ASEAN-5 and Indian Financial Market Linkages: Evidence from Cointegration and Factor Analysis

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Abstract: Research Question: How the ASEAN-5 and Indian markets are integrated with respect to pre and post 2008 financial crisis? **Motivation:** The past studies have not covered ASEAN-5 and Indian market. Further, the market integration has implication for portfolio diversification. This Puzzle is solved by adopting different investment portfolio options for pre- and post-crisis period. Majority of the past studies were conducted using weekly or monthly data but the present study is conducted using daily data to get results that are more robust. **Idea:** The core idea is that examining the portfolio diversification opportunity and integration among the markets with respect to pre- and post-crisis. The study focuses on whether the level of integration among the markets improved after the crisis or not. **Data:** The study is performed covering a data from January 1, 1998 to 30 March 2020. A period from January 1, 1998 to June 30, 2008 is denoted as Pre-crisis period and a period from January 1, 2009 to March 30, 2020 is taken as a post-crisis period. The data of indexes are taken from investing.com database. The study is performed on the five original ASEAN members (Indonesia, Malaysia, the Philippines, Singapore, Thailand) and India. **Method/Tools:** The study is performed using Correction, Unit Root Test, Granger Causality Test, Johnsen Cointegration Test and Factor Analysis. The study has adopted descriptive research design. **Findings:** The outcome of the study reveals that after the financial crisis, the markets become more integrated with each other and hence the portfolio diversification opportunity is reduced for the investors as compare to pre-crisis period. The investors can diversify their investment portfolio to the relevant market. Further, the government can consider the level of integration to draft monetary and macroeconomic policies. **Contributions:** This study add latest findings to the literature review as it considers the 2008 global financial crisis for study and the study is conducted by considering the data till March 2020. It provides implications for Investors, government and MNCs.

Keywords: Market integration, ASEAN markets, financial crisis, cointegration test.
JEL Classification: F15, F21, G11, G15

1. Introduction

The market integration among the financial markets is an important topic of research in field of finance. The topic of financial market integration remains important for the academician, researchers and investors worldwide. The investors look the risk-return mechanism with respect to the financial market integration and designing the optimum investment portfolio.

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The market integration helps the investors to diversify their investment and generate better risk-return tradeoff. With the market, integration investors can allocate their fund to get maximum benefit (Click and Plummer, 2005). Moreover, the financial market integration has effect on the benefits of global diversity and financial consistency (Ibrahim, 2005). Until date, many researchers have studied the integration among the financial markets with respect to global financial crisis and stock market crashes. The Investors wants to examine the integration among the markets to evaluate the portfolio diversification opportunity. The Multinational companies are interested in market integration as it affects the exchange rate and international transactions. The government has concern for the integration about development of monetary and macroeconomic policies.

The Association of Southeast Asian Nations (ASEAN) is a regional Organisation, which promotes the intergovernmental cooperation and facilitate economic, political, military, education integration among its members and other countries of Asia. The ASEAN was set up in 1967, where Indonesia, Malaysia, the Philippines, Singapore and Thailand were members. Later on Brunei, Vietnam, Laos, Myanmar and Cambodia have joined ASEAN as members in early 1990s. ASEAN has attempted to increase the integration with China, Japan and South Korea under the ASEAN+3. This moved further and ASEAN has East Asia summit where India, Australia and New Zealand are included in ASEAN plus six.

The present study is focus on the integration among the ASEAN five original members (Thailand, Malaysia, Singapore, Philippines and Indonesia) and India. The India is one of the ASEAN+6 countries and the past study have not examined the integration of ASEAN-5 countries with India. Hence, the present study focuses on the market integration among the financial markets of ASEAN-5 Countries and India with respect to 2008 global financial crisis.

The rest of the paper is structured as follows. The literature review is covered in section 2. Section 3 shows the empirical framework. The data analysis and empirical findings are shown on section 4. The Section 5 covers the conclusion and implications of study.

2. Literature Review

2.1 Review of Past Studies

The market integration and portfolio diversification is studied over many years. In early 1970s and 1980s, many studies found lower integration among the markets. Grubel (1968) reveals the benefits of portfolio diversification in international market. Past studies conducted by Subrahmanyam (1975) and Kenen (1976) also find the existence of market integration. Neal (1985) found strong integration among the European financial markets. In a study, Vos (1988) found that the market become more integrated and the co-movement among the markets has been rising over a period.

In past many researchers have explored the integration of ASEAN markets with each other (at regional level) and with other markets (global level). Many researchers applied different methods and found existence of integration among the ASEAN markets. Examples of such recent studies include those by Azman-Saini (2002), Click and Plummer (2005), Kim (2011), Patel and Patel (2011, 2012), Kim and Lee (2012), Karim and Ning (2013), Sriboonchitta and Chaiboonsri (2013), Rahman *et al.* (2014), Chien *et al.* (2015), Lee and Jeong (2016), Jiang *et al.* (2017), Chan *et al.* (2018), Fry-McKibbin *et al.* (2018), and Mensah and Premaratne (2018). In a study, Azman-Saini (2002) examined the integration among the markets of Indonesia, Malaysia, Philippines, Singapore and Thailand using the weekly data from 1988 to 1999. The study found that all the markets are integrated with each other in loge-term except Singapore. Hence, the Singapore offers the portfolio diversification opportunity. Click and Plummer (2005) found that the ASEAN markets holds strong integration with the passage of time and hence the portfolio diversification opportunity reduces. However, the portfolio

diversification opportunity is still existing in limited frame. Kim and Lee (2012) found existence of strong integration among the markets of Indonesia, Malaysia, Philippines, Singapore and Thailand during 1990-2008. Kim (2011) found that the strong bilateral trade and investment among the ASEAN countries makes strong integration among the ASEAN markets.

Karim and Ning (2013) examined the integration among Malaysia, Thailand, Indonesia, the Philippines and Singapore markets from 2001 to 2010. The Authors applied OLS Regression and found strong integration among the markets. Further, the study also reveal that the ASEAN countries have strong bilateral which makes the integration stronger. Using C-D Vine Copula Approach, Sriboonchitta and Chaiboonsri (2013) studied the integration among the ASEAN markets and found strong integration. By applying the Markov switching approach, Rahman *et al.* (2014) studied the integration among ASEAN, China, Japan and Korea markets. The study found strong integration among all the markets, except china. Chien *et al.* (2015) examined the integration among the markets of China and ASEAN Countries during 1994 to 2002. The author applied cointegration analysis and found that the level of integration is increase among all the markets.

Lee and Jeong (2016) studied the integration among the US, China and ASEAN markets. The outcome of the study reveal that the ASEAN markets are more regionally integrated than global markets. Jiang *et al.* (2017) studied the integration among the ASEAN markets during 2009 to 2016. By applying the wavelet and VMD-based copula tests, the author found that the markets become more integrated with the passage of time. Chan *et al.* (2018) studied the integration among ASEAN members during 1980 to 2014. The study is performed using panel Cointegration test and found existence of integration among the markets. Fry-McKibbin *et al.* (2018) studied the integration among the markets of East Asian and ASEAN countries during 1997 to 2016. The Study found that the markets become more integrated with the passage of time. Mensah and Premaratne (2018) studied the integration among the ASEAN markets covering a period from 2000 to 2012. By Applying a dynamic conditional correlation GARCH framework, the study found that the markets are strongly integrated with each other.

Few researchers have evaluated the ASEAN market integration with respect to financial crisis. They have studied the level of integration among the ASEAN markets for pre and post-crisis and found stronger integration post-crisis. Examples of such recent studies include those by Liu *et al.* (1998), Jang and Sul (2002), Shabri Abd. Majid *et al.* (2008), Huyghebaert and Wang (2010), Karim and Karim (2012), and Rahman *et al.* (2017). In a study, Liu *et al.* (1998) examined the integration among the markets of U.S., Japan, Hong Kong, Singapore, Taiwan, and Thailand. The study found that after the 1987 stock market crashes, the markets become more integrated. Jang and Sul (2002) studied the integration among the Asian markets with respect to Asian financial crisis. By applying the granger and Johnson cointegration test, the author found that the Asian markets holds stronger integration after the financial crisis. Shabri Abd. Majid *et al.* (2008) studied the integration among the ASEAN, US and Japan markets with respect to 1997 financial crisis. By applying the Cointegration & GMM, the authors found that Integration among the markets increase after the financial crisis and hence the portfolio diversification opportunity is diminished. Huyghebaert and Wang (2010) studied the market integration among the East Asian markets with respect to 1997-1998 financial crisis. The study found limited integration among the markets before the crisis. However, after the crisis the markets become strongly integrated. Using the ARDL approach, Karim and Karim (2012) studied the integration among the Malaysia, Thailand, Indonesia, the Philippines and Singapore markets. The study found that the all markets are integrated during and after various financial crisis. Further, the diversification opportunity is narrow due to integration. Rahman *et al.* (2017) examine the integration among the markets of China, Japan, Korea, Malaysia, Indonesia and Philippines from 1992 to 2013. The author applied VAR and VECM

on the data to examine the integration before and after the Asian crisis. The study found that the market become more integrated after the financial crisis. After the financial crisis, the trade among the markets become stronger and hence the level of integration increases among the markets (Patel, 2017).

Few researches found no integration among the ASEAN market and as a result, a portfolio diversification opportunity exist for the investors. Examples of such studies include those by Palac-McMiken (1997), Goh *et al.* (2005), Ibrahim (2006), Rajwani and Mukherjee (2013), Seth and Sharma (2015), Zhang and Matthews (2018), and Duong and Huynh (2020). In a study, Palac-McMiken (1997) studied the Integration among the ASEAN markets from 1987 to 1995. The Author applied Cointegration test and found no integration among the markets. Further, the study also reveals the opportunity of the portfolio diversification. Goh *et al.* (2005) found that the integration among the Singapore, Malaysia, Indonesia, Thailand and the Philippines market weaken after the 1997 Asian Financial crisis. Ibrahim (2006) applied Cointegration and found no integration among the US, Japan and ASEAN markets. By applying the Gregory and Hansen Cointegration technique, Rajwani and Mukherjee (2013) studied the integration of Indian market with other Asian markets. The outcome of the study reveals that the Indian market is not integrated with any of the market. Seth and Sharma (2015) studied the integration among the US and 13 Asian markets. By applying the Johansen's Cointegration test and Granger causality test the authors found that the integration among the markets is weaken after the financial crisis. Zhang and Matthews (2018) found weaker integration among the ASEAN markets port Asian and global financial crisis. Duong and Huynh (2020) examined the integration among the ASEAN markets from 2001 to 2017. The authors have adopted nonparametric approach as well as copulas and found that the markets are not much integrated and the portfolio diversification opportunity still exist.

Few researchers have found mix results that is integration of some markets and non-integration of some markets. Examples of such studies include those by Roca *et al.* (1998), and Jakpar *et al.* (2013). In a study, Roca *et al.* (1998) studied the integration among the markets of Malaysia, Singapore, Philippines, Indonesia and Thailand. The authors have used VAR, Impulse response analysis and Granger causality test. The study found mix outcome, that is, the markets are integrated in short term but not in long-term. Jakpar *et al.* (2013) examined the comovement among the markets of China, Malaysia, Singapore, Thailand, Indonesia and Philippines during 2000 to 2009. The author applied granger causality and Cointegration test and found mix results. The china has integration with Indonesia, Thailand and Singapore and does not hold any integration with Malaysia and Philippines. Patel (2019b) found integration among the markets due to international trade.

2.2 Contribution to Existing Literature

On scanning the past studies, I identified certain shortcomings in the past studies. First, the past studies were with respect to 1987 financial market crash or 1997 Asian financial crisis. Second, the past studies were mainly focusing on long-term integration. The past studies were conducted using the Cointegration test, VAR, VECM, GMM etc. (Goh *et al.*, 2005; Shabri Abd. Majid *et al*., 2008; Huyghebaert and Wang, 2010; Seth and Sharma, 2015; Patel 2016; Rahman *et al.*, 2017; Patel, 2017; Zhang and Matthews, 2018; Patel, 2019a). Third, majority of the past studied were done using weekly or monthly data series of the markets. Therefore, in order to fill this gap, this study has focused on the equity markets of ASEAN (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) and Indian markets. The present study fulfills the existing gap in following manner. First, none of the past studies has focus on ASEAN Market integration with respect to pre and post 2008 global financial crisis. Further, the past studies have not studied the Indian market with ASEAN-5 markets. Hence, the existing study is performed with respect to 2008 financial crisis and by considering Indian

market. Second, the present study is performed for both short-term and long-term integration among the markets. The study is also perform using various portfolio combinations in order to derive robust results. Further, the factor analysis is also performed to examine the integration among the markets. Third, the present study is done using daily data in order to get robust results.

The study is performed to examine the existence of the portfolio diversification opportunity with respect to the financial crisis that is pre-crisis and post-crisis period. First, the short-term integration among the markets is examine using correlation and granger causality test. Based on the short-term integration, different portfolio combinations are developed to examine the long-term integration among the markets. Those markets which does not hold the integration in both short and long-term reflects the existence of portfolio diversification opportunity. The study evaluates the existence of the portfolio diversification opportunity for the investors of ASEAN countries and India to reduce the risk of their investment and get better risk-return tradeoff.

3. Empirical Framework

The objective of this study is to examine the long-term integration among the ASEAN-5 and Indian capital market with respect to 2008 global financial crisis. The study also focuses on examining the short-term integration among the markets. The focus of the study is on examining the level of short-term and long-term integration among the markets with respect to pre and post-financial crisis. The study is performed using Correction Analysis, the Unit Root Test, the Granger Causality Test (Granger, 1986), the Johnsen Cointegration Test (Johansen, 1988; Johansen and Juselius, 1990), Factor Analysis. The lag length in all these tests has been determined as per the Akaike (1974) information criteria. The study has adopted three level methodology. First, examining the short-term integration with Correlation and Granger causality test with respect to pre and post-financial crisis. Second, evaluating the long-term integration using Johnson Cointegration test. Further, the Johnson Cointegration is performed by constructing various portfolio combinations. Third, factor analysis is applied to examine the integration level among the markets.

Majority of the past studies are conducted using weekly or monthly data. However, in order to get robust result, the present study is performed on the ASEAN-5 and Indian market using daily data. The reason to select these indices is that all the indexes are calculated based on the capitalization-weighted method. The study is performed covering a data from January 1, 1998 to 30 March 2020. The data of indexes are taken from investing.com database. The total duration of the study includes three periods, mention as below:

- A period from January 1, 1998 to June 30, 2008 is denoted as Pre-crisis period
- A period from July 1, 2008 to December 31, 2008 is not consider in the study as this period is of financial crisis. This period is avoided to get the disturbance-free outcome.
- A period from January 1, 2009 to March 30, 2020 is consider as a post-crisis period. The post-crisis period is considered until March 2020 in order to get the lasted and more robust results of the study.

The Cointegration method does not require the two data set to be in same currency (Ding *et al.*, 1999). Keeping this in mind, the present study ignores currency issues and the data of all the indexes are taken in the local currency units. One of the problem in the market data set is the missing frequency. The public holidays in various markets leads to missing observation and creates difficulty in investigating the market integration. Using the context of Occam's razor, Jeon and Von Furstenberg (1990) gave a suggestion that in case of missing value, the study can use the previous day's price to fill the missing value. Hence, here the missing data are managed with an adjacent day because the missing data negatively affect the results. The

study is performed on the five original ASEAN members (Indonesia, Malaysia, the Philippines, Singapore, Thailand) and India. The study is performed using following markets.

- Bombay Stock Exchange Index (BSE) for India;
- FTSE Malaysia Index (FTWIMALL) for Malaysia;
- FTSE Philippines Index (FTWIPHLL) for Philippines;
- FTSE Singapore Index (FTWISGPL) for Singapore;
- Jakarta Stock Exchange Composite Index (JKSE) for Indonesia; and
- Set Index (Thai composite stock market index) for Thailand.

4. Data Analysis

4.1 Trend Analysis

Figure 1 shows the trend analysis of the markets for pre and post-crisis period. The BSE market remain volatile from -4% to 4% during pre-crisis period. The market remains volatile in same range in the post-crisis period. However, as compare to pre-crisis period, the post-crisis period has less daily fluctuations. The FTSE Malaysia remain volatile in range of -2% to 2% in both the periods. However, the market was more volatile during 2007-2008 period. The Philippines market remain volatile in range of -4% to 4% in the pre-crisis period. Further, the market was highly volatile in 2007. The market remains volatile in range of -4% to 4% in post-crisis period. However, as compare to pre-crisis the post-crisis period has more daily fluctuations. The Singapore market remain volatile in pre-crisis period where the return was fluctuating from -4% to 4%. In the pre-crisis period, the market remains highly volatile during 2007 and 2008. As compare to pre-crisis period, the Singapore market remains less fluctuative in the post-crisis period, where the return was ranging from -3% to 3%. The Jakarta stock market remain volatile in range of -5% to 5% and -4% to 4%, in pre and post-crisis periods, respectively. The Thailand market remains fluctuative in range of -4% to 4% in both the periods. It is observed that majority of the markets have witness fluctuation during 2007-08 crisis period. Further, as compare to pre-crisis period, post-crisis period has reported less one day fluctuations, which further reveals that after the crisis the market become more stable.

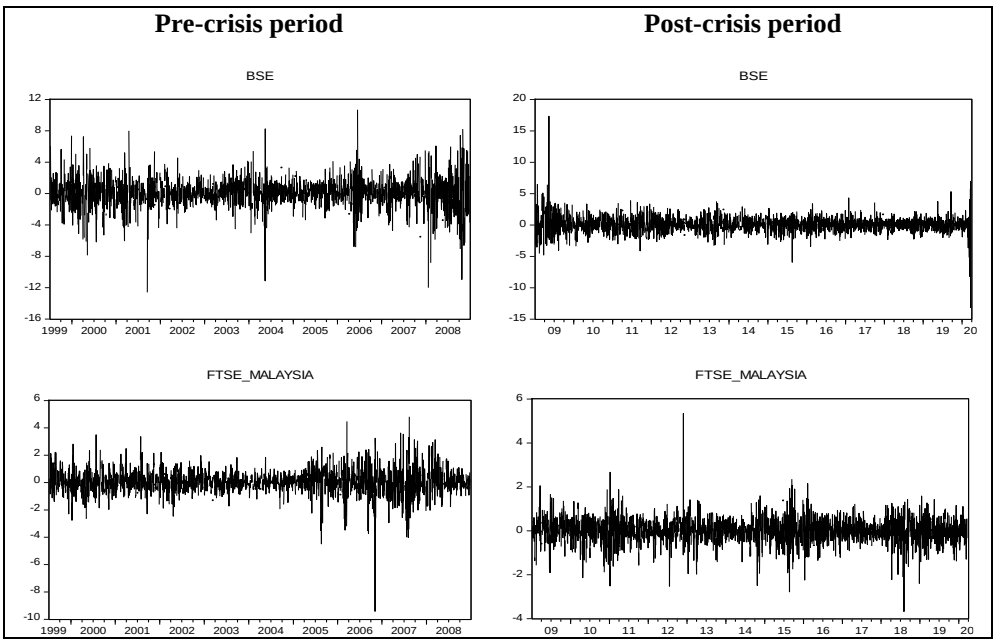

Figure 1: Trend analysis – pre and post-crisis period

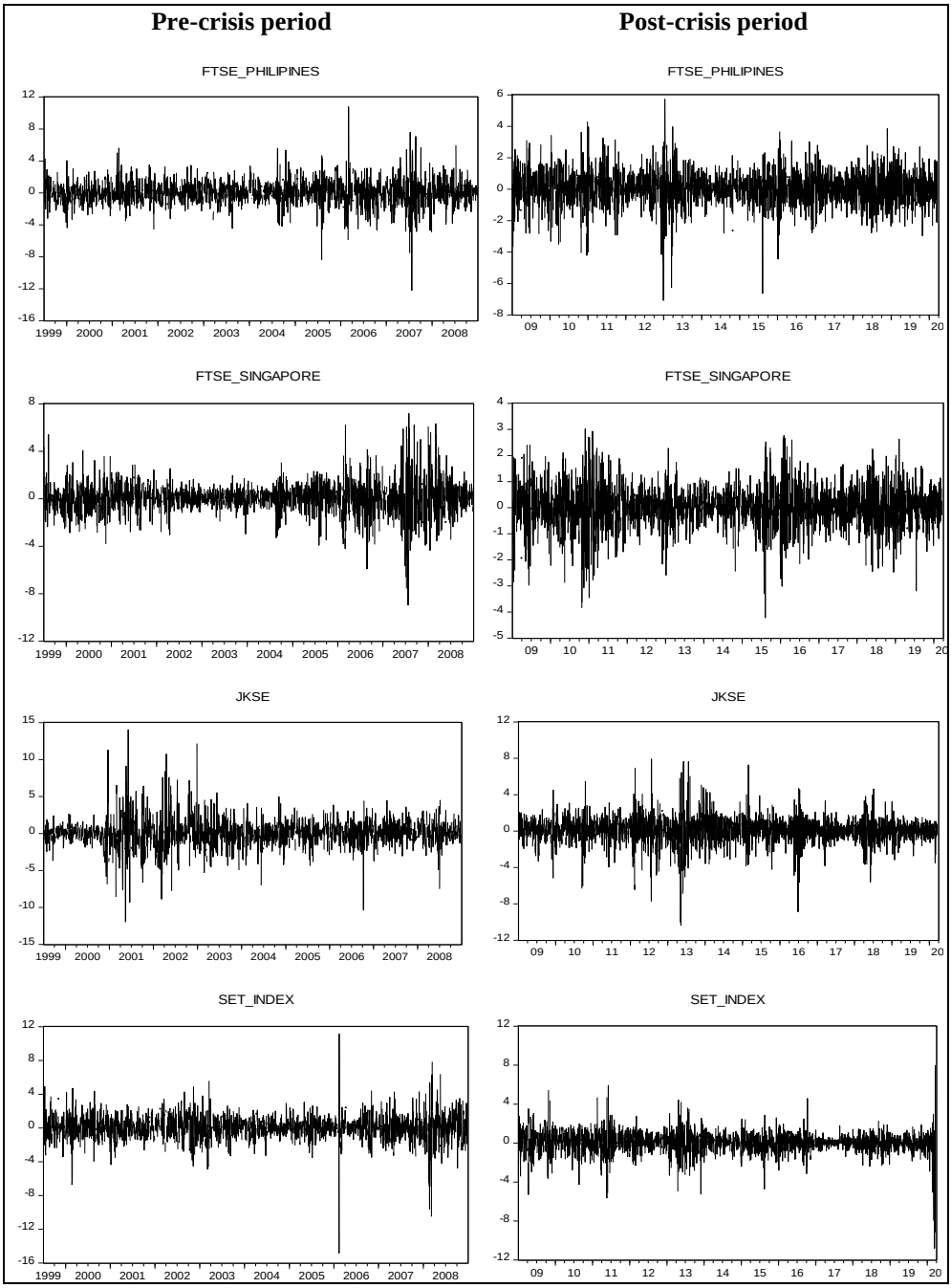

Figure 1 *(continued)*

4.2 Top 10 Rise and Fall Analysis

Figure 2 shows the Average of 10 major one-day rises and falls for the Pre-Crisis Period. The average is calculated based on 10 major one-day rises and falls. Indonesia has highest daily average rise of 9.53% and daily average fall of -8.62%. This is follow by India, with average high and low of 7.52% and -9.078%, respectively. Philippines has average high and low of

6.45% and -6.30%, respectively. Singapore has average rise of 6.08% and fall of -5.8%. Among all the markets, Malaysia has witnessed lowest average fall of -4.3% with average rise of 3.61%. The positive difference in the rise and fall is found in Indonesia (0.91%), Singapore (0.28%) and Philippines (0.15%). The negative difference in the rise and fall is found in Thailand (-1.71%), India (-1.56%) and Malaysia (-0.69%).

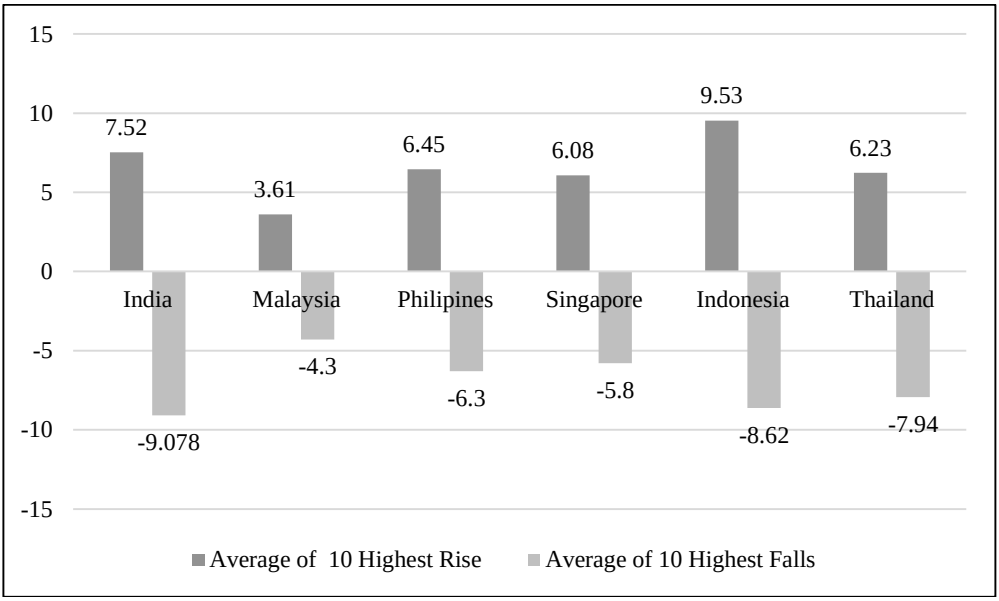

Figure 2: Average of 10 major one-day rises and falls (pre-crisis period)

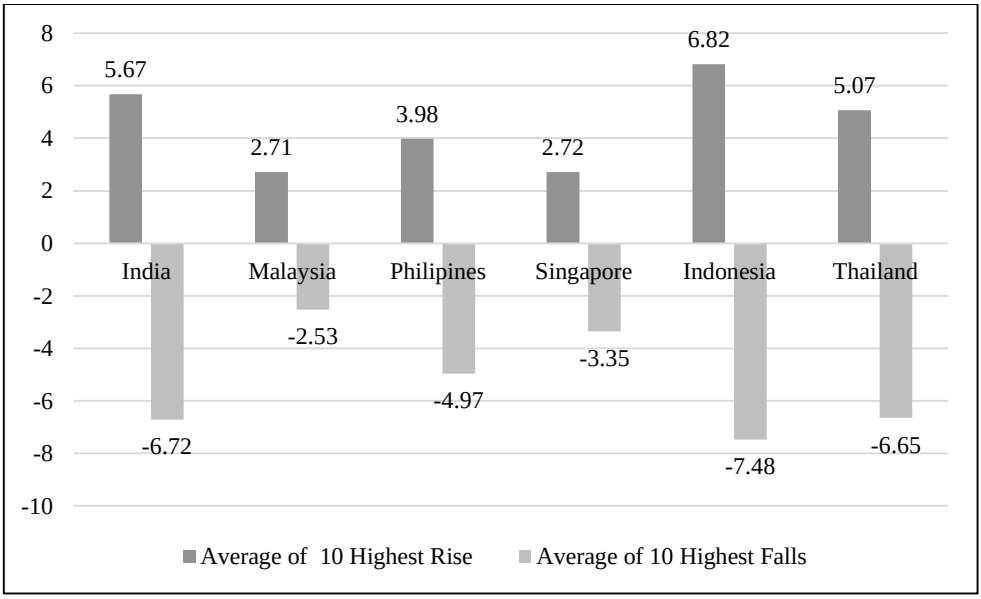

Figure 3: Average of 10 major one-day rises and falls (post-crisis period)

Figure 3 shows the Average of 10 major one-day rises and falls for the Post-Crisis Period. Indonesia has average daily rise of 6.82% with average daily fall of -7.48%. India has average one-day rise of 5.67% with fall of -6.72%. Thailand witnessed average daily rise and fall of 5.07% and -6.65%, respectively. Philippines has observed average daily rise and fall of 3.98% and -4.97%, respectively. Singapore has average daily rise of 2.72% with fall of -3.35%. Among all the markets, Malaysia has lowest average daily fall of -2.53% with average daily rise of 2.71%. The positive difference in the rise and fall is found in Malaysia (0.18%) market only. The negative difference in the rise and fall is found in Thailand (-1.58%), India (-1.05%), Philippines (-0.99%), Indonesia (-0.66%), and Singapore (-0.63%). Overall, it is observed that as compare to pre-crisis, the market become less volatile in post crisis. The average rise and fall in the index return decreases in the post-crisis period. This reveals that after the crisis the market become less volatile and more stable.

4.3 Descriptive Statistics

Table 1 shows the descriptive statistics of stock return for the ASEAN and Indian markets. During pre and post-crisis period, all the markets have reported positive average daily returns. During the pre-crisis period, the markets average daily return were 0.058%, 0.038%, 0.057%, 0.036%, 0.030% and 0.040% for India, Malaysia, Philippines, Singapore, Indonesia, and Thailand, respectively. During the post-crisis period, the markets average daily return were 0.069%, 0.006%, 0.037%, 0.007%, 0.079% and 0.020% for India, Malaysia, Philippines, Singapore, Indonesia, and Thailand, respectively. Among all the markets only India and Indonesia, witness the increase in daily average return after the financial crisis. Rest all the markets witnessed decrease in daily average return in post-crisis period. However, the return was remained positive in post-crisis period. India and Indonesia witnessed highest standard deviation of 1.89% and 1.41% in pre and post-crisis period, respectively. The level of daily average standard deviation is low in the post-crisis period as compare to pre-crisis period. The higher standard deviation in India and Indonesia markets proves the existence of finance theory on higher the risk higher the return. The skewness is positive for all the sample period, which further reveals the higher probability to earn positive returns in the market. The kurtosis value for all the sample period is more than three, which is suitable for further study.

Table 1: Descriptive statistics

Variable	BSE	FTSE Malaysia	FTSE Philippines	FTSE Singapore	JKSE	Set Index
Pre-crisis period						
Mean	0.06	0.04	0.06	0.04	0.03	0.04
Maximum	10.69	4.81	10.78	7.18	14.02	11.15
Minimum	-12.60	-9.42	-12.21	-8.96	-11.95	-14.83
Std. Dev.	1.89	0.89	1.70	1.32	1.32	1.68
Skewness	0.48	0.53	0.13	0.09	0.34	0.62
Kurtosis	7.94	11.57	8.42	7.89	10.17	12.84
Jarque-Bera	2183.30	6438.10	2540.30	2062.13	4477.05	8486.60
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Post-crisis period						
Mean	0.07	0.01	0.04	0.01	0.08	0.02
Maximum	17.33	5.34	5.71	3.01	7.92	7.95
Minimum	-13.15	-3.67	-7.08	-4.22	-10.37	-10.79
Std. Dev.	1.24	0.56	1.05	0.79	1.41	1.06
Skewness	0.61	0.10	0.39	0.28	0.49	0.97
Kurtosis	24.98	8.75	6.55	5.08	9.67	15.28
Jarque-Bera	52305.30	3573.20	1427.20	504.40	4907.19	16692.35
Probability	0.00	0.00	0.00	0.00	0.00	0.00

4.4 Correlation Analysis

Table 2 shows the results of correlation analysis among India and ASEAN markets for pre and post-crisis period. In pre-crisis period, among all the markets, India has highest correlation in stock return with Malaysia (0.289), whereas Indonesia has reported lowest correlation of returns with Thailand (0.0233). However, the degree of correlation between Malaysia and India shows somewhat positive correlation. During the post-crisis period, India and Indonesia holds somewhat positive correlation, whereas Indonesia and Singapore market holds no correlation. Indian market holds positive correlation with all the markets in both the periods. Malaysia, Philippines and Singapore has positive correlation with all the markets, however, Malaysia shows very less correlation with Indonesia and Thailand in both the periods. Indonesia and Thailand are having positive correlation with all the markets. However, both the markets are having somewhat positive correlation with Indian market as the degree of correlation of not of high magnitude. As compare to pre-crisis period, the markets hold more correlation with each other in the post-crisis period. Out of 15 pairs of the markets, 11 shows increase in the correlation in the post-crisis period. Overall, after the financial crisis, the markets hold more correlation with each other but the level of significance reveals somewhat correlation.

Table 2: Correlation

		Pre-crisis period					
Post-crisis period	Stock Market	BSE	FTSE Malaysia	FTSE Philippines	FTSE Singapore	JKSE	Set index
	BSE	1	0.289	0.180	0.140	0.15	0.248
	FTSE Malaysia	0.400	1	0.210	0.190	0.06	0.070
	FTSE Philippines	0.347	0.236	1	0.252	0.003	0.007
	FTSE Singapore	0.221	0.203	0.297	1	0.003	0.019
	JKSE	0.451	0.083	0.007	0.004	1	0.023
	Set Index	0.287	0.037	0.026	0.011	0.008	1

4.5 Unit Root Test

In order to perform granger causality and Johnson Cointegration test, the data need to be stationary (Gujarati, 1995). The results of unit root test are shown in Table 3. The unit root test is performed for each market for both pre and post crisis period. Here, the Augmented Dickey–Fuller (ADF) (1979), Dickey *et al.* (1986), and Phillips–Perron (1988) are performed in Eview 9. The H0 cannot be reject at 1% level of significance. However, the H0 can be rejected at first difference, which reveals that the data is fit to perform further test.

Table 3: Unit root test

Stock Market	Pre-crisis period				Post-crisis period			
	Level		First Difference		Level		First Difference	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
BSE	-2.81	-2.82	-84.56*	-83.56*	-2.88	-2.85	-125.60*	124.58*
FTSE Malaysia	-1.91	-1.99	-66.54*	-65.74*	-1.89	-1.87	-88.57*	-87.56*
FTSE Philippines	-2.65	-2.68	-75.65*	-74.65*	-2.46	-2.45	-124.50*	-123.60*
FTSE Singapore	-2.56	-2.57	-68.59*	-68.54*	-2.58	-1.89	-88.57*	-87.54*
JKSE	-2.48	-2.58	-74.56*	-73.25*	-2.64	-2.45	-90.56*	-84.56*
Set Index	-1.89	-1.89	-56.65*	-55.47*	-2.54	-2.54	-75.65*	-74.23*

Notes: * indicates significant at 1 percent level. The lag lengths are based on the AIC. The ADF and PP are with constant and trend.

4.6 Granger Causality Test

The results of the granger causality test are shown in Table 4. The Granger causality shows short-term integration among the markets. In the pre-crisis period, India has unidirectional relationship with Malaysia, Philippines and Singapore only. India hold bidirectional relationship with Indonesia and Thailand in pre-crisis period. However, in the post-crisis period, India has bidirectional relationship with all the markets, reveals that all the market granger cause to India and India also granger cause to all the markets. Malaysia has unidirectional relationship with India, Indonesia and Philippines in the pre-crisis period. However, after the financial crisis, the Malaysia has bidirectional relationship with India, Indonesia and Philippines. Malaysia does not have relationship with Singapore in pre-crisis period but in post-crisis Malaysia was granger cause by Singapore. Malaysia has bidirectional relationship with Thailand in both the periods. In both the periods, Philippines has bidirectional and unidirectional relationship with Singapore and Indonesia, respectively. In pre-crisis period, Philippines does not have any relationship with Thailand but in post-crisis period, Thailand granger cause to Philippines. Indonesia has unidirectional and bi-directional relationship with Singapore in pre and post-crisis, respectively. Thailand has unidirectional relationship with Singapore and Indonesia in pre-crisis period. However, in post-crisis period, Thailand has bidirectional relationship with Singapore and Indonesia. Overall, among all the markets the level of causality is improved from unidirectional to bidirectional during post-crisis period. In pre-crisis period, few markets do not have any causality relationship, which improve to one-way causality (Unidirectional) after the financial crisis.

Table 4: Granger causality test

Sr. No.	Pre-crisis Period			Post-crisis Period		
1	India	→	Malaysia	India	↔	Malaysia
2	India	←	Philippines	India	↔	Philippines
3	India	←	Singapore	India	↔	Singapore
4	India	↔	Indonesia	India	↔	Indonesia
5	India	↔	Thailand	India	↔	Thailand
6	Malaysia	←	Philippines	Malaysia	↔	Philippines
7	Malaysia	–	Singapore	Malaysia	←	Singapore
8	Malaysia	←	Indonesia	Malaysia	↔	Indonesia
9	Malaysia	←	Thailand	Malaysia	←	Thailand
10	Philippines	↔	Singapore	Philippines	↔	Singapore
11	Philippines	→	Indonesia	Philippines	→	Indonesia
12	Philippines	–	Thailand	Philippines	←	Thailand
13	Indonesia	←	Singapore	Indonesia	↔	Singapore
14	Thailand	→	Singapore	Thailand	↔	Singapore
15	Thailand	←	Indonesia	Thailand	↔	Indonesia

Notes: – – – – – – – – indicates no granger causality among the markets; ← – – or – – → indicates unidirectional granger causality among the markets; &↔ indicates bidirectional granger causality among markets.

4.7 Johnson Cointegration Test

Here, the Cointegration test is performed using different investment portfolio options. Table 5 and 6 shows the Cointegration tests on each investment portfolio combination for pre and post-crisis periods, respectively. During the pre-crisis period, nine different portfolio options are evaluated. The null hypothesis of no Cointegration among the markets is rejected at 1% level of significance for three different options. The H0 is found as rejected in option 4 (IND, PHP, SGP and THN), option 7 (IND, PHP, SGP, and INS) and option 9 (SGP, PHP and MLY). Moreover, the value of Trace Statistics and Max-Eigen Statistics is more than the critical value. This further reveals long-term association between ASEAN and Indian markets from early 1998 to mid-2008 period. The ASEAN and Indian markets are moving in same directions.

Table 5: Cointegration tests on each investment portfolio combination (pre-crisis period)

Option No.	Investment Portfolio Options	H0	Pre-crisis Period		
			Trace Statistics	Max-Eigen Statistics	Probability
1	IND, INS, MLY, PHP, SGP and THN	(r = 0)	1130.6610	263.5157	0.0001
		(r ≤ 1)	867.1454	214.6221	0.0001
		(r ≤ 2)	652.5233	186.8371	0.0001
		(r ≤ 3)	465.6862	180.3638	0.0001
		(r ≤ 4)	285.3224	150.9268	0.0001
		(r ≤ 5)	134.3956	134.3956	0.0000
2	INS, MLY, PHP, SGP and THN	(r = 0)	922.5806	261.7461	0.0001
		(r ≤ 1)	660.8345	188.2184	0.0001
		(r ≤ 2)	472.6161	180.2070	0.0001
		(r ≤ 3)	292.4092	161.4624	0.0001
		(r ≤ 4)	130.9468	130.9468	0.0000
3	INS, MLY, PHP, SGP and THN	(r = 0)	972.3074	261.8435	0.0001
		(r ≤ 1)	710.4639	214.4397	0.0001
		(r ≤ 2)	496.0242	183.1610	0.0001
		(r ≤ 3)	312.8632	171.2677	0.0001
		(r ≤ 4)	141.5955	141.5955	0.0000
4	IND, PHP, SGP and THN	(r = 0)	743.0972**	743.0972**	0.0001
		(r ≤ 1)	482.4351	482.4351	0.0001
		(r ≤ 2)	296.8165	296.8165	0.0001
		(r ≤ 3)	130.7299	130.7299	0.0000
5	IND, MLY, SGP and THN	(r = 0)	689.1177	207.1093	0.0001
		(r ≤ 1)	482.0084	181.2634	0.0001
		(r ≤ 2)	300.7450	168.0281	0.0001
		(r ≤ 3)	132.7169	132.7169	0.0000
6	MLY, PHP, SGP and THN	(r = 0)	764.7855	260.3432	0.0001
		(r ≤ 1)	504.4423	184.6834	0.0001
		(r ≤ 2)	319.7589	173.6664	0.0001
		(r ≤ 3)	146.0925	146.0925	0.0000
7	IND, PHP, SGP, and INS	(r = 0)	791.5783**	260.7327**	0.0001
		(r ≤ 1)	530.8456	211.6095	0.0001
		(r ≤ 2)	319.2361	178.1193	0.0001
		(r ≤ 3)	141.1168	141.1168	0.0000
8	THN, MLY, PHP, and INS	(r = 0)	739.4145	210.4212	0.0001
		(r ≤ 1)	528.9933	202.5078	0.0001
		(r ≤ 2)	326.4855	177.6463	0.0001
		(r ≤ 3)	148.8393	148.8393	0.0000
9	SGP, PHP and MLY	(r = 0)	556.3981**	203.7423**	0.0001
		(r ≤ 1)	352.6558	180.0617	0.0001
		(r ≤ 2)	172.5941	172.5941	0.0000

Notes: Here, IND, INS, MLY, PHP, SGP and THN represents the market of India, Indonesia, Malaysia, Philippines, Singapore and Thailand. r denotes the number of cointegrating vectors.∗∗ MacKinnon *et al.* (1999) P-values; ∗∗ significant at 1% level.

Table 6 shows the results of Cointegration tests on each investment portfolio combinations for post-crisis period. During the post-crisis period, the null hypothesis of no Cointegration is rejected at 1% level of significance for seven different options. The H0 is found as rejected in option 1 (IND, INS, MLY, PHP, SGP and THN), option 2 (INS, MLY, PHP, SGP and THN), option 3 (INS, MLY, PHP, SGP and THN), option 4 (IND, PHP, SGP and THN), option 5 (IND, MLY, SGP and THN), option 7 (IND, PHP, SGP, and INS) and option 9 (SGP, PHP and MLY). Moreover, the value of Trace Statistics and Max-Eigen Statistics is more than the critical value. This further enhances long-term integration between ASEAN and

Indian markets from 2009 to March 2020. The ASEAN and Indian markets become more integrated after the financial crisis. The integration among the ASEAN and Indian markets is increase due to increase in the bilateral trade among the markets after the financial crisis. The outcome of Bracker *et al.* (1999), that stronger the bilateral trade among the countries, the higher the degree of Cointegration makes these findings stronger and reliable. Further, the outcome of Janakiramanan and Lamba (1998) that geographically closer markets shows higher integration also supports the results of post-financial crisis.

Table 6: Cointegration tests on each investment portfolio combination (post- crisis period)

Option No.	Investment Portfolio Options	H0	Post-crisis Period		
			Trace Statistics	Max-Eigen Statistics	Probability
1	IND, INS, MLY, PHP, SGP and THN	(r = 0)	1752.1560**	413.9998**	0.0001
		(r ≤ 1)	1338.1560	352.4903	0.0001
		(r ≤ 2)	985.6659	303.7929	0.0001
		(r ≤ 3)	681.8730	244.1872	0.0001
		(r ≤ 4)	437.6858	229.3773	0.0001
		(r ≤ 5)	208.3085	208.3085	0.0000
2	INS, MLY, PHP, SGP and THN	(r = 0)	1489.1930**	401.3616**	0.0001
		(r ≤ 1)	1087.831	344.8634	0.0001
		(r ≤ 2)	742.9675	301.8469	0.0001
		(r ≤ 3)	441.1206	232.0846	0.0001
		(r ≤ 4)	209.0360	209.0360	0.0000
3	INS, MLY, PHP, SGP and THN	(r = 0)	1446.0260**	382.4178**	0.0001
		(r ≤ 1)	1063.608	344.4258	0.0001
		(r ≤ 2)	719.1823	273.7665	0.0001
		(r ≤ 3)	445.4158	237.1443	0.0001
		(r ≤ 4)	208.2715	208.2715	0.0000
4	IND, PHP, SGP and THN	(r = 0)	1237.3740**	391.5310**	0.0001
		(r ≤ 1)	845.8430	342.5077	0.0001
		(r ≤ 2)	503.3353	281.9648	0.0001
		(r ≤ 3)	221.3705	221.3705	0.0000
5	IND, MLY, SGP and THN	(r = 0)	1117.0750**	374.2562**	0.0001
		(r ≤ 1)	742.8192	301.6868	0.0001
		(r ≤ 2)	441.1323	233.6693	0.0001
		(r ≤ 3)	207.4631	207.4631	0.0000
6	MLY, PHP, SGP and THN	(r = 0)	1184.9890	376.2048	0.0001
		(r ≤ 1)	808.7840	330.4028	0.0001
		(r ≤ 2)	478.3812	267.3994	0.0001
		(r ≤ 3)	210.9818	210.9818	0.0000
7	IND, PHP, SGP, and INS	(r = 0)	1080.4520**	346.6184**	0.0001
		(r ≤ 1)	733.8338	292.8271	0.0001
		(r ≤ 2)	441.0068	233.8859	0.0001
		(r ≤ 3)	207.1208	207.1208	0.0000
8	THN, MLY, PHP, and INS	(r = 0)	1032.5490	307.1510	0.0001
		(r ≤ 1)	725.3983	264.9962	0.0001
		(r ≤ 2)	460.4021	235.0496	0.0001
		(r ≤ 3)	225.3525	225.3525	0.0000
9	SGP, PHP and MLY	(r = 0)	689.6532**	251.3593**	0.0001
		(r ≤ 1)	438.2939	232.5661	0.0001
		(r ≤ 2)	205.7278	205.7278	0.0000

Notes: Here, IND, INS, MLY, PHP, SGP and THN represents the market of India, Indonesia, Malaysia, Philippines, Singapore and Thailand. r denotes the number of cointegrating vectors. ** MacKinnon *et al.* (1999) P-values; ** significant at 1% level.

4.8 Factor Analysis

Here, the factor analysis is performed for India and ASEAN markets for pre and post-crisis period. The results of factor analysis are shown below.

4.8.1 Pre-crisis Period Analysis

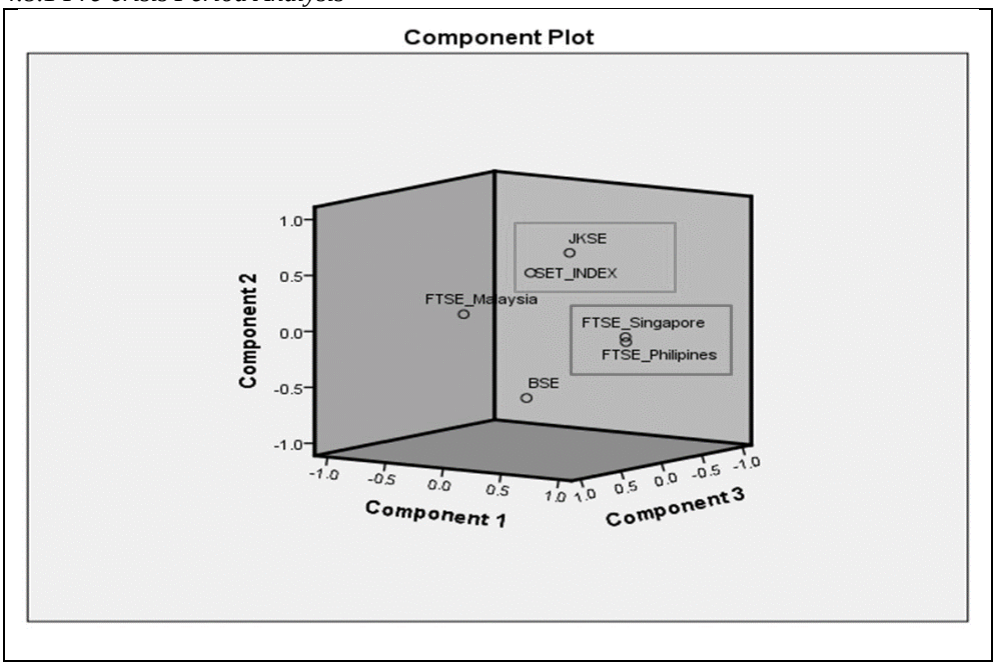

Figure 4: Component plot- pre-crisis period

Figure 4 shows component plot for the pre-crisis period. In order to perform factor analysis, the KMO value should be more than 0.5 that is 50% (Hair *et al.*, 1998; Leech *et al.*, 2005, p. 82). Here, the KMO value is 0.876 that is 87.6%, which is more than required level of 0.5. Furthermore, the result is middling for the data (Hutcheson and Sofroniou, 1999). The result of the factor analysis reveals that the Indonesia and Thailand Markets are closer and integrated. In the same line, Singapore and Philippines markets are integrated. The Indian and Malaysian market are not integrated with any of the market. Hence, in pre-crisis period, India and Malaysia markets are available to investors for portfolio diversification.

4.8.2 Post-crisis Period Analysis

Figure 5 shows the component plot for the post-crisis period. Here, the KMO value is 0.887, which is 88.7%, which is more than required level of 0.5. Further, the result is middling for the data (Hutcheson and Sofroniou, 1999). The result of the factor analysis reveals that the India and Thailand Markets are closer and integrated. In the same line, Singapore and Philippines markets are integrated. The Indonesia and Malaysian market are integrated with each other. Further, the outcome of Janakiramanan and Lamba (1998) that geographically closer markets shows higher integration proves over here. All integrated markets are geographically close to each other. Hence, in post-crisis period, all the markets are integrated with some of the markets. However, the Indian investors can diversify the investment to all markets except, Thailand. Similarly, an investor from Thailand can diversify the fund to any market except India. The Malaysian Investor can diversify the fund to any market except, Indonesia. Likewise, the Indonesian investor can diversify the investment to any market

except Malaysia. An investor from Philippines can diversify the investment to any country except Singapore and wise a versa.

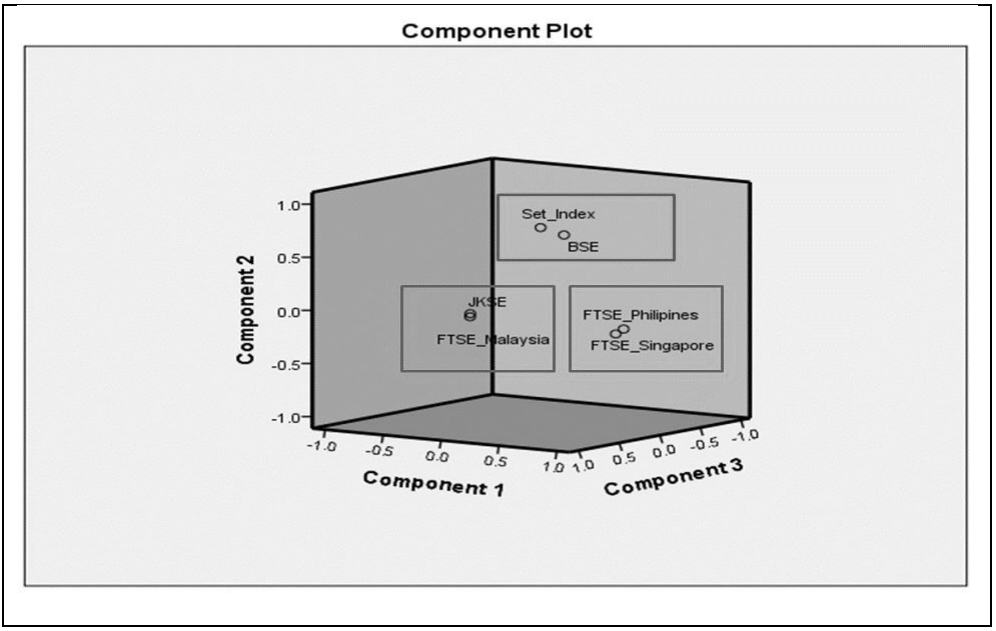

Figure 5: Component plot- post-crisis period

5. Conclusion and Implication

The objective of this study is to examine the long-term integration among the ASEAN-5 and Indian capital market with respect to 2008 global financial crisis. The study also focuses on examining the short-term integration among the markets. The study is performed using Correction, Unit Root Test, Granger Causality Test, Johnsen Cointegration Test and Factor Analysis.

The trend analysis found that majority of the markets have witness fluctuation during 2007-08 crisis period. Further, as compare to pre-crisis period, post-crisis period has reported less one day fluctuations, which further reveals that after the crisis the market become more stable. After the crisis the level of risk reduce among the markets due to increase in international trade. The decrease in risk level is beneficial for the investors. The correlation increase among the markets in the post-crisis period. This reveals that after the financial crisis the level of short-term integration is increases among the market.

The Granger causality shows short-term integration among the markets. During the pre-crisis period majority of the markets has unidirectional relationship with other markets. Malaysia and Singapore does not have relationship. Similarly, Philippines and Thailand does not have relationship. Philippines and Singapore has bidirectional relationship. Similarly, India has bidirectional relationship with Indonesia and Thailand. After the financial crisis, the markets become more integrated. Post-crisis, majority of the markets have bidirectional relationship with each other. Malaysia has unidirectional relationship with Singapore and Thailand only. Philippines has unidirectional relationship with Indonesia and Thailand only. Overall, after the financial crisis, the markets become more integrated in short-term. The increase in level of integration is due to increase in trade among the India and ASEAN markets.

The Cointegration test is performed on nine different investment portfolio options for pre and post-crisis period. During the pre-crisis period, three portfolio options, option 4 (IND, PHP, SGP and THN), option 7 (IND, PHP, SGP, and INS) and option 9 (SGP, PHP and MLY) are found to have Cointegration. This reveals long-term association between ASEAN and Indian markets from early 1998 to mid-2008 period. In the post-crisis period, seven portfolio options, option 1 (IND, INS, MLY, PHP, SGP and THN), option 2 (INS, MLY, PHP, SGP and THN), option 3 (INS, MLY, PHP, SGP and THN), option 4 (IND, PHP, SGP and THN), option 5 (IND, MLY, SGP and THN), option 7 (IND, PHP, SGP, and INS) and option 9 (SGP, PHP and MLY). The ASEAN and Indian market become more integrated after the financial crisis. The integration among the ASEAN and Indian markets is increase due to increase in the bilateral trade among the markets after the financial crisis. The factor analysis is performed to check the closeness among the markets. In the pre-crisis period, Indonesia and Thailand are integrated. Similarly, Singapore and Philippines are integrated. However, India and Malaysia market remain unintegrated with other markets. In the post-crisis period, the markets hold strong integration with other market. After the crisis, the level of integration increase among the markets. Here, the results of the factor analysis show limited integration among the markets where as the results of Johnson Cointegration test shows portfolio wise integration among the markets. Looking at the output, the investors should go with the Johnson Cointegration test output to diversify their investment.

The study has implications for Investors, Multination corporations, ASEAN countries and India. The investors have availability of portfolio diversification opportunities in the pre-crisis period. However, those investors who have diversified their investment after the financial crisis can have better risk-return tradeoff. The investors, who diversifies the investment after the financial crisis, can have higher return and lower risk as compare to pre-crisis period. As the integration is high between the ASEAN and Indian market post-crisis, each country can consider other nations before developing the monetary policies. Such linkage is need to consider for developing the monetary policies to take advantage of the linkages. Further, if the ASEAN countries and India develop the macroeconomic policies by mutual consideration, it can help the all the countries to get synergy gain in the economy. The development of monetary and macroeconomic policies with mutual consideration can help to reduce the impact of economic specific risk and international level financial crisis. Hence, the government and the policy makers can develop the policies accordingly. The multinational companies need to develop their financial policies by considering the integration among the market as the exchange rate volatility can affect the wealth of shareholders. As the exchange rate has different framework in each country, it is not possible for each country to fully consider each other's exchange rate and methodology for the development of monetary policies. However, as all the countries have integration; one country can consider the monetary policy of other country up to an extent to take advantage of integration in economic growth. In future, more studies can be performed to explore the portfolio diversification benefits with the ASEAN markets.

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