STOCK MARKET EFFICIENCY AND INTEGRATION: EVIDENCE FROM TOP TEN COMPETITIVE ASIA-PACIFIC COUNTRIES

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Abstract

The objective of this study is to examine the market efficiency and integration simultaneously for select Asia-Pacific countries. The selected Asia-Pacific countries is based on the Global Competitiveness Report by the World Economic Forum. The selected Asia-Pacific countries are Singapore (STI), Japan (N225), Hongkong (HSI), Taiwan (TWII), Malaysia (KLSE), New Zealand (NZ50), Australia (AXJO), Republic of Korea (KOSPI), Republic of China (SSE), and Thailand (SET). The samples are the monthly closing prices during 2003 until 2015. The data were taken from Yahoo Finance (http://www.finance.yahoo.com). The statistical method used to run and test the data, those method are runs test, Augmented Dickey-Fuller test, Phillips-Perron test, Pearson correlation, Johansen's Co-integration test, Granger causality test, and GARCH (1,1) test. All methods tested using Eviews 8 and SPSS 22 for Windows program. The result indicate there is significant short-term and long-term relationship between the stock market.

Keywords: *stock market efficiency, market integration, runs test, stationarity test, Pearson correlation, co-integration test, Granger causality test, GARCH (1,1) model*

RESEARCH BACKGROUND

One of the most popular investment instrument is stock market. Through the stock market, investors has a big chance to grab higher return than making saving into bank's deposit. The stock market also can be an alternative gate for foreign investors to purchasing listed stocks. In this globalization era, investors tend to have as much as possible investment in different countries. According to Issing (2000) there has been a steady increase in cross-border financial flows around the world over the decades. First, many various institutional investors have expanded their activities geographically. Second, the more mature securities markets have gained a clear cross-border orientation. In many instances, newly

issued securities are designed and offered to the public in such a way to maximize their appeal to international investors.

Globalization of securities markets attracts the attention of various stakeholders in view of recent instability in investment levels and global financial turmoil. It is a known fact that the efficiency and integration tests conducted by different researchers have produced contradictory results, making it difficult to comment on stock market efficiency and integration with definitiveness. Most of the studies individually examined the stock market efficiency (Omran and Farrar, 2006; Gupta and Basu, 2007) and stock market integration (Siddiqui, 2009a; Marashdeh and Shrestha, 2010). There are studies which have examined efficiency considering only Asian markets (Kim and Shamsuddin, 2008) or only US markets (Davidson and Dutia, 1989; Seiler and Walter, 1997). In the same way, the degree of integration was observed separately for Asian markets (Siddiqui, 2009b; Mukherjee and Mishra, 2010) and US markets (Alam and Hasan, 2003). But a comprehensive study of stock market efficiency and integration for the Asian markets with US market is still awaited.

Market efficiency is one of the most important topics in finance and the subject of numerous studies. The notion itself is abstract and although its simplicity, there is not a straight forward pattern to prove the efficiency or not of a market. An efficient market provides on continues basis a platform no opportunities to engage in profitable trading activities. If market is not efficient, the regulatory authorities normally take necessary steps to ensure that the stocks are correctly priced leading to stock market efficiency. The efficiency of emerging markets is characterized by regular and unexpected changes in variance. It is to be noted that national and international events in the countries pave way for high volatility are found during the periods.

Regarding the integration of markets, several studies indicate that it is a gradual process and takes many years with occasional reversal. Besides, requires major reforms in the financial sector, securities, economic and political processes and the ability of foreign investors to make direct investments (Carrieri, Errunza & Hogan, 2007). The benefits gained are diverse, particularly economic, because integration accelerates the growth of the economies of the countries, have a support in times of crisis (Asness, Israelov & Liew, 2011) and achieve decreasing transaction costs (Thapa & Poshakwale, 2010).

RESEARCH SCOPE

The focus of this study is to examine the informational efficiency and integration simultaneously between Asia-Pacific countries. The researcher will use the top ten competitive countries in Asia-Pacific: Singapore, Japan, Hongkong, Taiwan, New Zealand, Malaysia, Australia, South Korea, Republic of China, and Thailand as the sample country. The period of the time frame for the sample data focuses within the thirteen years from 2003-2015.

The method used by the researcher are runs test, to test the randomness of the data; augmented Dickey-Fuller and Phillips-Perron test to test the stationarity of the data. The researcher used Pearson correlation and Granger causality test to analyze the short-run relationship between the variables and Johansen's co-integration test to measure the long-term relationship. To test the market efficiency, the researcher used GARCH (1,1) to analyze whether the stock market is significant in the weak form, semi-strong form, or strong form. The measure of efficiency is shown if the sum of the ARCH (1) and GARCH (1) are close to unity or 1.

RESEARCH PROBLEM

The researcher would analyze:

1. Is there any short-term relationship between the stock market among the top ten competitive countries in Asia-Pacific?
2. Is there any long-term relationship between the stock market among the top ten competitive countries in Asia-Pacific?
3. Are the variables significant in the weak form efficient market hypotheses?

RESEARCH OBJECTIVE

1. To analyze the short-term relationship between the stock market of the top ten competitive Asia-Pacific countries.
2. To analyze the long-term relationship between the stock market of the top ten competitive Asia-Pacific countries.
3. To analyze the efficiency of the stock market based on the efficient market hypothesis (EMH).

RESEARCH CONTRIBUTION

Hopefully, this research will give positive advantages and provide contribution to academic and managerial in giving better understanding academic contribution. The academic contribution of this study is to give a better understanding about stock market efficiency and integration. The managerial contribution, for any stock market, different stakeholders or operators are individual/institutional investors, portfolio managers, policy makers and agents/brokers. This study would facilitate them to use international stock markets to diversify their capital and at the same time to hedge against the a typical adverse shocks like recent financial crisis, especially when these shocks exist for a short while. They can use this study for quitting or continuing with existing portfolios.

LITERATURE REVIEW

Market Efficiency

Market efficiency is one of the most important topics in finance and the subject of numerous studies. An efficient market is the term used to describe a market where investors cannot outperform their rivals by generating abnormal risk-adjusted returns in a consistent manner. Ideally, a perfectly efficient capital market is "*a market in which firms can make production-investment decisions and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time fully reflect all avaiable information*" (Fama, 1970: 383).

According to Fama (1965), the level of market efficiency can be divided into three forms: the weak form, semi-strong form, and strong form. Each form of the EMH has the ability to rule out the possibilities of consistent outperformance by a certain group of investors who use certain type of information as the tool in trading activities.

Three different forms of EMH (Reilly and Brown, 2003):

1. Weak Form Efficient Market Hypothesis
   The weak-form assumes that current stock prices fully reflect all security market information, including the historical sequence of prices, rates of return, trading volume data, and other market-generated information. This implies that the past rates of return and other market data should have no relationship with future rates of return.
2. Semi-Strong Form Efficient Market Hypothesis
   The semi-strong form efficient market hypothesis asserts that security prices adjust rapidly to the release of all public information; that is, current security prices fully reflect all public information. This implies that decision made on new information after it is public should not lead to above-average risk-adjusted profits from those transaction.
3. Strong Form Efficient Market Hypothesis
   The strong-form efficient market hypothesis contends that stock prices fully reflect all information from public and private sources. This implies that there is no group of investors should be able consistently derive above-average risk-adjusted rates of return. This form assumes that perfect markets in which all information is cost-free and avaiable to everyone at the same time.

Market Integration

Eun and Shim (1989) found existence of substantial interdependence among national stock markets with USA being the most influential market on investigating daily stock market returns of nine major world stock markets. Smith et al. (1993) examined the linkages between US, UK, Germany and Japanese stock markets and found unidirectional causality from USA to other countries except Germany after 1987 worldwide crisis. Choudhry (1996) investigated stock indices of six European markets during 1925-1936 using Johansen's multivariate

cointegration test and results indicated stationary long-run relationship among indices during the 1925-1936 and also during pre-October-1929 stock crash period (1925-1929), whereas no stationary relationship was found during post-crash period. Masih and Masih (1997) assessed linkages among six major world stock markets for pre and post-1987 crash. The results indicated that the crash does not affect leading role played by US stock market over other markets and German and British markets seemed to have become more dependent on other markets over post-crash period as compared to pre-crash era.

Masih and Masih (1999) again examined dynamic causal linkages among four developed and four South Asian emerging stock markets for the period of five years. The results confirmed the existence of significant short and long-term relationship between developed and emerging markets. Yang et al. (2003) verified the relationship among the five largest emerging African stock markets and the US market. The evidences of both long-run and short-run causal linkages were found among these Jeon and Jang (2004) examined the inter-relationship between stock prices in USA and Korea by applying Vector Autoregression model to daily stock prices. They found that US stock market plays leading role over Korean market at every level of aggregation, while the reverse direction of influence was not found in the study. Ahmad et al. (2005) examined the co-movements of Indian market with US and Japanese stock market and found that there was no long-term relationship of Indian equity market with US and Japanese equity market.

Link between Market Efficiency and Integration

Lence and Falk (2005) state in their study that the co-integration test is not informative toward market efficiency and market integration and vice versa. It is stated that market efficiency, market integration, and co-integrated prices are independent restriction in condition of the equilibrium prices, which are unit root.

Previously, a similiar finding was proposed by Dwyer and Wallace, they showed that there is no link between efficiency and co-integration when random walk is replaced with no-arbitrage condition. A contradictory result was reported in Chan et al. (1997), which examined 18 national equity markets. They showed that all markets are efficient individually and few of the showed evidence of co-integration with others, which means that an absence of linkage between market efficiency and market integration is not categorical. Conto and Navaro (2011) studied the market integration and financial efficiency of the Colombian stock market. their subsequent regression analysis reports a similiar trend between those measures as well as a significant indicator of Colombian stock market to explain 13.36% of variability in the financial efficiency.

Another study by Hooy and Lim's (2013) doing the direct empirical study between market integration and informational efficiency. They consider data from 49 national stock markets, and empirical results show robust evidence supporting the hypothesis that the level of market integration is significantly and positively related to the degree of informational efficiency.

Carrieri et al. (2013) stated that improvement in corporate governance, transparency, and macro-institutions would complement market liberalization

policies in further integrating emerging markets. This is consistent with the findings of Morck et al. (2000) and Lim and Brooks (2010) which suggest on the importance of institutional reforms for the efficient functioning of stock markets.

Through market efficiency is closely related with the integration literature, it is worth highlighting that market integration and informational efficiency have remained separate subjects in finance, only few studies that including two different subject in their studies.

The Top-Ten Asia Pacific Countries

The World Economic Forum has determine ten competitive Asia-Pacific countries is chosen by the performance of the economics, the development of the markets, the condition of the competitiveness including governance, infrastructure, education, innovation, and the market condition. The countries also chosen by the stability of the market in each countries. The World Economic Forum use twelve pillars for measuring the competitiveness index. The twelve pillars divided into three group: basic requirements, efficiency enhancers, and innovation and sophistication factors.

The first group of the pillar is the basic requirements which includes institutions, infrastructure, macroeconomic, and health and primary education. The second group of the pillar is the efficiency enhancers, which is higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, and market size. The last group of the pillar is innovation and sophistication that including business innovation and sophistication. The rank is summarized in the table below:

Country	Asia-Pacific Rank	World Rank
Singapore	1st	2nd
Japan	2nd	6th
Hong Kong	3rd	7th
Taiwan	4th	14th
New Zealand	5th	17th
Malaysia	6th	20th
Australia	7th	15th
Republic of Korea	8th	26th
Republic of China	9th	28th
Thailand	10th	31st

This table shows the ranks of the selected countries of Asia-Pacific in the Global Competitiveness Index report. It also show the world rank of the selected Asia-Pacific countries and the Asia-Pacific rank. Singapore placed in the first rank

of Asia-Pacific, because Singapore got the highest score almost in all the twelve pillars. Followed by Japan in the second rank, Hongkong in the third rank, Taiwan in the fourth rank, New Zealand in the fifth rank, Malaysia in the sixth rank, Australia in the seventh rank, Republic of Korea in the eighth rank, Republic of China in the ninth rank, and in the last rank, Thailand.

RESEARCH METHODOLOGY

Classification of the research

This research tends to highlight the relationship between the global markets from selected countries. The research based on secondary data and has recourse some theories and formula to sort out the basic queries leading the research. After using different methodology and tools analysis are expected to imply some findings. The finding then can contribute to the building of business and investment knowledge.

Data Analysis Technique

- Run test is used to detect statistical dependencies in return series. The null hypothesis of test is that the observed series is random.When $|Z|$ value is greater than 1.96, null hypothesis for Run test is rejected at 5 percent level of significance.

- Unit root test is used for testing the existence of stationarity in time series, both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used for the purpose of testing stationarity of time series.

- GARCH (1, 1) model is used to test WFME of stock markets. This model captures the existence of volatility clustering in stock markets, which is a sign of market inefficiency.

- Pearson correlation is used to find short-run relation between the movements of stock markets. It is used to measure the extent of association between stock markets.

- Johansen's cointegration test is used for pinpointing long-run relationships among stock markets under study.

- For causality testing, Engle Granger test is used, which identifies whether one series has significant explanatory power for another series. It is used to find out short-term relationship among sample markets.

RESULTS

1. Based on the run test, there are randomness in the data return that used in this research based on the significant level above 0.05 level of significance.

Variable	Asym. Sig Value	Meaning
STI	0.05 < 0.335	Significant
N225	0.05 < 0.520	Significant
HSI	0.05 < 0.520	Significant
TWII	0.05 < 1.000	Significant
NZ50	0.05 < 0.520	Significant
KLSE	0.05 < 1.000	Significant
AXJO	0.05 < 0.520	Significant
KOSPI	0.05 < 0.520	Significant
SSE	0.05 < 0.148	Significant
SET	0.05 < 0.108	Significant

2. The result of descriptive statistics shows that Taiwan stock market dominates the daily return by showing the highest median at -0.00601 points and also has the highest average at -0.00164 points, and SSE or Republic of China index shows the highest volatility by having the highest standard deviation at 0.085925 points.

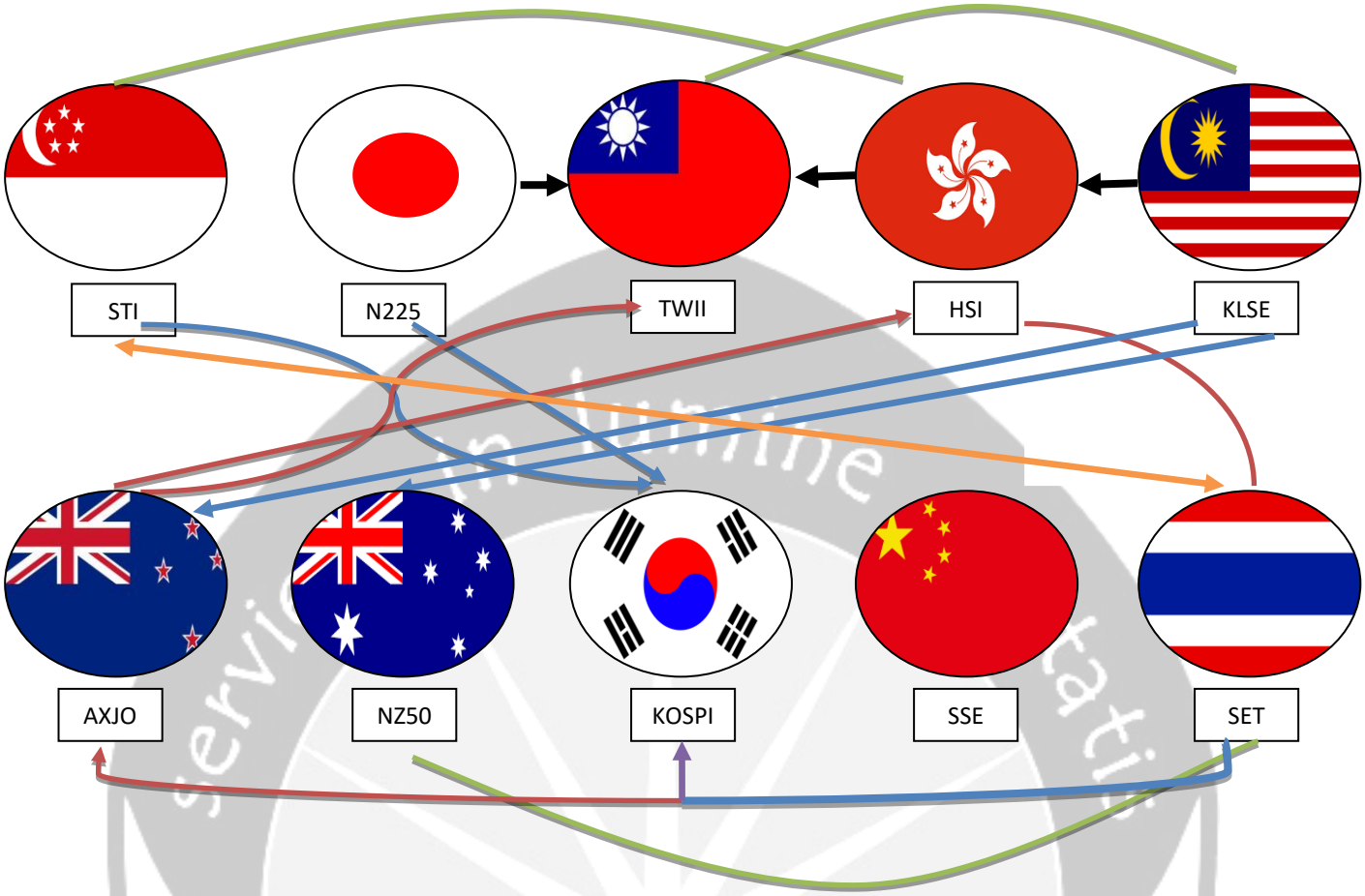
	STI	N225	HIS	TWII	NZ50	KLSE	AXJO	KOSPI	SSE	SET
Mean	-0.0038	-0.003675	-0.003618	-0.00164	-0.00693	-0.00529	-0.00298	-0.00609	-0.00195	-0.00596
Median	-0.0116	-0.006496	-0.010364	-0.00601	-0.01001	-0.00898	-0.01271	-0.01082	-0.00723	-0.01361
Maximum	0.31474	0.3128	0.289759	0.231993	0.134483	0.17956	0.144973	0.30097	0.326812	0.432166
Minimum	-0.1755	-0.113867	-0.145837	-0.13045	-0.08037	-0.1193	-0.06812	-0.11911	-0.21536	-0.16334
Std. Dev.	0.05278	0.05788	0.062671	0.057531	0.034096	0.0372	0.039335	0.05687	0.085925	0.065608

3. The Unit-Root test in this case using Augmented Dickey-Fuller and Philips-Perron test, use to test the stationarity of the data. Based on the ADF and PP test, all the variables are stationary at the level.

Variables	Test	t-Statistic	McKinnon critical value			Prob	Meaning
			0.01	0.05	0.1		
STI	ADF	-9.732374	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-9.920694	-3.472813	-2.880088	-2.576739	0.0000	Stationary
N225	ADF	-10.27974	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-10.36640	-3.472813	-2.880088	-2.576739	0.0000	Stationary
HIS	ADF	-10.92530	-3.472813	-2.880088	-2.576739	0.0000	Stationary

	PP	-11.00150	-3.472813	-2.880088	-2.576739	0.0000	Stationary
TWII	ADF	-10.21828	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-10.32143	-3.472813	-2.880088	-2.576739	0.0000	Stationary
NZ50	ADF	-10.82719	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-10.81439	-3.472813	-2.880088	-2.576739	0.0000	Stationary
KLSE	ADF	-10.74252	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-11.02933	-3.472813	-2.880088	-2.576739	0.0000	Stationary
AXJO	ADF	-10.68714	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-10.96062	-3.472813	-2.880088	-2.576739	0.0000	Stationary
KOSPI	ADF	-12.24066	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-12.29310	-3.472813	-2.880088	-2.576739	0.0000	Stationary
SSE	ADF	-6.684342	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-11.46472	-3.472813	-2.880088	-2.576739	0.0000	Stationary
SET	ADF	-10.22631	-3.472813	-2.880088	-2.576739	0.0000	Stationary
	PP	-10.41081	-3.472813	-2.880088	-2.576739	0.0000	Stationary

4. The next test is Pearson correlation, to test the correlation between the markets. The Pearson correlation is measured by 1% significant level and two-tailed with 5% level of significance. and the If ρ less than 0.05, it can be said that there are positive correlation between the variables. If ρ more than 0.05, it means there are no positive correlation between the variables. The result of Pearson correlation that all the variables are highly correlated by the values of Pearson correlation which is more than 0.01, means the correlation are significant, and also from the two-tailed significant values, which shows that all values are less than 0.05 level of significance, at 0.0000 points. It shows that there are positive correlation among one stock market and another stock markets.
5. Based on Granger causality test, there are 18 cases a variable Granger cause another variable. STI Granger cause HSI, STI Granger cause TWII, STI Granger cause KOSPI, SET Granger cause STI, N225 Granger cause TWII and KOSPI, HSI Granger cause TWII, KLSE, AXJO, and SET Granger cause HSI and TWII, KLSE and SET Granger cause NZ50, KLSE and KOSPI Granger cause AXJO, SET Granger cause KOSPI.



6. Based on Johansen co-integration test with lag 1 to 4, the series are co-integrated and based on the trace test, all the series are co-integrated because there are ten co-integrating equations based on the value of probability at 0.05 level, ten equations fulfill the minimum values to decide the series are co-integrated or not. But on the maximum Eigenvalue test, there are at least four co-integrating equations based on the value of probability at 0.05 level. It means that only four series are co-integrated in the long term based on the maximum Eigenvalue test.

SERIES: STI N225 HSI TWII KLSE NZ50 AXJO KOSPI SSE SET
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.442925	410.0313	239.2354	0.0000
At most 1 *	0.333356	321.6879	197.3709	0.0000
At most 2 *	0.320978	260.4575	159.5297	0.0000
At most 3 *	0.304194	202.0052	125.6154	0.0000
At most 4 *	0.216821	147.2398	95.75366	0.0000
At most 5 *	0.186688	110.3363	69.81889	0.0000
At most 6 *	0.165926	79.13361	47.85613	0.0000
At most 7 *	0.127432	51.73714	29.79707	0.0000

At most 8 *	0.109437	31.15362	15.49471	0.0001
At most 9 *	0.086447	13.65249	3.841466	0.0002

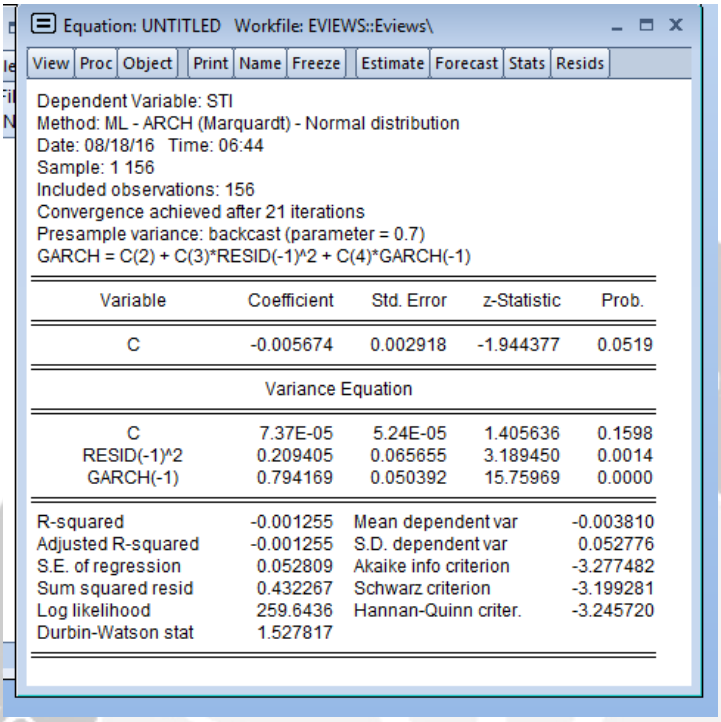
Trace test indicates 10 cointegrating eqn(s) at the 0.05 level

SERIES: STI N225 HSI TWII KLSE NZ50 AXJO KOSPI SSE SET
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.442925	88.34332	64.50472	0.0001
At most 1 *	0.333356	61.23046	58.43354	0.0258
At most 2 *	0.320978	58.45230	52.36261	0.0106
At most 3 *	0.304194	54.76543	46.23142	0.0049
At most 4 *	0.216821	36.90345	40.07757	0.1092
At most 5 *	0.186688	31.20270	33.87687	0.1009
At most 6 *	0.165926	27.39647	27.58434	0.0528
At most 7 *	0.127432	20.58352	21.13162	0.0595
At most 8 *	0.109437	17.50113	14.26460	0.0149
At most 9 *	0.086447	13.65249	3.841466	0.0002

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level

7. The last step of this research is GARCH (1,1) test. Based on GARCH (1,1) which stated that sum of ARCH(1) and GARCH(1) coefficient are close to unity, the series is considered to be volatile and presence of volatility clustering indicates inefficiency in stock markets. Singapore (STI) and Republic of Korea (KOSPI) got the perfect results at 1.003574 points and 1.003151 points. It means that this two stock markets are highly volatile among the other stock markets, and both Singapore and Republic of Korea are inefficient both in the weak form and semi-strong form. Following the STI and KOSPI, there are eight variables or eight stock markets which also got the result above 8, Taiwan (TWII) at 0.987380 points, Thailand (SET) at 0.970095 points, Republic of China (SSE) at 0.956601 points, New Zealand (NZ50) at 0.946875 points, Malaysia (KLSE) at 0.945997 points, Hongkong (HSI) at 0.917151 points, Japan (N225) at 0.894114 points, and the last is Australia (AXJO) at 0.892525 points. All these stock markets also efficient in the strong form.



Equation: UNTITLED Workfile: EVIEWS::Eviews\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: STI
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 08/18/16 Time: 06:44
Sample: 1 156
Included observations: 156
Convergence achieved after 21 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(2) + C(3)*RESID(-1)^2 + C(4)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-0.005674	0.002918	-1.944377	0.0519
Variance Equation				
C	7.37E-05	5.24E-05	1.405636	0.1598
RESID(-1)^2	0.209405	0.065655	3.189450	0.0014
GARCH(-1)	0.794169	0.050392	15.75969	0.0000

R-squared	-0.001255	Mean dependent var	-0.003810
Adjusted R-squared	-0.001255	S.D. dependent var	0.052776
S.E. of regression	0.052809	Akaike info criterion	-3.277482
Sum squared resid	0.432267	Schwarz criterion	-3.199281
Log likelihood	259.6436	Hannan-Quinn criter.	-3.245720
Durbin-Watson stat	1.527817		

	Coefficient		Sum of
Variables	ARCH(1)	GARCH(1)	Coefficient
STI	0.209405	0.794169	1.003574
N225	0.104134	0.78998	0.894114
HIS	0.163083	0.754068	0.917151
TWII	0.266743	0.720637	0.98738
KLSE	0.092953	0.853044	0.945997
NZ50	0.140817	0.806058	0.946875
AXJO	0.323408	0.569117	0.892525
KOSPI	0.106426	0.896725	1.003151
SSE	0.130097	0.826564	0.956661
SET	0.21138	0.758715	0.970095

CONCLUSIONS

Conclusions

1. Based on the analysis, there are short and long-term relationship between the stock markets in the top ten competitive Asia-Pacific countries.
2. Based on GARCH (1,1) analysis, all of the stock markets are inefficient in the weak form, but efficient in the strong form because the sum of ARCH(1) and GARCH(1) are close to unity

Limitation and Suggestion

This research is really far from perfect, because only take sample from limited countries (groups), and overall apart from the financial crisis, this research does not conduct detailed analysis that affect the integration and efficiency. For further research, it may better to include the detailed analysis to explain the portfolio diversification, the advantages and disadvantages since the investor may need detailed information. Future studies on the same or related issues may cover more stock markets, employ more advanced techniques for data analysis and use more presentative data in order to add to the literature on stock market efficiency and integration.

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