Diversification Benefit of International Equity Markets Subject to Investment Restrictions

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ABSTRACT

This paper investigates the impact of constraints of *short-sale* and *over-weight* to international diversification benefits. We find that the short-sale restriction alone does not influence the diversifying benefit while the addition of over-weighting constraint significantly worsens mean-variance of optimal portfolio. This finding holds for the analyses of regional and cross-regional portfolios. The portfolio with more emerging markets exhausts more unit-risk performance than the one with developed countries when the over-weighting limitation is installed. The analysis of cross-continent portfolios suggests the portfolio with both equity markets in developing and developed countries tends to lose less mean-variance efficiency than the portfolio with only emerging markets or developed countries. The results support greater variety of geographical location and economic development among markets in portfolio will enhance the diversification benefit and decrease the loss brought by the investment constraints.

Key Words: Asset Allocation; Short-sale Constraints; Over-weighting Investment Constraints, International Diversification.

JEL Classification: F37, G11, G15,

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I. Introduction

The understanding of the impacts of investment constraints to mean-variance efficiency of international portfolio facilitates investors to allocate capital more effectively. Previous researches suggest that global diversification, especially with the inclusion of emerging markets, allows for drop of volatility of portfolio return without sacrificing expected return. A globally diversified portfolio also displays better mean-variance efficiency than purely domestic investment since the correlations of asset yields across countries are lower than within a country. However, investors may not necessarily be able allocate assets by completely following the principles of the optimal portfolio frontier proposed by Markowitz (1952) due to the investibility of stocks[1]. In practice, fund managers consider not only the profitability of investing assets but also their marketability and liquidity. It is also common to find that fund managers disclose the targeted areas of assets when they recruit investing money. This geographical definition not only is out of clients' demand of understanding of investment targets but also is caused by the limitation of management of fund managers. Previous study by De Roon, Njjman, and Werker (2001) and Li, Sarkar, and Wang (2003) indicate the international diversification benefit does not entirely vanish by importing short-sale constraint. However, the impact of limitation to international investment, such as over weights and investing areas, remains unclear. In this paper, we examine the influence of over-

[1] Bae, Chan, and Ng (2004) investigate the relation between the degrees that foreign investors to trade in the domestic market and the stock return risks and suggest the market liberalization triggers the increase of exposures.

weighting and regional constraints on mean-variance efficiency of international diversifying portfolio.

Previous empirical evidences confirm the enhancement of mean-variance brought by international diversification. De Roon, Njjman, and Werker (2001), Harvey (1995), and Li, Sarkar, and Wang (2003) suggest U.S. investor gain better performance by including emerging markets into a portfolio constructed by stocks from developed countries. French and Poterba (1991) suggest the biased expectation to domestic stock returns can be used to explain the lack of international diversification, although the cost of transaction is lower than the benefit of investment among industrial countries. Cosset and Suret (1995) found that the inclusion of countries of higher political risk in international portfolio increases investment efficiency. De Roon, Njjman, and Werker (2001), Harvey (1995), Li, Sarkar, and Wang (2003), and Pástor and Stambaugh (2000) point out the limitation of short-sale does not completely eliminate the benefit of global diversification. De Roon, Njjman, and Werker (2001), Jagannathan and Ma (2003), and Wang (1998) study the impact of different constrains to diversifying benefit and found the effects vary in different group of markets. Errunza, Hogan, and Hung (1999) further provide empirical evidence that the benefit of international diversification can be duplicated by domestically traded securities.

The effectiveness of international diversification is an important factor that associates with the degree of international markets integration. In recent four decades, the integration of international equity markets triggers the fluctuations of stock prices more synchronized. Bekaert and Harvey (1995), Bekaert, Harvey, and Ng (2005), and Errunza, Losq, and Padmanabhan (1992) suggested the world market is mildly segmented

and the degree of global market integration is time-varying. Chuah (2004) find that the world market integration in rich countries come from economic fundamentals but in developing countries come from financial sector. Bekaert, Harvey, and Lundblad (2005) and Stulz and Williamson (2003) suggest that the economic development and integration of global financial market is mutually affected. In general, the world market integration increased and emerging markets were more segmented while perfect integration of developed countries with the world market is rejected. The existence of markets of low correlations with other countries enhances the mean-variance efficiency of international diversification. Thus investigations of benefit of continental and global diversification facilitate decision of asset allocation as well as market integration.

The institutional and cultural heterogeneities among countries cause the non-synchronous comovement of international markets although the degree of global integration has enhanced. Beck, Demirgüç-Kunt, and Levine (2003) Demirgüç-Kunt and Maksimovic (1998) suggest the international differentiations of financial markets can be explained by natural resources and legal tradition. Stulz and Williamson (2003), on the other hand, indicate the openness and development of financial markets is determined by cultural background such as major religion and language. Bekaert and Harvey (2003) report the major characteristics of emerging markets and their chronological variation from late 1970s. The varieties of cultural, institutional, natural, and legal background deter integration of international financial so that investors gain the increase of mean-variance from overseas diversification.

The current research investigates the impact of short sale and over weight constraints to performance of international diversification formed by the optimal portfolio

frontier. To catch the change of mean-variance efficiency, two measures of diversifying benefits are utilized. The first one is modified from the method of Li, Sarkar, and Wang (2003) and Wang (1998). The major difference is the current study employs the risk-adjusted performance indicators instead of the change of raw return. One can calculate the loss of mean-variance efficiency of the most efficient portfolio (MEP) on the international or regional frontiers under various constraints. The second method is to quantify the loss of mean-variance efficiency of minimum variance portfolio (MVP) on the efficient frontiers given different constraints. Elton and Gruber (1995, chapter 12) suggest that investors may try to reduce the volatility of their portfolio because it is difficult to forecast expected return. The examinations of loss of mean-variance efficiency of the MVP brought by various constraints generate information regarding the impact of limitation of investment to global and regional portfolios.

The rest of this paper proceeds as follows. In Section 2 we discuss calculations of loss of international diversification brought by various investment constraints. In Section 3, we report the data utilized in this study and show the first-step finding about international diversification. In Section 4, we describe the empirical results. The losses of mean-variance efficiency measured by the MEP and MVP in different regions and combination of regions are reported. In Section 5, we discuss some related issues and conclude.

II Measures of Efficiency With Investment Restrictions

We measure the loss of mean-variance efficiency caused by various investment constraints of international diversification in global markets as well as various geographic

areas by forming efficiency frontiers of different investment limitations. Suppose a representative Arrow-Debreu investor faces international security markets. The investment opportunities can be described as a vector of multivariate Gaussian stochastic returns of *N* assets:

$$\mathbf{R}^{\mathrm{T}} = [r_1, r_2, \ldots, r_N]. \qquad (1)$$

The mean vector and variance-covariance matrix of asset return can be characterized as $\boldsymbol{\mu}^{\mathrm{T}} = [\mu_1, \mu_2, \ldots, \mu_N]$ and $\mathbf{V} = [\mathbf{R}\mathbf{R}^{\mathrm{T}} - \mathbf{R}\boldsymbol{\mu}^{\mathrm{T}}] / N$, respectively. Let *S* be the set of all real vectors $\mathbf{w}^{\mathrm{T}} = [w_1, w_2, \ldots, w_N]$ which defines the weight of each asset such that $\mathbf{w}^{\mathrm{T}}\mathbf{1} = w_1 + w_2 + \ldots + w_N = 1$, where **1** is an *N*-vector of ones . We further define the subset *P* as the possible array of portfolio weights with investment constraints. If there is no restriction on asset allocation, *S*=*P*.

We further follow the optimal portfolio selection methodology proposed by Markowitz (1952) to construct the efficient frontier. A non risk-loving investor will select the asset of minimum risk among assets of the same return. Specifically,

$$\min_{\{\mathbf{w}\}} \frac{1}{2}\mathbf{w}^{\mathrm{T}}\mathbf{V}\mathbf{w}$$

s.t.

$\mathbf{w}^{\mathrm{T}}\boldsymbol{\mu} = \mu_p$, and

$$\mathbf{w}^{\mathrm{T}}\mathbf{1} = 1, \qquad (2)$$

where μ_p denotes the expected return on portfolio. In this setting, the negative portfolio weights (i.e., short sales of asset) are permitted. Combining the objective function and restrictions, one may form the Lagrangian:

$$\min_{\{\mathbf{w},\phi,\eta\}} \Xi = \frac{1}{2}\mathbf{w}^{\mathrm{T}}\mathbf{V}\mathbf{w} + \phi(\mu_p - \mathbf{w}^{\mathrm{T}}\boldsymbol{\mu}) + \eta(1 - \mathbf{w}^{\mathrm{T}}\mathbf{1}), \qquad (3)$$

where ϕ and η are two positive constants. The solution of quadratic programming, $\mathbf{w_p}$, can be obtained by the first-order conditions of Equation (3) because $\mathbf{V}$ is a positive definite matrix.

Our measure of mean-variance efficiency enhancement is different from the previous study by De Roon, Nijman, and Werker (2001), Li, Sarkar, and Wang (2003), and Wang (1998). The purpose of international diversification is not only to seek better yield brought by more investment opportunities but also to eliminating risk which can be offset by movement of oversea securities. Consequently, the variance-adjusted performances but not the raw return generated by global diversification should be concerned by global investors. The risk-adjusted performances are computed by the maximum Sharpe ratio (MSR) and the maximum Treynor ratio (MTR) on the efficient frontier:

$$\text{MSR} = \max_{\{\mathbf{w_p}\}} \{(\mathbf{w_p}^{\mathrm{T}}\boldsymbol{\mu}) / (\mathbf{w_p}^{\mathrm{T}}\mathbf{V}\mathbf{w_p}) \,|\, \mathbf{w_p}^{\mathrm{T}} \in S\}, \text{ and} \qquad (4)$$

$$\text{MTR} = \max_{\{\mathbf{w_p}\}} \{(\mathbf{w_p}^{\mathrm{T}}\boldsymbol{\mu}) / (\mathbf{w_p}^{\mathrm{T}}\boldsymbol{\beta}) \,|\, \mathbf{w_p}^{\mathrm{T}} \in S\}, \qquad (5)$$

where $\boldsymbol{\beta}$ is the vector of global systematic risk of assets. The global beta of individual country *i* is following the international capital asset pricing mode (I-CAPM) suggested by Solnik (1974).

Consider the short-selling is prohibited to international markets, a new constraint is further introduced in the system of Lagrangian optimalization in Equation (3):

$$0 \le w_i \le 1, \forall i. \qquad (6)$$

The computation of risk-adjusted performance is:

$$\text{Max Sharpe Ratio} = \max_{\{\mathbf{w_p}\}} \{(\mathbf{w_p}^{\mathrm{T}}\boldsymbol{\mu}) / (\mathbf{w_p}^{\mathrm{T}}\mathbf{V}\mathbf{w_p}) \,|\, \mathbf{w_p}^{\mathrm{T}} \in P_1\}, \qquad (6)$$

and

$$\text{Max Treyor Ratio} = \max_{\{\mathbf{w_p}\}} \{(\mathbf{w_p}^{\mathrm{T}}\boldsymbol{\mu}) / (\mathbf{w_p}^{\mathrm{T}}\boldsymbol{\beta}) \,|\, \mathbf{w_p}^{\mathrm{T}} \in P_1\}, \qquad (7)$$

where $P_1 = \{\mathbf{w_p} \in S : 0 \le w_i \le 1,\ i = 1,2,\ldots,N\}$. (8)

The installation of short-sale constraint might not be sufficient enough to define a practicable optimal global asset allocation. When fund managers make decision regarding the allocation of international portfolio, they not only consider the profitability but also take into account the liquidity of investment targets. The short-sale constraints reflect the unattainability of borrowing portfolio but not necessarily contemplate the over-weighting of securities in the markets of small capitalization. The overwhelming investment in small economies instigates a puzzle of infeasibility of asset allocation since there may be of insufficiency of tradable securities to fulfill the demand of substantial foreign investors. The flows of fund caused by the excessive proportion of investment in minor capital markets might trigger volatility of asset values when the optimal investment strategy is implemented. The over-weighting allocation of fund may distort the mean-variance efficiency of each equity market. If a large number of investors follow the optimal asset allocation without taking the over-weighting problem in small markets into account, one may expect the flow of international capital will trigger disturbance of asset prices in those small markets.

To eliminate the unpracticability caused by excessive investment in minor markets, we further restrict the weights of optimal portfolio combination should not be

greater than three times of shares of the world capitalization of each markets. Specifically, the subset P_2 narrows as:

$$P_2 = \{\mathbf{w_p} \in S: 0 \le w_i \le 3w(\text{Cap})_i,\ i = 1,2,\ldots,N\}\ , \qquad (9)$$

where $w(\text{Cap})_i$ is the weight of the world market value of each country.

We also present the parameters of minimum-variance portfolio (MVP) on each spanning of equity markets. The risk-adjusted performance and expected return are good indicators to measure the diversifying efficiency but are difficult to be predicted. Elton and Gruber (1995) suggest that investors will seek to minimize the exposure of portfolio as an alternative of to maximize the yield. In this case, the vector of weights of the MVP is obtained from the follow:

$$\mathbf{w}_{\text{MVP}} = \min_{\{\mathbf{w}_p\}}[\mathbf{w}_p^{\text{T}}\mathbf{V}\mathbf{w}_p \,|\, \mathbf{w}_p^{\text{T}} \in P]\,. \qquad (10)$$

where P can be various domains S, P_1, and P_2. To decide the impact of the addition of restrictions to portfolio efficiency, we report the U.S. Dollar based return, risks, and their performance indicators given different constraints.

In this study, we will investigate the impact of investment constraints to the optimal international asset allocation. We suggest no short-sale constraints in the previous study is not enough to describe the consideration of international investors since the over weighting in small markets may make optimal investment strategy infeasible. The consideration of relative magnitude among markets is helpful to maintain the liquidity of combination of international portfolios.

III Data

The U.S. Dollar-denominated monthly returns of the Morgan Stanley Capital International (MSCI) for twenty-one developed countries and thirteen developing countries are utilized. The developed countries include Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Denmark (DNK), France (FRA), Finland (FIN), Germany (DEU), Hong Kong (HKG), Ireland (IRL), Italy (ITA), Japan (JPN), the Netherlands (NLD), Norway (NOR), Singapore (SGP), Spain (ESP), Sweden (SWE), Switzerland (CHE), United Kingdom (GER), and the United States (USA). The emerging markets are Argentina (ARG), Brazil (BRA), Chile (CHL), Greece (GRC), Indonesia (IDN), South Korea (KOR), Malaysia (MAL), Mexico (MEX), Philippines (PHL), Portugal (PRT), Taiwan (TWN), Thailand (THL), and Turkey (TUR). The sample period is from January 1988 to December 2004. Compare with the sample of Li, Sarkar, and Wang (2003), the empirical results of our analyses demonstrate more updating diversifying benefit among international markets.

Table 1 lists the countries, their world market value, ratio of market capitalization, and geographical area as of the end of 2002. The data of equity market value are obtained from the World Federation of Exchanges. Most developed countries are in Central/West Europe and North America and most developing economies are in East Asia and Latin America. The stock markets in developed countries represent about 95% of world equity market value. The sum of weights of market value of G-7 countries equity markets is about 85%. Among them, the share of the U.S. market value is the highest and stands for one half of the world capitalization. On the other hand, the share

of capitalization of in each emerging market is small. Among the developing countries, Taiwan is the only country that its world capitalization share is greater than one percent.

[Table 1]

To investigate the diversifying benefit of global and regional portfolio, countries are further categorized according to their geographical locations. One may find that most developing countries are in the groups of East Asia or Latin America and most developed countries are in Europe and North America. This classification of markets enables us to examine the diversification benefits subject to geographical constraint as well as short-sale and over-weighting restrictions.

In Table 2, we report the fundamental statistics of each market. One may find the stock price risks, both measured by standard deviation and global beta, in developed countries are smaller than the ones in developing countries. On the other hand, risk-adjusted performances, Sharpe ratio and Treynor ratio, in emerging markets generally are worse than the ones in rich economies. The Jarque-Bera statistics indicate the departure from normality of equity returns in most countries. The violation of Gaussian distribution can be confirmed by the common phenomena of asymmetry of maximum and minimum, negative skewness, and leptokurtic. The Augmented Dickey-Fuller (ADF) tests suggest the hypothesis of unit-root of stock return is rejected in all countries. By and large, our finding is similar to statistics provided by Bekaert and Harvey (1995), Harvey (1995) and Li, Sarkar, and Wang (2003).

[Table 2]

The summary of coefficients of correlations of all countries in Table 3 confirms the benefits of diversification cross various countries and geographical areas. The developed countries demonstrate higher correlations among themselves than the correlation with developing countries. The means of correlation coefficients among developed countries in more than half of industrial nations are greater than 0.5. In contrast to rich economies, most emerging markets are of low correlation both with developed countries as well as among themselves. The low coefficients of correlations among developed countries and developing countries suggest that investors from developed countries may benefit from diversifying in emerging markets, so do the investors from developing countries, especially the ones of relatively low mean-variance efficiency.

[Table 3]

The coefficients of correlations in Table 3 present evidence of benefits brought by the geographical diversification. The bolded numbers represent the two most correlated regions of each stock market. Most markets, including both developed countries and developing countries, are relatively more interrelated with the markets within the same areas. In particular, the coefficients of correlations between the markets within North America and Oceania are substantially high (0.75 and 0.68). The low correlation of outside areas suggests that investors in different regions may gain the diversifying

advantage from cross-continent investment. In addition, North America is the region that most countries have highest correlation coefficient except the home region of each country. This implies the stock market performance in North America, especially the United States, causes considerable impact to the equity values to other countries.

The correlation among countries of this study is different from the previous study by De Roon, Nijman, and Werker (2001) and Li, Sarkar, and Wang (2003). To maintain the practicability of investment strategy and to catch the change of international markets, the updated stock prices data (from January 1988 to December 2004) are implemented. Unlike to the correlation matrices using older data, it is found no negative correlation among all countries in recent years[2]. The intensification of international market connection in past three decades instigates the increase of value of coefficient of correlation and causes the vanishing of negative correlation.

This paper includes more comprehensive coverage of equity markets than previous researches on international diversification. Most of them focus on either diversifying benefit among developed countries or developing countries and seldom include large amount of both groups. For instance, the examination by De Roon, Nijman, and Werker (2001) concentrates on the diversifying benefit of emerging markets and utilizes three developed countries as benchmark. The report of Li, Sarkar, and Wang (2003), on the other hand, only includes seven major industrial countries and eight less developed countries in their analysis. A broader inclusion of investigated markets in this paper allows us provide more practicable result regarding international asset allocation

[2] De Roon, Nijman, and Werker (2001) used data from January 1985 to June 1996 and Li, Sarkar, and Wang (2003) used data from January 1976 to December 1999. In the two researches, the performances of stock markets in developing countries are measured by the International Finance Corporation (IFC) and the developed countries are obtained by the MSCI.

and more feasible investment strategy. In addition, the current paper utilizes more updated data so that we can generate understanding regarding integration of international financial markets by comparing the benefit brought international diversification with the previous researches.

IV. Empirical Result

We examine the change of internationally diversifying benefit caused by short-sale and over-weight constraints during the period from January 1988 to December 2004. To achieve the maximum of utility, a rational consumer-investor will select a mixture of market portfolios that maximize performance per unit risk. The optimal asset allocations without investment constraint, with short-sale restriction, as well as with short-sale and over-weight limitations are presented. To investigate the mean-variance efficiency, the risk-adjusted performances of different areas and combinations of areas are also reported.

4.1 Global Diversification Benefit

The benefit of global diversification without and with constraint is demonstrated in Figure 1 and Figure 2. In Figure 1, the mean-variance efficiency of the portfolio contenting all thirty-four markets is higher than either the group of rich countries or developing countries. The efficient frontier composed by equities in developed countries tends to be of lower return and of lower volatility, while the emerging markets tend to be of higher return and risk. In Figure 2, one may confirm the cross-continent variation of trade-off relationship between yield and risk. The efficiency frontiers of Latin American countries and North American countries are the two closest to the global efficient frontier

but the one of East Asia is the most distant from the world efficient frontier. The flexibility to allocate asset globally will eventually enhance the risk-adjusted performance of investment.

[Figure 1]

[Figure 2]

It is worthy to notice that the selection of investing areas but not merely the number of countries in the portfolio draws impact to mean-variance efficiency. The number of countries in the portfolio of East Asia (nine) is greater than the ones of North America (two) and Oceania (two), however, the efficient frontier composed by the later two are on the left-hand side of the former one. In addition, portion of the efficient frontier generated by four Latin American countries is more mean-variance efficient than the efficiency frontier constructed by seventeen European country. In addition, imposing investment constraints also affects the attainable area and sharp of efficient frontier. The optimal portfolios of globally and regionally international markets do not significantly change after imposing short sale constraint, while the limitation of over-weight investment diminishes the area of possible return-volatility combination of international portfolios.

The risk-adjusted returns, MSR and MTR, as well as weights of globally diversifying portfolio of various constraints are demonstrated in Table 4. The imposition of short-sale has no impact on the determination of optimal portfolios while the over-weighting restriction does influence the combination of portfolios of efficient frontier,

especially the markets in Americas. Specifically, the weights of Chile and Mexico have adjusted downwards drastically, and the equities of Argentina, Brazil, and the United States are included. It is not surprising that the weight of U.S. equity market increase to more than eighty percent after including over-weighting constraint. Among European countries, the weights of Swiss and Danish equities drop dramatically while Greek and Swedish stocks are incorporated. More strikingly, due to poor ex ante performance and high correlation with the rest of the world during the sample period, none of East Asian and Oceania countries is included in optimal portfolios without and with investment constraints. Figure 3 demonstrates that the imposition of both short-sale and over-weighting restriction decrease the mean-variance efficiency of international portfolio.

[Table 4]

[Figure 3]

4.2 Regional Portfolios

The Sharpe ratio and Treynor ratio, as well as their weights of the MEP and MVP of each single area under various constraints are demonstrated from Table 5 to Table 9. Among them, the portfolio composed by four Latin American countries is the most efficient measured. The portfolio of Latin American countries is of highest volatility and highest return so that its unit-risk yields outperform the ones of the other areas. On the other hand, the Oceania portfolio is the least efficient according to MEP while the East Asian portfolio is of the worst mean-variance efficiency as indicated by the MVP, respectively. This finding is consistent with the zero weight of those two areas in the

optimally global portfolio. In the groups of North America and Oceania, the optimal portfolio is to allocate all funds in the countries of bigger share of equity market capitalizations, the United States and Australia. The volatility of optimal portfolio return of North America, which collapses to the U.S. market, is the smallest amongst all other regional portfolios that are constructed by more than one market. The European portfolio, on the other hand, demonstrates moderate price exposure and relatively tolerable performance.

[Table 5]

[Table 6]

[Table 7]

[Table 8]

[Table 9]

The restriction of short-sale does not but the blending of short-sale and over-weighting constraints affects the optimal spanning of expected return and standard deviation of each continental portfolio. In Table 5 to Table 9, one may find the Sharpe and Treynor ratios of the MEP and MVP and their weights of countries in general does not change under only short-sale restriction but adjust significantly after considering the over weight. In Figure 4 to 8 one also can find that Sharpe index curves without and with short-sale constraint of all regional portfolios are overlapping, while the risk-performance efficiency including over-weighting constraint is lower.

[Figure 4]

[Figure 5]

[Figure 6]

[Figure 7]

[Figure 8]

The magnitude of impact brought in over-weighting constraint to regionally international portfolio varies from area to area. The portfolios of European markets and East Asian markets are of the most transformation by the addition of over-weighting constraint. In the European portfolio, the over-weighting restriction drives a large proportion of asset allocation shift from Switzerland and Denmark to France. This proportion-diversifying condition forces the East Asian portfolio from completely holding stocks in Hong Kong without investment constraint to allocting assets to other countries: Indonesia, Korea, Malasyia, Singapore, and Taiwan. Japanese stocks are not included in the optimal portfolio becuase of the relatively low mean-variance efficiency. The change of efficient frontiers in portfolios of Latin America, North America, and Oceania is trivial.

4.3 Cross-Region Portfolios

We further investigate the impact of expanding areas of investing assets given different portfolio constraints. It is well known that mean-variance efficiency of portfolio can be substantially enhanced by inflating investing assets. However, one may need more empirical results of cross-region portfolios to determine the advantageous

combination of regional portfolio with any given geographical area. Specifically, we try to verify the area where can generate the highest marginal increment of return-risk performances to the investors of the other regional portfolio. Just like the efficiency measure of single area, not only the number of assets but also the correlations among the national portfolios as well as their unit-risk performance determine the improvement of mean-variance efficiency.

The Sharpe ratio and Treynor ratio as well as their weights of the MEP and MVP of the mixture of two geographical regions given different constraints are shown from Table 10 to Table 19. Generally, the region of more emerging markets, such like East Asia and Latin America, gain more risk-adjusted performance by bringing together with the portfolio of more developed countries, and the investor of stocks in rich countries benefit most by bringing in equities in developing countries. The portfolio of Latin America gain most efficiency by adding European countries without and with investment constraints. According to the MEP without and with short-sale constraint evaluated by Max Sharpe and Max Treynor, the optimal weights of capital of are overwhelmingly allotted in Latin American nations. Those risk-adjusted returns are very close to the ones of the global portfolio with thirty-four countries. After taking disproportionate distribution of capital between two regions into account, the weights of the Latin America and Europe are more balanced but the mean-variance efficiency significantly sacrifices. One may also find the risk-adjusted performances of portfolio containing North American and Latin American countries enhance and risks of optimal asset combination decrease.

[Table 10]

[Table 11]

[Table 12]

[Table 13]

[Table 14]

[Table 15]

[Table 16]

[Table 17]

[Table 18]

[Table 19]

A similar phenomenon can be found by comparing the portfolios consisted of East Asia and other regions. These empirical results are reported in Table 10, 14, 15, and 16. The addition of portfolio of European markets considerably increases performance of investment by lowering the total volatility. On the other hand, due to the relatively poor performance of national portfolios in East Asia, the weights of East Asian countries vanish in blending portfolios of this area with North America and Latin America. One may find that investment efficiency of East Asian investors also improve by adding other areas.

The insertion of other area of more developed markets help investors in industrial countries still can improve risk-adjusted performance. In Table 11, 13, and 18, the extension of portfolio from single-region to dual-region benefits investors in North America, Europe, and Oceania. Since the Oceania countries are of worse mean-

variance efficiency than the ones in Europe and North America, the weights of Oceania area are zero in the combining portfolios.

Resembling the results of single-area diversification, the short-sale alone does not cause impact to optimal asset allocation but the synchronizing constraint of short-sale and over-weight does decrease investment efficiency. From Figure 9 to 18, one may find the Sharpe ratio curves of two constraints are significantly lower than the overlapping one of no restriction and only short-sale constraint except the merging portfolio of East Asia and North America. The phenomena reflect the correlations among international financial markets are increasing in recent twenty years so that there is no short-sale position on the international optimal frontier. However, the joining constraints of short-sale and over-weighting influence the investment efficiency because of the enforced diversification based upon market shares.

[Figure 9]

[Figure 10]

[Figure 11]

[Figure 12]

[Figure 13]

[Figure 14]

[Figure 15]

[Figure 16]

[Figure 17]

[Figure 18]

The short-selling and over-weighting investment restrictions draw greater impact on investment efficiency on the portfolio containing area of more emerging markets. The Sharpe ratio and Treynor ratio of East-Asia-Latin America joining portfolio with two constraints decrease from 0.005 to -0.018 and 0.003 to -0.011, respectively. This combination of international markets represents the one of the largest percentage of loss caused by the insert of over-weighting constraint. The risk-adjusted performances of other cross-continent portfolios containing the areas of more developing countries also sacrifice 30% to 72%. On the other hand, the fact that the Sharpe and Treynor ratios of Europe-North America portfolio moderately decline about 14% and 18% indicate this portfolio is less sensitive to the restraint of over-weighting investment.

V. Conclusion

The current paper investigates the impact of constraints of short-sale and over-weight of investment to international diversification benefit by utilizing the risk-adjusted performance indices on efficient frontiers during the period of 1988 – 2004. Two measures of unit-risk performance, MSR and MTR, are used to catch the most efficient portfolio (MEP) of international markets on the optimal portfolio frontier. The performance, exposures, Sharpe index, and Treynor ratio of minimum-variance portfolio (MVP) on each efficient frontier of global portfolios are reported. It is found that the short-sale constraint does not influence the weights of the optimal investment while short-sale and over-weighting constraints significantly worsen mean-variance efficiency of portfolio frontier composed by global portfolio. The enhancement of integration of

international financial market can be used to explain why the diversifying benefit of the current paper is lower than the finding of Li, Sarkar, and Wang (2003).

We further show that the benefits of regionally international diversification and the losses of risk-adjusted performance caused by investment constraints vary from area to area. The portfolio of Latin American markets outperformed the rest of the world while the portfolio of East Asia demonstrates the worst risk-adjusted performance among all. The weights and mean-variance efficiency of regional portfolios of higher proportion of emerging markets, i.e., East Asia and Latin America are more sensitive to over-weighting constraints. On the other hand, the optimal combinations and performances of European and North American portfolios do not change significantly after importing restriction of over-weight. Finally the results of cross-region analysis suggest that the loss of unit-risk performance in the portfolio with more emerging markets is greater than in the one of more rich countries.

Our analysis of the international diversification benefits demonstrates three contributions. First, we utilize risk-adjusted performance evaluation and consider over-weighting constraint in international portfolio management. These conditions make results more realistic since international investors desire high return and low risk without sacrificing liquidity and marketability. Second, the methodologies are widely applied and the results can be easily interpreted. Once the time-series of yields of international markets are generated and the investment constraints are defined, it is straightforward to compute the related parameters of MEP and MVP. Finally, we compare the variation of geographical portfolio. The results not only provide international fund mangers insight about the expansion of portfolio as well as the loss of investment efficiency of each

region, but also present the evidence of variation of integration of international financial market.

The major drawback of this research is we consider the long-term optimal asset allocation without taking dynamic hedge into account. Chang, Errunza, Hogan, and Hung (2005) examine the demands of market risk hedge and currency exposure hedge in international asset pricing. Bekaert and Harvey (1995) and Bekaert, Harvey, and Ng (2005) document the time-variation of the integration of international financial market. Harvey (1995) also suggests the predictability of international equity returns. However, the purpose of the current paper is to investigate the international diversification benefits and their changes caused by investment constraints in global and continental portfolios. Future researches of the impact of international investment restrictions and diversifying benefits may apply intertemporal asset pricing theory and take into account the demands of hedge to market exposure and exchange rate.

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