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Interaction Impact of Monetary Policy and Inflation on Corporate Debt in Developing Nations

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Abstract: Research Question: Several firms in developing countries are increasing debt capital to take advantage of debt interest tax-shield but they are also exposed to bankruptcy, especially during this recent coronavirus pandemic period. **Motivation:** After 60 years of scholarly research, the determination of firms' capital structure is still a puzzle and is unending. Modigliani and Miller (1963) theory incorporates taxes and it allows for usage of 100 percent debt capital because of absence of bankruptcy costs; but Myers (1984) theory argues for the existence of an optimal capital structure that maximize firms' value. This study provides empirical validation to the effectiveness of monetary policy to lower corporate debt in the firms' capital structure. **Idea:** The article examines the moderating role of monetary policy on the relationship between corporate debt ratios and inflation rate in developing countries, and the moderating role of monetary policy on the relationship between corporate debt ratios and interest rate. **Data:** Monetary policy rate data are obtained from the official website of each country and from the Economics Trading Websites. Other macroeconomic data are obtained from the World Bank Databases. Institutional quality data are obtained from World Governance Indicators. The firm-level data are obtained from the Datastream databases. We use a total of 3,827 listed firms covering 2007 to 2015 periods. **Method/Tools:** The study applies the two-step system generalized method of moments which mitigate endogeneity problem. **Findings:** The findings reveal that monetary policy weakens the positive effect of inflation rate on corporate debt ratios. Conversely, monetary policy strengthens the negative effect of interest rates on corporate debt ratios. These findings suggest that that monetary policy appears effective to lower corporate debt ratios. Moreover, firms should take monetary policy signals into consideration when formulating capital structure decisions. **Contributions:** First, the article extends earlier studies by introducing new variable – the money market rate as a proxy for monetary policy and examine the issue of whether monetary policy moderate the relationship between inflation rate and corporate debt. Second, the article examines the issue of the moderating role of monetary policy on the relationship between interest rate and corporate debt.

Keywords: Corporate debt ratio, policy rate, interest rate, inflation rate, international evidence.
JEL classification: G32, G33, G37

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1. Introduction

Monetary policy is the first line of defense against economic slowdowns, especially when there is a need to take immediate action to restore stability in the economy (Kaplan *et al.*, 2018). The Central Bank monetary policy seems to affect interest rate; for example, a contractionary monetary policy appears to raise the policy rate which in turn affects the interest rate banks lend to firms (Tillmann *et al.*, 2019) and such policy may lower excessive corporate debt usage. Likewise, in periods of high inflation, interest rates may increase to compensate for inflation rate risk, and an increase in interest rate could discorage firms from borrowing debt capital, which may result in lower debt usage.

Several firms in developing countries are increasing debt capital to take advantage of debt interest tax-shield; but they are also exposed to bankruptcy. This bankruptcy problem is more noticeable during the recent coronavirus pandemic which has halted economic activity, hurting firms and pushing them further into bankruptcy (Didier *et al*., 2020). From Asia to Africa to Latin America, the pandemic is confronting firms in developing countries with threat of economic crisis leading to bankruptcy problem.

Besides, several developing countries are facing rising inflation problems. The inflation rate in Sub-Saharan Africa is on average 10.4 percent in 2018 compared to 7.3 percent and 7.1 percent in 2015 and 2012, respectively (International Monetary Fund, 2018). Furthermore, during most of the 20th century, several South American countries were marked by high and volatile inflation and failed attempts to control inflation (Marcel, 2018; Naudon and Vial., 2016). Moreover, inflation rose in the Association of Southeast Asian Nations [ASEAN-5] countries (Organisation for Economic Co-operation and Development, 2018). Inflation influence firms' desires to obtain debt capital. The tradeoff theory predicts positive effect of inflation on corporate debt because the real value of debt interest tax-shield increases when inflation expectation is high.

Moreover, the interaction between corporate debt and macroeconomic factors is an underexplored research area (Katagiri, 2014) and macroeconomic factors instability may affect corporate debt (Demirgüç-Kunt *et al.*, 2020); the moderating role of monetary on the relationship between interest rate and corporate debt, and the relationship between inflation rate and corporate debt remain unexplored. Additionally, many studies (e.g. Antoniou *et al.*, 2008; Demirgüç-Kunt *et al.*, 2020; Frank and Goyal, 2009; Khémiri and Noubbigh, 2018; Kumar *et al.*, 2017) focus on interest rate and inflation rate as macroeconomic determinants of capital structure but overlooked the indirect effect of monetary policy variable through interest rate and inflation on capital structure.

This study builds on capital structure literature in four main ways. First, the article extends earlier studies on the macroeconomic factors that influence corporate debt or capital structure. Precisely, the article introduces new variable – the money market rate as a proxy for monetary policy and examine the issue of whether monetary policy moderate the relationship between inflation rate and corporate debt. This issue is important as firms' operating in developing countries with higher inflation rates may use more debt because the real value of tax deductions on debt seems higher when inflation is expected to be high. However, a monetary policy that raises the policy rate may reduce the increasing effect of inflation on corporate debt. As inflation is a sign of an overheated economy, the monetary authority may slow this overheating by raising interest rates to make lending more expensive to firms which in turn lower their corporate debt usage.

Second, the article examines the issue of the moderating role of monetary policy on the relationship between interest rate and corporate debt. We provide empirical validation to the effectiveness of monetary policy to lower corporate debt in the firms' capital structure. This is important as monetary authorities may rely on raising the policy rates to curtail firms' excessive borrowing behaviour. Third, we use two proxies of capital structure in a single

study, controlling for the 2007/2008 financial crisis years, and use adequately large firm-level and country-level datasets of developing countries to enhance the robustness of our conclusion. Precisely, the sample consisted of annual firm-level and country level data of 3,827 listed firms from 21 developing countries.

Our findings reveal that monetary policy moderates the relationship between inflation rate and corporate debt ratio. Put differently, monetary policy weakens the positive effect of inflation on corporate debt in developing countries. The results suggest that contractionary monetary policy appears effective to combat the rising inflation rate effect on corporate debt ratio. Furthermore, the results reveal that monetary policy moderates the relationship between interest rate and corporate debt ratio. Specifically, monetary policy strengthens the negative effect of interest rates on corporate debt ratio. The results suggest that a contractionary monetary policy (i.e., raising the policy rate) is effective in constraining the ability of companies to raise debt capital in developing countries. Moreover, in a robustness check, the findings reveal that financial crisis is negatively related to corporate debt ratio, suggesting that when compared to non-financial crisis period, in a period of financial crisis firms are reluctant to raise their corporate debt level for fear of inability to repay the debt capital plus interest. The empirical findings also show that firms make adjustments to their target debt when there is a deviation from the target debt level; this is consistent with the dynamic version of trade-off theory.

The rest of the article is organized as follows. Section 2 reviews relevant literature. Section 3 presents the model and data. Section 4 analyzes the results. Section 5 is the conclusion.

2. Literature Review

2.1 Theoretical Framework

After the publication of the Modigliani and Miller (1958) capital structure (debt) irrelevance theory, the choice of corporate debt depends on two competing theories, namely the tradeoff and pecking order theories[2]. The tradeoff theory implies that the choice of corporate debt depends on the tradeoff between the costs and benefits of debt (Bradley *et al.*, 1984; Khoo *et al.*, 2017). The major benefit of debt is the debt-interest tax-shield. Modigliani and Miller (1963) incorporate taxes into their theoretical model and argues that corporations can use debt to take advantage of the debt-interest tax-shield benefits. Within the framework of the tradeoff theory, it is possible to observe an optimum debt level that maximizes the debt interest tax-shield. The trade-off theory supports the moderate use of debt by a firm paying taxes.

The trade-off theory states important predictions that are intuitively reasonable. Firstly, an increase in costs of bankruptcy decreases the optimal debt level. Secondly, increase in taxes raises the optimal debt level. Third, when capital structure is at an optimal level, a rise in marginal bondholder tax rate reduces the optimal debt level (Myers, 1984). Nonetheless, the main challenge of the trade-off theory is that the optimal debt level is not observable and a proxy is needed (Frank and Goyal, 2009). The usual practice is to express the optimal debt level as a function of firm-specific factors (e.g. fixed assets, profits, size, non-debt tax shield, and growth opportunity etc.) and macroeconomic factors (e.g. interest rate and inflation).

The tradeoff theory predicts expected inflation to be positively related to corporate debt. The reason is that the real value of tax deductions on debt (i.e., debt interest tax-shield) is higher when inflation is expected to be high (Taggart, 1985). Moreover, monetary policy should moderate the positive relationship between inflation rate and corporate debt. One of the main goals of monetary policy is to keep inflation low. Monetary policy that raises the

[2] The pecking order theory postulate that a firm prefer to use internally generated profits. Internally generated profit is the first in the pecking-order, then debt, and equity issue is the last (Myers, 2001). The market timing theory states that external finance-weighted average of the historical market to book ratio has negatively impact current debt via net equity issues (Baker and Wurgler, 2002).

policy rate increases lending rates, which in turn makes firms borrow and expand less and less business expansion lower inflation. Low inflation discourages usage of more debt capital. Therefore, we hypothesized (H1) that an increase in policy rate should weaken the positive effect of inflation rate on corporate debt ratio.

As interest rate changes, the firm would adjust their capital structure accordingly in response to favorable or unfavorable changes in interest rate. For instance, higher interest rate increases the costs of debt financing and discourages the firms to use more debt (Antoniou *et al.*, 2008). Therefore, interest rate is negatively related to corporate debt ratio. Monetary policy that raises the policy rate should increase the interest rate banks lend money to firms, lowering corporate debt usage. Thus, we hypothesized (H2) that increase in policy rate should strengthen the negative effect of interest rate on corporate debt ratio.

2.2 Empirical Review

2.2.1 Inflation Rate and Corporate Debt Relationship

Bajaj *et al.* (2020) investigate the corporate debt dynamics of firms listed on the Indian National Stock Exchange and Shanghai Stock Exchange and how they adjust their capital structures based on trade-off behaviour focusing on different macroeconomic factors. The authors report positive effects of inflation on debt ratios of firms in India and China. Likewise, Khemir and Noubbigh (2018) examine the determinants of corporate debt ratio in five sub-Saharan African countries (i.e. South Africa, Ghana, Kenya, Nigeria and Zimbabwe). They find that inflation rate is positively related to book debt ratio, which is attributed to the real value of tax deductions (tax saving) that is high during inflationary periods. Belkhir *et al.* (2016) paper provides novel evidence on firm- and country-level (including inflation) determinants of corporate debt decisions in the Middle Eastern and North Africa (MENA) region. They find that firms located in countries with higher inflation rates operate with more debt. A one-unit increase in inflation is associated with an increase in the book debt of nearly 5.7 percentage points. Similarly, a one-unit increase in inflation is associated with an increase in the market debt of nearly 28.5 percentage points, ceteris paribus. In an earlier study, Frank and Goyal (2009) examine the relative importance of several factors in the debt decisions of publicly traded American firms over the 1950 to 2003 period. Inflation rate is identified as one of the six reliable factors that affect corporate debt in the United States. Inflation is also among the six core factors that provide a more powerful account of a market-based definition of debt than of a book-based definition of debt (Frank and Goyal 2009). They report positive effects of inflation on both the book debt and market debt ratios, which is consistent with the tradeoff theory. Frank and Goyal (2009) reason that when inflation is expected to be high, firms tend to have high debt. Also, Fan *et al.* (2012) examine the influence of macroeconomic factor on firms' debt and debt maturity choices by examining a cross-section of firms in 39 countries (25 developed and 14 developing countries). Fan *et al.*'s (2012) panel regression controls for industry dummies and their results indicate that inflation has a positive effect on market debt of developing countries, but it has insignificant effect on market debt of developed countries.

Unlike previous studies, we introduce a new variable – the money market rate as a proxy for monetary policy rate and examine the moderating role of monetary policy on the interest rate and corporate debt relationship. Moreover, we investigate the moderating role of monetary policy on the inflation rate and corporate debt relationship. Additionally, we use two different measures of corporate debt ratios in a single study, and in a robust check, we control for the 2007/2008 financial crisis years as well as the leftover cross-country differences via a dummy variable technique to enhance the validity of our findings.

2.2.2 Interest Rate and Corporate Debt Relationship

Délèze and Korkeamäki (2018) study the effects of the rapid growth in corporate debt financing attributed to the introduction of the euro. The move to euro has reduced firms' exposure to interest rate fluctuation. This reduction is consistent with the suggestion that deeper markets in home-currency corporate debt allow firms to better manage their interest rate exposures (Délèze and Korkeamäki 2018). At the firm level, they find that interest rate positively affects firms' debt (ratio of long-term debt to total assets), and firms entering the public debt markets experience a significant shift in their interest rate exposure. Conversely, Khemir and Noubbigh (2018) examine the determinants of corporate debt in five sub-Saharan African countries. They find that nominal interest rate is positively related to book debt ratio (ratio of long-term debt to total assets). Moreover, the positive relationship between the nominal interest rate and the debt emerges when loan rates include expected inflation increase. Likewise, Antoniou *et al.* (2008) investigate how firms operating in capital market oriented economies and bank oriented economies determine their corporate debt choice. The authors argue that it is important to control for the effect of interest rate on corporate debt. Interest rate effects are common to all firms and can change through time. Antoniou *et al.*'s (2008) panel generalized method of moment results reveal a significant negative effect of interest rates on both the book and market measures of debt of majority of the sample countries. Precisely, interest rate has a negative effect on corporate debt in France, Japan, United Kingdom, and United States, except Germany. The negative effect of interest rate on debt indicates that a higher interest rate increases the costs of debt and it discourages firms to use more debt (Antoniou *et al.*, 2008).

Unlike previous studies, we introduce a new variable – the money market rate as a proxy for monetary policy rate and investigate the moderating role of monetary policy on the inflation rate and corporate debt relationship. Moreover, we examine the moderating role of monetary policy on the interest rate and corporate debt relationship. Additionally, we use two different measures of corporate debt ratios in a single study, and in a robust check, we control for the 2007/2008 financial crisis years to enhance the validity of our findings.

3. Model and Data

3.1. Empirical Model and Estimation Strategy

Gungoraydinoglu and Oztekin (2011) have concluded that adjustment costs are nontrivial and that firm-fixed effects are important to capture unobserved firm-specific heterogeneity. This study follows Gungoraydinoglu and Oztekin (2011) and applies the standard partial adjustment model to capture the dynamic adjustment toward the target debt level. Rather than estimate a static panel model based on contemporaneous debt ratios, the study estimates a dynamic panel model that produce an estimate of the unobserved target debt as well as the adjustment speed to the target debt level, that is:

$$Debt^*_{ij,t} - Debt_{ij,t-1} = \lambda(Debt^*_{ij,t} - Debt_{ij,t-1}) + \mu_{ij,t} \quad (1)$$

where λ is the average speed of adjustment (SOA) to the target debt level each period for all the sample firms, $Debt^*_{ij,t}$ is the target debt level, while $Debt_{ij,t}$ and $Debt_{ij,t-1}$ are the current and lagged 1 period debt ratios, respectively. The study uses two measures of debt (market total debt ratio and book total debt ratio). The model assumes that firm has a target debt level and adjust if there is a deviation from the target debt level. Full adjustment occurs when λ =1 while λ =0 means there is no adjustment. In the partial adjustment model, the actual adjustment of debt should be between 0 and 1. The target debt level is unobservable, so, we proxy it with the fitted values from a regression of observed debt on a set of firms' specific

and macroeconomic determinants of the target debt (Gungoraydinoglu and Oztekin, 2011) shown in equation 2.

$$Debt^*_{ij,t} = \beta X_{ij,t} + \eta_i + \alpha_t + \mu_{ij,t} \quad (2)$$

where X_{ijt} represents the firm specific and macroeconomic determinants of debt ratios, η_i and α_t are firm-specific effects and year fixed-effects, respectively. After we substitute the target debt from Equation (2) into the partial adjustment model in Equation (1) and rearranging the terms, the estimation in a single equation becomes:

$$Debt^*_{ij,t} = (1-\lambda)Debt_{ij,t-1} + \lambda\beta X_{ij,t} + \eta_i + \alpha_t + \mu_{ij,t} \quad (3)$$

$$Debt^*_{ij,t} = (1-\lambda)Debt_{ij,t-1} + \lambda(\beta_1 + \beta_2 Int_{j_t} + \beta_3 Inf_{j_t} + \beta_4 Mmr_{jt} + \beta_5 (Int * Mmr)_{jt} + \beta_6 (Int * Mmr)_{j,t} + \psi Firm\_Control_{i\,j,t} + \varphi Macro\_Control_{jt} + \eta_i + \alpha_t + \mu_{ij,t} \quad (4)$$

Where

$Debt_{ij,t}$	=	debt for the i firm in country j and t time (using both the market debt [TDM] and book debt [TDB] ratios as proxy for capital structure)
$Debt_{ij,t-1}$	=	lagged 1 period debt ratios for the i firm in country j and t time
$ß_1$	=	the constant
Mmr_{jt}	=	monetary policy variable (proxy by money market rate) for the j country and t time
Int_{jt}	=	interest rate for the j country and t time
Inf_{jt}	=	inflation rate for the j country and t time
$(Int*Mmr)_{jt}$	=	the interaction of interest rate and money market rate for the j country and t time
$(Inf*Mmr)_{jt}$	=	the interaction of inflation rate and money market rate for the j country and t time
η_i	=	the unobservable firm-specific effects
α_t	=	the year fixed effects
$1-\lambda$	=	speed of adjustment to target debt level
μ_{ijt}	=	the residual term

Subscript 'i' 'j' and't' represents a firm, country and time period, respectively

The model is estimated with two-step system generalized method of moments (GMM) because debt displays persistence behaviour (Lemmon *et al.*, 2008). This suggests that previous year debt affects the current year debt. Moreover, the article uses two-step system generalized method of moments because of the possibility of endogeneity problem. Endogeneity problem arises in two ways and it biases the variable coefficients. Firstly, omitting and important explanatory variables which are correlated with the error-term would bias the variable coefficients in the model specification. Second, the possibility of reverse causality between variables. For example, causality may go from debt to inflation or from debt to any of the independent variables and not vice versa, and this would bias the estimated variable coefficient. If there is no exogenous variation in the independent variable of interest, it becomes impossible to isolate a causal effect from alternative hypotheses driven by omitted variables or reverse causality (Jiang, 2017). In order to overcome the problem of endogeneity, researchers mostly rely on instrumental variable technique. The researchers search for an instrument that is correlated with the independent variable of interest but uncorrelated with the error-term. However, it may be difficult to get good external instruments and the use of bad instruments would cause more problem (Jiang, 2017).

Application of traditional ordinary least squares method to estimate parameters in a dynamic model that include firm-specific effects and lagged debt variable would produce biased coefficients (Flannery and Hankins, 2013). Therefore, this study applies the two-step system generalized method of moments because it is recognized as one of the best methods to estimate parameters of the target debt in the presence of firm-specific-effects and lagged debt variable (Flannery and Hankins, 2013). Two-step system generalized method of moments combine level-equation and difference-equation. Moreover, the use of system generalized method of moments reduces the endogeneity problem using the lag levels and lag differences of the independent and dependent variables as internal instruments (Blundell and Bond, 1998). The two-step system generalized method of moments combine the difference generalized method of moments' conditions and additional moment condition to produce unbiased estimators. The study treats the firm-specific factors and institutional quality variables as endogenous variables and the two-step system generalized method of moments internal instruments are used to mitigate the endogenous problem. The lagged levels of the dependent variable (debt) used as instruments in the difference generalized method of moments become weak instrument if they are persistent (Blundell and Bond, 1998). Thus, the two-step system generalized method of moments adds additional moment conditions. In all estimations, the article uses two-step estimates because this method uses the first-step errors to construct heteroskedasticity-consistent standard errors or optimal weighting matrices (Blundell and Bond, 1998).

3.2 Sample and Data

The full sample data consist of 3,827 listed firms from 21 developing countries. The countries and number of firms selected in each country are India (795 firms), Malaysia (728 firms), Pakistan (93 firms), Philippines (103 firms), Bangladesh (10 firms), Srilanka (139 firms), Indonesia (319 firms), Ghana (17 firms), Kenya (38 firms), Nigeria (40 firms), Tunisia (32 firms), Mauritius (29 firms), Egypt (88 firms), Jordan (115 firms), South Africa (190), Mexico (98), Chile (144), Brazil (188), Peru (77), Poland (339), Turkey (245).. The article defines developing countries based on their income level following World Bank classification. The years covered are 2007 to 2015. The data start from 2007 and end in 2015 due to data availability for capital structure (debt) determinants. Monetary policy rate is our main moderating variable and it is obtained from the official website of each country and from Economics Trading website. Other macroeconomic data such as interest rate, inflation rate, bank credit to the private sector, market capitalization, and gross domestic product growth rate are obtained from the World Development Indicators (World Bank database) and are unbalanced panel data. Institutional quality (i.e. rule of law, regulatory quality and control of corruption) data are obtained from the World Governance Indicators.

The other firm-specific data were extracted from Datastream databases and are also unbalanced panel data. As part of the data-sampling process, financial firms are excluded because their financial statement differs significantly from that of non-financial listed firms. Furthermore, the article excludes regulated firms (e.g. real estate investment trusts) because their debt ratio is usually higher than in other non-financial firms (Rajan and Zingales, 1995). The final full sample comprises 28,558 firm-year observations. The article applies the winsorization technique as in Lemmon *et al.* (2008) to mitigate the effects of extreme values of some data on the estimated parameters. All the firm-level data used as control variables (e.g., fixed assets, profits, size, price-to-book ratio, non-debt tax-shield, firm age, dividend payout, ownership structure) are the traditional firm-level determinants of firms' debt ratios. Moreover, the article controls for other macroeconomic determinants of firms' debt ratios.

3.3 Variables Justification

Table 1 shows the variables unit of measurement. The dependent variable is debt ratios and the article uses two measures of firms' debt. The article uses market total debt ratio as the main dependent variable because firms actaully adjust their debt to market fluctuations. Ratio of total debt-to-market value of assets has been used in previous studies (e.g. Frank and Goyal, 2009; Matemilola *et al.*, 2018b), and it is reliable measure of capital structure (Frank and Goyal, 2009). Previous studies mostly use either book total debt ratio or market total debt ratio as proxy for the proportion of debt in firms' capital structure. But this article uses market total debt ratio as main proxy and book total debt ratio as a robustness tests. Specifically, the article measures debt ratio as the ratio of book value of total debt to market value of equity plus book value to total debt (TDM) and the ratio of book value of total debt to book value of total assets (TDB).

Table 1: Variables unit of measurement

Variables	Definition
TDB	The ratio of short-term debt plus long-term debt to total assets (property, plant and equipment).
TDM	The ratio of book value of total debt to market value of equity plus book value to total debt.
Mmr	Money market rate variable in percentage (proxy for the policy rate)
ROL	Rule of Law: reflects perceptions of the extent to which agents have confidence and abide by society rules (ranges from 0 to 100)
REGQ	Regulatory Quality: reflects perceptions of the ability of the government to formulate & Implement sound policies (ranges from 0 to 100)
CC	Control of Corruption: reflects perceptions of the extent to which public power is exercised for gain (ranges from 0 to 100).
Int	Interest rate: annual interest rate
Inf	Inflation: annual inflation rate. Growth in consumer price index
GDPGR	Annual growth in nominal gross domestic product (in percentage)
BC	Banking Credit: ratio of the domestic credit provided by the banking sector to gross domestic products (in percentages)
MC	Market Capitalization: ratio of stock market capitalization of listed firms to gross domestic products (in percentage)
FA	The ratio of property, plant and equipment to book value of total assets
PRF	The ratio of earnings before interest, tax and depreciation to book value of total assets
Size	The log of total assets
PB	The ratio of book value of debt plus market value of equity to book value of total assets
Ndts	Ndts is the ratio of depreciation to total assets
Fage	Firm-age: natural log of (one plus firm-age)
DPO	Dividend pay-out: natural log of (one plus percentage of dividend pay-out)
OWS	Ownership structure: dummy variable equal to 1 if managers own more than 5 percent Shares and zero otherwise

The moderating variable is monetary policy proxy by money market rate while the main independent variables are interest rate and inflation. Although, policy rate is the main monetary policy variable, but it is not easily available for several countries. Therefore, this article uses the money market rate as monetary policy variable beacuse it is closely related to the policy rate. Policy rate affects the money market rate, then lending rate (Matemilola *et al.*, 2018a) and inflation. Several researchers (e.g. Holton and Rodriguez d'Acri, 2018; Tang *et al.*, 2015; Petrevski and Bogoev, 2012) that conduct research on policy rate passthrough to lending rate and deposit rate rely on the money market rate as a proxy for policy rate because of difficulty in obtaining policy rate data and the general belief that the policy rate is closely related to the money market rate. To confirm this belief, we conduct a

correlation analysis between policy rate and money market rate for countries with policy rate data. The correlation coefficient between policy rate and money market rate is 0.85 (refer to appendix 1 to see the correlation matrix). Therefore, policy rate is closely related to money market rate in these countries, and would serve as a substitute for the policy rate. The tradeoff theory predicts expected inflation to be positively related to corporate debt because the real value of debt interest taxshield is higher when inflation is expected to be high (Taggart, 1985; Frank and Goyal, 2009). One of the main goals of monetary policy is to keep inflation low. Monetary policy that raise the policy rate increases lending rate which makes firms borrow and expand less, and less business expansion lower inflation. Low inflation would in turn discourage debt usage because the real value of debt interest taxshield is lower when inflation appears low. We expect monetary policy to weaken the positive effects of inflation rate on corporate debt. Moreover, as interest rate changes, firms adjust their capital structure in response to favorable or unfavorable changes in interest rate. A higher interest rate increases the costs of debt financing and discourages firms to use more debt (Antoniou *et al.*, 2008). This article expects monetary policy to strengthen the negative effects of interest rate on corporate debt because raising the policy rate increases the interest rate bank lend money to firms, thus lowering corportate debt usage. Moreover, the article controls for other firm-level and macroeconomic determinants of firms' debt ratios established in the literature (e.g. Khémiri and Noubbigh, 2018; Kumar *et al.*, 2017; Matemilola and Ahmad, 2015; Frank and Goyal, 2009). Industry factor via dummy variables approach are included in the model specification. The industries included are agriculture, construction, manufacturing, transportation and communications, services, retail trade, and wholesale trade. Wholesale trade are excluded during the data analysis to avoid dummy variable trap.

4. Results

Tables 2 shows the descriptive statistics. The monetary policy rate variable proxy by money market rate (MMR) has a minimum value of 0.1000 and a maximum value of 23.9400. The mean value of the money market rate variable is higher than the median, therefore, the data is positively skewed. Moreover, market capitalization (MC) has the highest standard deviation

Table 2: Descriptive statistics

Variables	Mean	Median	Max.	Min.	S.D.
TDB	0.3483	0.2879	1.0000	0.0000	0.2880
TDM	0.2708	0.2241	1.0000	0.0000	0.9063
MMR	6.2134	6.0000	23.9400	0.1000	2.9384
INT	4.7116	3.5734	41.3454	1.3102	7.3949
INF	5.9501	5.4408	26.2398	0.6782	3.7249
GDPGR	5.1230	5.1991	14.0460	4.8260	2.7310
BC	47.4853	40.7244	123.8840	0.0000	40.4134
MC	80.9110	61.9900	278.3920	7.8270	54.0940
ROL	53.9684	55.2885	89.4737	10.4265	15.1772
REGQ	55.8236	55.0239	93.3014	17.4757	16.4745
CC	49.9175	52.6829	91.3876	3.9024	17.5062
FA	0.3558	0.3377	1.8240	0.0000	0.2437
EBIT	0.0499	0.0671	21.0402	0.8818	1.9633
LSIZE	14.6227	14.1684	26.1749	0.0000	3.1439
PB	2.6244	1.0500	43.0000	3.900	52.2092
NDTS	0.0261	0.0212	5.4915	0.0000	0.0426
FAGE	3.2706	3.3673	5.5174	0.0000	0.9563
DPO	15.2125	0.0000	100.0000	0.0000	23.3018
OWS	0.5492	1	8	0	0.5026

value suggesting that it is the most volatile variable. Conversely, non-debt tax-shield has the lowest standard deviation value suggesting that it is the least volatile. We conduct panel unit root test to confirm if the variables are stationary[3].

Tables 3 contain the correlation results. The correlation results reveal that the degree of association between most of the variables is weak because the correlation coefficients are generally lower among the independent variables. Thus, there is little risk of multi-collinearity among the independent variables.

Table 3: Correlation results

Panel A	TDM	TDB	MMR	INT	INF	GDPGR	BC	MC	ROL	REGQ
TDM	1.00									
TDB	0.19[a]	1.00								
MMR	0.08[b]	0.02[b]	1.00							
INT	0.02[c]	0.01	0.27[a]	1.00						
INF	0.11[a]	0.03[b]	0.53[a]	-0.18[a]	1.00					
GDPGR	0.06 [b]	0.02[c]	-0.01	-0.14[a]	0.22[a]	1.00				
BC	-0.13[a]	-0.04 [a]	-0.42 [a]	-0.04[a]	-0.48 [a]	-0.34[a]	1.00			
MC	-0.05[a]	-0.03[b]	-0.39 [a]	-0.04[a]	-0.35[a]	0.10 [a]	0.50 [a]	1.00		
ROL	-0.02[c]	-0.01	-0.35[a]	-0.09[a]	-0.42[a]	-0.09 [a]	0.48[a]	0.42[a]	1.00	
REGQ	-0.14[a]	-0.03[b]	-0.45[a]	-0.01	-0.43[a]	-0.29 [a]	0.49[a]	0.31[a]	0.43[a]	1.00

Panel B	TDM	TDB	CC	FA	EBIT	SIZE	PB	NDTS	FAGE	DPO	OWS
TDM	1.00										
TDB	0.19[a]	1.00									
CC	-0.09[a]	-0.02[c]	1.00								
FA	0.10[a]	0.03[b]	-0.06[a]	1.00							
EBIT	-0.02[c]	-0.41[a]	-0.01	0.01	1.00						
SIZE	0.11[a]	0.02[c]	-0.31[a]	0.06[a]	0.03[b]	1.00					
PB	-0.02[c]	-0.01	0.01	-0.01	0.02[c]	0.01	1.00				
NDTS	-0.01	0.05[a]	-0.01	0.24[a]	-0.04[a]	0.03[b]	-0.01	1.00	0.02[b]		
FAGE	0.03[b]	0.01	-0.03[b]	0.03[b]	0.05[a]	0.18[a]	-0.02[c]	0.02[c]	1.00		
DPO	-0.17 [a]	-0.02[c]	0.03[b]	0.02[c]	-0.02[c]	0.10 [a]	0.01	0.02[c]	0.10[a]	1.00	
OWS	0.05 [a]	-0.01	-0.10 [a]	0.04[a]	0.01	0.12[a]	-0.02[c]	0.02[c]	0.05[a]	0.03[a]	1.000

Notes: a, b, and c indicate that correlation coefficient is significant at 1%, 5%, and 10%, respectively.

Tables 4 report the two-step system generalized method of moment's results for the sample of 3,827 listed firms from 21 developing countries. The diagnostic checks on the two-step system generalized method of moments reveal that the models passed the AR (2) tests, as indicated by the insignificant p-values showing the absence of second-order serial correlation. Overall, we confirm the validity of the instruments and the additional instruments, as indicated by the insignificant p-values of the difference-in-Hansen tests in the models. Moreover, the number of cross-sectional observations exceeds the number of instruments and it gives support to the validity of the estimations. Additionally, the results reveal that there is absence of cross-sectional dependency (CD) problem in the data because the p-value of the CD test is insignificant. In the empirical results, the market total debt ratio is our main proxy for capital structure and the book total debt ratio is used to check the robustness of our findings to alternative measures of corporate debt ratio.

The lagged dependent variable is statistically significant at the 1% level in all the models and it supports the use of dynamic model to conduct the capital structure research.

[3] The article adopts the LLC (Levin *et al*., 2002), the IPS (Im *et al*., 2003), and PP-Fisher Chi-square (Phillips and Perron, 1988). Based on the results of the stationary test of each variable, the variables have stationary characteristics because the null of the unit root are rejected. The results are not reported to save space.

Table 4: System-GMM Two-step Estimation Results for 3,827 Listed Firms from 21 Developing Countries

	Model 1 (Market Debt)		Model 2 (Book Debt)	
TDM_{it-1} / TDB_{it-1}	0.5382***	(59.69)	0.2928***	(71.48)
Interest rate (Int)	-0.0026***	(-5.46)	-0.0003**	(-2.09)
Inflation rate (Inf)	0.0094***	(12.40)	0.0032***	(6.62)
Money Market Rate (Mmr)	-0.0066***	(-7.14)	-0.0018***	(-3.16)
Int*Mmr	-0.0001**	(-2.23)	-0.0001**	(-2.17)
Inf*Mmr	-0.0003***	(-4.29)	-0.0001***	(-3.12)
Rule of Law (ROL)	0.0011***	(5.55)	0.0008***	(5.12)
Regulatory Quality (REGQ)	0.0008***	(3.50)	0.0009***	(5.18)
Control of Corruption (CC)	0.0001*	(1.95)	0.0005***	(3.13)
FA (Fixed Assets)	0.0412**	(2.18)	0.0751***	(5.52)
PRF (Profits)	-0.0200***	(-8.83)	-0.5196***	(-23.52)
Size	0.0014*	(1.80)	0.0105***	(14.94)
PB (Price-to-book ratio)	-0.0001***	(-8.36)	-0.0001	(-0.97)
Ndts (Non-debt tax-shield)	-0.2944*	(-1.84)	-0.8561***	(-4.58)
Firm age (Fage)	0.0125***	(4.37)	0.0079***	(3.21)
Dividend payout (DPO)	-0.0031***	(-15.04)	-0.0010***	(-6.35)
Ownership structure (OWS)	0.0330***	(4.64)	-0.0030	(-0.99)
GDP Growth rate (GDPGR)	0.0007*	(1.92)	0.0007***	(2.80)
BC (Bank Credit)	0.0008***	(9.68)	0.0002***	(3.81)
MC (Market Capitalization)	-0.0004***	(-11.40)	-0.0001**	(-2.18)
AR2	0.7240		0.8373	
Difference Hansen Test (P-value)	0.1920		0.1740	
Instruments	249		249	
Variance Inflation Factor	3.6900		3.5600	
Cross-dependency test (p-value)	0.1490		0.1370	
Cross-sectional observation (N)	3,827		3,827	

Notes: [a] See Table 1 for the definition of variables and measurements. Asterisks indicate significance at 1% (***), 5% (**), and 10 (*). [b] T-statistics (in parenthesis) of the Two-step System-GMM model are based on Windmeijer-corrected standard errors. [c] 2nd order serial correlation in first difference is distributed as N (0, 1) under the null of no serial correlation in the residuals. [d] Difference-in-Hansen over identification test and null that instruments are valid. [e] TDM_{it-2}, TDB_{it-2}, FA_{it-2}, PRF_{it-2}, $Size_{it-2}$, $Ndts_{it-2}$, PB_{it-2}, Age_{it-2}, DPO_{it-2}, ROL_{it-2}, $REGQ_{it-2}$, and CC_{it-2} are used as instruments. [f] Industry dummies are included in all the estimations.

The dynamic results suggest that if firms deviate from their target debt, they make adjustments. This study's main focus is on the indirect effects of money market rate variable. We explore this indirect effect by interacting money market rate with inflation rate and interacting money market rate with interest rate to determine their effects on corporate debt ratios. For example, if monetary policy variable (proxy by money market rate) is important, the interaction terms (i.e. interest rate * money market rate and the inflation rate * money market rate) should be significant. Moreover, if the interaction terms coefficients are greater than zero (interaction term coefficients are less than zero) and if the interest rate and inflation rate positively (negatively) affect debt ratios, the money market rate strengthens the effects of the interest rate and inflation rate on debt, suggesting that the interest rate and money market rate as well as the inflation rate and money market rate factors complement each other. Conversely, if the interaction terms coefficients are less than zero (interaction terms coefficients are greater than zero) and if the interest rate and inflation rate positively (negatively) affect debt ratios, the money market rate moderates the effects of the interest rate and inflation rate on debt ratios, suggesting that the interest rate and money market rate as well as the inflation rate and money market rate factors are substitutes.

The empirical results show that the interaction terms of the money market rate and inflation rate are negative and statistically significant. These results reveal that money market

rate negatively moderates the relationship between inflation rate and firms' debt ratios. These results suggest that the money market rate weakens the positive effect of the inflation rate on the market debt ratio (Table 4, Model 1) and book debt ratio (Table 4, Model 2), suggesting that the inflation rate and the money market rate factors are substitutes. Moreover, the results support our reasoning that holding other factors constant, monetary policy that raises the policy rate increases lending rate, which in turn makes firms borrow and expand less and less expansion lower inflation. This reasoning is in accordance with Coibion and Gorodnichenko (2011) observation that increased focus on fighting inflation via raising the monetary policy rate help stabilized inflationary expectations and removed economic instability in the United States.

Likewise, the interaction term of the money market rate and interest rate are negative and statistically significant. These results reveal that money market rate negatively moderates the relationship between interest rate and firms' debt ratios. These results suggest that the money market rate strengthen the negative effect of the interest rate on the market debt ratio (Table 6, Model 1) and book debt ratio (Table 4, Model 2), suggesting that the interest rate and the money market rate factors are complement. Moreover, the results support our reasoning that holding other factors constant, monetary policy that raises the policy rate should increase the interest rates banks lend money to firms, thereby lowering corporate debt usage in developing countries.

The empirical results reveal that the inflation rate has a direct positive effect on market debt ratio (see Table 4, Model 1) and book debt ratio (Table 4, Model 2), but interest rate is statistically significant and has a direct negative effect on the market total debt ratio (Table 4, Model 1) and book debt ratio (Table 4, Model 2). Additional robust checks control for the 2007/2008 financial crisis years and the results are similar, but the magnitude of the coefficients of some variables change. The financial crisis has a negative effect on both the market total debt ratio (see Table 5, Model 3) and book total debt ratio (see Table 5, Model 4) of the firms. This result is consistent with Jermann and Quadrini (2012) simulation findings that the firms' ability to borrow in 2008-2009 worsen with a sharp economic downturn. Also, the results is consistent with Demirgüç-Kunt *et al.* (2020) findings that the impact of the global financial crisis of 2008–09 cause a widespread deleveraging of firms in developing countries and in developed countries. They noted that the deleveraging was associated with a reduction in the use of long-term debt finance, in both the developing country and developed country, including in countries that did not experience a financial crisis.

The tradeoff theory predicts expected inflation to be positively related to corporate debt. The reason is that real value of debt interest taxshield is higher when inflation is expected to be high (Taggart, 1985; Frank and Goyal, 2009). The negative effect of interest rate on firms' debt ratios is consistent with Antoniou *et al.*'s (2008) reasoning that higher interest rate increases the costs of debt financing and discourages the firms to use more debt. The result is also consistent with Délèze and Korkeamäki (2018) findings that interest rate is negatively related to firms' debt ratios. Conversely, the result is inconsistent with Khemir and Noubbigh (2018) findings that nominal interest rate is positively related to book debt ratio.

Regarding the inflation rate variable, the positive effect of inflation on firms' debt ratios is consistent with Khemir and Noubbigh (2018) findings that inflation rate is positively related to book debt ratio which is attributed to the real value of tax deductions (tax saving) that are high during inflationary periods. The result is also consistent with Frank and Goyal (2009) findings that inflation rate is positively related to both the book debt and market debt ratios which is consistent with the tradeoff theory. The empirical results also show that firms make adjustments to their target debt, especially the book debt ratio, when there is a deviation from the target debt level; this is consistent with the dynamic version of trade-off theory. The

speed of adjustment to the target debt level is calculated as 1-λ, where λ is the coefficient of the lagged debt variables. Previous researchers (e.g., Matemilola *et al.* (2018b), Flannery and Hankins (2013), Gungoraydinoglu and Oztekin (2011)) find evidence that firms adjust to their target debt level.

Table 5: System-GMM Two-step Estimation Results for 3,827 Listed Firms from 21 Developing Countries with financial crisis dummy (Robust check)

	Model 3 (Market Debt)		Model 4 (Book Debt)	
TDM_{it-1} / TDB_{it-1}	0.5527***	(61.14)	0.2948***	(71.42)
Interest rate (Int)	-0.0027***	(-5.63)	-0.0004*	(-1.89)
Inflation rate (Inf)	0.0067***	(8.68)	0.0023***	(4.48)
Money Market Rate (Mmr)	-0.0064***	(-7.04)	-0.0017***	(-2.95)
Int*Mmr	-0.0001**	(-2.49)	-0.0001**	(-2.12)
Inf*Mmr	-0.0003***	(-3.61)	-0.0001**	(-2.64)
Rule of Law (ROL)	0.0013***	(6.45)	0.0008***	(4.90)
Regulatory Quality (REGQ)	0.0007***	(3.24)	0.0008***	(4.64)
Control of Corruption (CC)	0.0007***	(2.94)	0.0003***	(2.10)
FA (Fixed Assets)	0.0458**	(2.44)	0.0804***	(5.93)
PRF (Profits)	-0.0197***	(-8.87)	-0.5235***	(-23.55)
Size	0.0020**	(2.52)	0.0104***	(14.68)
PB (Price-to-book ratio)	-0.0003***	(-8.15)	-0.0001	(-1.06)
Ndts (Non-debt tax-shield)	-0.2400	(-1.66)	-0.2658*	(-1.92)
Firm age (Fage)	0.0150***	(5.34)	0.0090***	(3.65)
Dividend payout (DPO)	-0.0030***	(-14.59)	-0.0009***	(-5.94)
Ownership structure (OWS)	0.0158*	(1.98)	-0.0028	(-0.63)
GDP Growth rate (GDPGR)	0.0012***	(3.23)	0.0007***	(3.12)
BC (Bank Credit)	0.0007***	(9.34)	0.0003***	(4.48)
MC (Market Capitalization)	-0.0002***	(-6.38)	-0.0001**	(-4.14)
Financial Crisis Dummy_07&08	-0.0367***	(-11.00)	-0.0098***	(-4.84)
AR2	0.8139		0.8338	
Difference Hansen Test (P-value)	0.1870		0.1690	
Instruments	250		250	
Variance Inflation Factor	3.4700		3.5100	
Cross-dependency test (p-value)	0.1380		0.1460	
Cross-sectional observation (N)	3,827		3,827	

Notes: [a] See e 1 for the definition of variables and measurements. Asterisks indicate significance at 1% (***), 5% (**), and 10 (*). [b] T-statistics (in parenthesis) of the Two-step System-GMM model are based on Windmeijer-corrected standard errors. [c] 2nd order serial correlation in first difference is distributed as N (0, 1) under the null of no serial correlation in the residuals. [d] Difference-in-Hansen over identification test and null that instruments are valid. [e] TDM_{it-2}, TDB_{it-2}, $FA_{it-2,}$ PRF_{it-2}, $Size_{it-2}$, $Ndts_{it-2}$, PB_{it-2}, Age_{it-2}, DPO_{it-2}, ROL_{it-2}, $REGQ_{it-2,}$ and CC_{it-2} are used as instruments. [f] Industry dummies are included in all the estimations.

5. Conclusion

Our paper adds to the growing literature on capital structure-macroeconomic factors relationship by introducing the monetary policy variable (proxy as money market rate) as new variable that moderate the inflation rate and corporate debt relationship, and the interest rate and corporate debt relationship. Moreover, we use large firm-level and country-level dataset from 21 developing countries, and we account for the effects of the 2007/2008 financial crisis years to strengthen the robustness of our conclusion.

This article examines the moderating role of monetary policy on the relationship between inflation rate and corporate debt and the relationship between interest rate and corporate debt for a panel of 3,827 listed firms from 21 developing countries. Our findings reveal that monetary policy weakens the positive effect of inflation rate on corporate debt ratios. Conversely, monetary policy strengthens the negative effect of interest rate on corporate debt

ratios. Our results are robust after controlling for the financial crisis years. The results suggest that contractionary monetary policy (i.e., raising the policy rate) appears effective to combat rising inflation and lower corporate debt ratios. Also, interest rate has direct negative effects on corporate debt ratios. Conversely inflation rate has a direct positive effect on corporate debt ratios, consistent with previous findings in the literature. The empirical results also show that firms in developing countries make adjustment to their target debt level.

These results have several policy implications. Firstly, the findings that monetary policy weakens the positive effect of inflation on corporate debt ratio in developing countries suggest that contractionary monetary policy appears effective to combat rising inflation rate effect on corporate debt. As inflation is a sign of overheated economy, the monetary authorities should slow down economic growth by raising interest rate to make lending more expensive to firms, thereby reducing firms' ability to borrow debt capital to finance business expansion. Secondly, the findings that monetary policy strengthens the negative effect of interest rate on corporate debt suggest that a contractionary monetary policy (i.e. raising the policy rate) is effective in constraining the ability of firms to raise debt capital in developing countries. Moreover, monetary authorities may rely on contractionary monetary policy to reduce firm excessive growth during the economic boom period in order to restore economic stability in developing countries. Third, the additional findings that financial crisis is negatively related to corporate debt suggest that firms should plan ahead to minimize the effect of future financial crisis (as financial crisis has become a repeated cycle) that may reduce their borrowing capacity.

One limitation of our work is that we use money market rate as proxy for the policy rate because the policy rate variable is not available for several developing countries. Nevertheless, money market rate is closely related to the policy rate and it is widely regarded as a substitute for the policy rate. An avenue for future research is to explore whether monetary policy is effective to reduce costs of capital and stimulate firms' investments in both the developed and developing countries. Another avenue for future research is to explore the impact of the money market rate on the speed of adjustment to the target debt ratios. It is possible that the money market rate like other established macroeconomic factors also impact the speed of adjustment to the target debt ratios.

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Appendix

Table A: Correlation result

	Pr	Mmr
Pr	1.00	
Mmr	0.85*	1.00

Notes: * indicate correlation is significant at 1%. Pr is the policy rate and Mmr is the money market rate. Policy rate data is available for Kenya and Nigeria.

Does Entropy Index Explain the Determinant of Capital Market Integration in ASEAN?

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Abstract: Research Question: This study will examine whether the entropy index by Ruefli (1990) could become the main determinant of capital market integration in ASEAN. **Motivation:** Continuing the study of Pretorius (2002) and Bracker and Koch (1999) who successfully used the correlation equation model to explore the capital market integration determinants in several regions, this study utilizes the correlation method to identify some new determinant of the capital market integration in ASEAN such as level of intra industry competition and intensity of role of global investors. **Idea:** This study is proposed a new thinking in the capital market integration i.e. when the capital market is integrated so thus there is no relevant for international diversification; but it will shift to the industrial diversification. **Data:** This study needs not only four data years 2006-2009 but also requires 10 industrial groups from the Global Industry Classification Standard (GICS) version from OSIRIS toward 5 ASEAN countries hence we obtain 240 data observations in order to employ SUR. Especially 10 industrial groups from GICS is used to estimate entropy index by Ruefli (1990) for each industry. **Method/Tools**: We must use SUR (Seemingly Unrelated Regression) and for estimation process is compliance to Zellner's assumption that there should be a contemporaneous correlation of error from each equation of 5 ASEAN countries. **Findings**: we find that the entropy index of Ruefli (1990) is proven as an effective proxy for level of intra industry competition which functions as primary determinant of capital market integration in ASEAN. While the other finding is some stock market such as Malaysia looks so restrictive towards the existence of global investors. The finding confirms the result of Mitchell and Joseph (2010) and Omay and Iren (2019) about the strict foreign exchange control regime in Malaysia. **Contribution**: We are probably one of the market integration studies that obtain industrial structure becomes the main determinant of market integration through entropy index and we reconfirm the studies of Faff and Mittoo (2003), Roll (1992), Pretorius (2002), Carrieri *et al.* (2004) and Hwang and Sitorus (2014) which has considered about industry factors.

Keywords: Entropy index, unconditional and dynamic conditional correlation, SUR (Seemingly Unrelated Regression), stock market in ASEAN
JEL classification: G15, G32, Q02

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1. Introduction

From Cheng (2000) and Yusof and Madjid (2006) and then Do *et al.* (2016), we can identify two groups of studies of market integration namely IRGISG (Intensity of Role of Global Investors Study Group) and Industry Factors Study Group (IFSG). Examples of IRGISG namely Bekaert *et al.* (2002), Edison and Warnock (2003) and Froot and Ramadorai (2008) and examples of IFSG are Tu (1998), Faff and Mittoo (2003) and Carrieri *et al.* (2004). Both of studies claim that Local Pull Factors (LPF) and Global Push Factors (GPF) are more important to one another, although they refer to the theory of stock market interdependence from Pretorius (2002). These conditions will bring to the *first research gap* i.e. the divergence from Local Pull Factors and Global Push Factors as main determinant of market integration.

The theory of stock market interdependence of Pretorius (2002) says there are three determinants of the integration such as the contagion, economic integration and capital market characteristics. Capital market characteristics include volatility, liquidity and industry similarity. From the theory of stock market interdependence it is stated that Global Push Factors associated with contagion because contagion occurs as a result of increased international capital flows. Meanwhile, Local Pull Factors are characteristic of the appeal of a capital market for global investors.

In the view of IRGISG, Global Push Factors will be more relevant as a determinant of integration due to the role of global investors since the era of liberalization of capital markets increased. The role of global investors is demonstrated by the increasing global investor fund flows. According to Froot and Ramadorai (2008), the increased flow of funds will affect the global investor in the stock market index of a country. Dvořák (2005) and Aggarwal *et al.* (2009) states the foreign funds flow will affect the level of integration for a more open capital markets would be utilized by global investors to be more aggressive in penetrating. But the study of Edison and Warnock (2003) and Bae *et al.* (2004) stated that some countries increase the level of protection for local investors. This is because the more negative the dominant role of global investors who are expected to take action to destabilize the local stock exchange to trigger an increase in the volatility of the stock and in turn lead to bubble. Nevertheless study of Bekaert and Harvey (2000) declared that global investor also has the positive role that can bring improved performance and liquidity of the market index trading. Which then becomes a problem is the behavior change of global investors is hard to be detected at any time by the regulator.

Meanwhile in the opinion of Industry Factors Study Group (IFSG), Local Pull Factors more relevant as a determinant of integration as an industry sector will have an attraction for global investors. Before the flow of investment funds, global investors will study the characteristics of each industrial sector. Based on the study of MSCI Barra, every country in ASEAN has a unique respective industry. According to the study of Carrieri *et al.* (2004) and Dutt and Mihov (2008) the industrial sector is expected to affect the level of integration because it has a risk exposure that is worthy of consideration by every global investor in calculating the benefits of international diversification. In the classical model ICAPM, the higher the expected return required of an industry makes the higher the risk to be borne by the industry. Moreover it would be true if the industry is categorized as the global industry such as the Faff and Mittoo (2003). More relevant Local Pull Factors (LPF) as a determinant of integration as well as the industrial sector has two arguments i.e. the similarity of industrial structure and industry strategic risk. According to Roll (1992), industrial structure similarity is that if two countries have similar industrial structures, the comovement between the two countries in the market index will increase along with the high concentration of cash flow.

While it also industry strategic risk associated with competitive conditions in the industry. These factors should be considered by global investors because it adds to the risk component of international diversification. Menchero and Morozov (2011) declared that the global investor can further enhance the benefits of diversification through a more focused strategy of diversification in industries with low levels of competition. But the next question arises of how to measure the level of competition. Biker and Haaf (2002) and Hsin and Tseng (2012) measure the level of industry competition with HHI (Herfindahl Hirschman Indices), whereas the HHI is designed to industry concentration. Industry concentration may reflect the nature of competition in the long life industry. In the turbulence industry such as information technology, concentration does not reflect the nature of competition in the industry and the consequences it was to be inadequate if HHI is continue to used as a proxy of competition. Thus it will create *a second research gap* that is the need for measures the level of competition in the industry as a more appropriate because it is generally a qualitative measure of competition. One of example is Porter's Five Forces. So this study takes a measure of competition is more quantitative. Gauge this competition is the entropy index by Ruefli (1990) that will measure how drastic changes in its ranking in the industry for a period of observation. Entropy indices are calculated by OTSA (Ordinal Time Series Analysis) is considered superior to the HHI (Herfindahl Hirschman Indices).

Based on the first and second gap, it will also be created *the third gap of this study* i.e. how to model simultaneously both determinants of the level of integration of both Local Pull Factors (LPF) and the Global Push Factors (GPF). Simultaneously modeling is expected to justify the theory of stock market interdependence of Pretorius (2002) that these two equally important factors. Simultaneous modeling of both the determinants of integration is still dominated by panel data regression and cointegration techniques. Panel data regression conducted by Chuah (2005) and Bekaert *et al.* (2011) find that the LPF is more important than GPF in emerging markets (including ASEAN). Cointegration techniques in ASEAN were conducted by Click and Plummers (2005) and Kuper and Lestano (2007) with more focus on Global Push Factors. This is because the motive for their study is the detection of long run equilibrium relationship between ASEAN countries indexes and index of developed countries. The findings of these two approaches are contradictory, so in our opinion it was taken a more comprehensive modeling.

Finally for the academic contribution we have two items, first, we will address to examine the capital market integration determinant using two indicators that is entropy index by Ruefli (1990) referred to Roll (1992), Pretorius (2002), Faff and Mittoo (2003), Dutt and Mihov (2008) and the other is the intensity of the role of global investors the basis of international capital mobility argument from Marston (1995) and Mishkin and Eakins (2000) and the role of global investors from Bekaert and Harvey (2005) and Froot and Ramadorai (2008).

Secondly, we extend correlation equation model from Bracker and Koch (1999) and Pretorius (2002) with stressing the derivation of the empirical model (section 3.1 until 3.3) and adding the new factor determinant of capital market integration in ASEAN countries i.e. Entropy Index by Ruefli (1990) and the Entropy Concept by Ng (1995). The estimation of Entropy Index must need data construction of GICS in ASEAN.

2. Literature Review and Hypotheses Development

2.1 Stock Market Interdependence

According to Pretorius (2002), the assumption of stock market interdependence is LOOP (Law of One Price). LOOP itself states an integrated market is the market where the asset has the same expected return regardless of where assets are traded. As for the capital market is segmented then the expected return of asset markets will depend on the location of the

related asset. LOOP is a consequence of the enactment of global investors needs to consider the global risks. LOOP enforceability will depend also on how much the mobility of international capital flows. Mobility of international capital flows will increase the linkage of each stock market. International capital flows will become into the mechanism of global investors for international diversification activities. On the one hand they will secure the investment in capital markets of host countries and on the other hand they also will secure savings (risk-free investment) in the country of origin. If there is no substitution effect between saving and investment, international capital flows will continue to flow and the stock market will raise interdependences. Pretorius (2002) states independences of stock market will depend on contagion, economic integration and capital market characteristics.

2.2 Contagion

Contagion can be described as the comovement of the stock market is not caused by the general movement of fundamental factors. There are two factors that work such as the informational factors and institutional factors. Informational factors based on well-known from the comparison between the stock market and the "Keynesian Beauty Contest". By the same analogy with the "Keynesian Beauty Contest", investors in the stock market will sell its investment in specific asset class if they believe that other investors will sell their investments in the same class. Herding behavior of investors will lead to excessive volatility as noted also by Bekaert *et al.* (2005).

While institutional factors related to redemption and about two stage investment strategy of hedge fund. Most of the flow of funds into emerging market is open end fund that commonly purchased by global investors. When faced with large scale withdrawal, then the hedge fund will sell all the assets into more liquid market or they will allocate their assets into several indices-weighting. Their action would create an excessive decline in the performance of the market.

2.2.1 Economic Integration

There are two explanatory factors that is bilateral trade and macroeconomic variables like as interest rate and inflation. The extent of correlation between variables was applied to the two countries thus the correlation between the two countries over the market return will also increase depending on the closeness of the bilateral trade between the two countries. When conducting the return correlation testing in ASEAN, Click and Plummers (2005) finds the similar pattern to the return correlation between Singapore and Malaysia is stronger than the return correlation between Singapore and Philippines.

Bracker and Koch (1999) states that the interest rate and inflation has an influence on the market return. So the correlation between the two variables will also influence the correlation of the market return. It is also reinforced by Roll (1992) that the interest rate and inflation will be considered by global investors when making asset valuations. In contrast to the bilateral trade is positively related to the correlation of stock returns, therefore interest rate and inflation would have a negative influence each other.

2.2.2 Capital Market Characteristics

There are three components of capital market characteristics i.e. the volatility, liquidity and industry sectors (but that overlooked here is the industrial sector). The argument is that when two countries have similar industrial structures, the correlation between the two market indexes will rise. For example, when the two markets in emerging market index is dominated by the stocks in a sector such as Oil and Gas, so when a decline in world oil demand will result in a significant reduction of its share price of Oil and Gas in the two countries. The dominance of this industry sector was much easier to make international

factors affecting the movement of market indices compared to the two countries if these countries have a heterogeneous structure of the industry. One important part of the industrial structure according to the study of Ng (1995) is the industry concentration. Industry concentration relates to the opinions of Roll (1992) about the similarity of industrial structure. The stock return correlation between two stock markets will increase when the composition of the growing industrial sectors of both countries has similarities. Increase in correlation is not only because the flow of funds from bilateral relations on the basis of economic policy and business cycles but also due to the homogenization of the international diversification of industrial structure on a global investor. Homogenization of the industry structure here is the dominance of the industrial sector on a consolidated market index.

Roll (1992) then describes the context of the industrial structure in terms of volatility and correlation difference. When an industrial sector in a country has a high volatility will not necessarily follow the same conditions in other countries. This happens because of the dominance of the industrial sector as the dominant sector in each country will vary according to the economic potential of each country. Volatility that occurred that was caused by the excess of (induced) negative international diversification, which in the beginning but then expect an increase in return that there is an increase in correlation. In a study of Roll (1992) the Herfindahl index was used as a proxy for industrial structure affects the volatility of returns. These results reinforce the view that the industrial structure has the potential to be a correlation of stock returns explanatory variables. This is because the volatility or the variance return is the decisive element return correlations are important in addition to the covariance of two related stock returns.

Meanwhile Bekaert and Harvey (1997) suggests the increase in correlation is due to the increased volatility of stock returns. But as soon as they argued that the increased volatility of stock returns will be an attraction for global investors in the international diversification strategy. Despite the high volatility of return raises the level of correlation, but Chen and Zhang (1997) suggests the benefits of international diversification remains a reliable global investors from an industry that provides a higher return. This condition is realized when global investors put forward as a partner country portfolio and this is reinforced Bekaert and Harvey (1997) and Cha and Oh (2000) who found a low correlation between the market return the developed and developing countries. One other issue about the relationship between industry sectors with the stock market interdependence is the relationship between industrial sectors with other industrial sectors. Park and Woo (2002) found a correlation significance of the industry return index in developed countries over the period 1973-2001. Of particular interest is the correlation between the level of the industry in general the European countries is higher when compared to USA, except for industrial TMT (Technology, Media and Telecommunication). The findings of Park and Woo (2002) for non TMT industries in line with the assumption of bilateral trade in economic integration. While for the TMT industry showed higher idiosyncratic risk of the TMT (USA) from TMT (Europe) like as IT Bubble.

2.3 Hypothesis Development

2.3.1 Concept of Entropy

In general, entropy is a measure of the amount of disorder in the system. High entropy means disorder is high while the low entropy reflects the regularity. According to the laws of thermodynamics, the higher the entropy will be more chaotic a system. In the science of industrial organization, entropy is often associated with concentration and competition [see Ng (1995)]. While the financial science, entropy has been used by Tu (1998) to test the integration of capital markets of Taiwan and the USA with entropy-based pricing (EBP) derived from Consumption CAPM (CCAPM). Ng (1995) suggests the concept of entropy to

measure industry concentration is relevant because the entropy reflects the number of firms in the industry and the equity market. The essence of entropy in this context aims to measure the level of industry concentration through the information described as a probability distribution of market share. With so entropy can be interpreted as a measure of uncertainty associated company's market share. In her study Ng (1995) using the arithmetic mean value of the minimum and maximum entropy to measure the concentration index depends on the class boundaries, the number of players in one class and size class specific industries.

Because entropy is a measure of disorder, uncertainty and randomness in a system then according to Ng (1995) entropy will also be useful to measure industry competition. The argument of this is the entropy will vary according to shape the pattern of randomness or randomness that occurs. Entropy will depend on the number of firms in the industry and a growing number of companies in the industry will reflect the level of intra industry competition is getting higher and higher entropy. In addition the entropy depends on the distribution of market share will increase competition and higher entropy will too. Entropy was inversely proportional to the concentration of industry, so that a high entropy will reflect the low concentration level and the competition will high.

Associated with Tu (1998), the concept of EBP is derived from the SDF model (Stochastic Discount Factors) proved the integration of Taiwan and the USA. Because of a component model for the function Langrangian EBP (L) is identical with the entropy index Ruefli (1990); $L = \sum_{i=1}^{S} p_j \ln (p_j / q_j) + \sum_{i=1}^{n} \lambda_j (-\sum_{j=1}^{S} p_j X_{ij}) + \lambda_0 (1 - \sum_{j=1}^{S} p_j)$, the concept of entropy will be relevant as a determinant of capital market integration.

2.3.2 The Concept of Intensity Role of Global Investors

Initially Bekaert and Harvey (2000) have not so justified the negative role of global investors that is as speculators. This is related to the phenomenon of increased capital market liberalization in ASEAN exchange authority on the belief that the role of investors in ASEAN investors will give added value to increase trading liquidity and market indexes. But with the Asian monetary crisis of 1997/1998 and 2007/2008 the global financial crisis is the perception of the authority of several exchanges began to change toward the role of global investors. They began to increase the level of resistance but in indirect form are generally in the form of protection against domestic investors. Conducting direct obstacle in the form of restrictions on current stock market is less relevant because of liberalization has done more than 20 years. Thus it may be clear that stock markets are opened for foreigner. If there is more reason for global investors play a positive and negative role is always associated with efforts to secure the benefits of international diversification in emerging markets. As noted by Bekaert and Harvey (1997), emerging market has two attractiveness for global investors such as high volatility and the market index return correlations are low. High volatility can be seen with the dynamics of the movement of market indexes in each ASEAN country. The existence of high volatility is attractive to global investors with short time horizons that do Covered Interest Arbitrage (CIA) which focuses on capital gains in exchange rate risk compensation. While the low correlation to attract global investors with long time horizon which generally as informed investors who seek the fundamental value.

Observing the negative and positive role of global investors, each authority should be familiar with it. Positive role can be seen from non negative NFFF (Net Foreign Fund Flow) what it means more global investors to channel funds to the local exchanges so that the local market indexes rose. However the essence of NFFF is hot money thus possible occurrence of a negative NFFF. It can be recognized during the period of crisis in the form of falling market indexes. As a reaction to that negative role, the exchange authority can increase the level of protection for domestic investors. Level of protection is not just a tight capital

controls, such as Malaysia but can be a limitation of series A and B shares in China's capital markets. But this protection must be well managed so that the positive role of global investors is not lost. This is because the status of emerging markets that depend on the intensity of the role of global investors can not be eliminated although the regulators have an option to protect their domestic investors from the aggressive global investors.

2.3.3 Level of Intra Industry Competition and Degree of Capital Market Integration

Engwall (1973) and Ruefli (1990) conducted a study on the importance of industry structure for the company in terms of the dynamics of competition in an industry sector. They hold the view that the importance of analysis of competition between firms as measured by the entropy index in addition to knowing the position of superior and inferior inter-company now also be able to predict the position of superior and inferior among companies in the future. This is because technically the entropy index is calculated on the basis of time-series and use the ordinal scale (ranking) for example 1,2,3,4, 5…. n where for n indicates the number of firms in the industry. Refer to Collins and Ruefli (1992) that is the nature of the dynamics of competition in entropy is derived from the information theory of Shannon. As we know the information theory is related to disorder, uncertainty and randomness in a system.

Characteristic of the dynamics of competition between firms within the business environment can be brought to the dynamics of competition among the company's stock if the company is also related to listing on the stock market of a country. The use of entropy index in evaluating the performance ranking of companies listing on stock exchange will attract the attention of global investors because of the assessment ranking for this by using common ratio scale proved disappointing market participants as in the case of Enron and World at bubble dotcom and probably the fallen of Lehman Brother in 2008 due to global financial crisis.

When examined in the study of capital market integration, the author's knowledge no one has to use the entropy index Ruefli (1990) as a determinant factor. That has existed so far is proving the integration of capital markets in the context of industrial sectors such as studies Cavaglià *et al.* (2000), Ratner and Leal (2005) and Antoniou *et al.* (2007). They have a view of the context of industrial integration is sufficient to provide a picture for global investors see the potential in each industry sector is viable or not as part of their portfolio of industrial diversification. However, when examined using the entropy index, the dynamic changes of each company in one industry sector will be more apparent, so too when they need full information about the general picture of the existing industrial sector in the capital market, then the numbers in the sub-component of entropy (lower, diagonal and upper entropy) is expected to be more objective in the assessment of strategic industry risk. Based on the description, the alternative hypothesis (H1) proposed is:

H1: Level of intra industry competition will influence toward degree of capital market integration in ASEAN countries

2.3.4 The Intensity of Role of Global Investors and Capital Market Integration

Two arguments are used to explain the relationship between the two is the role of global investors and international financial integration through the concept UCIRP (Uncovered Interest Rate Parity). Both of these arguments stem from a grand theory: international capital mobility. According to Sula and Willet (2009), with increasingly free flow of capital from developed country to a developing country as a result of liberalization and free trade, then physical activity, economics and finance of each country as if it had been fused. This happens because the enactment of a good standard in shape, size and price in each country who declare themselves as members of an economic and trade bloc, so that each country

will declare readiness to open with each other and compete freely with each other. A manifestation of international capital mobility is greatest in the history of European economic integration which gave birth to the EEC (European Economic Community). On each member of the EEC (see now the EU) will occur in an efficient capital mobility, because member state have been open with each other and compete freely. As for non-members countries, then capital mobility occurs when common rules which would receive a reduction in restrictions.

At a higher level then the international capital mobility will reach the level of Optimum Currency Area (OCA), such as the formation of the Euro Currency in 1999. When the context has led to the standardization of currencies like euro and dollar, the level of integration has led to a discussion of domain Interest Rate Parity (IRP). This is because the flow of capital that occurs because of differences in interest rates. Marston (1995), Bhatt and Virmani (2005) and Solnik and McLeavey (2009) state the interest rate differential may be relevant to CIRP (Covered Interest Rate Parity) and UCIRP (Uncovered Interest Rate Parity). CIRP related to international capital flows are not restricted tend to equate the nominal interest rate if they are tied up in a common currency (single). Seeing the EEC who already have the Euro currency then it should be applied CIRP. However this is not easily realized because the EEC became the European Union has changed and although the Euro (except Pound Sterling) still exist but tend to be less bargaining power Euro against the U.S. dollar. Not easy to apply CIRP create the context of financial integration are discussed with UCIRP. UCIRP associated with unrestricted capital flows tend to equalize nominal interest rates. An effort to cope with exchange rate risk, and then by taking into account differences in domestic interest rate (i_d) and abroad (i_f), make global investors are always looking for opportunities to do the CIA (Covered Interest Arbitrage). According to Marston (1995) and Solnik and Mcleavey (2009), the CIA can be done by purchasing foreign securities because of the condition of the forward discount. The phenomenon of the CIA in lines with the argument that there cointegration between international capital flows and exchange rates in addition to the interest rate even if only for the case of Indonesia. This is because global investors who bring different currency than the local currency on the one hand can be correlated with the movement of local currency and may also be correlated with stock market conditions. Based on a study of Dvořák (2005) and Aggarwal *et al.* (2009) in Indonesia, the activity appeared to be particularly dominant global investors as domestic investors. But the unique despite the inferior performance of global investors in the short term, but were superior in the long run. Explanation of differences in the performance of global investors it is a phenomenon of the difference of information between global investors and domestic investors. Domestic investors are perceived to have the advantage of knowledge of local conditions of Indonesia, while foreign (global) investors are considered to have the experience and global network of brokerage as a form of information superiority. In order to become the most dominant, the investor needs to have a combination of local ownership and global capabilities of information brokerage.

Bekaert and Harvey (2000) state there are two roles of global investors in emerging markets. The first role relates to the actions of global investors in influencing the technical aspects of trading in a stock because it could potentially increase the liquidity, efficiency and value of related shares. While the role of the second act of a global investors to better obtain information superiority. But according to Bekaert and Harvey (2000) the role of negative impact if it is so global investors does not get the information advantages, then they will make a withdrawal. In larger-scale withdrawal of funds called the phenomenon of surge or sudden stop of capital flows (Sula and Willet, 2009). This phenomenon triggers global investor's restrictions such in Malaysia since 1998. The restriction is conduct by increasing level of protection toward domestic investors. It is not only make limit purchase

some series stock like as in China and Philippines but also increasing the tight control of capital outflow from Malaysia. Hence starting in 1999 Malaysia imposed this restriction by excluding its investable index from IFC. Based on previous description, we propose alternative hypothesis (H2) as follow:

H2: The intensity of the role of global investors tend to raise the degree of capital market integration in ASEAN countries.

3. Empirical Model Development

3.1 Entropy Index

Ruefli (1990) provides a decrease in the entropy index denoted by $H(S)_k$ by starting from the transition matrix. This transition matrix is defined as a matrix that will show changes in the ranking of all players in an industry (k) can be symbolized as T_k, which has a t_{ij} element that is the frequency of ranking position changes between players in one industry each year divided by the number of years of observation (m). The T_k is then converted to p_k matrix, from the relative transition frequency of the p_{ijk} which can be formulated as follows:

$$p_{ijk} = t_{ijk} / m \quad (1)$$

Furthermore, with the p_k transition matrix, a number of measures that will provide information about the level of uncertainty associated with the behavior of ranking changes among players in an industry can be raised. Then based on the large number of players denoted as q, then obtained:

$$H(S)_k = [\sum_i (\sum_j p_{i,j,k}/n\ p_{i,j,k})/q/- \ln(1/q)] \quad (2)$$

where $H(S)_k$ is the entropy index for industry k, i is the row side of the transition matrix and j is the column side of the transition matrix. $H(S)_k$ will reach its maximum condition if $\sum$ 1.1. / q ln (1 / q) = - ln (1 / q). And because ln (1 / q) = - ln (q) then equation 2 can be written:

$$H(S)_k = [\sum_i (\sum_j p_{i,j,k} \ln p_{i,j,k}) /q \ln (q)] \quad (3)$$

According to Ruefli (1990), H (S) k follows the log-linear property of the entropy function which has three forms of uncertainty position namely improving (lower), holding (diagonal) and worsening (upper). Therefore, for the sake of analysis, $H(S)_k$ which is the total entropy needs to be decomposed into 3 parts, namely lower, diagonal and upper entropy. In the case of the dynamics of the life cycle of the fragmented software industry life cycle, the results of the study of Ruefli (1990) show that the lower entropy position is smaller than the upper entropy. This means that more company members in the industry are downgraded compared to upgraded. This also means that the dynamics of industrial competition are very high because of the short life cycle that has a low level of industrial concentration and high competition as a result of the large number of players in the industry. Based on the previous explanation, the steps of estimating the entropy index from Ruefli (1990) operationally are as follow:

1) Making a tabulation of ranking based on the movement of outcomes such as net profit and sales between companies in the industrial sector. If the context is international diversification, it is more appropriate to use net profit on the grounds that this net profit will determine the target of global investor returns.
2) Make ordinal rank data from the first process.

3) Create a transition matrix.
4) Perform calculations with the formula H $(S)_k$. Following is an example of the steps in the calculation of H $(S)_k$ for the case in Bursa Malaysia as follows:

a) Tabulation of ranking on the basis of net profit 3 shares of the basic material industry sector (code 15 in GICS) namely M, J and P on the Malaysian exchange suppose the results are as follows:

Stock (Code)	2008	2007	2006	2005
(M) Melawar Industrial Group Berhad	2	3	2	3
(J) Jaya Tiasa Holding Berhad	3	1	3	2
(P) Press Metal Berhad	1	2	1	1

b) Make an ordinal rank tabulation from process a with the following results:

Rank Number	2008	2007	2006	2005
1	P	J	P	P
2	M	P	M	J
3	J	M	J	M

c) Perform a transition matrix calculation that is the frequency of ranking position changes between players in one industry each year divided by the number of years of observation. The formula appears as $p_{ijk} = t_{ijk} / m$. And if it is made in a transition matrix table it will be described as below:

Ranking at t	Ranking at t+1			
	1	2	3	Total column
1	$P_i(1,1)$	$P_i(1,2)$	$P_i(1,3)$	$\sum P_i(1,k)$
2	$P_i(2,1)$	$P_i(2,2)$	$P_i(2,3)$	$\sum P_i(2,k)$
3	$P_i(3,1)$	$P_i(3,2)$	$P_i(3,3)$	$\sum P_i(3,k)$
Total row	$\sum P_i(j,1)$	$\sum P_i(j,2)$	$\sum P_i(j,3)$	$\sum P_i(j,k)$

d) Perform the calculation of $H(S)_k$ with the formula $H(S)_k = [\sum_i (\sum_j p_{i,j,k} \ln p_{i,j,k}) / q \ln (q)]$. The estimation of $H(S)_k$ will include 3 components namely diagonal entropy namely $P_i(1,1)$, P_i (2,2) and P_i (3,3), upper entropy including P_i (1,2), P_i (2,3) and P_i (1,3) and finally lower entropy include P_i (3,1), P_i (3,2) and P_i (2,1). The value of $H(S)_k \approx 0$ means the level of competition in an industry is getting lower and vice versa if $H(S)_k \approx 1$.

3.2 Dynamic Conditional Correlation

Conditional Correlation is calculated by the DCC (Dynamic Conditional Correlation) from Engle (2002). Study of Antoniou *et al.* (2007) and Kuper and Lestano (2007) state that DCC has the advantage of UCC (Unconditional Correlation) because it is a combination of the flexibility of the volatility model (GARCH) and is able to produce a parsimony model for estimation of correlation (Log Likelihood). This model is also flexible because it allows different securities of one portfolio to have different volatility measurement models, depending on the GARCH model which is the most optimum for that security. The number of parameters estimated is linearly related to the number of securities in the portfolio to the parsimony model.

Furthermore according to Antoniou *et al.* (2007) and Kuper and Lestano (2007), DCC calculations are generally carried out in three stages namely:

a) GARCH model (1,1) for k asset return where $r_t \mid F_{t-1} \sim N(0, H_t)$. (4)
b) Calculation of standardized residual that is $\varepsilon_{it} = r_{it} / (h_{it})\ 1/2$. (5)
c) Calculation of time-varying correlation ($\rho_{ij,t}$).

Steps a, b and c above can begin with the determination of the conditional variance (H_t) matrix which is formulated as follows:

$$H_t = D_t R_t D_t \quad (6)$$

where R_t is the conditional correlation matrix n x n and D_t is the diagonal matrix n x n whose elements are time-varying standard deviations from the GARCH univariate model with the diagonal i. The GARCH univariate specification for D_t is stated as follows:

$$h_{it} = \omega_i + \alpha_i r_i^2{}_{t-1} + \beta_i h_{t-1} \quad (7)$$

where h_{it} is conditional volatility, $r_i^2{}_{t-1}$ is the past square innovations, and α_i and β_i are the coefficients of the parameters $r_i^2{}_{t-1}$ and h_{t-1}. The specifications of this GARCH univariate can be modified to accommodate asymmetric effects. Next the residuals are standardized with the standard deviation conditional and can be written as follows:

$$\varepsilon_{it} = r_{it} / (h_{it})^{1/2};\ \varepsilon_{it} \sim N(0, R_t) \quad (8)$$

Based on the equation 8 above, conditional correlation is defined as $\rho_{ij,t} = E[\varepsilon_{it}, \varepsilon_{jt}]$ which is the Engle (2002) of DCC model. In more detail $\rho_{ij,t}$ can be stated as:

$$\rho_{ij,t} = \frac{E_{t-1}[r_{it}, r_{jt}]}{\{E_{t-1}[r_{it}^2] E_{t-1}[r_{jt}^2]\}^{1/2}} \quad (9)$$

The dynamic correlation structure $\rho_{ij,t}$ consists of Q_t, R_t and Q_t^* expressed as follows:

$$Q_t = (1 - \alpha_n - \beta_n)\ Q + \alpha_n (\varepsilon_{t-1}, \varepsilon'_{t-1}) + \beta_n Q_{t-1} \quad (10)$$

$$R_t = Q_t^{*-1}\ Q_t\ Q_t^{*-1} \quad (11)$$

$$\text{diag}\ (Q_t^*)^{1/2} = \text{diag}\ [1/(q_{11,t})^{1/2} \ldots\ldots 1/(q_{kk,t})^{1/2}] \quad (12)$$

where $\overline{Q}$ = unconditional covariance from standardized residuals. If $\alpha_n + \beta_n < 1$, the correlation will mean reverting (after shock, the correlation will return to normal levels), and if $\alpha_n + \beta_n = 1$ then this correlation will be integrated. To estimate Q_t^* in the component model in equation 12, the log likelihood function is needed as follows:

$$\log L\ (\theta_1 \theta_2 \mid X_t) = 1/2^T \textstyle\sum_{t=1} [k \log(2\pi) + \log (\mid R_t \mid) + 2 \log (\mid D_t \mid) + r'_t D^{-1}_t R^{-1}_t D^{-1}_t r_t] \quad (13)$$

Model 13 has 2 components, namely volatility (θ_1) and dynamic correlation (θ_2). As noted from Antoniou *et al.* (2007), the volatility component model (θ_1) and dynamic correlation (θ_2) can be written into models at equation 14 and 15, namely:

$$\log L\ (\theta_1 \mid r_t) = -1/2^T \textstyle\sum_{t=1} [k \log(2\pi) + \log (In) + 2\log(\mid D_t \mid) + r'_t D^{-1}_t R^{-1}_t D^{-1}_t r_t] \quad (14)$$

$$\log L\ (\theta_2 \mid \theta_1, r_t) = -1/2^T \textstyle\sum_{t=1} [k \log(2\pi) + \log (\mid R_t \mid) + 2\log(\mid Dt \mid) + \varepsilon'_t R_t^{-1} \varepsilon_t^{-1} - \varepsilon'_t \varepsilon_t] \quad (15)$$

Estimated θ_1 with GARCH and θ_2 with maximum likelihood BEKK or Marquardt.

3.3 Empirical Testing Model

Suppose the unconditional correlation function between return for industry i in country j and return for world factors (w) at time t can be formulated as follows:

$$\rho(R_{ijt},R_{wt}) = \frac{\text{Cov } R_{ijt},R_{wt}}{\sigma_{Rijt}.\sigma_{Riwt}} \quad (16)$$

where:

$\rho(R_{ijt},R_{wt})$ = correlation of R_{ijt} and R_{wt} unconditional correlation (estimated by Pearson)
Cov R_{ijt}, R_{wt} = covariance of R_{ijt} and R_{wt} that is $\sum_{i,j,w=1}^{t} [R_{ijt} - E(R_{ijt})].[R_{wt} - E(R_{wt})]$
σ_{Rijt} = standard deviation of R_{ijt} (return of industry i at country j at time t)
σ_{Rwt} = standard deviation of R_{wt} (world indices return w at time t)

If the calculation is done in detail, $\rho(R_{ijt},R_{wt})$ can be displayed in the form:

$$\rho(R_{ijt},R_{wt}) = \frac{\sum_{i,j,w=1}^{t} [R_{ijt}-E(R_{ijt})].[R_{wt}-E(R_{wt})]}{\sigma_{Rijt}.\sigma_{Rwt}} \quad (17)$$

where:

$\rho(R_{ijt},R_{wt})$ = correlation of R_{ijt} and R_{wt} unconditional correlation (estimated by Pearson)
Cov R_{ijt}, R_{wt} = covariance of R_{ijt} and R_{wt} that is $\sum_{i,j,w=1}^{t} [R_{ijt} - E(R_{ijt})].[R_{wt} - E(R_{wt})]$
σ_{Rijt} = standard deviation of R_{ijt} (return of industry i at country j at time t)
σ_{Rwt} = standard deviation of R_{wt} (world indices return w at time t)
$E(R_{ijt})$ = expected return of industry i at country j at time t
$E(R_{wt})$ = expected return of world indices (w) at time t

As is known from Koutolas and Kryzanowski (1994)'s of IAPT model, R_{ijt} and R_{wt} can be considered identical to R_{it} and R_{gt}. R_{it} has a decomposition factor (I_{1t}, I_{2t}, .. I_{nt}). These decomposition factors include industry and country dummies as determinants of R_{it} in the model of King (1966) and Heston and Rouwenhorst (1994). The R_{it} model itself is

$$R_{it} = \beta_0 + \beta_1 I_{1t} + \beta_2 I_{2t} + \beta_3 I_{3t} + \beta_4 I_{4t} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta_n I_{nt} \quad (18)$$

where:

R_{it} = return of industry i at time t
I_{1t}, I_{2t}, .. I_{nt} = decomposition factors R_{it} covering country and industry dummies 1, 2, 3, 4, 5, ….. n at time t according to study of Heston and Rouwenhorst (1994)
$\beta_1, \beta_2, \ldots \beta_n$ = coefficient of decomposition factor I_{1t}, I_{2t}, .. I_{nt}
β_0 = intercept from R_{it}

While R_{gt} or R_{wt} because it is an international index return such as MSCI, DJGI, and FTSE will be formulated differently. According to the study of Jorion and Schwartz (1986), R_{wt} is estimated from the F_{it} projection equation which is $F_{it} = R_{it} - (\lambda_0 + \lambda_1 R_{wt})$. Because F_{it} is an error from R_{it} and F_{it} projection equation is intended to overcome the autocorrelation problem between R_{it} and R_{wt}, R_{wt} as a component of ρ (R_{it}, R_{wt}) is approached by the MA (q) process of Bekaert and Harvey (1997), so R_{wt} is:

$$R_{wt} = \delta_0 + \delta_1 \varepsilon_{t-1} + \delta_2 \varepsilon_{t-2} + \delta_3 \varepsilon_{t-3} + \ldots\ldots\ldots\ldots\ldots + \delta_q \varepsilon_{t-q} + \varepsilon_t \quad (19)$$

where:

ε_t = residual of R_{wt} [world (w) return at time t]
$\varepsilon_{t-1}, \varepsilon_{t-2}, \varepsilon_{t-3}, \ldots\ldots \varepsilon_{t-q}$ = lag from residual of R_{wt}
q = orde from MA (Moving Average) process
$\delta_0, \delta_1, \delta_2, \delta_3, \ldots\ldots \delta_q$ = intercept and coefficient $\varepsilon_{t-1}, \varepsilon_{t-2}, \ldots\ldots\ldots\ldots \varepsilon_{t-q}$

When the R_{it} component in equation (18) and the R_{wt} component in equation (19) are substituted into equation (17) then for ρ (R_{ijt}, R_{wt}) is obtained:

$$\rho(R_{ijt},R_{wt}) = \frac{\sum_{i,j,w=1}^{t} [\beta_0+\sum_{i=1}^{1} \beta_{nt} I_{nt} - E(R_{ijt})].[\delta_0+\sum_{q=1}^{q} \delta_q \varepsilon_{t-q} - E(R_{wt})]}{\sigma_{Rijt}.\sigma_{Rwt}} \quad (20)$$

where:

$\rho(R_{ijt},R_{wt})$ = correlation R_{ijt} and R_{wt} unconditional correlation (by Pearson)
σ_{Rijt} = standard deviation of R_{ijt} (industry return i on country j at time t)
σ_{Rwt} = standard deviation of R_{wt} (international indices return (world) w at time t)
$E(R_{ijt})$ = expected return of industry i on country j at time t
$E(R_{wt})$ = expected return of world (w) indices at time t
R_{it} = $\beta_0 + \sum_{i=1}^{1} \beta_{nt} I_{nt}$ (I is decomposition factor according to equation 3)
R_{wt} = $\delta_0 + \sum_{q=1}^{q} \delta_q \varepsilon_{t-q}$ (q is orde of MA process according to equation 4)

Because ρ (R_{ijt}, R_{wt}) is assumed to be close to the normal distribution (iid: independent and identically distributed) in the form of N (μ, σ) $\approx$ N (0,1) then $\sigma R_{ijt} = 1$, $\sigma R_{wt} = 1$ so σR_{ijt} x $\sigma R_{wt} = 1$, then on the basis of studies from Longin and Solnik (1995) and Pukthuanthong and Roll (2009) about the nature of the relationship between R_{ijt} and R_{wt}, equation (20) changes to:

$$\rho(R_{ijt},R_{wt}) = \frac{\sum_{i,j,w=1}^{t} [\beta_0+\sum_{i=1}^{1} \beta_{nt} I_{nt} - 0].[\delta_0+\sum_{q=1}^{q} \delta_q \varepsilon_{t-q} - 0)]}{1.1} \quad (21)$$

where estimation of $\rho(R_{ijt}, R_{wt})$ is carried out by substitution of the property σR_{ijt}, σR_{wt}, R_{it}, R_{wt}, $E(R_{ijt})$ and $E(R_{wt})$ according to the assumption N (0.1). This equation (6) is further simplified to:

$$\rho(R_{ijt},R_{wt}) = [\beta_0 + \sum_{i=1}^{I} \beta_{nt} I_{nt}] + [\delta_0 + \sum_{q=1}^{q} \delta_q \varepsilon_{t-q}] \quad (22)$$

where since $[\delta_0 + \sum_{q=1}^{q} \delta_q \varepsilon_{t-q}]$ is also notified by the R_{wt} residual, $\delta_0 + \sum_{q}^{q} = 1$ $\delta_q \varepsilon_{t-q}$ is seen as ε_{it} in ρ (R_{it}, R_{wt}). This is because q is the R_{wt} MA (Moving Average) process order in model (19). So this model (22) can be modified to:

$$\rho(R_{ijt},R_{wt}) = [\beta_0 + \sum_{i=1}^{I} \beta_{nt} I_{nt}] + \varepsilon_{it} \quad (23)$$

and when applied in country j, the model (23) will change to:

$$\rho(R_{ijt},R_{wt}) = [\beta_0 + \sum_{i,j=1}^{I} \beta_{njt} I_{njt}] + \varepsilon_{ijt} \quad (24)$$

where:

$\rho(R_{ijt},R_{wt})$ = R_{ijt} and R_{wt} unconditional correlation (by Pearson)
I_{njt} = decomposition factor n for $\rho(R_{ijt},R_{wt})$ in country j at time t

β_{njt} and β_0 = coefficient of I_{njt} and intercept from $\rho(R_{ijt},R_{wt})$
ε_{ijt} = error (residual) from $\rho(R_{ijt},R_{wt})$

Theoretical model (24) can be employed into the empirical model 25 and 26 because component of $\sum_{i,j=1}^{I} \beta_{njt} I_{njt}$ consists of $\beta_1 E_{ij,t-1}$, $\beta_2 DINDG_{ij,t}$, $\beta_3 PGDP_{ij,t-1}$, $\beta_4 LNMCAPS_{ij,t-1}$, $\beta_5 NFFF_{jt}$, $\beta_6 FOR_{jt}$ and $\beta_7 d(F_X)_{jt}$. The empirical model $\rho(R_{ijt}, R_{wt})$ is obtained as follows:

$$\rho(R_{ijt},R_{wt}) = f\,[E_{ij,t-1,}\, DINDG_{ijt},\, PGDP_{ij,t-1,}\, LNMCAPS_{ij,t-1,}\, NFFF_{jt},\, FOR_{jt,}\, d(F_X)_{jt}] \qquad (25)$$

Model equation 25 will be also conducted to test for DCC (Dynamic Conditional Correlation) from estimation process in equation 9. So model equation 25 can be formulated as follow:

$$\rho(R_{jt},R_{wt}) = f\,[E_{ij,t-1,}\, DINDG_{ijt},\, PGDP_{ij,t-1,}\, LNMCAPS_{ij,t-1,}\, NFFF_{jt},\, FOR_{jt,}\, d(F_X)_{jt}] \qquad (26)$$

From equation 26 we can see that $E_{ij,t-1,}$ is representing to the Level of Intra Industry Competition respecting to the entropy index of Ruefli (1990) and $DINDG_{ijt}$, $PGDP_{ij,t-1,}$ and $LNMCAPS_{ij,t-1}$ are respectively used to supporting industry factors. While for the Intensity of Role of Global Investors we use $NFFF_{jt}$ and FOR_{jt} as the proxies and $d(F_X)_{jt}$ is to supporting international factors. Explanation of each variable will be presented at table 1.

4. Research Method

SUR model in equation 25 and 26 consists of five equations y_1, y_2, y_3, y_4 and y_5 in its simplest form $y = X\beta + e$. For estimating operationally we can set model 25 (UCC) into:

$$\begin{aligned}\rho(R_{iMt},R_{wt}) = {} & \delta_{10}+\delta_{11}E_{iMt-1} + \delta_{12}\,DINDG_{iMt} + \delta_{13}PGDP_{iMt-1} \\ & + \delta_{14}LNMCAPS_{iMt-1} + \delta_{15}NFFF_{Mt} + \delta_{16}FOR_{Mt} \\ & + \delta_{17}d(Fx)_{Mt} + \varepsilon_{iMt}\end{aligned} \qquad (27)$$

$$\begin{aligned}\rho(R_{iSt},R_{wt}) = {} & \delta_{20} + \delta_{21}E_{iSt-1} + \delta_{22}DINDG_{iSt} + \delta_{23}PGDP_{iSt-1} + \delta_{24}LNMCAPS_{iSt-1} \\ & + \delta_{25}\,NFFF_{St} + \delta_{26}\,FOR_{St} + \delta_{27}\,d(Fx)_{St} + \varepsilon_{iSt}\end{aligned} \qquad (28)$$

$$\begin{aligned}\rho(R_{iTt},R_{wt}) = {} & \delta_{30} + \delta_{31}E_{iTt-1} + \delta_{32}DINDG_{iTt} + \delta_{33}PGDP_{iTt-1} + \delta_{34}LNMCAPS_{iTt-1} \\ & + \delta_{35}NFFF_{Tt} + \delta_{36}FOR_{Tt} + \delta_{37}d(Fx)_{Tt} + \varepsilon_{iTt}\end{aligned} \qquad (29)$$

$$\begin{aligned}\rho(R_{iPt},R_{wt}) = {} & \delta_{40} + \delta_{41}E_{iPt-1} + \delta_{42}DINDG_{iPt} + \delta_{43}PGDP_{iPt-1} + \delta_{44}LNMCAPS_{iPt-1} \\ & + \delta_{45}NFFF_{Pt} + \delta_{46}FOR_{Pt} + \delta_{47}d(Fx)_{Pt} + \varepsilon_{Pt}\end{aligned} \qquad (30)$$

$$\begin{aligned}\rho(R_{iRt},R_{wt}) = {} & \delta_{50} + \delta_{51}E_{iRt-1} + \delta_{52}DINDG_{iRt} + \delta_{53}PGDP_{iRt-1} + \delta_{54}LNMCAPS_{iRt-1} \\ & + \delta_{55}NFFF_{Rt} + \delta_{56}FOR_{Rt} + \delta_{57}d(Fx)_{Rt} + \varepsilon_{Rt}\end{aligned} \qquad (31)$$

Following Dufour and Khalaf (2002) and Gatignon (2014), we realized that it must be shown about the contemporaneous correlation of error across using the Breusch-Pagan test of independence of the errors. If $\lambda = T\sum_{i=2}^{M}\sum_{j=1}^{i-1} r_{ij}^2$ is larger than λ^2 (df) of table then we can conclude at least 1 covariance from equation 27 - 31 is not equal to zero. For estimating operationally SUR we can also set model 26 (DCC) into as follow:

$$\begin{aligned}\rho(R_{Mt},R_{wt}) = {} & \delta_{10} + \delta_{11}E_{iMt-1} + \delta_{12}LNMCAPS_{iMt-1} + \delta_{13}PGDP_{iMt-1} \\ & + \delta_{14}NFFF_{Mt} + \delta_{15}FOR_{Mt} + \delta_{16}d(Fx)_{Mt} + \varepsilon_{iMt}\end{aligned} \qquad (32)$$

$$\rho(R_{St},R_{wt}) = \delta_{20} + \delta_{21}E_{iSt-1} + \delta_{22}LNMCAPS_{iSt-1} + \delta_{23}PGDP_{iSt-1} + \delta_{24}NFFF_{St} + \delta_{24}FOR_{St} + \delta_{25}d(Fx)_{St} + \varepsilon_{iSt} \quad (33)$$

$$\rho(R_{Tt},R_{wt}) = \delta_{30} + \delta_{31}E_{iTt-1} + \delta_{22}LNMCAPS_{iTt-1} + \delta_{23}PGDP_{iTt-1} + \delta_{34}NFFF_{Tt} + \delta_{35}FOR_{Tt} + \delta_{36}d(Fx)_{Tt} + \varepsilon_{iTt} \quad (34)$$

$$\rho(R_{Pt},R_{wt}) = \delta_{40} + \delta_{41}E_{iPt-1} + \delta_{42}LNMCAPS_{iPt-1} + \delta_{43}PGDP_{iPt-1} + \delta_{44}NFFF_{Pt} + \delta_{45}FOR_{Pt} + \delta_{46}d(Fx)_{Pt} + \varepsilon_{iPt} \quad (35)$$

$$\rho(R_{Rt},R_{wt}) = \delta_{50} + \delta_{51}E_{iRt-1} + \delta_{52}LNMCAPS_{iRt-1} + \delta_{53}PGDP_{iRt-1} + \delta_{54}NFFF_{Rt} + \delta_{55}FOR_{Rt} + \delta_{56}d(Fx)_{Rt} + \varepsilon_{iRt} \quad (36)$$

In fact, this study not only uses four data years 2006-2009 but also requires 10 industrial groups from the Global Industry Classification Standard (GICS) version from OSIRIS database toward 5 ASEAN countries hence we can obtain 240 data observations in order to maximize the SUR (Seemingly Unrelated Regression) analysis which is estimated by System Equation and could not be estimated one by one like OLS and GLS as Single Equation. Testing the SUR model in equation 25-36 is to see to what extent is the effectiveness of entropy from Ruefli (1990) as the first determinant of capital market integration in ASEAN. The SUR model (equation 32-36) takes into account the feasibility aspects, namely the presence of contemporaneous correlation of error across of each equation using the Breusch-Pagan test of independence (Dufour and Khalaf, 2002). For explanation of each variable in equation from 26 which will be applied in detail of SUR model at 27-31 and 32-36 equations respectively, we can expose table 1 below.

Table 1: Operational definition for DV (dependent variable) and IDV (independent variable)

Type	Notation	Detail explanation of each variables
DV	$\rho(R_{ijt},R_{wt})$	Unconditional Correlation (UCC) between R_{ijt} (industry *return* i in country j at period t) and R_{wt} (international indexes (*world*) return w at period t), where international index is MSCI. To calculate this correlation we used Pearson techniques To count R_{ijt} we employ database as well as used to entropy index.
DV	$\rho(R_{jt},R_{wt})$	Dynamic Conditional Correlation (DCC) between R_{jt} (market *return* country j at period t) and R_{wt} (international indexes (*world*) return w at period t), where international index is MSCI. To calculate this correlation we used DCC approach by GARCH from Engle (2002).
IDV	$E_{ij,t-1}$	Entropy index from industry i in country j at period t-1 which derived from Ruefli (1990) and Collins and Ruefli (1992). Process to calculate $E_{ij,t-1}$ is important to test the H2. $E_{ij,t-1}$ is calculated by adaptation formula of $H(S)_k = [\sum_i (\sum_j p_{i,j,k} \ln p_{i,j,k)} / q \ln q]$. To calculate $H(S)_k$ we conduct 3 steps: create a database for 10 GICS of 5 countries in ASEAN, to rank the firm in industry by net profit, to make a transition matrix (p_{ijk}).
IDV	$DINDG_{ijt}$	Global industry dummy (D=1) and regional (D=0). This variable is adapted from study of Faff and Mittoo (2003).
IDV	$PGDP_{ij,t-1}$	Proportion of GDP inter industry i in country j at t-1.
IDV	$LNMCAPS_{ij,t-1}$	Log natural of *market capitalization* industry i in country j at t-1.
IDV	$NFFF_{jt}$	*Net Foreign Fund Flow* in country j at period t.
IDV	FOR_{jt}	*Foreign Ownership Restriction* is one minus the ratio between MSCI Investable Index and MSCI Global Index in country j at period t [which could be written as follow: FOR=1- (MSCI-II / MSCI-GI)]. FOR = 1 means market is closed for global investors' participation while FOR = 0 means that market will open 100%. It refers to Edison and Warnock (2003).
IDV	$d(Fx)_{jt}$	Deviation of IRP in country j at period t. Formulation with $i_d - i_f$ or $(S_{t+1} - S_t)/S_t$. Code of Fx is *foreign exchange* in country j at period t and not an *identifier*
-	$\delta_0, \delta_{i1t}, \ldots \delta_{i5t}$	Intercept and coefficient for each independent variables.
-	ε_{ijt}	error (residual) for model 4.1 i.e. common factors beside $E_{ij,t-1}$, $DINDG_{ijt}$ $PGDP_{ij,t-1}$, $LNMCAPS_{ij,t-1}$, $NFFF_{jt}$, FOR_{jt} and $d(Fx)_{jt}$.

5. Result and Discussion

5.1 Industrial Structure Profile from ASEAN Countries

As seen at Table 2 below, each country in ASEAN has value of entropy index (E_{ijt}) respecting to industry sectors of GICS. Most of ASEAN countries has total entropy about 0.2 – 0.45 as sum of component Lower Entropy (LE), Diagonal Entropy (DE) and Upper Entropy (UE). The value of total entropy which has not exceeded 0.5 indicates that industry sectors of GICS did not expose tight competition. According to Collins and Ruefli (1992), if the industry has low competition, then decision making will be easier because the low strategic risk. Thus in context of international diversification, the low level of intra industry competition will be more attractive for global investor to enlarge their portfolio in ASEAN.

Table 2: Total entropy index result from each ASEAN countries

Industry sectors (GICS code)	Philppines (E_{iPt})	Thailand (E_{iTt})	Malaysia (E_{iMt})	Singapore (E_{iSt})	Indonesia (E_{iIt})
Oil and Gas (10)	0.2425	0.3383	0.3848	0.3528	0.3536
Basic Material (15)	0.3372	0.3517	0.3404	0.3878	0.3344
Industrial Goods (20)	0.3741	0.3256	0.2955	0.2502	0.3237
Services Goods (25)	0.3068	0.3889	0.3388	0.3172	0.3448
Consumer Goods (30)	0.3091	0.2791	0.2499	0.3515	0.2927
Health Care (35)	0	0.2701	0.5484	0.1981	0.2145
Financial Institution (40a)	0.3015	0.3112	0.2512	0.2903	0.3392
Property and Real Estate (40b)	0.2640	0.3741	0.3320	0.3378	0.3698
Technology (45)	0.4508	0.3121	0.3249	0.3582	0.3796
Utilities-Telecommunication (50)	0.4011	0.3243	0.3078	0.3230	0.1182

From Table 2 we can also show that Thailand, Malaysia and Singapore has higher total entropy than Philippines and Indonesia. This implicates that Thailand, Malaysia and Singapore will give more challenge for global investors when form their portfolio since the level of intra industry competition are slightly higher than Philippines and Indonesia. But that condition does not mean Philippines and Indonesia are less attractive. We must see about comparing between Upper Entropy (UE) and Lower Entropy (LE) in ASEAN Countries as presented at Table 3. According to Ruefli (1990), we see that industry with condition of UE < LE will be more interesting since firms of this industry could have raised their ranks.

Table 3: Comparing upper entropy (UE) and lower entropy (LE) in ASEAN

Industry sectors (GICS code)	Philppines	Thailand	Malaysia	Singapore	Indonesia
Oil and Gas (10)	UE = LE	UE = LE	UE = LE	UE = LE	UE > LE
Basic Material (15)	UE > LE	UE > LE	UE < LE	UE > LE	UE > LE
Industrial Goods (20)	UE > LE	UE > LE	UE = LE	UE < LE	UE < LE
Services Goods (25)	UE < LE	UE > LE	UE > LE	UE > LE	UE = LE
Consumer Goods (30)	UE < LE	UE = LE	UE > LE	UE > LE	UE > LE
Health Care (35)	-	UE > LE	UE < LE	UE > LE	UE = LE
Financial Institution (40a)	UE < LE	UE > LE	UE > LE	UE = LE	UE < LE
Property and Real Estate (40b)	UE > LE	UE < LE	UE > LE	UE > LE	UE > LE
Technology (45)	UE > LE	UE > LE	UE > LE	UE > LE	UE > UE
Utilities-Telecommunication (50)	UE > LE	UE = LE	UE = LE	UE > LE	UE = LE

Thus in the attractiveness point of global investors, each ASEAN countries have several condition of UE < LE i.e. Philippines (Financial Institutions), Thailand (Property and Real Estate), Malaysia (Health Care), Singapore and Indonesia (both are Industrial Goods).

5.2 Capital Market Integration Determinant by UCC (Unconditional Correlation)

We conducted two testing with UCC LOC and UCC USD at panel A and B of Table 4. From panel A the amount of 17 independent variables has significant effect. The value λ^2 – test is 39.393 is greater than λ^2 – table and significant at level 1%. Therefore the assumption of CC (contemporaneous correlation) toward residual of SUR will be confirmed.

Table 4: Hypothesis testing using UCC

Independent variables	Model estimation of seemingly unrelated regression (SUR) for 5 ASEAN countries				
	Philippines $\rho(R_{iPt},R_{wt})$	Thailand $\rho(R_{iTt},R_{wt})$	Malaysia $\rho(R_{iMt},R_{wt})$	Singapore $\rho(R_{iSt},R_{wt})$	Indonesia $\rho(R_{iIt},R_{wt})$
Panel A: UCC-LOC					
INTERCEPT	18.145	-7.523	-50.646	11.408	8.194
	(2.03)**	(-3.39)***	(-2.46)**	(0.61)	(2.19)**
$E_{(ij,t-1)}$	0.044	-2.145	0.027	-0.755	0.0059
	(0.60)	(-2.47)**	(0.04)	(-1.76)*	(0.04)
$DINDG_{(ij,t)}$	0.151	-0.188	-0.134	0.088	0.151
	(2.48)**	(-2.19)**	(-1.52)	(1.54)	(2.35)**
$PGDP_{(ij,t-1)}$	-0.001	-0.746	0.527	-0.991	0.0138
	(-0.01)	(-1.76)*	(0.93)	(-3.25)***	(0.07)
$LNMCAPS_{(ij,t-1)}$	-0.0095	0.048	-0.031	0.074	-0.003
	(-0.93)	(1.45)	(-0.71)	(3.64)***	(-0.27)
$FOR_{(j,t)}$	-22.812	14.138	81.747	-25.479	-11.508
	(-2.04)**	(3.71)***	(2.50)**	(-0.59)	(-2.11)**
$NFFF_{(j,t)}$	0.0035	-0.011	-0.134	0.0035	-0.585
	(0.24)	(-1.54)	(-1.85)*	(0.38)	(-2.20)**
$DIRP_{(j,t)}$	19.711	-14.691	-15.456	19.189	-37.082
	(2.96)***	(-1.63)	(-1.97)**	(0.70)	(-1.86)*
R^2	0.33	0.55	0.27	0.44	0.31
λ^2–test	39.393*** (Breusch-Pagan test of independence), *non iterated* SUR				
Panel B: UCC-USD					
INTERCEPT	3.463	-8.532	-4.428	0.704	0.619
	(0.11)	(-5.46)***	(-1.42)	(2.74)***	(0.56)
$E_{(ij,t-1)}$	0.252	-1.151	-0.627	-0.546	0.233
	(0.64)	(-1.29)	(-1.16)	(-1.68)*	(0.85)
$DINDG_{(ij,t)}$	-0.0034	-0.096	0.040	-0.044	0.027
	(-0.03)	(-1.01)	(0.56)	(1.00)	(0.47)
$PGDP_{(ij,t-1)}$	-0.894	-0.375	0.916	0.351	-0.536
	(-1.10)	(-0.82)	(1.98)**	(-1.51)	(-1.51)
$LNMCAPS_{(ij,t-1)}$	0.048	0.0917	-0.044	0.0477	0.0101
	(1.35)	(2.63)***	(-1.26)	(3.17)***	(0.64)
$FOR_{(j,t)}$	-3.582	12.205	7.424	-1.037	-0.776
	(-0.10)	(5.53)***	(1.75)*	(-1.25)	(-0.42)
$NFFF_{(j,t)}$	-1.809	0.354	-0.354	-0.003	0.1007
	(-1.02)	(1.27)	(-1.92)*	(-0.96)	(0.14)
$DIRP_{(j,t)}$	6.066	12.718	2.017	7.508	7.57
	(-0.13)	(1.57)	(0.88)	(1.22)	(1.74)*
R^2	0.30	0.62	0.25	0.48	0.38
λ^2–test	16.29 ** (Breusch-Pagan test of independence), *non iterated* SUR				

Notes: Panel A and Panel B using UCC-LOC and UCC-USD for degree of capital market integration in each ASEAN countries as dependent variable [$\rho(R_{iPt},R_{wt})$ until $\rho(R_{iIt},R_{wt})$] respectively. ***, ** and * indicate significant at level 1%, 5% and 10% respectively. λ^2-test is test for assumption of SUR that is contemporaneous correlation of residual.

The result testing of panel A has indicated that Thailand has owned the most dominant significant independent variables then followed by Singapore. For Philippines, Malaysia and Indonesia the hypothesis testing for level of intra industry competition is failed to reject H_0 (null hypothesis). This means that entropy index has only been evidently to influence degree of integration of Thailand and Singapore. Especially for Singapore it is found the consistent

result to reject H_0 for entropy index by Ruefli (1990). This result has implication that the most significantly of entropy index by Ruefli (1990) in Singapore which implied the closest of industrial structure of Singapore with GICS.

Returning to panel A, when we use proxy $NFFF_{(j,t)}$ therefore in the whole ASEAN countries the result is failed to reject H0. The testing result with proxy of $NFFF_{(j,t)}$ has been confirmed by the testing hypothesis result in Malaysia and Thailand. The tight mechanism of Malaysia and Thailand bourse through the high of FOR coefficient make inconclusive prejudice that Malaysia and Thailand bourse still conducts tight control of fund flow from global investors was reasonable enough. However if we compare to Philippines and Indonesia, it will indicate the different context. For both of them although it was failed to reject H_0 like as Malaysia but the testing result is still tend to reject H_0. On Philippines and Indonesia, intensity of role of global investors tend to increase integration since the FOR coefficient has the negative sign which will be different if we are comparing to FOR coefficient of Malaysia and Thailand.

From panel B above it will only eight independent variables for all of equations that significant. The sum of significant variable of UCC-USD is less than UCC-LOC. λ^2–test of 16.29 is bigger than λ^2–table and it is significant at level 1%. So that we conclude that assumption of CC (Contemporaneous Correlation) by SUR $\rho(R_{ijt},R_{wt})$ was still be fulfilled. The level of intra industry competition has not been proved to influence the degree of integration in Philippines, Thailand and Indonesia. Proxy of level of intra industry competition namely $E_{(ij,t-1)}$(entropy) has an effect toward the degree of integration $\rho(R_{ijt},R_{wt})$.

Meanwhile for the other bourse, global investors could consider alternative proxies that is in Thailand with $LNMCAPS_{(ij,t-1)}$ and Malaysia through $PGDP_{(ij,t-1)}$.. When using $NFFF_{(j,t)}$ as the proxy of intensity of role global investors then in all ASEAN countries it is failed to reject H_0..Non significantly of that fund flow is occurred since the capital control regime like as in Malaysia which could be confirmed by proxy $FOR_{(j,t)}$ on panel B above. The tight of capital control regime in Malaysia is also followed by Thailand that make $NFFF_{(j,t)}$ has no effect significantly toward $\rho(R_{ijt},R_{wt})$ although the sign is positive. Overall we can say the non-significant of fund flow to increase the integration level.

5.3 Capital Market Integration Determinant (Dynamic Conditional Correlation)

From panel A Table 5 below it can be seen the significant result of λ^2 – test is 29.468 greater than λ^2 – table. This result indicates the feasibility model DCC-LOC if estimated by SUR from Zellner. Model DCC-LOC produce 15 significant independent variables consisted of 11 independent variables from first determinant and 4 independent variables from second determinant respectively. When converted to DCC-USD on panel B, value of λ^2 – test is 39.422 larger than λ^2 –table. This result is also indicated the feasibility of model DCC-USD by SUR from Zellner. Model DCC-USD produce 18 significant independent variables consisted of 11 independent variables from first determinant (level of intra industry competition) and 7 independent variables from second determinant (intensity of role of global investors). According to number of significant independent variables then model DCC-USD is better than DCC-LOC.

On first determinant i.e. H_0 is level of intra industry competition do not influence integration level. According to panel C, it will indicate that all H_0 is rejected in five ASEAN countries. $E_{(ij,t-1)}$ is proxy of level of intra industry competition referring to entropy index Ruefli (1990) has proved to influence degree of market integration. When conducting for second determinant i.e. H_0 is intensity of role of global investors tend decrease integration level. From panel A is indicated that H_0 is rejected only for Indonesia and Malaysia. So that intensity of role of global investors still has significant effect toward level of integration. Overall testing hypothesis for proxy $E_{(ij,t-1)}$, $PGDP_{(ij,t-1)}$ and $LNMCAPS_{(ij,t-1)}$

indicates the significant proof in ASEAN both DCC-LOC and DCC-USD. This will carry implication that the better of integration level with DCC regarding to UCC. However in order to measure entropy index, PGDP and LNMCAPS concerning to level of intra industry competition in each bourse, these proxies will contain element of i (cross-section data) which probably will not fit to DCC that only contained element of j (time-series data).

Table 5: Hypothesis testing using DCC

Independent variables	Model estimation of seemingly unrelated regression (SUR) for 5 ASEAN countries				
	Philippines $\rho(R_{Pt},R_{wt})$	Thailand $\rho(R_{Tt},R_{wt})$	Malaysia $\rho(R_{Mt},R_{wt})$	Singapore $\rho(R_{St},R_{wt})$	Indonesia $\rho(R_{It},R_{wt})$
Panel A: DCC-LOC					
INTERCEPT	-13.439	-5.681	3.678	4.391	-6.478
	(-5.93)***	(-1.82)*	(0.86)	(2.71)***	(-2.84)***
$E_{(ij,t-1)}$	9.571	12.917	-2.757	-1.736	7.166
	(6.07)***	(3.09)***	(-1.85)*	(-2.23)**	(2.43)**
$LNMCAPS_{(ij,t-1)}$	0.267	0.176	0.129	-0.134	0.074
	(5.54)***	(0.64)	(0.80)	(-1.71)*	(1.06)
$PGDP_{(ij,t-1)}$	48.387	-30.052	-17.847	-12.512	38.711
	(6.54)***	(-0.47)	(-1.87)*	(-2.01)**	(4.22)***
$FOR_{(j,t)}$	4.119	2.062	-4.096	-1.711	-0.455
	(1.62)	(0.57)	(-0.86)	(-0.92)	(-2.86)***
$NFFF_{(j,t)}$	0.0021	-0.0011	0.0064	-0.00016	0.0019
	(-1.58)	(-1.03)	(2.36)**	(-0.63)	(0.44)
$DIRP_{(j,t)}$	5.142	8.572	3.136	-1.289	0.179
	(3.25)***	(2.88)***	(1.13)	(-0.74)	(0.24)
R^2	0.84	0.34	0.23	0.35	0.54
λ^2 –test	29.468 *** (Breusch-Pagan test of independence)				
Panel B: DCC-USD					
INTERCEPT	-2.162	1.529	5.814	3.586	3.412
	(-0.63)	(2.42)**	(2.07)**	(2.32)**	(1.98)*
$E_{(ij,t-1)}$	-3.457	0.898	-12.016	-3.272	1.773
	(-1.72)*	(0.71)	(-10.04)***	(-3.43)***	(0.70)
$LNMCAPS_{(ij,t-1)}$	0.266	-0.288	-0.246	0.0225	0.116
	(4.30)***	(-3.98)***	(-1.75)*	(0.25)	(1.80)*
$PGDP_{(ij,t-1)}$	-59.338	53.423	-9.046	-26.955	-85.368
	(-6.76)***	(3.22)***	(-1.13)	(-3.75)***	(-7.13)***
$FOR_{(j,t)}$	5.636	-2.784	2.622	-0.442	2.242
	(1.66)*	(-3.94)***	(1.80)*	(-1.58)	(3.34)***
$NFFF_{(j,t)}$	0.054	0.0108	0.023	0.00014	-0.018
	(0.74)	(0.98)	(2.81)***	(0.30)	(-0.34)
$DIRP_{(j,t)}$	-2.871	3.2005	-1.508	0.789	-3.446
	(-1.31)	(2.86)***	(-0.70)	(0.42)	(-3.15)***
R^2	0.62	0.31	0.72	0.61	0.62
λ^2 –test	39.422 *** (Breusch-Pagan test of independence)				

Notes: Panel A and Panel B using UCC-LOC and UCC-USD for degree of capital market integration in each ASEAN countries as dependent variable [$\rho(R_{iPt},R_{wt})$ until $\rho(R_{iIt},R_{wt})$] respectively. ***, ** and * indicate significant at level 1%, 5% and 10% respectively. λ^2-test is test for assumption of SUR that is contemporaneous correlation of residual.

In order to overcome the limitation of running model SUR, we conduct measurement by median respectively of PGDP and LNMCAPS. This is with the argument of median as the mid point of variable with the lowest standard deviation. It will bring implication to lowering standard of error from coefficient each proxy then will increase t-test (significant level). Specifically it will discuss the contrast result between DCC-LOC and DCC-USD when relating to entropy index. When we use DCC-LOC on the whole bourses, entropy indexes are consistently significant but for using of DCC-USD it cover only 60% of significant number.

That result indicates the effect of USD currency that will become disturbance in relationship among DCC and entropy index. Concerning to role of proxy FOR and NFFF as the second determinant of market integration using by DCC, it can be seen that we get the better result for DCC-USD. When we analyze for DCC-USD, FOR has four significant evidence in Thailand (negative sign) while Philippines, Indonesia and Malaysia (positive respectively). DCC for integration level which will assume to be changed over time to time (time-varying); but it is actually not changing the high-level protection from several bourses. Although Thailand has the low protection level, it will not make international fund flow come to entry significantly. As similar to DCC-LOC, Indonesian has the same result.

5.4 Discussion on Entropy as Determinant for Capital Market Integration

The results of the Entropy test in Singapore and Thailand, which have a significant negative impact on capital market integration (measured by UCC), show that the degree of competition that is not so high (i.e. low value) which has a positive meaning for global investors to make more international diversification in many industry sectors at two countries. Singapore as a developed industrial country and Thailand as a highly innovative country in the industry will serve as a model for Malaysia, Indonesia and the Philippines to further promote the attractiveness of their capital market for global investors. In this case, it improves the attractiveness of the industrial structure so that it is increasingly leading to low total entropy such as Singapore and Thailand.

For the industrial structure conditions are increasingly low total entropy, then every industrial sector must be made to lead to a lower entropy condition that is greater than upper entropy. In a detailed explanation of Setyawan and Wibowo (2019), lower entropy refers to the tendency of companies as members in an industry to experience a rating increase in time series. On the contrary for the industrial structure which has upper entropy conditions. An increase in rating means an increase in profit performance which is the main input for calculating company returns and something global investors are very much pursuing [see Bracker and Koch (1999) and Carrieri *et al.* (2004)]. Overall, our research is the first evidence in the literature on capital market integration studies that industrial structure can be a determining variable for capital market integration through the entropy index by Ruefli (1990). Of course this extends the results of study of Faff and Mittoo (2003), Roll (1992) and Pretorius (2002) only discussed per industry sector category. The use of entropy index by Ruefli (1990) could function as the effective substitute of industrial sector rotation in conducting international diversification in ASEAN from many global investors. As Hwang and Sitorus (2014) claimed that the use of GICS (Global Industry Classification Standard) for industry factors on which to base.

6. Concluding Remarks

This study has two important findings i.e. Singapore has the strong level of intra industry competition in ASEAN and Malaysia has still protective toward the existing of global investors. The result of Singapore can be drawn from the effective of entropy index by Ruefli (1990) as the first determinant of market integration when we conduct testing hypothesis using UCC-LOC, UCC-USD, DCC-LOC and DCC-USD. This result suggest the most potential for global investors to make inter industry diversification since industrial sector in Singapore closed to GICS.

The result of Malaysia can be shown by the still effective of proxy FOR and NFFF. Both variables is becoming the second determinant of market integration by UCC and DCC. Our result confirms the result of Mitchell and Joseph (2010) and also Omay and Iren (2019) about the strict foreign exchange control regime in Malaysia. Therefore it will need more and more approach from global investors to make penetration to Malaysia. They can adapt

Dvořák (2005) strategy namely building trust with local brokerage to inflow the fund into Malaysia.

Finally this study can continue effectively the correlation equation model from Pretorius (2002) and Bracker and Koch (1999) which have put alternative measurement of capital market integration and make model about determinant factors through correlation beside cointegration. In order to make better result in the future, we suggest using of DCC in industrial level from GICS. DCC industrial level from GICS will be fitted with entropy index of Ruefli (1990). This study completes the discussion on the results level difference of integration of capital markets at country and industrial level in ASEAN according to Setyawan and Wibowo (2019). In situations such as the global covid-19 pandemic in the world and especially in ASEAN, every global investor must prioritize a dynamic international diversification strategy based on the risk on and risk off approach from Smales (2016). However, the challenge in estimating the empirical model is combining it with entropy index by Ruefli (1990).

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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.

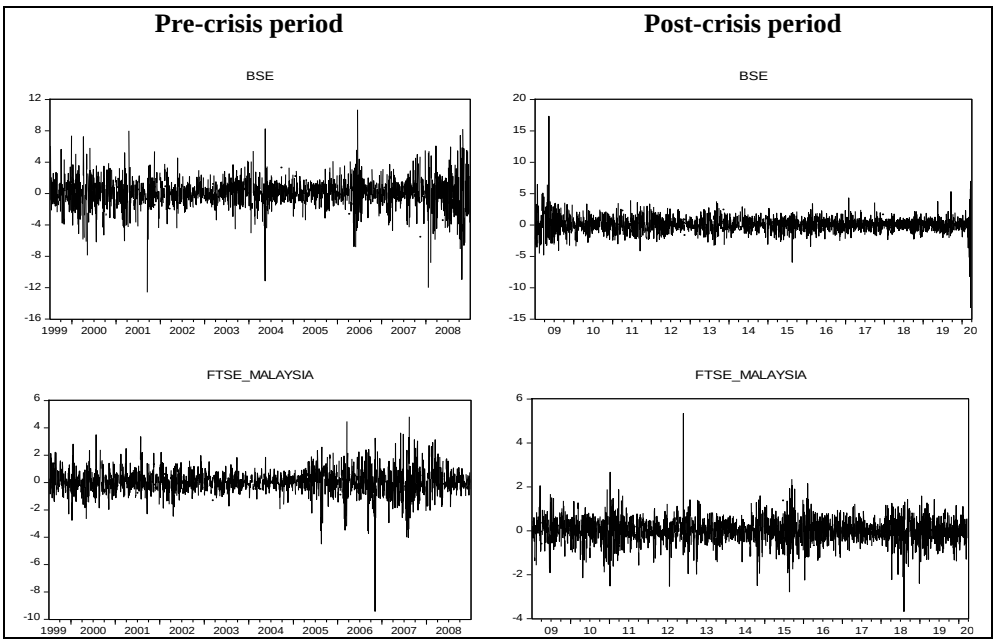

Figure 1: Trend analysis – pre and post-crisis period

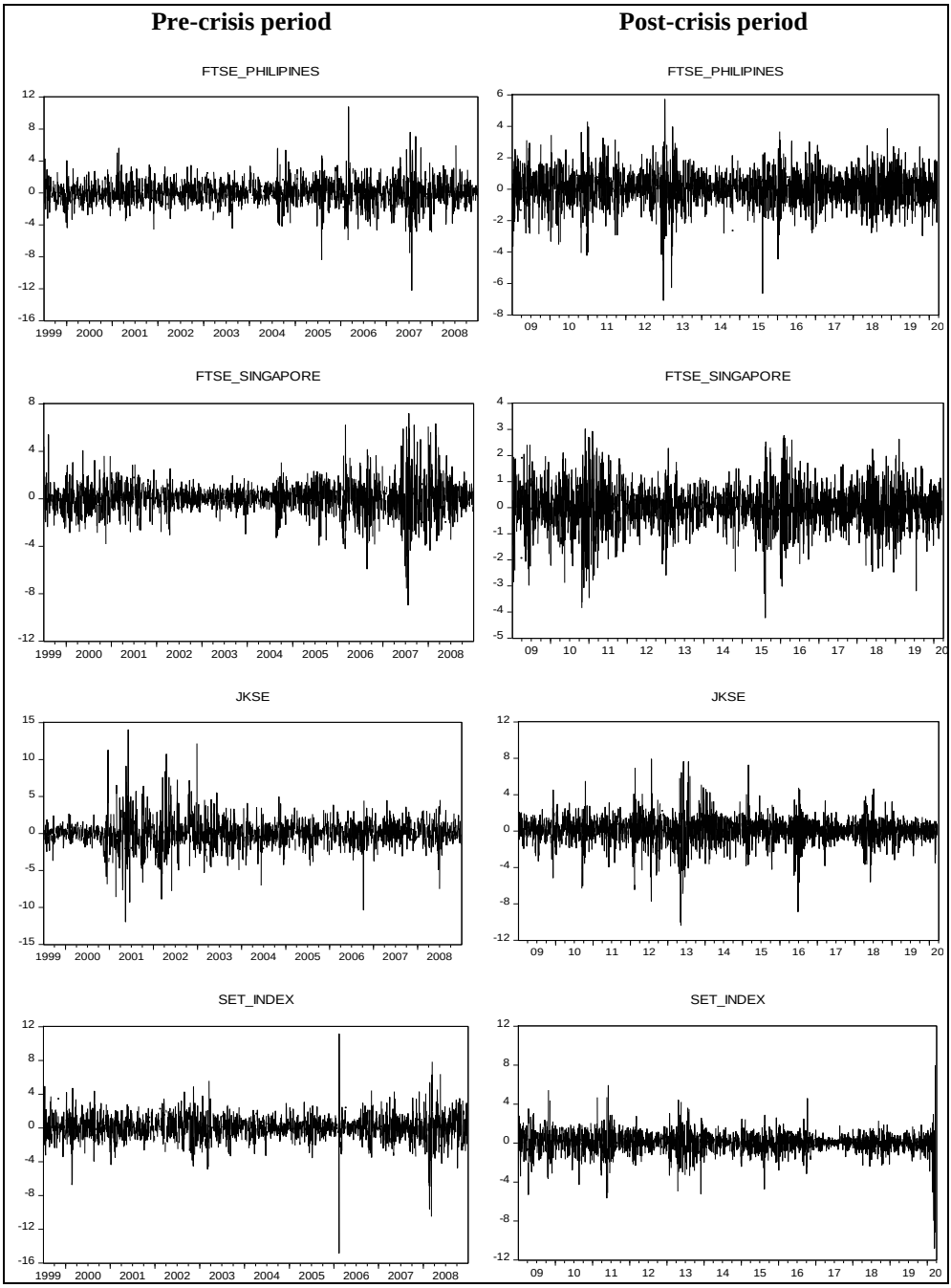

Figure 1 *(continued)*

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%).

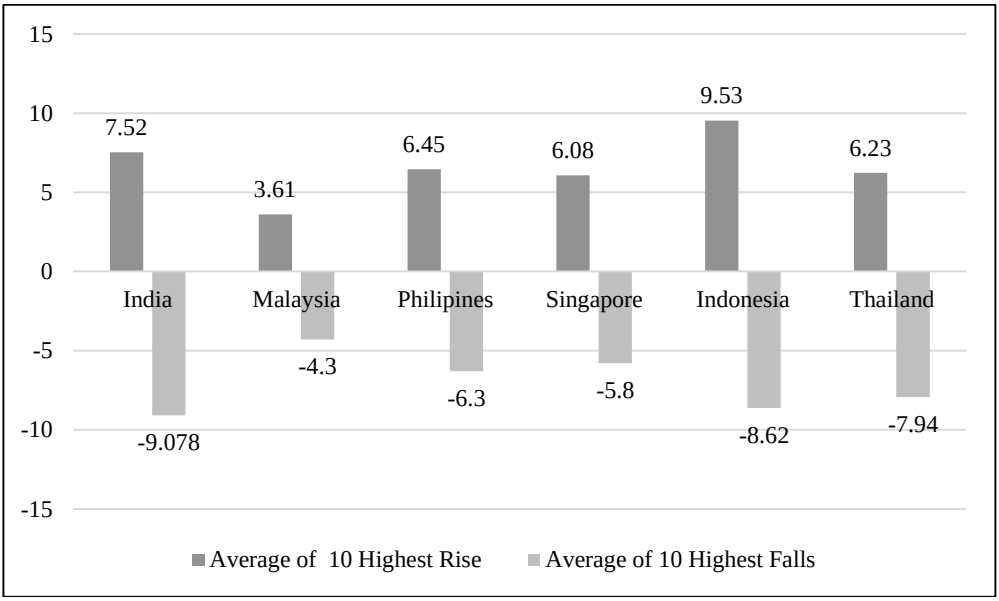

Figure 2: Average of 10 major one-day rises and falls (pre-crisis period)

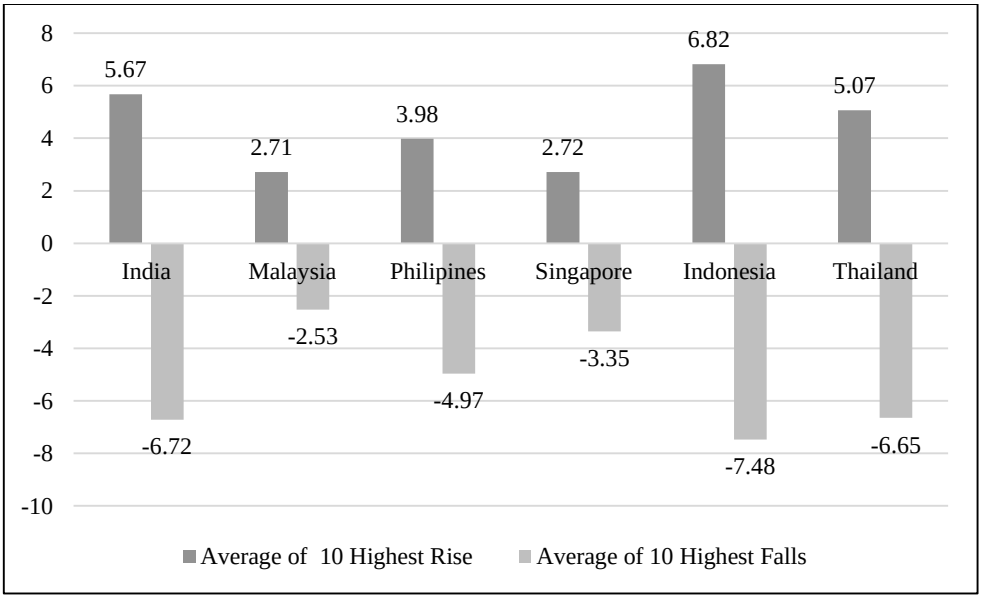

Figure 3: Average of 10 major one-day rises and falls (post-crisis period)

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

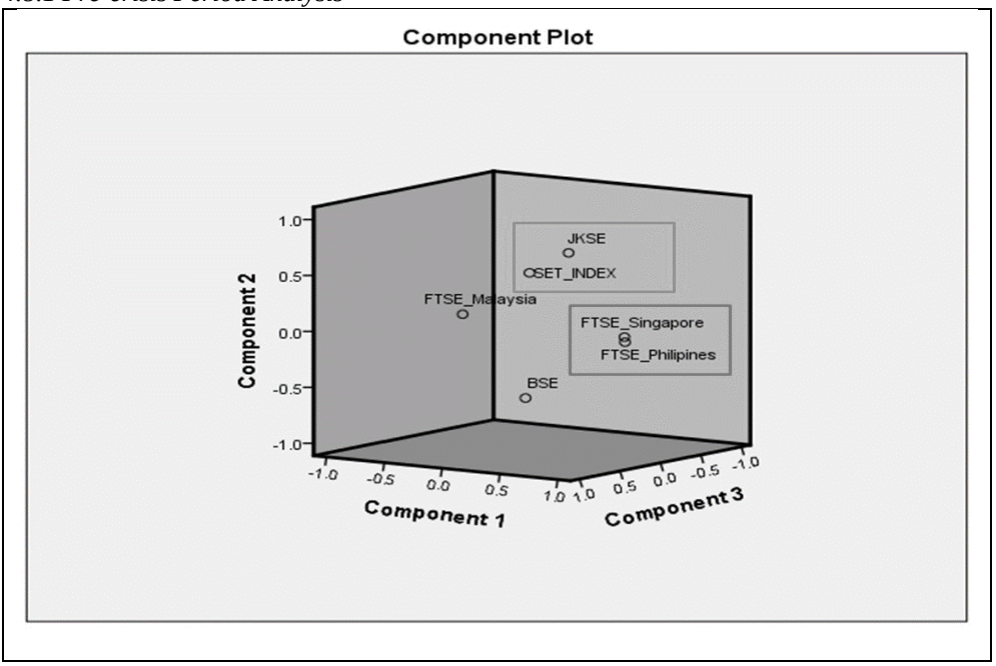

Figure 4: Component plot- pre-crisis period

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.

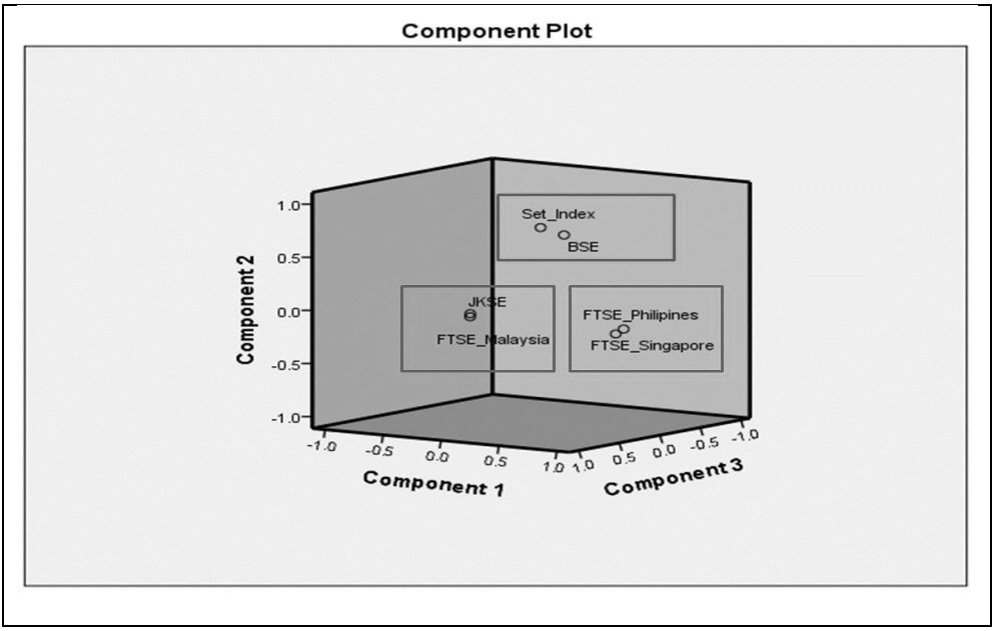

Figure 5: Component plot- post-crisis period

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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Noise Trader Risk-Evidence from China's Stock Market

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Abstract: Research Question: This paper examines the prevalence of noise trading and volatility asymmetry in the Chinese stock market. **Motivation:** Noise trader risk is a pervasive risk in the world's stock markets. It is driven by emotions and run counter to market stability. Noise trading has its practical repercussions. Hence, it is imperative for policymakers and investors to understand the behaviour and causes of noise risk to enhance market efficiency and optimize the financial decision-making process. Although most studies have confirmed the existence of noise in China's stock market, the volatility response findings have been mixed. Besides, prior studies found that China's stock market's volatility response behaves differently from its Western counterparts. **Idea:** In an attempt to examine the asymmetrical volatility response over different market conditions, we build our study on Feng *et al.* (2014) but over a different market sentiment period. Additionally, we combine our quantitative research with qualitative analysis. Hence, our paper verifies the existence of noise trading in China's stock market and dissects the plausible rationales behind the findings, keeping China's unique historical developments and market conditions in mind. **Data:** Our sample data comprises the daily Shanghai Stock Exchange (SHSE) A-share index between 2nd January 2014 to 1st July 2019. **Methods:** We first employ a variance ratio method to test for noise trading evidence and subsequently develop an EGARCH-M model to detect yield asymmetry in the SHSE A-share market. **Findings:** Our result suggests that noise trading is prevalent in China's stock market and that market returns are more volatile in the face of good news than bad news. Hence, our findings are similar to Chen and Huang (2002) but contradict Feng *et al.* (2014). We attribute our findings to the investor's irrational investment psychology and behaviour, such as the widespread "catch up and kill down" operations among the noise traders and the market's deficiencies. **Contributions:** Hence, our results provide important indications to investors and policymakers to assess the market conditions and devise optimal strategies.

Keywords: Noise trading, variance ratio, volatility asymmetry, EGARCH-M, market efficiency, behavioural finance.
JEL classification: G14, G40

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1. Introduction

Noise trader risk is recognized as a pervasive risk in the world's stock market. Its most direct impact is challenging the market efficiency theory. If noise trading is prevalent and persistent, it will tend to overturn the random walk theory. One of the most significant and often undesirable implications of noise trading is volatility-evoking. Volatility induces instability of stock markets. Therefore, it is not surprising that this hot research of many decades has attracted attention from a wide range of interested parties, including investors and policymakers. Due to its practical implication, it is imperative for policymakers and investors to gain a more in-depth understanding of the behaviour and causes of noise risk to enhance the market efficiency and to optimize the financial decision-making process.

Noise is a concept as opposed to information. Noise is distorted and false information, and noise traders are the investors who form a wrong idea about the future return distribution of risky assets. Noise traders select portfolios of securities based on their own ideas, as opposed to arbitrageurs whose optimal strategy is to take advantage of such mistakes by noise traders to push the price of securities back to a level consistent with their underlying value.

The theory of efficient markets has been controversial since its introduction. It is contended that the view does not correspond to reality. The logic goes like this. When investors trade with noise traders who engage in short-term arbitrage, they encounter the main risk of further price distortions in the short run as noise trader trades in the market based on their own, often distorted views. Under the assumption of noise trader's unpredictable investing behaviours, when they make wrong judgments about the market, their behaviour will inevitably drag prices further away from the fundamentals. They may even cause the price to go to the extremes before returning to normal. In such circumstances, the arbitrageurs bear the risk caused by the noise traders' misbehaviour. Thus, arbitrage trading becomes much less attractive, and noise trader's trading activities may further aggravate the price deviation from its underlying value. The spiralling effect causes a less efficient market.

In the early days of noise theory, scholars argued that noise traders did not exist for long. Fama (1970) argued that noise traders could not survive persistently because of market selection and arbitrage behaviour, as they were pushed out of the market by rational traders. These earlier researchers contend that noise traders are in a weaker position than arbitrage investors. Arguably, when noise traders are in an interactive game with arbitrage investors, the former often make errors in judgment. Such errors will result in noise traders continuously losing money and disappearing from the market. Numerous empirical studies show that noise trading is widespread in the world's financial markets (Lee *et al.*, 1991; Baker and Stein, 2004). Some recent studies have reported that investors' irrational behaviour could even lead to noise generation and persistence (Long *et al.*, 1990b).

Noise trading affects the stability of the stock market. Researchers have found that noise traders cause a stock price to deviate from its intrinsic value, causing market bubbles (Shiller *et al.*, 1984; West, 1988; Binswanger, 1999). The phenomenon is expected to be more pronounced and impactful in less competitive and efficient markets. At present, China's stock market is one of the largest markets in the world. Of interest is that the market distinguishes itself by its unique development history and market characteristics. For context, China's stock market has an enormous influence on the country's overall economy, and policymakers have been continuing to implement various reform policies to improve the market competitiveness and efficiency, and ultimately promote overall economic development. However, some imperfections and deficiencies exist in the Chinese stock market, limiting its progress towards achieving optimal functions and efficiency. One of the most intuitive manifestations is the stock price deviation from the fundamental value and irregular fluctuations with stock returns. It is noteworthy that the market is dominated by a substantial proportion of small investors and speculative trading, which implies that the irrational investment psychology and investing

behaviour may be more severe than other developed counterparts. Hence, noise trading is likely to be more prevalent in the market. Thus, the paper's first objective is to verify the prevalence of noise trading in China, which carries significant implications for both the regulators and investors.

When noise traders affect prices and thus returns, the risk they cause is volatility. Market yield volatility asymmetry is a widespread phenomenon in the world's stock markets. Studies show that volatility asymmetries exist in most developed countries' stock markets. In China, there have been some empirical studies on the market's volatility. Although most studies have confirmed the existence of noise in China's stock market, the volatility response findings have been mixed. Studies found that volatility response in China's stock market mostly behaves differently from Western counterparts. Even for the China market, studies on the topic have not provided conclusive evidence on how the market behaves in the face of good news and bad news. While some studies reported that fluctuations in China's stock market react more strongly to positive shocks than adverse shocks (Chen and Huang, 2002), other studies documented contrary evidence (Feng *et al.*, 2014). Our paper is similar to Feng *et al.* (2014). The authors tested noise behaviour from 2008 to 2013, a bearish era surrounding the Global Financial Crisis.

The authors reported a more robust response of market volatility to adverse shocks than positive shock. It is worth noting that after a seven-year of bearish sentiment, the year 2014 earmarked a significant turning point for China's stock market. In November 2013, China's government launched a "Deepening Reform," of which part of the resolution revitalized the stock market through a series of active system reforms. Due to the reforms, China's economic growth was stimulated, and a new round of economic growth in China began. Since then, market sentiment was lifted, and the market has transitioned from predominantly bearish to bullish. Against such a backdrop, we are motivated to gain insight into how noise trades' behaviour changes. This paper uses new data from 2014 to 2019 to investigate behavioural issues of noise trading and endeavour to depict a complete picture of the issue.

The extant literature of noise trading models and empirical studies agree on the existence of noise trading. It is argued that the fundamental characteristic that defines a noise trader is irrationality (Brown, 1999). Nonetheless, there is a lack of a classification of the psychological factors that explain noise trading. Furthermore, previous studies of noise trading entities in financial markets have mostly been market endogenous, with noise arising from innate incomplete rationality and information asymmetry that cannot be eliminated entirely. Looking at the capital markets of various countries, especially the Chinese capital market, which is in a phase of emerging-plus-transition, there is a large amount of exogenous policy noise in the market. Hence, it is worth studying how such noise affects the capital market. Empirical studies of stock market yield volatility confirm the GARCH-type model's ability to detect asymmetries. However, most studies omit the analysis of investor psychology and behaviour behind volatility asymmetries. Since China's stock market has been changing at breakneck speed in the past decade, and regulators have been implementing active reforms, our motivation is to engage more recent data that may better reflect the current market's real circumstances. We are also motivated to investigate the reasons behind the unsystematic noise trading and yield asymmetry, viewing from the angles of investors and market mechanisms.

The stock market in mainland China mainly consists of companies listed on the Shenzhen Stock Exchange (SZSE) and Shanghai Stock Exchange (SHSE). The market also comprises companies listed on the Hong Kong Stock Exchange (HKSE) in the Hong Kong Special Administrative Region. Aside from the first-tier markets, the Chinese stock market also consists of a second-tier market, mainly for the Chinese SMEs. The second-tier market was established in 2004. The third-tier market was initially established for delisting and OTC trading. In 2006, the China government set up another third-tier market (the new third-tier

market) for non-listed share-holding companies. Three years later, the Shanghai Stock Exchange (SHSE) established the Growth Enterprises Market (GEM) to offer small and medium-sized private companies financial services. The Ke Chuang Ban was established in 2019, focusing on new tech firms that are usually smaller. In China, A-share and B-share are the two major segments in the Chinese stock market. A-share refers to the share of domestic companies listed on the SZSE or SHSE, while B-share refers to the Chinese companies' shares allowed to be owned by foreigners, and they are usually traded in foreign currencies. The number of A-share stocks traded is much larger than the B-share stocks.

China's stock market has become one of the largest stock markets in the world. It has grown rapidly in recent years but has also been volatile at the same time. The depth of government intervention in the early stages of market formation and the unique circumstances define the market's peculiarities. At present, the market is still suboptimally functional, and the multifaceted systems are still imperfect, which has led to information asymmetry and speculative trading being very common in China's stock market.

The contributions of our paper are as follows. First, we confirm the Chinese stock market's noise existence. Second, our result indicates that market volatility is more responsive to positive shocks than adverse shocks. We posit that volatility characteristics are conditional upon the market state. Third, we explore the underlying reasons for China's stock market's noise trading and volatility asymmetry, mainly from an individual investor's perspective. Our work has normative implications for policymakers and investors. It will be conducive to the policymakers' accurate assessment of the causes when the market is abnormal or even dysfunctional to introduce relevant policies for necessary market intervention. Our work is also applicable for investors who can apply the findings to decision marking in future investments and adjust their investing behaviours and investing strategies to optimize their investment returns.

The remainder of the paper is structured as follows. The following section describes the data and descriptive statistics. Methodologies and empirical analysis are presented in Section 3. In Section 4, we discuss the findings from a mainly behavioural perspective. Section 5 concludes.

2. Data and Descriptive Statistics

We test the stock market returns' noise behaviour using the SHSE (Shanghai Stock Exchange) A-share index. The data is sourced from the RESSET database. We use 1340 daily observations of the SHSE A-share index between 2nd January 2014 to 1st July 2019 to compute the market returns. The market return is calculated as the logarithm yield rate of day t, namely r_t. Table 1 shows the descriptive statistics for the SHSE A-share index return over the investigation period.

$$r_t = lnP_t - lnP_{t-1} \tag{1}$$

where P_t is SHSE A-share index of day t.

Table 1: Descriptive statistics for SHSE A-share index return

Mean	0.0003	Kurtosis	9.7549
Median	0.0007	Jarque-bera	2838.8790
Maximum	0.0560	Probability	0.0000
Minimum	-0.0887	Sum	0.3679
Std.dev	0.0150	Sum sq.dev	0.3005
Skewness	-1.1503	Observation	1338

Figure 1 displays the volatility of r_t. As can be seen from Figure 1, the yields' volatility exhibits asymmetry. According to the skewness and kurtosis of the histogram of r_t (not displayed here), the skewness and kurtosis of r_t are -1.15 and 9.75. Hence, we conclude that r_t is not normally distributed.

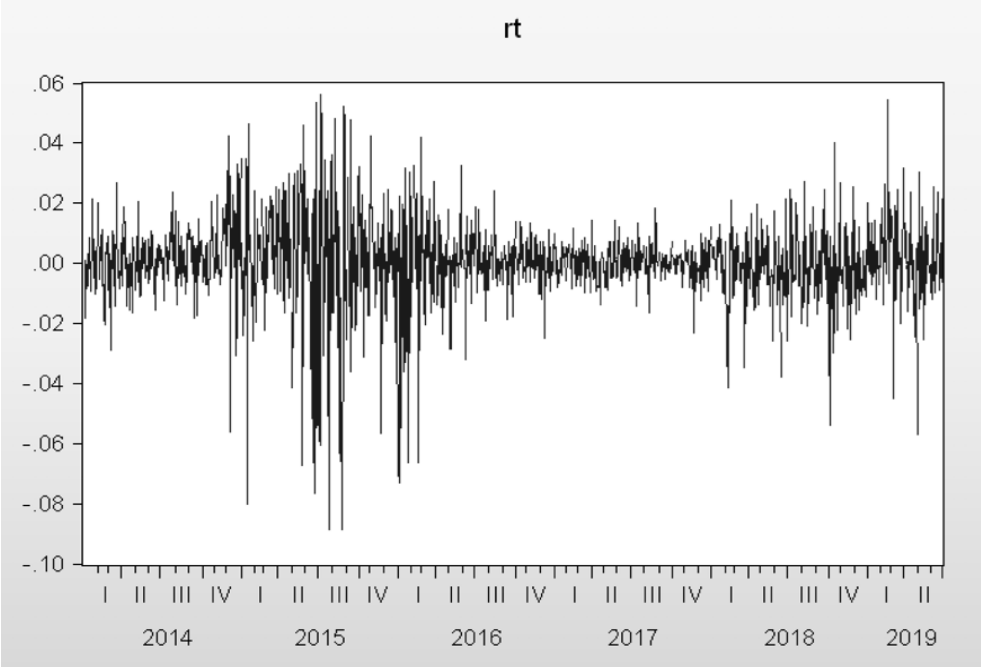

Figure 1: Volatility of r_t

3. Methodology and Empirical Results

This subsection delineates the econometric methodologies and empirical results. Following Lo and MacKinlay (1989), we first employ a variance ratio method to test the noise trading's prevalence and subsequently develop an EGARCH-M model to detect yield asymmetry in the SHSE A-share market. If yield asymmetry is detected, we investigate whether market yield volatility is more responsive in good news or bad news.

3.1 Variance Ratio as Random Walk Test

The variance ratio test is used to test the random walk hypothesis of r_t. The method's fundamental logic is that variance is a linear function of time when a random walk is assumed. The variance ratio VR(q) can be expressed as follows, where q is the lag phase:

$$VR(q) = \frac{\sigma^2(q)}{\sigma^2(1)} \tag{2}$$

where

$$\sigma^2(1) = Var(p_t - p_{t-1})$$
$$\sigma^2(q) = 1/q \times \ Var\left(p_t - p_{t-q}\right)$$

The equations to compute $\sigma^2(1)$ and $\sigma^2(q)$ are as follows:

$$\sigma^2(1) = \frac{1}{nq-1}\sum_{t=1}^{nq}(P_t - P_{t-1} - \hat{\mu})^2 \quad (3)$$

$$\hat{\mu} = \frac{1}{nq}\sum_{t=1}^{nq}(P_t - P_{t-1}) = \frac{1}{nq}(P_{nq} - P_0 \quad (4)$$

$$\sigma^2(q) = \frac{1}{nq-1}\sum_{t=1}^{nq}(P_t - P_{t-1} - \hat{\mu})^2 \quad (5)$$

$$m = q(nq - q + 1)\left(1 - \frac{q}{nq}\right) \quad (6)$$

There are nq+1 observations in the data time series, which starts from P_0, ends at P_{nq}. The null hypothesis of the variance ratio test is VR(q) equals 1. When VR(q) equals 1, the time series of yield conforms to a random walk, which implies that the market follows a random walk. If VR(1) does not equal 1, the market is not efficient at the statistical level. The standard normal test statistic Z(q) is applied to test the null hypothesis of random walk in the situation of homoscedasticity, while Z*(q) is applied to test the null hypothesis in the situation of heteroscedasticity of a random walk.

Table 2 clearly shows that the Z statistics are statistically significant, and therefore the random walk null hypothesis is rejected for the market. This result implies that the index does not conform to the random walk, the market is not efficient, and there are noises in the market. It is worth noting that the variance ratios monotonically decrease when q becomes progressively larger: the variance ratio decreases from 0.5492 (q=2) to 0.0189 (q=60). Correspondingly, the Z statistic's absolute value also progressively reduces as q gets larger. The declining variance ratios may be interpreted as the index showing a negative serial correlation in multi-period returns. Therefore, our results corroborate the earlier studies, confirming that the Chinese stock market exhibits non-random walk behaviour.

Table 2: Variance ratios for daily SHSE A-series index return

q	VR	Z	Z*
2	0.5492	-16.4845***	-8.2122***
3	0.3449	-16.0681***	-8.2906***
4	0.2410	-14.8355***	-7.8498***
5	0.2112	-13.1646***	-7.1003***
10	0.1132	-9.6038***	-5.4961***
15	0.0698	-8.0070***	-4.7524***
20	0.0478	-7.0055***	-4.2566***
30	0.0380	-5.7046***	-3.5717***
50	0.0222	-4.4456***	-2.8853***
60	0.0189	-4.0616***	-2.6760***

Notes: q denotes lag phase, VR is the variance ratio of r_t, Z and Z* stand for the conditions of homoscedasticity and heteroscedasticity. *** denotes 1% significance level.

3.2 EGARCH-M Model as Volatility Asymmetry Test

Before we construct the regression model, we applied a few preliminary tests on the data to ensure model suitability. We used the Augmented Dickey-Fuller (ADF) unit root test on the market return to test for data stationarity. The ADF test has p-values nearly equal to 0, which

shows that the data is stable and ready to be used for further analysis. The following shows the regression model of the market return of day t and day t-1.

$$r_t = c + r_{t-1} + u_t \tag{7}$$

where c is a constant term, u_t is residual. The estimation results of the regression are shown below. It is observed that both the constant term and the coefficient of r_{t-1} are not significant at a five per cent level.

$$r_t = 0.0003 + 0.0496 r_{t-1} \tag{8}$$

t-Sta (0.66) (1.81)

R^2 = 0.002 *AIC*=-5.563 *SC*=-5.555

Next, we test the heteroscedasticity of the residual error of u_t. The volatility of the residuals in the regression is depicted in Figure 2. From Figure 2, it can be seen that there may exist heteroscedasticity in the residuals. We then use the ARCH LM test to confirm the heteroscedasticity's existence. As shown in Table 3, our result rejects the null hypothesis that there is no ARCH effect in the error term, thereby confirming heteroscedasticity in the residuals and supporting the GARCH-type model's use for our subsequent study.

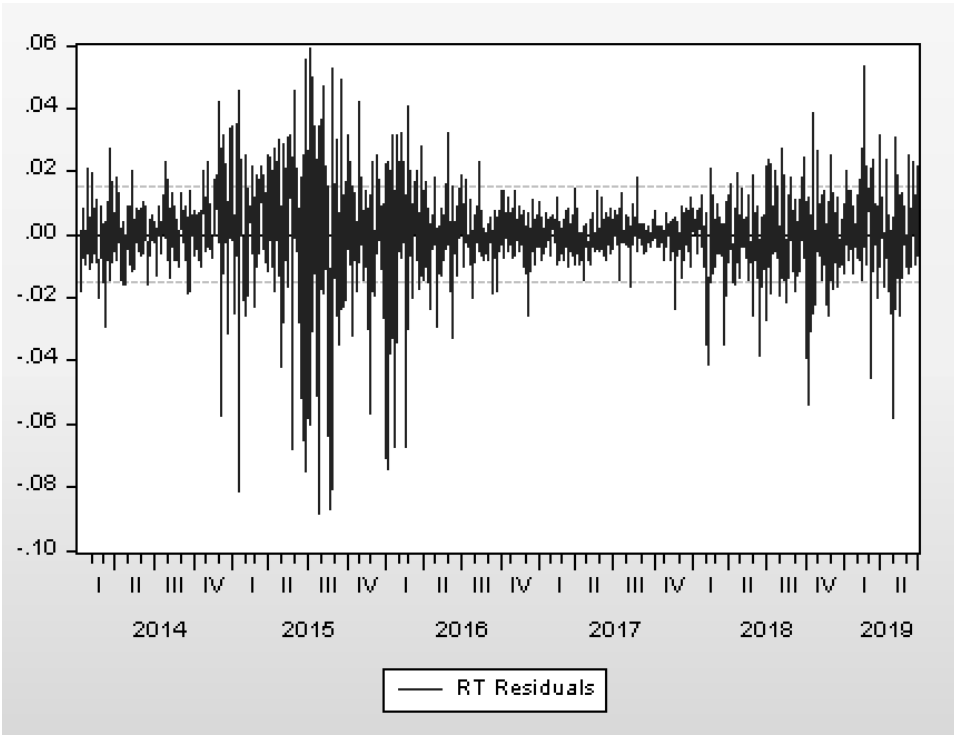

Figure 2: Residuals of r_t

Table 3: Heteroscedasticity test results - original model

F-statistic	68.1825	Prob. F(1,1334)	0.0000
Obs*R-squared	64.9643	Prob. Chi-Square (1)	0.0000

3.2.1 EGARCH-M Model

The GARCH model is a time series modelling method with heteroscedasticity in the ARCH model family. An essential characteristic of the GARCH (p,q) model is that the random error term's conditional variance obeys an ARMA (p,q) process. The GARCH (p, q) model supposes the conditional variance is a function of the squared lagged residuals, which, in this case, the variations are not influenced by the sign of residuals, and the conditional variance should be symmetrical in terms of responding to positive and negative price fluctuations. However, empirical studies have shown that volatility in yields caused by equal degrees of positive and negative information shocks tends to be asymmetrical. Therefore, the linear GARCH model cannot portray this asymmetry in the return's conditional variance fluctuation. Engle *et al.* put forward the GARCH-M model in 1987. Some functional form of h_t, $f = (h_t)$ is used as an explanatory variable for y_t, to characterize time series as affected by their conditional variance. Since security returns incorporate compensation for risk, security returns and risks are closely related. The risks can be measured appropriately using the conditional variance of yields. Therefore, the GARCH-M model is well suited to study the relationship between security returns and risk. Nelson put forward the Exponential GARCH model (EGARCH) in 1991, and it can better depict the fluctuations' asymmetric phenomenon in the conditional variance of yields in the stock market.

To quantitatively describe the asymmetry in the market yield, we use the EGARCH-M model. The EGARCH-M model is based on the EGARCH model, and it takes the conditional variance on the conditional mean equation. The M-item in the conditional mean equation must conform to the Akaike information criterion (AIC) and Schwarz information criterion (SIC), reducing AIC and SIC after modification. Compared with the GARCH-M and EGARCH models, the EGARCH-M model has fewer constraints on the parameters, conforms better to the financial market's actual situation, and can describe its asymmetry well. Engle and Ng (1993) argued that GARCH-type models are good at estimating the properties of risk when the lagged order of ε_t and σ_t is one. As a result, EGARCH-M (1, 1) is selected. The following equation (9) shows the expression of conditional variance.

$$ln(\sigma_t^2) = \omega + \beta ln(\sigma_{t-1}^2) + \alpha \left|\frac{u_{t-1}}{\sigma_{t-1}}\right| + \gamma \frac{u_{t-1}}{\sigma_{t-1}} \tag{9}$$

The γ stands for the size of the asymmetric effect. If γ is close to 0 significantly, no asymmetry exists in shock. On the contrary, when $\gamma < 0$, it suggests that bad news induces a greater volatility response in yields than do good news to the same extent. In the opposite case, when $\gamma > 0$, it suggests that the good news response is more robust than the response to bad news to the same extent. The expression of the conditional mean equation of the model is:

$$r_t = \mu + \rho r_{t-1} + \varphi ln\sigma_t^2 + u_t \tag{10}$$

The results of estimation shown in Table 3 can be summarized as below:

$$ln(\sigma_t^2) = -0.1422 + 0.9959\ln(\sigma_{t-1}^2) + 0.1460 \left|\frac{u_{t-1}}{\sigma_{t-1}}\right| + 0.0168 \frac{u_{t-1}}{\sigma_{t-1}} \tag{11}$$

p-value: (0.00) (0.00) (0.00) (0.03)

$$r_t = 0.0004 + 0.0114r_{t-1} - 0.0868ln\sigma_t^2 \quad (12)$$

p-value: (0.22) (0.66) (0.97)

R^2 = 0.001 *AIC* = -6.060 *SC* = -6.033

Compared with equation (8), the value of *AIC* and *SC* both declined, suggesting that the model's effectiveness is enhanced by introducing M-item to the mean equation. Also, referring to the variance equation results, γ equals 0.0168 with p-value equals 0.03. As demonstrated before, when $\gamma > 0$, it suggests that the response to positive shocks leads to more yields' volatility than adverse shocks' response to the same extent. The empirical results confirm the asymmetry in the SHSE A-share market. Table 4 illustrates the results of the model.

Table 4: Results of EGARCH-M model

	Coefficient	Std. Error	P-value
Conditional mean equation			
μ	0.0004	0.0003	0.2196
ρ	0.0114	0.0262	0.6627
φ	-0.0868	2.3935	0.9711
Conditional variance equation			
ω	-0.1422***	0.0206	0.0000
β	0.9959***	0.0023	0.0000
α	0.1460***	0.0119	0.0000
γ	0.0168**	0.0078	0.0315

Notes: μ, ρ and φ are the coefficients in the conditional mean equation. ω is the constant term, β, α and γ are the coefficients in the conditional variance equation. ** and *** denote 5% and 1% significance level.

After the model has been modified by adding the M item, we applied the heteroscedasticity test on the modified model to detect any heteroscedasticity problem in the residual. The results are shown in Table 5. With lag phase equals to 1, neither F-version nor LM-statistic provides significant values. Thus, the null hypothesis cannot be rejected, suggesting that the ARCH effect does not exist in the residual. We then conclude that there is no more heteroscedasticity in the residuals, and the model is optimized.

Table 5: Heteroscedasticity test result on modified model

F-statistic	0.5954	Prob. F(1,1334)	0.4405
Obs*R-squared	0.5960	Prob. Chi-Square (1)	0.4401

3.2.2 The Information Impact Curve

We demonstrate the yield volatility's asymmetry through a curve. Figure 3 depicts the information's impact curve derived from the previously developed EGARCH-M model. As shown in the figure, the horizontal axis is the value of lagged shock, representing the market's information shock. A positive sign implies good news in the market, and a negative sign indicates an opposite meaning. The higher the absolute value, the greater the news (shock).

The vertical axis implies the conditional variance, representing yield volatility's response to the market's information shocks. When lagged shock value is positive, the slope's absolute value is larger, and the curve is relatively steeper. On the contrary, when the lagged shock shows a negative number, the slope's absolute value is smaller, and the curve is relatively flatter. It implies that when there are two values of lagged shock with the same absolute value and opposite signs, the volatility of returns corresponding to positive information is more responsive to the information shock than the volatility corresponding to negative information.

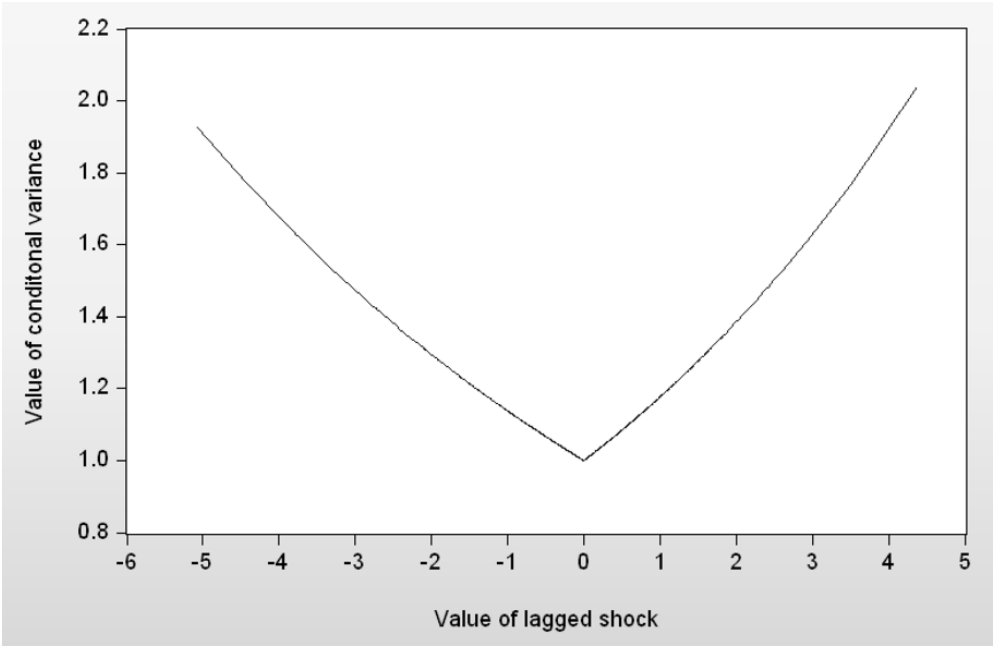

Figure 3: Information impact curve

The differences in the degree of responsiveness of yield volatility to different information embodied in the information's impact curves are consistent with the previous conclusions drawn from modelling observation parameters. The asymmetry exists, and market yield volatility is more responsive to positive information (good news), given the same degree of information shock in our study. This finding contrasts with Feng *et al.* (2014), who found that bad news has a more significant impact on market yield volatility than good news. This apparent contradiction, however, matches our initial conjecture. We have earlier mentioned that the prior study was conducted for the "seven-year bear market" of China in which market sentiment is believed to be severely impaired. Thus, the leverage effect was at play. Although our study produces an opposite finding, namely, good news induces a more robust volatility response than do bad news, we argue that it is caused by a more favourable market condition of our study period, a period when the market momentum has picked up due to the recent recovery from the global crisis and active reforms by the government. Based on the above, we suggest that noise behaviour, particularly volatility asymmetry, is conditional upon the market condition.

4. Discussions

Noise trading can be classified into systemic noise trading and non-systemic noise trading. Systemic noise trading cannot be eliminated, and in fact, it is necessary to enhance market liquidity so long as it is not excessive. Non-systemic noise trading is closely related to human decision-making. It undermines market efficiency but can be eliminated. From the results in the previous empirical study, it is shown that the SHSE A-share market is not efficient, and there are prevalent noise trading and asymmetry of the yield volatility in the market. In the next section, we evaluate the causes and explanations of the non-systemic noise trading and asymmetry in China's stock market. Combined with the characteristics of the current development of China's stock market mentioned above, such as China's stock market as an emerging market, the imperfect laws and systems, the majority of individual investors, and

an intense atmosphere of speculation, the irrational psychology and behaviour of investors can influence China's stock market significantly.

4.1 Investors' Expectation, Composition, and Psychology

4.1.1 Investors' Expectation

The significant market yield volatility is a manifestation of positive feedback trading behaviour (Long *et al.*, 1990a). Positive feedback trading behaviour builds on adaptive expectations, as past price growth generates expectations of further price growth and vice versa. It is characterized by over-anticipation of prices or follow-up to price movements too aggressively. This feedback is primarily a reaction to a sustained price growth pattern rather than occasional changes in prices. For example, in a bull market, a sustained rise in prices creates an expectation of further price rises, and investors follow through aggressively. This kind of operation is often called "catch up. " A decline in price in a bull market is perceived by investors as a random change in price and does not create expectations that prices will fall further. Therefore, the reaction to market yield volatility to negative shocks in a bull market is not very strong. In a bear market, falling prices create expectations of further price declines, and investors race to sell their stocks, this kind of operation is often called "kill down." When prices rise, investors do not have a sustained expectation of further price increases. Thus, the volatility of market yields in a bear market is more sensitive to bad news, and prices tend to fall further. Positive feedback trading has led to an intensification of the tendency to increase the magnitude of price movements.

Our finding shows that China's market return volatility is more responsive to positive information than negative information. The prevalence of the "catch up and kill down" operations in the market is likely to be one of the underlying rationales. When the market maintains upward momentum, bad news does not suppress investors' enthusiasm to "catch up," making the effect of negative information at this juncture less prominent. When the market is depressed, bad news can prompt some investors to sell their stocks. However, at the same time, a part of the investors may have "reluctant to sell" psychology in the market, which reduces market participation, offsetting some of the volatility in market yields due to "kill down" operations.

4.1.2 Investors' Composition

The investors' composition in China's stock market can be primarily divided into two categories. The first category is institutional investors that have absolute advantages in capital and information. Next is the category that consists of small and medium-sized investors with quantitative advantages, relatively small amounts of capital, weak access to information and analytical capacity, and concerted action difficulties. Since they are at a disadvantage considering the promptness and correctness of the information they receive, small and medium-sized investors believe that institutional investors' operations contain information they have not yet received. Thus, small and medium-sized investors are prone to actively keep up with institutional investors' operations, resulting in a "catch up and kill down" operation style for small and medium-sized investors. To achieve excess returns, institutional investors are likely to take split positions against each other, creating false volume practices, artificially creating lagging or even false information to lure small and medium investors into keeping up with the trend. Small and medium investors will then turn positive feedback traders, thereby increasing the stock market's volatility.

4.1.3 Investors' Psychology

From the viewpoint of investors' psychology, studies show that the market often participates in decisions that are not based on its own best value judgments but first extrapolates other

participants' judgments. This herding behaviour is also called the herding effect (Banerjee, 1992). Apart from the psychological factors, there are also factors such as news media messaging, market gossip, and market popularity that lead to crowd behaviour. Crowd behaviour generates a signal amplification mechanism. A piece of information that is not very important in the market is likely to resonate much among market investors through this amplification mechanism. That is to say, good news in a bull market and bad news in a bear market can easily create a herding effect.

4.2. Trading Mechanism of China's Stock Market

The short-selling mechanism and bilateral mechanism introduced in China's stock market are still in the embryonic development stage and have not yet matured. It leads to the asymmetry in the direction of the Chinese stock prices' fluctuations and exacerbates single-item market price fluctuations. The one-way operation leads to excessive speculation and short-term behaviour such as the "catch up and kill down," thus exacerbating the magnitude of price volatility. The biggest problem caused by an immature short-selling mechanism is eliminating systemic risk in the stock market. Moreover, the Chinese financial derivatives market is still underdeveloped, which means that investors have limited hedge risk options. Investors can only hedge systemic risk by exiting the stock market in the absence of a mature short-selling mechanism and sufficiently sophisticated risk-hedging tools.

4.3 Aggressive Investment Atmosphere in the Market

China's economy is growing at close to 10% per year, and investing in the Chinese economy can often achieve 20% or more annual returns. This makes the opportunity cost of investing in the stock market very high. As a result, equity funds management tends to adopt a more aggressive investment style, and investors tend to trade more aggressively.

4.4 Shortage of Financial Products in the Market

China's capital market follows a gradual reform path, with the pace of innovation and the introduction of financial products lagging behind its economic development. The breadth and depth of the current range of financial products on the market may still not meet the diversity of investors' appetites and preferences. This constraint may have led to significant market interest and overreaction whenever a new financial product class is launched. The temporary popularity of new products in the market, while not affecting the market's long-term trend, exacerbates the positive correlation between volatility and returns.

5. Conclusion

This study's central question is whether noise trading exists in China's stock market and its surrounding issues. We applied the variance ratio test on SHSE A-share yields to test the market's prevalence of noise risk. We show that the stock yields do not conform to a random walk, and the relevant information contained in the stock price is not fully reflected in the current stock price. There is also information content embedded in historical stock prices that is useful for future stock prices' prediction, which indicates that the market is not efficient. Noise is one of the critical factors that cause a stock's price to deviate from its intrinsic value, and it supports the fact that in the SHSE A-Share market, noise and noise trading are prevalent.

EGARCH-M model provides a good description of the yield volatility asymmetry in China's stock market. Numerous empirical studies have shown that one of the most critical manifestations of noise trading affecting the stock market is the yield volatility asymmetry. In this paper, by constructing the EGARCH-M model, we show that the results of both conditional variance and conditional mean equations in the EGARCH-M model are significant at 5% confidence intervals. The EGARCH-M model is optimized to give a better

fit than the regression model before modelling. The results indicate an asymmetry in the SHSE A-share market, and the market shocks' impact on risk is asymmetric. Our result demonstrates that SHSE A-share return volatility reacts firmer to positive surprises than adverse shocks. In other words, good news has a more significant influence on market risk than bad news to the same extent. This finding corroborates with earlier studies on the Chinese stock market.

After concluding that noise trading and market return asymmetries are prevalent in SSE, this paper explores and analyzes this finding in greater depth. Based on the uniqueness of the Chinese stock market, the paper focuses on the reasons that underlie unsystematic noise trading and yield asymmetry from the perspective of investors and market mechanisms and combines with knowledge from behavioural finance. We posit that many small and medium-sized investors in China's stock market have led to the proliferation of irrational investment behaviour and speculation. Investors generally have irrational expectations of returns, which has resulted in the widespread "catch up and kill down" operations. To some extent, irrationality has also become an unstable factor that causes the stock market turmoil, explaining the asymmetry of market returns.

One of the contributing factors of noise trading is the imperfect market mechanisms of the China stock market. The typical ones are the imperfect short-selling mechanism and the lack of financial products, making investors lack risk-hedging options and thus increases market volatility.

This study explores noise trading in the Chinese stock market and the asymmetry of yields using the A-share index and throughout an active market reform period of China. Future research can consider examining market volatility over multiple time frames, particularly during the pandemic crisis. It will be interesting to observe how divergent investor psychology and investment behaviour can be over such an unprecedently turbulent period.

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