Capital Markets Review Vol. 14, Nos. 1&2, pp 65-81(2006) ISSN 1823-4445

Stock Market Linkages in the ASEAN-5 Region and Implications on Seasonality Effect#

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Abstract: This study investigated stock market linkages in the ASEAN region and consequently their implications on seasonality. For the period of 1988-2005, this study established evidence of seasonality effect in the selected stock markets. The Granger causality tests suggest causal linkages with Singapore leads in the majority of cases. The time-series regression analysis detects contagion effect whereby stock returns in Singapore set the trend for Malaysia, Thailand and Indonesia. Further investigation on causal linkages due specifically to seasonality effect produced results that lend strong support to the view that seasonality effects in some stock markets are contagious. Specifically, seasonality effect in the Malaysian stock market is preceded by seasonality effect in Singapore and Thailand, which in turn is preceded by that in Indonesia and the Philippines, respectively. These findings imply that investors in such markets could elevate their ability to exploit seasonality effect by observing similar trends in the leader markets.

Keywords: Stock market linkages, seasonality effect, ASEAN countries

1. Introduction

Stock market linkages have recently received tremendous attention from academicians, policy makers and investors alike mainly due to their implications on investment decisions such as international diversification and arbitrage opportunities. Notwithstanding the perceived importance of emerging markets including ASEAN as investment centres that are capable of offering enormous potential and favorable payoff for various international fund managers (Masih and Masih 1999), studies which purely focus on linkages between emerging markets are still relatively scant (Narayan *et al.* 2004). More specifically are studies

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#The authors would like to extend their gratitude to the participants of the Conference of the Pacific Regional Science Conference Organization (PRSCO) Summer Institute 2006 for their valuable comments on the first draft of this paper.

that concentrate on linkages between neighboring emerging markets, because unlike advanced markets, the well-being and therefore potential of these markets tend to influence one another. This rationalisation is consistent with the growing notion that stock markets are increasingly becoming more integrated as a region. Such integration comes parallel with the growing importance of free capital mobility arising from the introduction of various economic integration mechanisms such as the European Union (EU), North American Free Trade Area (NAFTA) and ASEAN Free Trade Area (AFTA). Narayan *et al*. (2004) assert that liberalisation of barriers to trade (products) has also improved capital flows across national borders, resulting in the integration of the stock markets. Meanwhile, in their study which includes the world's most advanced stock markets (United States, United Kingdom and Japan) as well as four emerging Asian stock markets (Hong Kong, Thailand, Singapore, and Malaysia), Masih and Masih (1999) found that certain markets set the trend for specific geographical regions. In the case of the Southeast Asia region, their study found that stock market fluctuations are mostly influenced by the regional (that is, Hong Kong) rather than the advanced markets. More importantly, both of these studies (Masih and Masih 1999; Narayan *et al*. 2004) conclude that intra-regional linkages between stock markets are stronger than those with the advanced markets.

Based on these regards, the present study contributes to the existing literature on stock market interdependence through examining linkages among emerging markets in the ASEAN region, specifically Malaysia, Indonesia, Singapore, Thailand and the Philippines. But more importantly, it renews interest on a topic that has long been an intriguing issue in empirical finance, namely stock market seasonality, by associating it with stock market linkages. Apparently since it was re-introduced in 1976 (Rozeff and Kinney 1976), stock market seasonality in the form of January effect has become the most closely examined anomaly of efficient market hypothesis. This is particularly true for major capital markets like the New York Stock Exchange (NYSE) where studies on this issue are both voluminous and leaning towards supporting the January effect anomaly (cf. Haugen and Jorion 1996; Keim 1983; Rozeff and Kinney 1976). Even though less rigorous, studies done on other stock markets remain supportive of the January effect or seasonality effect in general (cf. Gultekin and Gultekin 1983; Nor Azuddin *et al*. 2005; Pandey 2002). Of interest to this study is neither the nature of seasonality in the selected markets nor explanations to the seasonality. It focuses instead on the implications of the findings of Masih and Masih (1999) and Narayan *et al*. (2004) that the ASEAN region is still characterised as one with leader-follower markets. This study argues that such an imperfect integration could indirectly create an arbitrage opportunity among stock markets within the region. One of the opportunities could come from the potential contagion effect of stock market seasonality, defined as abnormally high return patterns in one equity market (leader/origin) that triggers similar abnormally high return patterns in other equity markets. In other words, this leader-follower linkage is expected to allow investors in the follower equity market to exploit seasonality effect more efficiently by observing the trend in the leader equity markets.

Besides representing the most growing economies in the ASEAN region, the five countries selected in this study also posses a characteristic unique to the literature on stock market seasonality in that all of them do not impose tax on capital gains. The tax-loss selling hypothesis is the most compelling and tested explanation of January effect. The hypothesis implies the existence of seasonal month effect in the absence of tax on capital

gains. Our findings are expected to add evidence against the hypothesis considering the facts that January effect has been found in such systems (Jones *et al.* 1987; Kato and Schallheim 1985; Nor Azuddin *et al.* 2005; Ruzita and Dwipraptono 2006) as well as evidence against January effect when the tax motivation applies (Cox and Johnston 1998; Mehdian and Perry 2002). The remainder of this article is organised in the following manner. Section 2 discusses the data and presents the empirical specifications. This is followed by Section 3 that presents and discusses the results and Section 4 that presents the conclusions and discusses the implications.

2. Data and Methodology

The present study uses macro-level data as in the approach used by previous studies (Gu and Simon 2004; Johnston and Cox 2002; Othman Yong 1991; Rozeff and Kinney 1976; Ruzita and Dwipraptono, 2006). This approach offers advantages including minimising the micro-structure problem introduced in individual and/or institutional stocks (Johnston and Cox 2002), allows seasonality to be more easily detected (Pandey 2002) and avoids issues related to portfolio formation (Gu and Simon 2004). The monthly closing indexes, defined as the price index on the last trading day of the month, are drawn from Thompson Financial Datastream. Selecting for each country one broad-based stock market index which adequately represents the general equity market condition and that has a complete 12-month data starting January 1988 until December 2005 provided this study with the following sample stock market indexes: (1) the Exchange Main Board All Shares (EMAS) index for Malaysia; (2) Jakarta Composite Index (JCI) for Indonesia; (3) Stock Exchange of Thailand (SET) index for Thailand; (4) Singapore All Equities (SAE) index for Singapore; and (5) the Philippines Stock Exchange Composite Index (PCI) for the Philippines.[1] Throughout the study period, the monthly rate of return for the *i*th index for month *t* is given as

$$R_{i,t} = \frac{PI_{i,t} - PI_{i,t-1}}{PI_{i,t-1}} x100\ \% \qquad (1)$$

where $PI_{i,t}$ is the closing price of the *i*th national index in month *t*.

The study set the stage by re-examining the presence of seasonality effect in the sample markets using a time-series regression model, initially used by Pietranico and Riepe (2004)

$$R_{i,t} = \alpha_{0,i} + \alpha_{1,i}(D_{i,t}) + \varepsilon_{i,t}\,, \qquad (2)$$

where $R_{i,t}$ is the monthly return on the *i*th index at the end of month *t*, $\alpha_{0,i}$ is the intercept term for the *i*th index, $\alpha_{1,i}$ is the estimated coefficient of the seasonal month dummy variable ($D_{i,t}$) for the *i*th index/market and $\varepsilon_{i,t}$ is the error term for the *i*th index. The dummy variable in Equation (2) is defined as follows:

[1] Note that for Malaysia and Singapore, there are two broad indexes that fulfill the description. Nonetheless, since these indexes correlate highly, i.e. r = 0.979 between KLCI (Kuala Lumpur Stock Exchange Composite Index) and EMAS and r = 0.973 between Singapore Strait Times Index and SAE, we assumed that one index, that is, the broader of the two, is adequate to represent the equity market's condition.

$$D_i = \begin{cases} 1 & \text{if the month is the seasonal month for the respective } i\text{th market} \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

The coefficient of the dummy variable is significantly positive if the return series exhibits an abnormally positive pattern in the seasonal months and thus a proof of the presence of seasonality effect in the sample markets.

Then using Granger causality approach, the study investigated the presence of short-run linkages among returns of the sample equity markets to determine which stock markets act as the leaders and which get the spillovers/effects. Based on the direction of the Granger causality, we examined the presence of contagion effect whereby the leader (follower) markets were identified as the origin of (affected by) the contagion effect, that is, the effect of such linkages. In the spirit of Kanas (2005) and Narayan *et al.* (2004), we developed a time-series regression model to trace the contagion effect in the general stock market condition by extending Equation (2) to include return series of the other ASEAN countries which based on Granger Causality tests were identified as the leaders (l) or origins of contagion effect on returns of the follower (f) market. The resulting time-series regression models in general can be written in the following form;

$$R_t^f = \alpha_0^f + \alpha_1^f (D_t^f) + \sum_{l=1}^{N} \beta_l R_t^l + \varepsilon_t^f , \quad (4)$$

where $á_0$ is the intercept term, $á_1$ is the coefficient of the seasonal dummy variable (D), R_t is the return at the end of month t, l and f are the equity markets that are identified as the leaders/origins of and follower/affected by the contagion effect, respectively, β_l is the response of f equity market's return to the respective l equity market's returns and ε is the error term in the respective follower equity market specification. The specification in Equation (4) predicts that monthly returns on stocks in a particular equity market (follower) are explained not only by the return pattern in the seasonal month, but also by the patterns of returns on stocks in the other ASEAN equity markets that have been identified to originate/trigger the pattern. In other words, the return patterns in the 'origin' equity market are transmitted or contagious to the other equity markets in the region. Returns on Malaysian stocks, for instance, are not only explained by the abnormal December/February returns but also by the monthly returns on stocks traded in Thailand, Indonesian, the Philippines, and Singaporean markets.

Equation (4) nonetheless is restricted to linkages among the stock returns of the five equity markets in general. To dictate specific linkages due to seasonality, Equation (4) was modified to incorporate only returns of months that had been identified to exhibit seasonality effect, that is,

$$R_t^{f^*} = \alpha_0^{f^*} + \sum_{l=1}^{N} \beta_l R_t^{l^*} + \varepsilon_t^{f^*} , \quad (5)$$

where $R_t^{f^*}$ is the returns on index of the follower market for seasonal month t while other definitions remain.

3. Results and Discussion

Before we proceeded with tests on stock market linkages and contagion effects, an issue that needed to be resolved was the identification of the seasonal months which could vary from one market to another. For instance, in the case of Malaysia itself, seasonality effect is associated with January over the 1970-1988 period (Othman 1991), January/February over the 1980-2000 period (Mohd Rahimie 2002) or December/February over the period of 1992-2002 (Pandey 2002) and 1988-2005 (Ruzita and Dwipraptono 2006). The tendency toward February effect in Malaysia is probably because it is more easily associated with the Chinese New Year (henceforth, CNY) effect. The argument is that the abnormal returns in January and/or February are the results of the behaviour of Chinese investors, whose role in the Bursa Malaysia is vital around these months. This argument is compelling because for the last 18 years from 1988 to 2005, CNY has been celebrated in either one of the two months, mostly (67 per cent) in February.[2] The low average January returns are an initial indication of the CNY effect whereby these investors are cashing out for the celebration. The abnormally high returns in February in turn suggest that at the beginning of the CNY, their enthusiasm when re-entering the equity market drives prices abnormally high, a reflection very much welcomed because it signals good luck, fortune and prosperity.

3.1 Identification and Evidence of Seasonality Effect

The identification of the seasonal month, that is, month with potential seasonality effect in each equity market was based on the month with the highest average returns over the 18-year study period. We calculated for each equity market the average returns for month t

$$\overline{R}_{i,t} = \frac{\sum_{y=1}^{n} R_{i,t,y}}{n_i} \tag{6}$$

where y is year 1988,..., 2005, t = month January, …,or December and i is the country's stock market index.

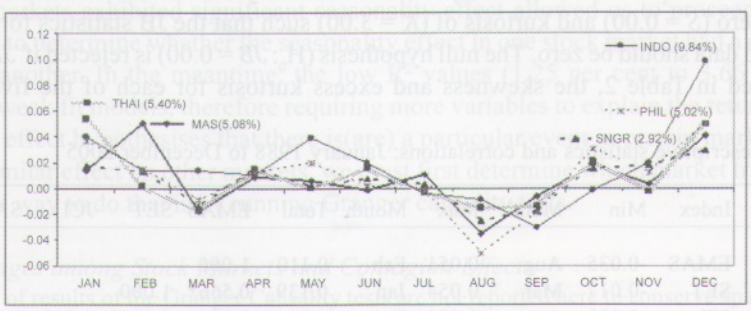


Figure 1. Average monthly returns for each of the ASEAN equity markets; January 1988 to December 2005

[2] For the past 18 years, the dates of Chinese New Year are as follows: 17/2/88; 6/2/89; 27/1/90; 15/2/91; 4/2/92; 23/1/93, 10/2/94; 31/1/95; 19/2/96; 7/2/97; 28/1/98; 16/2/99; 5/2/200; 24/1/01; 12/2/02; 1/2/03; 22/1/04; and 9/2/05.

The pattern of the average monthly returns for each country and the respective statistics are displayed in Figure 1 and Table 1, respectively. Figure 1 shows that the seasonal month is more appropriately attributed to February in the case of Malaysia because it reports the highest monthly returns of 5.08 per cent. For Thailand, the highest monthly return (5.40 per cent) was in January whereas for Indonesia, the Philippines, and Singapore the highest monthly returns were in December (9.84 per cent, 5.02 per cent and 2.92 per cent, respectively). The slight difference in terms of month with highest average returns in these countries disappeared on considering the month with the next highest returns. Both Malaysia and Thailand reported the second highest average monthly returns in December whereas Indonesia, the Philippines and Singapore reported the second highest average monthly returns in January. Briefly, except for Malaysia where the seasonal month appeared to be more appropriately registered as December/February, for the rest of the ASEAN countries it was registered as January/December. Accordingly, if seasonality effect is to be determined by recognising such prolonged effect (for example, Silvapulle (2004) also discussed seasonality in the Australian market in the form of December/January and July/August), the dummy variable in Equation (3) must register these months as having a value of 1.

Next, as reported in Table 1, all stock markets except Thailand consistently reported August as the month with the lowest average monthly returns. Even then, Thailand reported the second lowest return in August (not reported). This feature is not unique to the ASEAN region because August is also the 'quiet month' in the US, the UK, and Japan (Mohd Rahimie 2002). Another similarity involves the returns pattern in five other months (January, February, April, May, and December) when all of these countries reported positive returns. The 'regionality' feature of these countries is further evidenced by the correlations that are consistently positive and highly significant (p-value < 0.01). Of the five equity markets, Indonesia seems to have a stock market that is relatively least correlated (0.344 to 0.404) with the others.

We next tested two basic assumptions of ordinary least squares (OLS), that is, the normality of the distribution and the stationarity of the series to justify the time series analysis. The Jarque-Bera (JB) tests posits that normally distributed data has a skewness value of zero ($S = 0.00$) and kurtosis of ($K = 3.00$) such that the JB statistics for normally distributed data should be zero. The null hypothesis (H_0: $JB = 0.00$) is rejected if $JB > \chi^2_{d.f.=2}$. As reported in Table 2, the skewness and excess kurtosis for each of the five indexes

Table 1. Descriptive statistics and correlations: January 1988 to December 2005

Market	Index	Min	Month	Max	Month	Total	EMAS	SET	JCI	SAE	PCI
Malaysia	EMAS	-0.035	Aug	0.051	Feb	0.110	1.000				
Thailand	SET	-0.017	Mar	0.054	Jan	0.139	0.566*	1.000			
Indonesia	JCI	-0.030	Aug	0.098	Dec	0.214	0.344*	0.364*	1.000		
Singapore	SAE	-0.025	Aug	0.029	Dec	0.083	0.674*	0.612*	0.351*	1.000	
Philippines	PCI	-0.050	Aug	0.050	Dec	0.091	0.545*	0.579*	0.404*	0.641*	1.000

Note: * indicates significance at 5 per cent level while abbreviations EMAS = Exchange Main Board All Shares, JCI = Jakarta Composite Index, SET = Stock Exchange of Thailand index, SAE = Singapore All Equities index, and PECI = Philippines Stock Exchange Composite Index (PCI).

Table 2. Normality of distributions and stationarity of return series: January 1988 to December 2005

Markets	Mean	Median	Min.	Max.	St. Dev.	Skewness	Kurtosis	*JB*	*ADF*
Malaysia	0.008	0.007	-0.243	0.336	0.084	0.449	5.795	77.55	-3.77
Thailand	0.009	0.008	-0.256	0.329	0.099	0.301	4.084	13.83	-3.77
Indonesia	0.018	0.012	-0.315	1.001	0.114	3.146	28.988	6434.71	-4.22
Singapore	0.006	0.006	-0.189	0.261	0.060	0.101	5.331	49.27	-4.37
Philippines	0.008	0.003	-0.272	0.393	0.091	0.499	5.665	72.88	-4.28

Note: In each test, d.f. = 18 (months). JB = Jarque-Bera statistics. All JBs are significant at 1 per cent level. The McKinnon critical values for 1 per cent, 5 per cent, and 10 per cent significant levels are -3.4639, -2.8458, and -2.5743, respectively.

suggest that the return distributions are not normal (JB = 13.83 to 6434.71). Fortunately, in time-series analysis, the assumption that is of greater concern is the stationarity of the series, which in this study was determined by computing the Augmented Dickey-Fuller (ADF). The ADF specifies the null hypothesis (H_0: $\tilde{a} = 0$) that the series have a unit root which is rejected if the ADF statistics is greater than the MacKinnon critical value. The last column of Table 2 shows that ADF values for all series are always greater than the critical value suggesting that the unit root hypothesis is consistently rejected (p-value < 0.01). Thus, the time series data is suitable for time-series regression.

To statistically quantify the significance of the abnormal high returns that often occur during the same months in the respective domestic equity market, we regressed the monthly returns on its seasonal dummy variable ($D_{i,t}$). As reported in Table 3, the coefficients of the seasonal dummy variables were all positive and highly significant. While evidence of seasonality effect was most prevalent in Malaysia and Indonesia; it was also as persistent during the 18-year studied period in the other equity markets including in the Singaporean equity market even though it was only significant at the conventional level. The fact that all of these markets exhibited significant seasonality effect allowed us to proceed with the next quest to determine whether the seasonality effect in one stock market had a contagion effect on another. In the meantime, the low R^2 values (1.25 per cent to 3.66 per cent) indicated weak fit models, therefore requiring more variables to explain the returns. Since contagion effect hypothesises that there is(are) a particular event in certain market(s) that triggers similar effect on other markets, we must first determine which market triggers the event. One way to do that is by running Granger causality tests.

3.2 Linkages among Stock Markets and Contagion Effects

The details of results of the Granger Causality tests are not reported here to conserve space, but are available from the first author on request. The details are reproduced in the form of a diagram in Figure 2 to illustrate the direction as well as the intensity of the causality. Obviously, Figure 2 shows three important observations: (i) there are three most persistent Granger causalities running from stock prices in Thailand to Malaysia, Singapore to Malaysia, and Singapore to Indonesia; (ii) there are three more moderate Granger causalities involving the movements of equity markets in Malaysia and the Philippines followed by Indonesia and Singapore,

Table 3. Regression of monthly returns of each equity market on its seasonal month dummy variable

Variables	Malaysia	Thailand	Indonesia	Singapore	Philippines
Constant	0.0004	0.006	0.0076	0.0023	0.0014
	(0.0587)	(0.0785)	(0.9089)	(0.5127)	(0.2146)
Dummy Variable, (D_{it})	0.0454	0.0512	0.0616	0.0212	0.0421
	(3.0215)***	(2.8733)***	(3.0281)***	(1.9297)*	(2.5594)**
Adjusted-R^2	0.0364	0.0326	0.0366	0.0125	0.0252
F-Statistics	9.129***	8.256***	9.170***	3.724*	6.551**
Durbin-Watson	1.8879	1.8614	1.7824	1.8803	1.8095

Note: Each cell contains coefficient followed by the (t-stat) and *, **, and *** indicates significance at 10 per cent, 5 per cent, and 1 per cent levels, respectively.The estimation for each market was done using the regression equation:

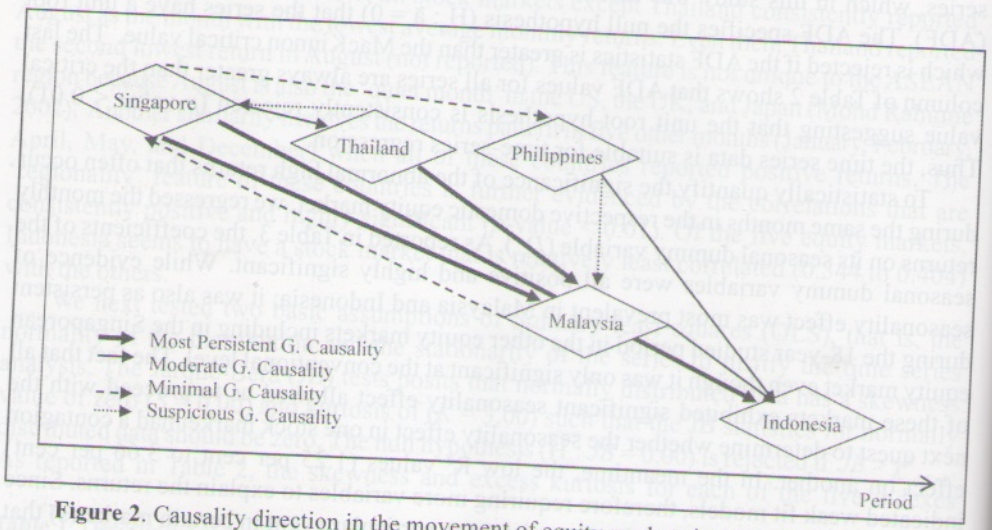


Figure 2. Causality direction in the movement of equity markets in ASEAN-5 countries

Note: For robustness, Granger causality tests are run using lag 1 until lag 6 specifications. To produce the diagram, intensity of the causality relationship was interpreted in the following manner: (i) most persistent when the causality was consistently significant in at least 5 tests; (ii) moderate when causality was consistently significant in at least 3 tests; (ii) minimal when the causality was significant in 2 tests; and (iv) suspicious when the causality was significant in only 1 test.

to Indonesia; (ii) there are three more moderate Granger causalities involving the movements of equity markets in Malaysia and the Philippines followed by Indonesia and movements in Singapore, followed by Thailand; and (iii) there are four other Granger causalities (from Singapore to the Philippines, Malaysia to Singapore, the Philippines to Malaysia, and Thailand to Singapore) with either minimal or suspicious intensity.

Neglecting the last observation for its minimal intensity allows us to discharge two possibilities of bidirectional causalities (that is, between Malaysia and Singapore and Thailand and Singapore) and consequently leads us to the following conclusions. First, the movement in the Singaporean equity market seems to precede all the other ASEAN equity markets except for the Philippines equity markets, such that Singapore should be identified as the location of the 'outbreak' of any particular movement in stock prices. More precisely, returns on stocks traded in Singapore should be given the role of explanatory factor to detect the contagion effect of stock market returns in Malaysia, Indonesia and Thailand. The leading role of Singaporean equity market is expected, given the level of its sophistication and stability relative to the remaining equity markets in the region. As argued by, among others, Eun and Shim (1989), Lee (2004), Liu *et al.* (1998), and Reyes (2001), transmission of stock market movement follows the arrival of information which flows in a unidirectional way from more developed to less developed countries.

Second, in addition to Singapore, Thailand equity market also Granger causes the Malaysian equity market such that returns on Thailand's stocks should also play a role as an explanatory factor for returns on stocks traded in Malaysia. This leading role of Thailand as opposed to Malaysia is consistent with the findings of Ariff and Khalid (2000) regarding the relative level of development of the world's top emerging stock markets. Third, the Indonesia equity market seems to be lagging behind all the other ASEAN equity markets except Thailand. Thus, for the purpose of detecting contagion effect in Indonesia, the regression model should include returns on stocks traded in all of the ASEAN countries except Thailand.

The results that we obtained from the Granger causality tests so far allowed us to examine the contagion effect in three equity markets and the results are reported in Table 4. For robustness, Equation (4) (represented by Model II) was simplified by excluding the effect of seasonality (Model I) as well as extended to include the lagged effects (Model III which was limited to 6 lags) of the returns on stocks of the leader equity markets which were identified as the source/origin of the contagion effect. The first round of regression analyses involved examining contagion effects in Indonesian stock returns. Except for the R_{SEAS}, none of the current as well as the lagged returns of the leader/source markets reported coefficients that were significant. In other words, if the specification employed in this study is a reasonable estimation of contagion effect, then the significant coefficient of variable R_{SEAS} suggests a contagion effect of seasonality coming from the Philippines stock market to the Indonesian stock market. Nonetheless, because the transmission takes place contemporaneously, it might not have much added value from an investment perspective.

The next round of regression analyses was conducted on the Malaysian equity market. The results suggest that there is indeed possibility for a more meaningful contagion effect because the significant results are not only limited to a contemporaneous relationship. The contagion effect of the Singaporean stock market is obviously contemporaneous because the coefficient of the R_{SNGR} is consistently positive and significant in all three models but none of the coefficient of the lagged R_{SNGR} is significant. However, the coefficient of the R_{THAI} is not only consistently positive and significant in all three models, but so does the coefficient of the 2-month lagged returns ($R_{THAI}(-2)$). These results suggest that while in any particular month, there are parallel co-movements of stock prices in Malaysia, Singapore and Thailand, the stock price movements in Malaysia can also be predicted by those in

Table 4. Regressions of monthly returns of follower on the leader equity markets

Independent variables	Indonesia			Malaysia			Thailand		
	Model I	Model II	Model III	Model I	Model II	Model III	Model I	Model II	Model III
Constant	0.013	0.006	-0.000	0.002	-0.003	-0.003	0.003	-0.002	-0.002
	(1.779)	(0.789)	(-0.004)	(0.437)	(-0.621)	(-0.658)	(0.605)	(-0.289)	(-0.338)
Seasonal dummy, D_{1J}		0.041	0.047		0.028	0.024		0.030	0.026
		(2.153)*	(2.306)*		(2.568)*	(2.172)*		(2.120)*	(1.727)
R_{SNGR}	0.127	0.118	-0.025	0.734	0.715	0.637	1.005	0.980	0.954
	(0.718)	(0.674)	(-0.132)	(8.621)**	(8.474)**	(7.335)**	(11.323)**	(11.040)**	(10.590)**
$R_{SNGR}(-1)$			0.029			0.032			0.056
			(0.152)			(0.373)			(0.620)
$R_{SNGR}(-2)$			0.186			-0.029			0.196
			(0.998)			(-0.335)			(2.163)*
$R_{SNGR}(-6)$			-0.040			-0.025			-0.131
			(-0.212)			(-0.285)			(-1.473)
R_{MAS}	0.197	0.198	0.211						
	(1.695)	(1.712)	(1.680)						
$R_{MAS}(-1)$			0.163						
			(1.303)						
$R_{MAS}(-2)$			-0.056						
			(-0.450)						
...									
$R_{MAS}(-6)$			0.036						
			(0.285)						
R_{PHIL}	0.351	0.326	0.363						
	(3.430)**	(3.190)**	(3.310)**						
$R_{PHIL}(-1)$			0.105						
			(0.977)						
$R_{PHIL}(-2)$			-0.047						
			(-0.434)						
...									
$R_{PHIL}(-2)$			0.092						
			(0.863)						
R_{THAI}				0.203	0.202	0.209			
				(3.917)**	(3.950)**	(3.943)**			
$R_{THAI}(-1)$						0.040			
						(0.758)			
$R_{THAI}(-2)$						0.180			
						(3.389)**			
...									
$R_{THAI}(-6)$						0.025			
						(0.475)			
Adjusted-R^2	0.176	0.190	0.199	0.491	0.504	0.537	0.372	0.382	0.395
F-Statistics	16.282**	13.579**	3.364**	104.735	73.856**	17.145**	128.211**	67.398**	18.052**
D-Watson	1.932	1.941	1.951	2.196	2.154	2.240	2.050	2.040	2.043

Notes:

(1) Each cell contains the coefficient followed by the (*t*-stats). Symbols * and ** indicates significance at the 5 per cent and 1 per cent levels, respectively. The results for lags 3 to 5 are similar to that of lag 6, thus omitted to save space. Durbin-Watson statistics ≈ 2.00 indicate no autocorrelations in the residuals.

(2) Based on the specification in Equation (5), the estimations for each affected market are as follows:

Indonesia: $R_t^{INDO} = \alpha_0^{INDO} + \alpha_1^{INDO}(D_t^{INDO}) + \beta_1(R_t^{SNGR}) + \beta_2(R_t^{MAS}) + \beta_3(R_t^{PHIL}) + \varepsilon_t^{INDO}$

Malaysia: $R_t^{MAS} = \alpha_0^{MAS} + \alpha_1^{MAS}(D_t^{MAS}) + \beta_1(R_t^{THAI}) + \beta_2(R_t^{SNGR}) + \varepsilon_t^{MAS}$

Thailand: $R_t^{THAI} = \alpha_0^{THAI} + \alpha_1^{THAI}(D_t^{THAI}) + \beta_1(R_t^{SNGR}) + \varepsilon_t^{THAI}$

Thailand, two months in advance. In addition, the total variations explained by these models are incredibly high, ranging from 49.1 per cent to 53.7 per cent, compared to a mere 3.64 per cent reported in Table 3.

The final round of the regression analyses was done on the Thailand stock returns. Unlike the results for Indonesia and Malaysian equity markets, the stock price movements in Singapore appeared to be more contagious to those in Thailand. Not only was the coefficient of R_{SNGR} significant, the coefficient of $R_{SNGR}(-2)$ was also significant. This findings suggest that while there is co-movement in any particular month in the two stock markets, the stock price movements in Thailand may also be predicted by the stock price movements in Singapore, two months in advance.

Overall, the findings so far suggest that despite the leadership of the Singaporean stock price movement, its contagion effect is only prevalent in Thailand while either weak in the case of Malaysia or non-existent in the case of Indonesia. In the meantime, contagion effect in general only seems to be meaningfully present in two markets, Malaysia and Thailand. Intuitively, these findings suggest that investors in the Malaysia stock markets have the advantage of being able to rely on the condition of the stock market in Thailand. In turn, investors in Thailand stock markes enjoy the same advantage by focusing on conditions of stock prices in Singapore. However, recall that the focus of this study is to determine the implication of linkages among stock markets on seasonality effect. The suggested trading rule is viable if the infected equity markets exhibit abnormal returns in the same month as the leader/origin stock market, such as the case with Thailand and Singapore. Nonetheless, for the stock market in Malaysia where seasonality is more closely associated with February, the advantage may not be so straightforward.

To address this issue, we ran another round of Granger causality tests which used only returns of seasonal months as the variables. Specifically, the tests only involved returns in February and December in the case of Malaysia and January and December in the case of the remaining equity markets. As with the first test, detailed results are not reported here to conserve space with only the significant causalities extracted and illustrated in the form of a diagram in Figure 3.

Unlike the first test, this Granger causality test produces less significant causalities but whenever it does, the causality is always unidirectional. Except for the Malaysian equity market which movement is still preceded by that of Singapore and Thailand, the other relationships show some changes. Instead of being the first, Singaporean equity market now is lagging behind the Philippines. Similarly, Indonesia which appears at the bottom of the chain in the first test now precedes Thailand. These relationships are not totally unexpected because they conform rather well to the nature of the seasonality in these markets. For instance, the Malaysian equity market moves last because seasonality is more pronounced in February. This most probably is also the reason that Thailand stock market is preceded by that of Indonesia given the fact that seasonality in the former market is more pronounced in January whereas that in the latter market is more pronounced in December. To quantify whether the relationships that emerged from the Granger causality tests in Figure 3 have certain intuitive meanings, we ran regression analyses based on Equation (5). Since this equation already incorporates the effect of seasonality (as represented by Model I), we only adjusted it to include the lagged effects (Model II which was limited to 6 lags) of the returns on stocks of the leader equity markets for robustness.

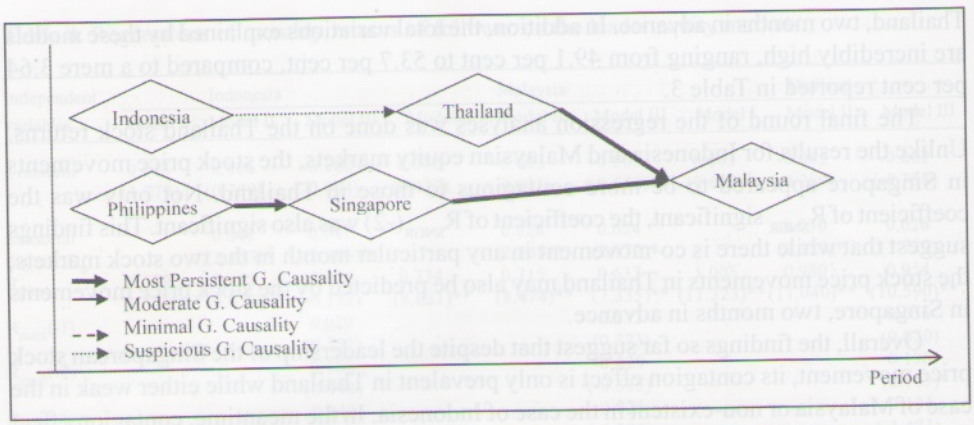


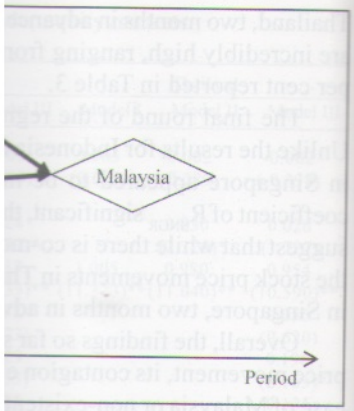
Figure 3. Causality direction in the movement of the equity markets in ASEAN-5 countries

Note: For robustness Granger causality tests are run using lag 1 until lag 6 specifications. To produce the diagram, intensity of the causality relationship was interpreted in the following manner: (i) most persistent when the causality was consistently significant in at least 5 tests; (ii) moderate when causality was consistently significant in at least 3 tests; (ii) minimal when the causality was significant in 2 tests; and (iv) suspicious when the causality was significant in only 1 test.

Consistent with the results of the Granger causality tests, the results in Table 5 in general provide strong evidence of contagion effect particularly with respect to Malaysia. Seasonality in this market to some extent is explained by seasonality (return patterns during the seasonal months) in Singapore and Thailand. This is because not only are the coefficients of the seasonal month returns of Singapore (R_{SNGR}) and Thailand (R_{THAI}) positively significant, but more importantly, the coefficients of the lagged (up to lag 2) seasonal months are also significant. Intuitively, these results suggest that the abnormal performance of the stock markets in Singapore and Thailand are contagious or transmitted to their neighboring equity market, Malaysia. From an investment standpoint, these contagion effects suggest that during the seasonal months of December and February, prices of stocks traded in Malaysia seem to have responded significantly to the current up to the last two seasonal month returns in Singapore and Thailand. In other words, efficient investors in Malaysia should be able to grab the abnormal high returns in $December_{t-1}$/$February_t$ by exploiting the information they have on the performance of the Singaporean and Thailand equity markets from $October_{t-1}$/$November_{t-1}$ onwards.[3]

Evidence of transmission of seasonality is nonetheless lacking in the case of Singapore and Thailand. Even though seasonality in the leader equity markets significantly explains seasonality in the follower market, this is only limited to contemporaneous relationships. This is particularly evidenced in the case of Thailand. The resulting adjusted-R^2 suggests that the current seasonal month returns of Indonesia explain a mere 4.2 per cent of the

[3] Note that seasonality in Malaysia is attributed to December and February abnormal returns whereas in the other ASEAN countries, January and December. Accordingly, in interpreting the regression results for Malaysia in Table 5, a contemporaneous relation refers to $Dec/Feb_{Malaysia}$ and Dec/Jan_{Others}, 1-month lagged relation refers to $Dec/Feb_{Malaysia}$ and Nov/Dec_{Others}, 2-month lagged relation refers to $Dec/Feb_{Malaysia}$ and Oct/Nov_{Others}, and so forth.



markets in ASEAN-5 countries

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bruary abnormal returns whereas in n interpreting the regression results $Feb_{Malaysia}$ and Dec/Jan_{Others}, 1-month gged relation refers to $Dec/Feb_{Malaysia}$

Table 5. Regressions of seasonal month returns of follower on the leader equity markets

Independent Variables	Malaysia Model I	Malaysia Model II	Independent Variables	Thailand Model I	Thailand Model II	Independent Variables	Singapore Model I	Singapore Model II
Constant	0.005	0.003	Constant	0.007	0.007	Constant	0.002	0.002
	(1.817)	(1.122)		(2.2572)*	(1.909)		(1.256)	(1.429)
R_{MAS}*	0.410	0.466	R_{INDO}*	0.134	0.135	R_{PHIL}*	0.303	0.300
	(3.592)**	(4.395)**		(3.249)**	(3.244)**		(9.499)**	(9.303)**
R_{MAS}*(-1)		-0.656	R_{INDO}*(-1)		0.075	R_{PHIL}*(-1)		-0.046
		(-6.134)**			(1.809)			(-1.422)
R_{MAS}*(-2)		0.225	R_{INDO}*(-2)		-0.012	R_{PHIL}*(-2)		-0.010
		(2.099)*			(-0.290)			(-0.297)
R_{MAS}*(-3)		-0.047	R_{INDO}*(-3)		-0.013	R_{PHIL}*(-3)		-0.009
		(-0.435)			(-0.315)			(-0.280)
R_{MAS}*(-4)		-0.002	R_{INDO}*(-4)		-0.013	R_{PHIL}*(-4)		0.009
		(-0.017)			(-0.315)			(-0.280)
R_{MAS}*(-5)		-0.007	R_{INDO}*(-5)		-0.013	R_{PHIL}*(-5)		-0.009
		(-0.070)			(-0.315)			(-0.280)
R_{MAS}*(-6)		-0.012	R_{INDO}*(-6)		-0.013	R_{PHIL}*(-6)		-0.009
		(-0.117)			(-0.315)			(-0.276)
R_{THAI}*	0.164	0.198						
	(2.861)**	(3.681)**						
R_{THAI}*(-1)		0.318						
		(5.807)**						
R_{THAI}*(-2)		0.131						
		(2.394)*						
R_{THAI}*(-3)		0.003						
		(0.054)						
R_{THAI}*(-4)		-0.010						
		(-0.181)						
R_{THAI}*(-5)		-0.012						
		(-0.220)						
R_{THAI}*(-6)		-0.010						
		(-0.189)						
Adjusted-R^2	0.128	0.296	Adjusted-R^2	0.042	0.034	Adjusted-R^2	0.293	0.288
F-Statistics	16.847**	7.276**	F-Statistics	10.553**	2.035	F-Statistics	90.233**	13.077**
D-Watson	1.988	1.998	D-Watson	2.331	2.371	D-Watson	1.489	1.505

Notes:

(1) Symbols * and ** indicate significance at the 5 per cent and 1 per cent levels, respectively. Durbin-Watson statistics ≈ 2.00 indicate no autocorrelations in the residuals.

(2) Based on the specification in Equation (6), the estimations for each affected market are as follows:

Malaysia: $R_t^{MAS*} = \alpha^{MAS*} + \beta_1(R_{,t}^{SNGR*}) + \beta_2(R_t^{THAI*}) + \varepsilon_t^{MAS*}$

Thailand: $R_t^{THAI*} = \alpha^{THAI*} + \beta_1(R_{,t}^{INDO*}) + \varepsilon_t^{THAI*}$

Singapore: $R_t^{SNGR*} = \alpha^{SNGR*} + \beta_1(R_{,t}^{PHIL*}) + \varepsilon_t^{SNGR*}$

fluctuations in Thailand. Adding the lagged returns of Indonesia deteriorates the explanatory power of the model further to 3.4 per cent (p-value > 0.05). Singapore also suffers a reduction in the adjusted-R^2 after adding the lagged returns of the Philippines, but the effect is minimal (from 29.3 per cent to 28.8 per cent). The fact that such results involve equity markets that have the same seasonal months, that is, December/January, suggests that the contagion effect of seasonality in the Philippines on Singapore stock markets is rather short-lived while that of seasonality in Indonesia on Thailand stock markets is practically non-existent. This notion is in contrast with the contagion effect of stock market seasonality running from Singapore and Thailand to Malaysia. The contagion effect is apparently meaningful because the causation begins two seasonal months in advance. In other words, investors in Malaysia can predict and accordingly exploit the seasonality in seasonal month t by observing the fluctuations of returns in Thailand and Singapore starting from seasonal month t-2, t-1 and t.

4. Conclusion and Implications

This study examined the issue of stock market linkages in Malaysia as well as four other neighboring countries in the ASEAN region, that is, Singapore, Thailand, the Philippines and Indonesia. Besides the geographical region, another common characteristic of these markets is the tax exemption on capital gains, which in itself is significant in the literature on seasonality in stock market because tax-loss selling hypothesis has been a widely accepted explanation of the phenomenon. The preliminary results suggest that except for Malaysia where the seasonality effect is more appropriately associated with February effect, acknowledging the seasonality effect in a slightly broader span (by including the month with the second highest returns) reduces the differences to almost nil. Specifically, while seasonality effect is associated with December/February effect in Malaysia, it is associated with December/January effect in the other four countries. The results from our first regression models of Equation (3) confirm previous finding (Ruzita and Dwipraptono 2006) that the seasonality effect is significant in all of these countries including in Singapore. Given that the results are obtained from markets that exempt tax on capital gains, this study provides additional evidence to reject the tax-loss selling hypothesis.

The rest of the study was aimed at establishing evidence of linkages among the stock markets and the effect on seasonality in stock market. Using Granger causality tests on the overall stock returns data, we found evidence consistent with previous studies (Masih and Masih 1999; Narayan *et al.* 2004) that some equity markets set the trend for the others. The regression models of Equation (5) that were developed to reflect the causality directions confirm that there are contagion effects in the general stock market performance. To examine the implication of such linkages and contagion effects on stock market seasonality, another round of Granger causality tests were conducted using only seasonal month returns. The results of regression analyses confirmed those from the Granger causality tests that seasonality in the Malaysian stock market tends to be preceded by stock market seasonality in Singapore and Thailand which in turn is preceded by the stock market seasonality in the Philippines and Indonesia, respectively. However, with respect to Singapore, the seasonality effect is originated but only contemporaneously from the Philippines whereas for Indonesia, similar evidence is rather minimal. Overall, our analysis provides considerable evidence

of contagion effect of stock market seasonality in the ASEAN region. The practical implication of the contagion effect is that decisions on equity investment (sale or purchase) should not solely be based on the confined condition of one's own market, but rather on other markets in the region as a whole. Furthermore, the contagion effect indicates that opportunities exist for investors in these countries to make abnormal profits through international diversification, at least in the short term.

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