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Do positive and negative variations in stock indexes lead to depreciation in local currencies? A beyond symmetrical evidence from ASEAN-5 region

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ABSTRACT

Preliminary studies overlooked the importance of the financial crisis in the asymmetric transmission of financial market shocks to FX market returns. Moreover, existing studies also concentrated on the response of aggregate equity market returns to the forex market returns rather than the vice versa asymmetric effect for the ASEAN-5 region. We utilised the panel based ARDL and NARDL framework using pooled mean group method for conducting this study. There are 415 observations spanning the pre-crisis period of January 2001 to December 2007. Furthermore, 595 and 1135 observations are taken into consideration when post-recessionary, and overall sampling periods of January 2010 to December 2019 and January 2001 to December 2019 are considered, correspondingly. Overall, the findings indicated that in the short run, only negative equity market returns caused depreciation in the local currencies of ASEAN-5 member countries during the pre-crisis period, whereas only positive shocks during the post-crisis regime appreciated the local currencies of ASEAN-5 member countries. Furthermore, only longer-term negative financial market shocks contribute to post-crisis local currency deflation in the ASEAN-5 member nations. This demonstrates that investors and exporters must consider the importance of the particulate crisis period when formulating forward currency arrangements.

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1. Introduction

The ASEAN-5[1] equity returns fell in early 2008 because of the international economic slump (Samsi et al., 2018) and adverse effects on ASEAN-5 financial markets (FM) mainly contributed due to the 'contagion effect' (Samsi et al., 2018). The ASEAN-5

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equity market is heavily interconnected with global FM and the 'contagion effect' increased the transmission of volatility from US FM towards individual equity markets of the ASEAN-5 region (Vo & Tran, 2020). Hence, domestic regional production within ASEAN-5 fell in 2008 because of the US subprime mortgage crunch (Plummer & Yue, 2009). Furthermore, intra-ASEAN trade reached a peak of approximately 27% by the start of 2008 but fell by 24.5% at the end of 2008 (Samsi et al., 2018). In addition, the 2008 financial slowdown has negatively impacted ASEAN's bilateral trading with all of its significant trading allies including the European Union, the US, China, and Japan. 2008 economic crunch disrupted the international supply chain and distributional networks, affected intra-regional trading agreements, and decreased absolute as well as relative consumption by ASEAN's key trading partners. Razmi et al. (2016) highlighted that the Indonesian economy faced inflationary pressure during the 2007–2009 global recession as compared to the 1998 Asian crisis figures. Although the adjusted consumer price index for ASEAN-4 nations in 2007–2008 was as higher as those in the 1997–98 Asian economic recession. According to Ain Shahrier (2022), serious financial disaster might result from Covid-19's disruption. Additionally, the dramatic increase in US dollar value has been a conspicuous and unanticipated aspect of the economic recessionary regime (Fratzscher, 2009). Therefore, a question arises whether bearish and bullish equity market conditions in ASEAN-5 economies cause deflation in the ASEAN-5 exchange rate against US dollars during the 2008 economic recession.

The above question about the impact of FM volatility on ASEAN-5 FX returns has practical ramifications for international traders who contractually commit themselves to forward exchange rate agreements. ASEAN-5 region as being a group of 5 largest export-oriented economies after the EU and China, makes this question worth exploring. The ASEAN region acts as a primary gateway for luring FDI throughout the world. For example, according to the market intelligence report by S&P Global,[2] the total amount of inward FDI climbed from around $120000 million per year in the preceding ten years to $174000 million between 2019 and 2021. According to Markwat et al. (2009), the recessionary era exacerbates correlational features of global stock returns due to error variance propagation. Moreover, Kang et al. (2019) debated that there is an increase in return connectedness amongst global FM, indicating the strength of information transmission during a crisis regime. Similarly, Vo and Tran (2020) showed growing connectivity between ASEAN and US equities market risk propagation to be an essential feature of enhanced global financial interconnectedness. This prompted the additional investigation into the ASEAN-5 FM's price jump's asymmetric impact on FX market returns.

Local FMs' connection to the global financial system renders them susceptible to risk transmission shocks from the US (see Markwat et al., 2009; Kang et al., 2019; Vo & Tran, 2020). Furthermore, macroeconomic determinants of ASEAN-5 nations' exposure to US FM improved the shock reception capacity of domestic equities markets, causing currency devaluations (see Figure 1). Recently, several studies emphasized the role of transmission of shocks towards equity market returns from exchange rates (Khan et al., 2021; Mahapatra & Bhaduri, 2019; Zhu et al., 2022) by following theoretical linkages of either arbitrage pricing or flow-oriented approach. However,

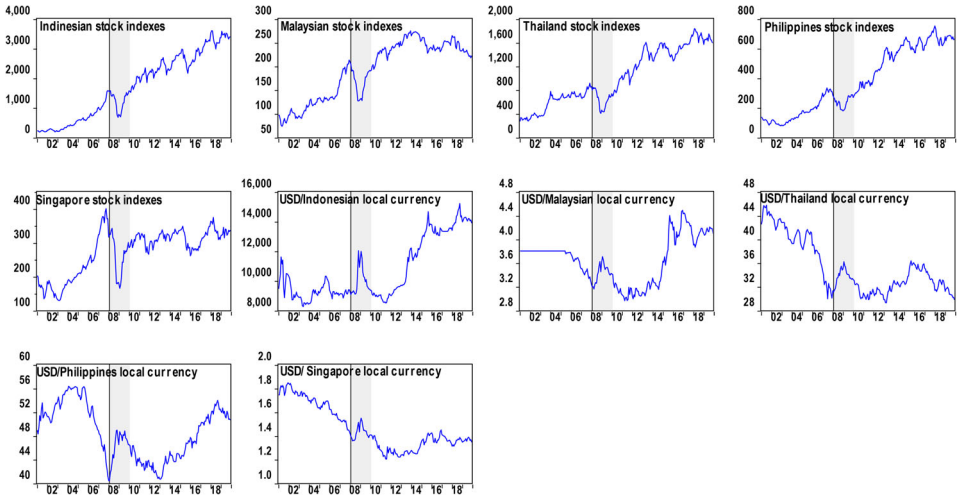

Figure 1. ASEAN-5 stock indexes and exchange rate fluctuations during the Global financial crisis 2008.
Source: Author's work.

limited efforts are made to explain whether bearish or bullish stock market (SM) conditions may cause exchange rate deflation in the ASEAN-5 region and the role of the pre-post financial crisis regime in effecting asymmetric SM transmission towards forex market shocks.

To fill the above-mentioned gap, we disintegrated the overall sample period from the 3rd quarter of 2001 towards the last date of the 4th quarter of 2019 into a pre-economic crunch (1st January 2001 to 31st December 2007), post-economic crunch (1st January 2010 towards 31st December 2019) and overall sample duration (1st July 2001 towards 31st December 2019). The selection of this time framework is to avoid the impact of Covid-19 as well as the great depression during the Asian financial crisis (Athukorala & Chongvilaivan, 2010). The first objective is to compute cross-sectional dependence[3] and cross-sectional augment IPS unit root test of Pesaran (2007) followed by the implementation of the NARDL framework into the panel settings (PNARDL) for exploring the different transmission of negative and positive shocks towards ASEAN-5 FM. As suggested that conventional 1st generation panel-based unit root testing procedures may provide spurious estimates in the presence of cross-sectional dependence. Moreover, we utilized the Hausman test to select between PNARDL with pooled mean group approach or mean group approach to classifying whether constraints on the longer-term coefficients are non-identical under multiple sampling durations. As a 2nd objective, we also utilized the approach of Dumitrescu and Hurlin (2012) for dynamic asymmetric granger causality estimation between the variables for the non-homogenous panel series under pre-post-financial crunch and overall sampling time frames. Our selection of PNARDL with pooled mean group approach is in line with the diagnostics of the Hausman test and Mensah et al. (2019).

Figure 1 depicts the precipitous decrease in equity indexes experienced by all ASEAN-5 countries from 2008 to 2009. However, the most damaging stock market loss has been experienced by equity indexes in Indonesia and Singapore, followed by

Thailand, Malaysia, and ultimately the Philippines. The Indonesia (Singapore) equity market indices began to fall in early 2008, starting around 1400 (400) and falling to about 700 (150) index points by end of the year. While Thailand (Malaysian) stock market indexes rose to a level over 800 (200) at the beginning of 2008, equity indices fell to a level below 400 (140) by the end of the 2008 period as a result of the global economic downturn. On the other hand, during the pre-economic downturn of 2008, there is a tremendous appreciation in the local currencies of Singapore, the Philippines, Thailand, and Malaysia. However, during 2008 and 2009, the domestic currencies of Indonesia, the Philippines, Malaysia, and Thailand depreciated by 33.3%, 22.5%, 18.75%, and 20.1%, respectively (see Figure 1). This motivates researchers to explore the asymmetric transmission of shocks from financial towards forex markets under multiple regimes: pre-post crisis period. Another motivation stems from the fact that few studies have addressed the impact of the Asian and global economic recession of 2008 on the shock transmission mechanism from ASEAN-5 FM towards FX market returns. As 2008 recession causes a loss of equity and forex market returns in the aftermath of the Great Recession 2008 (see Figure 1), which could be attributed to international FM integration with US FM and the error variance propagation process from the US to ASEAN-5 economies. Despite these challenges, non-performing loans (NPLs) in the Indonesian (Philippines) banking industry fell from 24% (26.5%) in 2002 to 2.1% (2.4%) in 2012. In Thailand, NPL fell from 15.7% in 2002 to 2.7% in 2012 (World bank, 2013).[4] These furthermore instigated researchers to investigate the short-long run transmission of shocks from bearish and bullish equities market conditions to exchange rate changes throughout three separate periods.

This research article departed from mainstream research in the following ways. *Firstly*, prior studies mainly examined the linear transmission mechanism of forex market returns in effecting country specific sectoral returns (Roubaud & Arouri, 2018; Areli Bermudez Delgado et al., 2018; Singhal et al., 2019; Tian et al., 2021; Salisu et al., 2022; Kumeka et al., 2022; Ghani et al., 2022) while ignoring the perspective of vice versa effect. This is the first attempt to explore whether positive and negative jumps in ASEAN-5 FM prices may have a dissimilar effect on forex market returns. For example, Granger and Yoon (2002) suggested that linear econometric error correction models cannot explore the 'hidden asymmetric co-integration' between financial variables. However, few studies ignored dependence and non-identical distribution within the forex and FM price jumps and utilized only symmetric Time Series (TS) approaches, i.e., VAR, ARDL (Singhal et al., 2019), Markov switching VAR (Roubaud & Arouri, 2018), VECM (Areli Bermudez Delgado et al., 2018), ARDL (Singhal et al., 2019), VAR with time-varying parameter (TYP-VAR) (Tian et al., 2021) or mixed frequency generalized autoregressive framework (Ghani et al., 2022) for exploring financial-forex market symmetric nexus. Additionally, all of these studies did not consider the role of specific crisis periods on the asymmetric transmission of negative-positive equity price jumps on forex market returns.

Secondly, building upon either arbitrage pricing theory or traditional flow-oriented approach, all of the period studies on symmetric-asymmetric transmission between forex and FM returns are focused on the forex market's impact on FM of China

(Tian et al., 2021), Egypt (El-Masry & Badr, 2021), Nigeria (Kumar, 2019), Turkey (Kassouri & Altıntaş, 2020), Pakistan (Ghani et al., 2022), India (Kumar et al., 2023, 2021) and US (Salisu et al., 2022). However, this is the first attempt to understand the asymmetric transmission of positive and negative price jumps in FM of the whole ASEAN-5 region on regional forex market returns. Therefore, prior studies mainly relied upon TS-based econometric frameworks in examining dynamics of shocks flowing from forex towards FM returns (Bahmani-Oskooee & Saha, 2016a, 2016b; Kumar, 2019; Kumar et al., 2023; Kassouri & Altıntaş, 2020; Salisu & Vo, 2021; Salisu et al., 2022). However, Wang and Su (2021) suggested that panel-based models are more effective in calculating econometric impacts with lower estimation bias. Similarly, Fasanya and Akinwale (2022) applied the TS-based ARDL and NARDL approach to exploring the role of shocks in the Nigerian equity market sectors on currency fluctuations and observed the different responses of currency fluctuations to the sectoral returns. Therefore, we not only applied panel based NARDL framework with a pooled mean group approach to analyze the asymmetric transmission of shocks from negative-positive FM price jumps on forex returns but also considered the asymmetrical granger causality approach of Dumitrescu and Hurlin (2012) for non-linear dynamic analysis.

The remainder of the paper is broken into sections. The second section discusses previous research on the relationship between FX and FM returns, while the third section discusses a methodological econometric approach. The fourth and fifth sections, on the other hand, discuss results with practical implications and conclusions with future research directions.

2. Literature review

The modernization and acceleration of economic reforms, the convergence of the global finance sector, and increasing foreign investment have strengthened the correlation between international stock and foreign exchange markets. It is a pattern that researchers studied throughout numerous financial crises, including the financial crisis of 1997 in Asia and the financial crisis of 2008 in the European region and the world (Lee & Wang, 2015). An overview of longer and shorter-term dynamics among global capital and currency markets will also help policymakers in different economies to establish specific fiscal management, reducing any detrimental effects of exchange rate fluctuations and stock market volatility on a country's economic development. Contrary to the traditional approach, the perspective of a portfolio balanced approach is that the accelerating stock market indexes entail higher foreign as well as domestic equity market investors' demand for assets in an economy. As a result, local currency demand will appreciate and local currency values against dollar values lead towards appreciation (Dornbusch, 1976; Dornbusch & Fischer, 1980). In a region like ASEAN-5, accelerating stock market indices can contribute towards the appreciation of local exchange rates against international dollar values due to their export-centric characteristics (Pradhan et al., 2014). However, the question arises whether positive and negative price jumps in financial equity returns yield a similar effect on the ASEAN-5 forex markets.

Major of the researchers emphasized exploring the response of equity market returns in a developing economy, i.e., Mexico to the shocks in exchange rates by utilizing the linear econometric TS approaches such as VECM (Areli Bermudez Delgado et al., 2018), ARDL (Singhal et al., 2019). Whereas, others have explored dynamic but symmetric shocks transmission between Egyptian equity and forex market returns with aid of the VAR framework (El-Masry & Badr, 2021), and interrelation between commodity, forex, and FM returns by using globalized VAR (Salisu et al., 2022) or TS based Markov regime switching VAR approaches (Roubaud & Arouri, 2018). Similarly, Tian et al. (2021) explored a time-varying parameter-based symmetric VAR framework to explore the dynamic transmission of shocks propagating between commodity, financial, and the Chinese forex market. However, few other studies relied upon the utilization of a symmetrical panel-based vector auto-regression framework (Kumeka et al., 2022). More recently, Ghani et al. (2022) utilized a mixed frequency-based GARCH framework to explore the linear response of Pakistani stock market indices to several macroeconomic fundamentals including currency devaluations. Therefore, all of these studies either ignored the perspective that TS data may exhibit non-identical distribution, dependence, or non-linear characteristics (Kim et al., 2003) and prior studies are outside the context of ASEAN-5. Similarly, Granger and Yoon (2002) also suggested that in the presence of non-identical distribution in time-series data, estimation of 'hidden co-integration' in a symmetric fashion may yield biased estimates.

Previous studies explained the asymmetric forecastability of financial markets (FM) through exchange rate variations rather than the response of currency rates to ASEAN-5 FMs' positive or negative shocks over different sample periods. For example, Bahmani-Oskooee and Saha (2016a, 2016b) observed that exchange rate positive and negative partial sums yield a differential short-term impact on the financial market by using the NARDL model. Similarly, a few other studies, i.e., (Kumar et al., 2023, 2021) explore the non-linear asymmetric association between precious metal, commodity, and FM returns in the Indian context by utilizing the NARDL approach by Shin et al. (2014). Suresh Kumar et al. (2023) found an adverse negative impact of the forex market on financial returns by using TS based NARDL approach, while Kumar (2019) explored the asymmetric response of Nigerian equity returns to appreciative and depreciative currency rate variations by utilizing NARDL approach. Moreover, building upon the discussion that exchange rate positive or negative partial sums do not necessarily yield a similar effect, Salisu and Vo (2021) explored the response of FM to the exchange rate appreciative or depreciative shocks under a higher vs lower interest rate environment. Similarly, Kassouri and Altıntaş (2020) explored the forecast ability of certain macro-macroeconomic fundamentals in Turkey, i.e., money supply, interest, and currency rates in explaining FM returns by utilizing a non-linear threshold-based co-integrating approach. Similarly, in the developing economy's context, Chang et al. (2021) explained the predictive capacity of Pakistan's FM by incorporating the macro-non-macroeconomic fundamentals as regressors in the asymmetric ARDL framework. However, Nusair and Olson (2022) explored the asymmetric dynamism between G7 forex and FM returns and found that appreciative and depreciative forex market returns yield an asymmetric impact on the developed economy's equity returns.

Above mentioned studies emphasized asymmetric or non-asymmetric response of FM returns to the forex market shocks rather than the possibility of vice versa asymmetric effect and mainly utilized TS econometric approaches. Wang and Su (2021) explained that panel data may be used to simulate shared as well as individualistic group behavior dynamics. According to these researchers, the TS combined with cross-sectional data has more flexibility and effectiveness as compared with TS data. The TS-based estimations cannot discover or quantify econometric impacts that panel data can predict. Panel data can reduce estimation errors that might occur when groups are combined into a single TS data (Wang & Su, 2021). Building upon the superiority of panel data estimation techniques over TS, Salisu et al. (2022) explored the response of firm-level US equity market returns to appreciative and depreciative trends in the exchange rate and found that positive shocks in currencies outweigh negative counterparts in terms of magnitude for effecting US firm-level equity market prices. By taking one step ahead, we are interested in investigating the vice versa effect of bearish and bullish FM shocks on the exchange rate of ASEAN-5 by utilizing panel based NARDL approach with pooled mean group approach (PMG) to explore whether the global economic crunch affected asymmetric transmission mechanism.

3. Data and methodology

3.1. Data

The Monthly data sets for ASEAN-5 are available on country-specific stock market websites (such as FTSE-Indonesia, FTSE-Bursa-Malaysia-100 Index, Thailand-SETI00, FTSE-Philippines, and FTSE-Singapore). In contrast, FX market prices of ASEAN-5 member nations are obtained from DataStream and anticipated returns are calculated as $Ln(p_t) - Ln(p_{t-1})$. We further separated monthly data into three scenarios (pre-economic crunch, post-economic crunch, and full sample duration) to see how swings in ASEAN-5 local currency values have non-linearly responded to bearish or bullish ASEAN-5 stock market conditions in three different financial regimes. There are 415 observations spanning the pre-crisis period of January 2001 to December 2007. Furthermore, 595 and 1135 observations are taken into consideration when post-recessionary and overall sampling periods of January 2010 to December 2019 and January 2001 to December 2019 are considered, respectively. According to Figure 1, the financial crisis era is defined as the period from January 2008 to December 2009, during which time stock indices of all ASEAN-5 had a comparable downward pattern before rising at the end of 2009. The US dollar against ASEAN-5 domestic currency strengthened at the beginning of 2008 (local ASEAN-5 currency devaluation) until falling back after the 4th quarter of 2008. This invites the researcher to look into the asymmetric effects of both positive and negative FX market shocks on the ASEAN-5 equity returns.

3.2. Methodology

To estimate the regional bearish and bullish equity market return's impact on the ASEAN-5 forex market returns, we applied the NARDL method purposed by Shin

et al. (2014) to the panel data settings. However, panel-based symmetric and non-linear ARDL models can only be applied if the regressors, as well as regressand, must exhibit either similar $(I(1))$ or mixed $\left(I(0)and\ I(1)\right)$ order of integration. Furthermore, Mensah et al. (2019) suggested that in the presence of cross-sectional dependence, the conventional panel-based unit root tests purposed by Hadri (2000), Levin et al. (2002), and Choi (2001) may provide biased outcomes. A cross-sectional dependency test by Pesaran (2004) is carried out to confirm whether the application of first generation unit root test for panel-based data is a valid approach or whether there is a need to apply second generational panel unit root test classified as cross-sectional augmented IPS unit root testing procedure (CIPS) set by (Pesaran, 2007). Both the tests of CD and CIPS can be estimated in the following manner,

$$\mathrm{CD} = \sqrt{\frac{2T}{N(N-1)}\left(\sum_{i=1}^{N-1}\sum_{j=1+1}^{N}\widehat{\rho_{i,j}}\right)} \tag{1}$$

$$\mathrm{CIPS(N,\ T)} = N^{-1}\sum_{i=1}^{N} t_i(N,T), \tag{2}$$

The formula for estimating 'cross-sectional dependence' is stated mathematically and indicated by CD in equation no 1. The words 'N and T' are symbolized by the number of ASEAN-5 nations as cross-sectional units and TS observations from each country, respectively. The correlation of residuals in the form of pairwise classification is indicated by $\widehat{\rho_{i,j}}$. Once the cross-sectional dependence is found, the 2nd generation panel-based unit root testing technique developed by Pesaran (2007) is used to detect the problem of seasonality (see equation no 2). Equation no 2–3 represents the symmetrical method of estimating the ARDL model with pooled mean group approach by Pesaran et al. (1999) and ECT in a panel setting, respectively. While the appropriate lag length is selected by using the Akaike information criterion (AIC).

$$\begin{aligned}\Delta\mathrm{exchangerate}_{it} = {} & \alpha_{0i} + \alpha_{1i}exchangerate_{it-1} + \beta_{1j}indexes_{it-1} \\ & + \sum_{j=1}^{p}\gamma_{ij}\Delta\mathrm{exchangerate}_{it-j} + \sum_{j=0}^{q}\delta_{ij}indexes_{it-j} + u_i + \varepsilon_{it}\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta\mathrm{stock}indexes_{it} = {} & \alpha_{0i} + \pi_{1i}\xi_{it-1} + \sum_{j=1}^{p}\gamma_{ij}\Delta\mathrm{stockindexes}_{it-j} \\ & + \sum_{j=0}^{q}\delta_{ij}\Delta exchangerate_{it-j} + u_i + \varepsilon_{it}\end{aligned} \tag{4}$$

In equation no 3, $\Delta\mathrm{exchangerate}_{it}$ is the regressand with its difference operator and is observed for country i of the ASEAN-5 region in a time t. $\alpha_{1i}exchangerate_{it-1}$ and $\beta_{1j}indexes_{it-1}$ are the long-run regressors without 1st

difference operators. In equation no 3, the lagged value of the regressand ($\alpha_{1i} exchangerate_{it-1}$) is utilized amongst the list of regressors to make the equation dynamic. However, short-run coefficients are represented by $\sum_{j=1}^{p} \gamma_{ij} \Delta \text{exchangerate}_{it-j}$ and $\sum_{j=0}^{q} \delta_{ij} indexes_{it-j}$. Whereas, ε_{it} is the error term. However, we have also utilized the BDS test of non-linearity by Broock et al. (1996) to determine whether the application of the non-linear ARDL modeling approach is most suitable in the panel data set and can be written in mathematical form as $BDS_{\varepsilon,m} = \frac{\sqrt{N}[C_{\varepsilon,m} - (C_{\varepsilon,1})^m]}{\sqrt{V_{\varepsilon,m}}}$. Whereas $V_{\varepsilon,m}$ is defined as standard deviation of $\sqrt{N}[C_{\varepsilon,m} - (C_{\epsilon,1})^m]$.

The BDS test statistics are utilized for every sampling duration to determine the existence of independence and identical distribution in unstructured and undated panel settings. Rejection of the null hypothesis signals that Panel based NARDL modeling approach is more suitable and conclusive. For the application of PNARDL with pooled mean group (PMG) approach, the stock indexes can be broken down into positive and negative returns prescribed by Shin et al. (2014) as follow,

$$stockindexes_{it}^{+} = \sum_{k=1}^{t} \Delta stockindexes_{ik}^{+} = \sum_{k=1}^{t} \max(\Delta stockindexes_{ik,} 0)$$

$$stockindexes_{it}^{-} = \sum_{k=1}^{t} \Delta stockindexes_{ik}^{-} = \sum_{k=1}^{t} \min(\Delta stockindexes_{ik,} 0)$$

Equations no 5 and 6 represented the extension of equations no 3 and 4 respectively to estimate panel based NARDL modeling approach,

$$\begin{aligned} \Delta Exchangerte_{it} = {} & \alpha_0 + \alpha_1 Exchangerate_{it-1} + \alpha_2^{+} indexes_{it-1}^{+} + \alpha_2^{-} indexes_{it-1}^{-} \\ & + \sum_{k=1}^{p} \beta_k \Delta Exchangerate_{it-k} + \sum_{k=0}^{q} (\delta_k^{+} \Delta \text{Indexes}_{it-k}^{+} \\ & + \delta_k^{-} \Delta \text{Indexes}_{it-k}^{-}) + \ u_i + \ \varepsilon_{it} \end{aligned} \tag{5}$$

$$\begin{aligned} \Delta Exchangerate_{it} = {} & \alpha_{0i} + \pi_{1i}^{+} \xi_{it-1}^{+} + \pi_{1i}^{-} \xi_{it-1}^{-} + \sum_{j=1}^{p} \gamma_{ij}^{+} \Delta Exchangerate_{it-j}^{+} \\ & + \sum_{j=1}^{p} \gamma_{ij}^{-} \Delta Exchangerate_{it-j}^{-} + \sum_{j=1}^{p} \delta_{ij}^{+} \Delta Indexes_{it-j}^{+} \\ & + \sum_{j=1}^{p} \delta_{ij}^{-} \Delta Indexes_{it-j}^{-} + u_i + \varepsilon_{it} \end{aligned} \tag{6}$$

In equations, no 5 and 6, FM indexes of the ASEAN-5 region have been disintegrated into their respective positive $\alpha_2^{+} indexes_{it-1}^{+}$ and negative returns $\alpha_2^{-} indexes_{it-1}^{-}$ for examining the impact of both appreciation and depreciation of

stock returns on currency value fluctuations. Long-run positive and negative returns of stock indexes of the ASEAN-5 stock market are represented by $\alpha_2^+ indexes_{it-1}^+$, $\alpha_2^- indexes_{it-1}^-$, respectively and $\sum_{k=0}^{q}(\delta_k^+ \Delta\text{Indexes}_{it-k}^+, \delta_k^- \Delta\text{Indexes}_{it-k}^-)$ is the representation of short-run coefficients. The Null hypothesis of 'Wald test' statistics signifies the existence of long-run symmetric ($\alpha_2^+ indexes_{it-1}^+ = \alpha_2^- indexes_{it-1}^-$) shock transmission from the indexes towards the currency value fluctuations. However, the alternative hypothesis supported the presence of long-run asymmetric ($\alpha_2^+ indexes_{it-1}^+ \neq \alpha_2^- indexes_{it-1}^-$) shock transmission effect. Similarly, Wald test statistics is also utilized to investigate the presence of asymmetric ($\sum_{k=0}^{q}(\delta_k^+ \Delta\text{Indexes}_{it-k}^+ \neq \delta_k^- \Delta\text{Indexes}_{it-k}^-$) or symmetric regional's FM shock transmission impact ($\sum_{k=0}^{q}(\delta_k^+ \Delta\text{Indexes}_{it-k}^+ = \delta_k^- \Delta\text{Indexes}_{it-k}^-$) on currency values in the shorter run. Furthermore, we have also utilized the asymmetric ECT(-1) term 'ρ' depicted in equation no 6 ($\pi_{1i}^+ \xi_{it-1}^+$, $\pi_{1i}^- \xi_{it-1}^-$) for the examination of the asymmetrical association between two variables in longer horizons. Furthermore, the Hausman test is utilized to identify whether the pooled mean group is more approach for estimating the PNARDL or whether we should rely upon the mean group approach.

3.3. Asymmetrical granger causation by Dumitrescu and Hurlin (2012)

We also used the granger causation approach devised by Dumitrescu and Hurlin (2012) to investigate the dynamic relationship between positive and negative shocks in stock indexes and international US dollar values. This granger non-causality approach for non-homogenous panel data sets in eq.7 is more practical when the size of the sample is relatively smaller, and the number of cross sections included in the panel set is larger or smaller than the TS dimensions (T < or > N) with cross-sectional dependence properties.

$$exchangerate_{it} = \alpha_i + \sum_{k=1}^{k} \lambda_i^k indexes_{i,t-k} + \sum_{k=1}^{k} \beta_i^k exchangerate_{i,t-k} + \varepsilon_{i,t} \qquad (7)$$

In eq.7, the β_i^k is denoted by the coefficient of regression with fixed order of lags (k) of exchange rate fluctuations and λ_i^k is the autoregressive parameter. The null and the alternative hypothesis to testify the causality flowing from stock indexes toward exchange rate fluctuations is denoted as follow,

$$H_0 : \beta_i = 0 \forall_1 = 1, \ldots\ldots N$$

$$H_1 : \beta_i = 0 \forall_1 = 1, \ldots\ldots N1$$

$$\beta_1 \pm 0 \forall_1 = \text{N1} + 1, \ \text{N1} + 2 \ldots\ldots\ldots\ldots \text{N}$$

The parameters which are not known can be represented by N_1, but the condition of N_1/N*1 must be fulfilled in such a way that it should be equal to or less than 0. Therefore in a given situation, N_i/N should be lesser than 1 because in case if N_i is equal to N, which means that there is no existence of causation between the variables.

However, if N_i is equal to 0, this implies the existence of causality between exchange rate fluctuations and stock indexes.

Equation no 7 can be rewritten as follow to find out the granger causation running from positive and negative shocks in stock indexes towards currency value fluctuations,

$$Exchangerate_{it} = \alpha_i + \sum_{k=1}^{k} \lambda_i^k Indexes_{i,t-k}{}^{+} + \sum_{k=1}^{k} \lambda_i^k Indexes_{i,t-k}{}^{-} + \sum_{k=1}^{k} \beta_i^k exchangerate_{i,t-k} + \varepsilon_{i,t} \quad (8)$$

4. Results with practical implications for exporters, importers, and regulators

According to Table 1, the negative skewness before and after the 2008 financial crisis reveals that the majority of the values of the ASEAN-5 economies' stock indexes deviated from the symmetrically bell-shaped curvature. However, lower negatively skewed equity market returns during the pre-recessionary period as compared to the post-recessionary period demonstrate the post-crisis regime as a favorable investment regime for ASEAN-5 investors due to the occurrence of less adverse equity returns. However, during the post-crisis period, the ASEAN-5 nations' stock indexes displayed leptokurtic distribution, indicating that stock market returns diverged from the mean returns in either direction and were dominated by significant outliers. Because of the likelihood of a downtrend, the existence of significant outliers indicated the prospect of higher losses with a lower probability of gains. Despite the increased kurtosis in equity returns during the post-financial-recessionary period, higher adverse skewness may be advantageous for risk managers, risk-taking fund managers, and shareholders

Table 1. Descriptive statistics for exchange rate and equity market returns of the ASEAN-5 region

	Pre-Crisis period		Post-Crisis period		Overall sample period	
	ΔLn (Indexes)	ΔLn (Exch.Rate)	ΔLn (Indexes)	ΔLn (Exch.Rate)	ΔLn (Indexes)	ΔLn (Exch.Rate)
Mean	0.012835	−0.00206	0.004645	0.000855	0.006546	−0.00011
Median	0.017753	0.000073	0.007883	0.00004	0.009682	−0.000026
Maximum	0.21032	0.107518	0.136675	0.093905	0.210549	0.146459
Minimum	−0.19928	−0.18144	−0.20191	−0.07427	−0.32942	−0.18144
Std. Dev.	0.061823	0.021002	0.041236	0.018712	0.057308	0.020977
Skewness	−0.22274	−0.82593	−0.52968	0.382369	−0.61336	0.086695
Kurtosis	3.980508	18.92294	4.644314	5.477565	6.871055	12.47856
Jarque-Bera	20.05557	4431.315	94.85332	166.6782	779.8361	4250.253
Probability	0.000044	0	0	0	0	0
Sum	5.326487	−0.85311	2.763638	0.508693	7.430069	−0.12238
Sum Sq. Dev.	1.582332	0.182613	1.010061	0.207983	3.724228	0.499013
Observations	415	415	595	595	1135	1135

Note: The descriptive statistics of logarithmically transformed ASEAN-5-member nation stock and currency returns are presented in three separate regimes: pre-recessionary, post-recessionary, and when the complete sample is included.
Source: Author's work.

when developing risk-reduction tactics and portfolio optimization procedures. This is because the majority of successful and effective risk reduction techniques are built on negatively skewed financial data to gain long-term profit and risk minimization in the face of increased volatility. Along with the leptokurtic distribution, substantially positively skewed currency returns in the post-crisis period demonstrate the preponderance of more US dollar depreciation.

Although a leptokurtic distribution indicates the presence of deviation in either the upward or downward direction, the presence of negatively skewed returns together with positive excess kurtosis during the pre-economic crunch considerably suggests an upward departure from the mean exchange rate and equity market returns. This is linked with local currency depreciation due to appreciation in USD/ASEAN-5 exchange rate. However, during the post-2008 economic crisis, the distribution of positively skewed and leptokurtic exchange rate returns enhances the likelihood of local currency appreciation. This indicates that negative values in USD predominate due to the bigger right tail of the distribution graph and smaller deviation from mean currency returns in post-crisis compared to the pre-crisis environment. This furthermore motivates us to examine the asymmetric transmission of positive or negative shocks towards the forex market returns under different crisis periods.

Table 2 shows that the null hypothesis of the BDS test of linearity is rejected and data sets for both exchange rate volatilities and stock indexes of ASEAN-5 economies exhibited non-linear characteristics. This furthermore confirms the absence of identical distribution and independence in datasets. BDS test is executed for every regime independently and before ordering the data into structured and dated panel settings. Tables 3 and 4 present the results of cross-sectional dependence and Panel based cross-sectional augmented IPS unit root test for detecting the presence of seasonality at the level within the panel data sets.

In the presence of cross-sectional dependencies, first-generation panel-based unit root tests such as Breitung (2001), Hadri (2000), Choi (2001), Levin et al. (2002), and Kim et al. (2003) may not provide consistent, efficient and robust results. Thereby, there is a need to apply the cross-sectional augmented IPS unit root testing approach by Pesaran (2007).

The cross-sectional augmented IPS unit root test (see Table 4) signifies that there is a seasonality in the panel datasets at the level, however, after differencing them 1 time, all the variables become free from stationarity.

Table 2. BDS test of non-linearity purposed by Broock et al. (1996).

Non-linearity Confirmatory test dimensions	Pre-Crisis		Post-Crisis		Overall period	
	Indexes	ER	Indexes	ER	Indexes	ER
$M = 2$	0.194***	0.198***	0.229***	0.212***	0.276***	0.325***
$m = 3$	0.3384***	0.332***	0.347***	0.340***	0.34***	0.487***
$m = 4$	0.438***	0.448***	0.438***	0.449***	0.391***	0.55***
$m = 5$	0.509***	0.493***	0.518***	0.591***	0.472***	0.62***
$m = 6$	0.526***	0.557***	0.538***	0.601***	0.60***	0.71***

Note: This table evaluates the properties of identical distribution and independence of panel data series for FX and the equity market values of the ASEAN-5 region. The null hypothesis of linearity can be rejected if the level of significance falls below 0.01, 0.05, and 0.1. The Rejection of the null hypothesis implies that cross-sectional-based time series data is not linear or not identically distributed. We have transformed the panel data sets into the unstructured or updated format to perform the BDS test purposed by (Broock et al., 1996).
Source: Author's work.

Table 3. Cross-sectional dependence test during the three regimes.

	2008-Pre-recession regime		Post-recession regime of 2008		Complete Sample	
Multiple CD Tests	Indexes	ER	Indexes	ER	Indexes	ER
Breusch Pagan LM test	677.19***	326.6***	491.9***	617.2***	1797.9***	751.8***
Pesaran scaled LM test	149.18***	70.79***	107.7***	135.7***	399.7***	165.9***
Bias-corrected scaled LM test	149.15***	70.76***	107.7***	135.7***	399.7***	165.8***
Pesaran CD test	25.9***	15.16***	20.8***	24.24***	42.23***	18.6***

Note: Null hypothesis of cross-sectional dependence can be rejected if the level of significance falls below 0.01, 0.05 or 0.1
Source: Author's work.

Table 4. Cross-sectional augmented IPS unit root test by Pesaran (2007).

	CS augmented IPS unit root test								
	AT level				After taking 1st difference				
Variable	CIPS-1	CIPS-2	CIPS-3	CV	CIPS1	CIPS2	CIPS3	CV	Order of Integration
Pre-2008									
Indexes	−1.2	−1.4	−1.65	−1.86	−4.87	−6.54	−11.43	−1.86	*I(1)*
ER	−0.7	−1.32	−1.4	−1.72	−3.65	−4.32	−4.87	−1.72	*I(1)*
Post-2008									
Indexes	−0.8	−1.213	−1.62	−1.98	−7.2	−13.76	−13.9	−1.98	*I(1)*
ER	−0.1	−0.98	−1.62	−2.10	−4.21	−4.598	−5.82	−2.1	*I(1)*
Complete sample									
Indexes	−1.5	−1.87	−2.018	−2.21	−8.87	−9.17	−10.32	−2.21	*I(1)*
ER	−0.9	−1.10	−1.57	−1.863	−2.87	−3.10	−3.56	−1.86	*I(1)*

Note: This table contains the values of the CS augmented IPS unit root test at multiple lag values such as CIPS 1, CIPS 2, and CIPS 3. If the values of the cross-sectional augmented IPS unit root test fall below the critical values, then we cannot be able to reject the null hypothesis of non-stationarity.
Source: Author's work.

According to the results of the BDS test of linearity purposed by (Kim et al., 2003), the cross-sectional dependency analysis by Pesaran (2004), and the cross-sectional augmented IPS unit root testing approach by Pesaran (2007), we have estimated Panel based NARDL modeling approach with a pooled mean group (PMG) estimating technique. Tables 5, 6, and 7 present the coefficients estimated of the Panel based symmetric and asymmetric ARDL framework with pooled mean group (PMG) approach[5] during pre, post economic crunch and overall sample duration, respectively. We utilized the Hausman test to decide between the estimation of the PNARLD approach with either the MG or PMG approach. Tables 5–7 are divided into two parts: the left section shows the estimated results from the Panel based ARDL, whereas the right section is based on the results from the estimation of Panel based NARDL approach.

According to Table 5, the panel-based symmetric ARDL approach cannot be able to establish the long-run symmetric transmission of ASEAN-5 FM shocks towards the FX returns during the pre-financial crunch period. Moreover, the error-correction term 'ρ' is also statistically insignificant. But in the short term, a 1% depreciation in the FM returns leads toward the 0.07% appreciation in USD against the ASEAN-5 economies. This would cause the local currency to depreciate due to FM depreciation. However, building upon the findings provided by (Bahmani-Oskooee & Saha, 2016a, 2016b), there may be the possibility that the symmetrical ARDL approach cannot be able to detect the 'hidden asymmetric co-integration' between the variables because of the presence of positive and negative price jumps in the regressors. However, based

Table 5. Panel-based ARDL and Panel-based NARDL model during the Pre-economic crisis period.

	Panel-based ARDL framework with pooled mean group approach (PMG)				Panel-based NARDL framework with Pooled mean group approach (PMG)			
	Coeff.	Std.Error	t-statistics	*p*-values	Coeff.	Std.Error	t-statistics	*p*-values
Long run coefficients								
LnIndexes	0.8461	1.6304	0.5190	0.6041				
LnER								
Linear ECT (−1)	0.0043	0.0042	1.0173	0.3096				
indexes +					0.00004**	0.00002	2.02876	0.04320
Indexes −					0.00015**	0.00006	2.50130	0.01280
Asymmetric ECT (−1)					−0.0909**	0.0400	−2.2691	0.0238
Short run coefficients								
LnIndexes	−0.0702**	0.0344	−2.0390	0.0421				
LnIndexes (−1)	−0.0108	0.0173	−0.6230	0.5336				
LnER								
indexes +					−0.0002	0.0001	−1.5991	0.1106
Indexes −					−0.0001***	0.0000	−3.0384	0.0025
Hausman Test					1.43(0.90)			
Hsiao Test of heterogeneity					6272.93***			
Long run asymmetries								
Indexes (+) = indexes (−)					1.89*			
Short run asymmetries								
Indexes (+) = indexes (−)					3.91***			
Akaike info criterion	−5.35016				−7.111227			
Schwarz criterion	−5.10005				−6.703546			
Hannan-Quinn criteria	−5.2513				−6.950016			

Note: This table explains the short-term and long-term linear and non-linear impact of the stock indexes on the currency value fluctuations during the pre-economic recessionary regime. Housman test and Hsiao test of heterogeneity are also conducted to confirm that either PMG or MG approach is appropriate and the presence of heterogeneity within the panel data series, respectively. *, **, *** Significant at 10%, 5%, 1% respectively.
Source: Author's work.

upon the PNARDL estimations, there exists a long-term asymmetric impact of bearish and bullish ASEAN-5 equity market behavior on the forex market returns of the region (see right part of Table 5). This asymmetric impact may be because of the stronger effect of negative equity market shocks on the forex market returns in terms of magnitude and significance as compared with the positive shocks during the pre-crisis period. Moreover, short-term coefficients of the PNARDL model with the PMG approach confirm the existence of short-term asymmetric transmission of shocks from the negative FM returns towards the ASEAN-5 FX market. This asymmetric transmission exists due to the significance of only the short-term impact of negative FM returns on the FX market, whereas the positive jumps in the returns insignificantly affected the exchange rates.

During the pre-financial crunch of 2008, 1% long-term appreciation (depreciation) in the FM returns causes the 0.004% (0.015%) appreciation (depreciation) in the USD against ASEAN-5 local currencies. This shows that the appreciative impact of FM positive shocks on the local currency devaluation is lower as compared with the impact of FM negative shocks on the local currency appreciation. The direct effect of both the positive and negative price jumps on the exchange rate can be understood based on certain facts. *Firstly*, after the great ASIAN crisis in 1998, there may be the possibility that ASEAN-5 economies have adopted expansionary fiscal and monetary policies, which would lead toward a greater supply of money within the economy with greater government spending and reduction in local interest rates. Therefore, because of the increase in capital inflows within the system, the demand for imported

Table 6. Panel-based ARDL and Panel based NARDL model during the Post-economic crisis period.

	Panel-based ARDL framework with pooled mean group approach (PMG)				Panel-based NARDL framework with pooled mean group approach (PMG)			
	Coeff.	Std.Error	t-statistics	*p*-values	Coeff.	Std.Error	t-statistics	*p*-values
Long run coefficients								
LnIndexes	−0.3543	0.2723	−1.3013	0.1937				
LnER								
Linear ECT(−1)	−0.0782*	0.0262	−2.9807	0.0030				
indexes +					0.7246	0.8106	0.8938	0.3718
Indexes −					−2.09***	0.7338	−2.8520	0.0045
Asymmetric ECT (−1)					−0.0644***	0.0146	−4.4217	0.0000
Short run coefficients								
LnIndexes	−0.6331**	0.3133	−2.0209	0.0438				
LnIndexes(−1)	−0.599*	0.3319	−1.8075	0.0712				
LnER								
indexes +					−0.959***	0.3127	−3.0682	0.0023
Indexes −					−0.2997	0.3893	−0.7697	0.4418
Hausman Test					1.76(1.22)			
Hsiao Test of heterogeneity					8373.22***			
Long run asymmetries								
Indexes (+)= indexes(−)					4.87***			
Short run asymmetries								
Indexes (+) = indexes(−)					6.10***			
Akaike info criterion	−3.9043				−3.7513			
Schwarz criterion	−3.6771				−3.1097			
Hannan-Quinn criteria	−3.8158				−3.5015			

Note: This table explains the short-term and long-term linear and non-linear impact of the stock indexes on the currency value fluctuations during the post-economic recessionary regime. Housman test and Hsiao test of heterogeneity are also conducted to confirm that either PMG or MG approach is appropriate and the presence of heterogeneity within the panel data series, respectively.
*, **, *** Significant at 10%, 5%, 1% respectively.
Source: Author's work.

items increases, and this would have a downward effect on the local exchange rate. Therefore, because of increased capital inflows, low cost of capital borrowings, and enhanced governmental spending, ASEAN-5 FM returns increase. Therefore, the long-term appreciation (depreciation) in the financial market may increases (decrease) the USD and thus have an adverse (positive) impact on the local currency. The long-term direct but asymmetric FM effect on US dollar appreciation is also confirmed for the overall sample period (see Table 7). *Secondly*, because of the increase in local stock prices, demand for local currency increases, which may also contribute towards appreciation in investments inflows within the economic system and higher supply of money and inflationary pressures. Possibly, these adverse macroeconomic shocks would lead to local currency devaluation in long term. On the contrary, in the short term and during the pre-economic crunch, only a 1% depreciation in local FM returns led to a 0.01% depreciation of the local currency. This shows that only the short-term FM depreciation is associated with the short-term local currency devaluation and short-term stock market appreciation yields an insignificant effect on the FX market. This again proves the short-term asymmetric transmission of shocks from FM towards the ASEAN-5 FX market returns during the pre-crisis regime. This shows that portfolio balanced effect only holds for the short term negative equity market shocks during the pre-GFC period. However, these findings remain inconsistent with the PNARDL model estimations during the post-crisis regime.

During the post-crisis period, the linear PARDL model with the PMG approach estimates only the short-term inverse effect of local equity market returns on the forex market (See the left section of Table 6). According to the short-term results based upon the estimation of the PARDL framework, a 1% appreciation in FM returns led to a local currency appreciation of 0.63% during the post-economic crunch regime. Whereas, one period lags positive equity market returns also lead towards the local currency appreciation by 0.59% but the effect is significantly lower in magnitude as compared with the immediate short-term effect. However, the effect is symmetric. On the other side, estimations of the Panel based NARDL approach with the pooled mean group for the post-crisis regime shows the long and short-term asymmetric transmission of FM shocks towards the forex returns. Moreover, the asymmetric error correction term (ρ) is also statistically significant and shows that model corrects its longer-term disequilibrium at an adjusting speed of 6.4%. According to Table 6, only a 1% depreciation in FM returns causes the long-term depreciation in local currency by 2.09%, whereas FM positive returns insignificantly impacted the ASEAN-5 FX market returns during the post-crisis period. Moreover, the asymmetric process of transmitting dissimilar financial shocks toward the FX market is also visible in the short term. In the short term and during the post-crisis period, only a 1% appreciation in equity market price returns led toward the 0.96% appreciation in the domestic ASEAN-5 currency returns. According to the direct channel indebted in a portfolio-balanced approach (Rudiger Dornbusch, 1976), the persistent depreciation of the ASEAN-5 stock indexes prevents international investors from selling their overseas assets and investing in the ASEAN-5 member nations' local equity markets. Therefore, the demand for a local currency decreases and puts a depreciative impact on the local exchange rate. However, when stock indexes fell, local investors also became increasingly hesitant to invest in local ASEAN-5 equity markets. As a result, a drop in stock indexes may cause the foreign currency to appreciate.

These findings propose several practical implications for exporters, importers, regulators, and researchers. *Firstly*, long-term exporters and importers as well as FX investors should emphasize the asymmetric transmission of ASEAN-5 equity market negative and positive shocks on the FX market returns rather than considering only the average symmetric effect. Instead of relying upon the fiscal and monetary policy determinants of the forex market returns, this research article purpose that negative and positive FM jumps also impact the forex market returns but the magnitude of positive and negative equity market price jumps' effect is largely varied. Before the occurrence of the financial recession, positive (negative) price jumps in the ASEAN-5 FM lead to 0.004% (0.015%) long-term depreciation (appreciation) in the local currency. This shows that positive (negative) shocks in ASEAN-5 equity market returns put downward (upward) pressure on local currency in the long term before the 2008 crisis period. This provides practical implications for the importers and exporters as the local currency devaluation is harmful to the local importers because it would not only decrease the product demand by adversely affecting the consumer's spending activities but also would lead to lower profitability. However, local currency depreciation increases the profit margins for export-centric firms by enhancing their

Table 7. Panel-based ARDL and Panel based NARDL model during the overall period.

	Panel-based ARDL framework with pooled mean group approach (PMG)				Panel-based NARDL framework with Pooled mean group approach (PMG)			
	Coeff.	Std.Error	t-statistics	*p*-values	Coeff.	Std.Error	t-statistics	*p*-values
Long run coefficients								
LnIndexes	0.2017***	0.0546	3.6926	0.0002				
LnER								
Linear ECT(−1)	−0.0136**	0.0069	−1.9812	0.0478				
indexes +					0.000783**	0.0004	2.0414	0.0415
Indexes −					0.001074*	0.0006	1.9440	0.0522
Asymmetric ECT (−1)					−0.0155***	0.0031	−5.0242	0.0000
Short run coefficients								
LnIndexes	−0.1089***	0.0241	−4.5257	0.0000				
LnIndexes(−1)	−0.0154	0.0121	−1.2731	0.2033				
LnER								
indexes +					−0.00044**	0.0002	−2.0689	0.0388
Indexes −					−0.000458*	0.0002	−1.9057	0.0570
Hausman Test					1.31(0.88)			
Hsiao Test of heterogeneity					10823.3***			
Long run asymmetries								
Indexes (+)= indexes(−)					1.91*			
Short run asymmetries								
Indexes (+) = indexes(−)					2.2**			
Akaike info criterion	−5.0023				−5.0336			
Schwarz criterion	−4.7105				−4.6921			
Hannan-Quinn criteria	−4.8921				−4.9046			

Note: This table explains the short-term and long-term linear and non-linear impact of the stock indexes on the currency value fluctuations during the complete sample period. Housman test and Hsiao test of heterogeneity are also conducted to confirm that either PMG or MG approach is appropriate and the presence of heterogeneity within the panel data series, respectively. *, **, *** Significant at 10%, 5%, 1% respectively.
Source: Author's work.

competitiveness in the international market due to the depreciating (appreciating) local ASEAN-5 currency (USD). Moreover, the directly proportionate impact of positive and negative shocks in the financial market on the local exchange rate may be because of the increased money supply within the ASEAN-5 region and this would increase the inflationary pressures and higher rate of interest. These factors may have contributed adversely to the local currency appreciation in the longer term. However, in the short term and before the financial crunch, only negative financial market shocks depreciated the local currency appreciations. On the contrary, during the post-recessionary phase, only negative (positive) shocks in FM returns depreciated (appreciated) the local ASEAN-5 currency by 2.1% (0.96%) in the long (short) term, whereas the positive (negative) equity market price jump insignificantly affected the FX returns in the long (short) term.

These findings propose that long-term exporters (short-term importers) should focus on the negative (positive) equity market price jumps because of their depreciative (appreciative) impact on the local exchange rate during the post-crisis regime. This also shows that exporters and importers need to consider both the positive and negative financial market shocks because of their differential impact on the ASEAN-5 exchange rate. Long-term Equity market negative shocks (short-term equity market positive shocks) during the post-crisis regime are much more favorable for the local exporters (importers) because of adverse (favorable) impacts on the local currency. Whereas, during the pre-crisis period, short-term equity market negative shocks are much more beneficial for local exporters of the ASEAN-5 region, whereas short-term

Table 8. Asymmetric granger causality approach by Dumitrescu and Hurlin (2012).

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
Pre-Crisis:			
SI^+ does not cause ER^+	6.42186	4.62803	0.000004
ER^+ does not cause SI^+	6.1657	4.35661	0.000010
SI^+_ does not cause ER^-	4.27215	2.35024	0.018800
ER^- does n cause SI^+	5.58326	3.73947	0.000200
SI^- does not cause ER^-	3.03224	1.03647	0.300000
ER^- does not cause SI^-	11.4646	9.97119	0.000000
SI^- does not cause ER^+	3.22465	1.24034	0.214800
ER^+_ does not cause SI^-_	5.00366	3.12534	0.001800
Post Crisis period:			
SI^+ does not cause ER^+	13.721	12.5993	0.000000
ER^+ does not cause SI^+	3.76813	1.86733	0.061900
SI^+ does not cause ER^-	23.8707	23.5436	0.000000
ER^- does n cause SI^+	2.73743	0.75594	0.449700
SI^- does not cause ER^-	5.49516	3.72956	0.000200
ER^- does not cause SI^-	7.68454	6.09033	0.000000
SI^- does not cause ER^+	18.6927	17.9602	0.000000
ER^+ does not cause SI^-	1.81812	−0.23533	0.814000
Whole sample period			
SI^+ does not cause ER^+	4.55105	2.78028	0.005400
ER^+ does not cause SI^+	8.84994	7.4994	0.000000
SI^+_ does not cause ER^-	8.28894	6.88355	0.000000
ER^- does n cause SI^+	13.4256	12.5223	0.000000
SI^- does not cause ER^-	6.5501	4.97474	0.000001
ER^- does not cause SI^-	17.955	17.4945	0.000000
SI^- does not cause ER^+	9.51278	8.22703	0.000000
ER^+ does not cause SI^-	10.9014	9.75137	0.000000

Note: The rejection of the null hypothesis at 1%, 5%, and 10% levels of significance implies the granger causation between the variables. SI and ER are the abbreviations for the stock indices and exchange rate of the ASEAN-5 economies in terms of USD/ASEAN-5 local currency, respectively.
Source: Author's work.

positive FM shocks remain statistically insignificant in affecting the exchange rate. Therefore, the consideration of a particular sample set is also very important before formulizing the contractual forward exchange rate agreements. This is because of the differential FM price jump impact on the FX returns. *Secondly*, regional reserve banks should also consider particular sample settings before implementing either expansionary or tight fiscal as well as monetary policies. This would not only affect the regional equity market returns but also indirectly affect the region ASEAN-5 forex market returns and thereby may have an influence on the global competitive positioning of the region. Apart from PNARDL with pooled mean group approach, we also examined the asymmetric dynamic granger causation between the variables (see Table 8).

According to Table 8, positive shocks in the ASEAN-5 regional equity market returns granger cause positive and negative shocks in the exchange rate during pre-economic crunch, whereas negative price jumps in the equity returns cannot be able to granger cause the exchange rate variations. This furthermore confirms the presence of asymmetries. On the other side, both the positive and negative thresholds of the equity market return granger caused positive as well negative shocks in the ASEAN-5 FX market. This shows that exporters, importers, and regulators need to emphasize the particulate sample period while formalizing contractual agreements on forward exchange rates and implementing expansionary fiscal or monetary policies within the region, respectively. These findings have real consequences for investors, as the

industrialized economies, particularly the United Kingdom, are on the verge of a novel but more severe financial catastrophe following Covid-19.

5. Conclusion with future research directions

Prior studies mainly examined the symmetric or asymmetric transmission of shocks from the forex market returns towards the FM and ignored the asymmetric transmission mechanism from the FM towards the forex market returns of ASEAN-5 economies. Moreover, prior studies ignored the role of the fiscal crisis in effecting the asymmetric transmission of FM shocks and also focused on the individual economy's aggregate equity market returns rather than the role of regional FM returns in causing the local currency deflation. We have applied the panel-based ARDL and NARDL framework with mean and pooled mean group approach after checking the stationarity behavior of the variables through an advanced 2nd generation panel-based unit root test. Overall findings suggested that in the short run, only negative equity market returns caused depreciation in the local ASEAN-5 currencies during the pre-crisis period, whereas only positive shocks during the post-crisis regime appreciated the local currency of ASEAN-5 member countries. Furthermore, only longer-term negative FM shocks lead to the local currency declination in the ASEAN-5 member economies during the post-crisis period. This shows that not only the FM differential shocks are relevant while confirming the portfolio balanced effect but investors as well as exporters, and importers need to consider the importance of the particulate crisis period while formalizing the forward currency agreements. This research examined the asymmetric shock transmission between FM and currency rates, whereas future studies should examine the role of fiscal as well as monetary policy uncertainty on the dynamic conditional correlation between FX and FM returns.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. According to a report by the Asian Development Bank, the ASEAN-5 countries (consisting of Malaysia, Thailand, Singapore, Indonesia, and the Philippines) have open, medium-sized economies that are greatly influenced by dominant global economic powers like the United States. This means that any shifts or changes in the US economy can have a significant impact on these economies (Han & Ng, 2011). In another study conducted by Kang et al. (2019), the financial market contagion over time between the ASEAN-5 economies and global equity market returns was explored using the methodology developed by Diebold and Yilmaz (2012). This study aimed to understand how changes in the global equity market returns can affect the economies of the ASEAN-5 countries (Kang et al., 2019).
2. https://www.spglobal.com/marketintelligence/en/mi/research-analysis/asean-foreign-direct-investment-inflows-reach-record-high.html
3. Pesaran (2004).

4. World Bank. (2013). International finance corporation (IFC) annual report 2013. Washington DC. Retrieved from http://documents.worldbank.org/curated/en/728101468326955026/Main-report
5. In panel data (PD) situations, MG approach compensates for calculating heterogeneously by averaging the individual coefficients (Pesaran & Smith, 1995). Large macro-PD sets often have temporal dimensions longer enough to do separate regression analysis on each individual coefficient in the cross-sectional (CS) unit. CS dependencies are also possible since CS units may display correlational properties with one another. This is owing to some typically connected unobserved components that may influence each of the cross-sectional units as a result of varied technology developments, geographical and geopolitical positions of the cross-sectional units, and so on. These widely observed relevant characteristics may be excluded from the calculated dynamic regression models and may correlate with regressors. In this circumstance, the MG estimator becomes erroneous and may be incapable of producing efficient and robust findings. Pesaran (2006) devised a method for dealing with the circumstance by averaging the dependent and independent variables of numerous cross-sections. This may lead to unbiased estimate via model augmentation in the form of "common correlated effects," and is known as PMG estimators.

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