EM</i>
<i>USA</i>	0.0018	0.0017	0.0015	0.0017	0.0020
<i>WORLD</i>	0.0017	0.0019	0.0021	0.0019	0.0022
<i>EAFE</i>	0.0015	0.0021	0.0025	0.0021	0.0024
<i>G7</i>	0.0017	0.0019	0.0021	0.0019	0.0021
<i>EM</i>	0.0020	0.0022	0.0024	0.0021	0.0048

**Table 23: Regional Indices Summary Statistics 1993-2010**

	Return	Risk
<i>3 mo. T Bill (rf)</i>	0.28%	-
<i>USA</i>	0.52%	4.44%
<i>WORLD</i>	0.47%	4.43%
<i>EAFE</i>	0.43%	4.84%
<i>G7</i>	0.43%	4.35%
<i>EM</i>	0.79%	7.04%

<b>Correlation</b>	<i>USA</i>	<i>WORLD</i>	<i>EAFE</i>	<i>G7</i>	<i>EM</i>
<i>USA</i>	1.0000	0.9342	0.7869	0.9433	0.7134
<i>WORLD</i>	0.9342	1.0000	0.9534	0.9966	0.7926
<i>EAFE</i>	0.7869	0.9534	1.0000	0.9379	0.7766
<i>G7</i>	0.9433	0.9966	0.9379	1.0000	0.7694
<i>EM</i>	0.7134	0.7926	0.7766	0.7694	1.0000

<b>Covariance</b>	<i>USA</i>	<i>WORLD</i>	<i>EAFE</i>	<i>G7</i>	<i>EM</i>
<i>USA</i>	0.0020	0.0018	0.0017	0.0018	0.0022
<i>WORLD</i>	0.0018	0.0019	0.0020	0.0019	0.0024
<i>EAFE</i>	0.0017	0.0020	0.0023	0.0020	0.0026
<i>G7</i>	0.0018	0.0019	0.0020	0.0019	0.0023
<i>EM</i>	0.0022	0.0024	0.0026	0.0023	0.0049

**Table 24: G7 Countries Summary Statistics 1970-2010**

	Return	Risk
<i>3 mo. T Bill (rf)</i>	0.46%	-
CANADA	0.73%	5.79%
FRANCE	0.74%	6.56%
GERMANY	0.74%	6.33%
ITALY	0.49%	7.38%
JAPAN	0.83%	6.30%
UK	0.67%	6.48%
USA	0.58%	4.51%

<b>Covariance</b>	CANADA	FRANCE	GERMANY	ITALY	JAPAN	UK	USA
CANADA	0.0033	0.0020	0.0017	0.0017	0.0013	0.0021	0.0019
FRANCE	0.0020	0.0043	0.0029	0.0027	0.0018	0.0026	0.0016
GERMANY	0.0017	0.0029	0.0040	0.0024	0.0016	0.0021	0.0015
ITALY	0.0017	0.0027	0.0024	0.0054	0.0018	0.0020	0.0012
JAPAN	0.0013	0.0018	0.0016	0.0018	0.0040	0.0016	0.0010
UK	0.0021	0.0026	0.0021	0.0020	0.0016	0.0042	0.0017
USA	0.0019	0.0016	0.0015	0.0012	0.0010	0.0017	0.0020

<b>Correlation</b>	CANADA	FRANCE	GERMANY	ITALY	JAPAN	UK	USA
CANADA	1.0000	0.5299	0.4710	0.4047	0.3674	0.5584	0.7374
FRANCE	0.5299	1.0000	0.7087	0.5556	0.4313	0.6075	0.5519
GERMANY	0.4710	0.7087	1.0000	0.5230	0.3998	0.5148	0.5301
ITALY	0.4047	0.5556	0.5230	1.0000	0.3918	0.4260	0.3710
JAPAN	0.3674	0.4313	0.3998	0.3918	1.0000	0.4032	0.3505
UK	0.5584	0.6075	0.5148	0.4260	0.4032	1.0000	0.5702
USA	0.7374	0.5519	0.5301	0.3710	0.3505	0.5702	1.0000

**Table 25: G7 Countries Summary Statistics 1988-2010**

	Return	Risk
<i>3 mo. T Bill (rf)</i>	0.33%	-
<i>CANADA</i>	0.78%	5.64%
<i>FRANCE</i>	0.72%	5.95%
<i>GERMANY</i>	0.72%	6.62%
<i>ITALY</i>	0.38%	6.92%
<i>JAPAN</i>	0.07%	6.35%
<i>UK</i>	0.45%	4.87%
<i>USA</i>	0.64%	4.30%

<b>Covariance</b>	<i>CANADA</i>	<i>FRANCE</i>	<i>GERMANY</i>	<i>ITALY</i>	<i>JAPAN</i>	<i>UK</i>	<i>USA</i>
<i>CANADA</i>	0.0032	0.0021	0.0023	0.0021	0.0016	0.0018	0.0018
<i>FRANCE</i>	0.0021	0.0035	0.0034	0.0028	0.0017	0.0022	0.0018
<i>GERMANY</i>	0.0023	0.0034	0.0044	0.0031	0.0016	0.0023	0.0019
<i>ITALY</i>	0.0021	0.0028	0.0031	0.0048	0.0018	0.0020	0.0016
<i>JAPAN</i>	0.0016	0.0017	0.0016	0.0018	0.0040	0.0016	0.0011
<i>UK</i>	0.0018	0.0022	0.0023	0.0020	0.0016	0.0024	0.0015
<i>USA</i>	0.0018	0.0018	0.0019	0.0016	0.0011	0.0015	0.0018

<b>Correlation</b>	<i>CANADA</i>	<i>FRANCE</i>	<i>GERMANY</i>	<i>ITALY</i>	<i>JAPAN</i>	<i>UK</i>	<i>USA</i>
<i>CANADA</i>	1.0000	0.6240	0.6087	0.5434	0.4525	0.6460	0.7609
<i>FRANCE</i>	0.6240	1.0000	0.8639	0.6820	0.4553	0.7447	0.6916
<i>GERMANY</i>	0.6087	0.8639	1.0000	0.6863	0.3907	0.7101	0.6782
<i>ITALY</i>	0.5434	0.6820	0.6863	1.0000	0.4158	0.5823	0.5281
<i>JAPAN</i>	0.4525	0.4553	0.3907	0.4158	1.0000	0.5202	0.4174
<i>UK</i>	0.6460	0.7447	0.7101	0.5823	0.5202	1.0000	0.7179
<i>USA</i>	0.7609	0.6916	0.6782	0.5281	0.4174	0.7179	1.0000



**Table 26: G7 Countries Summary Statistics 1993-2010**

	<b>Return</b>	<b>Risk</b>
<i>3 mo. T Bill (rf)</i>	0.28%	-
CANADA	0.94%	6.06%
FRANCE	0.58%	5.79%
GERMANY	0.69%	6.56%
ITALY	0.56%	6.97%
JAPAN	0.15%	5.80%
UK	0.40%	4.56%
USA	0.52%	4.43%

<b>Covariance</b>	CANADA	FRANCE	GERMANY	ITALY	JAPAN	UK	USA
CANADA	0.0037	0.0025	0.0027	0.0023	0.0018	0.0020	0.0021
FRANCE	0.0025	0.0033	0.0033	0.0030	0.0016	0.0022	0.0019
GERMANY	0.0027	0.0033	0.0043	0.0032	0.0015	0.0023	0.0022
ITALY	0.0023	0.0030	0.0032	0.0048	0.0017	0.0020	0.0018
JAPAN	0.0018	0.0016	0.0015	0.0017	0.0033	0.0014	0.0012
UK	0.0020	0.0022	0.0023	0.0020	0.0014	0.0021	0.0016
USA	0.0021	0.0019	0.0022	0.0018	0.0012	0.0016	0.0020

<b>Correlation</b>	CANADA	FRANCE	GERMANY	ITALY	JAPAN	UK	USA
CANADA	1.0000	0.7098	0.6748	0.5562	0.5251	0.7271	0.7875
FRANCE	0.7098	1.0000	0.8863	0.7502	0.4799	0.8282	0.7616
GERMANY	0.6748	0.8863	1.0000	0.7066	0.3983	0.7673	0.7678
ITALY	0.5562	0.7502	0.7066	1.0000	0.4203	0.6410	0.5878
JAPAN	0.5251	0.4799	0.3983	0.4203	1.0000	0.5137	0.4777
UK	0.7271	0.8282	0.7673	0.6410	0.5137	1.0000	0.7749
USA	0.7875	0.7616	0.7678	0.5878	0.4777	0.7749	1.0000

**Table 27: DM Countries Summary Statistics 1988-2010**

*DM Risk Return Profile 1988-2010*

	Return	Risk
3 mo. T Bill (rf)	0.33%	-
THE WORLD INDEX	0.46%	4.41%
USA	0.64%	4.31%
AUSTRALIA	0.72%	5.99%
AUSTRIA	0.62%	7.61%
BELGIUM	0.53%	6.03%
DENMARK	1.06%	5.76%
FINLAND	0.94%	9.35%
GREECE	0.88%	10.68%
HONG KONG	0.97%	7.65%
IRELAND	0.20%	6.54%
NETHERLANDS	0.66%	5.48%
NEW ZEALAND	0.17%	6.79%
NORWAY	0.90%	7.60%
PORTUGAL	0.27%	6.65%
SINGAPORE	0.86%	7.28%
SPAIN	0.71%	6.71%
SWEDEN	1.08%	7.48%
SWITZERLAND	0.86%	5.02%

**Table 27: DM Countries Summary Statistics 1988-2010**

**DM Covariance Matrix 1988-2010**

<b>Covariance</b>	<b>WORLD</b>	<b>USA</b>	<b>AUSTRALIA</b>	<b>AUSTRIA</b>	<b>BELGIUM</b>	<b>DENMARK</b>	<b>FINLAND</b>	<b>GREECE</b>	<b>HONG KONG</b>	<b>IRELAND</b>	<b>NETHERLANDS</b>
WORLD	0.0019	0.0017	0.0019	0.0019	0.0019	0.0018	0.0026	0.0022	0.0021	0.0021	0.0020
USA	0.0017	0.0018	0.0016	0.0015	0.0016	0.0014	0.0023	0.0017	0.0018	0.0018	0.0017
AUSTRALIA	0.0019	0.0016	0.0036	0.0024	0.0019	0.0017	0.0029	0.0025	0.0025	0.0022	0.0021
AUSTRIA	0.0019	0.0015	0.0024	0.0058	0.0029	0.0025	0.0026	0.0043	0.0025	0.0028	0.0027
BELGIUM	0.0019	0.0016	0.0019	0.0029	0.0036	0.0024	0.0022	0.0033	0.0019	0.0026	0.0027
DENMARK	0.0018	0.0014	0.0017	0.0025	0.0024	0.0033	0.0025	0.0026	0.0019	0.0023	0.0023
FINLAND	0.0026	0.0023	0.0029	0.0026	0.0022	0.0025	0.0087	0.0033	0.0029	0.0029	0.0028
GREECE	0.0022	0.0017	0.0025	0.0043	0.0033	0.0026	0.0033	0.0114	0.0024	0.0031	0.0029
HONG KONG	0.0021	0.0018	0.0025	0.0025	0.0019	0.0019	0.0029	0.0024	0.0058	0.0020	0.0022
IRELAND	0.0021	0.0018	0.0022	0.0028	0.0026	0.0023	0.0029	0.0031	0.0020	0.0043	0.0025
NETHERLANDS	0.0020	0.0017	0.0021	0.0027	0.0027	0.0023	0.0028	0.0029	0.0022	0.0025	0.0030
NEW ZEALAND	0.0017	0.0014	0.0030	0.0025	0.0017	0.0016	0.0027	0.0026	0.0024	0.0021	0.0020
NORWAY	0.0024	0.0019	0.0030	0.0037	0.0030	0.0030	0.0037	0.0037	0.0029	0.0030	0.0030
PORTUGAL	0.0018	0.0013	0.0018	0.0028	0.0023	0.0021	0.0027	0.0041	0.0020	0.0023	0.0023
SINGAPORE	0.0022	0.0019	0.0026	0.0027	0.0021	0.0020	0.0028	0.0025	0.0042	0.0022	0.0024
SPAIN	0.0023	0.0018	0.0025	0.0029	0.0026	0.0025	0.0033	0.0039	0.0026	0.0027	0.0027
SWEDEN	0.0026	0.0022	0.0028	0.0027	0.0026	0.0028	0.0046	0.0035	0.0029	0.0029	0.0030
SWITZERLAND	0.0016	0.0013	0.0015	0.0022	0.0020	0.0018	0.0020	0.0022	0.0016	0.0018	0.0021

**Table 27: DM Countries Summary Statistics 1988-2010**

**DM Covariance Matrix 1988-2010 (Continued)**

<b>Covariance</b>	<b>NEW ZEALAND</b>	<b>NORWAY</b>	<b>PORTUGAL</b>	<b>SINGAPORE</b>	<b>SPAIN</b>	<b>SWEDEN</b>	<b>SWITZERLAND</b>
<i>WORLD</i>	0.0017	0.0024	0.0018	0.0022	0.0023	0.0026	0.0016
<i>USA</i>	0.0014	0.0019	0.0013	0.0019	0.0018	0.0022	0.0013
<i>AUSTRALIA</i>	0.0030	0.0030	0.0018	0.0026	0.0025	0.0028	0.0015
<i>AUSTRIA</i>	0.0025	0.0037	0.0028	0.0027	0.0029	0.0027	0.0022
<i>BELGIUM</i>	0.0017	0.0030	0.0023	0.0021	0.0026	0.0026	0.0020
<i>DENMARK</i>	0.0016	0.0030	0.0021	0.0020	0.0025	0.0028	0.0018
<i>FINLAND</i>	0.0027	0.0037	0.0027	0.0028	0.0033	0.0046	0.0020
<i>GREECE</i>	0.0026	0.0037	0.0041	0.0025	0.0039	0.0035	0.0022
<i>HONG KONG</i>	0.0024	0.0029	0.0020	0.0042	0.0026	0.0029	0.0016
<i>IRELAND</i>	0.0021	0.0030	0.0023	0.0022	0.0027	0.0029	0.0018
<i>NETHERLANDS</i>	0.0020	0.0030	0.0023	0.0024	0.0027	0.0030	0.0021
<i>NEW ZEALAND</i>	0.0046	0.0027	0.0021	0.0027	0.0025	0.0029	0.0017
<i>NORWAY</i>	0.0027	0.0058	0.0027	0.0032	0.0032	0.0037	0.0021
<i>PORTUGAL</i>	0.0021	0.0027	0.0044	0.0018	0.0031	0.0029	0.0019
<i>SINGAPORE</i>	0.0027	0.0032	0.0018	0.0053	0.0026	0.0031	0.0017
<i>SPAIN</i>	0.0025	0.0032	0.0031	0.0026	0.0045	0.0037	0.0021
<i>SWEDEN</i>	0.0029	0.0037	0.0029	0.0031	0.0037	0.0056	0.0023
<i>SWITZERLAND</i>	0.0017	0.0021	0.0019	0.0017	0.0021	0.0023	0.0025

**Table 27: DM Countries Summary Statistics 1988-2010**

**DM Correlation Matrix 1988-2010**

<b>Correlation</b>	<b>WORLD</b>	<b>USA</b>	<b>AUSTRALIA</b>	<b>AUSTRIA</b>	<b>BELGIUM</b>	<b>DENMARK</b>	<b>FINLAND</b>	<b>GREECE</b>	<b>HONG KONG</b>	<b>IRELAND</b>	<b>NETHERLANDS</b>
WORLD	1.0000	0.8788	0.7063	0.5821	0.7260	0.7066	0.6418	0.4610	0.6123	0.7298	0.8434
USA	0.8788	1.0000	0.6139	0.4478	0.6161	0.5788	0.5763	0.3766	0.5472	0.6376	0.7310
AUSTRALIA	0.7063	0.6139	1.0000	0.5357	0.5203	0.5085	0.5106	0.3956	0.5391	0.5650	0.6394
AUSTRIA	0.5821	0.4478	0.5357	1.0000	0.6321	0.5785	0.3707	0.5296	0.4266	0.5739	0.6547
BELGIUM	0.7260	0.6161	0.5203	0.6321	1.0000	0.6811	0.3972	0.5085	0.4151	0.6511	0.8078
DENMARK	0.7066	0.5788	0.5085	0.5785	0.6811	1.0000	0.4721	0.4234	0.4280	0.6169	0.7279
FINLAND	0.6418	0.5763	0.5106	0.3707	0.3972	0.4721	1.0000	0.3340	0.4075	0.4787	0.5545
GREECE	0.4610	0.3766	0.3956	0.5296	0.5085	0.4234	0.3340	1.0000	0.2951	0.4427	0.4910
HONG KONG	0.6123	0.5472	0.5391	0.4266	0.4151	0.4280	0.4075	0.2951	1.0000	0.4032	0.5301
IRELAND	0.7298	0.6376	0.5650	0.5739	0.6511	0.6169	0.4787	0.4427	0.4032	1.0000	0.6949
NETHERLANDS	0.8434	0.7310	0.6394	0.6547	0.8078	0.7279	0.5545	0.4910	0.5301	0.6949	1.0000
NEW ZEALAND	0.5751	0.4700	0.7303	0.4931	0.4096	0.4071	0.4320	0.3634	0.4555	0.4665	0.5467
NORWAY	0.7037	0.5977	0.6557	0.6352	0.6527	0.6823	0.5234	0.4520	0.5016	0.6026	0.7164
PORTUGAL	0.6013	0.4596	0.4422	0.5482	0.5861	0.5512	0.4286	0.5735	0.4030	0.5378	0.6444
SINGAPORE	0.6795	0.6110	0.5993	0.4886	0.4820	0.4821	0.4104	0.3267	0.7488	0.4696	0.5939
SPAIN	0.7814	0.6418	0.6191	0.5632	0.6442	0.6464	0.5348	0.5495	0.5052	0.6239	0.7327
SWEDEN	0.7887	0.6721	0.6204	0.4740	0.5739	0.6621	0.6621	0.4435	0.5045	0.5900	0.7391
SWITZERLAND	0.7369	0.5988	0.5014	0.5835	0.6631	0.6274	0.4240	0.4149	0.4127	0.5519	0.7514

**Table 27: DM Countries Summary Statistics 1988-2010**

**DM Correlation Matrix 1988-2010 (Continued)**

<b>Correlation</b>	<b>NEW ZEALAND</b>	<b>NORWAY</b>	<b>PORTUGAL</b>	<b>SINGAPORE</b>	<b>SPAIN</b>	<b>SWEDEN</b>	<b>SWITZERLAND</b>
<i>WORLD</i>	0.5751	0.7037	0.6013	0.6795	0.7814	0.7887	0.7369
<i>USA</i>	0.4700	0.5977	0.4596	0.6110	0.6418	0.6721	0.5988
<i>AUSTRALIA</i>	0.7303	0.6557	0.4422	0.5993	0.6191	0.6204	0.5014
<i>AUSTRIA</i>	0.4931	0.6352	0.5482	0.4886	0.5632	0.4740	0.5835
<i>BELGIUM</i>	0.4096	0.6527	0.5861	0.4820	0.6442	0.5739	0.6631
<i>DENMARK</i>	0.4071	0.6823	0.5512	0.4821	0.6464	0.6621	0.6274
<i>FINLAND</i>	0.4320	0.5234	0.4286	0.4104	0.5348	0.6621	0.4240
<i>GREECE</i>	0.3634	0.4520	0.5735	0.3267	0.5495	0.4435	0.4149
<i>HONG KONG</i>	0.4555	0.5016	0.4030	0.7488	0.5052	0.5045	0.4127
<i>IRELAND</i>	0.4665	0.6026	0.5378	0.4696	0.6239	0.5900	0.5519
<i>NETHERLANDS</i>	0.5467	0.7164	0.6444	0.5939	0.7327	0.7391	0.7514
<i>NEW ZEALAND</i>	1.0000	0.5348	0.4697	0.5535	0.5491	0.5645	0.4882
<i>NORWAY</i>	0.5348	1.0000	0.5330	0.5738	0.6290	0.6557	0.5600
<i>PORTUGAL</i>	0.4697	0.5330	1.0000	0.3794	0.7062	0.5863	0.5764
<i>SINGAPORE</i>	0.5535	0.5738	0.3794	1.0000	0.5426	0.5654	0.4692
<i>SPAIN</i>	0.5491	0.6290	0.7062	0.5426	1.0000	0.7383	0.6369
<i>SWEDEN</i>	0.5645	0.6557	0.5863	0.5654	0.7383	1.0000	0.6050
<i>SWITZERLAND</i>	0.4882	0.5600	0.5764	0.4692	0.6369	0.6050	1.0000

**Table 28: DM Countries Summary Statistics 1993-2010**

*DM Risk Return Profile 1993-2010*

	Return	Risk
3 mo. T Bill (rf)	0.28%	-
THE WORLD INDEX	0.47%	4.42%
USA	0.52%	4.43%
AUSTRALIA	0.77%	6.03%
AUSTRIA	0.45%	7.10%
BELGIUM	0.44%	6.13%
DENMARK	1.05%	5.69%
FINLAND	1.51%	9.87%
GREECE	0.64%	9.25%
HONG KONG	0.76%	7.92%
IRELAND	0.12%	6.44%
NETHERLANDS	0.63%	5.83%
NEW ZEALAND	0.41%	6.57%
NORWAY	0.97%	7.65%
PORTUGAL	0.60%	6.45%
SINGAPORE	0.73%	7.75%
SPAIN	0.95%	6.82%
SWEDEN	1.17%	7.66%
SWITZERLAND	0.84%	4.85%

**Table 28: DM Countries Summary Statistics 1993-2010**

**DM Covariance Matrix 1993-2010**

<b>Covariance</b>	<b>WORLD</b>	<b>USA</b>	<b>AUSTRALIA</b>	<b>AUSTRIA</b>	<b>BELGIUM</b>	<b>DENMARK</b>	<b>FINLAND</b>	<b>GREECE</b>	<b>HONG KONG</b>	<b>IRELAND</b>	<b>NETHERLANDS</b>
WORLD	0.0019	0.0018	0.0021	0.0021	0.0020	0.0018	0.0031	0.0025	0.0022	0.0021	0.0022
USA	0.0018	0.0018	0.0018	0.0018	0.0018	0.0016	0.0028	0.0022	0.0020	0.0020	0.0020
AUSTRALIA	0.0021	0.0018	0.0036	0.0029	0.0023	0.0020	0.0033	0.0030	0.0030	0.0025	0.0025
AUSTRIA	0.0021	0.0018	0.0029	0.0050	0.0032	0.0027	0.0028	0.0041	0.0027	0.0029	0.0030
BELGIUM	0.0020	0.0018	0.0023	0.0032	0.0037	0.0025	0.0027	0.0035	0.0021	0.0028	0.0030
DENMARK	0.0018	0.0016	0.0020	0.0027	0.0025	0.0032	0.0028	0.0030	0.0021	0.0023	0.0025
FINLAND	0.0031	0.0028	0.0033	0.0028	0.0027	0.0028	0.0097	0.0041	0.0032	0.0033	0.0035
GREECE	0.0025	0.0022	0.0030	0.0041	0.0035	0.0030	0.0041	0.0085	0.0027	0.0031	0.0033
HONG KONG	0.0022	0.0020	0.0030	0.0027	0.0021	0.0021	0.0032	0.0027	0.0062	0.0021	0.0026
IRELAND	0.0021	0.0020	0.0025	0.0029	0.0028	0.0023	0.0033	0.0031	0.0021	0.0041	0.0027
NETHERLANDS	0.0022	0.0020	0.0025	0.0030	0.0030	0.0025	0.0035	0.0033	0.0026	0.0027	0.0034
NEW ZEALAND	0.0019	0.0016	0.0030	0.0029	0.0022	0.0019	0.0031	0.0030	0.0028	0.0022	0.0024
NORWAY	0.0026	0.0022	0.0034	0.0039	0.0033	0.0032	0.0041	0.0042	0.0032	0.0031	0.0033
PORTUGAL	0.0018	0.0016	0.0021	0.0028	0.0026	0.0023	0.0033	0.0036	0.0022	0.0023	0.0026
SINGAPORE	0.0023	0.0021	0.0031	0.0028	0.0024	0.0021	0.0031	0.0031	0.0048	0.0022	0.0027
SPAIN	0.0024	0.0021	0.0028	0.0031	0.0029	0.0026	0.0037	0.0041	0.0028	0.0028	0.0031
SWEDEN	0.0027	0.0024	0.0031	0.0029	0.0028	0.0030	0.0053	0.0038	0.0033	0.0029	0.0035
SWITZERLAND	0.0016	0.0014	0.0017	0.0022	0.0021	0.0017	0.0023	0.0024	0.0018	0.0018	0.0022



**Table 28: DM Countries Summary Statistics 1993-2010**

**DM Covariance Matrix 1993-2010 (Continued)**

<b>Covariance</b>	<b>NEW ZEALAND</b>	<b>NORWAY</b>	<b>PORTUGAL</b>	<b>SINGAPORE</b>	<b>SPAIN</b>	<b>SWEDEN</b>	<b>SWITZERLAND</b>
<i>WORLD</i>	0.0019	0.0026	0.0018	0.0023	0.0024	0.0027	0.0016
<i>USA</i>	0.0016	0.0022	0.0016	0.0021	0.0021	0.0024	0.0014
<i>AUSTRALIA</i>	0.0030	0.0034	0.0021	0.0031	0.0028	0.0031	0.0017
<i>AUSTRIA</i>	0.0029	0.0039	0.0028	0.0028	0.0031	0.0029	0.0022
<i>BELGIUM</i>	0.0022	0.0033	0.0026	0.0024	0.0029	0.0028	0.0021
<i>DENMARK</i>	0.0019	0.0032	0.0023	0.0021	0.0026	0.0030	0.0017
<i>FINLAND</i>	0.0031	0.0041	0.0033	0.0031	0.0037	0.0053	0.0023
<i>GREECE</i>	0.0030	0.0042	0.0036	0.0031	0.0041	0.0038	0.0024
<i>HONG KONG</i>	0.0028	0.0032	0.0022	0.0048	0.0028	0.0033	0.0018
<i>IRELAND</i>	0.0022	0.0031	0.0023	0.0022	0.0028	0.0029	0.0018
<i>NETHERLANDS</i>	0.0024	0.0033	0.0026	0.0027	0.0031	0.0035	0.0022
<i>NEW ZEALAND</i>	0.0043	0.0032	0.0022	0.0032	0.0026	0.0031	0.0018
<i>NORWAY</i>	0.0032	0.0058	0.0030	0.0035	0.0036	0.0040	0.0023
<i>PORTUGAL</i>	0.0022	0.0030	0.0041	0.0021	0.0033	0.0031	0.0020
<i>SINGAPORE</i>	0.0032	0.0035	0.0021	0.0060	0.0029	0.0033	0.0018
<i>SPAIN</i>	0.0026	0.0036	0.0033	0.0029	0.0046	0.0038	0.0022
<i>SWEDEN</i>	0.0031	0.0040	0.0031	0.0033	0.0038	0.0058	0.0023
<i>SWITZERLAND</i>	0.0018	0.0023	0.0020	0.0018	0.0022	0.0023	0.0023

**Table 28: DM Countries Summary Statistics 1993-2010**

**DM Correlation Matrix 1993-2010**

<b>Correlation</b>	<b>WORLD</b>	<b>USA</b>	<b>AUSTRALIA</b>	<b>AUSTRIA</b>	<b>BELGIUM</b>	<b>DENMARK</b>	<b>FINLAND</b>	<b>GREECE</b>	<b>HONG KONG</b>	<b>IRELAND</b>	<b>NETHERLANDS</b>
WORLD	1.0000	0.9342	0.8097	0.6888	0.7467	0.7389	0.7038	0.6090	0.6387	0.7424	0.8736
USA	0.9342	1.0000	0.6961	0.5658	0.6543	0.6455	0.6434	0.5298	0.5741	0.6944	0.7718
AUSTRALIA	0.8097	0.7521	1.0000	0.6752	0.6253	0.5790	0.5559	0.5378	0.6261	0.6390	0.7053
AUSTRIA	0.6888	0.6345	0.6752	1.0000	0.7479	0.6646	0.3966	0.6313	0.4778	0.6367	0.7187
BELGIUM	0.7467	0.5766	0.6253	0.7479	1.0000	0.7190	0.4462	0.6253	0.4326	0.7042	0.8344
DENMARK	0.7389	0.6632	0.5790	0.6646	0.7190	1.0000	0.5086	0.5788	0.4777	0.6294	0.7606
FINLAND	0.7038	0.5722	0.5559	0.3966	0.4462	0.5086	1.0000	0.4561	0.4076	0.5186	0.6063
GREECE	0.6090	0.4980	0.5378	0.6313	0.6253	0.5788	0.4561	1.0000	0.3694	0.5249	0.6163
HONG KONG	0.6387	0.6577	0.6261	0.4778	0.4326	0.4777	0.4076	0.3694	1.0000	0.4059	0.5581
IRELAND	0.7424	0.5768	0.6390	0.6367	0.7042	0.6294	0.5186	0.5249	0.4059	1.0000	0.7236
NETHERLANDS	0.8736	0.6858	0.7053	0.7187	0.8344	0.7606	0.6063	0.6163	0.5581	0.7236	1.0000
NEW ZEALAND	0.6733	0.5881	0.7633	0.6174	0.5386	0.5067	0.4789	0.5017	0.5502	0.5314	0.6225
NORWAY	0.7626	0.7345	0.7455	0.7181	0.7090	0.7286	0.5431	0.6023	0.5377	0.6375	0.7537
PORTUGAL	0.6510	0.5540	0.5316	0.6154	0.6639	0.6362	0.5160	0.6044	0.4326	0.5481	0.7002
SINGAPORE	0.6848	0.6454	0.6598	0.5180	0.4997	0.4872	0.4028	0.4290	0.7803	0.4396	0.6021
SPAIN	0.7987	0.6213	0.6940	0.6337	0.6918	0.6829	0.5503	0.6509	0.5228	0.6370	0.7811
SWEDEN	0.8111	0.6817	0.6815	0.5382	0.6053	0.6848	0.7049	0.5446	0.5420	0.5878	0.7842
SWITZERLAND	0.7440	0.5553	0.5896	0.6360	0.6994	0.6363	0.4871	0.5385	0.4613	0.5834	0.7734

**Table 28: DM Countries Summary Statistics 1993-2010**

*DM Correlation Matrix 1993-2010 (Continued)*

<i>Correlation</i>	<i>NEW ZEALAND</i>	<i>NORWAY</i>	<i>PORTUGAL</i>	<i>SINGAPORE</i>	<i>SPAIN</i>	<i>SWEDEN</i>	<i>SWITZERLAND</i>
<i>WORLD</i>	0.6733	0.7626	0.6510	0.6848	0.7987	0.8111	0.7440
<i>USA</i>	0.5610	0.6406	0.5459	0.6153	0.7010	0.7159	0.6383
<i>AUSTRALIA</i>	0.7633	0.7455	0.5316	0.6598	0.6940	0.6815	0.5896
<i>AUSTRIA</i>	0.6174	0.7181	0.6154	0.5180	0.6337	0.5382	0.6360
<i>BELGIUM</i>	0.5386	0.7090	0.6639	0.4997	0.6918	0.6053	0.6994
<i>DENMARK</i>	0.5067	0.7286	0.6362	0.4872	0.6829	0.6848	0.6363
<i>FINLAND</i>	0.4789	0.5431	0.5160	0.4028	0.5503	0.7049	0.4871
<i>GREECE</i>	0.5017	0.6023	0.6044	0.4290	0.6509	0.5446	0.5385
<i>HONG KONG</i>	0.5502	0.5377	0.4326	0.7803	0.5228	0.5420	0.4613
<i>IRELAND</i>	0.5314	0.6375	0.5481	0.4396	0.6370	0.5878	0.5834
<i>NETHERLANDS</i>	0.6225	0.7537	0.7002	0.6021	0.7811	0.7842	0.7734
<i>NEW ZEALAND</i>	1.0000	0.6308	0.5104	0.6224	0.5933	0.6156	0.5792
<i>NORWAY</i>	0.6308	1.0000	0.6123	0.5942	0.6842	0.6862	0.6100
<i>PORTUGAL</i>	0.5104	0.6123	1.0000	0.4142	0.7547	0.6383	0.6459
<i>SINGAPORE</i>	0.6224	0.5942	0.4142	1.0000	0.5529	0.5592	0.4799
<i>SPAIN</i>	0.5933	0.6842	0.7547	0.5529	1.0000	0.7374	0.6819
<i>SWEDEN</i>	0.6156	0.6862	0.6383	0.5592	0.7374	1.0000	0.6310
<i>SWITZERLAND</i>	0.5792	0.6100	0.6459	0.4799	0.6819	0.6310	1.0000

**Table 29: EM Countries Summary Statistics 1988-2010**

*EM Risk Return Profile 1988-2010*

	Return	Risk
<i>3 mo. T Bill (rf)</i>	0.33%	-
<i>WORLD</i>	0.46%	4.41%
<i>EM</i>	1.09%	6.97%
<i>USA</i>	0.64%	4.31%
<i>BRAZIL</i>	2.50%	15.34%
<i>CHILE</i>	1.44%	7.09%
<i>INDONESIA</i>	1.74%	14.88%
<i>KOREA</i>	1.03%	11.26%
<i>MALAYSIA</i>	0.88%	8.57%
<i>MEXICO</i>	1.89%	9.28%
<i>PHILIPPINES</i>	0.83%	9.25%
<i>TAIWAN</i>	0.90%	10.84%
<i>THAILAND</i>	1.02%	11.27%
<i>TURKEY</i>	2.03%	17.03%

**Table 29: EM Countries Summary Statistics 1988-2010**

*EM Covariance Matrix 1988-2010*

<i>Covariance</i>	<i>WORLD</i>	<i>EM</i>	<i>USA</i>	<i>BRAZIL</i>	<i>CHILE</i>	<i>INDONESIA</i>	<i>KOREA</i>
<i>WORLD</i>	0.0019	0.0022	0.0017	0.0030	0.0013	0.0021	0.0026
<i>EM</i>	0.0022	0.0048	0.0022	0.0075	0.0031	0.0048	0.0040
<i>USA</i>	0.0017	0.0022	0.0018	0.0026	0.0013	0.0021	0.0021
<i>BRAZIL</i>	0.0030	0.0075	0.0026	0.0234	0.0044	0.0048	0.0031
<i>CHILE</i>	0.0013	0.0031	0.0013	0.0044	0.0050	0.0031	0.0023
<i>INDONESIA</i>	0.0021	0.0048	0.0021	0.0048	0.0031	0.0221	0.0063
<i>KOREA</i>	0.0026	0.0040	0.0021	0.0031	0.0023	0.0063	0.0126
<i>MALAYSIA</i>	0.0016	0.0035	0.0013	0.0027	0.0023	0.0058	0.0031
<i>MEXICO</i>	0.0022	0.0044	0.0022	0.0053	0.0028	0.0040	0.0036
<i>PHILIPPINES</i>	0.0017	0.0035	0.0016	0.0035	0.0026	0.0066	0.0031
<i>TAIWAN</i>	0.0019	0.0041	0.0016	0.0042	0.0028	0.0035	0.0042
<i>THAILAND</i>	0.0024	0.0049	0.0022	0.0044	0.0033	0.0076	0.0066
<i>TURKEY</i>	0.0027	0.0055	0.0023	0.0075	0.0035	0.0045	0.0038

**Table 29: EM Countries Summary Statistics 1988-2010**

***EM Covariance Matrix 1988-2010 (Continued)***

<b><i>Covariance</i></b>	<b><i>MALAYSIA</i></b>	<b><i>MEXICO</i></b>	<b><i>PHILIPPINES</i></b>	<b><i>TAIWAN</i></b>	<b><i>THAILAND</i></b>	<b><i>TURKEY</i></b>
<i>WORLD</i>	0.0016	0.0022	0.0017	0.0019	0.0024	0.0027
<i>EM</i>	0.0035	0.0044	0.0035	0.0041	0.0049	0.0055
<i>USA</i>	0.0013	0.0022	0.0016	0.0016	0.0022	0.0023
<i>BRAZIL</i>	0.0027	0.0053	0.0035	0.0042	0.0044	0.0075
<i>CHILE</i>	0.0023	0.0028	0.0026	0.0028	0.0033	0.0035
<i>INDONESIA</i>	0.0058	0.0040	0.0066	0.0035	0.0076	0.0045
<i>KOREA</i>	0.0031	0.0036	0.0031	0.0042	0.0066	0.0038
<i>MALAYSIA</i>	0.0073	0.0025	0.0043	0.0038	0.0053	0.0032
<i>MEXICO</i>	0.0025	0.0086	0.0029	0.0039	0.0042	0.0043
<i>PHILIPPINES</i>	0.0043	0.0029	0.0085	0.0041	0.0063	0.0030
<i>TAIWAN</i>	0.0038	0.0039	0.0041	0.0117	0.0053	0.0043
<i>THAILAND</i>	0.0053	0.0042	0.0063	0.0053	0.0127	0.0045
<i>TURKEY</i>	0.0032	0.0043	0.0030	0.0043	0.0045	0.0289

**Table 29: EM Countries Summary Statistics 1988-2010**

**EM Correlation Matrix 1988-2010**

<b>Correlation</b>	<b>WORLD</b>	<b>EM</b>	<b>USA</b>	<b>BRAZIL</b>	<b>CHILE</b>	<b>INDONESIA</b>	<b>KOREA</b>
<i>WORLD</i>	1.0000	0.7197	0.8788	0.4396	0.4124	0.3244	0.5168
<i>EM</i>	0.7197	1.0000	0.6549	0.7078	0.6214	0.4651	0.5123
<i>USA</i>	0.8788	0.6549	1.0000	0.3944	0.4334	0.3245	0.4355
<i>BRAZIL</i>	0.4396	0.7078	0.3944	1.0000	0.4019	0.2093	0.1775
<i>CHILE</i>	0.4124	0.6214	0.4334	0.4019	1.0000	0.2943	0.2877
<i>INDONESIA</i>	0.3244	0.4651	0.3245	0.2093	0.2943	1.0000	0.3753
<i>KOREA</i>	0.5168	0.5123	0.4355	0.1775	0.2877	0.3753	1.0000
<i>MALAYSIA</i>	0.4310	0.5934	0.3632	0.2071	0.3745	0.4578	0.3273
<i>MEXICO</i>	0.5477	0.6760	0.5655	0.3765	0.4226	0.2946	0.3420
<i>PHILIPPINES</i>	0.4195	0.5513	0.4036	0.2474	0.3926	0.4826	0.2944
<i>TAIWAN</i>	0.3910	0.5429	0.3527	0.2562	0.3621	0.2170	0.3492
<i>THAILAND</i>	0.4778	0.6254	0.4546	0.2582	0.4090	0.4570	0.5198
<i>TURKEY</i>	0.3571	0.4657	0.3198	0.2865	0.2905	0.1768	0.1986

**Table 29: EM Countries Summary Statistics 1988-2010**

***EM Correlation Matrix 1988-2010 (Continued)***

<b><i>Correlation</i></b>	<b><i>MALAYSIA</i></b>	<b><i>MEXICO</i></b>	<b><i>PHILIPPINES</i></b>	<b><i>TAIWAN</i></b>	<b><i>THAILAND</i></b>	<b><i>TURKEY</i></b>
<i>WORLD</i>	0.4310	0.5477	0.4195	0.3910	0.4778	0.3571
<i>EM</i>	0.5934	0.6760	0.5513	0.5429	0.6254	0.4657
<i>USA</i>	0.3632	0.5655	0.4036	0.3527	0.4546	0.3198
<i>BRAZIL</i>	0.2071	0.3765	0.2474	0.2562	0.2582	0.2865
<i>CHILE</i>	0.3745	0.4226	0.3926	0.3621	0.4090	0.2905
<i>INDONESIA</i>	0.4578	0.2946	0.4826	0.2170	0.4570	0.1768
<i>KOREA</i>	0.3273	0.3420	0.2944	0.3492	0.5198	0.1986
<i>MALAYSIA</i>	1.0000	0.3208	0.5461	0.4130	0.5504	0.2226
<i>MEXICO</i>	0.3208	1.0000	0.3386	0.3910	0.4073	0.2759
<i>PHILIPPINES</i>	0.5461	0.3386	1.0000	0.4152	0.6104	0.1902
<i>TAIWAN</i>	0.4130	0.3910	0.4152	1.0000	0.4361	0.2322
<i>THAILAND</i>	0.5504	0.4073	0.6104	0.4361	1.0000	0.2359
<i>TURKEY</i>	0.2226	0.2759	0.1902	0.2322	0.2359	1.0000



**Table 30: EM Countries Summary Statistics 1993-2010**

*EM Risk Return Profile 1993-2010*

	Return	Risk
3 mo. T Bill (rf)	0.28%	-
THE WORLD INDEX	0.47%	4.42%
EM	0.79%	7.02%
USA	0.52%	4.43%
BRAZIL	1.90%	11.54%
CHINA	0.33%	10.78%
INDIA	1.14%	9.01%
CHILE	0.99%	6.90%
COLUMBIA	1.58%	9.45%
INDONESIA	1.33%	13.64%
KOREA	1.15%	11.82%
MALAYSIA	0.74%	9.13%
MEXICO	1.04%	8.89%
PERU	1.71%	9.51%
PHILIPPINES	0.44%	9.37%
POLAND	1.94%	14.61%
SOUTH AFRICA	1.07%	8.06%
TAIWAN	0.65%	9.40%
THAILAND	0.66%	11.90%
TURKEY	2.28%	16.31%

**Table 30: EM Countries Summary Statistics 1993-2010**

*EM Covariance Matrix 1993-2010*

<b>Covariance</b>	<b>WORLD</b>	<b>EM</b>	<b>USA</b>	<b>BRAZIL</b>	<b>CHINA</b>	<b>INDIA</b>	<b>CHILE</b>	<b>COLUMBIA</b>	<b>INDONESIA</b>	<b>KOREA</b>
WORLD	0.0019	0.0024	0.0018	0.0032	0.0022	0.0019	0.0017	0.0015	0.0029	0.0029
EM	0.0024	0.0049	0.0022	0.0061	0.0051	0.0040	0.0035	0.0031	0.0059	0.0050
USA	0.0018	0.0022	0.0018	0.0029	0.0022	0.0016	0.0016	0.0013	0.0026	0.0025
BRAZIL	0.0032	0.0061	0.0029	0.0132	0.0055	0.0049	0.0048	0.0041	0.0062	0.0047
CHINA	0.0022	0.0051	0.0022	0.0055	0.0116	0.0039	0.0034	0.0025	0.0058	0.0042
INDIA	0.0019	0.0040	0.0016	0.0049	0.0039	0.0081	0.0031	0.0031	0.0047	0.0038
CHILE	0.0017	0.0035	0.0016	0.0048	0.0034	0.0031	0.0047	0.0027	0.0045	0.0032
COLUMBIA	0.0015	0.0031	0.0013	0.0041	0.0025	0.0031	0.0027	0.0089	0.0049	0.0034
INDONESIA	0.0029	0.0059	0.0026	0.0062	0.0058	0.0047	0.0045	0.0049	0.0185	0.0070
KOREA	0.0029	0.0050	0.0025	0.0047	0.0042	0.0038	0.0032	0.0034	0.0070	0.0139
MALAYSIA	0.0017	0.0038	0.0014	0.0030	0.0046	0.0028	0.0027	0.0026	0.0072	0.0036
MEXICO	0.0025	0.0048	0.0025	0.0064	0.0043	0.0034	0.0033	0.0027	0.0049	0.0040
PERU	0.0019	0.0042	0.0015	0.0063	0.0038	0.0032	0.0033	0.0033	0.0049	0.0034
PHILIPPINES	0.0018	0.0039	0.0017	0.0035	0.0050	0.0026	0.0031	0.0025	0.0075	0.0039
POLAND	0.0032	0.0056	0.0027	0.0073	0.0047	0.0046	0.0033	0.0030	0.0063	0.0058
SOUTH AFRICA	0.0023	0.0043	0.0019	0.0048	0.0049	0.0032	0.0029	0.0025	0.0047	0.0047
TAIWAN	0.0022	0.0046	0.0020	0.0048	0.0056	0.0035	0.0031	0.0027	0.0047	0.0048
THAILAND	0.0026	0.0055	0.0024	0.0052	0.0066	0.0034	0.0039	0.0033	0.0091	0.0083
TURKEY	0.0035	0.0063	0.0033	0.0082	0.0049	0.0051	0.0045	0.0050	0.0057	0.0054

**Table 30: EM Countries Summary Statistics 1993-2010**

*EM Covariance Matrix 1993-2010 (Continued)*

<b>Covariance</b>	<b>MALAYSIA</b>	<b>MEXICO</b>	<b>PERU</b>	<b>PHILIPPINES</b>	<b>POLAND</b>	<b>SOUTH AFRICA</b>	<b>TAIWAN</b>	<b>THAILAND</b>	<b>TURKEY</b>
WORLD	0.0017	0.0025	0.0019	0.0018	0.0032	0.0023	0.0022	0.0026	0.0035
EM	0.0038	0.0048	0.0042	0.0039	0.0056	0.0043	0.0046	0.0055	0.0063
USA	0.0014	0.0025	0.0015	0.0017	0.0027	0.0019	0.0020	0.0024	0.0033
BRAZIL	0.0030	0.0064	0.0063	0.0035	0.0073	0.0048	0.0048	0.0052	0.0082
CHINA	0.0046	0.0043	0.0038	0.0050	0.0047	0.0049	0.0056	0.0066	0.0049
INDIA	0.0028	0.0034	0.0032	0.0026	0.0046	0.0032	0.0035	0.0034	0.0051
CHILE	0.0027	0.0033	0.0033	0.0031	0.0033	0.0029	0.0031	0.0039	0.0045
COLUMBIA	0.0026	0.0027	0.0033	0.0025	0.0030	0.0025	0.0027	0.0033	0.0050
INDONESIA	0.0072	0.0049	0.0049	0.0075	0.0063	0.0047	0.0047	0.0091	0.0057
KOREA	0.0036	0.0040	0.0034	0.0039	0.0058	0.0047	0.0048	0.0083	0.0054
MALAYSIA	0.0083	0.0027	0.0027	0.0049	0.0045	0.0029	0.0043	0.0058	0.0037
MEXICO	0.0027	0.0079	0.0044	0.0036	0.0060	0.0039	0.0037	0.0046	0.0060
PERU	0.0027	0.0044	0.0090	0.0029	0.0044	0.0039	0.0034	0.0040	0.0040
PHILIPPINES	0.0049	0.0036	0.0029	0.0087	0.0040	0.0037	0.0041	0.0074	0.0035
POLAND	0.0045	0.0060	0.0044	0.0040	0.0213	0.0050	0.0039	0.0052	0.0075
SOUTH AFRICA	0.0029	0.0039	0.0039	0.0037	0.0050	0.0065	0.0038	0.0057	0.0051
TAIWAN	0.0043	0.0037	0.0034	0.0041	0.0039	0.0038	0.0088	0.0057	0.0047
THAILAND	0.0058	0.0046	0.0040	0.0074	0.0052	0.0057	0.0057	0.0141	0.0047
TURKEY	0.0037	0.0060	0.0040	0.0035	0.0075	0.0051	0.0047	0.0047	0.0265

**Table 30: EM Countries Summary Statistics 1993-2010**

*EM Correlation Matrix 1993-2010*

<b>Correlation</b>	<b>WORLD</b>	<b>EM</b>	<b>USA</b>	<b>BRAZIL</b>	<b>CHINA</b>	<b>INDIA</b>	<b>CHILE</b>	<b>COLUMBIA</b>	<b>INDONESIA</b>	<b>KOREA</b>
<i>WORLD</i>	1.0000	0.7926	0.9342	0.6248	0.4642	0.4771	0.5503	0.3524	0.4791	0.5504
<i>EM</i>	0.7926	1.0000	0.7134	0.7625	0.6765	0.6410	0.7231	0.4759	0.6209	0.6008
<i>USA</i>	0.9342	0.7134	1.0000	0.5698	0.4680	0.4137	0.5140	0.3009	0.4272	0.4836
<i>BRAZIL</i>	0.6248	0.7625	0.5698	1.0000	0.4403	0.4772	0.6121	0.3762	0.3953	0.3488
<i>CHINA</i>	0.4642	0.6765	0.4680	0.4403	1.0000	0.4025	0.4655	0.2464	0.3961	0.3279
<i>INDIA</i>	0.4771	0.6410	0.4137	0.4772	0.4025	1.0000	0.5011	0.3677	0.3865	0.3558
<i>CHILE</i>	0.5503	0.7231	0.5140	0.6121	0.4655	0.5011	1.0000	0.4220	0.4805	0.3886
<i>COLUMBIA</i>	0.3524	0.4759	0.3009	0.3762	0.2464	0.3677	0.4220	1.0000	0.3831	0.3025
<i>INDONESIA</i>	0.4791	0.6209	0.4272	0.3953	0.3961	0.3865	0.4805	0.3831	1.0000	0.4353
<i>KOREA</i>	0.5504	0.6008	0.4836	0.3488	0.3279	0.3558	0.3886	0.3025	0.4353	1.0000
<i>MALAYSIA</i>	0.4153	0.5983	0.3405	0.2843	0.4703	0.3389	0.4311	0.2981	0.5792	0.3387
<i>MEXICO</i>	0.6527	0.7733	0.6285	0.6266	0.4514	0.4257	0.5360	0.3251	0.4089	0.3793
<i>PERU</i>	0.4521	0.6346	0.3462	0.5785	0.3693	0.3698	0.5066	0.3714	0.3789	0.3003
<i>PHILIPPINES</i>	0.4409	0.5954	0.4125	0.3279	0.4974	0.3153	0.4842	0.2834	0.5862	0.3502
<i>POLAND</i>	0.4981	0.5437	0.4258	0.4351	0.3015	0.3504	0.3317	0.2219	0.3163	0.3374
<i>SOUTH AFRICA</i>	0.6468	0.7630	0.5439	0.5138	0.5624	0.4384	0.5317	0.3271	0.4271	0.4933
<i>TAIWAN</i>	0.5214	0.6974	0.4721	0.4482	0.5520	0.4165	0.4853	0.3082	0.3718	0.4384
<i>THAILAND</i>	0.4994	0.6625	0.4599	0.3834	0.5184	0.3221	0.4802	0.2973	0.5623	0.5903
<i>TURKEY</i>	0.4936	0.5506	0.4633	0.4359	0.2805	0.3517	0.3999	0.3267	0.2570	0.2823

**Table 30: EM Countries Summary Statistics 1993-2010**

*EM Correlation Matrix 1993-2010 (Continued)*

<b>Correlation</b>	<b>MALAYSIA</b>	<b>MEXICO</b>	<b>PERU</b>	<b>PHILIPPINES</b>	<b>POLAND</b>	<b>SOUTH AFRICA</b>	<b>TAIWAN</b>	<b>THAILAND</b>	<b>TURKEY</b>
WORLD	0.4153	0.6527	0.4521	0.4409	0.4981	0.6468	0.5214	0.4994	0.4936
EM	0.5983	0.7733	0.6346	0.5954	0.5437	0.7630	0.6974	0.6625	0.5506
USA	0.3405	0.6285	0.3462	0.4125	0.4258	0.5439	0.4721	0.4599	0.4633
BRAZIL	0.2843	0.6266	0.5785	0.3279	0.4351	0.5138	0.4482	0.3834	0.4359
CHINA	0.4703	0.4514	0.3693	0.4974	0.3015	0.5624	0.5520	0.5184	0.2805
INDIA	0.3389	0.4257	0.3698	0.3153	0.3504	0.4384	0.4165	0.3221	0.3517
CHILE	0.4311	0.5360	0.5066	0.4842	0.3317	0.5317	0.4853	0.4802	0.3999
COLUMBIA	0.2981	0.3251	0.3714	0.2834	0.2219	0.3271	0.3082	0.2973	0.3267
INDONESIA	0.5792	0.4089	0.3789	0.5862	0.3163	0.4271	0.3718	0.5623	0.2570
KOREA	0.3387	0.3793	0.3003	0.3502	0.3374	0.4933	0.4384	0.5903	0.2823
MALAYSIA	1.0000	0.3342	0.3067	0.5741	0.3399	0.3963	0.5038	0.5401	0.2484
MEXICO	0.3342	1.0000	0.5271	0.4286	0.4631	0.5510	0.4476	0.4366	0.4126
PERU	0.3067	0.5271	1.0000	0.3268	0.3217	0.5128	0.3850	0.3557	0.2590
PHILIPPINES	0.5741	0.4286	0.3268	1.0000	0.2947	0.4893	0.4687	0.6650	0.2315
POLAND	0.3399	0.4631	0.3217	0.2947	1.0000	0.4305	0.2834	0.3019	0.3146
SOUTH AFRICA	0.3963	0.5510	0.5128	0.4893	0.4305	1.0000	0.5058	0.5966	0.3913
TAIWAN	0.5038	0.4476	0.3850	0.4687	0.2834	0.5058	1.0000	0.5158	0.3061
THAILAND	0.5401	0.4366	0.3557	0.6650	0.3019	0.5966	0.5158	1.0000	0.2434
TURKEY	0.2484	0.4126	0.2590	0.2315	0.3146	0.3913	0.3061	0.2434	1.0000

**Table 31: DM & EM Countries Summary Statistics 1988-2010**

*DM & EM Risk Return Profile 1988-2010*

	Return	Risk
<i>3 mo. T Bill (rf)</i>	0.33%	-
<i>WORLD</i>	0.46%	4.41%
<i>USA</i>	0.64%	4.31%
<i>AUSTRALIA</i>	0.72%	5.99%
<i>AUSTRIA</i>	0.62%	7.61%
<i>BELGIUM</i>	0.53%	6.03%
<i>DENMARK</i>	1.06%	5.76%
<i>FINLAND</i>	0.94%	9.35%
<i>GREECE</i>	0.88%	10.68%
<i>HONG KONG</i>	0.97%	7.65%
<i>IRELAND</i>	0.20%	6.54%
<i>NETHERLANDS</i>	0.66%	5.48%
<i>NEW ZEALAND</i>	0.17%	6.79%
<i>NORWAY</i>	0.90%	7.60%
<i>PORTUGAL</i>	0.27%	6.65%
<i>SINGAPORE</i>	0.86%	7.28%
<i>SPAIN</i>	0.71%	6.71%
<i>SWEDEN</i>	1.08%	7.48%
<i>SWITZERLAND</i>	0.86%	5.02%

	Return	Risk
<i>EM</i>	1.09%	6.97%
<i>BRAZIL</i>	2.50%	15.34%
<i>CHILE</i>	1.44%	7.09%
<i>INDONESIA</i>	1.74%	14.88%
<i>KOREA</i>	1.03%	11.26%
<i>MALAYSIA</i>	0.88%	8.57%
<i>MEXICO</i>	1.89%	9.28%
<i>PHILIPPINES</i>	0.83%	9.25%
<i>TAIWAN</i>	0.90%	10.84%
<i>THAILAND</i>	1.02%	11.27%
<i>TURKEY</i>	2.03%	17.03%

**Table 31: DM & EM Countries Summary Statistics 1988-2010**

*DM & EM Covariance Matrix 1988-2010*

<i>Covariance</i>	<i>WORLD</i>	<i>EM</i>	<i>USA</i>	<i>BRAZIL</i>	<i>CHILE</i>	<i>INDONESIA</i>	<i>KOREA</i>
<i>WORLD</i>	0.0019	0.0022	0.0017	0.0030	0.0013	0.0021	0.0026
<i>EM</i>	0.0022	0.0048	0.0020	0.0075	0.0031	0.0048	0.0040
<i>USA</i>	0.0017	0.0020	0.0018	0.0026	0.0013	0.0021	0.0021
<i>AUSTRALIA</i>	0.0019	0.0028	0.0016	0.0035	0.0015	0.0032	0.0033
<i>AUSTRIA</i>	0.0019	0.0030	0.0015	0.0034	0.0017	0.0042	0.0025
<i>BELGIUM</i>	0.0019	0.0021	0.0016	0.0028	0.0015	0.0025	0.0022
<i>DENMARK</i>	0.0018	0.0021	0.0014	0.0027	0.0014	0.0022	0.0022
<i>FINLAND</i>	0.0026	0.0033	0.0023	0.0046	0.0018	0.0025	0.0043
<i>GREECE</i>	0.0022	0.0036	0.0017	0.0056	0.0021	0.0038	0.0026
<i>HONG KONG</i>	0.0021	0.0038	0.0018	0.0042	0.0026	0.0047	0.0032
<i>IRELAND</i>	0.0021	0.0025	0.0018	0.0034	0.0014	0.0022	0.0030
<i>NETHERLANDS</i>	0.0020	0.0024	0.0017	0.0032	0.0015	0.0027	0.0024
<i>NEW ZEALAND</i>	0.0017	0.0026	0.0014	0.0033	0.0013	0.0043	0.0032
<i>NORWAY</i>	0.0024	0.0035	0.0019	0.0051	0.0024	0.0039	0.0031
<i>PORTUGAL</i>	0.0018	0.0023	0.0013	0.0037	0.0014	0.0025	0.0021
<i>SINGAPORE</i>	0.0022	0.0038	0.0019	0.0039	0.0026	0.0056	0.0036
<i>SPAIN</i>	0.0023	0.0030	0.0018	0.0046	0.0018	0.0029	0.0029
<i>SWEDEN</i>	0.0026	0.0033	0.0022	0.0049	0.0020	0.0034	0.0035
<i>SWITZERLAND</i>	0.0016	0.0017	0.0013	0.0022	0.0010	0.0022	0.0019

**Table 31: DM & EM Countries Summary Statistics 1988-2010**

**DM & EM Covariance Matrix 1988-2010 (Continued)**

<b>Covariance</b>	<b>MALAYSIA</b>	<b>MEXICO</b>	<b>PHILIPPINES</b>	<b>TAIWAN</b>	<b>THAILAND</b>	<b>TURKEY</b>
<i>WORLD</i>	0.0016	0.0022	0.0017	0.0019	0.0024	0.0027
<i>EM</i>	0.0035	0.0044	0.0035	0.0041	0.0049	0.0055
<i>USA</i>	0.0013	0.0022	0.0016	0.0016	0.0022	0.0023
<i>AUSTRALIA</i>	0.0018	0.0026	0.0023	0.0023	0.0034	0.0027
<i>AUSTRIA</i>	0.0023	0.0025	0.0025	0.0029	0.0030	0.0044
<i>BELGIUM</i>	0.0014	0.0021	0.0016	0.0019	0.0024	0.0025
<i>DENMARK</i>	0.0015	0.0019	0.0015	0.0015	0.0020	0.0027
<i>FINLAND</i>	0.0021	0.0036	0.0017	0.0026	0.0026	0.0053
<i>GREECE</i>	0.0019	0.0024	0.0024	0.0019	0.0027	0.0070
<i>HONG KONG</i>	0.0038	0.0033	0.0041	0.0036	0.0049	0.0031
<i>IRELAND</i>	0.0018	0.0023	0.0016	0.0024	0.0024	0.0031
<i>NETHERLANDS</i>	0.0019	0.0021	0.0018	0.0019	0.0024	0.0033
<i>NEW ZEALAND</i>	0.0022	0.0022	0.0026	0.0018	0.0033	0.0035
<i>NORWAY</i>	0.0022	0.0030	0.0022	0.0027	0.0031	0.0038
<i>PORTUGAL</i>	0.0015	0.0015	0.0018	0.0013	0.0021	0.0042
<i>SINGAPORE</i>	0.0042	0.0035	0.0042	0.0038	0.0053	0.0042
<i>SPAIN</i>	0.0020	0.0030	0.0021	0.0022	0.0028	0.0034
<i>SWEDEN</i>	0.0025	0.0031	0.0022	0.0027	0.0030	0.0052
<i>SWITZERLAND</i>	0.0013	0.0016	0.0016	0.0010	0.0019	0.0022



**Table 31: DM & EM Countries Summary Statistics 1988-2010**

**DM & EM Correlation Matrix 1988-2010**

<b>Correlation</b>	<b>WORLD</b>	<b>EM</b>	<b>USA</b>	<b>BRAZIL</b>	<b>CHILE</b>	<b>INDONESIA</b>	<b>KOREA</b>
WORLD	1.0000	0.7197	0.8788	0.4396	0.4124	0.3244	0.5168
EM	0.7197	1.0000	0.6549	0.7078	0.6214	0.4651	0.5123
USA	0.8788	0.6549	1.0000	0.3944	0.4334	0.3245	0.4355
AUSTRALIA	0.7063	0.6619	0.6139	0.3773	0.3593	0.3589	0.4842
AUSTRIA	0.5821	0.5588	0.4478	0.2959	0.3138	0.3701	0.2879
BELGIUM	0.7260	0.5091	0.6161	0.3048	0.3419	0.2811	0.3278
DENMARK	0.7066	0.5168	0.5788	0.3096	0.3545	0.2628	0.3457
FINLAND	0.6418	0.5072	0.5763	0.3236	0.2704	0.1793	0.4058
GREECE	0.4610	0.4905	0.3766	0.3415	0.2765	0.2377	0.2188
HONG KONG	0.6123	0.7073	0.5472	0.3561	0.4806	0.4138	0.3702
IRELAND	0.7298	0.5430	0.6376	0.3377	0.3051	0.2288	0.4144
NETHERLANDS	0.8434	0.6213	0.7310	0.3811	0.3759	0.3267	0.3881
NEW ZEALAND	0.5751	0.5509	0.4700	0.3166	0.2802	0.4247	0.4144
NORWAY	0.7037	0.6645	0.5977	0.4383	0.4408	0.3430	0.3690
PORTUGAL	0.6013	0.5060	0.4596	0.3626	0.2912	0.2556	0.2814
SINGAPORE	0.6795	0.7496	0.6110	0.3524	0.5026	0.5167	0.4376
SPAIN	0.7814	0.6389	0.6418	0.4454	0.3889	0.2897	0.3848
SWEDEN	0.7887	0.6407	0.6721	0.4248	0.3875	0.3091	0.4168
SWITZERLAND	0.7369	0.4834	0.5988	0.2914	0.2685	0.2950	0.3318

**Table 31: DM & EM Countries Summary Statistics 1988-2010**

***DM & EM Correlation Matrix 1988-2010 (Continued)***

<b><i>Correlation</i></b>	<b><i>MALAYSIA</i></b>	<b><i>MEXICO</i></b>	<b><i>PHILIPPINES</i></b>	<b><i>TAIWAN</i></b>	<b><i>THAILAND</i></b>	<b><i>TURKEY</i></b>
<i>WORLD</i>	0.4310	0.5477	0.4195	0.3910	0.4778	0.3571
<i>EM</i>	0.5934	0.6760	0.5513	0.5429	0.6254	0.4657
<i>USA</i>	0.3632	0.5655	0.4036	0.3527	0.4546	0.3198
<i>AUSTRALIA</i>	0.3475	0.4709	0.4201	0.3532	0.5048	0.2659
<i>AUSTRIA</i>	0.3547	0.3581	0.3515	0.3552	0.3544	0.3380
<i>BELGIUM</i>	0.2658	0.3813	0.2846	0.2875	0.3534	0.2414
<i>DENMARK</i>	0.3115	0.3644	0.2868	0.2363	0.3144	0.2775
<i>FINLAND</i>	0.2692	0.4139	0.2007	0.2575	0.2507	0.3355
<i>GREECE</i>	0.2109	0.2424	0.2420	0.1670	0.2228	0.3879
<i>HONG KONG</i>	0.5809	0.4640	0.5827	0.4330	0.5648	0.2388
<i>IRELAND</i>	0.3144	0.3854	0.2693	0.3401	0.3289	0.2762
<i>NETHERLANDS</i>	0.4064	0.4215	0.3609	0.3274	0.3912	0.3497
<i>NEW ZEALAND</i>	0.3849	0.3448	0.4214	0.2522	0.4314	0.3001
<i>NORWAY</i>	0.3399	0.4322	0.3084	0.3306	0.3581	0.2924
<i>PORTUGAL</i>	0.2611	0.2487	0.2881	0.1819	0.2779	0.3686
<i>SINGAPORE</i>	0.6681	0.5263	0.6304	0.4826	0.6483	0.3357
<i>SPAIN</i>	0.3412	0.4867	0.3401	0.3091	0.3767	0.3015
<i>SWEDEN</i>	0.3958	0.4540	0.3212	0.3346	0.3615	0.4109
<i>SWITZERLAND</i>	0.3087	0.3459	0.3362	0.1878	0.3377	0.2619

**Table 32: DM & EM Countries Summary Statistics 1993-2010**

*DM & EM Risk Return Profile 1993-2010*

	Return	Risk
3 mo. T Bill (rf)	0.28%	-
WORLD	0.47%	4.42%
USA	0.52%	4.43%
AUSTRALIA	0.77%	6.03%
AUSTRIA	0.45%	7.10%
BELGIUM	0.44%	6.13%
DENMARK	1.05%	5.69%
FINLAND	1.51%	9.87%
GREECE	0.64%	9.25%
HONG KONG	0.76%	7.92%
IRELAND	0.12%	6.44%
NETHERLANDS	0.63%	5.83%
NEW ZEALAND	0.41%	6.57%
NORWAY	0.97%	7.65%
PORTUGAL	0.60%	6.45%
SINGAPORE	0.73%	7.75%
SPAIN	0.95%	6.82%
SWEDEN	1.17%	7.66%
SWITZERLAND	0.84%	4.85%

	Return	Risk
EM	0.79%	7.02%
BRAZIL	1.90%	11.54%
CHINA	0.33%	10.78%
INDIA	1.14%	9.01%
CHILE	0.99%	6.90%
COLUMBIA	1.58%	9.45%
INDONESIA	1.33%	13.64%
KOREA	1.15%	11.82%
MALAYSIA	0.74%	9.13%
MEXICO	1.04%	8.89%
PERU	1.71%	9.51%
PHILIPPINES	0.44%	9.37%
POLAND	1.94%	14.61%
SOUTH AFRICA	1.07%	8.06%
TAIWAN	0.65%	9.40%
THAILAND	0.66%	11.90%
TURKEY	2.28%	16.31%

**Table 32: DM & EM Countries Summary Statistics 1993-2010**

**DM & EM Covariance Matrix 1993-2010**

<i>Covariance</i>	<i>WORLD</i>	<i>EM</i>	<i>USA</i>	<i>BRAZIL</i>	<i>CHINA</i>	<i>INDIA</i>	<i>CHILE</i>	<i>COLUMBIA</i>	<i>INDONESIA</i>
<i>WORLD</i>	0.0019	0.0024	0.0018	0.0032	0.0022	0.0019	0.0017	0.0015	0.0029
<i>EM</i>	0.0024	0.0049	0.0022	0.0061	0.0051	0.0040	0.0035	0.0031	0.0059
<i>USA</i>	0.0018	0.0022	0.0020	0.0029	0.0022	0.0016	0.0016	0.0013	0.0026
<i>AUSTRALIA</i>	0.0021	0.0033	0.0018	0.0042	0.0034	0.0027	0.0021	0.0021	0.0038
<i>AUSTRIA</i>	0.0021	0.0032	0.0018	0.0041	0.0029	0.0028	0.0020	0.0027	0.0042
<i>BELGIUM</i>	0.0020	0.0025	0.0018	0.0033	0.0020	0.0021	0.0019	0.0019	0.0032
<i>DENMARK</i>	0.0018	0.0024	0.0016	0.0034	0.0020	0.0021	0.0019	0.0019	0.0029
<i>FINLAND</i>	0.0031	0.0037	0.0028	0.0052	0.0029	0.0029	0.0023	0.0015	0.0032
<i>GREECE</i>	0.0025	0.0037	0.0022	0.0044	0.0026	0.0037	0.0028	0.0029	0.0041
<i>HONG KONG</i>	0.0022	0.0042	0.0020	0.0045	0.0057	0.0029	0.0028	0.0022	0.0059
<i>IRELAND</i>	0.0021	0.0025	0.0020	0.0034	0.0019	0.0018	0.0017	0.0019	0.0026
<i>NETHERLANDS</i>	0.0022	0.0028	0.0020	0.0038	0.0025	0.0024	0.0019	0.0020	0.0034
<i>NEW ZEALAND</i>	0.0019	0.0030	0.0016	0.0034	0.0026	0.0022	0.0022	0.0024	0.0045
<i>NORWAY</i>	0.0026	0.0039	0.0022	0.0052	0.0035	0.0033	0.0029	0.0027	0.0043
<i>PORTUGAL</i>	0.0018	0.0025	0.0016	0.0036	0.0017	0.0028	0.0017	0.0015	0.0033
<i>SINGAPORE</i>	0.0023	0.0043	0.0021	0.0046	0.0053	0.0033	0.0032	0.0027	0.0069
<i>SPAIN</i>	0.0024	0.0032	0.0021	0.0043	0.0028	0.0026	0.0024	0.0021	0.0038
<i>SWEDEN</i>	0.0027	0.0036	0.0024	0.0047	0.0029	0.0031	0.0026	0.0023	0.0041
<i>SWITZERLAND</i>	0.0016	0.0019	0.0014	0.0025	0.0013	0.0015	0.0014	0.0013	0.0028

**Table 32: DM & EM Countries Summary Statistics 1993-2010****DM & EM Covariance Matrix 1993-2010 (Continued)**

<b>Covariance</b>	<b>KOREA</b>	<b>MALAYSIA</b>	<b>MEXICO</b>	<b>PERU</b>	<b>PHILIPPINES</b>	<b>POLAND</b>	<b>SOUTH AFRICA</b>	<b>TAIWAN</b>	<b>THAILAND</b>	<b>TURKEY</b>
<i>WORLD</i>	0.0029	0.0017	0.0025	0.0019	0.0018	0.0032	0.0023	0.0022	0.0026	0.0035
<i>EM</i>	0.0050	0.0038	0.0048	0.0042	0.0039	0.0056	0.0043	0.0046	0.0055	0.0063
<i>USA</i>	0.0025	0.0014	0.0025	0.0015	0.0017	0.0027	0.0019	0.0020	0.0024	0.0033
<i>AUSTRALIA</i>	0.0039	0.0021	0.0032	0.0033	0.0027	0.0041	0.0034	0.0030	0.0042	0.0039
<i>AUSTRIA</i>	0.0030	0.0022	0.0029	0.0029	0.0025	0.0039	0.0034	0.0026	0.0032	0.0038
<i>BELGIUM</i>	0.0027	0.0014	0.0024	0.0021	0.0018	0.0030	0.0025	0.0021	0.0024	0.0030
<i>DENMARK</i>	0.0026	0.0016	0.0023	0.0018	0.0016	0.0032	0.0022	0.0019	0.0024	0.0031
<i>FINLAND</i>	0.0048	0.0022	0.0040	0.0022	0.0019	0.0065	0.0033	0.0026	0.0031	0.0070
<i>GREECE</i>	0.0040	0.0023	0.0032	0.0030	0.0023	0.0053	0.0036	0.0027	0.0027	0.0055
<i>HONG KONG</i>	0.0038	0.0042	0.0039	0.0026	0.0045	0.0050	0.0038	0.0044	0.0057	0.0044
<i>IRELAND</i>	0.0031	0.0016	0.0027	0.0017	0.0015	0.0035	0.0024	0.0025	0.0025	0.0033
<i>NETHERLANDS</i>	0.0029	0.0021	0.0028	0.0022	0.0020	0.0036	0.0026	0.0025	0.0028	0.0041
<i>NEW ZEALAND</i>	0.0038	0.0025	0.0028	0.0029	0.0029	0.0043	0.0030	0.0026	0.0041	0.0043
<i>NORWAY</i>	0.0037	0.0023	0.0037	0.0035	0.0026	0.0052	0.0039	0.0033	0.0036	0.0047
<i>PORTUGAL</i>	0.0025	0.0016	0.0023	0.0023	0.0018	0.0044	0.0024	0.0019	0.0024	0.0036
<i>SINGAPORE</i>	0.0041	0.0045	0.0041	0.0033	0.0048	0.0048	0.0039	0.0042	0.0060	0.0050
<i>SPAIN</i>	0.0035	0.0021	0.0034	0.0029	0.0023	0.0046	0.0028	0.0026	0.0033	0.0043
<i>SWEDEN</i>	0.0040	0.0027	0.0036	0.0030	0.0024	0.0056	0.0032	0.0032	0.0033	0.0060
<i>SWITZERLAND</i>	0.0023	0.0013	0.0018	0.0016	0.0016	0.0030	0.0019	0.0015	0.0020	0.0026

**Table 32: DM & EM Countries Summary Statistics 1993-2010****DM & EM Correlation Matrix 1993-2010**

<b>Correlation</b>	<b>WORLD</b>	<b>EM</b>	<b>USA</b>	<b>BRAZIL</b>	<b>CHINA</b>	<b>INDIA</b>	<b>CHILE</b>	<b>COLUMBIA</b>	<b>INDONESIA</b>
<i>WORLD</i>	1.0000	0.7926	0.9342	0.6248	0.4642	0.4771	0.5503	0.3524	0.4791
<i>EM</i>	0.7926	1.0000	0.7134	0.7625	0.6765	0.6410	0.7231	0.4759	0.6209
<i>USA</i>	0.9342	0.7134	1.0000	0.5698	0.4680	0.4137	0.5140	0.3009	0.4272
<i>AUSTRALIA</i>	0.8097	0.7869	0.6961	0.6075	0.5213	0.4919	0.5048	0.3711	0.4650
<i>AUSTRIA</i>	0.6888	0.6384	0.5658	0.5005	0.3859	0.4325	0.4082	0.4104	0.4324
<i>BELGIUM</i>	0.7467	0.5729	0.6543	0.4742	0.2977	0.3854	0.4481	0.3342	0.3823
<i>DENMARK</i>	0.7389	0.6142	0.6455	0.5165	0.3312	0.4206	0.4766	0.3479	0.3733
<i>FINLAND</i>	0.7038	0.5330	0.6434	0.4548	0.2745	0.3272	0.3348	0.1615	0.2368
<i>GREECE</i>	0.6090	0.5700	0.5298	0.4137	0.2629	0.4454	0.4444	0.3306	0.3275
<i>HONG KONG</i>	0.6387	0.7546	0.5741	0.4968	0.6738	0.4050	0.5163	0.2948	0.5459
<i>IRELAND</i>	0.7424	0.5633	0.6944	0.4618	0.2812	0.3144	0.3924	0.3197	0.2981
<i>NETHERLANDS</i>	0.8736	0.6952	0.7718	0.5705	0.3970	0.4559	0.4846	0.3615	0.4260
<i>NEW ZEALAND</i>	0.6733	0.6598	0.5610	0.4560	0.3646	0.3799	0.4855	0.3815	0.5082
<i>NORWAY</i>	0.7626	0.7325	0.6406	0.5925	0.4253	0.4808	0.5556	0.3806	0.4175
<i>PORTUGAL</i>	0.6510	0.5601	0.5459	0.4870	0.2503	0.4789	0.3795	0.2534	0.3715
<i>SINGAPORE</i>	0.6848	0.7896	0.6153	0.5148	0.6398	0.4695	0.5926	0.3718	0.6517
<i>SPAIN</i>	0.7987	0.6756	0.7010	0.5538	0.3808	0.4191	0.5042	0.3225	0.4136
<i>SWEDEN</i>	0.8111	0.6806	0.7159	0.5386	0.3479	0.4580	0.4938	0.3208	0.3950
<i>SWITZERLAND</i>	0.7440	0.5674	0.6383	0.4514	0.2591	0.3456	0.4081	0.2913	0.4251

**Table 32: DM & EM Countries Summary Statistics 1993-2010****DM & EM Correlation Matrix 1993-2010 (Continued)**

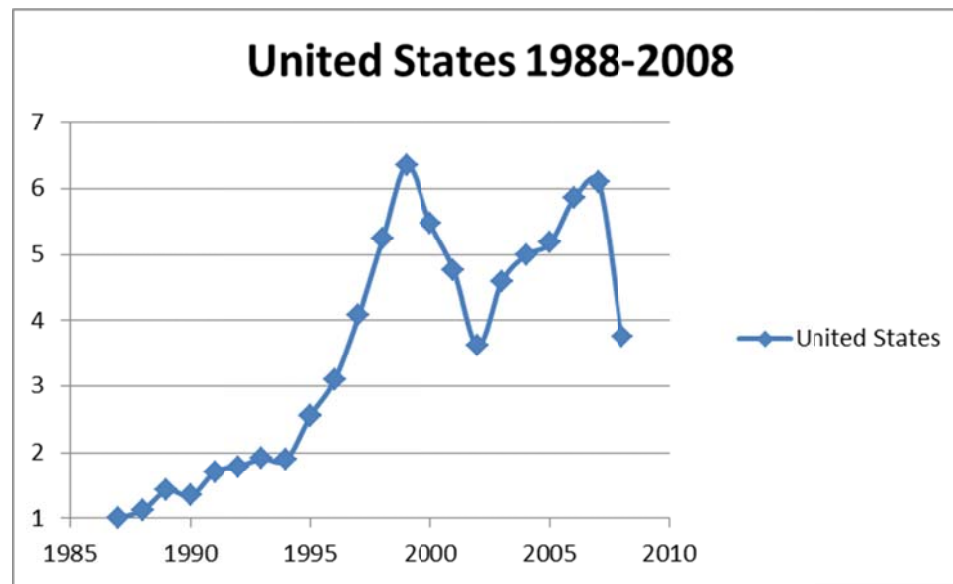
<b>Correlation</b>	<b>KOREA</b>	<b>MALAYSIA</b>	<b>MEXICO</b>	<b>PERU</b>	<b>PHILIPPINES</b>	<b>POLAND</b>	<b>SOUTH AFRICA</b>	<b>TAIWAN</b>	<b>THAILAND</b>	<b>TURKEY</b>
<i>WORLD</i>	0.5504	0.4153	0.6527	0.4521	0.4409	0.4981	0.6468	0.5214	0.4994	0.4936
<i>EM</i>	0.6008	0.5983	0.7733	0.6346	0.5954	0.5437	0.7630	0.6974	0.6625	0.5506
<i>USA</i>	0.4836	0.3405	0.6285	0.3462	0.4125	0.4258	0.5439	0.4721	0.4599	0.4633
<i>AUSTRALIA</i>	0.5550	0.3784	0.6087	0.5736	0.4740	0.4706	0.6982	0.5329	0.5813	0.3965
<i>AUSTRIA</i>	0.3605	0.3447	0.4645	0.4316	0.3838	0.3767	0.5936	0.3941	0.3842	0.3276
<i>BELGIUM</i>	0.3800	0.2579	0.4421	0.3673	0.3141	0.3321	0.5015	0.3647	0.3344	0.3062
<i>DENMARK</i>	0.3860	0.3116	0.4568	0.3258	0.3051	0.3859	0.4901	0.3530	0.3585	0.3402
<i>FINLAND</i>	0.4124	0.2454	0.4614	0.2364	0.2022	0.4496	0.4108	0.2831	0.2660	0.4397
<i>GREECE</i>	0.3692	0.2724	0.3955	0.3466	0.2682	0.3946	0.4911	0.3093	0.2509	0.3680
<i>HONG KONG</i>	0.4035	0.5827	0.5516	0.3439	0.6088	0.4336	0.5932	0.5959	0.6126	0.3450
<i>IRELAND</i>	0.4064	0.2811	0.4716	0.2844	0.2573	0.3715	0.4598	0.4143	0.3295	0.3117
<i>NETHERLANDS</i>	0.4258	0.4040	0.5376	0.3908	0.3711	0.4275	0.5533	0.4562	0.4055	0.4308
<i>NEW ZEALAND</i>	0.4862	0.4262	0.4901	0.4623	0.4734	0.4472	0.5755	0.4309	0.5218	0.4070
<i>NORWAY</i>	0.4084	0.3256	0.5421	0.4887	0.3653	0.4687	0.6272	0.4550	0.3977	0.3761
<i>PORTUGAL</i>	0.3308	0.2746	0.4055	0.3795	0.3009	0.4671	0.4602	0.3137	0.3148	0.3440
<i>SINGAPORE</i>	0.4535	0.6366	0.5942	0.4551	0.6582	0.4224	0.6313	0.5765	0.6507	0.3941
<i>SPAIN</i>	0.4315	0.3385	0.5700	0.4523	0.3599	0.4595	0.5121	0.4113	0.4022	0.3894
<i>SWEDEN</i>	0.4489	0.3912	0.5282	0.4137	0.3426	0.4993	0.5273	0.4522	0.3600	0.4843
<i>SWITZERLAND</i>	0.4024	0.2976	0.4198	0.3432	0.3559	0.4272	0.4775	0.3391	0.3424	0.3345

# Appendix B

Appendix B includes all input data used to construct the GNI weighted portfolios. The historical returns used were monthly returns on MSCI country indices. The returns were annualized using the equation provided in the methodology section. The raw GNI data, as well as the annual GNI based portfolio weights are also presented in this appendix. The data is organized by the three different portfolio types: G7 country, DM, and EM. The optimal portfolio weights for the GNI portfolios are also included in this section.



*Figure 18: United States Index Return 1988-2008*



**Table 33: G7 GNI Portfolio Data***G7 GNI 1988-2008 (in bil. USD)*

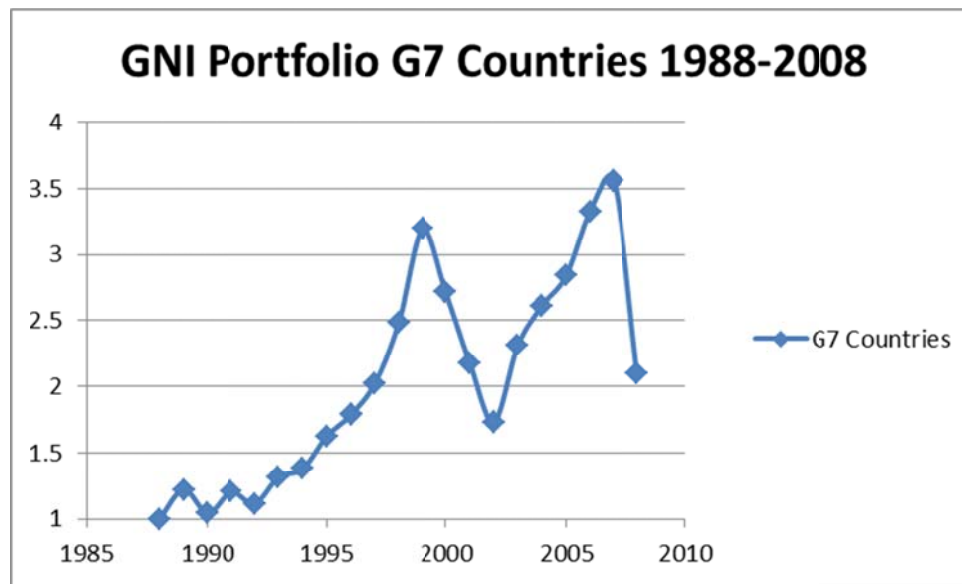
	<i>Canada</i>	<i>France</i>	<i>Germany</i>	<i>Italy</i>	<i>Japan</i>	<i>UK</i>	<i>USA</i>
1987	382.23	729.52	963.78	593.07	1,888.72	583.24	4,579.05
1988	430.45	921.51	1,240.37	762.34	2,547.78	719.67	4,946.89
1989	486.23	1,020.75	1,387.82	864.22	2,917.59	813.57	5,233.69
1990	529.20	1,113.36	1,549.05	958.35	3,125.89	898.32	5,511.28
1991	551.38	1,177.66	1,697.30	1,058.89	3,257.84	946.88	5,695.94
1992	566.83	1,310.15	1,927.20	1,190.75	3,477.07	1,043.40	6,072.35
1993	584.14	1,342.05	2,010.06	1,154.79	3,954.83	1,070.11	6,511.30
1994	590.24	1,413.03	2,167.16	1,133.14	4,467.41	1,115.22	7,006.47
1995	595.38	1,496.56	2,337.42	1,122.57	5,061.20	1,138.25	7,431.42
1996	599.89	1,578.62	2,457.97	1,184.99	5,200.50	1,208.16	7,805.28
1997	620.58	1,571.75	2,402.76	1,214.41	4,868.84	1,290.39	8,154.64
1998	614.33	1,513.45	2,228.97	1,208.34	4,167.69	1,371.76	8,446.44
1999	636.67	1,496.71	2,145.44	1,194.51	4,097.94	1,455.80	9,003.67
2000	680.92	1,481.56	2,096.72	1,189.52	4,392.08	1,525.91	9,708.42
2001	696.78	1,416.20	1,977.94	1,150.60	4,465.12	1,528.68	9,929.42
2002	716.42	1,378.32	1,895.91	1,130.28	4,236.59	1,556.37	10,145.80
2003	780.64	1,565.90	2,114.19	1,277.12	4,268.72	1,732.50	10,896.30
2004	912.98	1,904.99	2,558.68	1,556.74	4,687.94	2,068.10	12,068.30
2005	1,069.59	2,190.87	2,895.18	1,790.60	4,976.30	2,337.02	12,966.90
2006	1,205.05	2,325.82	3,062.16	1,897.30	4,929.93	2,487.11	13,536.60
2007	1,333.74	2,483.38	3,229.78	1,995.96	4,827.17	2,688.73	13,980.30
2008	1,453.77	2,695.62	3,506.92	2,121.60	4,869.12	2,827.34	14,573.60

**Table 33: G7 GNI Portfolio Data**

*G7 Annual GNI Weights (1988-2008)*

	<i>Canada</i>	<i>France</i>	<i>Germany</i>	<i>Italy</i>	<i>Japan</i>	<i>UK</i>	<i>USA</i>
1987	3.93%	7.51%	9.92%	6.10%	19.43%	6.00%	47.11%
1988	3.72%	7.97%	10.72%	6.59%	22.02%	6.22%	42.76%
1989	3.82%	8.02%	10.91%	6.79%	22.93%	6.39%	41.13%
1990	3.87%	8.14%	11.32%	7.00%	22.84%	6.56%	40.27%
1991	3.83%	8.19%	11.80%	7.36%	22.65%	6.58%	39.59%
1992	3.64%	8.40%	12.36%	7.64%	22.31%	6.69%	38.96%
1993	3.51%	8.07%	12.09%	6.95%	23.79%	6.44%	39.16%
1994	3.30%	7.90%	12.11%	6.33%	24.97%	6.23%	39.16%
1995	3.10%	7.80%	12.18%	5.85%	26.38%	5.93%	38.74%
1996	2.99%	7.88%	12.27%	5.91%	25.96%	6.03%	38.96%
1997	3.08%	7.81%	11.94%	6.03%	24.19%	6.41%	40.52%
1998	3.14%	7.74%	11.40%	6.18%	21.32%	7.02%	43.20%
1999	3.18%	7.47%	10.71%	5.96%	20.46%	7.27%	44.95%
2000	3.23%	7.03%	9.95%	5.64%	20.84%	7.24%	46.07%
2001	3.29%	6.69%	9.35%	5.44%	21.10%	7.22%	46.91%
2002	3.40%	6.54%	9.00%	5.37%	20.12%	7.39%	48.18%
2003	3.45%	6.92%	9.34%	5.64%	18.86%	7.65%	48.14%
2004	3.54%	7.40%	9.93%	6.04%	18.20%	8.03%	46.85%
2005	3.79%	7.76%	10.26%	6.34%	17.63%	8.28%	45.94%
2006	4.09%	7.90%	10.40%	6.44%	16.74%	8.45%	45.97%
2007	4.37%	8.13%	10.58%	6.54%	15.81%	8.80%	45.78%
2008	4.54%	8.41%	10.94%	6.62%	15.19%	8.82%	45.47%

*Figure 19: G7 GNI Portfolio Return 1988-2008*



**Table 34: DM GNI Portfolio Data**

*DM GNI 1988-2008 (in bil. USD)*

	Australia	Austria	Belgium	Denmark	Finland	Greece	Hong Kong	Ireland
1987	183.17	91.99	114.12	80.94	71.28	53.22	46.01	25.07
1988	200.37	117.82	145.73	98.88	90.99	64.33	53.42	31.02
1989	232.97	132.33	162.10	107.93	107.04	73.91	60.01	34.29
1990	275.31	146.38	178.72	117.06	118.96	83.01	68.17	39.92
1991	295.69	158.25	193.64	124.68	116.70	93.38	78.93	42.51
1992	302.85	179.31	218.32	140.47	113.55	106.80	91.62	46.95
1993	321.45	188.76	228.07	144.41	100.35	110.11	112.93	49.14
1994	330.24	202.41	249.40	156.61	99.71	117.26	131.21	53.18
1995	343.31	218.60	269.66	168.90	108.98	125.99	144.58	58.42
1996	368.72	234.98	284.97	181.16	123.81	137.15	154.69	66.19
1997	398.08	229.61	284.24	183.21	132.77	144.42	168.31	73.53
1998	399.41	216.32	264.77	174.73	128.53	142.08	162.83	76.94
1999	398.60	209.64	260.48	172.37	129.55	138.83	168.43	82.20
2000	396.59	206.98	260.02	169.97	131.84	137.15	177.10	88.17
2001	382.16	194.70	245.28	164.06	129.17	135.94	174.10	89.18
2002	383.11	193.28	241.40	161.61	128.56	137.91	167.58	93.40
2003	410.39	217.60	272.76	182.98	144.20	163.64	173.97	114.86
2004	500.84	263.53	331.19	224.62	177.08	206.23	186.57	144.46
2005	601.20	305.13	380.83	263.35	201.88	241.87	191.82	174.79
2006	687.02	323.54	408.22	283.80	217.59	263.66	202.48	194.58
2007	751.52	345.52	437.13	296.50	232.58	285.99	218.66	211.10
2008	862.46	382.67	477.26	323.02	252.90	319.18	219.26	220.28

**Table 34: DM GNI Portfolio Data**

*DM GNI 1988-2008 (in bil. USD) (Continued)*

	Netherlands	New Zealand	Norway	Portugal	Singapore	Spain	Sweden	Switzerland
1987	180.24	28.35	77.35	-	20.11	240.62	138.93	139.65
1988	223.76	34.90	87.17	-	23.74	311.84	170.46	181.00
1989	247.54	39.91	95.57	-	28.35	370.49	193.18	200.99
1990	266.08	41.88	104.29	-	34.14	435.36	213.13	218.31
1991	284.20	39.47	111.50	486.90	39.56	496.50	227.78	226.56
1992	315.76	39.49	123.69	435.13	47.16	567.58	245.89	249.27
1993	334.65	42.16	125.66	423.44	56.46	565.93	230.69	258.29
1994	361.40	47.11	131.08	393.21	69.69	557.04	232.30	271.41
1995	396.30	54.24	139.63	392.14	81.97	573.14	236.40	296.18
1996	424.64	60.41	153.69	386.30	92.25	604.21	255.91	317.23
1997	432.56	62.57	163.79	391.64	103.10	616.66	262.63	315.61
1998	405.40	58.03	156.92	314.75	92.26	604.70	259.64	295.96
1999	415.10	55.75	155.53	258.15	90.58	608.09	258.08	285.75
2000	423.28	51.90	161.06	250.28	92.50	620.97	259.70	289.32
2001	410.09	51.50	169.38	259.62	87.64	613.51	243.32	273.20
2002	408.43	54.10	177.90	305.80	87.57	624.69	240.41	267.69
2003	467.24	65.78	200.98	374.49	91.72	738.13	270.30	310.66
2004	576.90	84.40	243.82	491.38	103.64	921.51	329.22	368.94
2005	650.80	100.38	288.08	639.12	118.05	1,104.66	379.62	422.44
2006	712.36	105.28	318.58	827.97	133.61	1,209.99	410.81	440.19
2007	761.89	114.38	363.81	1,072.69	146.34	1,316.27	438.59	449.49
2008	811.35	118.82	416.44	1,371.17	168.23	1,454.80	469.42	424.52

**Table 34: DM GNI Portfolio Data**

*DM Annual GNI Weights 1988-2008*

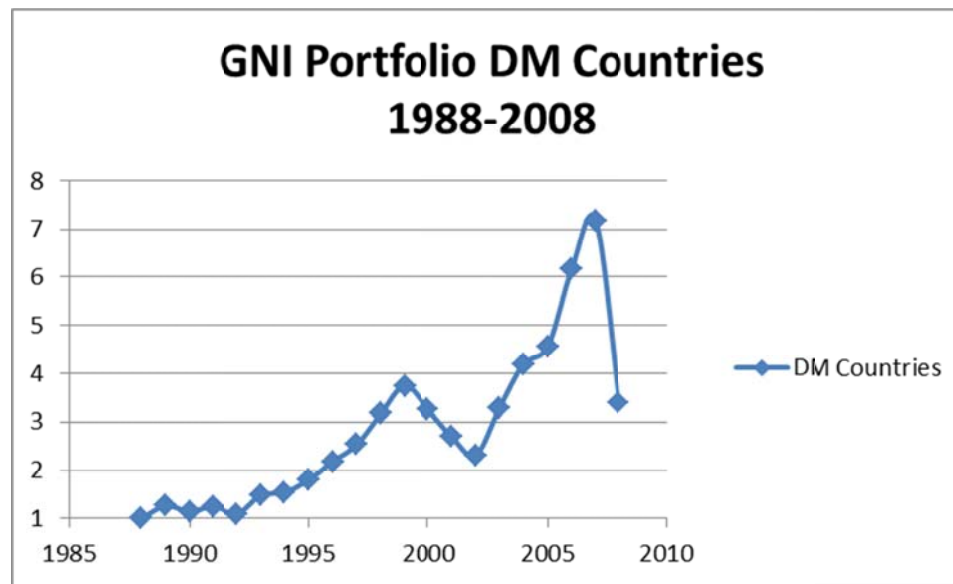
	<i>Australia</i>	<i>Austria</i>	<i>Belgium</i>	<i>Denmark</i>	<i>Finland</i>	<i>Greece</i>	<i>Hong Kong</i>	<i>Ireland</i>
1987	12.28%	6.17%	7.65%	5.43%	4.78%	3.57%	3.09%	1.68%
1988	10.92%	6.42%	7.94%	5.39%	4.96%	3.50%	2.91%	1.69%
1989	11.16%	6.34%	7.77%	5.17%	5.13%	3.54%	2.88%	1.64%
1990	11.76%	6.25%	7.64%	5.00%	5.08%	3.55%	2.91%	1.71%
1991	9.80%	5.25%	6.42%	4.13%	3.87%	3.10%	2.62%	1.41%
1992	9.39%	5.56%	6.77%	4.36%	3.52%	3.31%	2.84%	1.46%
1993	9.76%	5.73%	6.93%	4.39%	3.05%	3.34%	3.43%	1.49%
1994	9.70%	5.95%	7.33%	4.60%	2.93%	3.45%	3.86%	1.56%
1995	9.51%	6.06%	7.47%	4.68%	3.02%	3.49%	4.01%	1.62%
1996	9.59%	6.11%	7.41%	4.71%	3.22%	3.57%	4.02%	1.72%
1997	10.05%	5.79%	7.17%	4.62%	3.35%	3.64%	4.25%	1.86%
1998	10.64%	5.76%	7.05%	4.66%	3.42%	3.79%	4.34%	2.05%
1999	10.81%	5.69%	7.06%	4.67%	3.51%	3.77%	4.57%	2.23%
2000	10.67%	5.57%	7.00%	4.57%	3.55%	3.69%	4.76%	2.37%
2001	10.55%	5.37%	6.77%	4.53%	3.57%	3.75%	4.81%	2.46%
2002	10.43%	5.26%	6.57%	4.40%	3.50%	3.75%	4.56%	2.54%
2003	9.77%	5.18%	6.49%	4.36%	3.43%	3.90%	4.14%	2.74%
2004	9.72%	5.11%	6.43%	4.36%	3.44%	4.00%	3.62%	2.80%
2005	9.91%	5.03%	6.28%	4.34%	3.33%	3.99%	3.16%	2.88%
2006	10.19%	4.80%	6.06%	4.21%	3.23%	3.91%	3.00%	2.89%
2007	10.10%	4.64%	5.87%	3.98%	3.13%	3.84%	2.94%	2.84%
2008	10.40%	4.62%	5.76%	3.90%	3.05%	3.85%	2.64%	2.66%

**Table 34: DM GNI Portfolio Data***DM Annual GNI Weights 1988-2008 (Continued)*

	<i>Netherlands</i>	<i>New Zealand</i>	<i>Norway</i>	<i>Portugal</i>	<i>Singapore</i>	<i>Spain</i>	<i>Sweden</i>	<i>Switzerland</i>
1987	12.09%	1.90%	5.19%	0.00%	1.35%	16.14%	9.32%	9.37%
1988	12.19%	1.90%	4.75%	0.00%	1.29%	16.99%	9.29%	9.86%
1989	11.86%	1.91%	4.58%	0.00%	1.36%	17.76%	9.26%	9.63%
1990	11.37%	1.79%	4.46%	0.00%	1.46%	18.60%	9.11%	9.33%
1991	9.42%	1.31%	3.70%	16.14%	1.31%	16.46%	7.55%	7.51%
1992	9.79%	1.22%	3.84%	13.50%	1.46%	17.61%	7.63%	7.73%
1993	10.16%	1.28%	3.82%	12.86%	1.71%	17.19%	7.01%	7.84%
1994	10.62%	1.38%	3.85%	11.55%	2.05%	16.37%	6.83%	7.98%
1995	10.98%	1.50%	3.87%	10.87%	2.27%	15.88%	6.55%	8.21%
1996	11.04%	1.57%	4.00%	10.04%	2.40%	15.71%	6.65%	8.25%
1997	10.92%	1.58%	4.13%	9.88%	2.60%	15.56%	6.63%	7.96%
1998	10.80%	1.55%	4.18%	8.39%	2.46%	16.11%	6.92%	7.89%
1999	11.26%	1.51%	4.22%	7.00%	2.46%	16.49%	7.00%	7.75%
2000	11.39%	1.40%	4.33%	6.73%	2.49%	16.71%	6.99%	7.78%
2001	11.32%	1.42%	4.68%	7.17%	2.42%	16.93%	6.72%	7.54%
2002	11.12%	1.47%	4.84%	8.32%	2.38%	17.01%	6.54%	7.29%
2003	11.13%	1.57%	4.79%	8.92%	2.18%	17.58%	6.44%	7.40%
2004	11.19%	1.64%	4.73%	9.53%	2.01%	17.88%	6.39%	7.16%
2005	10.73%	1.66%	4.75%	10.54%	1.95%	18.22%	6.26%	6.97%
2006	10.57%	1.56%	4.73%	12.28%	1.98%	17.95%	6.10%	6.53%
2007	10.24%	1.54%	4.89%	14.41%	1.97%	17.69%	5.89%	6.04%
2008	9.79%	1.43%	5.02%	16.54%	2.03%	17.55%	5.66%	5.12%



*Figure 20: DM GNI Portfolio Return 1988-2008*



**Table 35: EM GNI Portfolio Data***EM GNI 1988-2008 (in bil. USD)*

	<i>Brazil</i>	<i>Chile</i>	<i>China</i>	<i>Colombia</i>	<i>India</i>	<i>Indonesia</i>	<i>Korea</i>	<i>Malaysia</i>
1987	125.19	17.77	319.14	35.60	80.50	262.18	141.01	-
1988	156.01	20.52	323.91	36.91	82.22	287.02	144.11	32.52
1989	194.58	24.85	326.20	37.71	90.86	368.65	175.23	36.47
1990	242.85	28.03	350.18	39.55	105.06	380.13	222.13	40.93
1991	289.58	32.16	387.17	39.90	107.72	418.60	267.01	45.48
1992	320.93	39.44	435.42	43.38	120.23	412.08	313.89	52.19
1993	360.99	45.75	480.99	49.36	149.38	423.72	365.43	61.89
1994	412.20	51.34	551.67	64.07	170.56	485.44	411.83	71.91
1995	485.82	62.42	643.56	80.15	194.82	604.46	347.07	83.01
1996	549.67	72.31	788.44	94.04	218.09	733.69	339.19	94.61
1997	560.27	79.96	919.04	100.25	222.42	842.57	349.19	99.73
1998	425.69	79.14	981.84	98.38	135.08	825.86	383.16	80.54
1999	429.97	74.94	1,058.43	90.87	119.65	709.80	431.34	76.57
2000	465.91	74.60	1,168.77	90.62	119.46	673.69	500.87	80.18
2001	515.94	71.72	1,273.21	90.19	143.15	584.18	552.66	84.09
2002	563.21	68.09	1,406.92	91.55	156.66	549.94	600.07	91.74
2003	606.72	69.09	1,631.40	94.17	179.20	539.40	664.01	102.82
2004	712.40	79.86	1,937.84	105.58	221.85	612.63	756.22	119.33
2005	813.66	96.58	2,273.28	123.68	256.58	739.60	833.35	133.45
2006	915.26	113.17	2,639.33	148.72	289.40	906.32	911.14	149.07
2007	1,027.56	135.37	3,179.86	180.41	341.31	1,151.26	989.52	170.49
2008	1,046.29	157.46	3,888.08	207.94	426.79	1,401.33	1,062.40	195.96

**Table 35: EM GNI Portfolio Data***EM GNI 1988-2008 (in bil. USD) (Continued)*

	<i>Mexico</i>	<i>Peru</i>	<i>Philippines</i>	<i>Poland</i>	<i>South Africa</i>	<i>Thailand</i>	<i>Turkey</i>
1987	20.78	31.65	-	35.56	79.32	46.64	81.03
1988	14.57	34.67	-	47.06	97.88	56.36	85.72
1989	13.42	39.18	-	54.96	114.39	67.52	92.95
1990	15.67	42.94	-	63.64	113.32	79.70	116.73
1991	24.11	44.58	-	73.74	114.73	91.11	135.80
1992	30.96	48.30	69.69	88.55	116.01	103.78	156.92
1993	35.29	53.99	85.69	93.64	127.53	121.36	175.39
1994	41.85	62.74	94.52	98.90	138.09	140.18	153.74
1995	47.75	71.22	114.55	106.47	146.43	161.97	166.09
1996	53.41	83.07	139.93	115.36	150.40	177.27	173.15
1997	57.98	88.36	161.40	118.34	150.59	164.83	192.43
1998	55.94	79.21	166.65	117.19	137.65	126.00	209.13
1999	53.74	78.16	169.54	118.09	135.14	120.63	219.68
2000	53.34	80.31	176.64	118.56	134.39	122.10	265.19
2001	52.06	81.42	178.64	115.50	126.98	119.97	222.95
2002	54.41	81.24	185.33	115.85	119.41	120.95	226.51
2003	58.73	86.76	209.00	131.48	131.45	132.96	251.71
2004	65.55	97.89	238.08	159.79	168.23	154.26	339.69
2005	74.07	107.33	277.57	183.29	225.60	170.47	443.31
2006	82.47	119.49	317.97	190.26	256.96	190.30	516.14
2007	95.12	141.53	373.61	202.61	274.32	217.03	590.91
2008	115.06	170.41	447.09	219.63	283.19	247.17	666.59

**Table 35: EM GNI Portfolio Data**

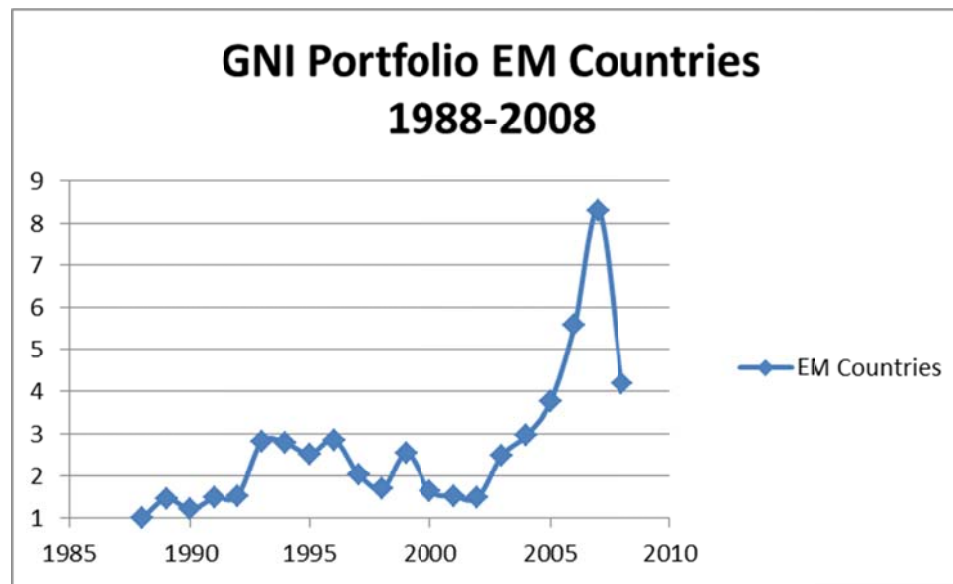
*EM Annual GNI Weights 1988-2008*

	<i>Brazil</i>	<i>Chile</i>	<i>China</i>	<i>Colombia</i>	<i>India</i>	<i>Indonesia</i>	<i>Korea</i>	<i>Malaysia</i>
1987	16.18%	2.30%	-	-	-	33.88%	18.22%	-
1988	19.58%	2.57%	-	-	-	36.02%	18.09%	4.08%
1989	19.98%	2.55%	-	-	-	37.86%	18.00%	3.75%
1990	20.77%	2.40%	-	-	-	32.51%	19.00%	3.50%
1991	13.98%	1.55%	18.69%	1.93%	5.20%	20.21%	12.89%	2.20%
1992	13.65%	1.68%	18.51%	1.84%	5.11%	17.52%	13.35%	2.22%
1993	13.72%	1.74%	18.29%	1.88%	5.68%	16.11%	13.89%	2.35%
1994	13.98%	1.74%	18.71%	2.17%	5.78%	16.46%	13.96%	2.44%
1995	14.65%	1.88%	19.41%	2.42%	5.88%	18.23%	10.47%	2.50%
1996	14.53%	1.91%	20.84%	2.49%	5.77%	19.40%	8.97%	2.50%
1997	13.64%	1.95%	22.38%	2.44%	5.42%	20.51%	8.50%	2.43%
1998	10.91%	2.03%	25.17%	2.52%	3.46%	21.17%	9.82%	2.06%
1999	11.06%	1.93%	27.23%	2.34%	3.08%	18.26%	11.10%	1.97%
2000	11.30%	1.81%	28.34%	2.20%	2.90%	16.33%	12.14%	1.94%
2001	12.25%	1.70%	30.22%	2.14%	3.40%	13.87%	13.12%	2.00%
2002	12.71%	1.54%	31.75%	2.07%	3.53%	12.41%	13.54%	2.07%
2003	12.41%	1.41%	33.37%	1.93%	3.67%	11.03%	13.58%	2.10%
2004	12.35%	1.38%	33.59%	1.83%	3.85%	10.62%	13.11%	2.07%
2005	12.05%	1.43%	33.67%	1.83%	3.80%	10.95%	12.34%	1.98%
2006	11.82%	1.46%	34.07%	1.92%	3.74%	11.70%	11.76%	1.92%
2007	11.33%	1.49%	35.06%	1.99%	3.76%	12.69%	10.91%	1.88%
2008	9.93%	1.49%	36.90%	1.97%	4.05%	13.30%	10.08%	1.86%

**Table 35: EM GNI Portfolio Data***EM Annual GNI Weights 1988-2008 (Continued)*

	<i>Mexico</i>	<i>Peru</i>	<i>Philippines</i>	<i>Poland</i>	<i>South Africa</i>	<i>Thailand</i>	<i>Turkey</i>
1987	2.68%	-	-	-	10.25%	6.03%	10.47%
1988	1.83%	-	-	-	-	7.07%	10.76%
1989	1.38%	-	-	-	-	6.93%	9.55%
1990	1.34%	3.67%	-	-	-	6.82%	9.98%
1991	1.16%	2.15%	-	3.56%	5.54%	4.40%	6.56%
1992	1.32%	2.05%	2.96%	3.77%	4.93%	4.41%	6.67%
1993	1.34%	2.05%	3.26%	3.56%	4.85%	4.61%	6.67%
1994	1.42%	2.13%	3.20%	3.35%	4.68%	4.75%	5.21%
1995	1.44%	2.15%	3.45%	3.21%	4.42%	4.88%	5.01%
1996	1.41%	2.20%	3.70%	3.05%	3.98%	4.69%	4.58%
1997	1.41%	2.15%	3.93%	2.88%	3.67%	4.01%	4.69%
1998	1.43%	2.03%	4.27%	3.00%	3.53%	3.23%	5.36%
1999	1.38%	2.01%	4.36%	3.04%	3.48%	3.10%	5.65%
2000	1.29%	1.95%	4.28%	2.87%	3.26%	2.96%	6.43%
2001	1.24%	1.93%	4.24%	2.74%	3.01%	2.85%	5.29%
2002	1.23%	1.83%	4.18%	2.61%	2.69%	2.73%	5.11%
2003	1.20%	1.77%	4.27%	2.69%	2.69%	2.72%	5.15%
2004	1.14%	1.70%	4.13%	2.77%	2.92%	2.67%	5.89%
2005	1.10%	1.59%	4.11%	2.71%	3.34%	2.52%	6.57%
2006	1.06%	1.54%	4.10%	2.46%	3.32%	2.46%	6.66%
2007	1.05%	1.56%	4.12%	2.23%	3.02%	2.39%	6.51%
2008	1.09%	1.62%	4.24%	2.08%	2.69%	2.35%	6.33%

*Figure 21: EM GNI Portfolio Return 1988-2010*



**Table 36: GNI Efficient Portfolio Statistics 1988-2008**

*GNI Efficient Portfolio 1988-2008*

	<b>Weight</b>	<b>Mean</b>	<b>Risk</b>
<i>3 mo. T Bill (rf)</i>		3.98%	-
<i>USA</i>	53%	8.18%	19.97%
<i>G7</i>	0%	5.70%	19.29%
<i>DM</i>	0%	9.19%	23.21%
<i>EM</i>	47%	13.06%	35.83%
<b>Portfolio</b>	<b>100%</b>	<b>10.45%</b>	<b>22.57%</b>
<b>Sharpe Ratio</b>	<b>0.2867</b>		
<i>*no Short Sales</i>			

<b>Covariance</b>	<i>USA</i>	<i>G7</i>	<i>DM</i>	<i>EM</i>
<i>USA</i>	0.0379	0.0331	0.0355	0.0275
<i>G7</i>	0.0331	0.0353	0.0399	0.0445
<i>DM</i>	0.0355	0.0399	0.0512	0.0585
<i>EM</i>	0.0275	0.0445	0.0585	0.1220

<b>Correlation</b>	<i>USA</i>	<i>G7</i>	<i>DM</i>	<i>EM</i>
<i>USA</i>	1.0000	0.9037	0.8060	0.4039
<i>G7</i>	0.9037	1.0000	0.9389	0.6777
<i>DM</i>	0.8060	0.9389	1.0000	0.7398
<i>EM</i>	0.4039	0.6777	0.7398	1.0000

**Table 37: GNI Efficient Portfolio Statistics 1993-2008**

*GNI Efficient Portfolio 1993-2008*

	Weight	Return	Risk
3 mo. T Bill (rf)		3.35%	-
USA	0%	6.93%	21.03%
G7	0%	6.13%	20.17%
DM	85%	10.65%	24.57%
EM	15%	12.89%	38.40%
<b>Portfolio</b>	<b>100%</b>	<b>10.99%</b>	<b>24.58%</b>
<b>Sharpe Ratio</b>	<b>0.3106</b>		
*no Short Sales			

<b>Covariance</b>	USA	G7	DM	EM
USA	0.041	0.036	0.040	0.026
G7	0.036	0.038	0.044	0.047
DM	0.040	0.044	0.057	0.064
EM	0.026	0.047	0.064	0.138

<b>Correlation</b>	USA	G7	DM	EM
USA	1.0000	0.9098	0.8317	0.3470
G7	0.9098	1.0000	0.9428	0.6439
DM	0.8317	0.9428	1.0000	0.7278
EM	0.3470	0.6439	0.7278	1.0000



# Nicholas G. Baccash

## EDUCATION:

### The Pennsylvania State University

*The Schreyer Honors College, Smeal College of Business*

Double Major Bachelor of Science Finance and Bachelor of Science German

Double Minor in International Business and Economics

Smeal College of Business and The Liberal Arts College Student Marshal Fall 2010

President's Freshman Award Fall 2006 Semester

### IES Berlin Language Area Studies Program

Hessen International Sommer Universität

**University Park, PA**

*Graduation: Dec 2010*

**Berlin, Germany**

*Mar 2009-Jun 2009*

**Marburg, Germany**

*Jul 2007-Aug 2007*

## RELEVANT EXPERIENCE

### PricewaterhouseCoopers

*Forensic Services Intern*

- Worked in team based and individual roles to create high quality client deliverables
- Developed and honed research and time management skills
- Received and accepted full time employment offer

**Philadelphia, PA**

*Jun 2010-Aug 2010*

### Siemens A.G.

*Corporate Finance Reporting Intern*

- Worked in *Finance Training*, Siemens' online accounting and finance training department
- Reviewed, edited, and provided feedback on employee training courses; helped establish language standards
- Used IFRS as lead accounting standard

**Munich, Germany**

*Jul 2009- Aug 2009*

### Siemens Capital Company LLC

*Corporate Treasury Intern*

- Developed reports to analyze fluctuations in foreign currency hedges, interest rate products and other derivatives
- Assisted in preparation of monthly and quarterly financial reports for managerial meetings
- Helped identify customer base for implementation of Siemens' Supply Chain Finance

**Iselin, NJ**

*Jan 2009- Feb 2009*

### Siemens Corporation

*Corporate Accounting Intern*

- Implemented online forecasting tool to improve forecasting efficiency and compatibility
- Selected to participate in Siemens' Intern Experience at Walt Disney World, 10% of interns selected nation-wide
- Won group award for best presentation at Intern Experience

**Iselin, NJ**

*May 2008-Aug 2008*

### Penn State Investment Association

*Member/ PSIA Certified*

- Completed certification to qualify for analyst position
- Performed DCF analysis for equities using Bloomberg data

**University Park, PA**

*Sep 2007-May 2008*

### Smeal Idea Pitch Competition

*Business Analyst, Sushi Tokyo Inc.*

- Won 3<sup>rd</sup> place in 2007 competition (30+ entries)
- Developed comprehensive business plan to help expand Philadelphia, PA based sushi distribution company

**University Park, PA**

*Jan 2008-May 2008*

## LEADERSHIP/ACTIVITIES:

### Penn State Lion Ambassadors

*Food Subhead Guard the Lion Shrine 2009*

- Manage all food related activities for annual homecoming-eve tradition with over 1,000 guests

**University Park, PA**

*Jan 2008-Present*

*Membership Committee*

- Responsible for application process and interviewing prospective new members

*Co-Chair Embassy Education*

- Research, develop, and present continuing education topics using video, PowerPoint, and guest speakers

*Strategic Planning Committee*

- Provided guidance for direction of organizations' projects and their respective goals

### F.C. Atlas Intramural Soccer

*Captain and Coach*

*Aug 2008-May 2010*

### Atlas Thon

*Member*

*Sep 2007- May 2008*

### Pride of the Lions Pep Band

*Trumpet Section*

*Dec 2006-Mar 2007*

## SKILLS:

**German:** Fluent (speaking, reading, writing); Summer internship and two study abroad programs completed using German Language

**Computer Skills:** SAP Experience, Proficient in Microsoft Office applications

**Mathematical and Analytical Skills:** Completed multi-variable calculus course and differential equations course