Journal of Stock & Forex Trading
ISSN: 2168-9458

Safarzadeh and Nazarian, J Stock Forex Trad 2012, 1:2
DOI: 10.4172/2168-9458.1000102

Research Article Open Access

Risk and Return to Investment in Five Emerging Nations: A *Mathematica* Simulation

Mohammad R. Safarzadeh[1]* and Fatemeh Ibrahimi Nazarian[2]

[1]*Professor, Economics Department, California State Polytechnic University, Pomona, CA 91768, USA*

[2]*Professor, Finance and Business Economics, Marshall School of Business, University of Southern California, Los Angeles, CA 90089, USA*

Abstract

This paper compares the *Mathematica* simulations of optimum allocation ratios derived from the application of Modern Portfolio Theory to historical data of five emerging nations with the actual allocations as presented in MSCI BRIC Index Fund (BKE) and Emerging Markets Index Fund (EEM). The paper finds that the BKE and EEM allocations of funds are not consistent with the optimum allocations of funds derived from the *Mathematica* simulation whether the risk of exchange rate volatility is factored in or not.

JEL Classification Code: G15

Keywords: Risk and return; Fund allocation; Efficient frontiers; Emerging nations

Introduction

While most of the developed economies and their financial markets have experienced one of the most volatile periods in the past decade, a number of countries known as emerging nations have had rapid technological advancement, economic growth, and booming stock markets. Much of this growth is fueled by the macroeconomic idea of convergence, in which these developing countries are able to grow and industrialize at an immense rate due to the technology already existing in other nations. Whereas industrialized nations are dependent on the innovations of new technology to achieve economic growth, developing nations are able to grow from already existing technologies that they have not yet adopted. A corollary development in such countries has been fiscal reforms, increased civil rights, and relative law and order, which have resulted in more industrialization, urbanization, and increased global trade.

The combination of large economic growth and increased political stability has led to more domestic and international investments in emerging nations. These countries are shaping and developing their securities market infrastructures, providing not only diversification but also increased returns. Along with direct investment in emerging nations, the flow of investment to these countries has been accelerated by investors' access to a broad range of Exchange-Traded Funds (ETFs) that provide them choice and flexibility in implementing their investment strategies in these countries[1].

In addition to gains from diversification, the high economic growth of emerging nations has resulted in significant equity return to investment in these countries. However, these gains come with a number of increased risks to which investors have exposure. Among these are country/political risk and risks derived from security, regulation, liquidity, and poor corporate governance. There is an additional risk due to exchange rate volatility that may reduce rewards to investment and alter the allocation of funds to be invested in the stock markets of these countries[2]. The negative impact of exchange rate variability on international trade and other fundamental economic variables has been well documented in the economic literature. However, the relationship between exchange rate volatility and stock returns has been controversial. Many economists believe that exchange rate volatility impedes international investment flows by adding risk to the rate of return on foreign financial assets and causing volatility in stock markets. However, empirical studies of the relationship between exchange rate variations and stock market returns have been inconclusive with respect to the significance of the link between volatility of exchange rates and stock prices[3].

Using a variation of Modern Portfolio Theory (MPT), this paper examines the performance of the major stock indices of five leading emerging nations. The monthly data for major stock indices of selected countries are used to measure risk and return to investment in these countries and to find the optimum portfolio based on minimizing risk for the given level of return. Allowing for the effects of expected variations in exchange rates on returns to investments, the optimum portfolio is recalculated. A *Mathematica* simulation then is used to measure the effects of exchange rate volatility on returns as well as the optimum allocation of investment funds among the selected countries. The results of the simulations are compared with the actual allocations of investment funds to two ETFs, BRIC Index Fund (BKF) and Emerging Markets Index Fund (EEM).

Review of the Literature

Markowitz' Portfolio Selection [1] is the basis of modern portfolio theory. To obtain higher returns, investors have to expose themselves to risks. To reduce the risk, investors must balance the risk and return of each security against the risk and return of a pool of other securities in the portfolio.

A number of studies have argued in favor of using CAPM for analyzing risk and return of investment in developing and emerging nations. Jagannathan and McGrattan (1995) argued that although academic controversy will continue for the time being, CAPM is still useful for investors with a long-run time horizon. Achour, Campbell, Hopkins and Lang's (1998) argued that the current modus operandi for

[1]Please see Appendix 1, market indices for the selected emerging nations.
[2]Please see Appendix 2, exchange rate variations of selected emerging nations.

***Corresponding author:** Mohammad R. Safarzadeh, Professor, Economics Department, California State Polytechnic University, Pomona, CA 91768, USA, E-mail: mrsafarzadeh@csupomona.edu

Received March 24, 2012; **Accepted** June 28, 2012; **Published** July 01, 2012

Citation: Safarzadeh MR, Nazarian FI (2012) Risk and Return to Investment in Five Emerging Nations: A *Mathematica* Simulation. J Stock Forex Trad 1:102. doi:10.4172/2168-9458.1000102

investment in emerging markets focused on country selection, rather than stock selection due to the high costs to develop a stock selection game plan. Achour, et al. concluded that country selection was not the only option investors had to add value to their portfolio in emerging markets. The authors believed there should be studies that blend both stock selection and country selection together, in order to improve the returns on investment in emerging markets.

With the assumption that sources of risk for developed and emerging nations are different, (Harvey, 2000) analyzed 18 measures of risk in 47 different international markets. He concluded that risk measured from the asset pricing theory did stand reasonably well with world markets.

With respect to the relationship between exchange rates and stock prices, the results differ based on the country and the time period under the study. Following the Chinese exchange rate reform in 2005, Zhang, Feng, Li and Wang (2008) analyzed the relationship between the exchange rate and the domestic stock market. They found that in the long run, the Shanghai A-share index was highly influenced by the exchange rate and there was long-term cointegration between the two variables.

Zhang, et al. results contrasts with that of Tabak [2]. Analyzing the relationship between stock markets and exchange rates in Brazil from August 1994 to May 2002, Tabak found no long-run relationship between the two variables. However, Tabak found linear Granger causality running from stock prices to exchange rates and non-linear Granger causality running from exchange rate to stock prices.

In a research on Malaysia, Azman-Saini, Habibullah and Law (2007) conducted an analysis for the 1997 Asian crisis. The results indicated one-way causality from exchange rates to stock prices. Ismail and Bin Isa (2009) study for the Asian crisis of 1997 showed that there was no cointegration between stock price indices and exchange rates. A study by Ghazali, Ismail, Yasoa and Lajuni (2008) for the period July 2005 to March 2007, a period in which Malaysian ringgit (MYR) was unpegged, found no cointegration between exchange rate and stock prices. However, using Toda-Yamamoto and Engle-Granger causality tests, Gazali, et al. found causality from changes in stock prices to changes in exchange rates.

Pan, Fok and Liu (2007) analyzed seven Asian countries: Japan, Taiwan, Korea, Thailand, Malaysia, Hong Kong and Singapore for the period January 1988 - October 1998. The study found a significant causal relationship from respective of exchange rates to stock prices for Japan, Thailand, Malaysia and Hong Kong. During the 1997 crisis, they detected no significant causality from stock prices to exchange rates. However, there was a causal relationship from exchange rates to stock prices in all countries except Malaysia.

Aydemir and Demirhan (2009) study for Turkey used daily data from February 2001 to January 2008. The study showed that there was a negative causal relationship from exchange rates to all Turkish stock market indices analyzed. Another paper by Rahman and Uddin (2009) analyzed Pakistan, India and Bangladesh from January 2003 to June 2008. The study found no cointegration between stock prices and exchange rates. A Granger causality test found no causal relationship between stock prices and exchanges.

A study by Hong and Lee [3] used data from January 1998 to June 2006. The study found a negative relationship between the exchange rate and the Japanese stock market. There was also a negative relationship between the exchange rate and the United States' stock market.

Choice of Nations and Indices

There are estimated to be 28 emerging nations in the world today. Emerging market economies represent nearly 70% of the world population. Most of them have been growing at an annual rate of nearly 10% over the last decade compared to only 5% in developed markets. The market capitalization of emerging countries is nearly $10 trillion, which is nearly 20% of the world capital, hence making them an important part of the world economy. This paper will examine five dynamic economies: Brazil, China, India, Russia, and Turkey. The first four, known as the "BRIC," are the fastest growing economies and are set to collectively rival the G7 in the next decade or so. Turkey is among the next generation emerging markets, known as "next-11," that seem most likely to become contenders of the "BRIC," although further down the road.

Brazil has been rapidly industrializing, moving away from agriculture and into manufacturing. Top exports include airplanes, cars and electrical equipment. Additionally, the cultivation of ethanol fuel, which uses fermented corn, sugar cane and other grains to produce fuel, has bolstered the nation's agriculture industry, making it increasingly important alongside manufacturing and technology in driving the economy. Brazil among the "BRIC" actually, has the capacity to continue simultaneously all elements, namely manufacturing, services, and raw material-resource supplying. The BOVESPA stock index (BVSP) is a composite of 50 companies traded on the Sao Paulo Stock Exchange. It is widely cited as a measure of the equity market in Brazil. It covers about 80% of the trades taking place in terms of volume and about 70% of the market capitalization of the Sao Paulo Stock Exchange. The index rose from 16388 in early 2000 to 68588 at the end of 2009, a total increase of 318.53% over the past 10 years.

China is in a league of its own compared to other "BRIC" countries and might even surpass the US equity market's capitalization in the future to become the largest equity market. China has experienced soaring real GDP in recent years. This rapid growth have been attributed to a tremendous increase in capital investment, fast productivity growth that has resulted predominantly from a transition from a centrally planned economy, and openness which has increased its trade significantly. Despite its weak banking system, increasing income inequality and high unemployment among rural workers, China is a manufacturing giant, rapidly developing technologically. Economically, China continues to relax trade restrictions and increase private property and business ownership rights. As the second largest trading partner of the United States, China benefits from a fixed exchange rate, insuring their goods are reasonably priced in the U.S. and other foreign markets.

[3]Empirical studies analyzing the relationship between the exchange rate and stock prices have been inconclusive with respect to the effect of exchange rate variations on stock prices. Aggarwal and Solnik found a weak positive relationship between exchange rate variations and stock returns [4,5]. Levy [6], Soenen and Hennigar [7], and Hong and Lee [3] found a strong negative relationship between changes in exchange rates and U.S. stock prices. Jorion [8] found that the effect of exchange rate variations on stock returns of corporations depended on the percentage of foreign operations of U.S. multinationals. Ma and Kao [9] found differentiated effects of exchange rates on stock prices based on whether the country in the study was import-dominant or export-dominant. Choi and Prasad [10] emphasized higher exchange risk sensitivity during the weak-dollar period than during the strong-dollar period. Analyzing the relationship between the stock markets and exchange rates in Brazil, Tabak [2] found no long-run relationship between the variables. In a study of 37 non-financial firms from 37 countries, Bartram and Bodnar [11] determined that the relationship between exchange rate and stock returns was more agreeable with a cash flow effect than with a discount rate effect. Clearly, exchange rate variations can affect stock prices either by adding risk to the rate of return on financial assets or by influencing trade, investment flows, and other fundamental economic variables.

The SSECD index is a composite index in the Shanghai Stock Exchange. It reached an all-time high in 2007 and plummeted by 65% during the following global economic crises, reflecting both China's strength and its vulnerability to changes in world demand for its goods. The index rose from 1535 in early 2000 to 3277 at the end of 2009, a total increase of 113.49% over the past 10 years.

India is the most populous democracy in the world and has the world's second largest work force. Following decades of socialist-inspired regulation of the economy, a liberalization that started in the early 1990s has seen more market-driven policies and subsequent growth and development of technology and manufacturing. India will become after China the dominant supplier of manufactured goods. India is not only a large exporter of goods, but an exporter of services. Exporting of customer-service jobs, from call-centers and personal assistants to doctors and engineers, have promoted education and global exposure to the country. The NSEID index, nicknamed the "nifty fifty," is a composite of 50 diverse companies located throughout India. It covers 25 sectors of the Indian economy and captures approximately 60% of its equity market capitalization. The Index rose from 1546 in early 2000 to 5201 in late 2009, a total increase of 236.42% over the past 10 years.

Economically the weakest member of the BRIC, Russia converted to market economy in 1991. During the 1990s, the Russian economy underwent through cycles of growth and economic crisis that resulted in loss of investors' confidence and flight of foreign investments. By the end of the 1990s, the Russian economy had achieved stability meeting its foreign debt obligations and attracting foreign investments. The average real GDP growth of 7% over the past decade has made Russia the 9th largest economy. The RTS Index in Russia comprises of the stocks of the fifty largest companies, capturing 85% of the total market capitalization of the Russian Trading System exchange. The Index rose from 172.31 in early 2000 to 1444.61 in late 2009, a total increase of 738.13% over the past 10 years.

Turkey began a series of reforms in the mid 1980s that were designed to shift the economy to a more private sector, market-based model. However, it was not until 2001 when the serious social and economic reforms of earlier years started paying dividends in the form of high economic growth and a low inflation rate. Investors' confidence in Turkey's economy increased and foreign investment soared. Turkey is rapidly industrializing its economy with automotive, home appliances, electronics, and shipbuilding as the leading industries. After years of low levels of foreign direct investment, Turkey succeeded in attracting over $21 billion in 2007 and is expected to attract higher figures in the following years. The Index rose from 16715 in early 2000 to 52825 in late 2009, a total increase of 216.03% over the past 10 years.

Though the above choice of nations and indices is not comprehensive, it provides an adequate foundation for studying the investment prospects of emerging markets. Data from earlier decades is also not desirable because emerging nations have undergone much recent change.

Methodology and the Model

The study utilizes a variation of the MPT model that minimizes the risk of a portfolio of the selected five emerging nations' main market indices, subject to constraints on the portfolio's expected return and allocation of funds.

$$\text{Minimize: } \text{Risk} = W^T \Sigma W$$

$$\text{Subject to: } R^T W = R_p$$

$$\Sigma w_i = 1, \; i = 1 \ldots 5$$

Where, W is a vector of weights with elements W_i as the weight that country i's market index carries in the portfolio; Σ is the variance-covariance matrix, with elements S_i^2 as the sample variance of the return to investment in country i and S_{ij} as the sample covariance between the returns to investments in countries i and j; R is a vector of expected return to investments with elements R_i as the expected return to investment in country i, and $R_p = \Sigma w_i E(R_i)$.

Using monthly data for stock indices and exchange rates of five emerging nations for the period 2000.01 – 2009.12, R and Σ were estimated and a *Mathematica* constrained optimization technique was applied to find the optimum solution. Since investing in foreign countries adds a new risk to the portfolio due to unexpected changes in exchange rates, the risk and return matrices (R and Σ) were recalculated by including the expected changes in exchange rates as part of a return to measure the parity between investing in the home country and investing in foreign countries. A *Mathematica* simulation then was used to track the optimum solutions and the corresponding optimum weights (Ws) that are the fraction of funds to be invested in each country for the expected variations in exchange rates.

Data and the Empirical Results

The data for exchange rates and stock indices were collected on a monthly basis for the period 2000:01-2009:12, from the Global Financial Database[4]. To avoid the serial correlation resulting from temporal aggregation, the study uses the end of the month closing prices in markets and the end of the month spot dollar prices of foreign currencies[5].

All the exchange rate and stock return data were tested for the presence of unit roots in the individual time series. In this study, we have tested for unit roots using the Augmented Dickey-Fuller (ADF) test, (1979), and the Phillips-Perron (1988) test[6]. The tests showed that the stock indices of the five countries in the study were non-stationary. However, a test of cointegration among the stock indices showed that the null hypothesis, existence of at least one cointegrating vector, could not be rejected at the 95% level of significance. This test shows that even though the stock index for each country has a stochastic trend, over the long-run the indices do not move far away from each other[7]. The unit root tests for the return and net return on stock indices showed that the null hypothesis of a unit root could not be rejected at the 95% level of significance. Table 1 shows the summary statistics on monthly return, standard deviation, and coefficient of variation (CV) for the data of the five countries over the period 2000:01-2009:12.

For the period 2000:1-2009:12, Russia has the highest average monthly return of 1.79% and China has the lowest, .64%. However, for the exchange rate adjusted return (net return), Russia still holds the highest return, 1.74%, with Turkey having the lowest net return at .13% per month. Using the coefficient of variation as a measure of risk per dollar of return on investment, China is the highest, and Russia

[4]It should be noted that all returns are calculated using price indices. Dividends would have further increased returns to shareholders, increasing investors' total returns.
[5]Since the study of Working [12], it has been known that temporal aggregation will cause serial correlation to appear even in data from an efficient market.
[6]The Dickey-Fuller [13] test assumes that errors are statistically independent and have a constant variance. The Phillips-Perron [14] test is a generalization of the Dickey-Fuller procedure that allows for fairly less restrictive assumptions concerning the distribution of errors.
[7]See, for example, Walter Enders [15], page 359 and Appendix 1.

the lowest. This is due to a very high average return to investment in Russia relative to China, even though the risk, measured by standard deviation, is significantly higher in Russia than China.

When adjusted for exchange rate parity, Turkey has the highest coefficient of variation, while Russia holds its position as having the lowest CV. A look at the volatility of the exchange rate in Table 2 explains the risk that an investor is taking due to this volatility.

As table 2 shows, over the period 2000:01–2009:12, Turkey has the highest variations in exchange rate, with a 112.9% change in the range of exchange rate variations and .213 as the coefficient of variation. Next to Turkey, Brazil has 89.43% change in the range of exchange rate variations and .226 as CV. China, on the other hand, has the lowest variations in exchange rate, with a CV of .070. The Chinese currency (Yuan) is formally pegged to a basket of currencies that includes the U.S. dollar. The Yuan began appreciating against the U.S. dollar in 2005, but this halted abruptly in 2008 as the global financial crisis took effect. Since then, the Yuan's value has remained at roughly 6.83 to $1.

Figure 1 compares the simulation results of expected return to the optimum portfolio with the expected net return (exchange rate adjusted return) for increasing levels of risk. The figure clearly shows the negative effect of exchange rate volatility on the expected return. Over the past decade, for any level of risk, the return to optimum portfolio is higher than the exchange rate adjusted return. At extremely high levels of risk, the higher weights of the countries with high returns and volatile exchange rates more than compensate for the negative effects of exchange rate parity.

This result is also confirmed by comparing the efficient frontiers, or "the Markowitz frontiers," calculated by maximizing expected return and expected net return for a given level of risk. The simulation outcomes of every possible combination of market indices of the five countries are plotted on two risk-and-return spaces in Figure 2. For every level of risk, return plus exchange rate parity is lower than the return only.

The plot of the weights derived from the optimizing models and simulations reveals an interesting pattern consistent with the conclusions above. Inclusion of the exchange rate parity as part of the return to portfolio results in more variations in the optimum weights of the funds allocated to different countries included in the portfolio. Among the five countries, India and China have the least volatile weight in the optimum portfolios, whether exchange rate parity is included as part of the expected return or not. India has the lowest variation in exchange rate, with a CV of .061, and China has the second lowest variation, with a CV of .070. Turkey has the highest rate of variation in exchange rate, with a 112.91% change in the range of variations over the past decade (Chart 1 & Chart 2).

The following pie charts summarize the results of simulations on optimum portfolio and fund allocation. Chart 3 shows the allocation of funds when only return to portfolio is concerned. Chart 4 shows the allocation of funds when exchange rate parity is included with return.

The results of the simulations of optimum allocation of funds show that, at any level of risk, countries with more stable exchange rates, such as China and India, should receive a larger fraction of the funds than countries with higher exchange rate volatility, such as Turkey and Brazil. Only at a very high level of risk, can the high returns to investment in countries such as Russia and Brazil justify a significant allocation of funds. The two ETFs specific to emerging nations are BRIC Index Fund (BKF) and Emerging Markets Index Fund (EEM). As shown in Chart 5, both ETFs' allocation of funds among the countries are similar, with 38% of funds allocated to China, 31% to Brazil, 14% to 15% to India, 12% to 13% to Russia, and 1% to 3% to Turkey.

This allocation is not consistent with any optimum allocation derived from the simulations, whether the risk of exchange rate volatility is factored in or not. Only a very low-risk allocation of funds, where the optimum allocation does not take into account the risk of exchange rate volatility, justifies the weights in the BKF and EEM allocation of funds. For the same levels of risk and return, with the risk of exchange rate volatility included, an optimum allocation of funds would require over 80% of funds to be allocated to China and India.

Concluding Remarks

Emerging markets can offer higher returns to an investor. Countries such as Brazil, Russia, India, China, and Turkey have enjoyed positive average annual returns of 16.83%, 23.72%, 12.95%, 7.68%, and 7.95% for the past decade, respectively. The average risk per dollar of investment in these countries, as measured by the coefficient of variation, is lower than that of the S&P 500. While the markets in some emerging nations show greater returns than the U.S. market with lower measures of risk, there are certainly other socioeconomic factors that may lead investors to not value these markets as low-risk. Among many, the one emphasized in this paper is the added risk due to variations in exchange rates. An appreciation of an emerging nation's domestic currency relative to the U.S. dollar results in an extra return to U.S. investors in that country. A depreciation of the domestic currency would result in a loss in return for a U.S. investor.

This paper addresses two questions on risk and return to investments in emerging nations. First, do ETFs investing in emerging nations

Country	Return	Net Return	S.D. Return	S.D. Net Return	CV Return	CV Net Return
Brazil	1.20	1.23	0.0810	0.11949	6.75	9.71
China	0.64	0.80	0.0883	0.08775	13.80	10.97
India	1.02	0.96	0.0812	0.09239	7.96	9.62
Russia	1.79	1.74	0.1164	0.12876	6.50	7.40
Turkey	0.98	0.13	0.1241	0.16036	12.66	123.35

Table 1: Statistics on Return to Investment 2000:01 – 2009:12.

Country	Average	Maximum	Minimum	% Change in Range	Standard Deviation	Coefficient of Variation
Brazil	2.36	3.84	1.57	89.43	0.53	0.226
China	7.90	8.29	6.83	19.39	0.55	0.070
India	45.69	52.36	39.39	28.46	2.79	0.061
Russia	28.63	35.97	23.43	42.87	0.46	0.086
Turkey	1.34	1.73	0.56	112.91	0.29	0.213

Table 2: Statistics on Exchange Rate Variations 2000:01 – 2009:12.

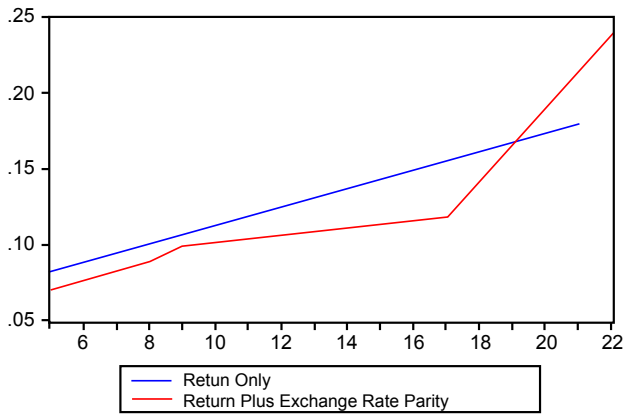

Figure 1: Simulation Results of Expected Return to the Optimum Portfolio.

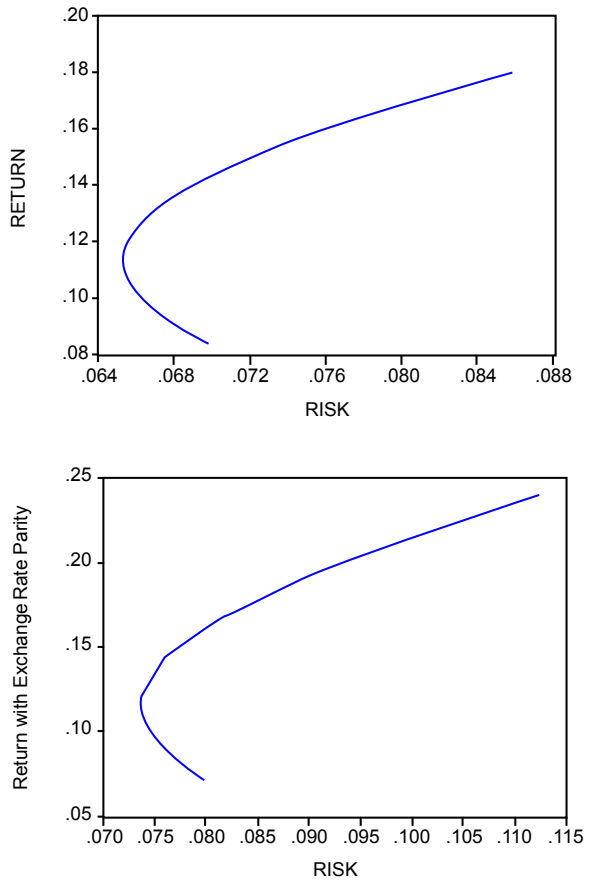

Figure 2: Simulation Results for Five Countries

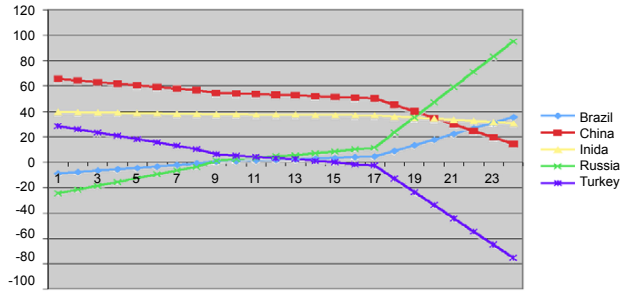

Chart 1: Percent Allocation of Funds in Optimum Portfolio Based on Risk and Return.

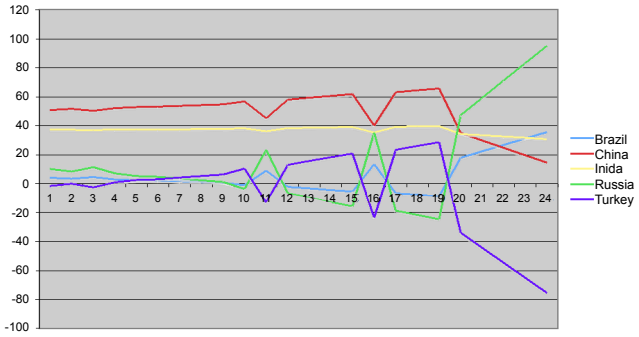

Chart 2: Percent Allocation of Funds in Optimum Portfolio Based on Risk and Return Plus Exchange Rate Parity.

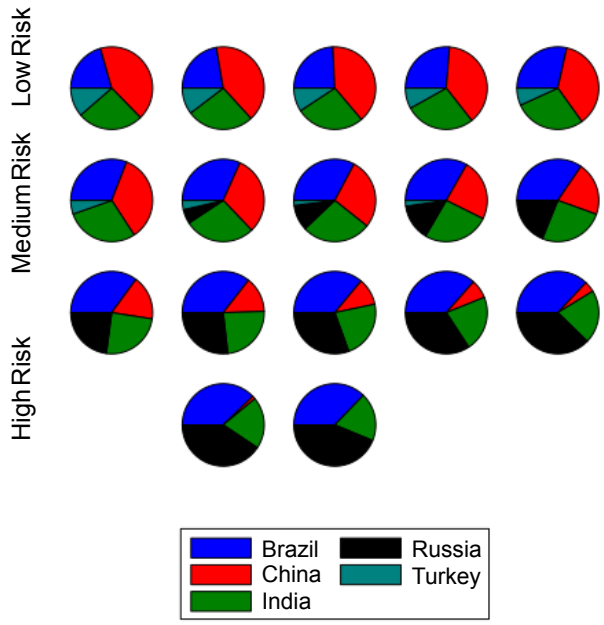

Chart 3: Allocation of Funds in Optimum Portfolio Based on Expected Return.

allocate funds based on the optimizing principles of Modern Portfolio Theory (MPT)? If yes, what is the risk level? Second, do ETFs factor in the risks resulting from exchange rate variations? To answer these questions, this paper compared *Mathematica* simulations of optimum allocation ratios, derived from the application of MPT to historical data of five emerging nations, with the actual allocations as presented in MSCI BRIC Index Fund (BKE) and Emerging Markets Index Fund (EEM). The simulations were done under the two assumptions that ETFs do and don't factor in exchange rate risk.

BKE and EEM have very similar allocation of funds among the five nations, with almost 70% of the funds allocated between Brazil and China and 30% among the other three countries. This allocation

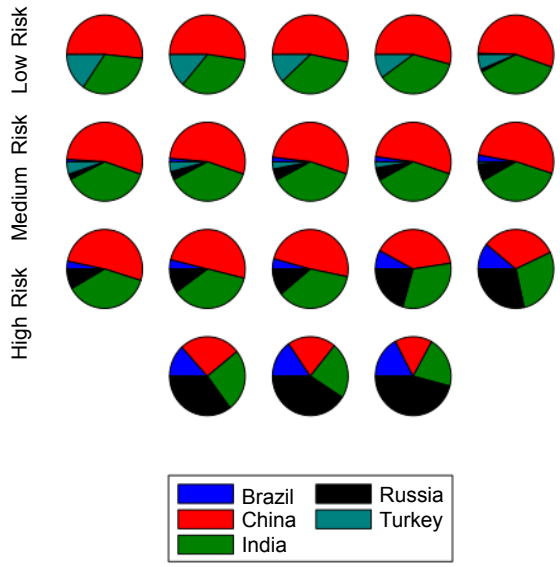

Chart 4: Allocation of Funds in Optimum Portfolio Based on Expected Return Plus Exchange Rate Parity.

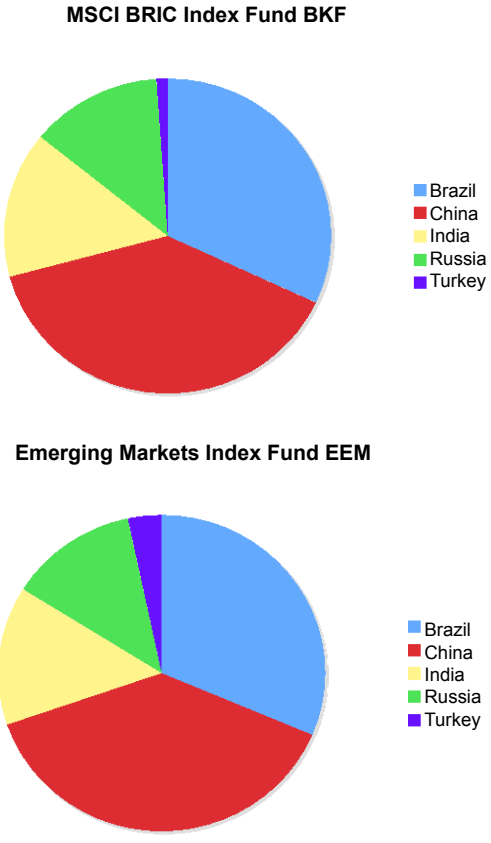

Chart 5: Actual Allocation of Funds in two ETFs.

is not consistent with any optimum allocation results derived from simulations whether the risk of exchange rate volatility is factored in or not. The two ETFs under-allocate funds to India and over-allocate to Brazil. For the same levels of risk and return including the risk of exchange rate volatility, an optimum allocation of funds requires over 80% of the funds to be allocated to China and India. India has the lowest exchange rate risk of the countries in the study. At any level of risk, the simulation results allocate a larger share of the fund to India than do BKE and EEM. BKE and EEM allocations of 12% to 13% of the funds to Russia is justified only at a very high risk to portfolio, and is not consistent with optimum allocation of funds in the simulation, whether the risk of exchange rate volatility is factored in or not.

References

1. Markowitz HM (1959) Portfolio Selection, Efficient Diversification of Investments. New York.
2. Tabak BM (2006) The Dynamic Relationship between Stock Prices and Exchange Rates: Evidence for Brazil. International Journal of Theoretical and Applied Finance 9: 1377-1396.
3. Hong WJ and JY Lee (2010) A Static Relatedness Analysis of Exchange Rate, U.S. Stock Price Return and Japan Stock Price Return Volatility: Using the Error Correction and Trivariate GJR-GARCH-M Model. Journal of Data Analysis.
4. Aggarwal R (1981) Exchange Rates and Stock Prices: A Study of the US capital markets under floating exchange rates. Akron Business and Economic Review.
5. Solnik B (1987) Using Financial Prices to Test Exchange Rate Models: Evidence from the Stock Market. Journal of Finance.
6. Levy M (1987) Corporate Profits and the U.S. Dollar Exchange Rate. Business Economics. 42: 141-149.
7. Soenen L and E Hennigar (1988) An Analysis of Exchange Rates and Stock Prices: The U.S. Experience Between 1980 and 1986. Akron Business and Economic Review.
8. Jorion P (1990) The Exchange Rate Exposure of U.S. Multinationals. Journal of Business.
9. Ma CK, Kao GW (1990) On Exchange Rate Changes and Stock Price Reactions. Journal of Business Finance & Accounting17: 441-449.
10. Choi JJ, Prasad AM (1995) Exchange Risk Sensitivity and its Determinants: A Firm and Industry Analysis of U.S. Multinationals. Financial Management 24: 77-88.
11. Bartram SM, Bodnar GM (2010) Crossing the Lines: The Conditional Relation Between Exchange Rate Exposure and Stock Returns in Emerging and Developed Markets. Social Science Research Network.
12. Working H (1960) A Note on the Correlation of First Differences of Averages in Random Chain. Econometrica 28: 916-918.
13. Dickey D and WA Fuller (1979) A Theory of the Estimators for Time Series Regression with a Unit Root. Journal of the American Statistical Association.
14. Phillips PCB, Perron P (1988) Testing for Unit Root in Time Series. Biometrika 75: 335-346.
15. Enders W (2010) Applied Econometric Time Series, (3rdedn) John Wiley & Sons, Inc.