HIGHER MOMENTS WITH FOREIGN INVESTMENT; A THAILAND'S PERSPECTIVE

SUPARAT AREEWONG

MASTER OF SCIENCE PROGRAM IN FINANCE
(INTERNATIONAL PROGRAM)
FACULTY OF COMMERCE AND ACCOUNTANCY
THAMMASAT UNIVERSITY, BANGKOK, THAILAND
MAY 2009

HIGHER MOMENTS WITH FOREIGN INVESTMENT; A THAILAND'S PERSPECTIVE

SUPARAT AREEWONG

MASTER OF SCIENCE PROGRAM IN FINANCE
(INTERNATIONAL PROGRAM)
FACULTY OF COMMERCE AND ACCOUNTANCY
THAMMASAT UNIVERSITY, BANGKOK, THAILAND
MAY 2009

Higher Moments with Foreign Investment; A Thailand's Perspective

Suparat Areewong

An Independent Study
Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science (Finance)

Master of Science Program in Finance
(International Program)
Faculty of Commerce and Accountancy
Thammasat University, Bangkok, Thailand
May 2009

Thammasat University

Faculty of Commerce and Accountancy

An Independent Study

By

Suparat Areewong

"Higher Moments with Foreign Investment;
A Thailand's Perspective"

has been approved as a partial fulfillment of the requirements
for the Degree of Master of Science (Finance)
On May, 2009

Advisor: …….

(Prof. Dr. Pornchai Chunhachinda)

Higher Moments with Foreign Investment; A Thailand's Perspective

ABSTRACT

This paper finds that the distribution of returns of 15 major emerging stock markets is not normal during January 1999 – December 2007, thus higher moments i.e. skewness cannot be disregarded in portfolio selection. To determine the optimal portfolio consisting of 15 emerging stock indices alternatives, polynomial goal programming (PGP) which the incorporation of investor's preferences for skewness can be integrated is employed. The empirical findings represent that a major change in the optimal portfolio construction is arisen when incorporating skewness into an investor's portfolio decision. Also, foreign exchange hedging, the choice of various investment horizons, and short sales restriction do influence the performance of the foreign portfolio. Finally, the portfolio performance is gauged by using Sharpe, and Treynor (two-moment performance measure), and Prakash and Bear's (three-moment performance measure). The evidence suggests that performance ranking of portfolios is diverse depending on the measure utilized.

I. INTRODUCTION

As widely known, additional choices of investment; including foreign investment, should yield investors the opportunity to further diversify their investment risk if the correlation between the returns of current assets in the portfolio and that of additional investment is relatively low. Specifically, many financial economists highlighted the benefits of global diversification over the past 50 years and verified that investing in foreign indices which are low correlated can reduce the volatility of domestic market portfolios. Likewise, investors may be able to enhance their returns from investing abroad since investment in stock or bond markets in some regions yield higher returns than local markets in some certain periods.

In the present day, emerging markets are one of attractive selections for investors who wish to diversify their portfolio internationally. There are plenty of empirical evidences regarding the investment opportunity of the emerging markets [e.g. Oldie, et al (1995), Bekaert and Urias (1999), and Chunhachinda (2005)] point out that the significantly incremental returns can be found when investors diversify their portfolio into emerging markets. In addition, these markets are likely to be low correlated not only with the developed markets but also among themselves. This signifies that expanding investment into emerging markets can better diversify portfolio risk as well as yields the advantages of higher average return.

Nevertheless, the risk of investing abroad, i.e. foreign exchange risk, must be taken into account as well in order to examine the benefits of global diversification since such advantages can be affected by the volatility of the exchange rate over the period of time. Specifically, the benefits from investing globally can be eliminated or expanded depending on the movement of exchange rate. Such evidence is confirmed by Abken and Shrikhande (1997) who suggest that the correlation between the local market return and foreign exchange return is one of the key additional risks of the global portfolio because of their positive relationship This indication is found to be consistent in the emerging markets as the study of Grandmont

and Soenen (2000) point out that the correlation between security's index and foreign exchange rate in the emerging markets is greater positive than those in other markets.

Additionally, to measure the portfolio performance by utilizing the classical mean-variance analysis, returns from investment are usually supposed to be normally distributed which is less likely to be proper. Specifically, there is ample of studies [e.g. Singleton and Wingender (1986), Chunhachinda, et al (1997), Soontornkit (2000), Jondeau and Rockinger (2002), and Maringer and Parpas (2007)] demonstrate that the distribution of individual asset and portfolio returns seems to be non-normal. Thus, the first and the second central moment may not be perfectly spoken for exhaustive portfolio investment. It must go beyond to the higher central moments i.e. skewness and kurtosis. However, the significance of higher moments is not depends on the asset returns' distribution only but also greatly depends on the functional form of investors' utility functions or their risk tolerance.

Up to this point, it seems that higher moments cannot be neglected in order to study portfolio selection and performance measure if there is no confirmation that the distribution of asset returns are normal and the investors' utility functional form is quadratic.

It is therefore interesting to examine the contribution of foreign portfolio investment in emerging markets in Thai investors' perspective when taking into account the non-normal distribution of asset returns and also the foreign exchange volatility that affects the gain of international diversification. Specifically, the objectives of this study are twofold.

First, in relation to portfolio selection and performance measure, this study aims to examine whether higher moments can be disregarded or not. To do so, asset returns' distribution has to be investigated for normality and the investors' utility function must be assured for not being quadratic.

Second, in relation to foreign portfolio investment, this study tries to observe contribution of foreign exchange hedging in enhancing the portfolio's performance. To do so, the returns from foreign investment are separated into two categories i.e. fully hedged and unhedged returns in order to explore the effect of exchange rate volatility on the benefits of international diversification in Thai investors' perspective.

II. LITERATURE REVIEW

In relation to portfolio theory, the concept of portfolio selection has been established by Markowitz (1952). He brought in the modern portfolio theory by using a mean-variance optimization to estimate suitable portfolio asset allocation. This technique tries to maximize portfolio return by given a certain level of risk or to minimize the portfolio risk by given a certain level of return, only when the correlations among assets in the portfolio are relatively low. Since then, there are many researchers that study and substantiate this approach in various aspects and criterions. However, numerous studies have pointed out that simply mean-variance approach seems too simplified and may not be sufficient in order to measure portfolio performance since there is ample evidence showing that the distribution of asset returns is not follow normality and the utility function of investors is unlikely to be quadratic.

Singleton and Wingender (1986), disagree with the empirical findings that ex-post returns of stocks are positively skewed consistently. They found that the incidence of positive skewness is stable comparatively over diverse time periods from 1961 to 1980. However, the persistence of skewness of individual stocks and portfolios of stocks is not found across various time intervals. Positively-skewed equity portfolios in a certain period seem not to be positive skewed in the next period. Thus, the historical positively-skewed returns do not forecast the ex-ante one.

Chunhachinda, et al (1997), study the world's 14 major stock markets and found that their returns are not normally distributed. Also, investors seem to prefer skewness maximizing in portfolio decision which causes dramatically change in optimal portfolio construction. They determine the portfolio selection with skewness by using polynomial goal programming in which investor preferences among objectives can be easily included. Their findings under both the short-sales and the no-short-sales cases point out that the mean-variance and the mean-variance-skewness efficient portfolios appear to be dominated by the investment components of the markets that have higher rankings of coefficients of variation, and have either relatively high mean return, low variance, or high skewness. Moreover, the skewness values of the

mean-variance-skewness efficient portfolios are found to be superior to those of the mean-variance. This implies that an investor will trade the expected return of a portfolio for skewness. Also by allowing short sales, investors can concurrently achieve both of higher expected return and skewness.

Similar to Chunhachinda, et al (1997), Soontornkit (2000), utilizes polynomial goal programming method to determine the optimal portfolio solution that incorporating higher moments into investors' investment decision, but his investigation is performed for the case of Thai stock market during 1975 and 1997. His findings seem consistent to Chunhachinda, et al (1997) that incorporation of higher moments into investor's decision causes a crucial change in the allocation of optimal portfolio, and that investor trades expected portfolio return for ex-ante skewness. Likewise, when allowing short sales, investors can be benefited from including higher moments into portfolio selection. However, when comparing performance of mean-variance efficient portfolio and mean-variance-skewness framework, the results show that the mean-variance-skewness approach can outperform the classical mean-variance for monthly investment horizon, not for weekly investment perspective yet.

Jondeau and Rockinger (2002), utilize a Taylor expansion of expected utility to estimate the effect of deviation from normality on the asset allocation by focusing on certain moments and to calculate the optimal portfolio allocation numerically. They point out that under moderate non-normality, the expected utility maximization can be correctly approximated by the mean-variance approach. However, when large deviation from normality occurred, the mean-variance criterion may be that useless. In such case, the three-moment or four-moment optimization strategies could play an important role in expected utility approximation.

Maringer and Parpas (2007) examine international portfolio optimization by including higher moments in their analysis to extend the classical Markowitz model since it is found that asset returns typically exhibit excess kurtosis and are often skewed. Also, investors seem to prefer positive skewness and try to make kurtosis of their portfolio returns decreased. To do so, they utilize two stochastic algorithms i.e. Differential Evolution (DE) and Stochastic Differential Equation (SDE).

Markowitz's portfolio theory has also been implemented to the concept of international portfolio by several researchers in order to analyze the benefits of the global diversification in enhancing portfolio performance.

Eun and Resnick (1988) point out that the dollar exchange market of the German mark and the Japanese yen are volatile nearly as much as their respective stock markets during 1980 – 1985 in the view of U.S. investors. They found that the correlations among the exchange rate changes are much higher than that among the local stock market. Also, the risk of local stock market can be diversified whereas much of the exchange risk cannot be that diversified one and then affect the overall portfolio risk. They utilize two methods of exchange risk reduction i.e. multicurrency diversification and the forward exchange contract. They also developed an ex-ante efficient portfolio selection strategy to determine the benefit from international diversification under the exchange rates fluctuation. Their findings represent that investors can be benefited from international diversification when the estimated risk is controlled.

Madura and Tucker (1992), demonstrate that the covariance between the returns of non-U.S. stocks and their corresponding currency values does influence the benefits from hedging the foreign exchange associated with investing in some major developed countries' stock indices. Their findings indicate that when there is a downward pressure on both international stock markets and the dollar exchange the risk and return are adversely affected by the hedging if the covariances are negative.

Glen and Jorion (1993) study the performance of G5 countries' mean-variance optimal portfolio by using an unrestricted mean-variance optimization with the assumptions of prohibition of short sales and other market frictions. Their findings show that foreign exchange hedging significantly improves the international portfolio performance at the 5% significant level.

Abken and Shrikhande (1997) study the advantages of international diversification for the US market in the period of 1980 to 1985. The average annual return and standard deviation of US domestic investment were used to compare with those of the international portfolios, the

G7 countries. Their study shows that the global portfolio offers a higher return for the same level of return's standard deviation when the correlation among market returns is relatively low which is also confirmed by the superior efficient frontier of the international portfolio above the US domestic one. Besides, they also examine the effect of foreign exchange among the respective currencies and suggest that correlation between the local market return and foreign exchange return is one of the key additional risks of the global portfolio because of their positive relationship.

Grandmont and Soenen (2000) apply Markowitz's mean-variance optimization to look into the benefits of international diversification of developed and emerging markets as the US investors' perspective and to examine the significant incremental returns from hedging the foreign exchange risk in that global portfolios. They find that the correlation between security's index and foreign exchange rate in the emerging markets is greater positive than those in other markets and foreign exchange risk hedging does not significantly develop the performance of international portfolios.

Conversely, Errunza, et al (1999) try to dishonor the benefit of global diversification by examining whether portfolios of domestically traded securities can imitate foreign indices, so that investment in assets that trade only abroad is not necessary to obtain the gains from international diversification. Their results show that gains beyond those attainable through home-made diversification are statistically and economically insignificant. Therefore, investors no longer need to trade abroad to obtain an internationally mean-variance efficient portfolio, however they should still be responsive to the exposed foreign risks.

Likewise, there are some studies related to foreign investment confirm the existing of incremental gains from investing in emerging markets for international portfolio.

Odier et al (1995) substantiate the incremental benefits when investments are expanded and diversified into emerging markets by examining the risk-return profile of emerging markets relative to the developed. Their findings show that emerging markets offer not only significantly higher returns but also higher levels of market volatility. Also, the correlation

between the returns of emerging markets and that of developed markets is found to be relatively low comparing to the study in 1993. Thus, it can be concluded that there are better opportunities to invest in emerging markets with the outstanding diversification.

A study by Bekaert and Urias (1999) on the investment opportunity of the emerging markets also demonstrates that emerging markets yield a higher average return than developed markets but also higher volatility. Also, these markets seem to be low correlated with the developed markets as well as among themselves.

Chunhachinda (2005) studies the benefits of international diversified investment in Thai investors' perspective of 15 emerging countries i.e. Argentina, Brazil, China, Greek, India, Indonesia, Malaysia, Mexico, Philippines, Portugal, Russia, South Africa, South Korea, Taiwan, and Thailand since January 2000 until December 2004. Similar to Bekaert and Urias (1999), he found that these markets are likely to be low correlated among themselves which can yield Thai investors opportunities to diversify their portfolio investment. Besides, the effect of foreign exchange also investigated by comparing expected return and expected risk of each individual country. He found that there exists variation of asset returns and risks among countries no matter which currency is used to determine. This can be concluded as the result from foreign exchange consequence.

In relation to portfolio performance measure, since the original works of Sharpe (1964) and Lintner (1965), investment performance is typically evaluated by using the two moment (mean-variance) performance composite measures which include Treynor's measure (1965), Sharpe's measure (1966), and Jensen's alpha measure (1968). However, such two moment performance measures are subject to criticism that they seem to be not adequate since the distributions of portfolio return are asymmetrical and investors value skewness. Therefore, other performance measures based on higher moments are developed by several researchers.

Arditti (1967, 1971) who argues that two moment performance measures may not be adequate if the distributions of portfolio return are asymmetrical and investors value skewness.

Ang and Chua (1979) use all of above two-moment measures to evaluate the performance of mutual funds in the United States during the years 1955 to 1974. Then, try to construct an excess return index using the three-moment CAPM developed by Kraus and Litzenberger (1976) which incorporates investors' preference for positive skewness of returns.

Prakash and Bear (1986) develop a composite performance measure incorporating skewness based on the Kraus and Litzenberger skewness preference model. The Prakash and Bear measure has the desirable property in reducing Treynor's measure's skewness absence.

Cumby and Glen (1990) point out that the Jensen measure is subject to some limitations by utilizing the Jensen measure evaluate the performance of 15 U.S.-based internationally diversified mutual funds between 1982 and 1988.

Stephens and Proffitt (1991) generalize the Prakash and Bear performance measure to account for any number of moments. The Stephens and Proffitt methodology is essentially the same as that of the Prakash and Bear except the Stephens and Proffitt measure is developed from Rubinstein's (1973) *n* parameter pricing model. Also, they utilize the Prakash and Bear measure to evaluate the performance of 27 internationally diversified mutual funds and note that the higher moment performance measure seems to be appropriate for evaluating the international mutual fund portfolios since the distributions of rate of return are asymmetrical.

Chunhachinda, et al (1994) evaluates the performance of a sample of 14 selected international stock markets using the two moment performance measures of Sharpe (1966) and Treynor (1965), and the developed higher moment performance measures of Prakash and Bear (1986) and Stephens and Proffitt (1991). They found that the rankings of stock markets are changed when higher moment measures are used. Also the measures based on higher moments rank the portfolios closer than those based on two moments in the presence of asymmetric return distributions. Their findings insist the appropriateness of the higher moment performance measures in evaluating the relative performances of the various stock markets.

III. DATA

In order to represent international diversified investment, the sample data consists of weekly, monthly and quarterly rates of return of 15 emerging stock market indices[1] i.e. Argentina, Brazil, China, Greece, India, Indonesia, Malaysia, Mexico, the Philippines, Portugal, Russia, South Africa, South Korea, Taiwan, and Thailand from January 1999 to December 2007. Besides, to explore the effect of exchange rate volatility on the benefits of international diversification in Thai investors' perspective and to observe contribution of foreign exchange hedging in enhancing the portfolio's efficient frontier, the returns from foreign investment will be separated into two categories, i.e. fully hedged and unhedged returns. For unhedged strategy, to avoid the difficulty that some currencies might be hardly found its exchange rate against THB and to allow the hypothetical portfolios exposed to simply one foreign currency, the rates of return of each market index are then converted to Thai Baht (THB) by using their cross rate between such currency against USD and USD/THB. Also, to perform the foreign currency hedging, forward rates of USD/THB with corresponding investment horizon are utilized.

Additionally, to measure portfolio performance, the risk-free rates utilized here are US Treasury Bill rates with the matching horizons. The market's rate of return series (R_{mt}) is constructed by utilizing MSCI Emerging Markets Index which is created by Morgan Stanley Capital International to measure equity market performance in global emerging markets. These market returns are used to calculate the covariance and coskewness for each portfolio. Note that all mentioned data are collected from Thomson Datastream.

[1] To minimize any intra-country risk, only well-diversified indices are chosen to represent the portfolio of each country.

IV. METHODOLOGY

4.1 Calculation of Key Variables

Return of Foreign Investment

In relation to international investment, investors diversify their portfolio by investing in emerging market indices. Thus, returns from investing abroad are not only affected by such returns on those market indices but also by the return on foreign exchange rate. Here, the returns from foreign investment are in term of each country's currency and investors therefore are assumed to convert those local returns into Thai Baht (THB) by using their respective exchange spot rates on the day which the returns are taken place. However, to avoid the difficulty that some currencies might be hardly found its exchange rate against THB and to allow the hypothetical portfolios exposed to simply one foreign currency, the rates of return of each market index are then converted to THB by using its cross rate between such currency against USD and USD/THB. For example, to calculate return from investing in Brazil stock market in Thai investors' view, the required data is;

i) Exchange rate of Brazilian currency against US Dollar (USD/BRL)

ii) Exchange rate of USD/THB, and

iii) Brazil stock market index in terms of Brazil currency (BRL)

Then, return from investing in Brazil stock market in Thai investors' view can be computed as follows:

i) Calculating BRL/THB by using USD/THB divided by USD/BRL, then computing its rate of return

$$e_i = \frac{Spotrate_t - Spotrate_{t-1}}{Spotrate_{t-1}} \tag{1}$$

where $\boldsymbol{e_i}$ denotes a return on i^{th} foreign exchange currency, obtained from a percentage change in i^{th} spot exchange rate against THB.

ii) Calculating the rate of return on Brazil market index in form of BRL

$$R_i = \frac{Index_t - Index_{t-1}}{Index_{t-1}} \tag{2}$$

where $\boldsymbol{R_i}$ is a return on i^{th} market index, obtained from a percentage change in the market of country i^{th} or so called local return.

iii) Converting Brazil stock rate of return into THB by

$$R_{i,THB} = (1 + R_i)(1 + e_i) - 1 \tag{3}$$

where $\boldsymbol{R_{i,THB}}$ is the exchange-rate-adjusted rate of return from investment in stock market i^{th} at time t. Here is defined as unhedged rates of return.

Also, the average return of country i^{th} can be calculated by

$$\overline{R}i,THB = \frac{1}{N}\sum_{t=1}^{N} R_{i,THB} \tag{4}$$

where $\boldsymbol{R_{i,THB}}$ denotes the average return on market index i^{th} stated in THB.

Asset Variance and Covariance

Variance and Covariance of asset can be computed from that asset return as follows:

$$\sigma_i^2 = \frac{1}{N}\sum_{i=1}^{N}\left[R_{i,THB} - \overline{R}i,THB \right]^2 \tag{5}$$

where σ_i^2 is variance of stock market index i^{th}.

$$\sigma_{ij} = \frac{1}{N}\sum_{i=1}^{N}\left[r_{i,THB} - R_{i,THB} \right]\left[r_{j,THB} - R_{j,THB} \right] \tag{6}$$

where σ_{ij} is covariance between stock market index i^{th} and stock market index j^{th}.

Asset Skewness and Coskewness

Skewness and Coskewness of asset can be computed from that asset return as follows:

$$S_i^3 = \frac{1}{N}\sum_{i=1}^{N}\left(R_{i,THB} - \overline{R}_{i,THB} \right)^3 \tag{7}$$

where S^3 is skewness of stock market index i^{th}.

$$S_{iij} = \frac{1}{N}\sum_{i=1}^{N}\left(R_{i,THB} - \bar{R}_{i,THB}\right)^2\left(R_{j,THB} - \bar{R}_{j,THB}\right)$$
$$S_{ijj} = \frac{1}{N}\sum_{i=1}^{N}\left(R_{i,THB} - \bar{R}_{i,THB}\right)\left(R_{j,THB} - \bar{R}_{j,THB}\right)^2 \quad (8)$$

where S_{iij} and S_{ijj} measure the co-skewness (curvilinear interaction) which occurs in the joint distribution of R_i and R_j.[2]

4.2 Hedging with Foreign Exchange Forward Contract

As stated earlier, returns from investing abroad are also affected by the returns on foreign exchange rate, thus the volatility of currency rates of return do play an important role on an international diversification. Fundamentally, the risk and return of the portfolio can be shaped by the choice of securities and their degree of diversification, however tailoring characteristics of the portfolio risk and return can be attained through the use of foreign currency hedging. Normally, investors make use of a currency-hedged strategy just to eliminate the risk of currency instabilities with their willingness to forgo some potential currency gains. Here, foreign exchange forward contract[3] is applied as a hedging tool of the international portfolio by given that the foreign currency exposure of the initial value of the investment position is fully covered[4]. Investors who sell foreign exchange forward contracts are able to lock in current exchange forward rates to manage their currency risk. Profits (losses) from the forward contracts are balanced by losses (profits) in the value of the currency which resulting in opposing exposure to the currency.

---

2 Jean (1971) indicates that the co-skewness (S_{iij}, S_{ijj}) is related to the third moment (S_i^3) in the same way as the covariance (σ_{ij}) is related to the second moment (σ_i^2). The signs and sizes of the co-skewness will diverge depending on the change of type and degree of curvilinear relationship between two securities.

3 A foreign exchange forward contract is an agreement between two parties to buy/sell foreign currency at a future date at an exchange rate determined at the time of the transaction, normally sold by commercial banks and typically have fixed and short-term maturities of one, six and nine months. It is straightforward and cost effective to modify the unpredictability of the portfolio return. Similar to other classes of derivatives, forward contract does not involve a net investment upon initiation of a position.

4 or so called "Unitary Hedging"

Similar to Equation (1) calculating currency return, the forward return can be computed as follows;

$$f_i = \frac{Forward_t - Forward_{t-1}}{Forward_{t-1}} \quad (9)$$

where $\boldsymbol{f_i}$ denotes a return on foreign exchange forward, obtained from a percentage change in USD forward exchange rate against THB.

For simplicity Equation (3) can be rewritten, as

$$Unhedged\ Return = (1+Local\ Total\ Return)*(1+Currency\ Return) - 1 \quad (a)$$

According to Standard & Poor's (2004), the hedge return can be then calculated as follows;

$$Hedge\ Return = Hedge\ Ratio * (Forward\ Return - Currency\ Return) \quad (b)$$

$$Hedge\ Return = Local\ Total\ Return + Currency\ Return\ on\ Unhedged\ Local\ Total\ Return + Hedged\ Return \quad (c)$$

To be more intuitive, Equation (c) can be broken down into its components with hedge ratio[5] as 1;

$$Hedged\ Return = Local\ Total\ Return + Currency\ Return * (1 + Local\ Total\ Return) + Hedge\ Return \quad (d)$$

Rearranging Equation (d) as follows,

$$Hedged\ Return = (Local\ Return + 1) * (1 + Currency\ Return) - 1 + Hedge\ Return \quad (e)$$

Then, combining Equation (e) with Equation (a),

$$Hedged\ Return = Unhedged\ Return + Hedge\ Return \quad (f)$$

Combining Equation (f) with Equation (b) and taking hedge ratio as 1,

$$Hedged\ Return = Unhedged\ Return + Forward\ Return - Currency\ Return \quad (10)$$

---

5 In order to find the optimal hedge ratio for minimizing total risk of a hedged portfolio, the method of standard variance minimization can be employed;

Hedge Ratio = Covariance of the portfolio return to forward return / Variance of Forward Return

However, this paper employing fully hedged strategy for simplicity in order to perform currency-hedged portfolio, thus the hedge ratio utilized here is equal to 1. See Standard & Poor's (2004) for the impact of varying the hedge ratio.

It can be seen that Equation (15) is more perceptive since when investors perform a 100% currency-hedged portfolio, they have to forgo the gains (or losses) on currency in return for gains (or losses) in a forward contract. Again, this also implies that the risk of exchange rate variability of investment in emerging stock markets can be offset by the foreign exchange forward contract. Likewise, the forward premium is generally identified as a practically unbiased predictor of the future change of the exchange rates i.e. $f_i \approx E(e_i)$. The currency-hedged strategy is therefore expected to bring about a lower portfolio risk or the portfolio performance should be advanced.

4.3 Test for Normality of Return Distribution

To investigate the normality of the return distributions of 15 emerging markets' stock indices, Wilk-Shapiro (*W*-test) is employed[6]. Specifically, the *W*-test hypothesis:

H_0: The distribution of the parent population is normal.

H_1: The distribution of the parent population is not normal.

To determine whether the null hypothesis of normality should be rejected, the probability (p-value) which is associated with the *W*-statistics must be examined. If this probability is less than some specified level, says 0.10, it means that the null hypothesis cannot be supported at that level of significance and thus the parent population is not normally distributed. The rejection of normality assumption suggests that only mean and variance are not enough for the analysis of portfolio selection and higher moments could play important role in the analysis.

[Table I]

Table I provides the results of the test for normality of return distributions using the *W*-test. For weekly rates of return, there is no market for which the result supports the null hypothesis of a normal distribution at the ten percent level of significance. In other words, all return distributions of 15 emerging markets exhibit significant skewness. For monthly rates of return, the probability associated with the *W*-statistic indicates that the null hypothesis of a normal

6 Karels and Prakash (1987) state that the *W*-test is the best procedure for testing normality under a range of alternative specifications of the probability distribution. Also, Shapiro, et al (1968) find that it is a superior measure of non-normality among various statistical methods of a complete sample.

distribution for seven markets cannot be supported at the ten percent level of significance i.e. seven of the 15 distributions exhibit significant skewness. These seven markets include Argentina, Brazil, China, India, Malaysia, Mexico and Russia. For quarterly rates of return, there are five markets i.e. Argentina, China, Malaysia, Russia and Taiwan for which the results do not support the null hypothesis of a normal distribution at the ten percent level of significance. In other words, five of 15 emerging markets exhibit significant skewness of return distributions. This empirical finding gives an idea that the shorter the assumed holding periods, the more the return distributions exhibit skewness.

[Table II]

[Table III]

For preliminary analysis, Table II and III list the means and the variances of the rates of return of the 15 emerging stock markets under unhedged and hedged strategy, respectively. A look at the first column of Table II reveals that for all investment horizons Russia has the highest means of the rates of return, followed by Brazil and India, whereas Philippines and Taiwan provide the lowest one. In column two, the evidence indicates that the volatility of returns for Portugal is the lowest for all three horizons under unhedged strategy. Respectively, that of Argentina, Brazil and Russia is the highest for weekly, monthly and quarterly investment horizons. The first and the second column of Table III discloses that under hedged strategy Russia provides not only the highest means but also the highest variability of the rates of return for all investment horizons, where Portugal still presents the lowest one. Interestingly, it can be seen that under both unhedged and hedged strategy the rates of return of Portugal afford the lowest volatility for all investment horizons.

Table II and III also provide the values of skewness and kurtosis for each of the indices' rates of return in column 3 and 4, respectively. The evidences in both tables demonstrate that most of the emerging stock markets exhibit positive skewness for all investment horizons. In Table II, for weekly rates of return, there are four markets (Argentina, India, South Africa, and South Korea) that provide negative skewness. For monthly rates of return, five markets i.e. India, Mexico, Philippines, Portugal, and South Africa exhibit negative skewness. Similarly,

that of India, Philippines, Portugal, and South Africa shows signs of negative skewness for quarterly investment horizon. Under hedged strategy which is represented in Table III, for weekly rates of return, Greece, India, Mexico, South Africa, South Korea, and Thailand display negative skewness, while India, Mexico, Philippines, and South Africa are those of negative for monthly investment horizon. For quarterly rates of return, simply Philippines, Portugal, and South Africa flaunt negative skewness.

Interestingly, under hedged strategy which is shown in Table III, the quarterly skewness and kurtosis of Malaysia appear to be the highest, whereas their weekly and monthly counterparts are relatively low. Similar evidence also appears with unhedged approach in Table II, Malaysia presents the highest skewness and kurtosis for the weekly and quarterly horizons, while their monthly complements are comparatively low. Likewise, such evidence also becomes visible in the Russia market under both hedging approaches, that is it has the highest monthly skewness and kurtosis, but relatively low weekly and quarterly ones. The incompatibility among weekly, monthly and quarterly higher co-moments may be characterized to the interval effects which also materialized in the study of Chunhachinda et al. (1994) on the higher-moment performance measure of the international stock markets. Unofficially, the skewness and the kurtosis of a data set can be observed as a check of normality, since the skewness and the kurtosis of a normal distribution is equal to three and zero, respectively. It can be seen from the third and the fourth column of Table II and III that the skewness and the kurtosis values of the 15 emerging stock markets are not respectively closed to three and zero. Thus, from the empirical findings at this step of the analysis, it can be safely assumed that the return distributions of emerging stock markets during the study period are not normal. Therefore, this assumption seems to be a valid argument that simply classical mean-variance approach is not adequate for portfolio selection and performance measure and the higher moments could become an important role in such analysis.

4.4 Mean-Variance Portfolio Optimization

After the risk and return of each market index are calculated, it is interesting to analyze what the best possible combinations of those indices for the international portfolio could be. To come across the optimal weights, both hedged and unhedged portfolios are constructed by employing Minimum-Variance Portfolio strategy. Also, such portfolios are optimized with the constraint of both no-short-allowed and short-allowed to simply compare the recommended allocation.

A return on the international portfolio is computed by

$$R_p = \sum_{i=1}^{N} x_i R_{i,THB} \tag{11}$$

where $\boldsymbol{R_p}$ is portfolio return.

$\boldsymbol{x_i}$ is a fraction on weight assigned to asset i^{th}.

$\boldsymbol{R_{i,THB}}$ denotes the average return on market index i^{th} stated in Thai Baht (THB).

Also, a risk of the international portfolio is calculated by

$$\sigma_p = \sqrt{\sum_{i=1}^{N} \sum_{j=1}^{N} x_i x_j \sigma_{ij}} \tag{12}$$

where σ_p is portfolio risk (standard deviation).

$\boldsymbol{x_i}$ is a fraction on weight assigned to asset i^{th}.

σ_{ij} is covariance between stock index of market i^{th} and market j^{th}.

According to the conventional Markowitz portfolio theory, the portfolio return and variance can be expressed in matrix form as follows:

$$R_p = x^T(\overline{R} - \overline{r}) \tag{13}$$

$$\sigma_p^2 = x^T V x \tag{14}$$

where $\boldsymbol{R_p}$ is portfolio return

$\boldsymbol{x}$ is a vector containing the investment weights of the N asset, $x = (x_1, x_2, \ldots, x_n)$

$\overline{R} - \overline{r}$ is a n x 1 vector of expected excess rate of return

σ_p^2 is the portfolio variance[7].

[7] Normally, variance of a hedged portfolio should be less than that of unhedged one because of lower volatility of foreign exchange rates (Levich, 2001). Thus, the efficient frontier achieved by the hedged portfolio is supposed to be more efficient than that afforded by the unhedged portfolio.

V is defined as the variance-covariance matrix

The underlying principle of using the Minimum-Variance Portfolio is that the asset allocation is not depending on only the return, but also on the associated risks. The objective problem and constraints can be stated in a matrix form as follows:

Objective function: $\underset{x}{Min} \; \sigma_p^2 = x^T V x$

Subject to: $x^T l = 1$

$x_i \geq 0$

$R_p = x^T (\overline{R} - \overline{r})$

where σ_p^2 is the portfolio variance.

x is a vector containing the investment weights of the *N* asset[8], $x = (x_1, \ldots, x_n)$.

V is defined as the variance-covariance matrix.

$\overline{R} - \overline{r}$ is a *n* x 1 vector of expected excess rate of return

1 is a vector of **1.**

The solution of this problem is the weight of each index that can contribute to the minimum variance for a given level of return. To be simplified, any investment difficulties in investing abroad, i.e. tax, transaction costs, etc. will be disrespected.

4.5 Mean-Variance-Skewness Portfolio Optimization

Similar to Minimum-Variance Portfolio strategy, Mean-Variance-Skewness portfolio selection will be performed for both hedged and unhedged return with no-short-allowed and short-allowed constraint. The mean, the variance, and the skewness of the portfolio returns can be defined in the matrix form as follows;

8 The sum of investment weights must be equal to one which means that all wealth is allocated.

$$R_p = x^T(\overline{R} - \overline{r})$$

$$\sigma_p^2 = x^T V x$$

$$\gamma_p = E\left[x^T(\overline{R} - \overline{R})\right]^3 \quad (15)$$

where $\boldsymbol{R_p}$ is portfolio return

$\boldsymbol{x}$ is a vector containing the investment weights of the N asset, $x = (x_1, x_2, \ldots, x_n)$

$\overline{R} - \overline{r}$ is a n x 1 vector of expected excess rate of return

σ_p^2 is the portfolio variance.

$\boldsymbol{V}$ is defined as the variance-covariance matrix

γ_p is the portfolio skewness.

$\overline{R}$ is the rate of return from investment in stock market i^{th}.

The multiple objectives are optimized since the optimal solution is to select a portfolio component X. The objective problem and constraints can be stated in a matrix form as follows;

Objective function: Maximize O_1 $\quad \underset{x}{Max}\ R_p = x^T(\overline{R} - \overline{r})$

Minimize O_2 $\quad \underset{x}{Min}\ \sigma_p^2 = x^T V x$

Maximize O_3 $\quad \underset{x}{Max}\ \gamma_p = E\left[x^T(\overline{R} - \overline{R})\right]^3$

Subject to: $\quad x^T l = 1$

$x_i \geq 0$

where σ_p^2 is the portfolio variance.

$\boldsymbol{x}$ is a vector containing the investment weights of the N asset, $x = (x_1, x_2 \ldots, x_n)$.

$\overline{R} - \overline{r}$ is a n x 1 vector of expected excess rate of return

$\boldsymbol{V}$ is defined as the variance-covariance matrix.

γ_p is the portfolio skewness.

$\overline{R}$ is the rate of return from investment in stock market i^{th}.

$\boldsymbol{1}$ is a vector of **1.**

Lai (1991) advises that the portfolio choice X can be rescaled and restricted on the unit variance space as ($X \mid X^T V X = 1$) since the key of portfolio decision is the relative weight recommended in each asset. The portfolio selection with skewness (P1) can be then formulated under the condition of unit variance as follows;

$$
\text{(P1)} \quad \begin{cases} \text{Maximize } O_1 & \underset{x}{Max}\ R_p = x^T(\bar{R} - \bar{r}) \\ \text{Maximize } O_3 & \underset{x}{Max}\ \gamma_p = E\left[x^T(\tilde{R} - \bar{R})\right]^3 \\ \text{Subject to:} & x^T l = 1 \\ & x_i \geq 0 \\ & X^T V X = 1 \end{cases}
$$

Typically, both objectives (O_1 and O_3) of the problem (P1) cannot be fulfilled simultaneously by any particular solution. However, such problem can be solved by the concept of a polynomial goal programming problem (PGP)[9]. In PGP, the objective function generally contains deviational variables, not the choice variables themselves, in order to decide the value of those choice variables. The deviational variables represent difference between goals and what causes those deviational variables. Thus, the objective here is to minimize the sum of the deviational variables, the relative amount of deviation from the goal must be then positive if the goals are at the same priority level.

Given an investor's preference between mean and skewness (p_1, p_3), the multi-objective function can be then formulated as:

$$
\text{(P2)} \quad \text{(g)} \begin{cases} \text{Minimize:} & O = (d_1)^{p_1} + (d_3)^{p_3} \\ & X^T(\bar{R} - \bar{r}) + d_1 = O_1^* \\ \text{Subject to:} & \\ & E\left[X^T(\tilde{R} - \bar{R})\right]^3 + d_3 = O_3^* & \text{(i)} \\ & X^T I = 1 & \text{(j)} \\ & X^T V X = 1 & \text{(k)} \\ & x_i \geq 0 & \text{(l)} \\ & d_1, d_3 \geq 0 & \text{(m)} \end{cases} \quad \text{(h)}
$$

where $\boldsymbol{O}_i^*$ is the extreme value of objective $\boldsymbol{O}_i$ when they are optimized individually rather than simultaneously.

9 PGP is much more flexible than the linear programming since it can simultaneously provide a solution of a system of multiple objectives rather than of a single objective. Also, the objective function of goal programming is able to be composed of heterogeneous units of measure, for example dollars and yen, rather than one type of unit.

d_i is nonnegative variables which represent the deviation of $\boldsymbol{O}_i$ from $\boldsymbol{O}_i$*.

p_i is nonnegative parameters representing the investor's subjective degree of preference (or trade-off) between objectives[10].

As suggested by Lai (1991), the marginal rate of substitution (MRS) between objectives O_i and O_j, can be used to determine the comparative desirability of sacrificing the objective i in order to gain the objective j. Since the *MRS* is the negative slope of the indifference curve, the changeable degree of preference between objectives (p_i) can then estimate the corresponding indifference curve. Also, the deviational variables (d_i) in the polynomial objective function can facilitate in developing a local approximation to the underlying utility function of an investor. The MRS_{ij} is expressed as;

$$MRS_{ij} = \frac{\partial O}{\partial d_i} \times \frac{\partial d_j}{\partial O} = \frac{p_i}{p_j} \times \frac{d_i^{p_i - 1}}{d_j^{p_j - 1}}$$

On the topic of the feasible space, the optimal portfolio is the one that has an indifference curve tangent to the frontier of non-dominated points in the presence of moments that are higher than the second. The efficient portfolios are thus the solutions of preference p_i combinations. Jean (1973) indicates that it is not necessary that investors who have standardized expectations in the distribution of security returns will choose the same combination of risky securities if they have different preferences. In other words, the risk premium is individual and hardly identical because of the difference of each investor's preferences.

As this study employs 15 emerging stock markets, the various expressions in (P2) can be computed as follows;

$$X^T(\overline{R} - \overline{r}) = \sum_{j=1}^{15} X_j(\overline{R}_j - \overline{r}) \tag{16}$$

$$E\left[X^T(\tilde{R} - \overline{R})\right]^3 = \sum_{j=1}^{15} X_i^3 S_i^3 + 3\sum_{i=1}^{15}\left(\sum_{j=1}^{15} X_i^2 X_j S_{iij} + \sum_{j=1}^{15} X_i X_j^2 S_{ijj}\right) \tag{17}$$

$$X^T I = \sum_{j=1}^{15} X_j \tag{18}$$

$$X^T V X = \sum_{j=1}^{15} X_j^2 \sigma_i^2 + \sum_{i=1}^{15}\sum_{j=1}^{15} X_i X_j \sigma_{ij} \tag{19}$$

10 Different combinations of p_i represent diverse preferences of the mean, the variance, and the skewness of a portfolio return i.e. the higher the p_1 (p_3), the more important the mean (skewness) of the portfolio return is to the investor.

4.6 Portfolio Performance Measure

The Two Moment Performance Measure

To determine the two moment performance, measures of Sharpe (1966) and Treynor (1965) are utilized.

$$Sharpe = \frac{R_p - R_f}{\sigma_p} \tag{20}$$

where Rp is portfolio return.

Rf is risk-free rate which is 3-month Treasury Bill here.

σ_p is portfolio standard deviation.

$$Treynor = \frac{R_p - R_f}{\beta_p} \tag{21}$$

where Rp is portfolio return.

Rf is risk-free rate which is 3-month Treasury Bill here.

β_p is portfolio beta.

The Three Moment Performance Measure

For the three moment performance, the developed higher moment performance measures of Prakash and Bear (1986) is employed.

Stephens and Proffitt (1991) restate the Rubinstein (1973) *n* moment CAPM as:

$$E(R_j) = R_f + \lambda_n \eta_n \sum_{i=2}^{n} \frac{1}{\eta_n} \sigma_{mj}(R_m, R_j) \tag{n}$$

where λ_n is the *n* moment performance measure given by

$$\lambda_n = \frac{E(R_p) - R_f}{\eta_n \sum_{i=2}^{n} \frac{1}{\eta_n} \sigma_{mj}(R_m, R_j)} \tag{o}$$

where $E(Rp)$ is portfolio expected return.

Rf is risk-free rate.

η is constant whose value depends on the type of underlying utility function of the investor.

σ_{mj} is joint central moment of order i between the market and portfolio return.

n is 2, 3 for covariance and coskewness, respectively.

For different values of n (= 2, 3), λ_n becomes the Treynor and Prakash and Bear performance measure as follows:

For $n = 2$, λ_2 simplifies to the Treynor measure as:

$$\lambda_2 = \frac{E(R_p - R_f)}{\eta_2 \frac{1}{\eta_2} \sigma_{m2}(R_m, R_p)} \tag{p}$$

For $n = 3$, λ_3 simplifies to the Prakash and Bear measure as:

$$\lambda_3 = \frac{E(R_p - R_f)}{\eta_3 \frac{1}{\eta_2} \sigma_{m2}(R_m, R_p) + \eta_3 \frac{1}{\eta_3} \sigma_{m3}(R_m, R_p)} \tag{q}$$

However, Chunhachinda, et al (1994) have found the way for empirical investigations by rewriting Equation (n) as:

$$R_{jt} = \theta_1 + \sum_{i=2}^{n} \theta_i Z_{jt} + \varepsilon_{jt} \tag{22}$$

where θ_i = Regression coefficient whose value for different values of n will proxy η_n / η_i ($i = 2, 3$)

R_{jt} = The rate of return of asset j at time t

$$Z_{jt} = \frac{1}{N} \sum_{t=1}^{N} \left[(R_{jt} - \overline{R_j})(R_{mt} - \overline{R_m})^{i-1} \right] = \sigma_{mi}\left(R_m, R_j\right)$$

t = The number of observations

R_{mt} = The market rate of return at time t

i = 2 for covariance, and 3 for coskewness

The ordinary least squares method is employed to estimate the parameters η's. Therefore,

θ_2 = OLS coefficient for the covariance term, and

θ_3 = OLS coefficient for the co-skewness term

Then, it can be written in term of the relationship of parameters θ's and η's as:

$$\frac{\theta_3}{\theta_2} = \frac{\eta_3}{\eta_2} = \mu_1 \tag{23}$$

Equation (p) and (q) can be substituted for $\eta_3 / \eta_2$by μ_1 as follow:

$$Treynor = \frac{\overline{R_j} - R_f}{\overline{Z_{j2}}} \tag{24}$$

$$P\ rakash\ and\ Bear = \frac{\overline{R_j} - R_f}{(\mu_1 \overline{Z_{j2}} + \overline{Z_{j3}})} \tag{25}$$

where

$$\overline{R_j} = \frac{1}{N} \sum_{t=1}^{N} R_{jt}$$

$$\overline{Z_{ji}} = \frac{1}{N} \sum_{t=1}^{N} Z_{jt}$$

i = 2 for covariance, and 3 for coskewness

V. EMPIRICAL RESULT

5.1 Portfolio Optimization

Tables IV - VI and Table VII - IX provide the mean values of the variances and the covariance for the weekly, the monthly, and the quarterly rates of return under both unhedged and hedged strategy, respectively. The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

[Table IV]

[Table V]

[Table VI]

[Table VII]

[Table VIII]

[Table IX]

Also, Tables X - XII and Table XIII – XV provide the mean values of skewness (diagonal) and co-skewness (off-diagonal) for the weekly, the monthly, and the quarterly rates of return under both unhedged and hedged strategy, respectively. Here, there are 210 co-skewness values (curvilinear interactions) for each investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Interestingly, under unhedged strategy, there are 181 negative curvilinear interactions for the weekly investment horizon, as opposed to 89 and 60 for the monthly and the quarterly counterparts, respectively. Similarly, under hedged strategy, the negative curvilinear interactions for the weekly, the monthly, and the quarterly investment horizon are 172, 62, and 65, respectively. It can be seen that the negative curvilinear interactions can be found most in the weekly investment horizons. In order to obtain the mean-variance-skewness efficient portfolios, the mean values of variances, covariance, skewness, and co-skewness from Tables IV – XV are utilized to

construct a polynomial goal programming for both unhedged and hedged strategies with three assumed investment horizons (week, month, and quarter).

[Table X]

[Table XI]

[Table XII]

[Table XIII]

[Table XIV]

[Table XV]

Table XVI and XVII provide the means, the standard deviations, and the coefficients of variation (CV) of the rates of return of 15 emerging stock markets under unhedged and hedged strategy, respectively. The last column of the table shows the ranking of CV which may afford some preliminary information of the potential candidacy to include into the optimal portfolio. From the column ranking of CV of both tables, Taiwan ranks at the top of the list for all three investment horizons, which implies that Taiwan market offers the lowest risk per a unit of return. On the other hands, Russia ranks at the bottom for the weekly and the monthly unhedged rates of return (Table XVI) and for the weekly hedged rates of return (Table XVII). Also, South Africa ranks at the bottom for the quarterly unhedged rates of return (Table XVI) and for the monthly and the quarterly hedged rates of return (Table XVII).

[Table XVI]

[Table XVII]

Using the information in Tables IV - XV, both unhedged and hedged portfolio selection with both no-short-sales and short-sales allowing are determined for the weekly, the monthly, and the quarterly investment horizons. First, computing the values of O_1* and O_3* separately. In order to find O_1*, Equation (h) in (P2) is placed as the objective function to maximize subject to constraints (j), (k) and (l)[11]. Likewise, to find O_3*, Equation (i) is maximized subject to constraints (j), (k) and (l). After the values of O_1* and O_3* are obtained, substituting both of them back into Equations (h) and (i). Then, minimizing the objective function (g)

[11] Constraint (f) is disregarded when short sales are allowed.

subject to constraints (h), (i), (j), (k), (l), and (m) and the portfolio solution is achieved. These optimization processes are then repeated for weekly, monthly, and quarterly portfolio selection under both currency hedging strategies and for both no-short-sales and short-sales allowing constraints.

Table XVIII and Table XIX shows respectively the optimal portfolio solution under unhedged and hedged strategy when short sales are not allowed, i.e. the portfolio weight x_i can take on positive values only, while Table XX and XXI represents such solutions when allowing short sales. The results also demonstrate that portfolio compositions are varied due to different combinations of p_1 and p_3. It can be seen obviously that a significant change occurred in the optimal portfolio construction when skewness is incorporated into an investor's portfolio decision.

[Table XVIII]

In Table XVIII, its results are interesting that Russia is the only one that most weights allocated to for both mean-variance and mean-variance-skewness portfolios for every investment horizons. Similar evidence can be found with China as it is allocated in both portfolio types for each investment horizons except that of weekly mean-variance-skewness portfolios.

For $p_1 = 1$ and $p_3 = 0$ (the mean-variance portfolio), China, Russia, and Portugal are respectively the top three allocated for each investment horizons. However, Argentina, Brazil, Greece, Philippines, South Korea, Taiwan, and Thailand are not included in the optimal portfolio.

For $p_1 = 1$ and $p_3 = 1$ (the mean-variance-skewness portfolio), Russia is still the most dominant component for each investment horizons, followed by Brazil. Interestingly, the weekly optimal portfolio consists of simply 6 countries i.e. Russia, Brazil, Argentina, Taiwan, Philippines, and Portugal, respectively, while the monthly portfolio is made up of 13 countries except India and Mexico. Similarly, the quarterly portfolio comprises of 14 countries except South Korea.

For the other two mean-variance-skewness portfolios ($p_1 = 1$ and $p_3 = 2$, and $p_1 = 2$ and $p_3 = 1$), the portfolio compositions are very comparable. The most allocations are still given to Russia for all investment horizons, followed by Brazil and Argentina, respectively. Interestingly, the weekly portfolio consists of simply 3 countries i.e. Russia 86.29%, Argentina 10.83%, and Brazil 2.88%.

[Table XIX]

Table XIX presents the efficient portfolio solution under hedged strategy when short sales are not allowed. For $p_1 = 1$ and $p_3 = 0$ (the mean-variance portfolio), most allocations are still be into China and Russia respectively for each investment horizons. Interestingly, the dominant component for the hedged portfolio is South Africa with the allocation of 8.15% in weekly portfolio, 25.97% in monthly portfolio, and 42.14% in quarterly portfolio. However, Portugal which is one of the top three in unhedged portfolio is not included in this portfolio.

For the mean-variance-skewness portfolio with various preferences ($p_1 = 1$ and $p_3 = 1$, $p_1 = 1$ and $p_3 = 2$, and $p_1 = 2$ and $p_3 = 1$), the portfolio compositions are very comparable. Again, Russia is the dominant component for each investment horizons particularly in weekly and monthly portfolio (87.30% in weekly portfolio, and 75.13% in monthly portfolio with $p_1 = 1$ and $p_3 = 1$, and 74.32% in the other two monthly portfolios).

Similarly, the unhedged and hedged optimal portfolios when short sales allowed of different combinations of p_1 and p_3 are obtained as shown in Table XX and Table XXI, respectively. A major change in allocation can be found as expected since investors are able to reach a higher level of satisfaction.

[Table XX]

Table XX presents the interesting results that China is still the dominant component in each portfolio approaches and preferences. Additionally, Greece which is hardly allocated into when short sales prohibited is now one of the dominant components in the weekly and monthly mean-variance-skewness portfolio.

For $p_1 = 1$ and $p_3 = 0$ (the mean-variance portfolio), China, Russia, and Malaysia are that dominants i.e. 34.55%, 33.20%, and 27.19%, respectively for weekly horizon. For monthly

portfolio, Russia, China, and Portugal are the most allocated as 29.97%, 29.57%, and 29.39%, respectively. For the quarter horizon, the top three allocations are given to Portugal 71.30%, Mexico 51.83%, and Russia 32.55%.

For the mean-variance-skewness portfolio with various preferences, the portfolio compositions are relatively comparable. For weekly portfolio, the dominant component is Portugal, followed by Mexico and Greece, respectively. For monthly investment horizon, a large amount of allocation is given to China, followed by Thailand and Mexico, respectively. Here, there exists the interesting point that Thailand to which seldom allocated is now one of the dominant components by a hundred percent approximately. Surprisingly, for the quarterly portfolio, Taiwan is the dominant component by 133% in each preference, followed by South Africa 67% and Thailand 45%.

[Table XXI]

Table XXI represents the optimal portfolio selection under hedged strategy when allowing short sales. For the mean-variance portfolio, the results of each investment horizons is relatively various. China, Indonesia and South Africa are the top three allocations by 31.35%, 28.02% and 25.78%, respectively, for the weekly investment horizon. For the monthly portfolio, South Africa is the main component (64%), followed by Brazil (30.72%) and China (27.67%). Again, South Africa is the main component (68.79%) in the quarterly portfolio, followed by Mexico (43.40%) and Argentina (35.63%).

For the mean-variance-skewness portfolio with various preferences, the portfolio compositions are again relatively comparable. For the weekly portfolio, Portugal is the dominant component, followed by Mexico and Philippines. Interestingly, Portugal is again the most allocated in the monthly portfolio but with double amount (281%) compared to the weekly portfolio (140%), followed by Philippines and Russia. However, for the quarterly portfolio, the dominant component is Malaysia 173%, followed by Brazil (60%) and South Africa (38%). Interestingly, Brazil and South Africa are one of that not included in the weekly and monthly portfolios, i.e. they are short sales, though become the dominant components in the quarterly portfolio.

5.2 The Performance of Emerging Stock Portfolios

Table XXII and Table XXIII list the means, variances, covariance, and coskewness of the 2-moment and 3-moment portfolios' rates of return, respectively. Covariance and coskewness represent the co-movement between the portfolios with the market rates of return calculated by using the Morgan Stanley emerging market index.

[Table XXII]

[Table XXIII]

Least squares regressions of the model specified in Equation (22) are utilized to obtain the regression coefficients of covariance (Z_{j2}) and coskewness (Z_{j3}) for both unhedged and hedged portfolios under various preferences on each investment horizons (week, month and quarter) when short sales are prohibited and allowed. Table XXIV and Table XXV show the results of the regressions of R_{jt} on Z_{j2} and Z_{j3}. It can be seen that whether short sales are prohibited or not, the estimated coefficients for the third moment (Z_{j3}) are statistically significant at the 1 percent level of significance for each portfolios in all investment horizons. Also, the skewness coefficients are positive values, as hypothesized by Kraus and Litzenberger (1976), Prakash and Bear (1986), and Chunhachinda, et al (1994). Thus, to evaluate the performance of the emerging stock portfolios, an equilibrium pricing model including the higher moments seems to be more appropriate.

[Table XXIV]

[Table XXV]

Using the mean values of the portfolios from Tables XXII and Table XXIII, and the regression coefficients obtained from Table XXIV and Table XXV, the performance of portfolios are ranked by the Sharpe, Treynor, and Prakash and Bear measures.

[Table XXVI]

Table XXVI presents the Sharpe and Treynor measure of the mean-variance portfolio. As presented in the first column, the Sharpe measure, the hedged portfolio when allowing for short sales is ranked first across all investment horizons, whereas the unhedged portfolio when short sales prohibited is ranked last. For Treynor measure, the weekly hedged portfolio when

allowing for short sales is also ranked first, while the first rank of the monthly portfolio is the unhedged strategy when allowing for short sales. It can be seen that allowing for short sales for weekly and monthly investment horizons makes the portfolio better performed when gauged by the Treynor measure. However, for the quarterly portfolio, the strategy that ranked first is the hedged one when short sales prohibited.

[Table XXVII]

Table XXVII presents performance measures of the mean-variance-skewness portfolio which are Treynor, and Prakash and Bear. According to the Treynor measure in the first column, the hedged portfolio when short sales prohibited with $p_1 = 1$ and $p_3 = 1$ is ranked first across all investment horizons. For the Prakash and Bear measure, the unhedged portfolio when short sales prohibited with $p_1 = 1$ and $p_3 = 2$, and the unhedged portfolio when short sales prohibited with $p_1 = 2$ and $p_3 = 1$ are ranked first.

Interestingly, it can be seen that when higher moments are taken into consideration, the performance of the portfolio is also changed, i.e. for the mean-variance portfolio, allowing for short sales strategy is relatively superior to the short sales prohibited, while for the mean-variance-skewness portfolio, the one that performed better is the short sales prohibited.

[Table XXVIII]

The performance between the mean-variance and the mean-variance-skewness portfolios is compared by using the Treynor measure as shown in Table XXVIII. The correct sign represents that such three-moment portfolio is outperformed when compared to the two-moment one. The results of comparison represent that the higher moment portfolio can perform better than the two-moment one in the monthly hedged strategy when short sales are prohibited. For the quarterly investment horizons, such higher-moment portfolios are superior in both unhedged and hedged approaches whether short sales are prohibited or not.

VI. CONCLUSION

In this study, the Wilk-Shapiro (*W*-test) is employed to investigate the normality of return distributions of 15 emerging markets' stock indices. The evidence indicates that for weekly rates of return, all return distributions of 15 emerging markets exhibit significant skewness. For monthly rates of return, the probability associated with the *W*-statistic indicates that 7 distributions display significant skewness. Lastly, for quarterly rates of return, simply 5 emerging markets reveal significant skewness of return distributions. This empirical finding gives an idea that the shorter the assumed holding periods, the more the return distributions exhibit skewness. Also, as the argument stated earlier, this finding substantiates that higher moments cannot be neglected in portfolio selection.

To determine the portfolio selection with skewness, polynomial goal programming (PGP) which the incorporation of investor's preferences for skewness can be integrated is employed. Also, the foreign exchange effect is explored by constructing two types of portfolios, i.e. unhedged and hedged portfolios. The empirical findings represent that a major change in the optimal portfolio construction is arisen when incorporating skewness into an investor's portfolio decision. Also, foreign exchange hedging, the choice of various investment horizons, and short sales restriction do influence the performance of the foreign portfolio. Interestingly, whether short sales is prohibited or allowed, Russia and China are constantly the dominant components in each portfolio for various investment horizons.

In relation to portfolio performance measure, the statistically significant coefficients for coskewness at the 1 percent level of significance for each portfolio in all investment horizons are obtained. Such evidence signifies that the higher moment performance measure seems to be more appropriate when evaluating the performance of the emerging stock portfolios. Then, for comparison purposes, the portfolio performance is gauged by using Sharpe, and Treynor (two-moment performance measure), and Prakash and Bear's (three-moment performance measure). The evidence suggests that performance ranking of portfolios is diverse depending on the measure utilized. Specifically, short-sales-allowed portfolios always outperform that of

short sales prohibited when employing two-moment performance measure, whereas this evidence seems not so obvious in the occurrence of three-moment performance measure. However, the hedged portfolios are consistently superior to the unhedged one no matter which performance measure is utilized. Additionally, Treynor is brought into play for performance comparison between the two-moment and three-moment portfolios. The evidence indicates that higher-moments portfolio performs better than the two-moment one in the monthly hedged strategy when short sales are prohibited. For the quarterly investment horizons, such higher-moment portfolios are superior in both unhedged and hedged approaches whether short sales are prohibited or allowed.

Table I

Results for normality tests of emerging stock market return distributions

Country	*W*-Statistics			Prob < *W* *		
	Week	**Month**	**Quarter**	**Week**	**Month**	**Quarter**
Argentina	**2.469**	**0.998**	**0.757**	**0.000**	**0.012**	**0.044**
Brazil	**0.933**	**0.719**	0.486	**0.018**	**0.059**	0.212
China	**3.829**	**1.029**	**0.761**	**0.000**	**0.010**	**0.043**
Greece	**3.925**	0.503	0.282	**0.000**	0.201	0.616
India	**3.020**	**1.619**	0.471	**0.000**	**0.000**	0.231
Indonesia	**2.260**	0.456	0.339	**0.000**	0.262	0.481
Malaysia	**9.617**	**1.021**	**0.690**	**0.000**	**0.011**	**0.066**
Mexico	**4.616**	**1.398**	0.489	**0.000**	**0.001**	0.208
Philippines	**1.378**	0.244	0.402	**0.001**	0.759	0.341
Portugal	**1.948**	0.563	0.438	**0.000**	0.142	0.278
Russia	**3.617**	**1.681**	**1.428**	**0.000**	**0.000**	**0.001**
South Africa	**1.591**	0.269	0.400	**0.000**	0.675	0.345
South Korea	**2.296**	0.322	0.380	**0.000**	0.525	0.384
Taiwan	**3.438**	0.498	**0.620**	**0.000**	0.207	**0.098**
Thailand	**1.260**	0.270	0.218	**0.003**	0.670	0.826

* If the probability (prob < *W*) is less than 0.10, the null hypothesis of normality cannot be supported at the ten percent level of significant which represented by the bold figures.

Table II

Summary statistics of 15 emerging stock markets under unhedged strategy

Country	Mean Return [1]			Variance [2]			Skewness [3]			Kurtosis [3]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	0.002	0.010	0.034	0.001	0.003	0.040	-0.557	0.005	0.175	2.012	1.477	2.655
Brazil	0.005	0.024	0.076	0.001	0.003	0.051	0.100	0.033	0.024	-0.020	0.507	0.404
China	0.004	0.017	0.059	0.000	0.001	0.028	0.398	1.136	1.014	2.146	2.433	1.602
Greece	0.002	0.007	0.023	0.000	0.002	0.020	0.130	0.273	1.067	2.843	1.452	2.870
India	0.005	0.022	0.064	0.000	0.002	0.022	-0.277	-0.565	-0.040	2.582	0.592	-0.878
Indonesia	0.005	0.020	0.063	0.000	0.002	0.047	0.066	0.615	2.481	2.675	2.964	10.224
Malaysia	0.003	0.015	0.043	0.000	0.001	0.018	1.737	1.072	2.891	9.875	3.820	12.664
Mexico	0.005	0.022	0.068	0.000	0.002	0.020	0.188	-0.235	0.515	2.381	0.246	2.323
Philippines	0.001	0.005	0.017	0.000	0.001	0.016	1.203	-0.221	-0.949	1.401	0.093	1.861
Portugal	0.002	0.007	0.021	0.000	0.001	0.008	0.173	-0.072	-0.325	1.322	-0.082	0.514
Russia	0.009	0.041	0.134	0.001	0.003	0.078	0.058	1.176	1.594	1.618	5.275	4.086
South Africa	0.004	0.016	0.049	0.000	0.001	0.009	-0.176	-0.400	-0.583	2.299	0.717	0.014
South Korea	0.004	0.015	0.052	0.000	0.002	0.029	-0.227	0.336	0.606	1.776	0.273	0.731
Taiwan	0.001	0.005	0.021	0.000	0.002	0.024	0.094	0.499	0.943	2.085	0.765	3.409
Thailand	0.002	0.009	0.028	0.000	0.001	0.017	0.094	0.277	0.668	2.559	1.167	0.376

[1] For all investment horizons Russia has the highest means of the rates of return, followed by Brazil and India, whereas the Philippines and Taiwan provide the lowest one.

[2] The volatility of returns for Portugal is the lowest for all three horizons. Respectively, that of Argentina, Brazil and Russia is the highest for weekly, monthly and quarterly investment horizons.

[3] Skewness and kurtosis characterize the third and fourth central moments of the rates of return, respectively. They can be examined as an informal check of normality; the skewness and the kurtosis of a normal distribution is respectively three and zero. The evidences demonstrate that most of the emerging stock markets exhibit positive skewness for all investment horizons.

Table III

Summary statistics of 15 emerging stock markets under hedged strategy

Country	Mean Return [1]			Variance [1]			Skewness [2]			Kurtosis [2]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	0.005	0.020	0.060	0.003	0.010	0.029	0.629	0.273	0.265	4.122	0.962	2.313
Brazil	0.006	0.027	0.086	0.002	0.007	0.029	0.026	0.039	0.776	0.957	0.099	0.686
China	0.004	0.017	0.059	0.001	0.007	0.027	0.498	1.144	1.015	2.169	2.591	1.628
Greece	0.002	0.008	0.025	0.002	0.005	0.020	-0.202	0.283	1.094	2.841	1.459	2.941
India	0.005	0.022	0.064	0.002	0.006	0.019	-0.458	-0.529	0.162	2.529	0.466	-0.835
Indonesia	0.005	0.022	0.068	0.001	0.005	0.025	0.217	0.941	1.799	2.301	3.813	6.701
Malaysia	0.003	0.010	0.031	0.001	0.004	0.013	0.388	0.351	2.467	7.055	2.558	9.544
Mexico	0.005	0.023	0.072	0.001	0.005	0.015	-0.034	-0.312	0.962	2.320	0.252	3.709
Philippines	0.002	0.007	0.023	0.001	0.005	0.012	0.252	-0.276	-0.548	2.038	0.382	0.139
Portugal	0.001	0.005	0.017	0.000	0.002	0.007	0.067	0.526	-0.386	2.792	1.095	-0.546
Russia	0.009	0.041	0.136	0.003	0.015	0.078	0.067	1.171	1.570	1.626	5.230	3.973
South Africa	0.004	0.017	0.054	0.001	0.002	0.007	-0.439	-0.100	-0.506	2.768	-0.019	0.697
South Korea	0.004	0.014	0.048	0.002	0.006	0.026	-0.142	0.511	0.744	1.869	0.770	1.084
Taiwan	0.001	0.006	0.023	0.001	0.006	0.022	0.001	0.603	1.353	2.278	1.092	5.037
Thailand	0.003	0.010	0.031	0.001	0.006	0.017	-0.064	0.298	0.649	2.581	1.162	0.337

[1] Under hedged strategy Russia provides not only the highest means but also the highest variability of the rates of return for all investment horizons, where Portugal still presents the lowest one.

[2] Skewness and kurtosis characterize the third and fourth central moments of the rates of return, respectively. They can be examined as an informal check of normality; the skewness and the kurtosis of a normal distribution is respectively three and zero. The evidences demonstrate that most of the emerging stock markets exhibit positive skewness for all investment horizons.

Table IV

Summary of covariances for *weekly* returns of emerging stock markets under *unhedged* strategy

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
Argentina (x_1)	**0.284%**														
Brazil (x_2)	0.139%	**0.320%**													
China (x_3)	-0.001%	0.002%	**0.139%**												
Greece (x_4)	0.041%	0.068%	0.003%	**0.151%**											
India (x_5)	0.050%	0.091%	0.015%	0.052%	**0.190%**										
Indonesia (x_6)	0.058%	0.088%	0.013%	0.031%	0.050%	**0.240%**									
Malaysia (x_7)	0.033%	0.040%	0.013%	0.021%	0.031%	0.034%	**0.106%**								
Mexico (x_8)	0.096%	0.148%	0.001%	0.050%	0.074%	0.052%	0.036%	**0.173%**							
Philippines (x_9)	0.047%	0.065%	0.002%	0.016%	0.045%	0.048%	0.034%	0.058%	**0.128%**						
Portugal (x_{10})	0.031%	0.053%	0.003%	0.039%	0.037%	0.015%	0.015%	0.033%	0.008%	**0.053%**					
Russia (x_{11})	0.073%	0.120%	0.004%	0.022%	0.063%	0.073%	0.040%	0.093%	0.045%	0.024%	**0.287%**				
South Africa (x_{12})	0.053%	0.098%	0.016%	0.055%	0.064%	0.059%	0.029%	0.078%	0.042%	0.033%	0.076%	**0.119%**			
South Korea (x_{13})	0.056%	0.122%	0.004%	0.046%	0.086%	0.085%	0.039%	0.093%	0.070%	0.022%	0.077%	0.081%	**0.229%**		
Taiwan (x_{14})	0.034%	0.063%	0.015%	0.032%	0.063%	0.039%	0.041%	0.052%	0.040%	0.022%	0.052%	0.050%	0.085%	**0.153%**	
Thailand (x_{15})	0.030%	0.057%	0.005%	0.022%	0.044%	0.070%	0.031%	0.045%	0.047%	0.010%	0.050%	0.041%	0.074%	0.040%	**0.120%**

The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

Table V

Summary of covariances for *monthly* returns of emerging stock markets under *unhedged* strategy

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
Argentina (x_1)	**1.232%**														
Brazil (x_2)	0.652%	**1.399%**													
China (x_3)	0.064%	0.020%	**0.664%**												
Greece (x_4)	0.262%	0.330%	0.034%	**0.521%**											
India (x_5)	0.346%	0.413%	0.069%	0.289%	**0.653%**										
Indonesia (x_6)	0.222%	0.340%	0.000%	0.149%	0.286%	**1.073%**									
Malaysia (x_7)	0.184%	0.242%	0.098%	0.136%	0.171%	0.296%	**0.532%**								
Mexico (x_8)	0.327%	0.538%	0.037%	0.127%	0.293%	0.284%	0.150%	**0.628%**							
Philippines (x_9)	0.169%	0.260%	0.032%	0.058%	0.218%	0.287%	0.242%	0.291%	**0.574%**						
Portugal (x_{10})	0.157%	0.299%	0.041%	0.154%	0.154%	0.027%	0.043%	0.077%	-0.066%	**0.247%**					
Russia (x_{11})	0.205%	0.430%	0.023%	0.140%	0.276%	0.543%	0.305%	0.329%	0.304%	-0.057%	**1.510%**				
South Africa (x_{12})	0.187%	0.356%	0.029%	0.216%	0.253%	0.263%	0.125%	0.234%	0.138%	0.114%	0.278%	**0.373%**			
South Korea (x_{13})	0.292%	0.530%	0.085%	0.173%	0.269%	0.326%	0.237%	0.353%	0.253%	0.087%	0.319%	0.231%	**0.673%**		
Taiwan (x_{14})	0.326%	0.522%	0.129%	0.219%	0.301%	0.176%	0.326%	0.274%	0.292%	0.128%	0.384%	0.203%	0.409%	**0.639%**	
Thailand (x_{15})	0.228%	0.284%	-0.063%	0.087%	0.206%	0.395%	0.277%	0.183%	0.329%	-0.007%	0.290%	0.166%	0.329%	0.280%	**0.550%**

The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

Table VI

Summary of covariances for *quarterly* returns of emerging stock markets under *unhedged* strategy

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
Argentina (x_1)	**3.880%**														
Brazil (x_2)	2.865%	**4.933%**													
China (x_3)	0.370%	0.014%	**2.724%**												
Greece (x_4)	1.324%	0.945%	0.016%	**1.953%**											
India (x_5)	1.532%	2.078%	0.209%	1.285%	**2.136%**										
Indonesia (x_6)	-0.070%	0.525%	0.633%	0.196%	1.164%	**4.596%**									
Malaysia (x_7)	0.316%	0.401%	0.704%	0.199%	0.680%	2.047%	**1.705%**								
Mexico (x_8)	0.706%	1.642%	0.218%	0.196%	0.655%	0.682%	0.777%	**1.927%**							
Philippines (x_9)	0.332%	0.861%	0.487%	-0.086%	0.454%	1.384%	0.793%	1.025%	**1.566%**						
Portugal (x_{10})	0.923%	1.087%	0.006%	0.732%	0.653%	-0.246%	-0.186%	-0.043%	-0.151%	**0.805%**					
Russia (x_{11})	0.149%	1.744%	0.423%	-0.561%	0.859%	3.716%	2.224%	1.583%	1.547%	-0.621%	**7.609%**				
South Africa (x_{12})	0.866%	1.144%	0.090%	0.662%	0.749%	0.707%	0.249%	0.528%	0.314%	0.296%	0.616%	**0.841%**			
South Korea (x_{13})	0.657%	1.900%	0.201%	0.416%	1.247%	2.352%	1.327%	1.284%	1.074%	0.044%	3.022%	0.768%	**2.831%**		
Taiwan (x_{14})	1.371%	2.507%	0.121%	0.695%	1.222%	0.943%	0.846%	1.270%	0.804%	0.475%	2.251%	0.535%	1.765%	**2.369%**	
Thailand (x_{15})	0.490%	1.011%	-0.012%	0.182%	0.865%	1.895%	0.754%	0.508%	0.694%	0.066%	1.420%	0.446%	1.333%	0.632%	**1.682%**

The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

Table VII

Summary of covariances for *weekly* returns of emerging stock markets under *hedged* strategy

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
Argentina (x_1)	**0.265%**														
Brazil (x_2)	0.084%	**0.179%**													
China (x_3)	-0.003%	0.002%	**0.138%**												
Greece (x_4)	0.039%	0.052%	0.002%	**0.150%**											
India (x_5)	0.047%	0.067%	0.013%	0.048%	**0.174%**										
Indonesia (x_6)	0.040%	0.042%	0.011%	0.028%	0.045%	**0.136%**									
Malaysia (x_7)	0.022%	0.026%	0.011%	0.020%	0.027%	0.030%	**0.087%**								
Mexico (x_8)	0.078%	0.099%	0.002%	0.043%	0.062%	0.035%	0.029%	**0.132%**							
Philippines (x_9)	0.048%	0.048%	0.005%	0.028%	0.044%	0.042%	0.024%	0.046%	**0.112%**						
Portugal (x_{10})	0.029%	0.038%	0.000%	0.027%	0.034%	0.015%	0.020%	0.036%	0.020%	**0.046%**					
Russia (x_{11})	0.074%	0.087%	0.003%	0.021%	0.059%	0.051%	0.038%	0.077%	0.039%	0.028%	**0.285%**				
South Africa (x_{12})	0.040%	0.052%	0.012%	0.038%	0.048%	0.040%	0.025%	0.053%	0.039%	0.025%	0.056%	**0.082%**			
South Korea (x_{13})	0.048%	0.083%	0.003%	0.039%	0.077%	0.060%	0.030%	0.074%	0.058%	0.029%	0.070%	0.062%	**0.198%**		
Taiwan (x_{14})	0.033%	0.043%	0.015%	0.027%	0.056%	0.032%	0.039%	0.042%	0.035%	0.025%	0.050%	0.041%	0.074%	**0.141%**	
Thailand (x_{15})	0.030%	0.039%	0.004%	0.021%	0.041%	0.052%	0.032%	0.038%	0.041%	0.014%	0.049%	0.032%	0.067%	0.037%	**0.119%**

The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

Table VIII

Summary of covariances for *monthly* returns of emerging stock markets under *hedged* strategy

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
Argentina (x_1)	**1.016%**														
Brazil (x_2)	0.328%	**0.684%**													
China (x_3)	0.002%	0.001%	**0.656%**												
Greece (x_4)	0.216%	0.257%	0.031%	**0.520%**											
India (x_5)	0.286%	0.270%	0.048%	0.265%	**0.588%**										
Indonesia (x_6)	0.213%	0.140%	0.022%	0.128%	0.201%	**0.529%**									
Malaysia (x_7)	0.153%	0.096%	0.046%	0.092%	0.141%	0.199%	**0.378%**								
Mexico (x_8)	0.244%	0.333%	0.024%	0.092%	0.232%	0.174%	0.109%	**0.465%**							
Philippines (x_9)	0.242%	0.175%	0.027%	0.116%	0.217%	0.241%	0.197%	0.213%	**0.469%**						
Portugal (x_{10})	0.072%	0.162%	0.042%	0.092%	0.132%	0.014%	0.056%	0.097%	0.000%	**0.214%**					
Russia (x_{11})	0.233%	0.289%	0.021%	0.137%	0.258%	0.349%	0.299%	0.257%	0.249%	-0.007%	**1.506%**				
South Africa (x_{12})	0.095%	0.142%	0.049%	0.115%	0.189%	0.115%	0.090%	0.171%	0.172%	0.071%	0.196%	**0.238%**			
South Korea (x_{13})	0.258%	0.284%	0.085%	0.125%	0.231%	0.188%	0.168%	0.271%	0.254%	0.078%	0.287%	0.179%	**0.589%**		
Taiwan (x_{14})	0.293%	0.300%	0.126%	0.188%	0.261%	0.129%	0.257%	0.227%	0.259%	0.144%	0.359%	0.194%	0.353%	**0.570%**	
Thailand (x_{15})	0.258%	0.145%	-0.066%	0.085%	0.189%	0.286%	0.242%	0.144%	0.332%	-0.014%	0.286%	0.114%	0.300%	0.262%	**0.547%**

The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

Table IX

Summary of covariances for *quarterly* returns of emerging stock markets under *hedged* strategy

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}
Argentina (x_1)	**2.820%**														
Brazil (x_2)	1.812%	**2.788%**													
China (x_3)	0.161%	-0.048%	**2.612%**												
Greece (x_4)	1.135%	0.684%	-0.014%	**1.947%**											
India (x_5)	1.423%	1.321%	0.110%	1.170%	**1.883%**										
Indonesia (x_6)	0.439%	0.277%	0.549%	0.266%	0.993%	**2.413%**									
Malaysia (x_7)	0.258%	0.079%	0.496%	-0.024%	0.486%	1.296%	**1.268%**								
Mexico (x_8)	0.568%	1.316%	0.102%	0.157%	0.492%	0.625%	0.461%	**1.439%**							
Philippines (x_9)	0.640%	0.455%	0.442%	0.139%	0.492%	1.134%	0.537%	0.499%	**1.180%**						
Portugal (x_{10})	0.622%	0.608%	-0.011%	0.487%	0.489%	-0.055%	0.016%	0.250%	0.105%	**0.659%**					
Russia (x_{11})	0.511%	1.091%	0.414%	-0.565%	0.839%	2.374%	2.015%	1.316%	0.847%	0.072%	**7.605%**				
South Africa (x_{12})	0.419%	0.707%	0.020%	0.387%	0.550%	0.366%	0.173%	0.528%	0.369%	0.219%	0.793%	**0.673%**			
South Korea (x_{13})	0.970%	1.178%	0.242%	0.281%	1.085%	1.697%	1.117%	1.040%	1.078%	0.132%	2.675%	0.747%	**2.495%**		
Taiwan (x_{14})	1.550%	1.641%	0.104%	0.566%	1.019%	0.739%	0.707%	1.059%	0.690%	0.590%	2.128%	0.591%	1.601%	**2.177%**	
Thailand (x_{15})	0.663%	0.649%	-0.038%	0.173%	0.797%	1.386%	0.743%	0.384%	0.792%	-0.065%	1.411%	0.203%	1.291%	0.615%	**1.667%**

The bold figures stand for the variances of the 15 emerging stock markets, while all other values correspond to the covariance. It can be seen that the covariance of the rates of return for all investment horizons are relatively low compared to the variances. This evidence signifies that when a portfolio is formed, the unsystematic risk can be diversified.

Table X

Summary of coskewness (curvilinear) for *weekly* returns of emerging stock markets under *unhedged* strategy

	x_1^2	x_2^2	x_3^2	x_4^2	x_5^2	x_6^2	x_7^2	x_8^2	x_9^2	x_{10}^2	x_{11}^2	x_{12}^2	x_{13}^2	x_{14}^2	x_{15}^2
Argentina (x_1)	**0.001%**	-0.001%	0.000%	0.000%	-0.002%	0.002%	0.001%	0.000%	-0.001%	0.000%	0.000%	-0.002%	-0.001%	0.000%	0.000%
Brazil (x_2)	-0.004%	**-0.002%**	-0.001%	0.000%	-0.001%	-0.002%	0.000%	0.000%	-0.002%	0.000%	0.001%	-0.002%	-0.002%	-0.001%	-0.001%
China (x_3)	-0.002%	0.000%	**0.004%**	-0.001%	-0.001%	-0.001%	-0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	-0.001%	-0.001%	0.000%
Greece (x_4)	-0.002%	-0.001%	0.000%	**-0.001%**	-0.001%	0.002%	-0.001%	-0.001%	0.000%	-0.001%	-0.001%	-0.002%	-0.002%	-0.002%	-0.001%
India (x_5)	-0.002%	-0.001%	0.000%	-0.001%	**-0.002%**	-0.001%	-0.002%	0.000%	-0.001%	0.000%	-0.002%	-0.002%	-0.002%	-0.001%	0.000%
Indonesia (x_6)	-0.001%	-0.002%	0.000%	0.000%	-0.001%	**0.004%**	-0.002%	-0.001%	0.000%	0.000%	0.000%	-0.001%	-0.001%	-0.001%	0.000%
Malaysia (x_7)	-0.001%	-0.002%	0.000%	0.000%	-0.001%	0.000%	**0.004%**	-0.001%	-0.001%	0.000%	0.000%	-0.001%	-0.002%	0.000%	-0.001%
Mexico (x_8)	-0.001%	-0.001%	-0.001%	-0.001%	-0.001%	0.000%	0.000%	**0.002%**	-0.001%	0.000%	0.001%	-0.002%	-0.001%	0.000%	0.000%
Philippines (x_9)	0.000%	-0.002%	-0.001%	-0.001%	-0.002%	-0.001%	-0.001%	-0.001%	**0.001%**	0.000%	-0.001%	-0.001%	-0.002%	-0.001%	0.000%
Portugal (x_{10})	-0.001%	-0.001%	0.000%	-0.001%	0.000%	-0.001%	0.000%	0.000%	0.000%	**0.000%**	-0.001%	-0.001%	-0.001%	-0.001%	0.000%
Russia (x_{11})	0.000%	-0.001%	0.000%	-0.001%	-0.001%	0.000%	-0.001%	-0.001%	-0.001%	0.000%	**0.006%**	-0.002%	-0.001%	0.000%	0.001%
South Africa (x_{12})	-0.002%	-0.002%	0.000%	-0.002%	-0.001%	0.001%	-0.001%	-0.001%	0.000%	0.000%	0.000%	**-0.002%**	-0.001%	-0.001%	0.000%
South Korea (x_{13})	-0.001%	-0.002%	-0.001%	-0.002%	-0.002%	-0.001%	-0.001%	0.000%	-0.001%	-0.001%	-0.001%	-0.001%	**0.000%**	-0.002%	0.000%
Taiwan (x_{14})	-0.001%	-0.002%	0.001%	-0.002%	-0.002%	0.000%	0.000%	-0.002%	0.000%	0.000%	0.000%	-0.001%	-0.001%	**0.000%**	-0.001%
Thailand (x_{15})	0.000%	-0.001%	0.000%	-0.001%	-0.001%	0.001%	-0.001%	-0.001%	0.000%	0.000%	0.001%	0.000%	0.000%	-0.001%	**0.000%**

The coskewness (curvilinear) is determined by multiplying x_i by x_j^2 (for $i, j = 1,\ldots,15$)

There are 210 co-skewness values (curvilinear interactions) for weekly investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Here, There are 181 negative curvilinear interactions for the weekly investment horizon.

Table XI

Summary of coskewness (curvilinear) for *monthly* returns of emerging stock markets under *unhedged* strategy

	x_1^2	x_2^2	x_3^2	x_4^2	x_5^2	x_6^2	x_7^2	x_8^2	x_9^2	x_{10}^2	x_{11}^2	x_{12}^2	x_{13}^2	x_{14}^2	x_{15}^2
Argentina (x_1)	**0.026%**	0.052%	0.001%	0.009%	-0.009%	0.047%	0.028%	0.003%	0.000%	0.007%	-0.001%	-0.002%	0.010%	0.009%	0.013%
Brazil (x_2)	-0.018%	**0.073%**	-0.003%	0.008%	-0.001%	0.008%	0.022%	-0.002%	-0.018%	0.006%	0.045%	-0.004%	0.020%	0.015%	-0.009%
China (x_3)	-0.015%	0.000%	**0.083%**	0.004%	0.006%	-0.017%	0.026%	0.013%	0.004%	0.001%	-0.003%	0.008%	0.012%	0.002%	-0.001%
Greece (x_4)	-0.008%	0.009%	0.010%	**0.017%**	-0.004%	0.021%	0.026%	-0.014%	-0.005%	-0.001%	0.029%	0.000%	-0.001%	0.010%	0.001%
India (x_5)	-0.026%	-0.015%	0.008%	-0.004%	**-0.001%**	-0.001%	0.012%	-0.005%	-0.005%	0.002%	0.053%	-0.004%	-0.004%	0.007%	-0.003%
Indonesia (x_6)	0.003%	-0.022%	0.023%	-0.027%	-0.012%	**0.111%**	-0.002%	0.002%	-0.004%	0.002%	0.101%	-0.002%	0.014%	-0.030%	0.019%
Malaysia (x_7)	0.006%	0.020%	0.022%	0.012%	0.000%	0.049%	**0.057%**	0.007%	-0.006%	0.005%	0.047%	-0.001%	0.020%	0.017%	0.011%
Mexico (x_8)	-0.026%	-0.007%	0.002%	-0.008%	-0.008%	0.022%	0.005%	**0.016%**	0.001%	0.004%	0.024%	-0.002%	0.021%	-0.002%	0.010%
Philippines (x_9)	-0.044%	-0.015%	0.010%	-0.013%	-0.004%	0.011%	0.006%	0.003%	**-0.004%**	-0.001%	0.055%	-0.005%	0.016%	-0.001%	0.014%
Portugal (x_{10})	0.003%	0.015%	0.010%	0.005%	-0.001%	-0.011%	0.008%	-0.006%	-0.003%	**0.003%**	-0.038%	0.004%	-0.007%	0.002%	-0.008%
Russia (x_{11})	-0.006%	-0.019%	0.011%	-0.008%	0.000%	0.068%	0.001%	0.002%	-0.008%	0.007%	**0.338%**	-0.007%	0.026%	-0.005%	0.006%
South Africa (x_{12})	-0.021%	-0.007%	0.004%	-0.006%	-0.006%	0.004%	0.001%	-0.004%	-0.012%	0.002%	0.026%	**0.003%**	0.002%	-0.004%	-0.005%
South Korea (x_{13})	0.007%	0.017%	0.010%	-0.005%	-0.007%	0.030%	0.020%	0.008%	0.001%	0.003%	0.023%	-0.003%	**0.039%**	0.014%	0.008%
Taiwan (x_{14})	-0.010%	0.023%	0.015%	0.002%	0.002%	0.002%	0.032%	-0.002%	-0.006%	0.003%	0.053%	-0.002%	0.019%	**0.032%**	-0.002%
Thailand (x_{15})	0.017%	-0.001%	-0.015%	-0.009%	-0.006%	0.048%	0.017%	0.001%	0.001%	0.001%	0.049%	-0.006%	0.013%	0.001%	**0.021%**

The coskewness (curvilinear) is determined by multiplying x_i by x_j^2 (for i,j = 1,…,15)

There are 210 co-skewness values (curvilinear interactions) for monthly investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Here, there are 89 negative curvilinear interactions for the monthly investment horizon.

Table XII

Summary of coskewness (curvilinear) for *quarterly* returns of emerging stock markets under *unhedged* strategy

	x_1^2	x_2^2	x_3^2	x_4^2	x_5^2	x_6^2	x_7^2	x_8^2	x_9^2	x_{10}^2	x_{11}^2	x_{12}^2	x_{13}^2	x_{14}^2	x_{15}^2
Argentina (x_1)	**0.388%**	0.484%	0.087%	0.158%	0.143%	-0.016%	0.065%	-0.057%	-0.209%	0.082%	-0.002%	0.089%	0.078%	0.068%	0.127%
Brazil (x_2)	0.382%	**0.778%**	0.022%	-0.029%	0.146%	-0.407%	-0.168%	0.109%	-0.245%	0.026%	0.614%	0.074%	0.149%	0.344%	0.035%
China (x_3)	-0.342%	-0.508%	**0.758%**	-0.015%	0.000%	0.672%	0.306%	-0.078%	-0.088%	0.004%	0.233%	-0.002%	0.014%	-0.233%	0.114%
Greece (x_4)	0.049%	0.040%	0.072%	**0.367%**	0.245%	-0.056%	-0.020%	0.034%	0.018%	0.033%	-0.174%	0.033%	0.050%	-0.019%	0.086%
India (x_5)	0.031%	0.186%	0.115%	0.225%	**0.262%**	0.438%	0.146%	-0.013%	-0.033%	0.050%	0.741%	0.038%	0.158%	0.063%	0.143%
Indonesia (x_6)	0.125%	-0.186%	0.227%	-0.143%	0.057%	**2.921%**	1.104%	-0.057%	0.149%	0.030%	3.428%	0.014%	0.662%	-0.085%	0.354%
Malaysia (x_7)	-0.095%	-0.139%	0.207%	0.009%	0.031%	1.789%	**0.763%**	0.100%	0.076%	0.032%	2.149%	0.010%	0.440%	0.076%	0.205%
Mexico (x_8)	-0.106%	0.028%	-0.026%	-0.037%	-0.030%	0.257%	0.126%	**0.394%**	-0.132%	0.026%	0.683%	0.016%	0.119%	0.070%	0.049%
Philippines (x_9)	-0.251%	-0.224%	0.022%	-0.130%	-0.025%	0.835%	0.321%	0.037%	**-0.123%**	-0.003%	0.947%	-0.029%	0.325%	0.084%	0.096%
Portugal (x_{10})	0.210%	0.129%	-0.004%	0.110%	0.099%	-0.450%	-0.199%	-0.117%	-0.040%	**0.011%**	-0.469%	0.039%	-0.118%	-0.045%	0.019%
Russia (x_{11})	-0.308%	0.412%	0.041%	-0.345%	-0.078%	2.892%	1.196%	0.158%	0.076%	-0.018%	**5.240%**	0.001%	0.972%	0.419%	0.203%
South Africa (x_{12})	0.151%	0.085%	0.016%	0.065%	0.065%	0.238%	0.083%	0.046%	-0.047%	0.028%	0.382%	**0.039%**	0.057%	-0.061%	0.057%
South Korea (x_{13})	0.042%	0.313%	0.037%	-0.092%	0.037%	1.396%	0.552%	0.118%	0.055%	0.021%	2.093%	0.017%	**0.573%**	0.321%	0.185%
Taiwan (x_{14})	0.123%	0.544%	0.092%	-0.054%	0.081%	0.483%	0.223%	0.139%	-0.026%	-0.004%	1.253%	0.032%	0.395%	**0.426%**	0.047%
Thailand (x_{15})	0.158%	0.161%	-0.101%	-0.063%	0.090%	0.988%	0.357%	0.000%	0.020%	0.048%	1.202%	0.003%	0.295%	0.040%	**0.235%**

The coskewness (curvilinear) is determined by multiplying x_i by x_j^2 (for $i, j = 1,\ldots,15$)

There are 210 co-skewness values (curvilinear interactions) for each investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Here, there are 60 negative curvilinear interactions for the quarterly investment horizon.

Table XIII

Summary of coskewness (curvilinear) for *weekly* returns of emerging stock markets under *hedged* strategy

	x_1^2	x_2^2	x_3^2	x_4^2	x_5^2	x_6^2	x_7^2	x_8^2	x_9^2	x_{10}^2	x_{11}^2	x_{12}^2	x_{13}^2	x_{14}^2	x_{15}^2
Argentina (x_1)	**0.011%**	0.001%	0.001%	0.000%	-0.002%	0.001%	0.000%	0.000%	-0.001%	0.000%	0.000%	-0.001%	-0.001%	0.000%	0.000%
Brazil (x_2)	-0.002%	**0.002%**	-0.001%	0.000%	-0.001%	-0.001%	0.000%	0.000%	-0.001%	0.000%	0.001%	-0.001%	-0.001%	0.000%	-0.001%
China (x_3)	-0.002%	0.000%	**0.004%**	0.000%	0.000%	0.000%	-0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	-0.001%	0.000%
Greece (x_4)	-0.002%	0.000%	0.000%	**-0.001%**	-0.001%	0.000%	0.000%	0.000%	0.000%	-0.001%	-0.001%	-0.001%	-0.002%	-0.002%	-0.001%
India (x_5)	-0.002%	-0.001%	0.000%	-0.001%	**-0.001%**	0.000%	-0.001%	0.000%	0.000%	-0.001%	-0.001%	-0.001%	-0.001%	-0.001%	0.000%
Indonesia (x_6)	0.000%	0.000%	0.000%	0.000%	-0.001%	**0.003%**	-0.001%	-0.001%	0.000%	0.000%	0.000%	0.000%	-0.001%	0.000%	0.000%
Malaysia (x_7)	-0.001%	-0.001%	0.000%	0.000%	-0.001%	0.000%	**0.001%**	-0.001%	0.000%	0.000%	0.000%	-0.001%	-0.002%	0.000%	-0.001%
Mexico (x_8)	-0.001%	0.000%	0.000%	-0.001%	-0.001%	0.000%	0.000%	**0.001%**	0.000%	0.000%	0.000%	-0.001%	-0.001%	0.000%	0.000%
Philippines (x_9)	0.001%	-0.001%	0.000%	-0.001%	-0.001%	0.000%	-0.001%	-0.001%	**0.001%**	0.000%	-0.001%	-0.001%	-0.001%	-0.001%	0.000%
Portugal (x_{10})	0.000%	-0.001%	0.000%	-0.001%	-0.001%	-0.001%	0.000%	0.000%	0.000%	**0.000%**	-0.001%	0.000%	-0.001%	-0.001%	-0.001%
Russia (x_{11})	0.000%	0.000%	0.000%	-0.001%	-0.001%	0.000%	0.000%	-0.001%	0.000%	0.000%	**0.006%**	-0.001%	-0.001%	0.001%	0.001%
South Africa (x_{12})	-0.002%	0.000%	0.000%	-0.001%	-0.001%	0.001%	0.000%	-0.001%	0.000%	0.000%	0.000%	**0.000%**	-0.001%	-0.001%	0.000%
South Korea (x_{13})	-0.001%	0.000%	-0.001%	-0.002%	-0.002%	0.001%	-0.001%	0.000%	0.000%	-0.001%	-0.001%	-0.001%	**0.000%**	-0.001%	0.000%
Taiwan (x_{14})	-0.001%	-0.001%	0.001%	-0.002%	-0.002%	0.001%	0.000%	-0.001%	0.000%	0.000%	0.001%	-0.001%	-0.001%	**0.000%**	-0.001%
Thailand (x_{15})	-0.001%	-0.001%	0.000%	-0.001%	-0.001%	0.001%	-0.001%	0.000%	0.000%	0.000%	0.001%	0.000%	0.000%	-0.001%	**0.000%**

The coskewness (curvilinear) is determined by multiplying x_i by x_j^2 (for $i, j = 1,\ldots,15$)

There are 210 co-skewness values (curvilinear interactions) for weekly investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Here, There are 172 negative curvilinear interactions for the weekly investment horizon.

Table XIV

Summary of coskewness (curvilinear) for *monthly* returns of emerging stock markets under *hedged* strategy

	x_1^2	x_2^2	x_3^2	x_4^2	x_5^2	x_6^2	x_7^2	x_8^2	x_9^2	x_{10}^2	x_{11}^2	x_{12}^2	x_{13}^2	x_{14}^2	x_{15}^2
Argentina (x_1)	**0.068%**	0.016%	0.000%	0.007%	-0.010%	0.033%	0.015%	-0.001%	0.001%	0.007%	0.000%	0.006%	0.007%	0.008%	0.014%
Brazil (x_2)	-0.015%	**0.038%**	-0.004%	0.012%	0.001%	0.006%	0.005%	0.001%	-0.010%	0.005%	0.030%	0.004%	0.021%	0.011%	0.001%
China (x_3)	-0.016%	0.003%	**0.082%**	0.005%	0.004%	-0.003%	0.010%	0.009%	0.009%	0.001%	-0.003%	0.004%	0.011%	0.002%	-0.001%
Greece (x_4)	-0.011%	0.015%	0.010%	**0.018%**	-0.003%	0.005%	0.011%	-0.010%	-0.010%	-0.002%	0.028%	0.002%	-0.001%	0.011%	0.002%
India (x_5)	-0.014%	0.000%	0.005%	-0.003%	**0.002%**	0.008%	0.010%	-0.003%	-0.005%	0.004%	0.056%	0.007%	0.000%	0.010%	-0.002%
Indonesia (x_6)	0.006%	-0.002%	0.013%	-0.009%	-0.006%	**0.058%**	0.001%	0.003%	0.000%	0.000%	0.061%	0.003%	0.001%	-0.015%	0.019%
Malaysia (x_7)	0.014%	0.003%	0.016%	0.005%	0.001%	0.026%	**0.016%**	0.003%	0.000%	0.008%	0.052%	0.003%	0.017%	0.011%	0.011%
Mexico (x_8)	-0.010%	0.001%	0.002%	-0.008%	-0.006%	0.013%	0.002%	**0.012%**	0.003%	0.004%	0.014%	0.008%	0.018%	0.001%	0.009%
Philippines (x_9)	-0.009%	-0.007%	0.008%	-0.012%	-0.007%	0.020%	0.002%	-0.002%	**-0.002%**	-0.003%	0.053%	0.004%	0.014%	0.000%	0.012%
Portugal (x_{10})	-0.013%	0.010%	0.012%	0.004%	0.002%	-0.008%	0.006%	0.000%	-0.001%	**0.007%**	-0.037%	0.003%	-0.003%	0.003%	-0.006%
Russia (x_{11})	0.007%	-0.007%	0.010%	-0.008%	0.004%	0.047%	0.006%	0.002%	0.003%	0.006%	**0.337%**	0.007%	0.029%	-0.003%	0.006%
South Africa (x_{12})	-0.012%	0.002%	0.007%	-0.004%	0.006%	0.006%	0.003%	0.006%	-0.002%	0.000%	0.027%	**0.007%**	0.011%	0.009%	0.004%
South Korea (x_{13})	0.003%	0.010%	0.011%	-0.005%	-0.004%	0.020%	0.009%	0.005%	0.002%	0.002%	0.031%	0.004%	**0.039%**	0.018%	0.010%
Taiwan (x_{14})	-0.003%	0.016%	0.015%	0.002%	0.004%	0.004%	0.011%	0.001%	-0.002%	0.006%	0.044%	0.007%	0.022%	**0.032%**	-0.002%
Thailand (x_{15})	0.022%	-0.005%	-0.015%	-0.009%	-0.005%	0.038%	0.007%	-0.003%	0.002%	-0.001%	0.049%	0.002%	0.014%	0.002%	**0.022%**

The coskewness (curvilinear) is determined by multiplying x_i by x_j^2 (for $i, j = 1,\ldots,15$)

There are 210 co-skewness values (curvilinear interactions) for monthly investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Here, there are 62 negative curvilinear interactions for the monthly investment horizon.

Table XV

Summary of coskewness (curvilinear) for *quarterly* returns of emerging stock markets under *hedged* strategy

	x_1^2	x_2^2	x_3^2	x_4^2	x_5^2	x_6^2	x_7^2	x_8^2	x_9^2	x_{10}^2	x_{11}^2	x_{12}^2	x_{13}^2	x_{14}^2	x_{15}^2
Argentina (x_1)	**0.457%**	0.415%	0.031%	0.157%	0.174%	-0.005%	0.029%	-0.016%	-0.031%	0.006%	0.112%	0.051%	0.207%	0.319%	0.117%
Brazil (x_2)	0.368%	**0.823%**	-0.045%	0.033%	0.133%	-0.203%	-0.087%	0.341%	-0.077%	-0.017%	0.446%	0.071%	0.115%	0.296%	0.041%
China (x_3)	-0.304%	-0.202%	**0.716%**	-0.006%	0.004%	0.288%	0.190%	-0.045%	-0.013%	0.003%	0.230%	-0.024%	0.007%	-0.232%	0.110%
Greece (x_4)	0.166%	0.134%	0.067%	**0.382%**	0.254%	-0.062%	-0.027%	0.025%	0.005%	-0.003%	-0.196%	0.037%	0.053%	0.035%	0.079%
India (x_5)	0.155%	0.209%	0.074%	0.236%	**0.282%**	0.221%	0.105%	-0.005%	0.010%	0.005%	0.790%	0.045%	0.177%	0.103%	0.142%
Indonesia (x_6)	-0.116%	-0.093%	0.147%	-0.020%	0.090%	**0.971%**	0.478%	-0.028%	0.042%	-0.027%	2.220%	0.004%	0.371%	-0.090%	0.253%
Malaysia (x_7)	-0.004%	-0.042%	0.159%	-0.058%	0.028%	0.715%	**0.416%**	0.008%	0.060%	0.002%	1.784%	0.014%	0.351%	0.089%	0.174%
Mexico (x_8)	-0.018%	0.425%	-0.034%	-0.036%	-0.016%	0.044%	0.039%	**0.367%**	-0.053%	-0.019%	0.549%	0.042%	0.063%	0.069%	0.025%
Philippines (x_9)	-0.079%	-0.019%	0.066%	-0.078%	0.025%	0.304%	0.143%	-0.009%	**-0.013%**	-0.035%	0.610%	0.027%	0.206%	0.053%	0.113%
Portugal (x_{10})	0.095%	0.054%	-0.050%	0.069%	0.065%	-0.162%	-0.073%	-0.032%	-0.026%	**0.002%**	-0.158%	0.007%	-0.032%	0.017%	-0.006%
Russia (x_{11})	-0.065%	0.281%	0.042%	-0.347%	-0.024%	1.348%	0.788%	0.164%	0.056%	-0.018%	**5.223%**	0.083%	0.872%	0.436%	0.205%
South Africa (x_{12})	0.041%	0.166%	-0.027%	0.059%	0.092%	0.063%	0.044%	0.112%	-0.017%	-0.022%	0.470%	**0.045%**	0.151%	0.132%	0.042%
South Korea (x_{13})	0.151%	0.275%	0.013%	-0.080%	0.079%	0.626%	0.343%	0.125%	0.038%	-0.023%	1.910%	0.063%	**0.519%**	0.363%	0.190%
Taiwan (x_{14})	0.308%	0.466%	0.065%	-0.056%	0.089%	0.147%	0.128%	0.153%	-0.006%	-0.010%	1.122%	0.076%	0.388%	**0.517%**	0.040%
Thailand (x_{15})	0.116%	0.122%	-0.103%	-0.067%	0.095%	0.503%	0.235%	-0.014%	0.043%	-0.005%	1.188%	0.013%	0.258%	0.043%	**0.236%**

The coskewness (curvilinear) is determined by multiplying x_i by x_j^2 (for $i, j = 1,\ldots,15$)

There are 210 co-skewness values (curvilinear interactions) for each investment horizon. Their sizes and signs are varied because of the degree of curvilinear relationship between the two markets. Here, there are 65 negative curvilinear interactions for the quarterly investment horizon.

Table XVI

Coefficient of variation rankings of emerging stock markets under *unhedged* strategy

Country	Mean Return			Variance			CV [a]			Rank of CV [b]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	0.002	0.010	0.034	0.024	0.053	0.200	10.625	5.156	5.966	3	4	4
Brazil	0.005	0.024	0.076	0.024	0.057	0.225	4.405	2.357	2.956	8	9	10
China	0.004	0.017	0.059	0.015	0.037	0.167	3.743	2.172	2.836	10	11	11
Greece	0.002	0.007	0.023	0.015	0.039	0.142	8.128	5.515	6.227	4	3	3
India	0.005	0.022	0.064	0.017	0.044	0.148	3.144	1.991	2.309	14	13	12
Indonesia	0.005	0.020	0.063	0.019	0.049	0.218	3.882	2.407	3.429	9	8	7
Malaysia	0.003	0.015	0.043	0.012	0.033	0.132	3.444	2.211	3.073	12	10	9
Mexico	0.005	0.022	0.068	0.016	0.042	0.141	3.396	1.913	2.074	13	14	14
Philippines	0.001	0.005	0.017	0.015	0.036	0.127	11.526	6.882	7.314	2	2	2
Portugal	0.002	0.007	0.021	0.010	0.023	0.091	6.147	3.242	4.398	6	6	6
Russia	0.009	0.041	0.134	0.023	0.054	0.280	2.485	1.322	2.088	15	15	13
South Africa	0.004	0.016	0.049	0.014	0.035	0.093	3.652	2.149	1.918	11	12	15
South Korea	0.004	0.015	0.052	0.020	0.048	0.171	4.911	3.098	3.260	7	7	8
Taiwan	0.001	0.005	0.021	0.016	0.039	0.156	13.634	7.493	7.593	1	1	1
Thailand	0.002	0.009	0.028	0.015	0.035	0.132	6.466	3.856	4.621	5	5	5

[a] CV represents the coefficient of variation = (σ / μ)

[b] From the column ranking of CV, Taiwan ranks at the top of the list for all three investment horizons, which implies that Taiwan market offers the lowest risk per a unit of return. On the other hands, Russia ranks at the bottom for the weekly and the monthly unhedged rates of return. Also, South Africa ranks at the bottom for the quarterly unhedged rates of return.

Table XVII

Coefficient of variation rankings of emerging stock markets under *hedged* strategy

Country	Mean Return			Variance			CV [a]			Rank of CV [b]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	0.005	0.020	0.060	0.052	0.101	0.170	11.430	5.064	2.855	8	8	8
Brazil	0.006	0.027	0.086	0.042	0.083	0.169	6.907	3.133	1.979	13	12	13
China	0.004	0.017	0.059	0.037	0.081	0.164	9.292	4.864	2.799	9	9	9
Greece	0.002	0.008	0.025	0.039	0.072	0.142	18.616	9.487	5.659	2	2	2
India	0.005	0.022	0.064	0.042	0.077	0.139	7.643	3.539	2.162	10	10	11
Indonesia	0.005	0.022	0.068	0.037	0.073	0.158	7.055	3.393	2.333	11	11	10
Malaysia	0.003	0.010	0.031	0.030	0.062	0.114	11.642	5.900	3.685	7	6	6
Mexico	0.005	0.023	0.072	0.036	0.068	0.122	6.960	2.975	1.684	12	14	14
Philippines	0.002	0.007	0.023	0.033	0.069	0.110	17.912	9.287	4.758	3	3	4
Portugal	0.001	0.005	0.017	0.022	0.047	0.082	16.335	8.729	4.935	4	4	3
Russia	0.009	0.041	0.136	0.053	0.123	0.280	5.757	2.996	2.053	15	13	12
South Africa	0.004	0.017	0.054	0.029	0.049	0.083	6.807	2.866	1.555	14	15	15
South Korea	0.004	0.014	0.048	0.045	0.077	0.160	12.047	5.611	3.358	6	7	7
Taiwan	0.001	0.006	0.023	0.038	0.076	0.150	26.275	12.834	6.407	1	1	1
Thailand	0.003	0.010	0.031	0.035	0.074	0.131	13.639	7.761	4.265	5	5	5

[a] CV represents the coefficient of variation = (σ / μ)

[b] From the column ranking of CV, Taiwan ranks at the top of the list for all three investment horizons, which implies that Taiwan market offers the lowest risk per a unit of return. On the other hands, Russia ranks at the bottom for the weekly hedged rates of return. Also, South Africa ranks at the bottom for the monthly and the quarterly hedged rates of return.

Table XVIII

The optimal portfolio selection under *unhedged* strategy allowing *no short sales*

Country	$p_1 = 1, p_3 = 0$ [a]			$p_1 = 1, p_3 = 1$ [b]			$p_1 = 1, p_3 = 2$ [b]			$p_1 = 2, p_3 = 1$ [b]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	-	-	-	1.098	1.205	0.000	10.826	1.205	0.000	10.826	1.205	0.000
Brazil	-	-	-	19.661	2.510	9.968	2.884	2.510	9.968	2.884	2.510	9.968
China	29.224	24.092	17.448	-	6.977	17.914	-	6.977	17.914	-	6.977	17.914
Greece	-	-	-	-	1.712	1.856	-	1.712	1.856	-	1.712	1.856
India	15.037	10.940	1.090	-	-	8.620	-	-	8.620	-	-	8.620
Indonesia	6.913	-	-	-	0.487	1.764	-	0.487	1.764	-	0.487	1.764
Malaysia	14.850	2.382	-	-	1.421	1.447	-	1.421	1.447	-	1.421	1.447
Mexico	5.817	14.837	15.405	-	-	11.559	-	-	11.559	-	-	11.559
Philippines	-	-	-	0.235	2.047	0.038	-	2.047	0.038	-	2.047	0.038
Portugal	1.116	19.239	26.287	0.009	0.174	9.137	-	0.174	9.137	-	0.174	9.137
Russia	27.043	23.493	13.413	78.685	77.678	17.912	86.291	77.678	17.912	86.291	77.678	17.912
South Africa	-	5.017	26.359	-	0.981	13.599	-	0.981	13.599	-	0.981	13.599
South Korea	-	-	-	-	0.740	-	-	0.740	-	-	0.740	-
Taiwan	-	-	-	0.311	2.246	0.045	-	2.246	0.045	-	2.246	0.045
Thailand	-	-	-	-	1.821	6.141	-	1.821	6.141	-	1.821	6.141
X (%)	100	100	100	100	100	100	100	100	100	100	100	100
Expected return	0.006	0.022	0.058	0.008	0.035	0.068	0.008	0.035	0.068	0.008	0.035	0.068
Skewness [c]	-	-	-	0.052	0.561	0.017	0.040	0.561	0.017	0.040	0.561	0.017

[a] This combination represents the mean-variance efficient portfolio.

[b] This combination represents the mean-variance-skewness efficient portfolio.

[c] Skewness represents the third central co-moments of the optimal portfolio returns.

[d] The results show that Russia is the only one that most weights allocated to for both mean-variance and mean-variance-skewness portfolios for every investment horizons. Similar evidence can be found with China as it is allocated in both portfolio types for each investment horizons except that of weekly mean-variance-skewness portfolios.

Table XIX

The optimal portfolio selection under *hedged* strategy allowing *no short sales*

Country	$p_1 = 1, p_3 = 0$ [a]			$p_1 = 1, p_3 = 1$ [b]			$p_1 = 1, p_3 = 2$ [b]			$p_1 = 2, p_3 = 1$ [b]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	0.751	1.942	2.753	0.000	6.236	0.835	0.000	3.236	0.835	0.000	3.236	0.835
Brazil	9.849	15.388	1.548	-	3.718	22.660	0.000	7.718	22.660	-	7.718	22.660
China	25.478	19.750	18.765	-	-	19.144	-	-	19.144	-	-	19.144
Greece	-	-	-	-	-	6.799	-	-	6.799	-	-	6.799
India	9.170	1.655	7.806	-	-	0.149	0.000	-	0.149	-	-	0.149
Indonesia	18.452	13.324	0.330	-	2.633	0.261	-	2.443	0.261	-	2.443	0.261
Malaysia	0.331	-	-	-	2.185	-	-	0.185	-	-	0.185	-
Mexico	7.282	9.152	19.661	-	-	4.907	-	-	4.907	-	-	4.907
Philippines	-	-	-	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	0.000	-	3.123	-	-	3.123	0.000	-	3.123
Russia	20.538	12.820	6.997	87.302	75.130	18.107	87.302	74.320	18.107	87.302	74.320	18.107
South Africa	8.149	25.970	42.140	-	0.000	17.462	-	0.000	17.462	-	0.000	17.462
South Korea	-	-	-	10.419	1.888	5.965	10.419	3.888	5.965	10.419	3.888	5.965
Taiwan	-	-	-	2.279	5.577	0.586	2.279	5.577	0.586	2.279	5.577	0.586
Thailand	-	-	-	-	2.633	-	-	2.633	-	-	2.633	-
X (%)	100	100	100	100	100	100	100	100	100	100	100	100
Expected return	0.006	0.023	0.065	0.009	0.037	0.074	0.009	0.037	0.074	0.009	0.037	0.074
Skewness [c]	-	-	-	0.045	0.505	0.027	0.045	0.521	0.027	0.045	0.521	0.027

[a] This combination represents the mean-variance efficient portfolio.

[b] This combination represents the mean-variance-skewness efficient portfolio.

[c] Skewness represents the third central co-moments of the optimal portfolio returns.

Table XX

The optimal portfolio selection under *unhedged* strategy *allowing short sales*

Country	$p_1 = 1, p_3 = 0$ [a]			$p_1 = 1, p_3 = 1$ [b]			$p_1 = 1, p_3 = 2$ [b]			$p_1 = 2, p_3 = 1$ [b]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	-7.59	-5.73	-5.33	-3.941	-11.443	-5.568	-4.319	-12.056	-5.519	-3.936	-11.407	-5.530
Brazil	-1.00	5.55	-7.23	12.123	17.556	-57.775	12.399	19.741	-57.779	12.119	17.407	-57.778
China	34.55	29.57	15.68	48.457	130.112	9.512	49.174	130.336	9.258	48.447	130.053	9.311
Greece	-0.83	-10.84	-7.10	60.703	15.536	-32.406	60.548	11.387	-32.316	60.705	15.812	-32.335
India	23.61	25.17	25.90	13.559	-8.476	6.241	14.559	-2.238	5.842	13.545	-8.887	5.925
Indonesia	11.39	-12.32	-8.85	25.825	-12.284	-9.204	26.183	-12.042	-9.436	25.820	-12.312	-9.388
Malaysia	27.19	28.20	-3.69	0.488	-26.813	-0.543	1.174	-23.238	-0.115	0.479	-27.034	-0.205
Mexico	15.86	23.82	51.83	63.391	17.687	-9.638	63.960	19.540	-10.173	63.383	17.590	-10.061
Philippines	-15.97	-16.19	-20.84	33.569	-36.047	-1.937	32.462	-40.309	-1.319	33.585	-35.805	-1.448
Portugal	3.95	29.39	71.30	127.323	-15.659	14.243	125.600	-19.718	14.366	127.347	-15.374	14.340
Russia	33.20	29.97	32.55	40.530	4.271	-14.824	41.699	7.977	-15.055	40.514	4.045	-15.006
South Africa	0.12	9.00	15.01	-407.143	-17.075	66.882	-407.129	-13.779	66.896	-407.143	-17.304	66.893
South Korea	5.21	8.30	-0.39	41.424	-33.776	-42.906	41.646	-31.896	-42.720	41.421	-33.902	-42.759
Taiwan	-25.75	-60.09	-58.47	22.508	-27.631	133.064	21.442	-31.819	133.062	22.522	-27.364	133.063
Thailand	-3.96	16.22	-0.37	21.183	104.041	44.861	20.602	98.112	45.009	21.191	104.481	44.978
X (%)	100	100	100	100	100	100	100	100	100	100	100	100
Expected return	0.007	0.032	0.095	0.042	0.085	0.236	0.041	0.081	0.236	0.042	0.085	0.236
Skewness [c]	-	-	-	45.197	2.790	16.480	45.204	2.821	16.480	45.197	2.790	16.480

[a] This combination represents the mean-variance efficient portfolio.

[b] This combination represents the mean-variance-skewness efficient portfolio.

[c] Skewness represents the third central co-moments of the optimal portfolio returns.

[d] China is still the dominant component in each portfolio approaches and preferences. Additionally, Greece which is hardly allocated into when short sales prohibited is now one of the dominant components in the weekly and monthly mean-variance-skewness portfolio.

Table XXI

The optimal portfolio selection under *hedged* strategy *allowing short sales*

Country	$p_1 = 1, p_3 = 0$ [a]			$p_1 = 1, p_3 = 1$ [b]			$p_1 = 1, p_3 = 2$ [b]			$p_1 = 2, p_3 = 1$ [b]		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Argentina	2.44	10.91	35.63	1.120	0.915	-10.071	1.159	1.501	-8.839	1.120	0.895	-10.132
Brazil	17.12	30.72	1.15	-2.096	-49.644	59.595	-1.319	-47.595	60.604	-2.107	-49.714	59.543
China	31.35	27.67	19.10	53.876	-12.095	-15.656	54.547	-11.554	-15.372	53.866	-12.113	-15.670
Greece	-3.61	-13.65	-9.83	48.973	-5.073	16.486	48.743	-7.649	16.074	48.977	-4.982	16.505
India	20.39	11.19	1.31	9.538	-34.356	-27.791	10.457	-32.728	-27.280	9.525	-34.413	-27.815
Indonesia	28.02	6.62	28.75	50.397	-11.141	-41.082	51.416	-10.400	-39.930	50.382	-11.166	-41.138
Malaysia	12.25	19.79	-14.42	24.439	-55.441	172.934	24.605	-56.011	172.726	24.437	-55.421	172.938
Mexico	16.17	11.23	43.40	58.129	-16.185	-39.281	58.963	-16.082	-38.299	58.116	-16.188	-39.328
Philippines	-17.21	-34.14	-35.62	57.941	63.071	29.622	57.006	60.860	28.555	57.955	63.147	29.673
Portugal	-24.40	-5.91	16.00	139.959	280.688	-1.270	137.151	280.550	-2.630	140.001	280.687	-1.201
Russia	25.73	14.43	17.04	30.366	32.110	-16.048	31.401	33.820	-15.271	30.351	32.050	-16.086
South Africa	25.78	64.00	68.79	-458.139	-83.701	37.875	-458.141	-82.309	38.895	-458.139	-83.747	37.825
South Korea	-7.12	-6.68	-23.10	45.411	8.610	-22.779	45.345	8.203	-23.299	45.412	8.623	-22.753
Taiwan	-21.04	-51.79	-55.81	28.476	-45.204	-30.051	27.652	-47.668	-32.249	28.488	-45.116	-29.941
Thailand	-5.88	15.63	7.60	11.609	27.446	-12.482	11.015	27.063	-13.684	11.617	27.459	-12.421
X (%)	100	100	100	100	100	100	100	100	100	100	100	100
Expected return	0.008	0.034	0.111	0.048	0.136	0.221	0.048	0.135	0.218	0.048	0.137	0.221
Skewness [c]	-	-	-	42.525	11.565	12.654	42.532	11.585	12.685	42.525	11.565	12.654

[a] This combination represents the mean-variance efficient portfolio.

[b] This combination represents the mean-variance-skewness efficient portfolio.

[c] Skewness represents the third central co-moments of the optimal portfolio returns.

Table XXII

Summary statistics of 2-moment portfolios

	Mean			Variance			Covariance*		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
Unhedge - No short	0.560	2.182	5.767	0.065	0.244	0.597	0.053	0.053	-0.122
Hedge - No short	0.577	2.283	6.550	0.058	0.208	0.647	0.051	0.066	0.068
Unhedge - Short	0.738	3.185	9.469	0.098	0.337	0.782	0.053	0.027	-0.140
Hedge - Short	0.820	3.400	11.086	0.103	0.283	0.969	0.055	0.044	-0.248

* Covariance represents co-moments between the portfolios and emerging stock market index

** Mean returns, variance and covariance are indicated in percent per holding period

Table XXIII

Summary of co-moments between 3-moment portfolios and emerging stock market index

	Mean			Variance			Covariance*			Coskewness*		
	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter	Week	Month	Quarter
No short sale												
Unhedge (1,1)	0.823	3.453	6.799	0.230	1.009	1.029	0.088	-0.021	-0.162	-0.002	0.001	-0.091
Hedge (1,1)	0.853	3.479	7.416	0.235	0.991	1.029	0.082	0.027	0.058	-0.001	-0.001	-0.066
Unhedge (1,2)	0.823	3.453	6.799	0.238	1.009	1.029	0.080	-0.021	-0.162	-0.002	0.001	-0.091
Hedge (1,2)	0.853	3.548	7.416	0.235	1.009	1.029	0.082	0.034	0.058	-0.001	-0.001	-0.066
Unhedge (2,1)	0.823	3.453	6.799	0.238	1.009	1.029	0.080	-0.021	-0.162	-0.002	0.001	-0.091
Hedge (2,1)	0.853	3.548	7.416	0.235	1.009	1.029	0.082	0.034	0.058	-0.001	-0.001	-0.066
Short sale allowed												
Unhedge (1,1)	0.154	2.069	-2.341	1.002	1.009	1.029	-0.015	0.030	-0.084	0.001	0.000	-0.032
Hedge (1,1)	-0.120	-1.514	0.285	1.002	1.009	1.029	0.025	0.060	0.130	0.002	-0.003	0.028
Unhedge (1,2)	0.174	2.430	-2.414	1.002	1.009	1.029	-0.014	0.032	-0.083	0.001	0.000	-0.032
Hedge (1,2)	-0.097	-1.358	0.627	1.002	1.009	1.029	0.026	0.061	0.122	0.002	-0.003	0.029
Unhedge (2,1)	0.154	2.045	-2.398	1.002	1.009	1.029	-0.015	0.030	-0.083	0.001	0.000	-0.032
Hedge (2,1)	-0.121	-1.520	0.269	1.002	1.009	1.029	0.025	0.060	0.131	0.002	-0.003	0.028

* Covariance and coskewness represent co-moments between the portfolios and emerging stock market index

** Mean returns, variance, covariance and coskewness are indicated in percent per holding period

Table XXIV

No short sales: OLS Regression Results

$R_{jt} = \theta_1 + \theta_2 Z_{j2t} + \theta_3 Z_{j3t} + \varepsilon_{jt}$

	θ_1			θ_2			θ_3		
	Week[1]	Month[2]	Quarter[3]	Week[1]	Month[2]	Quarter[3]	Week[1]	Month[2]	Quarter[3]
Unhedge (1,1)	0.0078	0.0328	0.0881	2.5553	-2.3690	-0.8709	110.9233	137.5512	23.6907
	(3.6600)	(3.9302)	(6.7109)	(2.3865)	(-1.2541)	(-0.9569)	(11.2956)	(6.2819)	(5.5265)
Hedge (1,1)	0.0083	0.0364	0.0922	2.3485	0.6102	-0.8238	120.6509	141.7091	26.6319
	(3.9416)	(4.3265)	(6.8651)	(2.1987)	(0.3039)	(-0.7807)	(11.5953)	(5.9365)	(5.0677)
Unhedge (1,2)	0.0079	0.0328	0.0881	2.6485	-2.3690	-0.8709	113.5273	137.5512	23.6907
	(3.6466)	(3.9302)	(6.7109)	(2.3486)	(-1.2541)	(0.9102)	(10.7662)	(6.2819)	(5.5265)
Hedge (1,2)	0.0083	0.0370	0.0922	2.3486	0.5441	-0.8238	120.6405	141.4215	26.6311
	(3.9413)	(4.3659)	(6.8651)	(2.1988)	(0.2746)	(1.0551)	(11.5948)	(6.0175)	(5.0677)
Unhedge (2,1)	0.0079	0.0328	0.0881	2.6485	-2.3690	-0.8709	113.5273	137.5512	23.6907
	(3.6466)	(3.9302)	(6.7109)	(2.3486)	(-1.2541)	(0.9102)	(10.7662)	(6.2819)	(5.5265)
Hedge (2,1)	0.0083	0.0370	0.0922	2.3486	0.5441	-0.8238	120.6407	141.4215	26.6311
	(3.9413)	(4.3659)	(6.8651)	(2.1988)	(0.2746)	(1.0551)	(11.5948)	(6.0175)	(5.0677)

[1] Regression of 467 observations

[2] Regression of 107 observations

[3] Regression of 35 observations

[4] The numbers in the parentheses are the values of t-statistics for the regression coefficients

[5] The estimated coefficients for the third moment (Z_{j3}) are statistically significant at the 1 percent level of significance for each portfolios in all investment horizons. Also, the skewness coefficients are positive values, thus to evaluate the performance of the emerging stock portfolios, an equilibrium pricing model including the higher moments seems to be more appropriate.

Table XXV

Short sales allowed: OLS Regression Results

$R_{jt} = \theta_1 + \theta_2 Z_{j2t} + \theta_3 Z_{j3t} + \varepsilon_{jt}$

	θ_1			θ_2			θ_3		
	Week[1]	Month[2]	Quarter[3]	Week[1]	Month[2]	Quarter[3]	Week[1]	Month[2]	Quarter[3]
Unhedge (1,1)	-0.0010	0.0207	-0.0153	1.2160	0.6091	0.5749	185.6505	82.2433	24.1508
	(-0.2466)	(2.6078)	(-1.0710)	(0.9297)	(0.4760)	(0.4310)	(10.5678)	(7.0294)	(3.8166)
Hedge (1,1)	-0.0040	-0.0124	-0.0075	0.8044	-0.6476	0.7878	147.2108	80.4366	33.2310
	(-0.9397)	(-1.5431)	(-0.5556)	(0.6328)	(-0.5019)	(0.6042)	(9.6553)	(7.0546)	(4.6092)
Unhedge (1,2)	-0.0008	0.0244	-0.0160	1.1952	0.8956	0.5814	186.5637	79.6916	24.1406
	(-0.1968)	(3.0394)	(-1.1214)	(0.9145)	(0.6860)	(0.4336)	(10.5965)	(6.7599)	(3.7984)
Hedge (1,2)	-0.0037	-0.0109	-0.0044	0.7873	-0.5298	0.8344	147.8370	79.0178	33.5878
	(-0.8814)	(-1.3533)	(-0.3237)	(0.6203)	(-0.4165)	(0.6353)	(9.6889)	(7.0800)	(4.6117)
Unhedge (2,1)	-0.0010	0.0204	-0.0159	1.2163	0.5903	0.5800	185.6382	82.4296	24.1427
	(-0.2473)	(2.5795)	(-1.1109)	(0.9299)	(0.4619)	(0.4331)	(10.5674)	(7.0484)	(3.8022)
Hedge (2,1)	-0.0040	-0.0125	-0.0077	0.8047	-0.6517	0.7855	147.2016	80.4875	33.2126
	(-0.9406)	(0.0080)	(-0.5669)	(0.6330)	(-0.5049)	(0.6027)	(9.6548)	(7.0538)	(4.6091)

[1] Regression of 467 observations

[2] Regression of 107 observations

[3] Regression of 35 observations

[4] The numbers in the parentheses are the values of t-statistics for the regression coefficients

[5] The estimated coefficients for the third moment (Z_{j3}) are statistically significant at the 1 percent level of significance for each portfolios in all investment horizons. Also, the skewness coefficients are positive values, thus to evaluate the performance of the emerging stock portfolios, an equilibrium pricing model including the higher moments seems to be more appropriate.

Table XXVI

Performance measure of the mean-variance portfolio

	Sharpe [1]						Treynor [2]					
	Week	Rank	Month	Rank	Quarter	Rank	Week	Rank	Month	Rank	Quarter	Rank
Unhedge - No short	0.2061	4	0.4104	4	0.6869	4	9.9920	4	38.0506	3	-43.4511	3
Hedge - No short	0.2241	2	0.4668	3	0.7570	3	10.5777	3	32.2802	4	89.3443	1
Unhedge - Short	0.2239	3	0.5222	2	1.0187	2	13.2389	2	110.6980	1	-64.2311	4
Hedge - Short	0.2444	1	0.6103	1	1.0792	1	14.2287	1	73.6511	2	-42.8907	2

[1] The Sharpe measure, the hedged portfolio when allowing for short sales is ranked first across all investment horizons, whereas the unhedged portfolio when short sales prohibited is ranked last.

[2] For Treynor measure, the weekly hedged portfolio when allowing for short sales is also ranked first, while the first rank of the monthly portfolio is the unhedged strategy when allowing for short sales.

Table XXVII

Performance measure of the mean-variance-skewness portfolio

	Treynor [1]						Prakash and Bear [2]					
	Week	Rank	Month	Rank	Quarter	Rank	Week	Rank	Month	Rank	Quarter	Rank
No short sales												
Unhedge (1,1)	8.9507	6	-154.1979	10	-39.1883	10	0.2063	3	2.6538	1	1.4711	1
Hedge (1,1)	9.9570	1	123.6520	1	118.9088	1	0.1939	6	0.5326	5	-3.5538	10
Unhedge (1,2)	9.8376	4	-154.1979	10	-39.1883	10	0.2296	1	2.6538	1	1.4711	1
Hedge (1,2)	9.9570	3	100.9139	2	118.9088	1	0.1939	5	0.3883	8	-3.5541	11
Unhedge (2,1)	9.8376	4	-154.1979	10	-39.1883	10	0.2296	1	2.6538	1	1.4711	1
Hedge (2,1)	9.9570	1	100.9139	2	118.9088	1	0.1939	4	0.3883	8	-3.5541	11
Short sales allowed												
Unhedge (1,1)	-7.9939	11	62.8666	5	33.2522	6	-0.0524	11	0.4656	6	0.7845	6
Hedge (1,1)	-6.1903	8	-27.9517	8	-1.3540	8	-0.0338	8	0.2250	11	-0.0319	8
Unhedge (1,2)	-9.9712	12	70.5416	4	34.7513	4	-0.0639	12	0.7929	4	0.8293	4
Hedge (1,2)	-5.0162	7	-24.6891	7	1.3556	7	-0.0267	7	0.1655	12	0.0335	7
Unhedge (2,1)	-7.9680	10	62.3753	6	34.4344	5	-0.0522	10	0.4467	7	0.8198	5
Hedge (2,1)	-6.2086	9	-28.0678	9	-1.4776	9	-0.0339	9	0.2272	10	-0.0348	9

[1] The Treynor measure, the hedged portfolio when short sales prohibited with $p_1 = 1$ and $p_3 = 1$ is ranked first across all investment horizons.

[2] The Prakash and Bear measure, the unhedged portfolio when short sales prohibited with $p_1 = 1$ and $p_3 = 2$, and the unhedged portfolio when short sales prohibited with $p_1 = 2$ and $p_3 = 1$ are ranked first.

Table XXVIII

Treynor Comparison between 2-moment and 3-moment portfolios

	Treynor Comparison					
	No short sales			Short sales		
	Week	Month	Quarter	Week	Month	Quarter
Unhedge (1,1)			✓			✓
Hedge (1,1)		✓	✓			✓
Unhedge (1,2)			✓			✓
Hedge (1,2)		✓	✓			✓
Unhedge (2,1)			✓			✓
Hedge (2,1)		✓	✓			✓

✓ = Such 3-moment portfolio outperforms the 2-moment portfolio

The results of comparison represent that the higher moment portfolio can perform better than the two-moment one in the monthly hedged strategy when short sales are prohibited. For the quarterly investment horizons, such higher-moment portfolios are superior in both unhedged and hedged approaches whether short sales are prohibited or not.

REFERENCES

[1] Abken, Peter A., and Shrikhande, Milind M., 1997, The Role of Currency Derivatives in Internationally Diversified Portfolios, *Federal Reserve Bank of Atlanta Economic Review Third Quarter*, 34-59.

[2] Ait-Sahalia, Yacine, and Brandt, Michael W., 2001, Variable Selection for Portfolio Choice, *The Journal of Finance* 56 (4), Papers and Proceedings of the Sixty-First Annual Meeting of the American Finance Association, New Orleans, Louisiana, 1297-1351.

[3] Ang, J.S., and J.H. Chua, 1979, Composite Measures for the Evaluation of Investment Performance, *Journal of Financial and Quantitative Analysis* 14, 361-384.

[4] Arditti, F.D., 1967, Risk and the Required Return on Equity, *Journal of Finance* 22, 19-36.

[5] _____, 1971, Another look at Mutual Fund Performance, *Journal of Financial and Quantitative Analysis* 6, 909-912.

[6] Bekaert, G., and Urias, M. S., 1999, Is There a Free Lunch in Emerging Market Equities?, *Journal of Portfolio Management* 25, 83-95.

[7] Chunhachinda, Pornchai, Dandapani, Krishnan, Hamid, Shahid, and Prakash, Arun J., 1997, Portfolio selection and skewness: Evidence from international stock markets, *Journal of Banking & Finance* 21, 143-167.

[8] _____, 1994, Efficacy of Portfolio Performance Measures: An Evaluation, *Quarterly Journal of Business & Economics* 33 (4), 74-87.

[9] Chunhachinda, Pornchai, 2005, Benefits of International Portfolio Diversification from Thai Perspectives, Journal of Business Management: Thammasat University 107, 13-34 (in Thai).

[10] Cumby, R.E., and Glen, J.D., 1990, Evaluating the Performance of International Mutual Funds, *Journal of Finance* 45, 497-521.

[11] Errunza, Vihang, Hogan, Ked, and Hung, Mao-Wei, 1999, Can the Gains from International Diversification Be Achieved without Trading Abroad?, *The Journal of Finance* 54 (6), 2075-2107.

[12] Eun, C.S., and Resnick, B.G., 1998, Exchange Rate Uncertainty, Forward Contracts and International Portfolio Selection, *Journal of Finance* 43, 197-215.

[13] Glen, J., and Jorion, P., 1993, Currency Hedging for International Portfolios, *Journal of Finance* 48, 1856-1886.

[14] Grandmont-Gariboldi, Nicole, and Soenen, Luc, 2000, On the significance of the incremental returns from hedging international portfolios, *Emerging Markets Review 1*, 271-286.

[15] Jensen, M.C., 1968, The Performance of Mutual Funds in the Period 1945-1964, *Journal of Finance* 23, 389-416.

[16] Jondeau, Eric, and Rockinger, Michael, 2002, The Allocation of Assets Under Higher Moments, FAME Research Paper Series 71.

[17] Kraus, A., and R.H. Litzenberger, 1976, Skewhess Preference and the Valuation of Risk Assets, *Journal of Finance* 31, 1085-1100.

[18] Kritzman Mark P., 1994, What Practitioners Need to Know about Higher Moments, Financial Analysts Journal 50 (5), 10-17.

[19] Lai, T.Y., 1991, Portfolio selection with skewness: A multiple-objective approach, *Review of Quantitative Finance and Accounting* 1, 293-305.

[20] Linther, J., 1965, The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, *Review of economics and Statistics* 47, 13-37.

[21] Madura J., and Tucker, AL., 1992, Hedging International Stock Portfolios, Lesson From the 1987 Crash, *Journal of Portfolio Management* 18 (3), 69-73.

[22] Maringer, Dietmar, and Parpas, Panos, 2007, Global optimization of higher order moments in portfolio selection, *Journal of Global Optimization*.

[23] Markowitz, Harry M., 1952, Portfolio Selection, *Journal of Finance* 7 (1), 77-91.

[24] _____, 1956, The optimization of a quadratic function subject to linear constraints, *Naval Research Logistics Quarterly 3*, 111-133.

[25] _____, 1991, Foundations of Portfolio Theory, *Journal of Finance* 46 (2), 469-477.

[26] McEntire, Paul L., 1984, Portfolio Theory for Independent Assets, *Management* Science 30 (8), 952-963.

[27] Odier, P., Solnik, B., Zucchinetti. S., 1995, Global Optimization of Swiss Pension Funds, *Finanzmarktund Portfolio Management*, 210-231.

[28] Prakash, A.J., and R.M. Bear, 1986, A Simplifying Performance Measure Recognizing Skewness, *The Financial Review* 21, 135-144.

[29] Rubinstein, M.E., 1973, The Fundamental Theorem of Parameter - Preference Security Valuation, *Journal of Financial and Quantitative Analysis* 8, 61-69.

[30] Sharpe, W.F., 1964, Capital Asset Prices: A Theory of Market Equilibrium under Condition of Risk, *Journal of Finance* 19, 425-442.

[31] Simkowitz, Michael A., and Beedles, William L., 1978, Diversification in a Three-Moment World, *The Journal of Financial and Quantitative Analysis* 13 (5), 927-941.

[32] Singleton, J. Clay, and Wingender, John, 1986, Skewness Persistence in Common Stock Returns, *The Journal of Financial and Quantitative Analysis* 21 (3), 335-341.

[33] Soontornkit, Supakorn, 2000, Higher Moments Portfolio Selection and Performance Measure: The Case of Thai Stock Market, Dissertation, Joint Doctoral Program in Business Administration Thammasat University, Chulalongkorn University and National Institute of Development Administration.

[34] Standard & Poor's, 2004, Standard & Poor's Currency-Hedged Index Series: Tools to Manage Currency Risk in International Portfolios.

[35] Stephens, A., and D. Proffitt, 1991, Performance Measurement When Return distributions are Nonsymmetric, *Journal of Business and Economics* 30, 23-41.

[36] Treynor, J.L, 1965, How to Rate Management of Investment Funds, *Harvard Business Review* 43, 63-75.