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Abstract

This paper examines the benefits of regionally and globally diversified portfolios from the perspective of investors holding domestic-only portfolios from different Asia-Pacific countries. Three groups of regional portfolio are constructed, with sorting based on relative strength ranking technique of Levy (1967). The step-down spanning technique is employed to uncover evidence that the global minimum-variance portfolio of a local investor can be improved by investing regionally or globally, but the evidence that the tangency portfolio can be improved is weak in all cases. The results also show an increase in Sharpe ratio when the investor invests regionally or globally but this benefit declines under the assumption of short-selling. The paper concludes that there are gains in diversifying globally but higher gains are realized by investing regionally.

JEL Classification: G11, G15, C10, F3
Keywords: Asia-Pacific Region; Sectoral diversification benefits; Relative Strength Ranking; Mean-Variance Spanning

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1.0. Introduction

Gains from international diversification largely hinges on the correlation of the assets in an investor's portfolio. The removal of trade and investment barriers over the past decades has spurred a dramatic increase in international investment activities worldwide. Nonetheless, the benefit from international diversification, which is driven by this rapid integration, differs according to the geographical location of one's investment. For instance, investing in an emerging market, with elevated economic growth rates could provide higher expected returns but with more risk, such as foreign exchange rate risk, less liquidity, increased chance of bankruptcy, among others. Advanced markets on the other hand may have lower growth potentials and low expected returns but be less prone to most of the risk found in emerging markets. Recent crisis events, particularly in US and Europe, have created some level scepticism among many investors about investing internationally. Thus, the importance of differentiating between the benefits of regionally or globally diversified portfolios as against a domestic-only portfolio cannot be overemphasized. Aside the geographical location of assets in one's portfolio, the class of assets could have an effect on the overall gains. This paper seeks to examine the benefits of regionally and globally diversified portfolios from the perspective of local investors in different Asia-Pacific economies. The local investor, who initially holds assets only from the domestic market, decides either to diversify across various markets within the Asia-Pacific region (regional portfolio) or in markets beyond the region, which we refer to as global portfolio. We distinguish between these two alternatives because investors tend to prefer holding assets from well-known investments opportunities, in this case the regionally diversified portfolio, as opposed to foreign investment opportunities (Huberman 2001; Grinblatt and Keloharju 2001). The importance of this study stems from the fact that asset allocation decisions are partly informed by the performance of industry

sectors in addition to the overall economic condition of the country or region and this paper shed more light in this regard.

Although the international diversification literature abounds with studies that include some Asia-Pacific countries (Li, Sarkar and Wang 2003; Chiou 2009; Chiou et al. 2009; Fletcher and Marshall 2005), it is almost the case that diversification potentials are not studied from the perspective of local investor in the region. Rather, most of the existing studies study the issue from perspective of investors US and other developed markets from the West, with a few (Chan and Leung 1990; Zhang 2011) examining whether the findings apply to Asia Pacific markets as well. In effect, studies on regional diversification benefits have not received much attention in the literature, as noted by Driessen and Laeven (2007). An important but unexplored area is the potential benefits that can be gained by an investor who already holds a domestic-only portfolio and decides either to include sectoral assets of various performance classes across the Asia-Pacific region or assets from markets outside the Asia-Pacific region, which is globally diversified portfolio. Thus, coming from the perspective of domestic investors, the current paper examines and provides robust evidence on the benefits of either investing in regional sectoral assets or having globally diversified portfolios.

The economic structures, level of development and maturity of the markets differ across the Asia-Pacific countries and this diversity makes them less prone to broad macroeconomic shocks. Moreover, although correlation between some Asian equity markets has been trending up recently, it remains low, between 0.4 and 0.5 (Fung et al. 2008). Since diversification requires assets and markets to have low correlation, the situation in the region makes it ripe for investors to realize such benefits. By thoroughly analysing diversification benefits from the perspective of local investors in the region, this paper intends to contribute in providing more information to investors and other interested parties.

Despite earlier studies on diversification benefits in the Asia-Pacific region (see for instance Chan and Leung 1990; Zhang 2011), there is still scope for further studies. First, although earlier studies such as Chan and Leung (1990) study the return potentials of Asia Pacific stock markets between 1979 and 1989, they only study it from the perspective of US, Japan and Hong Kong investors. Moreover, new development in the global financial markets such as the various crises and rising integration outdates their findings. In cases where an attempt has been made to study more recent data, the traditional mean-variance spanning test (Huberman and Kandel 1987) has been used. The test examines whether the minimum-variance frontier of a smaller set of benchmark assets coincides with that of a broader set of assets. For instance, Zhang (2011) employs the mean-variance spanning test and find that benefits from regionally diversified portfolios outweigh benefits from globally diversified portfolios. The test of spanning employed however, is weak in providing adequate information on the source of rejection or acceptance of the spanning hypothesis. For instance, in the case of an investor holding a domestic-only portfolio, the test could indicate rejection of the spanning hypothesis for a regionally diversified portfolio while showing acceptance for a globally diversified portfolio. Nonetheless, we cannot easily conclude whether the regionally diversified portfolio is a better investment opportunity than globally diversified portfolio for the investor since the test is carried out jointly and does not show the source of rejection or acceptance of the spanning hypothesis. The present paper addresses these concerns by employing the step-down approach (Kan and Zhou 2012), which helps in showing the source of rejection and allows for better assessment of the power of the test.

The second contribution of the paper lies in its use of industry level data rather than aggregate equity returns. Rather than using existing stock market indices to form the regional portfolios, as has been done by previous authors, we sample 124 indices from 10 industrial sectors across 15 Asia Pacific countries. In order to form the regional portfolio, we first

compute the current performance of the various sectoral indices relative to their 26-week average performance and rank them on weekly basis. This is followed by computation of the average rank for each index and sorting them in descending order. Based on the relative strength ranking, we construct three portfolios for the region namely *high performers*, *moderate performers,* and *low performers* – detail are discussed later. Levy (1967) proposed the relative strength as an asset selection criterion and to the best of our knowledge, none of the existing studies on diversification benefits has used this criterion. For the global test assets, 26 market indices from outside the Asia-Pacific region are used. The data used are of weekly frequency and covers the period 1996 to 2012.

The paper proceeds to examine the statistical significance of regional and global diversification benefits using the mean-variance spanning test developed by Huberman and Kandel (1987) and the step-down approach of Kan and Zhou (2012). From the economic perspective, we compute the magnitude of global diversification benefits based on improvement in the Sharpe ratio. Dynamic conditional correlations (Engle 2002) are also employed to determine the potential diversification benefits. In addition, the study investigates the diversification benefits both for markets with friction and for markets without friction.

The mean-variance spanning tests indicate that domestic-only portfolios span neither the regionally diversified sectoral portfolios nor the globally diversified portfolios. The evidence from the step-down test shows that the global minimum-variance portfolios can be improved by diversifying regionally or globally, but the evidence that the tangency portfolio can be improved. Greater benefits are also realised from the regionally diversified and globally diversified portfolios due to improvement in Sharpe ratios. Moreover, the results show that the gains in terms of improvement in Sharpe ratio are much higher for the regionally diversified portfolios compared to the globally diversified portfolios. Without constraints on

short-selling, the spanning test still shows benefits from regional and global diversification although the Sharpe ratios decline significantly for most countries. However, portfolio holdings with assets from moderate performing sectors in the Asia-Pacific region provide substantial benefits and even outshine the benefits from the global portfolio. The paper concludes that there are gains in diversifying regionally and globally but gains in the Asia Pacific sectoral portfolios exceed gains from a globally diversified portfolio.

The remainder of this paper proceeds as follows. Section 2 presents the econometric and statistical approaches employed. Section 3 presents the data and stylised facts on Asia Pacific equity markets. Section 4 presents the empirical results and analyses while section 5 concludes the paper.

2.0. Measuring Diversification Benefits

This section describes the econometric and statistical methods employed in measuring diversification benefits. The analysis is cast within the mean-variance framework of Markowitz (1952), and by this, a mean-variance utility function, or a normally distributed asset return is assumed for the investor. The statistical significance of the diversification benefit is tested using the mean-variance spanning test of Huberman and Kandel (1987) and the recent extension by Kan and Zhou (2012). From the economic perspective, improvements in Sharpe ratios are used to determine the magnitude of regional and global diversification benefits.

2.1. Mean-Variance Spanning Test

Huberman and Kandel (1987) first tested the mean-variance spanning hypothesis through a regression framework. Let K benchmark asset spans a broader set of $K + N$ test assets on condition that the minimum-variance frontier of the K risky assets coincides with that of the $K + N$ test assets. We define $R_t = [R'_{1t}, R'_{2t}]'$ as the realized returns on $K + N$ risky assets at time t, where R_{1t} is a $T \times K$ matrix of realized returns on the K benchmark assets over T

periods and R_{2t} is a $T \times N$ matrix of the returns on the N test assets. By projecting R_{2t} on R_{1t} , the following linear regression is obtained

$$R_{2t} = \alpha + \beta R_{1t} + \varepsilon_t, \quad t = 1,2, \dots, T \tag{1}$$

where $E[\varepsilon_t] = 0_N$ and $[\varepsilon_t R_{1t}'] = 0_{N \times K}$, 0_N is an N – vector of zeros and $0_{N \times K}$ is an N by K matrix of zeros. Now define $\delta = 1_N - \beta 1_K$ with 1_N being an N-vector of ones. The spanning hypothesis corresponds to imposing the following restrictions:

$$H_O: \alpha = 0_N , \ \delta = 0_N \tag{2}$$

When H_O holds, then for a portfolio of test assets (N), there is an equivalent portfolio of the K benchmark assets with same expected return (since $\alpha = 0_N$ and $\beta = 1_N$) but lower variance than the test assets (since R_{1t} and ε_t are uncorrelated and Var$[\varepsilon_t]$ is positive definite). In other words, an investor would be better-off holding a portfolio of the K benchmark assets. The joint hypothesis is tested using the likelihood ratio test under an exact distribution (Jobson and Korkie 1989). In order to test the individual components of the spanning hypothesis separately, which will enable us to know the source of rejection, we follow the step-down approach proposed by (Kan and Zhou 2012). This procedure enables us to weight α and δ based on their relative economic importance and by so doing, help in adjusting the size of the test as well show the source of rejection of the spanning hypothesis. The test is conducted in sequential order starting with the testing for $\alpha = 0_N$, followed by $\delta = 0_N$ conditional on $\alpha = 0_N$. The F- test for testing $\alpha = 0_N$ is as follows:

$$F_1 = \left(\frac{T-K-N}{N}\right)\left(\frac{|\bar{\Sigma}|}{|\hat{\Sigma}|} - 1\right) = \left(\frac{T-K-N}{N}\right)\left(\frac{\hat{a}-\hat{a}_1}{1+\hat{a}_1}\right) \sim F_{N,\ T-K-N} \tag{3}$$

where $\hat{\Sigma}$ is the unconstrained estimate of Σ and $\bar{\Sigma}$ is the constrained estimate of Σ when we only impose the constraint $\alpha = 0_N$. F_1 follows an F-distribution with N and $T - K - N$ degrees of freedom. The F-test for $\delta = 0_N$ conditional on $\alpha = 0_N$ is given as

$$F_2 = \left(\frac{T-K-N+1}{N}\right)\left(\frac{|\tilde{\Sigma}|}{|\bar{\Sigma}|} - 1\right) = \left(\frac{T-K-N}{N}\right)\left[\left(\frac{\hat{c}+\hat{d}}{\hat{c}+\hat{d}_1}\right)\left(\frac{1+\hat{a}_1}{1+\hat{a}}\right) - 1\right] \sim F_{N,\ T-K-N+1} \tag{4}$$

where $\tilde{\Sigma}$ is the unconstrained estimate of Σ when both constraints $\alpha = 0_N$ and $\delta = 0_N$ have been imposed.F_2 follows a central F- distribution with N and $T - K - N + 1$ degrees of freedom and is not dependent on F_1. The spanning hypothesis can only be accepted when both tests are accepted. When the rejection of the joint hypothesis is caused by the rejection of $\alpha = 0_N$ it suggest that the tangency portfolio of the benchmark assets (country portfolio) and that of the test portfolio (regional or global assets) are statistically different and therefore the tangency portfolio of a local investor can be improved by including the test assets. On the other hand, by rejecting $\delta = 0_N$, it suggests that the global minimum-variance portfolio of a local investor can be improved by adding either regional or global test assets.

2.2. Increase in Sharpe Ratio

The aim of holding a portfolio is to maximise return for a given level of risk. Define $\mathbf{R}^{\mathrm{T}} = [\mathrm{r}_1, \mathrm{r}_2, \ldots, \mathrm{r}_{\mathrm{N}}]$ as the realized returns of N assets representing the investment opportunities for an investor. Let the risk premium of asset returns be expressed as a vector $\boldsymbol{\mu}^{\mathbf{T}}$ and let $\mathbf{V}$ represents the variance-covariance matrix. Let G be the set of all real vectors $\mathrm{w}^{\mathbf{T}}\mathbf{1} = [\omega_1, \omega_2, \ldots, \omega_N]$ defining the weights of each asset such that $\mathrm{w}^{\mathbf{T}}\mathbf{1} = \omega_1 + \omega_2 + \cdots + \omega_N = 1$, where $\mathbf{1}$ is an *N*-vector of ones. The investor's problem lies in computing the appropriate weights that yields the minimum variance possible for a given level of returns and Markowitz (1952) provides the solution by forming a Lagrangian where, the objective function and constraints are combined as follows:

$$\min_{\mathrm{w},\emptyset,\lambda} \mathrm{L} = \frac{1}{2}\mathrm{w}^{\mathbf{T}}\mathbf{V}\mathrm{w} + \emptyset\left(\mu_p - \mathrm{w}^{\mathbf{T}}\boldsymbol{\mu}\right) + \lambda(1 - \mathrm{w}^{\mathbf{T}}\mathbf{1}) \quad (5)$$

where μ_p denotes the expected return of the portfolio, and $\emptyset$ and λ are constants with positive values. The weights, $\mathrm{w}_{\mathbf{P}}$, from the quadratic program are then obtained by the first-order condition. This setting allows for negative portfolio weights, which indicates short-selling.

Assuming that rational investors tend to select portfolio with the highest risk-adjusted performance, we can derive an economic measure of diversification benefit based on the

maximum Sharpe ratio(MSR). Following Asgharian and Hansson (2006), Chiou et al. (2009), the measure is defined as

$$\mathrm{MSR} = \max_{\{w_p\}} \left\{ \frac{(w_P^T \mu)}{(w_P^T V w_P)^{1/2}} \middle| w_P^T \in \boldsymbol{G} \right\} \quad (6)$$

Thus, for an investor already holding the regional portfolio, the additional benefit gained by including regional or global assets can be measured as

$$\gamma_i = MSR - SR_i \quad (7)$$

where SR_i is the Sharpe ratio of the of the K benchmark asset or the local portfolio of the Asia Pacific investor. When MSR is greater than SR_i, γ_i assumes a positive value, which implies a greater benefit from regional or global diversification than domestic local investment.

Investors tend to face constraints such as control on short selling, asset weighting, geographical restrictions and other restrictions. Some studies suggest that diversification benefits are not be completely eroded even when these investment constraints are present (Chiou et al. 2009; Li et al. 2003; De Roon et al. 2001). Some investors tend to overweight markets that perform well while others tend to concentrate funds in minor markets. In the latter case, the rapid inflow and outflow of funds have the tendency to causes volatility in asset prices and poses liquidity challenges (Chiou 2009). Short selling features as a hedging tool because it can reduce portfolio risk without affecting expected returns (Wang 1998). On the other hand, it tends to further drive down the prices of stock that have already suffered substantial percentage drop. This could have systemic damaging effects on an entire market and even wipe out one's investment. As a result, investment regulations in many countries do not permit it and it seems more realistic to impose short selling constraints on the portfolios. This helps to understand the possible effects that a change in institutional rules might have on the portfolio performance. Hence, empirical section makes use of the increase in Sharpe ratio

to measure the economic benefit of regional or global diversification. The measure is applied under the assumption of no short-selling as well when investors are allowed to short-sell.

3.0. Data and Descriptive Statistics

For the Asia Pacific benchmark countries, the national stock market index was used from fifteen countries, which include Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, and Thailand. For the regional test assets, 124 sectoral stock indices from 10 sectors for each of the fifteen Asia Pacific countries were obtained from Datastream depending on their availability. The sectors covered are oil and gas, basic materials, industrial, consumer goods, healthcare, consumer services, telecom, utilities, financial, and technology. For the global test assets, MSCI stock market indices for 26 countries outside the Asia Pacific–18 developed markets (DM) and 8 emerging markets (EM) – were used. For risk-free rates, e 3-month Treasury bill rates were taken from the respective markets.

For all the stock markets, weekly closing prices for the period January 1996 to November 2012 were used. Monthly series, although desirable, would be constrained by limited sample points, which will make the testing approach invalid, considering the number of sectors to be included in this study. The sample period could have been longer but data is unavailable for some countries. Moreover, developing markets usually undergo structural changes over time; hence, using data for a longer period could violate the stationarity assumptions that underlie the spanning test (Driessen and Laeven 2007).

3.1. Stock Ranking based on Relative Strength

The regional portfolios used in this study are formed by selecting stocks from the 124 sectoral indices available. For a typical investor, forming a regional portfolio with all the 124 sectors seems less reasonable due to the large number of assets whose performance vary. Performance ranks which measure *relative strength*, a technical analysis technique outlined

by Levy (1967), has been used in this paper. To the best of our knowledge, this criterion has not been applied in the existing studies on international diversification benefits.

We first compute a historical price ratio that measures the current performance of the stock relative to the average performance over the previous 6 months (26 weeks) using the following equation

$$Price\ Ratio = P_{27}/\bar{A}_{26wk} \quad (9)$$

where P is stock price for the 27th week and $\bar{A}_{26wk}$ is the previous 26 week average price of the stock. We compute the ratio for weeks 27 (since the average price from the previous 26 weeks are needed for the initial computation) through 828. We use moving averages for the computation in order to smooth out the temporarily fluctuations in price movements. In order to compute the relative strength ranks, we do a weekly horizontal ranking of the price ratios for all stock and assign values from 001 (for the stock with lowest price ratio) to 124 (for stock with the highest price ratio). As an example, supposing there are three stocks with corresponding price ratios shown in column 3 of Table 1 below, then the corresponding rankings could have appeared as in column 4 of Table 1. Similar rankings are carried out for week number 28 through 828.

Table 1: Price Ratios

Week No.	Stock Sector	Price Ratio ($\boldsymbol{P_{27}/\bar{A}_{26wk}}$)	Relative Strength Rank
027	Utilities	1.403	002
027	Telecom	1.123	001
027	Financial	1.651	003

Then the corresponding rankings could have appeared as in column 4 of Table 1. Similar rankings are carried out for week number 28 through 828.

Next, we compute average relative strength ranks over all weeks for each stock. After this step, we sort the average ranks in descending order and select stocks for various regional

portfolios accordingly. Based on the sorted information, the top 41 stocks are classified as the High Performers (APAC High), the next 42 as Moderate Performers (APAC Moderate) and the bottom 41 as the Low Performers (APAC Low). The ranking results are omitted and available upon request. A complete regional portfolio (APAC), comprising of all sectors, is also formed. By this measure, we contend that stocks that have historically been strong in price movement would remain relatively strong for some significant period, that is, successive stock price changes could be useful in selecting stocks for one's portfolio.

For each country, the diversification opportunities in shown in Table 2, where investors are allowed to optimize portfolio weights on the available stock indices.

Table 2: Portfolio Opportunities

Regional diversification	Global Diversification
1. All 124 Sectoral Indices in the Asia Pacific region (APAC)	1. Stock Indices for 26 Markets outside Asia Pacific Region (Global)
2. 41 Sectoral Indices from High Performers (APAC High)	2. Stock Indices for 18 Developed markets outside Asia Pacific Region (Global DM)
3. 42 Sectoral Indices from Moderate Performers (APAC Moderate)	3. Stock Indices for 8 Emerging markets outside Asia Pacific Region (Global EM)
4. 41 Sectoral Indices from Low Performers (APAC Low)	

The table shows the constructed regional and global portfolios. Stocks in the regional portfolios are selected based on relative strength ranking.

In-sample optimization over portfolio weights for a large set of assets could lead to poor out-of-sample performance (Jagannathan and Ma 2003; Driessen and Laeven 2007) hence, we impose a constraint on overweighting or underweighting in all indices.

Table 3 presents the descriptive statistics for the Asia Pacific countries and the average statistics for the various portfolio classes. Clearly, most of the markets, except Japan, show positive mean returns. Pakistan shows the highest average return (0.3%). The standard deviation, measuring risk, ranges from 1.84% to 4.54%, which correspond with New Zealand and Thailand respectively. In general, the markets do not follow the standard risk-return

trade-off. For instance, Thailand has the highest standard deviation although it ranks 10th in terms of mean returns. For the whole region, stocks from Low Performers show the highest average return while the Moderate performers show the highest standard deviation.

Table 3: Descriptive Statistics for Stock Market Returns from the Asia Pacific Countries

	Mean	Std. Dev.	Skewness	Kurtosis
Australia	0.0007	0.0212	-0.7076	5.7725
China	0.0010	0.0356	-0.0015	5.1804
Hong Kong	0.0006	0.0370	-0.5063	7.0652
India	0.0023	0.0372	-0.4032	4.5792
Indonesia	0.0023	0.0382	-0.5537	6.8384
Japan	-0.0008	0.0286	-0.4445	5.1940
Korea	0.0013	0.0419	-0.0296	6.5108
Malaysia	0.0003	0.0316	-0.2247	13.1733
New Zealand	0.0000	0.0184	-0.4979	6.8190
Pakistan	0.0030	0.0375	-1.0132	6.5578
Philippines	0.0007	0.0351	-0.1461	5.7227
Singapore	0.0001	0.0342	-0.0416	7.5993
Sri Lanka	0.0020	0.0411	0.8454	12.3176
Taiwan	0.0000	0.0351	-0.1814	4.4061
Thailand	0.0005	0.0454	-0.0357	5.3829
Averages of Regional Sectoral Indices				
APAC	0.0002	0.0227	1.1828	9.5789
APAC High	-0.0011	0.0235	1.0380	9.1819
APAC Moderate	0.0003	0.0251	1.1171	10.7701
APAC Low	0.0014	0.0225	1.0485	7.2889

Note: The table reports the summary statistics for the returns of the 15 Asia Pacific Stock markets and the average of the regional Portfolios from January 1996 to November 2012. APAC denotes Asia Pacific whereas High, Moderate and Low refers to portfolios from the various sub-classes.

The skewness and kurtosis of are shown in columns 3 and 4 of Table 3, respectively. These measures have important implications for risk management, asset allocation, option pricing and other financial market activities. Investors generally prefer stocks with low negative skewness and low kurtosis (Kim and White 2004). All fifteen Asia Pacific markets have negatively skewed returns while the regional portfolio show positive skewed returns. Possible reasons for high negative skewness include relatively high turnover and uncommon high returns over previous periods, which are reflected in the average mean returns of the various countries. The kurtosis coefficients provide evidence of fat-tail in the return

distributions. Table 4 shows corresponding descriptive statistics for the global test countries. Most of the developed markets show positive average returns while majority of the emerging market show negative returns.

Table 4: Descriptive Statistics for Weekly Stock Returns outside the Asia Pacific Region

	Mean	Std. Dev.	Skewness	Kurtosis
Developed Markets				
Austria	0.0007	0.0407	1.4691	9.2810
Belgium	0.0004	0.0364	1.1356	8.3876
Canada	-0.0009	0.0323	0.9281	7.0245
Denmark	-0.0012	0.0323	1.1480	8.7320
Finland	0.0006	0.0521	0.8291	6.2342
France	0.0000	0.0353	0.7426	6.0046
Germany	0.0000	0.0378	0.9430	6.2841
Greece	0.0028	0.0507	0.6946	5.1863
Ireland	0.0019	0.0413	0.9785	8.3273
Israel	-0.0003	0.0332	0.5547	5.1624
Italy	0.0007	0.0374	0.6503	5.7924
Netherlands	0.0003	0.0347	0.8293	6.5585
Portugal	0.0007	0.0341	0.8999	6.9908
Spain	0.0001	0.0386	0.5811	5.0221
Sweden	-0.0002	0.0432	0.8581	6.3786
Switzerland	-0.0007	0.0276	0.5860	5.0290
UK	0.0001	0.0289	0.7464	6.6547
USA	-0.0004	0.0259	0.8223	7.7812
Emerging Markets				
Brazil	0.0002	0.0566	2.0634	17.3812
Chile	-0.0007	0.0342	1.9490	22.7250
Colombia	-0.0019	0.0429	0.7912	8.3403
Czech republic	-0.0009	0.0413	0.9395	6.6789
Egypt	-0.0007	0.0435	0.8339	7.0240
Hungary	0.0002	0.0549	1.5178	11.2045
Peru	-0.0013	0.0431	0.7604	7.5913
south Africa	-0.0003	0.0413	1.2122	8.8297

Note: The table reports the summary statistics for the returns of the 18 global Stock markets and the average of the global Portfolios from January 1996 to November 2012. DM and EM denote developed markets and emerging markets respectively.

Table 5 shows the correlation among the various markets. In general, the dependence between the benchmark countries and test assets is not at high levels, as observed by the relatively low correlation coefficients. Table 6 displays the time-varying average correlations, using the dynamic conditional correlation (DCC) model (Engle 2002), across all the Asia

Pacific countries and the various portfolios. In general, correlations tend to fluctuate overtime but remains at low levels. The figure shows significant peaks in correlation during crisis periods. Noticeable among these are the periods 1997-1998, 2000-2001, 2007-2008, and 2011-2012, corresponding with the Asia Financial Crisis, Burst of the Dotcom bubble, sub-prime crisis, and Eurozone debt crisis, respectively. Therefore, the similar correlation patterns observed in Table 6 could be attributed to a common external factor driving stock returns in the region. There is vast agreement in the literature that correlations in equity markets rise up substantially due to economic and financial integration (Longin and Solnik 1995; Bekaert and Harvey 2000; Carrieri et al. 2004; Goetzmann et al. 2005; Bekaert et al. 2005; Baele and Inghelbrecht 2009). However, the low correlations observed across the Asian markets suggest that the integration process has not fully taken place. This is in line with the existing evidence pointing out that the global financial market is not fully integrated (Bekaert and Harvey 1995; Bekaert et al. 2005; De Jong and De Roon 2005; Errunza et al. 1992). The next section presents the results for the measure of diversification benefits.

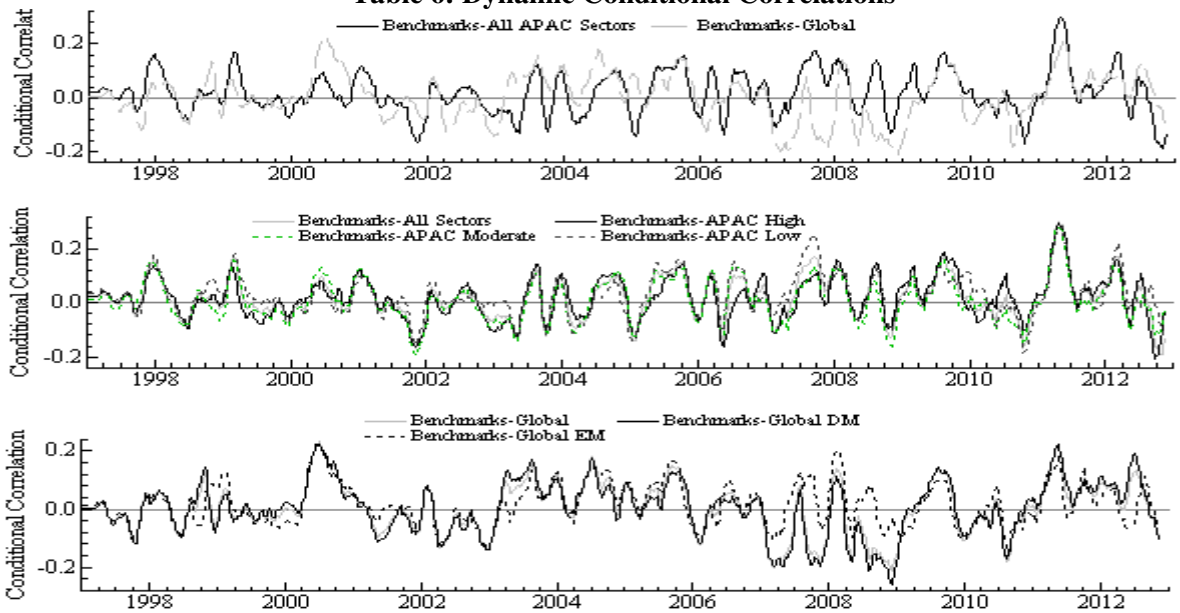
Table 5: Average Correlation Coefficients

	APAC	APAC HIGH	APAC MODERATE	APAC LOW	GLOBAL	GLOBAL DM	GLOBAL EM
Australia	0.0388	0.0431	0.0231	0.0467	-0.0136	-0.0217	0.0052
China	0.0343	0.0249	0.0131	0.0635	0.0278	0.0220	0.0357
Hong Kong	-0.0056	0.0025	-0.0192	0.0022	0.0023	-0.0018	0.0104
India	0.0045	0.0151	-0.0048	0.0036	-0.0163	-0.0259	0.0061
Indonesia	0.0122	0.0174	0.0082	0.0095	-0.0041	-0.0176	0.0247
Japan	-0.0340	-0.0323	-0.0463	-0.0167	-0.0612	-0.0644	-0.0459
Korea	0.0147	0.0208	0.0083	0.0136	0.0157	0.0058	0.0341
Malaysia	-0.0056	0.0068	-0.0215	0.0002	-0.0175	-0.0210	-0.0078
New Zealand	0.0042	0.0163	-0.0128	0.0102	0.0252	0.0229	0.0265
Pakistan	0.0251	0.0308	0.0032	0.0405	-0.0190	-0.0216	-0.0110
Philippines	0.0854	0.1010	0.0825	0.0601	0.0186	0.0070	0.0402
Singapore	-0.0031	0.0011	-0.0114	0.0024	0.0055	0.0032	0.0094
Sri Lanka	-	-0.0536	-0.0497	-0.0534	-0.0377	-0.0325	-0.0432

	0.0546						
Taiwan	0.0464	0.0426	0.0322	0.0598	0.0300	0.0175	0.0518
Thailand	0.0518	0.0486	0.0450	0.0553	0.0262	0.0148	0.0464

Table shows average correlation coefficients between the 15 Asia Pacific markets and the various portfolios. APAC denotes Asia-Pacific Sectoral Indices. High, moderate and Low denote Asia-Pacific high performing sectors, Moderate sector portfolio and Low sectoral portfolio, in that order. DM and EM refer to Developed markets and Emerging markets, respectively.

Table 6: Dynamic Conditional Correlations



Note: The figure presents the average dynamic conditional correlations estimates over the period 1996 to 2012. The upper panel presents estimate average conditional correlations of the Asia Pacific countries with the regional and global portfolios. The middle panel shows the average correlation across all 15 Asia Pacific countries and the regional portfolios. The lower panel shows the average DCC correlations across all 15 Asia Pacific countries with the global portfolios

4.0. Empirical Results

4.1. Mean-Variance Spanning Results

We estimated the regional and global diversification benefits for investors from the 15-benchmark countries selected from the Asia Pacific region. The first part of the empirical results covers the mean-variance spanning test and for the second part, we estimate the increase in Sharpe ratios. For the test assets, we use the 6 portfolios outlined previously.

The joint spanning hypothesis is rejected across all portfolio classes, implying that statistically there are benefits for domestic investors in the respective countries to invest abroad. The accompanying p-values show statistical significance at 1% when short-sale

constraints are imposed as well as when investors are allowed to short-sell. The joint tests of spanning results are omitted and available upon request.

4.1.1. Step-Down Test Results

Table 7 reports the step-down test results for the portfolios with no short-sale. The null hypothesis here is that the *K* benchmark assets span the *K+N* assets, against the alternative of no spanning. The F_1 and F_2test corresponds with $\alpha = 0_N$ and $\delta = 0_N$ respectively. The step-down test is carried out as a verification of the results obtained for the joint test. It is required that both the F_1 and F_1 be statistically insignificant in order for the spanning hypothesis to hold. In effect, the step-down approach enables us to know the source of rejection of the spanning hypothesis.

In testing for $\alpha = 0_N$, the large *p*-values associated with the F_1 suggest no spanning for all reasonable confidence levels across all portfolio classes for the various countries. On the other hand, the test for $\delta = 0_N$ is clearly rejected due to the very small *p*-values associated with the F_2 test. Our inability to reject $\alpha = 0_N$ shows that the tangency portfolio of the benchmark assets (i.e. domestic-only portfolio) and that of the test portfolios (i.e. regional or global portfolios) are not statistically different and therefore the tangency portfolio of a local investor cannot be improved by including the test assets. However, rejecting $\delta = 0_N$, suggest that the global minimum-variance portfolio of a local investor can be improved by adding either regional or global test assets.

Table 8 presents the step-down results when short-selling is allowed. For the test assets from whole of Asia Pacific region, high performing sectors and global portfolio, the step-down test results fully support rejection of the spanning hypothesis. Both the test for $\alpha = 0_N$ and $\delta = 0_N$ are clearly rejected as the accompanying *p*-values of the F_1 and F_2 test are below 5%. However, only the test for $\delta = 0_N$ is rejected for the remaining portfolios classes. We thus conclude that there are greater benefits for local investors who diversify in the Asia-

Pacific region as a whole, or focus on high performing sectors or invest globally if short-sales are allowed in the markets. Thus, the step-down test shows that both the global minimum-variance and tangency portfolio can be improved for local investors diversifying into any of the three portfolios, when short-sales are allowed.

Table 7: Mean-Variance Spanning (Step-down Test) No Short-sale

	Asia Pac Whole		Asia Pac High		Asia Pac Moderate		Asia Pac Low		Global		Global DM		Global EM	
	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Australia	2.49	56.44[a]	0.25	62.44**	2.49	56.44**	2.93	73.90**	2.27	130.18**	2.27	130.18**	0.01	128.75**
China	2.46	157.13**	0.29	224.52**	2.46	157.13**	2.96	223.7**	2.28	381.39**	2.28	381.39**	0.00	285.30**
Hong Kong	2.53	189.91**	0.28	223.63**	2.53	189.91**	2.98	250.50**	2.30	411.32**	2.30	411.32**	0.00	373.06**
India	2.58	202.28**	0.24	227.56**	2.58	202.28**	3.09	267.68**	2.32	440.99**	2.32	440.99**	0.01	373.44**
Indonesia	2.56	210.69**	0.29	265.69**	2.56	210.69**	2.95	262.6**	2.34	470.34**	2.34	470.34**	0.00	374.29**
Japan	2.48	128.47**	0.27	167.36**	2.48	128.47**	2.94	159.20**	2.23	297.55**	2.23	297.55**	0.00	263.54**
Korea	2.51	240.58**	0.29	318.0**	2.51	240.58**	2.96	315.83**	2.31	555.48**	2.31	555.48**	0.00	442.24**
Malaysia	2.54	145.37**	0.30	196.69**	2.54	145.37**	2.99	190.15**	2.36	355.45**	2.36	355.45**	0.00	288.69**
N. Zealand	2.53	33.9**	0.29	56.29**	2.53	33.91**	2.99	84.54**	2.32	105.09**	2.32	105.09**	0.00	82.64**
Pakistan	2.47	192.25**	0.25	240.46**	2.47	192.25**	2.96	254.81**	2.55	490.1**	2.55	490.19**	0.02	403.87**
Philippines	2.43	127.36**	0.26	180.60**	2.43	127.36**	2.98	224.46**	2.28	364.03**	2.28	364.03**	0.00	312.20**
Singapore	2.53	170.16**	0.29	197.35**	2.53	170.16**	2.99	234.00**	2.32	354.08**	2.32	354.08**	0.00	334.52**
Sri Lanka	2.71	273.4**	0.33	330.06**	2.71	273.41**	3.21	357.18**	2.29	528.51**	2.29	528.51**	0.03	537.94**
Taiwan	2.53	152.19**	0.29	201.93**	2.53	152.19**	2.98	229.50**	2.33	333.46**	2.33	333.46**	0.00	290.53**
Thailand	2.53	152.19**	0.29	201.93**	2.53	152.19**	2.98	229.50**	2.33	333.46**	2.33	333.46**	0.00	290.53**

Note: The table presents the results for the step-down test of spanning for local investors in Asia Pacific countries with the regional as well as the global portfolios. *F1* and *F2* denotes the separate tests for $\boldsymbol{\alpha = 0_N}$ and $\boldsymbol{\delta = 0_N}$, respectively. The test is carried out under assumption of no short-sale. ** denotes statistical significance at 1%.

Table 8: Mean-Variance Spanning (Step-down Test) Short-sale allowed

	Asia Pac Whole		Asia Pac High		Asia Pac Moderate		Asia Pac Low		Global		Global DM		Global EM	
	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
Australia	11.82**	4725.93**	14.78**	2166.11**	0.22	227.53**	0.46	2389.03**	4.26*	1221.70*	1.88	1031.44**	2.00	467.93**
China	12.30**	12698.48**	14.98**	5954.85**	0.29	787.06**	0.41	6555.15**	4.27*	3459.08*	1.95	2804.69**	1.95	1394.59**
Hong Kong	11.89**	14370.68**	14.68**	6774.80**	0.25	764.35**	0.47	7380.18**	4.20*	3793.43*	1.89	3135.95**	1.93	1500.10**
India	11.97**	14265.12**	14.88**	6637.09**	0.30	823.14**	0.42	7367.98**	4.37*	3799.43*	1.94	3130.13**	2.02	1541.6**
Indonesia	11.30**	15557.89**	14.26**	7260.20**	0.21	789.86**	0.52	7994.24**	4.17*	4110.16*	1.86	3364.50**	2.03	1621.55**
Japan	12.54**	8809.21**	15.14**	4077.08**	0.24	487.74**	0.42	4582.66**	4.2*	2360.79*	1.97	1937.05**	1.96	992.94**
Korea	11.75**	18436.08**	14.81**	8429.23**	0.24	976.35**	0.49	9575.64**	4.31*	4791.75*	1.95	3927.73**	2.00	1911.42**
Malaysia	12.02**	10195.60**	14.83**	4730.94**	0.25	573.11**	0.46	5233.68**	4.25*	2664.00*	1.91	2235.81**	1.92	1090.85**
N. Zealand	12.02**	3611.61**	14.81**	1697.27**	0.25	213.25**	0.47	1807.6**	4.2*	861.52*	1.91	703.12**	1.90	358.8**
Pakistan	11.41**	14861.19**	14.67**	6850.2**	0.20	765.39**	0.46	7614.25**	4.25*	3947.08*	1.94	3209.85**	1.87	1641.66**
Philippine	12.01**	12661.71**	14.93**	5802.11**	0.22	600.82**	0.46	6599.88**	4.2*	3329.50*	1.92	2770.48**	1.99	1290.31**
Singapore	12.01**	12291.99**	14.80**	5728.42**	0.25	623.34**	0.47	6387.69**	4.18*	3322.59*	1.89	2734.77**	1.90	1300.71**
Sri Lanka	12.12**	17284.86**	14.75**	8147.35**	0.23	929.56**	0.48	9146.85**	4.1*	4751.79*	1.81	3934.63**	1.85	1978.59**
Taiwan	12.05**	13105.91**	14.83**	6109.91**	0.25	624.22**	0.47	6738.90**	4.19*	3359.49*	1.90	2739.89**	1.90	1304.50**
Thailand	12.01**	21101.43**	14.85**	9760.93**	0.24	1098.68**	0.45	10825.28**	4.33*	5401.73*	1.96	4432.29**	1.96	2176.58**

Note: The table presents the results for the step-down test of spanning for local investors in Asia Pacific countries with the regional as well as the global portfolios. *F1* and *F2* denotes the separate tests for $\boldsymbol{\alpha} = \mathbf{0}_N$ and $\boldsymbol{\delta} = \mathbf{0}_N$, respectively. The test is carried out under assumption that investors are allowed to short-sell. ** and * denotes statistical significance at 1% and 5%, respectively.

4.2. Increase in Sharpe Ratio

In statistical terms, we have provided evidence via the joint test of spanning that there are benefits in regional and global diversification for domestic investors holding a portfolio of stocks in the local index. We have also shown through the step-down test that diversifying regionally or globally could improve global minimum-variance portfolio of the local investor although the tangency portfolio will not be affected much. This holds when short-selling is not allowed. We have also shown that both the global minimum-variance and tangency portfolio can be improved for a domestic investors diversifying into any of the three portfolios when short-sales are allowed.

The analysis in this section finds out whether the potential diversification benefits are economically significant, based on the increase in the Sharpe ratio. The results averaged across countries in Table 9 show that there are benefits for a local investor in the Asia Pacific region. For the regional portfolios, the average benefits are 54.76% for the whole region, 17.24% for the high performers, and 54.76% for the moderate performers and 48.98% for the low performers. The results show that the benefits from moderate and low performers outweigh benefits from the high performers, which is a somehow unusual. For the global portfolios, the average benefits are 27.10% for all countries combined, 27.10% for the portfolio of assets from developed markets and 8.340% for the emerging markets portfolio.

However, when short-selling is assumed, it is almost the case across all countries that there are either no improvement or Sharpe ratio decreases, as most of the values reported in the table tend to be zeros and negatives. When short-selling is allowed the average increases in Sharpe ratio are -127.21% for Asia Pacific regional portfolio; -73.32% for high performers; -56.18 for low performers; -27.70% for global portfolio; -21.47% for global developed markets portfolio; and -0.57% for global emerging markets portfolio. Nevertheless, for investors diversifying with moderate performing sectors, the average

Sharpe ratio is 8.19%. In particular, investors holding such portfolios gain as follows: Hong Kong (2.03%); Japan (7.16%); Malaysia (3.69%); Philippine (1.46%); and Singapore (3.1%).

4.2.1. Comparing Regional and Global Increase in Sharpe ratios

In order to find out whether regional diversification benefits outweigh the global benefits, we compute the differences between the Sharpe ratios of the regionally diversified portfolio and the globally diversified portfolios. The results are shown in Table 10 for investment with short-selling constraint (No SS) as well as the case where investors are allowed to short-sale (SS). Results in columns 2 to 7 correspond with the Asia Pacific regional portfolio (APAC) against the 3 global portfolios; columns 8 to 13 contain the difference between the Sharpe ratios of the Asia-Pacific sector portfolio; and columns 14 to 19 shows the results for the moderate performing sectors in the Asia-Pacific region.

When short-selling constraints are imposed, the benefits for diversifying across the whole region outweigh the benefits of investing globally, as shown by the positive values in columns 2, 4 and 6.

The case where short-selling is allowed is shown in columns 3, 5 and 7 of Table 10. While the cross-country variations are small, the average differences are -99 %, -106%, and -127%, corresponding with globally diversified portfolio (Global), globally diversified portfolio with test assets from developed markets only (Global DM) and globally diversified portfolio with test assets from emerging markets only (Global EM), respectively. This suggests that short-selling erodes the benefits of investing regionally.

On the contrary, mixed results are reported for the high performing sectors without short-selling constraint, as shown in columns 8, 10, and 12 of Table 10. Some of the reported differences in Sharpe ratios in the columns tend to be negative while others remain positive. For instance, there could gain greater global benefits for local investors from Hong Kong (-0.03), India (-0.58), Indonesia (-0.40), Japan (-0.03), Philippines (-0.02), Singapore (-0.02),

Sri Lanka (-0.50) and Thailand (-0.01) who are considering investing in high performing sectors in the Asia Pacific region. However, there could be regional gains if the global portfolio being compared contains assets from Developed markets only as shown by the positive values in column 12.

Table 9: Average Increase in Sharpe Ratio

Asia Pac Whole	Asia Pac High	Asia Pac Moderate	Asia Pac Low	Global	Global DM	Global EM
No Short-Selling						
0.548	0.172	0.548	0.49	0.271	0.271	0.083
With Short-Selling						
-1.272	-0.733	0.082	-0.562	-0.277	-0.215	-0.006

Note: The table presents the results for average Sharpe ratio increments ($\gamma_i = MSR - SR_i$) across 15 Asia-Pacific countries, due to international diversification. DM and EM denote developed markets and emerging markets outside the Asia Pacific region, respectively.

The difference in Sharpe ratio for high performers versus the three global portfolios, are shown in columns 9, 11, and 13 of Table 10, where investors are allowed to short-sell. Overall results indicate that the global benefits outweigh the regional benefits, as shown by the averages, which are -46% (Global), -52% (Global DM) and -73% (Global EM).

When considering the moderate performing sectors, regional diversification benefits generally outweigh the global benefits as shown in Columns 14-19 of Table 10. When allowing for short-selling, the average increase in Sharpe ratio of the regional diversification opportunities outweighs the global benefits by 36%, 30%, and 9%, referring to Global, Global DM and Global EM, respectively. Under the assumption that short-sales are allowed in the markets, the increase in Sharpe ratio from regional diversification with moderate performing assets surpasses the increase in Sharpe ratio from global diversification by 52.55% for Australian investors, 12.83% for investors in Japan, 3.69% for those in Malaysia and 30.04% for investors in Singapore. Others are 1.46% for investors in the Philippines, 136.57% for Taiwan investors and a surprising 310.99% for those in New Zealand.

The results show that substantial benefits could be gained by investing regionally rather than globally diversified portfolio. Averaged over all countries, the difference in regional and

global economic benefit from diversification is about 28% for entire regional portfolio; -10% for High performing portfolio; and 22% for moderate performing portfolio, as shown by the bold values in Table 10.

It is intriguing that benefits from the high performing sectors are lesser than benefits from the moderate. This may sound counter intuitive but it is explainable. Based on the relative strength rankings majority of the sectors forming the high performing portfolio are from emerging markets in the Asia pacific region; that is 25 compared with 16 from the developed markets. On the other hand, the moderate performing class has 23 sectoral stocks from developed markets and only 19 from emerging market in the Asia Pacific region. Similarly, the low performers comprise of 22 sectoral stocks from developed markets and only 19 from emerging markets. The high number of emerging market stocks dominating the high performing portfolio might be the reason for the relatively low outcomes.

5.0. Conclusion

This paper investigates the diversification benefits of regionally and globally diversified portfolios to local investor in the Asia Pacific region. Employing rankings based on relative strength of stocks, three sub-classes of regional portfolio were formed using sectoral indices from 15 Asia Pacific economies. The traditional mean-variance test spanning and step-down approach are employed to explore the statistical benefit of international diversification, in particular whether the portfolio holding of the local investor spans the regional or global portfolio. The study also relies on improvement in Sharpe ratio to estimate the economic benefit of international diversification.

Under the assumption of no short-selling, the results show greater benefits in diversifying regionally or globally. The results show that benefits of international diversification are larger for the local investor who selects assets from the region compared to going global. We also find that investors are better off investing in a portfolio of moderate and low performing

assets classes as compared to holding a regional portfolio of high performing assets. When short-sale is allowed, the regional and global portfolio still yields greater benefits under the spanning test. However, the economic benefit, measured by increase in Sharpe ratio, declines significantly for most countries. In contrast, portfolios with assets from moderate performers still provide substantial benefits and even surpass the global benefits.

We contribute to the existing literature by providing evidence on international diversification from the perspective of local investors in the Asia-Pacific region, who considers regional and global portfolio of diverse asset classes and where regional assets are selected based on relative strength rank. In line with Driessen and Laeven (2007), we show that there are benefits from international diversification for local investors outside the US. The findings have vital implications for portfolio management, and it may prove useful to investigate how the regional and global benefits changes in different sub-periods and different economic conditions.

Table 10: Gains from Sharpe ratios - Regional vs Global

	APAC - Global		APAC - Global DM		APAC- Global EM		APAC High - Global		APAC High - Global DM		APAC High - Global EM		APAC Moderate - Global		APAC Moderate - Global DM		APAC Moderate - Global EM	
	No SS	SS	No SS	SS	No SS	SS	No SS	SS	No SS	SS	No SS	SS	No SS	SS	No SS	SS	No SS	SS
Australia	0.22	0.00	0.22	0.00	1.14	0.00	0.13	0.00	0.13	0.00	1.05	0.00	0.22	0.53	0.22	0.53	1.14	0.53
China	0.24	0.00	0.24	0.00	0.56	0.00	0.14	0.00	0.14	0.00	0.46	0.00	0.24	-0.10	0.24	-0.10	0.56	-0.10
Hon Kong	0.01	0.00	0.01	0.00	0.05	0.00	-0.03	0.00	-0.03	0.00	0.01	0.00	0.01	0.02	0.01	0.02	0.05	0.02
India	0.54	0.00	0.54	0.00	1.12	0.00	-0.58	0.00	-0.58	0.00	0.00	0.00	0.54	0.00	0.54	0.00	1.12	0.00
Indonesia	0.42	0.00	0.42	0.00	0.83	0.00	-0.40	0.00	-0.40	0.00	0.00	0.00	0.42	0.00	0.42	0.00	0.83	0.00
Japan	0.01	-0.30	0.01	-0.32	0.06	-0.27	-0.03	-0.17	-0.03	-0.19	0.02	-0.14	0.01	0.13	0.01	0.11	0.06	0.16
Korea	0.19	0.00	0.19	0.00	0.33	0.00	-0.14	0.00	-0.14	0.00	0.00	0.00	0.19	0.00	0.19	0.00	0.33	0.00
Malaysia	0.20	0.00	0.20	0.00	0.61	0.00	0.11	0.00	0.11	0.00	0.52	0.00	0.20	0.04	0.20	0.04	0.61	0.04
N. Zealand	0.18	-9.61	0.18	-10.21	0.17	-12.08	0.09	-4.84	0.09	-5.43	0.09	-7.30	0.18	3.11	0.18	2.51	0.17	0.64
Pakistan	1.23	0.00	1.23	0.00	1.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.23	0.00	1.23	0.00	1.23	0.00
Philippines	0.02	0.00	0.02	0.00	0.07	0.00	-0.02	0.00	-0.02	0.00	0.03	0.00	0.02	0.01	0.02	0.01	0.07	0.01
Singapore	0.02	-0.84	0.02	-0.90	0.06	-1.11	-0.02	0.27	-0.02	0.22	0.02	0.00	0.02	0.30	0.02	0.25	0.06	0.03
Sri Lanka	0.71	0.00	0.71	0.00	1.22	0.00	-0.50	0.00	-0.50	0.00	0.00	0.00	0.71	0.00	0.71	0.00	1.22	0.00
Taiwan	0.08	-4.17	0.08	-4.43	0.11	-5.53	0.02	-2.11	0.02	-2.37	0.05	-3.47	0.08	1.37	0.08	1.11	0.11	0.00
Thailand	0.03	0.00	0.03	0.00	0.09	0.00	-0.01	0.00	-0.01	0.00	0.04	0.00	0.03	-0.01	0.03	-0.01	0.09	-0.01
Average	**0.28**	-0.99	0.28	-1.06	0.46	-1.27	**-0.10**	-0.46	-0.10	-0.52	0.09	-0.73	**0.22**	0.36	0.22	0.30	1.14	0.09

Note: The table presents the results for differences in Sharpe ratios for the regional diversification portfolios against the global diversification portfolios. A positive (negative) value indicates that regional diversification benefits outweigh (below) global benefits. APAC, High, and Moderate denotes All Asia Pacific regional portfolio, Asia Pacific portfolio for high performing sectors and Asia Pacific portfolio for Moderate performing sectors, respectively. Global, Global DM and Global EM denote global portfolio, global portfolio with assets from developed markets and global portfolio with assets from emerging markets, respectively.

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