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Stochastic Dominance Tests on the ASEAN40 Index

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Abstract. In recent years, ASEAN countries have been discussing the possibilities of collaborating and launching the ASEAN link equity exchange. The new exchange, if implemented, is expected to consist of the 30 largest market cap stocks from each member country. While countries that have agreed to join include Thailand, Singapore, and Malaysia, other countries in the regions are still considering whether the move will benefit their local investors. This paper aims to investigate this issue by comparing the benefits of adding international large-cap stocks into a portfolio as oppose to adding local mid and small-cap stocks. The stochastic dominance between ASEAN40 and each of its underlying index returns is studied to compare the two options. ASEAN40 consists of the 40 largest market cap stocks from 5 countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand) and each country index consists of large, mid, and small cap stocks in its local market. Results show that ASEAN40 dominates the Philippines, Singapore, and Thailand at all levels which means that investors who have monotonic utility function would be better off when investing in large-cap stocks and diversify across countries. However, the stochastic dominance in Indonesia and Malaysia switches. Sub-sample tests show that the stochastic dominance is insignificant in Indonesia and that the stochastic dominance between ASEAN40 and Malaysia is closely tied to Malaysia's economy. The overall results imply that international large-cap stocks add value to the portfolio and are attractive investments during normal time and especially during domestic economic recession. Therefore, the ASEAN link equity exchange is worth investing in and shows potential for ASEAN countries to benefit their local investors.

Keywords: stochastic dominance, equity markets, ASEAN40 Index, ASEAN link equity exchange

1. Introduction

The objective of this study is to test whether there is a stochastic dominance between the FTSE/ASEAN40 index and each underlying equity market index. If the FTSE/ASEAN40 index dominates its underlying equity market index, then investing only in large stocks across equity markets may be better than investing in all stocks with different sizes from the same equity market. The stochastic dominance of FTSE/ASEAN 40 Index over individual market indices will have implications on (i) Investors' risk averseness; if the first or second order stochastic dominance exists then it indicates that investors may not be risk averse. (ii) Benefit from international diversification; Manning (2002) and Ng (2002) found that after Asian Financial Crisis 1997, Asian equity markets are highly correlated so there is less benefit from international diversification. However, if FTSE/ASEAN 40 Index stochastic dominates individual indices, then it shows that international diversification still have benefit even when the markets are highly correlated. And (iii) The ASEAN linkage project; the ASEAN linkage project is the collaboration among Bursa Malaysia, Singapore Stock Exchange, and the Stock Exchange of Thailand to create a new ASEAN exchange for trading the top 30 stocks from each exchange that have largest market capitalization. ASEAN exchange is expected to be launched by the end of the year 2011. The Philippines Stock Exchange and the Indonesia Stock Exchange are considering the strength and weakness of joining the project. The evidence of FTSE/ASEAN 40 Index stochastic dominating individual indices could be used to promote the ASEAN linkage market as a new attractive investment opportunity for both local and foreign investors. This will also add value to the stocks traded in the local exchange.

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2. Background Theory

Stochastic dominance can be applied as the tool to rank investments with different expected returns and risk (Hadar & Russell, 1969), (Hanoch & Levy, 1969), (Rothschild & Stiglitz, 1970), (Rothschild & Stiglitz, 1971), (Whitmore, 1970). It is similar to Mean-Variance analysis with the difference that it relaxes the assumption on the distributions of returns. Mean-variance analysis assumes either the returns have normal distribution or that investors have quadratic utility function. However, in reality, investors should not have quadratic utility function because this function implies that investors are increasing risk averters. On the contrary, investors should be decreasing risk averters that is, if investors have more wealth, they would dare to take more risky investments as opposed to when they have less wealth. Because quadratic utility function is not realistic enough, mean-variance analysis relies more on the assumption on the distribution of returns. If the returns are not normally distributed, the investment decisions based on mean-variance analysis does not always increase the investors' utility. Consequently, investors can use stochastic dominance to compare risky investments that have any form of return distribution and make investment decisions that maximize their expected utility. Lean, Smyth, & Wong (2007) and Annaert, Osselaer, & Verstraete (2009) stated that the mean-variance criterion or CAPM statistics rely on the normality assumption and a limitation of these approaches is that they miss important information contained in the data such as higher moments (3rd, 4th and so on). Therefore, with non-normal stock returns, the more appropriate way is to use stochastic dominance test. Wong, Phoon, & Lean (2008) used stochastic dominance tests when comparing the performances of hedge funds and found that stochastic dominance exist among hedge funds. They recommended that the stochastic dominance approach is better than mean-variance approach in representing the funds' performance. In addition, the existence of third-order stochastic dominance in any period implies that risk seekers dominate the market during that period. (Kraus & Litzenberger, 1976)

3. Research Method

For each year, stochastic dominance tests are performed for each order of index series with the FTSE/ASEAN 40 Index. The first order stochastic dominance assumes that investors have monotonic utility function i.e., they prefer more to less. Then, all investors will agree that F is preferred to G if:

$$F(x) \leq G(x) \qquad or \qquad G(x) - F(x) \geq 0 \quad \forall\, x \tag{1}$$

Where *F(x)* and *G(x)* are the cumulative distributions of two risky investments, and *x* is the uncertain returns.

F dominates *G* at the second-order assuming investors are risk averse if:

$$\int_{-\infty}^{x} [G(y) - F(y)]dy \geq 0 \quad \forall\, x \tag{2}$$

F dominates *G* at the third-order, which captures the skewness preference, if:

$$\int_{-\infty}^{y} \int_{-\infty}^{x} [G(z) - F(z)]dy\, dz \geq 0 \quad \forall\, y \tag{3}$$

The next step is to use Kolmogorov-Smirnoff statistic to test the significance of the stochastic dominance (McFadden, 1989) (Barrett & Donald, 2003). It is empirically impossible to test the null hypothesis for the full support of the distribution (Wong, 2008) therefore the following hypotheses are tested:

H_0 : $F(x_i) = G(x_i)$ for all x_i, i = 1, 2, …, k;

H_A : $F(x_i) \neq G(x_i)$ for some x_i;

H_{A1} : $F(x_i) < G(x_i)$ for some x_i;

H_{A2} : $F(x_i) > G(x_i)$ for some x_i;

Based on the above hypotheses, H_0 means that there is no stochastic dominance between the two indices. H_A means that the two indices have different cumulative distribution. H_A with neither H_{A1} nor H_{A2} means that the stochastic dominance switches between the two indices. Only H_A and H_{A1} means that F(x) dominates G(x). Finally, only H_A and H_{A2} means that G(x) dominates F(x).

The first-order stochastic dominances (FSD) are tested first. Then, if there is no FSD, the second-order stochastic dominances (SSD) are tested. However, if there is FSD, it implies SSD. Then, if there is SSD, it implies third-order stochastic dominance (TSD). Finally, if there is no SSD then the TSD are tested.

4. Data & Results

Daily FTSE/ASEAN40 Index, Jakarta Composite Index (Indonesia), FTSE Bursa Malaysia KL Composite Index (Malaysia), Philippines Stock Exchange Index (Philippines), FTSE Singapore Straits Times Index (Singapore), and Stock Exchange of Thailand Index (Thailand) for the period of December 30, 2005 – December 31, 2010 is collected from Bloomberg Database. The daily Index return for the period of January 1, 2006 – December 31, 2010 is computed using $[Index_t/Index_{t-1}] - 1$. There are 1,301 observations for each index.

Table 1 reports the mean, standard deviation, minimum, maximum, skewness, kurtosis, and normality test of each index return series. The statistics show that the distributions of index return series are not normally distributed. Firstly, the D'Agostino skewness tests for all markets reject the null hypothesis that the distribution has no skewness (p-value < 0.05). Secondly, the Anscombe-Glynn tests also reject the null hypothesis that the distribution has no kurtosis (p-value < 0.05). Finally, the Jarque-Bera normality tests reject the null hypothesis that the distribution is normal for all markets (p-value < 0.05).

Table 1: Descriptive Statistics

	ASEAN40	***Indonesia***	***Malaysia***	***Philippines***	***Singapore***	***Thailand***
Mean	*0.000587*	*0.001024*	*0.000443*	*0.000647*	*0.000363*	*0.000400*
Standard Deviation	*0.013931*	*0.016285*	*0.008960*	*0.014952*	*0.014517*	*0.015172*
Minimum	*-0.078366*	*-0.103754*	*-0.09496*	*-0.12268*	*-0.083286*	*-0.148395*
Maximum	*0.072275*	*0.079212*	*0.04350*	*0.098178*	*0.078213*	*0.111567*
Count	*1301*	*1301*	*1301*	*1301*	*1301*	*1301*
D'Agostino test of skewness						
Skewness	*-0.252616*	*-0.406533*	*-1.18113*	*-0.531748*	*-0.029982*	*-0.856541*
p-value	*0.015172*	*0.000132*	*0.00E+00*	*1.04E-06*	*7.70E-01*	*2.69E-13*
Anscombe-Glynn test of Kurtosis						
Kurtosis	*6.948484*	*8.932033*	*15.58706*	*10.45847*	*7.35318*	*16.74958*
p-value	*4.20E-26*	*7.51E-35*	*5.03E-53*	*3.45E-40*	*4.26E-28*	*3.11E-55*
Jarque-Bera test for normality						
JB statistic	*858.973*	*1943.373*	*8890.959*	*3076.857*	*1027.453*	*10407.225*
p-value	*0*	*0*	*0*	*0*	*0*	*0*

In summary, the return distributions of all indices under this study have significant skewness and kurtosis. This result is consistent with other previous studies (Annaert, Osselaer, & Verstraete, 2009) (Lean, Smyth, & Wong, 2007) (Brown & Warner, 1985) (Andersen, Bollerslev, Frederiksen, & Nielsen, 2010) which found that return series exhibit fat tails and negative skewness. More importantly, these results suggest that the appropriate measurement for comparing index performance should be stochastic dominance method instead of the mean-variance analysis.

Table 2 reports the first order stochastic dominance tests. The null hypothesis is ASEAN40 does not dominate the country index. The three alternative hypotheses are H_A: there is a first order stochastic dominance, H_{A1}: ASEAN40 dominates, H_{A2}: ASEAN40 is dominated, and both H_{A1} & H_{A2}: the dominance changes over time.

H_0 : F(ASEAN40) = G(Each Underlying Index)

H_A : F(ASEAN40) ≠ G(Each Underlying Index)

H_{A1} : F(ASEAN40) < G(Each Underlying Index)

H_{A2} : F(ASEAN40) > G(Each Underlying Index)

Table 2: First Order Stochastic Dominance Test

H_0 & H_A	***KS Statistic***	***P-value***

Indonesia	*0.039201*	*2.70E-01*	***No FSD***
Malaysia	*0.119139*	*1.91E-08*	**
Philippines	*0.059185*	*2.10E-02*	*
Singapore	*0.047656*	*4.04E-02*	*
Thailand	*0.065334*	*7.75E-03*	**
H_{A1}	***KS Statistic***	***P-value***	
Indonesia	*0.027671*	*3.69E-01*	***No FSD***
Malaysia	*0.119139*	*9.55E-09*	**
Philippines	*0.059185*	*1.05E-02*	*
Singapore	*0.047656*	*4.21E-02*	*
Thailand	*0.065334*	*3.87E-03*	**
H_{A2}	***KS Statistic***	***P-value***	
Indonesia	*0.039201*	*1.35E-01*	***No FSD***
Malaysia	*0.096849*	*5.02E-06*	**
Philippines	*0.026134*	*4.11E-01*	***No FSD***
Singapore	*0.01153*	*8.41E-01*	***No FSD***
Thailand	*0.013067*	*8.01E-01*	***NO FSD***

* denotes significance at 5% level, and ** denotes significance at 1% level

Based on Table 2, the results show that at 5% significance level, ASEAN40 first order stochastic dominates the index returns of all markets except Indonesia and Malaysia. Since FSD implies SSD and TSD, the results indicate that ASEAN40 dominates index returns of the Philippines, Singapore, and Thailand at all levels. In the following section, the SSD is tested on the index returns of Indonesia and Malaysia.

Table 3: Second Order Stochastic Dominance Test

H_0 & H_A	***KS Statistic***	***P-value***	
Indonesia	*0.133743*	*1.56E-10*	**
Malaysia	*0.111453*	*1.92E-07*	**
H_{A1}	***KS Statistic***	***P-value***	
Indonesia	*0.074558*	*7.23E-04*	**
Malaysia	*0.093774*	*1.08E-05*	**
H_{A2}	***KS Statistic***	***P-value***	
Indonesia	*0.133743*	*7.82E-11*	**
Malaysia	*0.111453*	*9.58E-08*	**

* denotes significance at 5% level, and ** denotes significance at 1% level

Table 4: Third Order Stochastic Dominance Test

H_0 & H_A	***KS Statistic***	***P-value***	
Indonesia	*0.116065*	*4.89E-08*	**
Malaysia	*0.063797*	*1.00E-02*	**
H_{A1}	***KS Statistic***	***P-value***	
Indonesia	*0.116065*	*2.45E-08*	**
Malaysia	*0.063797*	*5.02E-03*	**
H_{A2}	***KS Statistic***	***P-value***	
Indonesia	*0.002306*	*0.993106*	***No TSD***
Malaysia	*0.053036*	*0.025746*	*

* denotes significance at 5% level, and ** denotes significance at 1% level

Based on Table 3 and Table 4, at 5% significance level, the second-order stochastic dominance switches between ASEAN40 and index returns of both Indonesia and Malaysia. At the third-order, there is still a switching dominance between ASEAN40 and index returns of Malaysia. However, ASEAN40 dominates index returns of Indonesia.

In conclusion, ASEAN40 Index stochastic dominates the Philippines, Singapore, and Thailand at the first order. Based on these results, it will be attractive for local investors to invest in international Asian large-cap stocks than to invest in the mid and small-cap stocks in their own markets.

For Indonesia, there is no clear domination to conclude if the mid and small-cap stock in their own countries is better or worse than the international Asian large-cap stocks. The dominance switches in both first and second orders. However, if we assume that Indonesian investors are decreasingly risk averse, international Asian large-cap stocks can be attractive alternative investments for them.

For Malaysia, the stochastic dominance switches at all levels between ASEAN40 and Index returns of Malaysia. Without market-timing, utility maximizing Malaysian investors should be indifferent between investing in their own markets and investing in ASEAN40.

This study divides the sample into two sub-samples. The report of the stochastic dominance tests for each country index returns with the ASEAN40 index for each sub-sample is available upon request. According to the statistics for Indonesia, the results of stochastic dominance tests are similar in both sub-samples and the whole sample. For Malaysia, the result is that investing in the mid and small-cap stocks in Malaysia is preferable during period 1, but not in period 2. According to the sub-sample tests, market-timingmatters in Malaysia, the Philippines, and Thailand. The results for five sub-samples show that the stochastic dominance is insignificant in Indonesia. Of all the five years, the ASEAN40 dominates Malaysia Index in two years (2006 and 2010). During these years, Malaysia had negative changes in real economic growth. In 2008 when Malaysia had the highest real economic growth, the Malaysia Index dominated ASEAN40. There was no dominance in 2007, and there was switching dominance in 2009.

5. Conclusion

The ASEAN40 index is found not to be consistently significantly stochastic dominated by any of its underlying stock index (Indonesia, Malaysia, Philippines, Singapore, and Thailand). These results imply that investing in the international large-cap stocks is better than or, at least, not worse than investing in the local mid and small-cap stocks. For the Philippines, Singapore, and Thailand, the country stock index is significantly dominated by the ASEAN40. For Indonesia, the test fails to reject the null hypothesis that there is no stochastic dominance between ASEAN40 and Indonesia stock index. For Malaysia, the whole sample test found that the dominance is switching. Further investigation shows that Malaysia stock index dominates ASEAN40 in just one year, when Malaysia experienced the highest real economic growth. On the contrary, ASEAN40 dominates Malaysia stock index in three years when Malaysia experienced negative change in real economic growth. Based on the results, international large-cap stocks can be the attractive alternative investments for local investors, and especially when domestic economy is down. Thus, it is worthy for ASEAN countries to participate in the ASEAN linkage exchange.

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