Volatility Co-movement of ASEAN-5 Equity Markets

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Abstract

Purpose – Economic cross-linkages and the increased co-movement of asset prices across international markets are important outcomes as the result of globalization. Hereby, the nature of international stock markets and the extent to which the 1997-1998 East Asian turmoil had affected the market relationship of five countries of Association of Southeast Asian Nations (ASEAN-5) remain as probing questions.
Design/methodology/approach – We resort to the standard time series econometrics analysis. These include the unit root, cointegration and the Granger causality tests. Hereby, further empirical analyzes is conducted upon two sub-periods of interest: (1) pre-crisis period from 1987:1 to 1997:7 and (2) post-crisis period from 1997:8 to 2007:12. This is to allow for possible transitional motion leading to and departing from the crisis.
Findings – Using an array of econometrics analysis upon the stock price volatility series, we found partial market integration for the pre-crisis; whereas in the post-crisis, complete integration prevails. Hence, the financial meltdown in 1997 is said to be a contagion led crisis as markets integrate well off after the crisis than prior to it. Nonetheless, long run portfolio asset diversification benefits across the ASEAN-5 basin are reduced as markets are integrated in both the pre- and post-crisis.
Originality/value – The paper is of value by showing to uncover the issue of interdependence of stock market integration focusing on the ASEAN-5 economies. The formation of the ASEAN Investment Area (AIA- 1998) parallel with the establishment of a developed ASEAN Index-Financial Times Stock Exchange (FTSE) regional index is viable to foster deeper regional market convergence.

Keywords: ASEAN-5, Portfolio Diversification, Volatility co-movement

Paper Type: Research paper

1. Introduction

Important linkage emerges between the real economy and both the financial and capital market structures. Evidences persistently points to the crucial role of capital markets in economic growth prospect (Bekaert and Harvey, 2002). Nonetheless, attributing causal chain between the real economy and the financial system can be rather complex. In respect to the various studies conducted on capital market integration, Markowitz (1952) had notioned that diversification cannot eliminate all variance. However, considering the expected returns-variance of returns (E-V) rule, not only does it imply diversification, it somehow emphasized

on the 'right kind' of diversification for the 'right reasons'. Elsewhere, Tobin (1958) had highlighted the empirical advantages of explaining diversification which provide a basis for liquidity preference in contrast to Keynes who believed that investor only holds one asset at a time.

Basically, foreign investment returns give rise to substantial gains in welfare to wealth holders (Grubel, 1968). Similarly, exchange of financial assets and the combinations of returns and risks all of which are superior to the undiversified portfolios as international diversification offers opportunities towards the elimination of certain domestic specific risks (Forbes, 1993). Holding diversified assets does not change the expected rate of return but does however reduces the risk of these portfolio investments as compared with holding only one-asset portfolio (see Masih and Masih, 1999; Hunter, 2006).

The integration of stock market relegates a structural change within capital markets. However, note that although market liberalization does integrate markets, regulatory liberalization does not necessarily define market convergence (Bekeart and Harvey, 2002). Considering that laws may pass all barriers to foreign participation in local markets, it might not be effective to result in market integration. Hereby, the growing sense of financial deregulations and liberalization of capital movements create an overwhelming phenomenon for both the integration and globalization of capital markets.

Market liberalization has somehow been associated with episodes of severe economic turbulence. The outset of the East Asian 1997-1998 financial crisis had caused notable implications towards the five Association of Southeast Asian Nations (ASEAN-5) economies

including Korea[1]. Likewise, the nature of the international stock markets and the extent to which the financial crisis may affect the relationship within the ASEAN-5 markets remain as probing questions.

There had been significant studies with regards to the events of stock market crisis. The volatility associated with the 1987 crash was brief and transitory for the US (Schwert, 1998). Tang and Mak (1995) examined the effects for periods before and after the stock crash in October 1987, while Ewing *et al.* (1999) basically were not in favor of the contagion notion from the 1987 US market crash as long-run international diversification benefits across the markets of North American were found. Through the inclusion of structural breaks though, Narayan and Smyth (2005) had discovered cointegration between New Zealand and US market. And within the Asian front, Fernández-Serrano and Sosvilla-Rivero (2001) suggested that the economies of Korea and Japan are integrated from April 1987. Concerning the 1997 crisis though, which did not seem to foreshadow disruption in the real economy, market are said to interact differently during the crisis and before the crisis (Jochum *et al.*, 1998).

However, studies on market volatility had been lacking. With more recent developments in both the theoretical and application aspects of economic modeling, this study serves as a platform to fill that gap. This study seeks to examine the market integration and volatility co-movement within this region. Specifically, this study examines the relationship among markets of the ASEAN-5 economies, namely: Jakarta Stock Exchange (JSX- Indonesia);

[1] The Association of Southeast Asian Nations (ASEAN) was being established through the agreement of the ASEAN Declaration, known as the Bangkok Declaration, on August 8, 1967. Initially, this declaration involves five nations of the Southeast Asian region: Indonesia; Malaysia; Philippines; Singapore and Thailand (which makes up the ASEAN-5). Along the way, it had expanded with other member countries joining the ASEAN. This includes Brunei (joined in 1984), Vietnam (joined in 1995), Laos and Myanmar (joined in 1997) and its latest member Cambodia (joined in 1999).

Bursa Malaysia (KLSE- Malaysia); The Philippines Stock Exchange (PSE- Philippines); Stock Exchange of Thailand (SET- Thailand); and Singapore Exchange (SGX- Singapore)[2].

The remaining of this paper is structured as follows: Section two provides the theoretical underpinnings. Section three, provides the empirical results, interpretations and discussions. Section four concludes the study with the summary and policy implications.

2. Theoretical Underpinnings

According to Narayan and Smyth (2005), integrated markets will contain information on the common stochastic trends. Hereby, market inefficiency exists as market predictability can be enhanced through the information contain in other stock markets[3]. However, recent empirical works lie upon the view that cointegration does not necessarily imply anything about efficiency (see Dwyer and Wallace, 1992; Masih and Masih, 2001; 2002)

Another important aspect within the context of market integration and interdependence is that assets associated with similar level of risk in different countries should lead to similar level of return (Masih and Masih, 1999). Whereas, Wheatly (1988) entailed that even without market integration; assets being diversified internationally could possibly be "mean-variance efficient"[4].

[2] Bursa Malaysia was formerly known as 'Kuala Lumpur Stock Exchange'. The abbreviation of it, 'KLSE', is still being frequently used.

[3] According to Ganger (1986), the cointegration between two prices reflects an inefficient market on the basis that two prices share a common trend in the long run. Thus, predictability of each price's movement does exist whereby one market maybe caused by another.

[4] The term "mean-variance efficient" simply means "higher risk, high returns". Vice versa, "lower risk, lower returns". One will not be able to expect that portfolios attribute both higher expected returns, while assuming lower risk. Should there be higher expected returns, higher will the risk be too. And if there are lower expected returns, the risk will hence be lower too.

Underlying the major corner stone of portfolio theory, the integration and stock market interdependence addresses the issue of diversifying assets (see Forbes, 1993). Basically, potential gains accruing from international diversification can be examined through the rate of returns on common stock (Levy and Sarnat, 1970). The rate of return for each country is defined as the percentage change in the dollar value of its common stocks' index as noted in expression (1):

$$r_i(t) = \frac{P_t(t) - P_i(t-1)}{P_i(t-1)} \tag{1}$$

Where $P_i(t)$ beholds the dollar value of the i^{th} country's stock index; and $r_i(t)$ is the rate of return in period *t*.

And based on Jang and Sul (2002), the return using stock market index can be simplified into expression (2) as follows:

$$R_t = [\log(CI_t) - \log(CI_{t-1})] \times 100 \tag{2}$$

Where R_t signifies the rate of return at period *t*; and CI_t is the stock market index (also known as the Composite Index-CI) during the same period.

3. Empirical Results and Findings

3.1 Data Description

The sample data for this study had been outsourced from the CEIC databank[5]. Stock prices range for a period of 21 years (1987:1 to 2007:12). The variables employed for this study includes the composite indexes in logarithm form for five ASEAN stock markets of JSX, KLSE, PSE, SET and SGX. Variables are tested through the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) modeling application to obtain the volatility series of GARCH. Hereby, further empirical analyzes is conducted upon two sub-periods of interest[6]: (1) pre-crisis period from 1987:1 to 1997:7 and (2) post-crisis period from 1997:8 to 2007:12. This is to allow for possible transitional motion leading to and departing from the crisis.

3.2 Cointegration Test

Based on the empirical approach of unit root tests, we do not reject the null hypothesis in level. Nonetheless, all series are said to be stationary in first difference. In other words, the *I(1)* phenomena prevails thus allowing us the prerequisite to test for JJ Cointegration. While, the unit root results are not presented here, it will be made available upon request.

Centering on the results of the JJ Cointegration test, both sub-periods provided varying findings. As presented in Table 1 (Panel A), both the trace and maximum eigenvalue tests concluded similar findings that the ASEAN-5 markets are very responsive, nonetheless, being partially integrated in the pre-crisis phase. Here, the null hypothesis of no cointegrating vector ($r = 0$); and at most one cointegrating vector ($r \leq 1$) are rejected at 1 per cent

[5] CEIC Data Company Ltd (CEIC) was founded in 1992. It compiles and updates hundreds of thousands of data series from sources all over, delivering a suite of databases relied upon by top Economists and Analysts worldwide.

[6] The GARCH methodological approach is briefly explained in the Appendix.

significance level. While markets bound together, they however do not share a common long-run equilibrium as a result of two common stochastic long-run trends.

[Insert Table 1 here]

Panel B on the other hand suggested that the cointegration and long-run equilibria between the markets were established thus complete integration prevails in the post-crisis. The null hypothesis of $r = 0$ is rejected at 5 per cent significance level. Statistically significant results indicate that markets share a common stochastic trend in the long run. The markets are said to be predictable among themselves as variation in one market leads to variation in others.

Hereby, the ASEAN-5 volatility series projects similar risk level across markets (see Bekaert and Harvey, 1995). Following the argument of Boyer *et al.* (2006), if international investors facing losses on developed markets tend to liquidate assets from foreign (emerging) markets, 'contagion' effect may result, where an increase in cross market correlations would occur. This explains the ripple effect of the currency led speculative attack in 1997 unto the ASEAN region.

While drafting out comparisons between the pre- and post-crisis period though, we are able to adhere that the 1997 crisis was indeed a reversal point (refer to Manning, 2002; and Kasa, 1995). According to Yusof and Majid (2006), the financial investors in Malaysia's market were rather inclined to diversify their investments domestically during the Asian financial crisis.

3.3 Granger Causality Test

The test of causality can be conducted in the form of VECM as markets were cointegrated. From the tabulated VECM results in Table 2, Panel A, several causality directions can be established. Seemingly, JSX market led the region throughout the pre-crisis. The uni-directional causality directions were established as follows: (1) JSX to PSE; (2) JSX to SGX[7]; and (3) SET to KLSE. Based on the significance of the ECTs, one may indicate that the PSE and SGX markets are two cointegrating vectors that direct the region into equilibrium, to result toward the togetherness of the regional ASEAN-5 markets.

[Insert Table 2 here]

As for post-crisis Panel B, the VECM tests extended several causality chains. Contrastingly, JSX is the market follower within the region as the other markets of KLSE, PSE, SGX and SET seemed to have implications towards JSX. Nevertheless, the remaining findings of uni-directional causations include: (1) JSX to KLSE; and (2) SGX to SET. Significantly, KLSE causes the regional bonding of the ASEAN-5 markets through the significance of ECT. In an illustrative manner, Figure 1 displays the diagram representation of the causality chains in summary of Table 2.

[Insert Figure 1 here]

[7] Through the causal effect from JSX to SGX, thus, it is unnecessarily true that only developed countries may impact the developing market (Azman-Saini et al., 2002). Developing nations (such as Indonesia) may also impact the developed markets (Singapore) basically in the short-run but not in the long run.

4. Conclusion

Through the various valid economic tests underlying the issue of economic integration, this bows to several policy repercussions, of which include the following. First, while the stock market volatility indicated that partial market integration prevails in the pre-crisis, the post-crisis period was in fact completely integrated. Second, the formation of Investment Union (IU) for ASEAN-5 is feasible and in fact desirable as market convergence provides one of the many preconditions in establishing a union (with the assessments of other conditional factors to be included as well). An IU provides a platform for investment funds to flow across borders. Free-flow of capital between borders would discourage saturation of funds within one market as free movement of capital enables the diversion of funds towards less saturated markets.

Third, conditionally too, investors may consider another form of investment targeting strategy drawn upon the CI's volatility through thorough mitigation of the volatility series. Overall, the securities commission (SC) of each market is responsible to ensure the co-movement of capital markets' policies and master plan. Witnessing the formation of the ASEAN Investment Area (AIA- 1998) parallel with the establishment of a developed ASEAN Index-Financial Times Stock Exchange (FTSE) regional index are in fact viable initial initiatives to foster regional market convergence[8].

[8] The FTSE/ASEAN Index Series was launched on September 21, 2005 and is the first to be designed specifically for the five stock exchanges within the ASEAN. Stocks of up to 180 stocks are selected and weighted by market capitalization from five South East Asian financial markets: JSX, KLSE, PSE, SET and SGX. The series is calculated in accordance with the Industry Classification Benchmark (ICB), a global standard which is developed in partnership between FTSE Group and Dow Jones Indexes. ICB is used to segregate markets into sectors within the macroeconomy that uses a system of 10 industries, partitioned into 18 supersectors that are divided into 39 sectors, which then contain 104 subsectors. The primary aim of ICB is to categorize individual companies into subsectors based on company's source of revenue as in the majority of revenue as to which it is being constituted from.

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Table 1: Cointegration Test

Panel A- Pre-crisis (1987:1-1997:7)

		k=3 r=2			
Null	**Alternative**	**λmax**		**Trace**	
r = 0	r = 1	86.887**	34.400	176.815**	75.980
r ≤ 1	r = 2	57.258**	28.270	89.928**	53.480
r ≤ 2	r = 3	15.466	22.040	32.670	34.870
r ≤ 3	r = 4	10.601	15.870	17.205	20.180
r ≤ 4	r = 5	6.603	9.160	6.603	9.160

Panel B- Post-crisis (1997:8-2007:12)

		k=6 r=1			
Null	**Alternative**	**λmax**		**Trace**	
r = 0	r = 1	42.752*	33.640	90.465*	70.490
r ≤ 1	r = 2	25.545	27.420	47.713	48.880
r ≤ 2	r = 3	10.577	21.120	22.168	31.540
r ≤ 3	r = 4	7.564	14.880	11.591	17.860
r ≤ 4	r = 5	4.027	8.070	4.027	8.070

Notes: The k is the lag length and r is the cointegrating vector(s). Chosen r: number of cointegrating vectors that are significant under both tests. Asterisk (*) and (**) denote statistically significances at 5 and 1 per cent levels respectively.

Table 2: Granger Causality Test

Panel A- Pre-crisis (1987:1-1997:7)

Dependent Variables	ΔJSX	ΔKLSE	ΔPSE	ΔSGX	ΔSET	ECT Coefficient	ECT t-ratio (p-value)
			χ^2 statistics (p-value)				
ΔJSX	-	0.167 (0.682)	0.138 (0.710)	0.137 (0.711)	0.916 (0.339)	0.004	0.348 (0.729)
						0.017	1.351 (0.179)
ΔKLSE	0.054 (0.816)	-	0.002 (0.968)	0.121 (0.728)	3.491 (0.062)	0.004	2.018 (0.046)
						0.002	0.800 (0.426)
ΔPSE	11.605 (0.001)	0.230 (0.631)	-	1.573 (0.210)	0.094 (0.759)	-0.030	-6.115 (0.000)
						-0.00	-0.194 (0.847)
ΔSGX	5.534 (0.019)	0.800 (0.371)	0.024 (0.881)	-	1.837 (0.175)	-0.010	-2.550 (0.012)
						0.005	1.275 (0.205)
ΔSET	0.002 (0.963)	0.546 (0.460)	1.648 (0.199)	0.057 (0.811)	-	0.003	0.515 (0.607)
						0.048	7.796 (0.000)

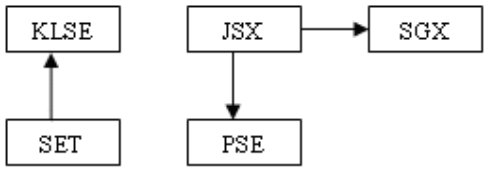
Panel B- Post-crisis (1997:8-2007:12)

Dependent Variables	ΔJSX	ΔKLSE	ΔPSE	ΔSGX	ΔSET	ECT Coefficient	ECT t-ratio (p-value)
			χ^2 statistics (p-value)				
ΔJSX	-	9.746 (0.002)	4.508 (0.034)	8.976 (0.003)	8.880 (0.003)	0.019	4.369 0.000
ΔKLSE	5.808 (0.016)	-	0.468 (0.494)	0.231 (0.631)	0.452 (0.501)	-0.003	-3.193 (0.002)
ΔPSE	0.037 (0.848)	0.228 (0.633)	-	0.077 (0.781)	1.167 (0.280)	0.003	1.022 (0.309)
ΔSGX	1.563 (0.211)	0.059 (0.808)	0.860 (0.354)	-	0.004 (0.951)	-0.002	-1.749 (0.084)
ΔSET	0.001 (0.981)	3.509 (0.061)	2.714 (0.099)	3.924 (0.048)	-	0.010	2.430 (0.017)

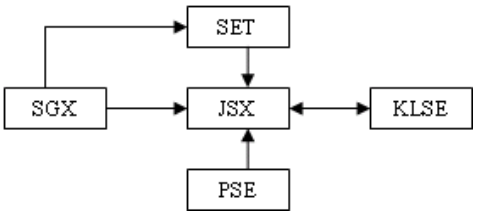
Notes: The significance of the error correction term is evaluated through the t-ratio. The symbol Δ is the first difference operator. Parenthesized values are the probability of rejection for Granger non-causality.

Figure 1: Directions of Causality for GARCH Volatility Series

Panel A: Pre-crisis



Panel B: Post-crisis



Notes: The causality directions are shown between the ASEAN-5 markets of JSX, KLSE, PSE, SGX and SET. The symbol ⟶ provides the direct causality directions, while, the symbol ⇢ represents the indirect causality directions that exist between the stock markets.

Appendix

Generalized Autoregressive Conditional Heteroscedasticity (GARCH)

Extended from the Autoregressive Conditional Heteroscedasticity (ARCH- Engle, 1982) modeling, the model is known to be the Generalized ARCH (GARCH) should the autoregressive moving average (ARMA) assumed for error variance. The GARCH model of Bollerslev (1986) is given as expression (1):

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + ... + \beta_p \sigma_{t-p}^2 \quad (1)$$

It can also be further summarized into expression 2 as follows:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2 \quad (2)$$

Where p is the order of the GARCH; and σ^2 and q is the order of the ARCH terms (ε^2).

Based on expression 1, the GARCH model will only be employed against the sets of data series in order to capture the GARCH volatilities series (y_t) of the data samples. Following several econometrical approaches of Unit Root, Cointegration and Granger Causality tests, these analytical conducts will henceforth be conducted against these series.