

International Portfolio Diversification at Industry Level within South-East Asian Stock Markets

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Abstract

The issue of financial integration, at the country level, is a well-documented phenomenon in the area of International Portfolio Diversification (IPD). Despite the increasing degree of financial integration, it is important to investigate the global integration at industry level to capture the potential benefits of IPD. Thus, this study attempts to evaluate the potential advantages of IPD for international investors when investing in emerging stock markets of South-East Asia, through examining the co-integration within these markets at industry level during 2000-2012. Using Multiple Fitness Functions Genetic Algorithm (MFFGA) and co-integration techniques, the results imply that South-East Asian emerging stock markets are not co-integrated at the industry level, and thus great diversification gains can still be achieved by cross-industry portfolio diversification in this region. However, another contribution of the study is that the findings explicitly identify the industries that are better suited for diversification purposes.

Keywords

Co-integration, Emerging markets, International portfolio diversification, Multiple Fitness Functions Genetic Algorithm (MFFGA), Optimization.

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Introduction

In recent years, advances in information technology have extended the scope and the speed of information and made geographic distances less significant. This has increased the speed and efficiency of global financial operations. Meanwhile, many national markets have been liberalized and opened up to international investors, regulatory barriers have been reduced, the difficulty of getting information and high transaction costs no longer restrict investors, and the volume of cross-border transactions and international investments have increased (Mansourfar, 2010).

Following the growth in global investments, co-integration has also increased in international financial markets. Consequently, International Portfolio Investment (IPI) has been an integral feature of global capital markets. IPI brings benefits of increasing returns and/or reducing risk, especially in emerging markets of Latin America, Europe, Central and East Asia, the Middle East, and North Africa. Meanwhile, International Portfolio Diversification (IPD) has great appeal for IPI, and thus foreign investments have become an important strategy to maximize shareholders' wealth. Modern portfolio theory (Markowitz, 1952, 1959) suggests that greater benefits would be available when lower correlation exists between returns and assets. Furthermore, international portfolio theory (Solnik, 1974) implies that more benefits from diversification can be sought from cross-border investments (Mansourfar, 2010; Tang, 2004).

With greater integration of advanced markets (Chang et al., 2006; Carrieri et al., 2006; Morana & Beltratti, 2008; Mansourfar, 2013), the studies of Worthington et al. (2003), Dunis and Shannon (2005), Gupta (2006), Ibrahim (2006), Rezayat and Yavas (2006), Gupta and Donleavy (2009), Chiou et al. (2009), Chiou (2009), Graham et al. (2012), and Gupta and Guidi (2012) show that emerging and developing markets can still provide diversification benefits for international investors, because developing markets experience higher economical growth than developed markets and provide greater returns despite being riskier.

Total net capital inflows to emerging markets have increased in general from 2003 to 2010 (Fig. 1) and amounted to \$1206 billion in 2011 and an estimated amount of \$1250 billion in 2012 (IIF, 2013). The net portfolio investment was \$5 billion in 2011 and was estimated to be \$124 billion in 2012; this indicates a robust increase of portfolio inflows to emerging markets by 2380% in 2012 (IIF, 2013). Figure 2 shows the volatility and increases in net portfolio investment in emerging markets from 1994 to 2011 in comparison with other types of net private capital flows. As indicated in Figure 1, *emerging Asia* accounts for a large portion of total net inflows to emerging markets from 2003 to 2010. Capital and portfolio inflows to emerging Asia have been estimated at \$597 and \$80 billion, respectively, which account for 48% and 65% of total capital inflows and portfolio inflows to emerging markets.

Figure 3 demonstrates the volatility and increase of net private capital flows by recipient economies in emerging Asia from 1994 to 2011. Among emerging Asian markets, the inflows to Hong Kong, Singapore, South Korea, and Taiwan (known as NIEs) have increased substantially during this period.

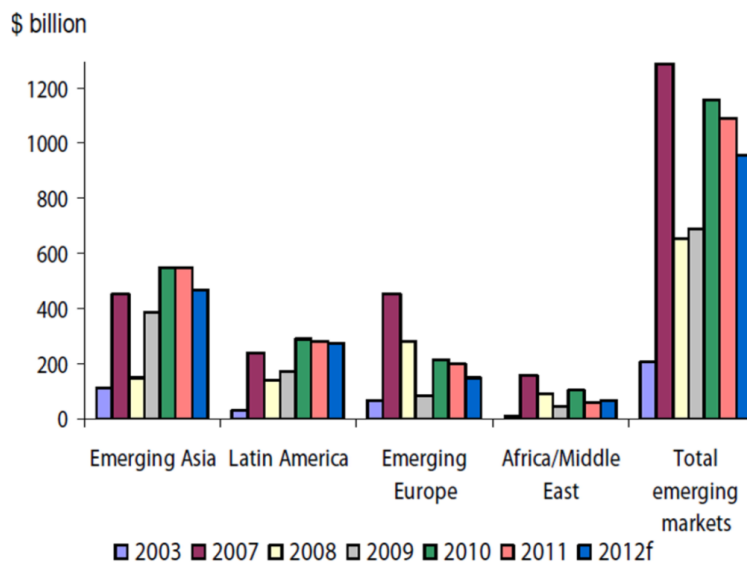


Fig. 1. Total net inflows to emerging markets from 2003 to 2010

Source: IIF

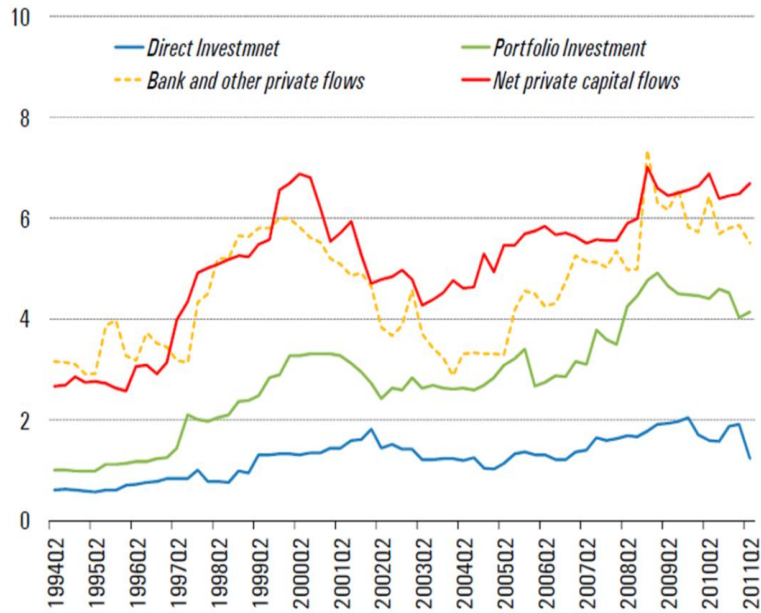


Fig. 2. Emerging Asia: Volatility of net private capital flows by flow type
Sources: IMF

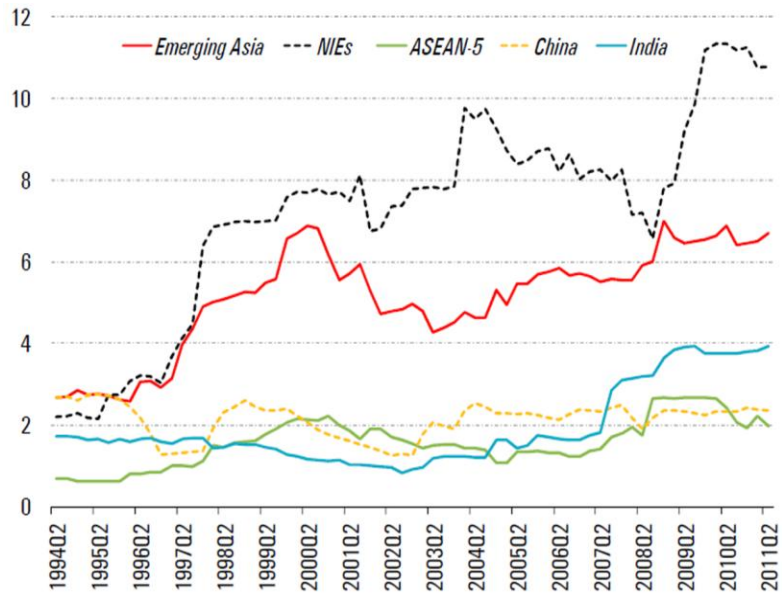


Fig. 3. Emerging Asia: Volatility of net private capital flows by recipient economies
Sources: IMF

Literature Review

As aforementioned, market liberalization and growth in international investment have been paralleled by a growth in integration of international financial markets. Examining global stock market integration is a central issue in finance given the implied consequences of asset allocation decisions and portfolio diversification (Graham et al., 2012). There is a large body of research on capital market integration and international diversification. Studies of Manning (2002), Phylaktis and Ravazzolo (2002), Leong and Felmingham (2003), Kawai (2005), Click and Plummer (2005), Dunis and Shannon (2005), Rana (2007), Chiang et al. (2007), Awokuse et al. (2009), Huyghebaert and Wang (2010), and Thao and Daly (2012) report that South-East Asian stock markets have been co-integrated, and therefore the benefits of international portfolio diversification have diminished in this region.

Contrary to the above studies, Deker et al. (2001), Ng (2002), Worthington et al. (2003), Gérard et al. (2003), Pongsaparn and Unteroberdoerster (2011), and Claus and Lucey (2012) find that South-East Asian stock markets have not been co-integrated yet and these markets can still provide great IPD benefits for international investors. Evidently, there is a paradox in the literature concerning the benefits of IPD within South-East Asian stock markets.

However, based on international asset-pricing models of Solnik (1974), Stulz (1981), Adler and Dumas (1983), and Errunza and Losq (1985), many empirical papers provide economic and statistical evidence of integration or segmentation at the country level. While integration at the country level has been extensively examined, the analysis of global integration processes at the industry level has not received much attention (Carrieri et al., 2004; Ferreira & Gama, 2010).

The investigation of global integration at the industry level is important because of increasing economic integration, industrial reorganization, and blurring of national boundaries. Indeed, it is possible that even if a country is integrated with the world capital

market, some of the industries may not be integrated, owing to, for example, industry-specific foreign ownership restrictions, absence of low-volume exports, or limited presence of firms from those industries on foreign exchanges. On the other hand, a country that is segmented from the world market may have industries that are not segmented to the same degree. Kavussanos et al. (2002) stated that investors could make capital gains by timing their investments, and/or adjusting the degree of their portfolio diversification, not only across industries domestically or across countries internationally, but also across global industries.

Hence, identifying whether there is a sizable industry-specific risk exposure is central for a comprehensive analysis of world market integration. The question of industry integration is also related to the importance of industrial structure for international diversification strategies. Although several studies suggest the dominance of the country factor (Lessard, 1976; Heston & Rouwenhorst, 1994; Baca et al., 2000), there is evidence of the importance of industry factors as well (Roll, 1992; Bai & Green, 2010). Indeed, if industry risk is priced, an investor can construct a portfolio with better risk–return characteristics by diversifying it across industries as well as geographies (Carrieri et al., 2004).

Carrieri et al. (2004) argue that country-level integration (segmentation) does not preclude industry-level segmentation (integration). Indeed, results suggest that a country is integrated with (segmented from) the world capital markets only if most of its industries are integrated (segmented). They also show that industries that are priced differently from either the world or domestic markets represent incremental opportunities for international diversification, and investors should use both cross-country and cross-industry diversification as a way to improve portfolio performance.

By investigating the time series of realized correlations between global industries and the world market over the 1979–2008 period, Ferreira and Gama (2010) find that industry correlations do not show a systematic increase over time, and thus industry portfolios constitute

an interesting dimension for international diversification, as opposed to the increasingly correlated country portfolios.

Since most of the previous studies examine co-integration at the country level and less attention has been paid to co-integration at industry level, and according to the paradox found in the literature, this study aims to investigate whether international investors can still benefit by diversifying their portfolios within emerging South-East Asian stock markets. For this purpose, based on portfolio optimization model and using Multiple Fitness Functions Genetic Algorithm (MFFGA), industries by which the benefits of portfolio is expected to be optimal are selected. In this paper, the classical Markowitz (1952, 1959) portfolio optimization model is developed by adding a third objective with an intention to minimize the number of excess industry indices in optimal portfolio. After selecting the optimal industries, co-integration between the industry indices is explored to capture the long-run benefits of portfolio diversification. The results indicate that there is no co-integration among South-East Asian stock markets at industry level, and thus the investors can benefit by diversifying their portfolios in these markets.

The rest of the paper is organized as follows: The data and the methodology of the study are described in Sections 2 and 3. The empirical results are presented in Section 4, and the conclusions are made in Section 5.

Data

As previously discussed, emerging markets can be considered as eligible investment opportunities for international investors to reduce their portfolio risk. Among these, the emerging markets of Southeast Asia play a potential role in providing international portfolio diversification benefits for international investors. This research focuses on the emerging markets of South-East Asia. Countries taken into consideration are Indonesia, China, South Korea, Malaysia, Taiwan, Thailand, Hong Kong, and Singapore.

The data set of FTSE¹ in the form of weekly price indices from

1. Financial Times Stock Exchange

Methodology

To evaluate the co-integration, we proceed in two steps. First, we need to find optimal portfolios; hence, Multiple-Fitness Function Genetic Algorithm is used to create the efficient frontier. Based on the estimated efficient frontier, three optimal portfolios will be created from common sectors among the stock markets. Second, the Johansen and Johansen and Juselius co-integration test is performed to evaluate the long-run relationship between the industries in each of created optimal portfolios, and also another portfolio including uncommon sectors within the stock markets.

Optimization Algorithm

Portfolio optimization problem can be formulated as follows:

$$\text{Maximize } R_p = \sum_{i=1}^N r_i x_i \quad (1)$$

$$\text{Minimize } \sigma_p = \sqrt{\sum_{i=1}^N \sum_{j=1}^N x_i x_j \text{cov}_{ij}} \quad (2)$$

$$\text{Minimize } D = \max \{0, \sum_{i=1}^N \varphi(x_i) - P\} \quad (3)$$

Subject to

$$\begin{aligned} \sum_{i=1}^N x_i &= 1 \\ x_i &\geq 0 \quad i = 1, 2, 3, \dots, N \end{aligned} \quad (4)$$

where:

R_p = The expected portfolio return

r_i = The expected return on index of industry i

x_i = The proportion of portfolio allocated to industry i

N = The number of industries

σ_p = Portfolio risk

cov_{ij} = Covariance between rates of return on indices of industries i and j , and $\text{cov}_{ij} = r_{ij} \sigma_i \sigma_j$

σ_i^2 = Variance of rate of return on index of industry i , and

$$\sigma_i^2 = \frac{\sum_{i=1}^N (r_i - \bar{r}_i)^2}{N-1} \quad (5)$$

D = Number of excess industry indices in optimal portfolio

P = Optimal diversity in portfolio

$$\varphi(x_i) = \begin{cases} 1 & x_i > 0 \\ 0 & x_i = 0 \end{cases}$$

To solve the proposed models and find the EFs, the Multiple-Fitness Function Genetic Algorithm (MFFGA) developed by Solimanpur et al. (2004) and Solimanpur and Ranjdoostfard (2009) is modified and applied. In this approach, each portfolio is represented by one chromosome with num_bits genes for each industry. Therefore, for a portfolio with N industries, the length of any chromosome would be $N \times num_bits$.

For the purpose of representing the genes, a binary encoding system is used. If the decoded decimal value of industry i be v_i , the following equation is defined to calculate the portion of capital allocated to industry i :

$$x_i = \frac{v_i}{\sum_{i=1}^N v_i} \quad (6)$$

In the above equation, x_i is the weight of capital allocated to industry i and N is the number of industries. Therefore, in the proposed coding system, for all portfolios it is obvious that $x_i \geq 0$ for $i = 1, 2, 3, \dots, N$ and $\sum_{i=1}^N x_i = 1$, which refer to the automatic satisfaction of the constraints of the optimization problem. This fulfillment will greatly increase the calculation efficiency of the algorithms.

It is certainly needed to define the K fitness functions in the quest for the objective space. Assuming that the objective functions R_p , σ_p , and D are represented by f_1 , f_2 , and f_3 , respectively, the fitness function of direction k would be derived as follows:

$$fit_k(S) = w_{k1}f_1(S) + w_{k2}f_2(S) + w_{k3}f_3(S), \quad (7)$$

where the fitness of portfolio S with respect to the k th search direction is represented by $fit_k(S)$, the value of the first, second, and third objective functions for portfolio S is indicated by $f_1(S)$, $f_2(S)$, and

$f_3(S)$, respectively, and the weights of objective functions are shown by w_{k1} , w_{k2} , and w_{k3} , respectively.

Since the values of risk and return vary in different ranges, it would be possible that an objective with a greater value dominates the contribution of other objectives. Therefore, the objective functions have been normalized as follows:

$$fit_k(S) = w_{k1} h_1(S) + w_{k2} h_2(S) + w_{k3} h_3(S) \quad (8)$$

where

$$h_l(S) = \frac{f_l(S)}{\max\{f_l(S') | \forall S' \in \Omega\}} \quad (9)$$

The normalized value of the objective function l for portfolio S is denoted by the function $h_l(S)$ and Ω denotes the set of all portfolios under evaluation.

To form search directions, MFFGA applies a uniform design technique. To calculate search directions, the numbers of directions are considered as levels and objective functions are treated as factors of a matrix. Hence, search directions are calculated as:

$$W = [w_{kl}]_{k \times 2} ; w_{kl} = \frac{u_{kl}}{\sum_{l=1}^2 u_{kl}} \quad (10)$$

where $W(K, 2)=[w_{kl}]_{k \times 2}$ is the uniform design matrix. Each row of the matrix W is a search vector and w_{kl} is the weight of the objective function l in fitness function k .

The genetic algorithm was programmed in Matlab.¹ The program consists of eleven function files: One main function and 10 subfunctions. In the main function file, first, the input information (i.e., the number of objective functions, the number of sectors, rate of return for each sector, the risk of each sector, average rate of return for sectors, and optimal diversity in portfolio) and controlling parameters (i.e., population size, mutation probability, crossover probability, maximum number of generations, and the number of repeats) are entered. Then the annual returns matrices of industries, the average

1. The files are available on request

returns matrices, and the standard deviation of annual returns (risk) matrices are created, and the number of sectors is entered.

Co-Integration Approach

The widely used Johansen (1988, 1991) and Johansen and Juselius (1990) co-integration tests based on the Vector Autoregressive (VAR) framework were utilized to identify long-term co-movements between international markets. Ratanapakorn and Sharma (2002) argue that all the smallest eigenvalues are taken into account by λ -trace statistic; thus, it tends to have more power than the maximum eigenvalue statistics. In addition, Johansen and Juselius (1990) indicate that the emphasis should be on λ -trace statistics rather than λ -max statistics when a conflict between these two test statistics occurs. Another relevant consideration is the choice of the appropriate lag length as the results of the Johansen-Juselius co-integration test are very sensitive to the order of the VAR model. This study specifies the optimal lag length using the Johansen's (1992) suggestion such that the VAR residuals must be Gaussian or serially uncorrelated.

However, before running a co-integration test, the nonstationarity of the data series has to be established. The commonly used unit root tests, Augmented Dickey–Fuller (ADF) test, and the Phillips and Perron (PP) nonparametric test are valid when there is no structural breakpoint in the time series; but with the existence of structural breakpoints, these tests would not provide reliable results for assessing the degree of co-integration. In other words, failing to consider a structural breakpoint may lead to a bias in the results of the unit root tests and failure to reject the null hypothesis of the unit root; finally, the results of the co-integration test might be spurious.

Therefore, in this paper, Zivot and Andrews' (1992), and Lumsdaine and Papell's (1997) unit-root tests are applied to investigate the presence of stochastic nonstationarity in the data. The Zivot-Andrews' (1992) unit root test for time series allows for one structural break in the series, which may appear in intercept, trend, or both, and the Lumsdaine and Papell's (1997) unit-root test allows for two structural breaks in the series, which may appear in intercept, trend, or both.

Findings

Portfolio Optimization

Among 178 sectors of South-East Asian stock markets in this study, six sectors have been chosen that are common between those eight countries and their data are available for 2003–2012 (i.e., 48 sectors). There is also another portfolio that consists of five sectors uncommon among those countries (Table 2). Therefore, portfolio optimization is performed on the portfolio consisting of 48 common sectors.

Weekly rates of return for sector A are converted to annual returns using Equation (11).

$$A = ((\Pi(r_A + 1))^{(1+T)}) - 1 \quad (11)$$

In this equation, Π is the product function, r_A is the weekly returns for sector A, and T is the conversion factor, which is equal to the number of weeks per year.

Table 2. List of sectors

Common sectors	Uncommon sectors
Consumer GDS	Indonesia personal goods
Financials	Indonesia pharm and bio
Inds transpt	Korea nonlife insurance
Industrials	Singapore aero/defense
Telecom	Taiwan life insurance
Fd producers	

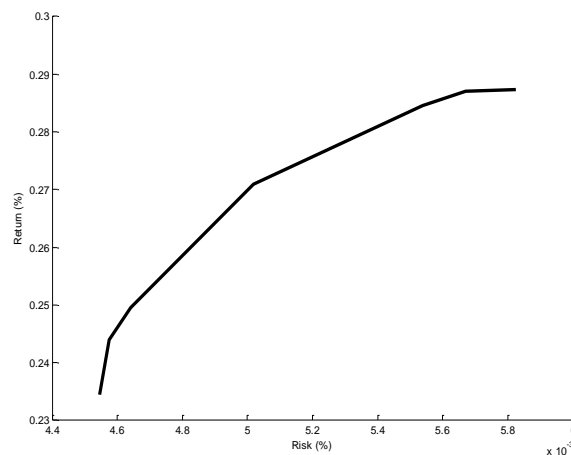


Fig. 4. Efficient frontier of international portfolios constructed by common sectors

Figure 4 shows the efficient frontier of the international portfolio constructed of common sectors. To proceed, three important portfolios from efficient frontier are selected to provide further realization and to explore the optimal capital allocation among stock markets. The selections include the minimum, the median, and the maximum risk–return portfolios.

Table 3 summarizes the results of portfolio optimization and shows the optimal capital allocation to each portfolio. In terms of optimal capital allocation, for instance, in the interest of selecting the minimum risk–return portfolio, the results are specified in the first column of the table. This portfolio will result in about 0.235% weekly return with 0.00455% risk. If investors are interested in constructing the minimum risk–return portfolio, the total capital that is optimally allocated to each sector should be as follows: Indonesia Financials (4%), Hong Kong Inds Transpt (12%), Singapore Industrials (5%), Thailand Telecom (23%), Malaysia Telecom (9%), China Fd Producers (31%), and Taiwan Fd Producers (16%). These results highlight the influential role of China Fd Producers industry in providing diversification benefits for international investors. Similarly, if the investors seek the maximum risk–return (which provides 0.287% weekly return with 0.00582% risk), the largest portion (50%) and the smallest portion (6%) of capital are respectively allocated to Indonesia Industrials sector and Malaysia Fd Producers sector. Likewise, a median risk–return portfolio, which results in 0.271% weekly return with 0.00502% risk, is suitable for investors interested in median risk and return.

Table 3. Optimal capital allocated to each sector

Minimum risk–return		Median risk–return		Maximum Risk–Return	
Country— Sector	Allocation (%)	Country— Sector	Allocation (%)	Country— Sector	Allocation (%)
Indonesia Financials	4	Thailand Consumer GDS	12	Korea Consumer Gds	22
Hong Kong Inds Transpt	12	Indonesia Financials	28	Thailand Financials	14
Singapore Industrials	5	China Financials	3	Indonesia Industrials	50
Thailand Telecom	23	Malaysia Inds Transpt	9	Hong Kong Inds Transpt	8

Continue Table 3. Optimal capital allocated to each sector

Minimum risk–return		Median risk–return		Maximum Risk–Return	
Country—Sector	Allocation (%)	Country—Sector	Allocation (%)	Country—Sector	Allocation (%)
Malaysia Telecom	9	Hong Kong Industrials	11	Malaysia Fd Producers	6
China Fd Producers	31	Singapore Telecom	14		
Taiwan Fd Producers	16	Korea Fd Producers	4		
		Taiwan Fd Producers	19		

Unit Root Tests

Tables 4-7 report the results of unit root tests for weekly price index of the aforementioned portfolios (the minimum risk–return portfolio, the median risk–return portfolio, the maximum risk–return portfolio, and the portfolio of uncommon sectors) using Zivot-Andrews (ZA) and Lumsdaine-Papell (LP) unit-root tests. Both ZA and LP tests suggest that the levels of all variables across the sample sectors contain unit roots, and thus follow stochastic trends in their levels. Therefore, all variables are integrated of first order (I(1)).

Table 4. Unit root tests of weekly price index for the minimum risk–return portfolio

Country—Sector	ZA		LP	
	<i>P</i> value	First difference	<i>P</i> value	First difference
China Fd Producers	0.0001	I(1)	0.0001	I(1)
Hong Kong Inds Transpt	0.0005	I(1)	0.0001	I(1)
Indonesia Financials	0.0001	I(1)	0.0001	I(1)
Malaysia Telecom	0.0001	I(1)	0.0001	I(1)
Singapore Industrials	0.0002	I(1)	0.0001	I(1)
Taiwan Fd Producers	0.0002	I(1)	0.0001	I(1)
Thailand Telecom	0.0001	I(1)	0.0001	I(1)

Table 5. Unit root tests of weekly price index for the median risk–return portfolio

Country—Sector	ZA		LP	
	<i>P</i> value	First difference	<i>P</i> value	First difference
China Financials	0.0011	I(1)	0.0001	I(1)
Hong Kong Industrials	0.0001	I(1)	0.0001	I(1)
Indonesia Financials	0.0001	I(1)	0.0001	I(1)
Korea Fd Producers	0.0001	I(1)	0.0001	I(1)
Malaysia Inds Transpt	0.0003	I(1)	0.0001	I(1)
Singapore Telecom	0.0001	I(1)	0.0001	I(1)
Taiwan Fd Producers	0.0002	I(1)	0.0001	I(1)
Thailand Consumer GDS	0.0001	I(1)	0.0001	I(1)

Table 6. Unit root tests of weekly price index for the maximum risk–return portfolio

Country—Sector	ZA		LP	
	<i>P</i> value	First difference	<i>P</i> value	First difference
Hong Kong Inds Transpt	0.0005	I(1)	0.0001	I(1)
Indonesia Industrials	0.0001	I(1)	0.0001	I(1)
Korea Consumer GDS	0.0001	I(1)	0.0001	I(1)
Malaysia Fd Producers	0.0001	I(1)	0.0001	I(1)
Thailand Financials	0.0001	I(1)	0.0001	I(1)

Table 7. Unit root tests of weekly price index for the portfolio of uncommon sectors

Country—Sector	ZA		LP	
	<i>P</i> value	First difference	<i>P</i> value	First difference
Indonesia personal goods	0.0001	I(1)	0.0001	I(1)
Indonesia pharm and bio	0.0003	I(1)	0.0001	I(1)
Korea nonlife insurance	0.0001	I(1)	0.0001	I(1)
Singapore aero/defense	0.0034	I(1)	0.0001	I(1)
Taiwan life insurance	0.0001	I(1)	0.0001	I(1)

Co-Integration Test

Table 8 reports the results of Johansen and Johansen and Juselius co-integration tests. Both λ -trace statistic and λ -max statistic show that the *p*-value for the minimum risk–return portfolio is over the α -value (0.05). Therefore, the null hypotheses of no co-integration cannot be rejected at the 5% level of significance. This implies that the selected sectors in this portfolio (i.e., Indonesia Financials, Hong Kong Inds Transpt, Singapore Industrials, Thailand Telecom, Malaysia Telecom, China Fd Producers, and Taiwan Fd Producers) are not co-integrated and risk-averse investors with long-term investment horizons can benefit by investing in this portfolio.

Table 8. The results of Johansen and Johansen and Juselius co-integration test

Portfolio	λ -trace statistic	λ -max statistic
Common sectors (minimum risk–return)	0.1633	0.2732
Common sectors (median risk–return)	0.1309	0.3949
Common sectors (maximum risk–return)	0.1452	0.0881
Uncommon sectors	0.4444	0.103

For the median risk–return portfolio, the null hypotheses cannot be rejected and no co-integrating vector is observed within the sectors. This indicates that in the long term, international investors who seek for an average level of risk and return can benefit by investing in

China Financials, Hong Kong Industrials, Indonesia Financials, Korea Fd Producers, Malaysia Inds Transpt, Singapore Telecom, Taiwan Fd Producers, and Thailand Consumer GDS.

The null hypotheses of no co-integration cannot be rejected at the 5% level of significance for the maximum risk–return portfolio, showing that risk-taker investors can get the maximum risk and return by allocating their capital in Hong Kong Inds Transpt, Indonesia Industrials, Korea Consumer GDS, Malaysia Fd Producers, and Thailand Financials.

Finally, the co-integration tests show that the p -value for the portfolio of uncommon sectors is over the α -value (p -value is, respectively, 0.4444 and 0.103 for λ -trace statistic and λ -max statistic). Therefore, the null hypotheses of no co-integration cannot be rejected at the 5% level of significance. This means that the selected sectors in this portfolio are not co-integrated and investors can benefit from investing in Indonesia Personal Goods, Indonesia Pharm and Bio, Korea Nonlife Insurance, Singapore Aero/Defense, And Taiwan Life Insurance.

Overall, the results of co-integration tests within the South-East Asian stock markets provide enough evidence for investors to benefit more by expanding their international portfolios through South-East Asian markets.

Conclusion

This paper evaluates possible benefits of IPD of South-East Asian stock markets for international investors by investigating the co-integration within South-East Asian stock markets at the industry level. To evaluate the co-integration, we proceed in two steps. First, the efficient frontier is created using the MFFGA. Based on the estimated efficient frontier, three optimal portfolios are created from common sectors among the stock markets (the minimum risk–return portfolio, the median risk–return portfolio, and the maximum risk–return portfolio). Second, the Johansen and Johansen and Juselius co-integration test is performed to evaluate the long-run relationship between the industries in each of created optimal portfolios and also

another portfolio including uncommon sectors within the stock markets.

The findings show that no co-integrating vector is observed within the industries of South-East Asian equity markets. This indicates that in the long term, all the price indices in South-East Asian stock markets at industry level can arbitrarily drift away from other markets' indices. Therefore, the possibility of gaining from international portfolio diversification within South-East Asian markets is noticeable.

The studies (Rana, 2007; Chiang et al., 2007; Awokuse et al., 2009; Huyghebaert & Wang, 2010) show that co-integration within emerging South-East Asian stock markets has increased during the past years and, as a result, the benefits of IPD have decreased in this region. On the other hand, these markets still receive a significant portion of international portfolio inflows compared to the other emerging regions. Findings of this study contribute to the literature by showing that the reason for ongoing portfolio inflows to this region (despite the increased co-integration) is that South-East Asian stock markets are not still co-integrated at industry level. Therefore, contrary to the studies of Manning (2002), Phylaktis and Ravazzolo (2002), Leong and Felmingham (2003), Kawai (2005), Click and Plummer (2005), Dunis and Shannon (2005), Rana (2007), Chiang et al. (2007), Awokuse et al. (2009), Huyghebaert and Wang (2010), and Thao and Daly (2012), the present study shows that these markets offer good opportunities for long-term investments to international investors who seek effective strategies for IPD.

Furthermore, the findings of this study would help international investors with different levels of risk tolerance (risk taker, risk averse, and moderate) in creating their portfolios by explicitly identifying the industries that are better suited for diversification purposes and the percentage of capital to allocate to each industry. For example, investors who are interested in maximum risk and return can construct a portfolio including Korea Consumer Gds, Thailand Financials, Indonesia Industrials, Hong Kong Inds Transpt, and Malaysia Fd Producers sectors and invest, respectively, 22%, 14%, 50%, 8% and 6% of their funds in each sector.

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