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Abstract

This study empirically examines the impact of economic integration on stock market co-movements of India with major Asian markets such as China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, and Thailand. We collect daily data on stock market indices from September 1999 to December 2017. The asymmetric generalised dynamic conditional correlation GARCH model is applied to estimate the time-varying conditional correlations among the various stock markets. Next, the panel autoregressive distributed lag method is applied to investigate the impact of economic integration on stock market co-movements. Our results show that economic integration has a significant positive impact on stock market co-movements in the region. The results also provide supporting evidence that the global financial crisis positively contributed to stock market interdependence in the Asian region.

JEL classification: C32, F15, F36, G01, G15

Keywords: Economic integration; stock market co-movements; GFC; AGDCC-GARCH; Asia

1. Introduction

Since the early 1990s, many countries around the world have begun to liberalise their economies. Policymakers have undertaken numerous initiatives including removing restrictions on foreign investments, reducing tariffs, and quotas on imported items. These initiatives have played an important role in interlinking and integrating the economies of various countries. Economic integration has not only brought economic prosperity and development to these countries, but also helped them mobilise resources (goods, services, and capital) more freely across borders. Increasing economic integration among nations has led to increased integration of stock markets. Therefore, it is crucial to understand the degree of influence of economic integration among different nations on their stock markets' co-movements.

Several theoretical and empirical investigations have been conducted on the bilateral trade linkages among nations and their impact on their stock markets' relationship. Huth (1994) argues that the profitability of domestic firms is influenced by the economic situations of the trading partner countries. Consequently, listed firms are becoming more sensitive to the economic circumstances of trading partners. Based on this expectation, several studies (e.g. Chen and Zhang, 1997; Paramati, Roca, and Gupta, 2016) have attempted to empirically investigate the role of bilateral trade linkage in stock market interdependence. The resulting evidence from these studies suggests that the trade relationship among the nations has a considerable positive impact on their stock markets' relationship.

Recent empirical studies have also shown that the economic integration among nations is becoming a crucial factor that influences their stock markets' co-movements. For instance, Paramati et al. (2018) find that the stock market linkages between Australia and China have been positively influenced by their trade linkages. In the context of the Australasian region, Paramati, Roca, and Gupta (2016) show that the economic integration between Australian and Asian markets is one of the major drivers of their stock markets' connectedness. Along similar lines, Paramati, Gupta, and Roca (2015) report that bilateral trade intensity has a positive impact on stock market correlations of Australia and its major trading partners. This evidence suggests that bilateral trade has recently become a major driver of stock market linkages[1].

Empirical attempts have been made to examine the role of geographical proximity in stock market integration. The findings from Flavin et al. (2002) and Portes and Rey (2005) suggest that geographical information and other key variables have an important role in equity market linkages and international transactions. Similarly, Fazio (2007) documents that contagion occurs only in countries that belong to the same region. Evidence from Karim and Majid (2010) reveals that bilateral trade linkages and geographic proximity play an important role in driving stock markets' integration, particularly among Malaysia and its major trading partners. Furthermore, the authors suggest that the removal of investment barriers and trade liberalisation play a crucial role in fostering financial market integration among the countries. Asgharian et al. (2013) also show that bilateral trade linkages drive stock market co-movements and further reveal

[1] Paramati (2015) provides detailed theoretical and empirical information on the role of bilateral trade linkage on stock market co-movements in the perspective of Australia and its trading partners. In another study, Paramati, Gupta and Hui (2016) highlight that both trade and investment linkages among the countries matter for their stock markets' long-run relationship.

that the stock market dependence increases over time while the importance of proximity decreases. This is particularly evident in recessions.

Despite this strong empirical evidence, not all studies show that bilateral trade and geographical proximity positively contribute to stock market linkages. Some authors document that the bilateral trade linkages among countries do not contribute to their stock markets' integration. Roca (1999) finds no long-run cointegration relationship among the stock markets of Australia and its major trading partners. Hatemi-J and Roca (2007) even show that there are no significant long-run causal relationships among the stock markets of Australia and its trading partners. They find low correlations among these markets. It is worth noting that these authors do not directly test the impact of bilateral trade linkages on the stock market indicators. Instead, they examine it indirectly by only selecting stock markets from countries with substantial bilateral trade linkages with Australia.

The literature mentioned previously provides mixed evidence regarding the impact of bilateral trade on stock market co-movements. Further, no empirical study has been conducted regarding the Indian stock market. This motivates us to empirically investigate the impact of bilateral trade linkages on stock market co-movements of India with major Asian economies such as China, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, and Thailand. This study uses data from 1999 to 2017 and employs robust time series and panel econometric techniques. Specifically, the asymmetric generalised dynamic conditional correlation (AGDCC) GARCH method is used with daily data to measure the time-varying correlations of the Indian stock market with the specified Asian markets. These estimated correlations are used as the dependent variable. Meanwhile, a measure of bilateral trade linkage and other key macro variables

are used as regressors. Panel data are constructed using these time series data. The panel autoregressive distributed lag (ARDL) method is applied to investigate the impact of economic integration on stock market co-movements. In its analysis, the study also focuses on the global financial crisis (GFC) to determine whether it has increased or decreased integration of the Indian stock market with the specified Asian markets.

Our study's findings suggest that in most cases, the Indian stock market's co-movements with the Asian markets are time-varying and increase over time. Further, the results, based on local currency (LC) indices, show that the Indian stock market's correlations are higher with those of the developed Asian markets such as Singapore and Korea, while are lower with other markets such as China. However, the correlations between India and China have been increasing in the last few years as both countries are becoming more economically integrated. In the context of panel data, the results also show that bilateral trade linkage has a significant positive impact on stock market correlations. Therefore, this evidence suggests that economic integration is becoming an important driver of stock market linkages in the Asian region. Our results also show that the GFC has played a role in bringing the stock markets together in the region by increasing their co-movements.

The rest of this paper is organised as follows. The next section provides relevant literature on bilateral trade relationships and stock market linkages. Section 3 outlines the nature of the data and the empirical methodology. Section 4 presents the empirical results, discussion, and policy implications. Section 5 provides the conclusions of this study.

2. Literature review

In the last few decades, there has been growing interest among practitioners and the research community to understand the nature and degree of impact of economic integration on stock market linkages. This motivation stems from the view that countries are becoming increasingly integrated due to their implementation of liberalised policies. At the same time, there is substantial evidence that their stock markets are also becoming more interdependent. Therefore, there is a growing debate that economic integration may be driving stock market interlinkages. In this section, we provide a theoretical and empirical background on how economic integration among nations can influence their stock markets.

One of the earlier studies by Huth (1994) documents that the increasing economic interdependence among the nations affects their stock market nexus by influencing the profitability of domestic firms. Specifically, the economic situation of trading partners first affects the profitability of firms and then their stock market linkages. Chen and Zhang (1997) investigate the impact of bilateral trade on stock market co-movements in a sample of Pacific Basin markets. The authors find that higher bilateral trade leads to higher stock market co-movements. Their evidence also reveals that the variations in stock market correlations could be explained by bilateral trade linkage with 5% to 40%. Their main conclusion is that trade linkage is one of the major drivers of stock market co-movements among the partner countries. Bracker, Docking, and Koch (1999) also empirically show that bilateral trade linkage has a substantial positive impact on stock market integration. Evidence from Soydemir (2000) shows that the US stock market has a strong nexus with the Mexican market, while it is weakly connected with the markets of Argentina and Brazil. The author attributes these findings to the differences in trade flows.

Together, this evidence suggests that the trade relationship is a key factor that can influence stock market linkages.

Pretorius (2002) provides a detailed theoretical explanation on how bilateral trade linkages influence the stock markets of partner countries. The author argues that if two nations are becoming increasingly interdependent with regards to exports and imports, then there is a high probability that their economies and financial markets move in a similar direction. This argument implies that higher economic interdependence among nations through bilateral trade can potentially drive their stock market relationship. Pretorius's (2002) view is that if country X depends heavily on country Y for its imports, then if a domestic recession occurs in country X, its imports from country Y fall. The domestic recession in country X will lead to a slowdown in its stock market performance. At the same time, due to a reduction in exports from country Y to country X, Y's stock market will also slow down. As a result of lesser than usual bilateral trade between countries X and Y, their stock markets demonstrate co-movement. This theoretical explanation indicates that higher economic interdependence between countries may potentially influence their stock market relationship.

Pretorius (2002) also explores the factors that drive the stock market linkages, particularly in the context of emerging economies across Latin America, Africa, Europe, and Asia. The author investigates this using a cross-sectional approach as well as a time-series approach. The findings from both these approaches show that the asset correlations are driven by the bilateral trade linkages and the growth differentials in industrial production. Likewise, Johnson and Soenen (2003) investigate the degree of nexus and the factors that influence the stock market co-movements of the US with those of Argentina,

Brazil, Canada, Chile, Colombia, Mexico, Peru, and Venezuela. Their findings provide evidence that a higher trade relationship with the US has a significant positive impact on their stock market co-movements. However, the authors highlight that higher volatility in bilateral exchange rates and higher ratio of stock market capitalisation compared to the US lead to lower co-movements. The long-run nexus between Australia's stock markets and its two major trading partners, Japan and the US, are examined by Shamsuddin and Kim (2003). The authors find a significant long-term cointegration relationship among these markets until the Asian Financial Crisis (AFC). However, in the later period of crisis, the markets become disintegrated.

Since then, several empirical attempts have been made to investigate the impact of bilateral trade on stock market cointegration and correlations. For instance, the empirical results from Forbes and Chinn (2004) clearly show that the economic interdependence between countries has a substantial positive impact on their stock markets' co-movements. Similarly, the role of economic integration in stock market linkages in a sample of 40 developed and emerging markets has been examined by Morgado and Tavares (2007). Their results show that the bilateral trade relationship between the countries plays a crucial role in bringing their stock markets together. Chambet and Gibson (2008) also argue that countries with homogenous trade structures have more integrated financial markets. The authors also stress that the degree of financial market integration among countries is predominantly determined by the level of openness of foreign trade. Using annual data from 1945 to 2002, Kazi (2008) examines whether the Australian stock market is cointegrated with its major trading partners such

as Canada, France, Germany, Japan, the UK, and the US. The results show that the stock markets of these countries demonstrated significant long-run relationships.

Tavares's (2009) findings also indicate that increasing bilateral trade nexus among countries can positively drive their stock markets' correlations. Beine et al. (2010) find another aspect to explain the role of trade linkages in stock market relationships. Specifically, the authors argue that increasing trade promotes business cycle synchronisation among member countries. This eventually affects the degree of stock market interdependence. Karim and Majid (2010) examine the role of bilateral trade linkage in the stock markets of Malaysia and its major trading partners such as China, Japan, Singapore, Thailand, and the US. Their empirical findings show that the Malaysian stock market is cointegrated with its trading partners' markets. The authors suggest that along with bilateral trade linkages, geographical proximity further assists in increasing stock market integration. They also stress that to achieve higher levels of financial market integration, countries should aim to reduce the barriers on mobility of capital and trade. Wälti (2011) also finds evidence that bilateral trade relationships contribute to higher stock market co-movements.

Several recent studies, particularly in the context of the Australasian region, have examined the role of economic integration in stock market interdependence. Paramati, Gupta, and Roca (2015) classify Australia's trading partners into three groups: major, medium, and minor. Next, they investigate whether bilateral trade intensity matters for stock market interdependence. Their empirical results clearly show that the bilateral trade intensity has a positive impact on the stock market correlations of the major trading partner countries. This implies that trade intensity affects stock market nexus. Paramati,

Roca, and Gupta (2016) find that the bilateral trade linkage between Australia and Asian countries plays a crucial role in driving their stock market co-movements. A more recent study by Paramati et al. (2018) also reports that the bilateral trade relationship between Australia and China is strengthening their stock market co-dependence.

This literature review demonstrates that bilateral trade linkages and geographical proximity play a crucial role in promoting stock market integration. However, no systematic empirical study exists that has investigated the impact of bilateral trade relationship on the Indian stock market's co-movements with its trading partners from the Asian region. We seek to address this important research gap. The findings of this study may be crucial for practitioners to understand the extent to which these stock markets are interdependent and the factors that drive their nexus. This knowledge may be useful to undertake appropriate investment decisions for diversifying across these major Asian economies.

3. Data and empirical methodology

3.1 Nature of the data

To estimate the time-varying correlations (CORR) between the stock markets of India and major Asian markets, we collect the daily closing price data on broad market indices such as NIFTY 500 (India), SHANGHAI SE A Share (China), IDX COMPOSITE (Indonesia), NIKKEI 225 (Japan), KOREA SE KOSPI 200 (Korea), FTSE BURSA (Malaysia), PHILIPPINES SE I (Philippines), STRAITS TIMES INDEX L (Singapore), and BANGKOK S.E.T. (Thailand) from September 1, 1999 to December 29, 2017. All these indices are measured in their respective LCs. To ensure robustness, we also collect

data on the MSCI stock indices of all the selected markets. These MSCI indices are measured in a common currency (CC)—the US dollar ($). The selection of the sample period is based on data availability.[2] The data on these indices are collected from DataStream.

To identify the impact of economic integration on stock market co-movements (measured using the above stock indices), we also collect yearly data for 1999-2017 on bilateral trade (EI) (total exports and imports) between India and major Asian economies. We also consider several other potential determinants of stock market co-movements such as exchange rates (EXR)[3] between India and the Asian economies, and the differences in gross domestic product growth (GDPG), inflation (INF), and lending interest rates (INTR). Finally, we incorporate a dummy variable in the model to account for the GFC during 2007-2009, as previous studies have advised (e.g. Paramati, Gupta, and Roca, 2015).[4] The data on EI are sourced from the International Monetary Fund (IMF), while those on EXR, GDPG, INF, and INTR are obtained from the World Development Indicators (WDI). Before we begin our estimation, we convert the data on EI and EXR into natural logarithms.

3.2 Empirical setting

To achieve the study objectives, we first estimate the time-varying conditional correlations among the stock market of India with those of the Asian economies. For this purpose, we utilize the asymmetric generalized dynamic conditional correlation (AGDCC)

[2] Data on the Singapore stock index (STRAITS TIMES INDEX L) are only available from September 1999. Hence, the sample period starts from that month.
[3] We first collect local currency per US$, the period average, and then convert it to Indian currency against the currencies of Asian economies.
[4] The value of dummy variable is one during the GFC (2007-09) period, and zero otherwise.

GARCH model to estimate the dynamic time-varying correlations using daily stock returns. We undertake the approach that is suggested by Cappiello et al. (2006) to estimate these time-varying conditional correlations. The main advantage of this method is that it not only takes into account of asymmetric information and also captures the heterogeneity that may exist in the data series. The estimated correlations from this technique will help us to understand the degree of interdependence between Indian and Asian stock markets. In a diversification standpoint, the higher correlations leads to lower risk-adjusted returns and vice versa. Therefore, it is important to understand the degree and nature of co-movements among the selected markets in the Asian region.

In the next step, we examine the long-run cointegration relationship among the stock indices of India and Asian markets by making use of daily log data from September 1999 to December 2017. To estimate long-run cointegration relationship among these markets, we employ the approach that is recommended by Johansen (1991, 1995). This estimation will convey whether these markets share a long-run common trend or not.

To determine the order of integration of the selected variables in a panel data context, we first employ several panel unit root tests. Specifically, Levin, Lin, and Chu (LLC) (2002), Im, Pesaran, and Shin (IPS) (2003) and Fisher-type Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests that were developed by Maddala and Wu (1999). All these tests work under the null hypothesis of no unit root. These unit root tests will determine to choose the appropriate panel econometric method to investigate the impact of economic integration on stock market correlations.

Given the evidences, mixed order of integration, from panel unit root tests, we examine the impact of economic integration on stock market co-movements by making use of yearly data, 1999 – 2017, and panel autoregressive distributed lag (ARDL) method. The panel ARDL is based on Pesaran et al. (1999). The main advantage of this technique is that it can be applied to a model that has variables with mixed order of integration. The suitable lag length for both the dependent and independent variables are selected based on the Akaike Information Criteria (AIC). Using the panel ARDL method, the following equation is estimated to determine the role of economic integration on stock market co-movements:

$$CORR_{it} = f\,(EXR_{it}, GDPG_{it}, GFC_{it}, INF_{it}, INTR_{it}, EI_{it}, v_i) \quad (1)$$

where CORR, EXR, GDPG, GFC, INF, INTR, and EI stand for conditional correlations, exchange rates, the differences in GDP growth, global financial crisis, the differences in inflation, the differences in the interest rate, and economic integration, respectively. v_i stands for individual country fixed effects, while the sample period and countries are indicated by *t* and *i*, respectively.

3.3. Preliminary investigation

We begin by discussing the economic integration or bilateral trade linkages between India and major Asian economies during 1999-2017. **Table 1** provides the total bilateral trade and the bilateral trade intensity of India with the selected Asian economies. From the bilateral trade data, we observe that Japan, Malaysia, and Singapore were India's major trade partners in 1999. Over the years, trade between India and China has grown remarkably. Among the selected Asian countries, by 2017, India’s major trade partners

were China, Indonesia, Korea, and Singapore. However, it is also important to highlight that the total trade volume with all the Asian economies continues to increase.

The second part of **Table 1** shows the trade intensity between India and the selected Asian economies. We observe that Japan was India's major trading partner in 1999. However, Japan's trade intensity gradually declined. The trade intensity between India and China has increased from 2.09% to 11.43% during 1999-2017. Further, we notice that the trade intensity of India with Indonesia, Korea, the Philippines, and Thailand has increased over the years, whereas it has slightly declined with Malaysia. The selected Asian countries' share of India's total trade has increased from 17.05% to 25.10% during the study period. These trade statistics suggest that the selected Asian economies share one-fourth of India's total trade in 2017 at approximately US$ 186 billion (or US$ 185,555 million). Given this significant bilateral trade linkage between India and Asian economies, we believe that based on empirical and theoretical grounds, the bilateral trade relationship may be affecting their stock market linkages over the years.

[Insert Table 1 here]

4. Results and discussion

4.1 Time-series analysis

This research is designed to achieve two main objectives. We first estimate stock market interdependence between India and major Asian markets. Then, we investigate whether their economic integration (bilateral trade linkages) has any effect on their stock markets' co-movements. To achieve these objectives, we first estimate the time-varying conditional correlations by using daily stock price data, both in LC and CC (US$), and

the AGDCC GARCH approach. Based on LC indices, **Figure 1** presents the conditional correlations of the Indian stock market with major Asian markets. These graphs suggest that the correlations between the Indian stock market and Asian markets increase over time. Similarly, **Figure 2** displays conditional correlations, based on CC indices, of the Indian stock market with those of the Asian markets. These graphs also show that the correlations of the Indian stock market with the Asian markets are time-varying and increasing over time. Together, **Figures 1 and 2** clearly demonstrate that the stock market correlations are changing and increasing over time.

[Insert Figure 1 here]

[Insert Figure 2 here]

Further, we provide yearly average conditional correlations[5] of the Indian stock market with those of the Asian markets in **Table 2**. The first part of the table provides conditional correlations based on the LC indices. These correlations show that the Indian stock market's linkages with all the Asian markets are increasing over time. It is also noticeable that the Indian stock market has increasing interdependence with China, Indonesia, Korea, and Thailand. On average, Singapore and Korea have higher correlations with the Indian stock market. The second part of **Table 2** displays conditional correlations based on CC indices. These correlations also reveal that the stock market independence in the region is increasing over the years. More noticeably, the Indian stock market's linkages with China, Indonesia, Korea, Philippines, and Thailand are rapidly increasing. It is also important to highlight that when we compare the

[5] Please note that the correlations for 1999 include data only from September to December.

conditional correlations between LC and CC indices, it is clearly evident that the Indian stock market is more integrated with the Asian markets with CC indices than the LC indices. With this evidence, we can stress that it is important to consider CC indices while estimating the stock market co-movements as the estimated co-movements may be distorted otherwise. Therefore, researchers must be cautious while selecting the stock indices which are available in LCs and CC.

[Insert Table 2 here]

In the next step, we aim to examine the long-run equilibrium relationship among the stock markets of India and major Asian economies. We apply the Johansen cointegration test on daily data of stock indices of the selected markets from September 1999 to December 2017. The cointegration test results are reported in **Table 3**. The first part of the table provides cointegration test results on the indices in LC, while the second part provides results in CC. The cointegration test results on both the LCs and CC suggest that there is a significant long-run equilibrium relationship among the stock markets of India and major Asian economies during the study period. These evidences imply that the Indian stock market is strongly cointegrated with the Asian markets in the long run.

[Insert Table 3 here]

To check the robustness of our results, we also apply the Bayer and Hanck (2013) cointegration test on these indices. This is a robust technique as it considers four conventional cointegration approaches while investigating the long-run relationship among the selected stock indices. The Bayer and Hanck (2013) cointegration test provides results on EG-J (Engle-Granger and Johansen) and EG-J-Ba-Bo (Engle-Granger,

Johansen, Banerji, and Boswick). The results of these tests from **Table 4** show a significant long-run cointegration relationship among the stock indices of India and major Asian countries in both LC and CC indices. Overall, these cointegration test results suggest that the stock markets in the Asian region are integrated in the long run.

[Insert Table 4 here]

4.2 Panel data investigation

The second objective of our study is to investigate the impact of economic integration on stock markets' co-movements of India and Asian countries. We collect yearly data from 1999 to 2017 on selected Asian economies. Specifically, we take the yearly average conditional correlations (CORR) and treat these as dependent variable. The bilateral trade intensity or economic integration (EI) variable is treated as an independent variable. The study also accounts for several potential determinants of stock market co-movements in the model such as exchange rates (EXR), the difference in GDP growth (GDPG) rates, difference in inflation (INF) rates, and difference in interest rates (INTR). We also consider the GFC in our estimation by incorporating a dummy variable. Using these yearly data on the selected countries and variables, we construct a balanced panel data set. We perform the panel estimation in three steps. First, we estimate the unconditional correlations among the selected variables. Second, we investigate the order of integration of the variables. Third, we examine the long-run estimates of conditional correlations. These estimates are discussed as follows.

Table 5 reports the unconditional correlations among the selected variables. The correlations, based on LC, have positive relationships with all variables except exchange

rates. These correlations have positive associations with GDP growth rates, inflation differences, and economic integration whereas the CC correlations have positive relationships with all variables except GDP growth rates. It is also important to highlight that the CC correlations have a higher positive relationship with economic integration. Overall, these preliminary estimates suggest that there is a considerable positive association between stock market co-movements and economic integration. To validate these association, we undertake further rigorous analysis as follows.

[Insert Table 5 here]

We apply four panel unit root tests to examine the stationary properties of the data series. Specifically, we apply the LLC test, under the assumption of common unit root process, and apply the IPS and the two Fisher-type tests, such as ADF and PP, under the assumption of individual unit root process. All these tests have the same null hypothesis, that is, non-stationary. The results of these tests are displayed in **Table 6**. These results indicate that the selected variables appear to have a mixed order of integration. The null hypothesis of a unit root are rejected for all variables at the level data, except exchange rates. Likewise, the null hypothesis is strongly rejected for all variables at the first difference data series.

[Insert Table 6 here]

The above estimates from panel unit root tests show that the selected variables have a mixed order of integration. Given the nature of our variables, in terms of order of integration, we choose the panel ARDL methodology to estimate the long-run impact of economic integration on stock market co-movements. We account for other potential

determinants in the model such as exchange rates, difference in GDP growth rates, difference in inflation, difference in interest rates, and finally the GFC. The long-run estimates of the panel ARDL method are provided in **Table 7**. The results, on LC indices, show that the increase in economic integration between India and the Asian economies positively contributes to the integration of their stock markets. Specifically, a 1 % increase in economic integration leads to a 0.055% raise in stock market co-movements. Further, our results show that an increase in differences of GDP growth, inflation, and interest rates improves stock market co-movements by 0.013%, 0.007%, and 0.006%, respectively. The results also suggest that the GFC had a significant positive impact on stock market correlations. However, the growth in exchange rates seems to have a negative impact on stock market correlations.

Further, we investigate the impact of economic integration on stock market correlations based on CC indices. The panel results show that economic integration has a significant positive impact on stock market correlations of India and other major Asian economies. The findings also reveal that the changes in differences of GDP growth, inflation, and interest rates positively contribute to stock market interdependence. However, exchange rates seem to negatively affect stock market correlations in the region. Among these indicators, the major determinant of stock market correlations in the region is economic integration. This shows the significance of economic integration in driving the stock market co-movements in the Asian region.

[Insert Table 7 here]

We use a graph to better understand the overall relationship between stock market co-movements and economic integration between India and other major Asian economies. Specifically, we take the yearly average conditional correlations, based on LC and CC indices of the Indian and Asian stock markets. Similarly, we calculate the average economic integration (or bilateral trade intensity) between Indian and Asian economies. The yearly average conditional correlations and economic integration (trade intensity) variables are plotted in **Figure 3**. This graph uses both LC and CC indices and suggests that the stock market co-movements are increasing over time. It is also clearly noticeable that the economic integration between India and Asian countries is also increasing. Further, we can see that during the GFC, particularly in 2007-08, the stock market co-movements significantly increased and then declined in 2009. On the contrary, the GFC seems to have no effect on bilateral trade linkages among these nations. Finally, we can see that the linear trends on all these measures show positive trends over the years.

[Insert Figure 3 here]

4.2 Policy implications

Our estimates offer several policy and practical implications which might be decisive for policy makers and the investment community in the Asian region. Our time-varying conditional correlations, based on both LC and CC indices, show that the stock market interdependence between India and the Asian economies is increasing over time. Further, our results from the panel ARDL approach provide evidence that economic integration is one of the major determinants of stock market co-movements among these nations. Given these findings, we discuss relevant policy and practical implications. The time-varying

correlations show that stock market interdependence is changing over time. Economic integration plays a key role in this process. This outcome has two important policy and practical implications. Specifically, the policy makers of major Asian economies must consider that stock market interdependence is increasing over time. We further advise that stock markets are no longer disintegrated in the region. Therefore, if something happens to one particular stock market in the region, either good or bad, it can then spread very quickly to other markets in the region and can cause sudden booms or busts across stock markets. Hence, policy makers must prepare for such shocks and should have back up planning to address such events in the future.

The second possible implication is that the investment community no longer enjoys higher risk-adjusted returns by simply diversifying their investments in the region. This is because the stock markets have become more integrated in recent times. Therefore, portfolio investors and fund managers must understand the potential determinants of stock market co-movements. This will help them to choose the right markets and the right time to diversify their investments to maximise their risk-adjusted returns. If investors ignore the factors contribute to stock market interlinkages, they would be less likely to maximise their returns by diversifying across markets. Therefore, we suggest that policy makers and practitioners should be aware that stock market interdependence is increasing, and that economic integration plays an important role in this process.

5. Conclusion

This study empirically examines the impact of economic integration on stock market co-movements of India and other Asian markets. We first estimate the time-varying

conditional correlations of stock market returns by using the AGDCC GARCH method with daily market data from September 1999 to December 2017. Next, we use these conditional correlations as dependent variable with economic integration (bilateral trade intensity), exchange rates, differences in GDP growth, inflation, and interest rates as exogenous variables. Specifically, we take the yearly average conditional correlations and yearly data on economic integration, along with other variables, to construct a balanced panel data set for the period ranging from 1999 to 2017.

Our empirical estimates from the AGDCC GARCH model suggest that the Indian stock market's correlations with the Asian markets are time-varying and increasing over time. The global financial crisis (GFC) seems to have positively affected these stock markets' interdependence, particularly when we measure the stock market co-movements using LC indices. These results imply that the stock market linkages between India and other Asian markets have increased considerably in recent times. However, it is not clear which factors are contributing towards this upward movement. During the same time, there is clear evidence that economic integration between India and other Asian countries has also significantly increased. We argue that the increasing stock market interdependence among these nations might be due to their strong economic integration in recent times. To empirically test their association, we apply the panel ARDL method. The results show that increasing economic integration between India and Asian economies positively contributes to their stock markets' interdependence.

We suggest that policy makers and practitioners in the Asian region should consider that stock market interdependence is increasing, and economic integration plays a key role in this process. The degree of economic integration is not only driving

economic prosperity but also stock market linkages in the region. It is also important for policy makers to realise that if a particular stock market in the region is negatively affected, it can have a detrimental effect on other markets. Therefore, policy makers must have back up policies to handle issues and events such as the GFC. Our findings also have important implications for practitioners. We suggest that investors and fund managers who wish to diversify their investments in the Asian region realise that stock market co-movements are increasing over time. Further, we advise the investment community to keep an eye on economic integration in the region as it is becoming one of the major determinants of stock market integration.

To the best of our knowledge, this empirical study is the first to examine the impact of economic integration on stock market co-movements in the Asian region, particularly in the context of India. Considering this, along with its policy and practical implications, we argue that this study makes a significant contribution to policy, practice, and the empirical literature.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Table 1: India's total bilateral trade (exports and imports) with main Asian economies

Year	China	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Thailand	Total trade
India's bilateral trade with main Asian economies (million US$)									
1999	1751	1217	4195	1738	2336	189	2131	732	14288
2000	2207	1308	3783	1446	1957	249	2308	845	14102
2001	2725	1421	3288	1584	1905	306	2243	999	14472
2002	4323	2049	3689	2028	2138	532	2711	1082	18553
2003	6448	2990	4208	3237	2758	482	3872	1353	25348
2004	10252	3663	4832	4016	3148	543	5836	1627	33917
2005	16399	4279	6248	5931	3529	698	8247	2157	47487
2006	23723	5745	7229	7088	5844	745	10864	2964	64202
2007	34887	6786	9497	8497	8079	805	14504	3879	86935
2008	44143	9245	11779	12716	10708	1036	17859	4927	112414
2009	38995	10736	9572	11589	8387	1017	12769	4276	97340
2010	58852	14291	13095	13579	9549	1201	16364	6094	133023
2011	74412	20856	16860	17261	13039	1455	24377	8292	176553
2012	67311	20346	19100	17632	13946	1609	22296	8919	171160
2013	65973	20430	17305	16552	14115	1774	20476	9359	165983
2014	71532	19714	15701	18233	15582	1838	16716	9172	168486
2015	71283	16837	14373	16797	14504	1828	15111	8814	159546
2016	69486	15447	13670	15766	12849	1968	14292	8279	151757
2017	84476	19993	14973	20501	14447	2299	18811	10055	185555
India's bilateral trade intensity with main Asian economies (%)									
1999	2.09	1.45	5.01	2.07	2.79	0.23	2.54	0.87	17.05
2000	2.38	1.41	4.08	1.56	2.11	0.27	2.49	0.91	15.21
2001	2.92	1.52	3.52	1.70	2.04	0.33	2.40	1.07	15.51
2002	3.96	1.88	3.38	1.86	1.96	0.49	2.48	0.99	17.00
2003	4.78	2.22	3.12	2.40	2.05	0.36	2.87	1.00	18.80
2004	5.86	2.09	2.76	2.30	1.80	0.31	3.34	0.93	19.40
2005	6.90	1.80	2.63	2.50	1.49	0.29	3.47	0.91	19.99
2006	8.00	1.94	2.44	2.39	1.97	0.25	3.66	1.00	21.64
2007	8.99	1.75	2.45	2.19	2.08	0.21	3.74	1.00	22.41
2008	8.55	1.79	2.28	2.46	2.07	0.20	3.46	0.95	21.77
2009	9.22	2.54	2.26	2.74	1.98	0.24	3.02	1.01	23.02
2010	10.26	2.49	2.28	2.37	1.66	0.21	2.85	1.06	23.19
2011	9.64	2.70	2.18	2.24	1.69	0.19	3.16	1.07	22.87
2012	8.55	2.58	2.43	2.24	1.77	0.20	2.83	1.13	21.73
2013	8.43	2.61	2.21	2.11	1.80	0.23	2.61	1.20	21.20
2014	9.19	2.53	2.02	2.34	2.00	0.24	2.15	1.18	21.65
2015	10.83	2.56	2.18	2.55	2.20	0.28	2.30	1.34	24.23
2016	11.24	2.50	2.21	2.55	2.08	0.32	2.31	1.34	24.55
2017	11.43	2.70	2.03	2.77	1.95	0.31	2.54	1.36	25.10
Average	7.54	2.16	2.71	2.28	1.97	0.27	2.85	1.07	20.86

Note: The trade data is sourced from the International Monetary Fund (IMF).

Figure 1: Time-varying stock market correlations of India with main Asian economies using local currency indices

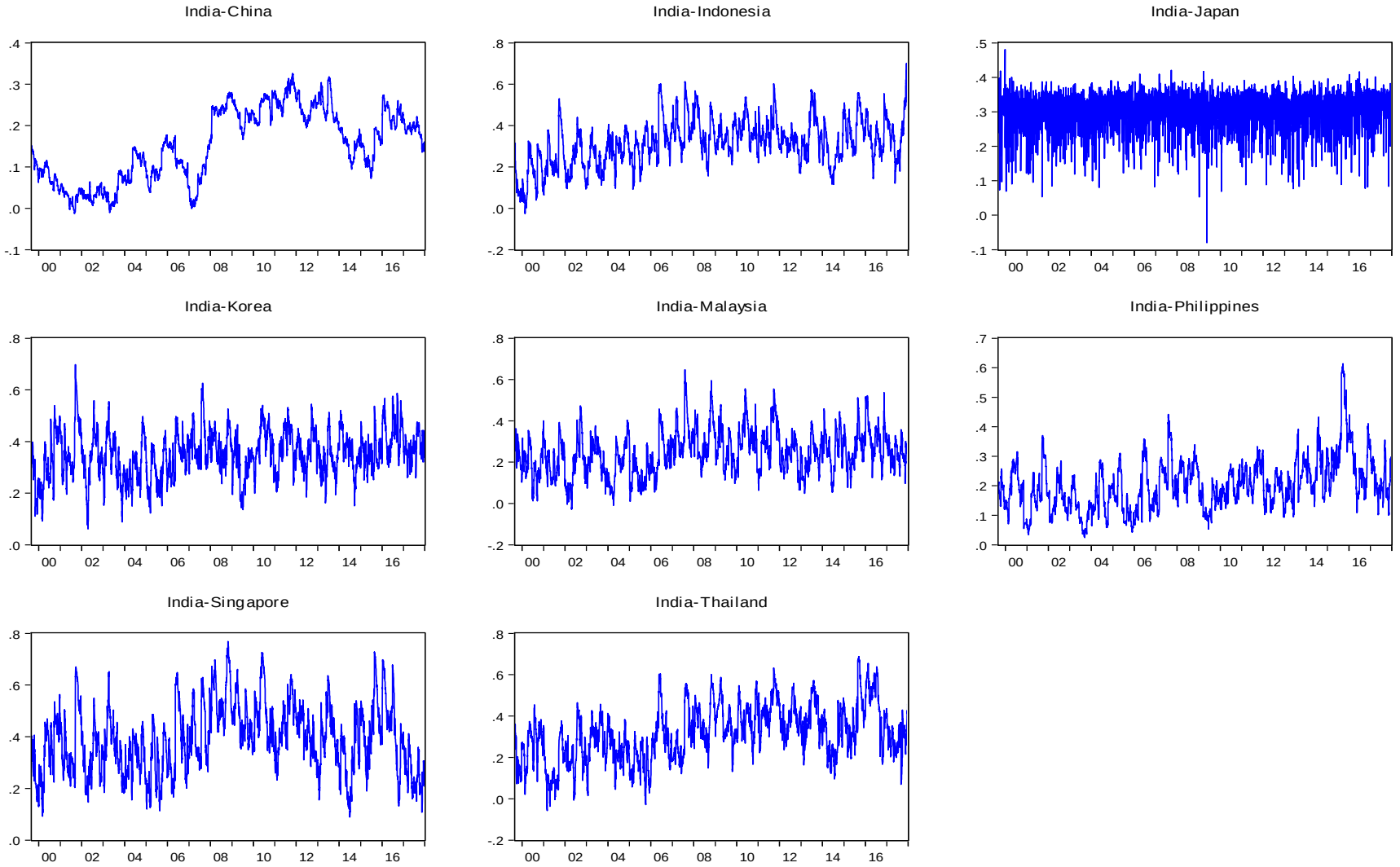

Figure 2: Time-varying stock market correlations of India with main Asian economies using common currency indices

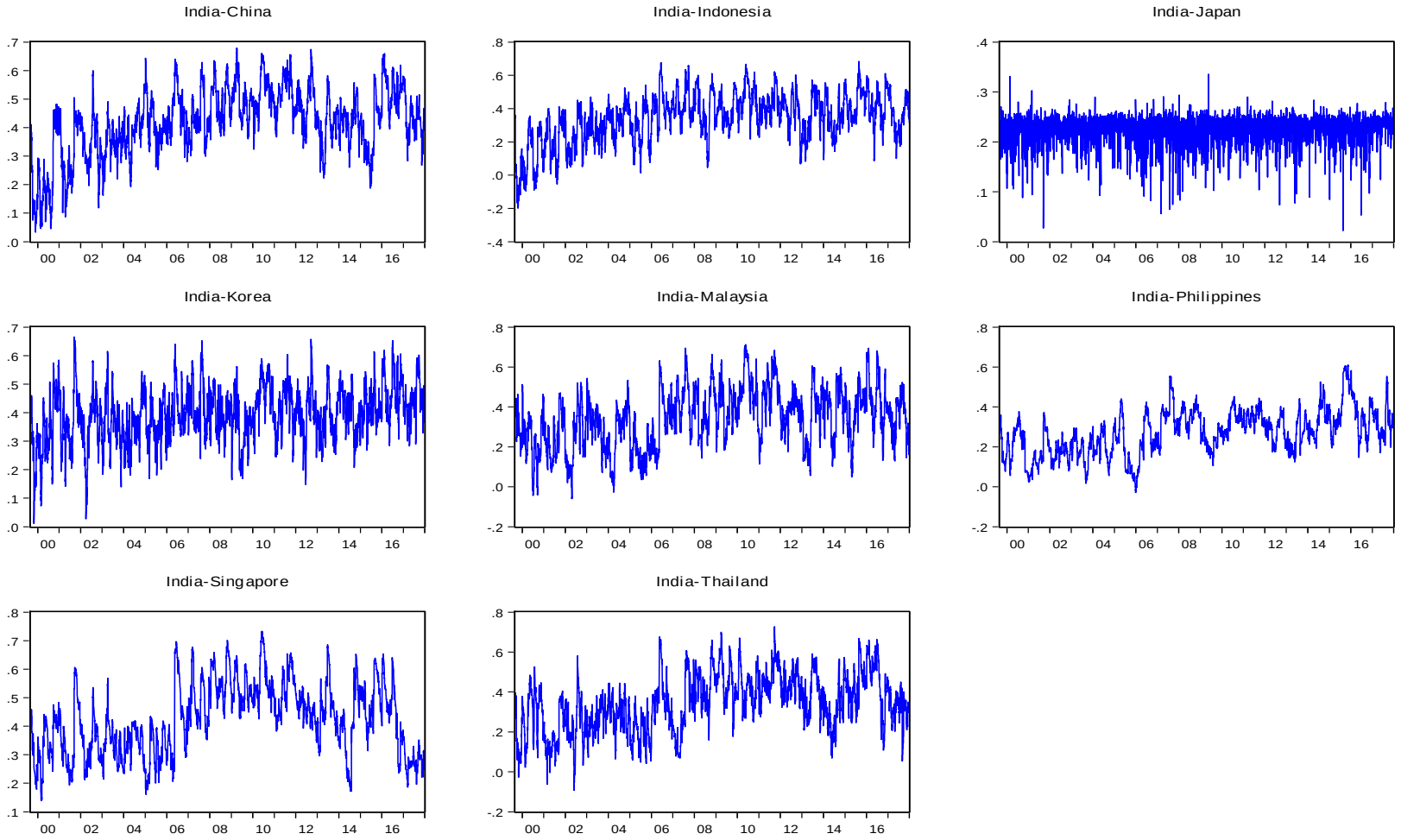

Table 2: Average conditional correlations of Indian stock market with main Asian markets

Year	China	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Thailand
Local currency (LC) indices								
1999	0.113	0.102	0.304	0.249	0.238	0.177	0.249	0.171
2000	0.077	0.168	0.297	0.318	0.190	0.185	0.353	0.268
2001	0.028	0.261	0.298	0.388	0.207	0.179	0.393	0.148
2002	0.032	0.229	0.295	0.328	0.185	0.151	0.315	0.226
2003	0.039	0.232	0.296	0.325	0.219	0.117	0.366	0.285
2004	0.106	0.300	0.305	0.307	0.197	0.163	0.319	0.244
2005	0.100	0.273	0.309	0.285	0.137	0.143	0.286	0.163
2006	0.119	0.370	0.308	0.347	0.239	0.178	0.372	0.321
2007	0.069	0.405	0.312	0.405	0.338	0.242	0.425	0.305
2008	0.242	0.381	0.299	0.378	0.315	0.245	0.565	0.385
2009	0.223	0.339	0.298	0.301	0.250	0.142	0.466	0.373
2010	0.245	0.382	0.304	0.395	0.321	0.192	0.491	0.390
2011	0.275	0.387	0.301	0.375	0.317	0.238	0.457	0.439
2012	0.240	0.311	0.306	0.371	0.223	0.180	0.408	0.385
2013	0.249	0.372	0.289	0.328	0.221	0.218	0.404	0.391
2014	0.154	0.262	0.305	0.363	0.264	0.246	0.313	0.288
2015	0.140	0.395	0.306	0.354	0.262	0.354	0.450	0.400
2016	0.229	0.348	0.306	0.441	0.321	0.267	0.445	0.467
2017	0.187	0.363	0.318	0.379	0.238	0.214	0.254	0.291
Average	0.151	0.310	0.303	0.349	0.247	0.202	0.386	0.313
Common currency (CC) indices								
1999	0.175	-0.017	0.228	0.273	0.301	0.185	0.292	0.146
2000	0.236	0.126	0.225	0.344	0.228	0.219	0.345	0.302
2001	0.306	0.223	0.226	0.384	0.249	0.159	0.364	0.181
2002	0.340	0.216	0.231	0.351	0.237	0.164	0.331	0.238
2003	0.341	0.284	0.227	0.363	0.292	0.183	0.336	0.260
2004	0.392	0.348	0.229	0.359	0.269	0.202	0.345	0.294
2005	0.410	0.278	0.230	0.364	0.164	0.186	0.304	0.190
2006	0.454	0.422	0.225	0.408	0.332	0.227	0.425	0.377
2007	0.434	0.438	0.228	0.437	0.429	0.353	0.487	0.298
2008	0.496	0.388	0.221	0.396	0.392	0.357	0.569	0.432
2009	0.501	0.388	0.227	0.346	0.384	0.230	0.526	0.457
2010	0.523	0.461	0.230	0.462	0.500	0.333	0.562	0.423
2011	0.520	0.428	0.227	0.411	0.465	0.351	0.527	0.476
2012	0.490	0.381	0.231	0.404	0.372	0.284	0.457	0.437
2013	0.400	0.357	0.230	0.373	0.335	0.253	0.462	0.387
2014	0.423	0.344	0.233	0.407	0.396	0.331	0.393	0.303
2015	0.377	0.443	0.230	0.420	0.373	0.407	0.493	0.440
2016	0.539	0.420	0.228	0.485	0.438	0.349	0.456	0.464
2017	0.429	0.358	0.237	0.444	0.343	0.321	0.274	0.318
Average	0.410	0.331	0.229	0.391	0.342	0.268	0.418	0.338

Note: The conditional correlations are estimated using the AGDCC-GARCH method.

Table 3: Cointegration relationship among the stock indices using Johansen approach

Hypothesized	Trace statistic				Max-Eigen statistic			
No. of CE(s)	Eigenvalue	test value	5% critical value	Prob.	Eigenvalue	test value	5% critical value	Prob.
Using local currency indices								
None	0.016	215.745***	197.371	0.004	0.016	78.653***	58.434	0.000
At most 1	0.008	137.092	159.530	0.422	0.008	40.733	52.363	0.451
At most 2	0.006	96.359	125.615	0.712	0.006	29.689	46.231	0.798
At most 3	0.004	66.670	95.754	0.823	0.004	21.062	40.078	0.946
At most 4	0.003	45.607	69.819	0.811	0.003	15.925	33.877	0.956
At most 5	0.003	29.682	47.856	0.735	0.003	12.308	27.584	0.920
At most 6	0.002	17.374	29.797	0.612	0.002	10.207	21.132	0.725
At most 7	0.001	7.167	15.495	0.558	0.001	6.035	14.265	0.609
At most 8	0.000	1.132	3.841	0.287	0.000	1.132	3.841	0.287
Using common currency indices								
None	0.012	212.794**	197.371	0.007	0.012	59.317**	58.434	0.041
At most 1	0.009	153.478	159.530	0.102	0.009	43.208	52.363	0.314
At most 2	0.008	110.270	125.615	0.292	0.008	38.561	46.231	0.261
At most 3	0.005	71.709	95.754	0.664	0.005	23.986	40.078	0.827
At most 4	0.003	47.723	69.819	0.733	0.003	15.773	33.877	0.960
At most 5	0.003	31.949	47.856	0.615	0.003	14.159	27.584	0.812
At most 6	0.002	17.791	29.797	0.582	0.002	10.641	21.132	0.683
At most 7	0.001	7.149	15.495	0.560	0.001	5.365	14.265	0.695
At most 8	0.000	1.785	3.841	0.182	0.000	1.785	3.841	0.182

Notes: The probability values are based on MacKinnon-Haug-Michelis (1999); *** and ** indicate the rejection of the null hypothesis of a no cointegration at the 1% and 5% significance levels, respectively.

Table 4: Cointegration analysis using Bayer-Hanck (2013) test

	Local currency indices		Common currency indices	
	EG-J	EG-J-Ba-Bo	EG-J	EG-J-Ba-Bo
Test statistics	31.061**	34.988**	25.751**	44.913**

Notes: The models were estimated using constant and a lag; the 5% critical values for EG-J and EG-J-Ba-Bo are 10.181 and 19.447, respectively; ** indicate the rejection of the null hypothesis of no cointegration at the 5% significance level.

Table 5: Unconditional correlations among the variables

	CORR_LC	CORR_CC	EXR	GDPG	INF	INTR	TI
CORR_LC	1.000						
CORR_CC	0.550	1.000					
EXR	-0.139	0.185	1.000				
GDPG	0.267	-0.257	-0.165	1.000			
INF	0.245	0.312	0.357	0.132	1.000		
INTR	0.105	0.078	0.534	0.142	0.602	1.000	
EI	0.113	0.391	0.113	-0.153	0.145	0.197	1.000

Note: CORR_LC and CORR_CC stand for correlations of local currency (LC) and common currency (CC) indices, respectively.

Table 6: Evidence from panel unit root tests

	CORR_LC		CORR_CC		EXR		GDPG		INF		INTR		EI	
Method	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Level data														
LLC	-4.482***	0.000	-4.183***	0.000	0.498	0.691	-8.856***	0.000	-2.751***	0.003	-4.747***	0.000	-4.388***	0.000
IPS	-3.199***	0.001	-2.601***	0.005	1.833	0.967	-9.508***	0.000	-1.752**	0.040	-3.841***	0.000	-2.258**	0.012
ADF	35.970***	0.003	33.016***	0.007	7.935	0.951	101.123***	0.000	23.279	0.107	41.459***	0.001	31.934***	0.010
PP	36.852***	0.002	59.109***	0.000	7.321	0.967	99.608***	0.000	30.560**	0.015	47.653***	0.000	58.115***	0.000
First difference data														
LLC	-11.075***	0.000	-8.459***	0.000	-6.558***	0.000	-11.324***	0.000	-7.234***	0.000	-7.126***	0.000	-7.338***	0.000
IPS	-10.175***	0.000	-8.842***	0.000	-4.905***	0.000	-12.230***	0.000	-5.037***	0.000	-6.762***	0.000	-6.004***	0.000
ADF	107.760***	0.000	94.323***	0.000	52.036***	0.000	136.770***	0.000	62.675***	0.000	73.212***	0.000	64.507***	0.000
PP	223.529***	0.000	223.382***	0.000	53.320***	0.000	1608.720***	0.000	126.686***	0.000	252.926***	0.000	78.777***	0.000

Notes: The panel unit root tests were estimated by incorporating constant in the model; *** and ** imply the rejection of the null hypothesis of a unit root at the 1% and 5% significance levels, respectively.

Table 7: Long-run estimates of conditional correlations using panel ARDL method

Variable	Coefficient	t-Statistic	Prob.	Coefficient	t-Statistic	Prob.
	CORR_LC = f (EXR, GDPG, GFC, INF, INTR, EI)			*CORR_CC = f (EXR, GDPG, GFC, INF, INTR, EI)*		
EXR	-0.068**	-2.620	0.011	-0.370***	-3.203	0.002
GDPG	0.013***	8.236	0.000	0.033***	4.480	0.000
GFC	0.085***	9.165	0.000	-0.104	-1.983	0.051
INF	0.007***	8.679	0.000	0.028***	5.015	0.000
INTR	0.006***	3.043	0.003	0.073***	3.302	0.001
EI	0.055***	3.323	0.001	0.342***	3.704	0.000

Notes: The models were estimated by incorporating constant and 1 lag; *** and ** imply the significance at the 1% and 5% levels, respectively.

Figure 3: The relationship between conditional correlations and trade intensity