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Exchange Rate Changes and Trade Flows in East Asia

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Abstract: This study investigates the impact of exchange rate changes on trade flows among East Asian countries spanning 1990–2021, using pooled mean group estimator, within the framework of panel data analysis. Findings indicate that world income, trade openness, and the real effective exchange rate strongly affect trade balance, and that the real depreciation of exchange rate exerts strong positive benefits on trade flows in the long run. The study also infers that trade openness and real effective exchange rate had strong influence on exports and imports for Hong Kong, Japan, and South Korea in the short run. However, the depreciation of their currencies discouraged imports in the long run. More so, world income strongly affects the exports and imports of Hong Kong and Japan, while trade openness is advantageous for all the countries. The study recommends the continuation of the prevailing trade-growth pattern, and the existing bilateral pegged exchange rate policy with their trading partners.

Keywords: asymmetry; East Asia; exchange rate; trade flows.

JEL classification: F14; F31; O24; P33; P45.

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1. INTRODUCTION

Since the breakdown of the Bretton Woods Agreement, characterized by the Nixon crisis of the 1970s, there appeared to be a dramatic shift from the fixed to the floating exchange rate regimes globally. Monetary authorities all over the world simultaneously adopted either the flexible or managed float regimes at one point in time or the other. A common feature with the flexible regime is its high susceptibility to incessant fluctuations with its attendant implications on a range of macroeconomic fundamentals, such as trade flows. Trade flows, has to do with the sum total of the transactions and movement of goods and services between one country and another (Doojav, 2018; Gbaka *et al.*, 2023).

One prominent feature with both developed and developing economies was the systematic devaluation or depreciation of their currencies relative to US dollar as a trade-enhancing measure. Against the backdrop of persistent negative balance of payments crises experienced, most developing economies (East Asia inclusive), embarked on the depreciation or devaluation of their local currencies in order to boost their export and curtail imports. However, devaluation can only yield positive tangible impact on trade balance and output if and only if the sum of elasticities of exports and imports for a country exceed unity, which is in consonance with the postulations of the Marshall-Lerner condition. The J-curve hypothesis on the other hand emphasizes an initial fall in the value of domestic output and trade balance, following the depreciation/devaluation of a nation's currency, up to a minimum point, after which trade output rises with trade balance, thus conforming to an identical J-shaped curve. However, the validity or otherwise of these models has constituted an unresolved debate in the literature. For instance, Doojav (2018), Karamelikli and Ongan (2022), Guo (2020), Adhikari (2018), Iqbal *et al.* (2015), and Choi (2012) for Marshall Lerner condition, and Ijirshar *et al.* (2023), Jain and Das (2022), Bahmani-Oskooee *et al.* (2020), Duru *et al.* (2022) for the case of J-curve hypothesis.

Some related studies such as Shahbaz *et al.* (2012) and Baharumshah (2001) found no support for the J-curve, with Shahbaz *et al.* concentrating on the real exchange rate and trade balance relationship in Pakistan, and Baharumshah examining the trade dynamics of Malaysia and Thailand with the US and Japan. These studies were limited in terms of the response of exports to changes in exchange rate and the substitution effect of imports leading to the long-run positive benefits of exchange rate changes. Besides, the Marshall-Lerner condition and country-specific effects were limited given the methodologies employed. In alignment with the methodology employed by Baharumshah (2001), and closely related to the current study, Onafowora (2003) concentrated on South-Eastern Asia, distinct from the current study's focus on Eastern Asia. Although Onafowora (2003) traced the effects of shocks on trade balance for each country in South-Eastern Asia, variations in trade composition, trading patterns, and the responsiveness of exports and imports to exchange rate changes may differ among Eastern Asian countries even within the same region. In a similar approach of using generalized impulse response functions, Hacker and Hatemi-J (2004) validated the J-curve for three transitional central European countries, while Barkat *et al.* (2022) confirmed its existence for Gulf Cooperation Council countries using a comparable approach. Other studies examined the asymmetries between exchange rate changes and trade balance (Tochitskaya, 2007; Chang *et al.*, 2018), while others have confirmed the evidence of J-curve (Trinh, 2014).

Exploring specific cases from Eastern Asia, Bahmani-Oskooee and Baek (2016) revealed asymmetric effects in Korea's bilateral trade with the US, while Barkat *et al.* (2022)

extended the analysis to seven Asian countries. These studies, covering Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, and Thailand, identified asymmetric effects in the selected Asian economies. Recognizing the uniqueness of each country in its trade responses to exchange rate changes, as well as the trade pattern and composition of these Asian countries, it has become imperative to unravel these conjectures and add to the existing debate on the subject matter in the light of the East Asian region.

Recent developments reveal that Asian countries feature prominently in the global business arena, and are fast becoming a global business hub. Most economies in East Asia particularly are either developed, developing or transition countries. Not only that they have increasingly opened up their economies to international trade participation and are major trade partners to the EU, Euro-Asian region, USA and Africa (Wilson *et al.*, 2003), they are also key players in the virtual market, portfolio investment and foreign direct investment. Changes in exchange rates due to its depreciation is expected to produce both symmetric and asymmetric impact on trade flows and output. Earlier studies in the 1970s concluded that its impact on trade is always expected to be negative. However, the works of de Azevedo *et al.* (2023), and Bahmani-Oskooee and Payesteh (1993) later confirmed the possibility of a positive impact.

The East Asian region comprises such countries as China, Hong Kong, Japan, Macau, Mongolia, North Korea, South Korea and Taiwan. With a landmark of 11,840, 000 square kilometers and an estimated population of about 1.69 billion people (United Nations, 2023 Estimates), the region is home to developed, transition and low income economies. These countries witnessed tremendous productivity growth in recent times, amidst exchange rate depreciation/devaluation of their local currencies. Innovations in the form of banking revolution, Research & Development (R&D), technological advancement, internet revolution and e-commerce have witnessed tremendous transformations in the region, especially in the last three decades. Taiwan and Hong Kong, currently classified as high income economies for instance, are labelled among the “Four Asian Tigers”, with massive magical transformation from typical underdeveloped to the verge of becoming developed economies (Hamadeh *et al.*, 2022). China is an upper middle income country, while Japan, another high income economy is currently being reckoned among the developed economies of the world. Mongolia, a resource-rich economy is ranked as the lower middle income economy since 2015 (Hamadeh *et al.*, 2022), just as South Korea and Macau are equally high income economies, with only North Korea ranking as a low income economy. It is equally on record that Asian advanced economies and China have recently emerged as the *innovation hubs* of the world, with about 57% of all global patents and 58% of the entire patents for digital technologies in 2020. Conversely, other Asian emerging market and developing low income economies are severely lagging in terms of innovation, accounting for a negligible share of 1% and 0.3% respectively for the same year (IMF, 2022).

Apart from Mongolia, the rest of the countries witnessed significant positive trade balance between 2011 and 2021, with slight fluctuations. Statistics from the World Bank (2022) Database reveal that the average net trade in goods over the period rose to US $5.56 billion for Hong Kong, US $2.70 billion for China, US $2.57 billion for Macau, US $0.24 billion for North Korea and US $5.25 billion for South Korea. On the other hand, Mongolia, and Japan suffered a decline in merchandize trade to the tune of US $-3.84 billion, and US $-4.19 billion respectively within the same decade. However, it is not very clear whether the giant economic feat simultaneously attained by these economies is connected with the persistent depreciation of their local currencies. This informs the motivation behind this study.

Moreover, the conflicting submission about the impact of exchange rate fluctuations on trade flows remains a hot debate in the literature (Perée and Steinherr, 1989; Chowdhury, 1993; Stokman, 1995; Kearns and Patel, 2016; Yakub *et al.*, 2019; Ijirshar *et al.*, 2023).

Arising from the above premise therefore, the following pertinent questions have been posed; 1. What has been the driving force of favourable trade flows achieved among the East Asian economies in recent times? 2. Has devaluation/depreciation as a market penetration strategy actually been instrumental in accelerating and sustaining the favourable trade position recorded by these economies? 3. Does the trade pattern of the East Asian economies satisfy the Marshall-Lerner condition and hence, exhibited the J-curve hypothesis? The actual impact of exchange rate fluctuation on trade flows, particularly in the East Asian region also appears to be lacking in the literature due to the mixed findings by previous studies. This study therefore fills this gap by determining whether or not devaluation as a market penetration strategy has actually been instrumental to accelerating and sustaining the pace of favourable trade position achieved in recent times by the East Asian economies, with particular focus on examining the asymmetric influence on the disaggregated values of trade flows (trade balance, imports, and exports), while accounting for specific country effects and heterogeneity among the countries using panel nonlinear autoregressive distributed lag (NARDL) approach. To do this, the study is structured into six sections. Section 2 deals with theoretical framework as well as with the review of empirical literature. The methodology of this study is captured in Section 3. While Section 4 deals with data presentation and analysis, Section 5 concludes and recommends policy implications for the regional economy.

2. LITERATURE REVIEW

2.1 Theoretical framework

This study employs a blend of theories to elucidate the intricate relationship between fluctuations in exchange rates and trade flows. The Purchasing Power Parity (PPP) theory, originating from the Salamanca School in 16th-century Spain and later refined by Cassel in 1918, posits that the nominal exchange rate between two currencies should mirror the ratio of aggregate price levels in their respective nations. This concept implies that a unit of currency from one country should have equivalent purchasing power in a foreign country. This theory links a country's current account transactions to foreign exchange market dynamics, drawing parallels to the "law of one price" model, which asserts that identical goods should share the same price in distinct markets. Despite criticisms for its static assumptions and disregard for non-trade-related exchange rate influences, PPP remains a valuable tool to understand currency value instability and its relation to inflation differentials.

The International Fisher Effect (introduced by Fisher in 1929) offers an alternative perspective, attributing exchange rate volatility to expected inflation rates and the gap between real and nominal interest rates, while highlighting the significance of interest rate parity. This theory underscores the role of interest rates and inflation expectations in driving exchange rate movements. While PPP focuses on price level differentials, the International Fisher Effect draws attention to interest rates and their impact on exchange rate behavior. Both theories provide valuable insights into understanding exchange rate dynamics, each offering a unique lens through which to analyze the complex interplay of factors shaping trade flows and currency values in the global economy.

The theory of comparative cost advantage (advanced by Ricardo in 1817), stresses the very precipitating factors upon which international trade flows is anchored. It attributes trade flows between East Asian countries and other nations for instance, to be primarily induced by factors such as variation in natural resource endowments and differences in the relative cost of production of commodities in those nations, which may partially be attributed to exchange rate variations. This would naturally foster division of labor, specialization and maximize world output and welfare. If the comparative cost advantage theory were to be strictly maintained by nations as a guiding principle of international trade, all nations would have possibly attained favorable exchange rates, since each nation's exports would reflect the world's real aggregate demand for her products, while her imports would be her demand for world output, which would in turn naturally cause the nation's exports to exceed her imports, thus, maintaining a favorable balance of payments and her long run real exchange rate stability. This would definitely minimize excessive volatility in the exchange rate of the domestic currencies of Asian economies for instance against other foreign currencies.

The J curve hypothesis (introduced by Davies in 1962) reveals an initial sharp fall in a country's trade balance due to exchange rate depreciation, accompanied by a substantial improvement in the long run. It is often used to observe the impact of a weaker currency on the trade balance of a country. It shows that depreciation/ devaluation immediately ameliorates a nation's trade balance by causing exports to be dearer and imports to be cheaper, hence trade deficit (or a negligible trade surplus). Afterwards, export volume increases gradually proportional to its prices. Consequently, the demand for domestic goods rises since they are comparatively cheaper than imports. However, trade balance recovers due to a rise in net positive returns to equity investment and diversification, which widens the productive base and hence, boots national productivity in the long run. It is not yet clear if the sustained economic progress apparently witnessed among the East Asian economies is in conformity with the postulations of the J curve hypothesis, given the simultaneous depreciation in their national currencies, especially in the last three decades. This study is therefore an attempt to verify the validity or otherwise of this model, in the context of the East Asian countries. The Marshall-Lerner condition (propounded by Marshall and Lerner in 1870), states that depreciation/devaluation of a country's currency can only be beneficial to such a country only if the sum of elasticity of its absolute imports and exports is greater than unity (Bahmani-Oskooee *et al.*, 2013). Though sharply criticized by scholars such as Choi (2012), due to misleading assumptions and the use of "absolute" as opposed to the "relative prices" of imports and exports, the model still remains a useful tool for analyzing exchange rate dynamics as well as policy prescription in a typical economy.

2.2 Review of related empirical literature

The empirical review section is considered under the following strands; the nature of the impact or relationship between exchange rate fluctuations and trade flows in perspective, the transmission channels involved, the degree of asymmetry and the persistence or strength of the volatility. Recently, literature has increasingly shifted focus to capture a unique aspect of international economics which has to do with the response of trade flows to persistent fluctuations in exchange rate. The universal submission by earlier empirical studies in the 1960s up to the 1980s generally indicated that exchange rate fluctuations negatively impacted on trade flows (Bahmani-Oskooee *et al.*, 2020). Such studies claimed that since exchange rate fluctuation is associated with uncertainty and, hence fuels business risk, its trade impact is always certainly expected to be adverse. Recent theoretical and empirical developments have however proven the possibility of the positive impact of exchange rate fluctuations on trade flows, due to changes in expectation and business forecast that often accompany exchange rate uncertainty. The pioneer works of Perée and Steinherr (1989) provided such empirical support. Thus, depending on the degree of uncertainty and traders' reaction to risk, there is the possibility of changes in exchange rates rather boosting trade. Generally, exchange rate fluctuation is said to constitute risk to business transaction. A trader's response to exchange rate fluctuation is a function of his attitude towards the risk of uncertainty (De Grauwe, 1988). A risk averse trader may tend to avoid risk as exchange rate fluctuation intensifies. Studies have equally alluded to the fact that instability in exchange rate may pose significant risk to business transaction and forecast, thus increasing the chance of uncertainty and negative impact on trade flows. This is applicable to both bilateral and multilateral trade engagements (Perée and Steinherr, 1989; Chowdhury, 1993; Stokman, 1995; Kim and Lee, 1996; Dell'Ariccia, 1998; Yakub *et al.*, 2019; Gbaka *et al.*, 2023). Moreover, some empirical studies treat the trade flow impact of exchange rate volatility from the perspective of either a single country versus the rest of the world; in terms of aggregated bilateral trade flow relations or nominal trade flows involving any two countries.

The impact of exchange rate on the trade balance has been extensively treated in the literature (Baharumshah, 2001; Onafowora, 2003; Hacker and Hatemi-J, 2004; Tochitskaya, 2007; Trinh, 2014; Bahmani-Oskooee and Baek, 2016; Bahmani-Oskooee and Kanitpong, 2017; Chang *et al.*, 2018; Barkat *et al.*, 2022). The general submission is that fluctuation in exchange rate, occasioned by depreciation or appreciation significantly influence trade balance, with variations in the direction and magnitude of impact. For instance, while there was no clear evidence of the J-curve effect established (Baharumshah, 2001; Shahbaz *et al.*, 2012). However, in another strand of empirical literature, the J-curve hypothesis and Marshall-Lerner condition were confirmed (Onafowora, 2003; Hacker and Hatemi-J, 2004; Trinh, 2014; Barkat *et al.*, 2022). Tochitskaya (2007) established a positive influence of exchange rate depreciation on trade balance both in the short and long run, whereas Chang *et al.* (2018) and Bahmani-Oskooee and Kanitpong (2017) obtained asymmetric effects, with only exchange rate appreciation imposing significant effect.

The argument that volatility engenders symmetric behavior in most financial variables, such as exchange rate is also established in the literature. But the effects of exchange rate volatility on trade flows are not just symmetric. Central Banks have developed a means of curtailing the impact of volatility of trade flows via strict monitoring and swift response system; For instance, if the central bank perceives trade flows to fall by 2% due to a rise in exchange rate fluctuation, it may respond accordingly by increasing trade flows by 2% within the period, thus producing asymmetric effects (Kearns and Patel, 2016). Also, not only do domestic prices respond to exchange rate volatility in an asymmetric manner, but import and export prices (Bussiere, 2013) and then the trade balance equally follows suit. Conversely, Bahmani-Oskooee and Payesteh (1993) and Bailey *et al.* (1986) could not obtain a negative relationship between exchange rate fluctuations and trade flows. Frankel and Wei (1993) found contradicting results. Earlier, Thorbecke (2011) had established a close functional link between exchange rate fluctuations and the degree or pattern of trade flows particularly among the East Asian economies.

On the channels of transmission of exchange rate fluctuation to trade flows, Kearns and Patel (2016) identified the working capital channel and financial channel. Exchange rate fluctuations are influenced by factors like government expenditure, money supply, terms of trade, and output shocks (Alagidede and Ibrahim, 2016), as well as government policy and regime type (Mpofu, 2016). In terms of the regime type, such studies are unanimous in their submission that exchange rates are generally more prone to fluctuations during flexible than fixed regimes, though the former is perceived to be relatively more beneficial to the economy.

Earlier studies primarily relied on the Marshall-Lerner condition to gauge the trade impact of exchange rate fluctuations (Arora *et al.*, 2003). The validity or otherwise of this model has been verified by several empirical studies, though there are differences in submissions. A group of scholars have confirmed that the model holds. For instance, see Doojav (2018) for the case of Mongolia using VECM model, Karamelikli and Ongan (2022) for South Korea versus Japan, using ARDL, Panda and Reddy (2016) for India-China trade relations between 1987-2014 using ARDL and Nakatani (2018), using Papua New Guinea as a case study. Other similar findings include Guo (2020) for China involving the period of 2008-2018, using ARDL, though it only validates the traditional as opposed to the so-called generalized model, Iqbal *et al.* (2015) involving multilateral transaction between Pakistan and its ten major trading partners between 1980-2013 but only for 6 trading partners out of the ten sampled countries (US, UK, South Arabia, China, Canada and France). Also, Ali *et al.* (2022) found evidence in support for the Marshall-Lerner condition for 7 disaggregated countries (Japan, China, Kuwait, Germany, US, Saudi Arabia and Italy) and Duru *et al.* (2022) for Nigeria in the long run. Conversely, Adhikari (2018) invalidates the model for the case of US-China trade ties, using VECM model, Guo (2020), Iqbal *et al.* (2015) for Pakistan and its 4 trading partners (Japan, Germany, UAE and Kuwait), Panda and Reddy (2016), Vieira and MacDonald (2016) for 106 selected countries for 2000-2011 and Panda and Reddy (2016), using the ARDL methodology in the long run. Choi (2012) had earlier provided a theoretical and deductive proof that it is practically impossible for devaluation to improve a country’s trade balance, even if the Marshall-Lerner condition holds. Instead, it would either reduce or worsen it.

The Marshall-Lerner condition is however considered to be grossly inadequate in adjudging the overall impact of exchange rate fluctuation on the trade balance. This is because, the actual transmission impact usually takes time due to the contract acquisition and execution process, the lag required to adopt and expand the exportable sector and the market adjustment mechanisms (such as the response of the stock market to spot returns on financial assets/portfolio). To arrive at a more balanced analysis therefore, the J curve hypothesis has to be estimated, as it provides a more realistic framework for depicting the long run adjustment of trade balance to changes in exchange rates. This study is therefore an attempt to fill this vital gap in the context of the East Asian economies by testing for the validity of the two models in the region.

The validity of the J curve hypothesis remains a contested issue, supported by studies like Jain and Das (2022), Hsing (2005), and others, while some affirm it only in the short run (Wang *et al.*, 2012; Bahmani-Oskooee *et al.*, 2017). Certain cases show validation in both short and long runs (Panda and Reddy, 2016; Ongan *et al.*, 2018), but others find no evidence for it (Singh, 2004; Duru *et al.*, 2022). These variations might arise from methodological choices, sample frames, or economic differences. This study contributes to the debate by re-evaluating the Marshall-Lerner condition and J curve hypothesis within East Asian economies, acknowledging that outcomes hold regardless of economic nature or development level.

3. RESEARCH METHODOLOGY

3.1 Data description

The study utilized annual panel data spanning from 1990 to 2021, obtained from World Development Indicators. The dataset encompassed several variables, including the real effective exchange rate (measured as an index), trade openness (expressed as a percentage of GDP), and world real GDP (measured in billions of current US dollars), which were employed as explanatory factors. Additionally, trade balance (BoP, current US$) in billions, exports of goods and services (BoP, current US$) in billions, and imports of goods and services (BoP, current US$) in billions were utilized as proxies for trade flows. To determine the elasticities, all variables, except for trade openness, were logarithmically transformed.

3.2 Model specification

To analyze the impact of the exchange rate on trade flows, this study follows the model previously employed by Serenis and Tsounis (2014) and Ijirshar *et al.* (2023) who assert that trade flows are determined by exchange rate and world real GDP, while incorporating trade openness as one of the explanatory variables of trade flows. Therefore, in order to accurately represent the functional relationships and capture the impact of the real effective exchange rate on trade balance (TBAL), as well as exports (EXPT) and imports (IMPT) as proxies for trade flows, both symmetric (equations 1 to 3) and asymmetric (equations 4 to 6) forms are considered (expressed in natural logarithm) as:

$$\ln TBAL_{it} = f\left(\ln REER_{it},\ OPEN_{it},\ \ln \mathrm{WRGDP}_{it}\right) \quad (1)$$

$$\ln EXPT_{it} = f\left(\ln REER_{it},\ OPEN_{it},\ \ln \mathrm{WRGDP}_{it}\right) \quad (2)$$

$$\ln IMPT_{it} = f\left(\ln REER_{it},\ OPEN_{it},\ \ln \mathrm{WRGDP}_{it}\right) \quad (3)$$

$$\ln TBAL_{it} = f\left(\ln REER\_POS_{it},\ \ln REER\_NEG_{it},\ OPEN_{it},\ \ln \mathrm{WRGDP}_{it}\right) \quad (4)$$

$$\ln EXPT_{it} = f\left(\ln REER\_POS_{it},\ \ln REER\_NEG_{it},\ OPEN_{it},\ \ln \mathrm{WRGDP}_{it}\right) \quad (5)$$

$$\ln IMPT_{it} = f\left(\ln REER\_POS_{it},\ \ln REER\_NEG_{it},\ OPEN_{it},\ \ln \mathrm{WRGDP}_{it}\right) \quad (6)$$

where $\ln$ is the natural logarithm, $TBAL$ is trade balance, $REER$ is the real effective exchange rate, $REER\_POS$ is positive changes in the real effective exchange rate, $REER\_NEG$ is negative changes in the real effective exchange rate, $OPEN$ is trade openness, and WRGDP is world real gross domestic product. Anticipating the effects of explanatory variables, a positive influence on trade balance and exports is expected from the real effective exchange rate if the combined elasticity of exports and imports to exchange rate changes surpasses 1, indicating elasticity. Conversely, if this elasticity is below 1, the net impact on trade balance may be negative. Additionally, increased world real GDP and trade openness are foreseen to positively affect trade flows. The stochastic form of the symmetric models and the asymmetric models for equation (1) and equation (6) gives:

$$\ln TBAL_{it} = \alpha_0 + \alpha_1 \ln REER_{it} + \alpha_2 \ln OPEN_{it} + \alpha_3 \ln WRGDP_{it} + \varepsilon_{it} \tag{7}$$

$$\ln EXPT_{it} = \beta_0 + \beta_1 \ln REER_{it} + \beta_2 \ln OPEN_{it} + \beta_3 \ln WRGDP_{it} + \varepsilon_{it} \tag{8}$$

$$\ln IMPT_{it} = \omega_0 + \omega_1 \ln REER_{it} + \omega_2 \ln OPEN_{it} + \omega_3 \ln WRGDP_{it} + \varepsilon_{it} \tag{9}$$

$$\ln EXPT_{it} = \alpha_0 + \alpha_1 \ln REER\_POS_{it} + \alpha_2 \ln REER\_NEG_{it} + \alpha_3 \ln OPEN_{it} + \alpha_4 \ln WRGDP_{it} + \varepsilon_{it} \tag{10}$$

$$\ln EXPT_{it} = \beta_0 + \beta_1 \ln REER\_POS_{it} + \beta_2 \ln REER\_NEG_{it} + \beta_3 \ln OPEN_{it} + \beta_4 \ln WRGDP_{it} + \varepsilon_{it} \tag{11}$$

$$\ln IMPT_{it} = \omega_0 + \omega_1 \ln REER\_POS_{it} + \omega_2 \ln REER\_NEG_{it} + \omega_3 \ln OPEN_{it} + \omega_4 \ln WRGDP_{it} + \varepsilon_{it} \tag{12}$$

where α_0 is the intercept, while $\alpha_1 - \alpha_3$, $\beta_1 - \beta_3$ and $\omega_1 - \omega_3$ are parameters for symmetric equations (6 to 9) while $\alpha_1 - \alpha_4$, $\beta_1 - \beta_4$ and $\omega_1 - \omega_4$ are parameters for asymmetric equations (10 to 12). $\alpha_0, \beta_0,$ and ω_0 are the intercepts, $\varepsilon_{it} = \mu_i + \eta_{it}$, β_0 =intercept, $\beta_1 - \beta_{10}$ =parameter to be estimated, μ_i =individual specific effect or fixed effects and η_{it} = idiosyncratic error, $i = 1,...,4,\ t = 1,...,32$. The above models have been employed to analyze the dynamic relationship between exchange rate changes and trade flows in four East Asian countries including China, Hong Kong, Japan and South Korea. It therefore follows that in the symmetric models (equation 7-9), the following *a priori* expectations are anticipated: In equation (7), REER< 0; OPEN>0 and WRGDP>0. In equation (8), REER<0, OPEN>0 and WRGDP>0. In equation (9), REER>0; OPEN>0; WRGDP>0.

The real effective exchange rate is expected to exert negative influence on exports and trade balance but positive influence on imports of goods and services. This is because an increase in the Real Effective Exchange Rate (REER) suggests an appreciation of the country's currency in real terms. Thus, when the REER increases, it indicates that the country's currency has strengthened in relation to the basket of foreign currencies, considering both exchange rate movements and changes in relative price levels. The implication is that the nominal exchange rate appreciates making imports cheaper for domestic consumers but reducing the competitiveness of the country's exports in global markets. This means that the country's goods and services become more expensive for foreign buyers when measured in a common currency. Consequently, it discourages exports of goods and services but encourages imports of goods and services.

The trade openness is expected to exert positive influence exports and trade balance and negative influence on imports of goods and services. This is because increased trade openness often means that a country is opening up its markets and reducing trade barriers. This provides domestic exporters with expanded access to international markets, allowing them to reach a broader customer base. Consequently, exporters are likely to find more opportunities to sell their goods and services in foreign markets. This can lead to an increase in export volumes as businesses take advantage of the newly accessible markets. While increased exports are a positive outcome, the overall impact on the trade balance depends on various factors, including the responsiveness of imports to changes in trade openness and the economic conditions of trading partners. But an increase in trade openness implies greater engagement in international trade, which can affect both exports and imports. The direction of the impact on the trade balance depends on how these two components respond.

The expected impact of world real Gross Domestic Product (GDP) on exports of goods and services and the trade balance is positive. This is because an increase in world real GDP leads to higher demand for goods and services across countries, positively influencing country's exports. This implies the expected impact of world real GDP on exports and the trade balance is generally positive, indicating increased global economic activity and demand for goods and services. On the other hand, the real Gross Domestic Product (GDP) is expected to exert positive influence on imports of goods and services. This is because a higher real GDP often implies increased consumer purchasing power and demand for a broader range of goods and services. Thus, as domestic consumption rises, there may be an increased need to meet this demand through imports, especially for products not readily available or competitively produced domestically.

3.3 Variable description

This study employed this study are presented in Table no. 1 as follows.

Table no. 1 – Description of Variables in the Study

S/N	Variable	Description	Measurement of Variable
1	TBAL	Trade balance	Expressed as the difference between a country's imports and exports in current US$ in billions
2	REER	Real Effective Exchange Rate	Measured as an index, which is expressed as the product of the exchange rate and the ratio of the foreign to domestic prices, multiplied by 100.
3	OPEN	Trade Openness	Determined as the ratio of the sum of export and import to GDP, and expressed as a percentage.
4	WRGDP	World Real Gross Domestic Product	Measured in billions of current US dollars
5	EXPT	Exports	Measured in Billions (BoP, current US$)
6	IMPT	Imports	Measured in Billions (BoP, current US$)

Source: authors' construction

3.4 Techniques of data analysis

The study begins by examining descriptive statistics and conducting various unit root tests, including Harris-Tsavalis, Breitung, Levin-Lin & Chu panel unit root tests, Im-Pesaran-Shin, ADF Fisher panel unit root tests, and Pesaran CD Test. The results confirm no common unit root process through the Hadri Lagrange Multiplier Stationarity test. The pooled mean group estimator and mean group estimator within non-stationary heterogeneous panel models are utilized, guided by the Hausman test. Granger noncausality is assessed using the Half-Panel Jackknife (HPJ) Wald-type test, and cross-sectional independence is evaluated using Pesaran's test.

4. RESULTS AND DISCUSSION

The findings and analysis are outlined in the following manner.

4.1 Overview of Statistics

Table no. 2 presents the results obtained from the descriptive statistics.

Table no. 2 – Descriptive statistics

	Overall		**China**		**Hong Kong**		**Japan**		**Korea**	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
TBAL	73.62	86.09	125.99	122.75	14.72	8.56	124.11	52.88	29.67	37.26
REER	110.37	21.46	100.34	15.81	117.78	18.05	98.08	18.52	125.27	20.53
OPEN	114.62	126.40	41.47	11.37	320.22	75.62	25.77	7.22	71.02	16.86
EXPT	651.45	656.88	1183.15	1086.18	373.11	206.41	658.37	204.47	391.17	248.51
IMPT	603.49	588.60	1041.68	978.95	367.42	202.85	644.87	228.48	359.98	221.24
WRGDP	58525.14	15936.10	58525.14	16127.73	58525.14	16127.73	58525.14	16127.73	58525.14	16127.73

Source: STATA 15 output

Results of the descriptive statistics in Table no. 2 reveal that world real gross domestic product (WRGDP) has the overall highest mean of US$58, 525.14 billion, with foreign direct investment (FDI) yielding the least average value of US$50.4836. The series has a highest spread for gross fixed capital formation (GFCF) and the lowest spread for real effective exchange rate (REER). Further results indicate that the average trade balance recorded in the East Asian region stands at US$73.62251. Mean real effective exchange rate (REER), openness index, gross fixed capital formation (GFCF) and foreign direct investment (FDI) for the region within the study period stands at US$110.3664, US$114.6218, US$959.8791 and US$50.4836 respectively. Also, mean real gross domestic product (RGDP) recorded is US$2917.962. Empirical evidence further indicates that the region witnessed more average export than import within the study period.

In terms of individual country performance, all the sampled countries recorded average favorable trade balance with China having the highest value of US$125.9908, followed by Japan with US$124.1123, while Hong Kong recorded the lowest average favorable trade balance of US$14.71617. Similarly, the highest export value was recorded by China (with the average of US$1183.152) as against Hong Kong which witnessed the lowest export performance of US$373.1075. However, China witnessed the highest average imports of US$1041.675 with the least average value of US$367.4199 from Hong Kong.

Hong Kong exhibited a high trade openness index of 320.22% of GDP, while China had a relatively lower index of 41.47%. A higher index indicates stronger trade influence on the economy. East Asian economies generally demonstrated openness to international trade during the study period. Japan's real effective exchange rate (REER) stood below 100 basis points, signaling a robust yen value. Positive Gross Fixed Capital Formation (GFCF) was evident in the region, with China leading at a mean value of US$2189.93. Population values mirrored the same pattern, aligning with other variables, and China had the highest population.

4.2 Results of panel unit root tests

The outcomes displayed in Table no. 3 provide evidence of the variables' stationarity as determined by the panel unit root tests. These results were utilized to ascertain the integration order of the variables. According to Table no. 3, the real effective exchange rate (LREER), openness (OPEN), and imports (LIMPT) were found to have first-order integration (I(1)) across all conducted tests. Conversely, other variables such as trade balance (LTBAL), exports (LEXPT), and world real gross domestic product (LWRGDP) achieved a mixed order of integration (both I(0) and I(1) processes). This implies that, except for world real gross domestic product and export of goods and services (LEXPT) as indicated by the Levin-Lin-Chu unit-root test, all other variables possessed unit roots at levels. However, after taking the first difference, all variables with unit roots achieved integration. To ensure dependable and robust results, non-stationary heterogeneous panel models were employed for estimating the panel. Optimal models were determined based on the Schwarz information criteria (SIC) results.

Table no. 3 – Panel Unit Root Test Results

S/N	Test Method	LTBAL	LREER	OPEN	LEXPT	LIMPT	LWRGDP
1	**Unit root with common process (Ho: Panels contain unit roots)**						
	Harris-Tsavalis (rho)	0.7270***a	0.2295***b	0.1362***b	0.0888***b	0.0874***b	-0.1496***b
	Breitung (t-stat) (Lambda λ)	-7.5128***b	-4.3724***b	-6.5822***b	-7.1990***b	-7.0133***b	-5.7727***b
	Levin, Lin& Chu (t*)	-4.5305***b	-4.7557***b	-3.9030***b	-1.6858**a	-6.1244***b	-1.7457**a
2	**Unit root with individual process (Ho: All panels contain unit root)**						
	Im-Pesaran-Shin (z-t-tilde-bar)	-6.1331***b	-4.7164***b	-5.3689***b	-5.7241***b	-5.7145***b	-6.4954***b
	ADF Fisher (Chi square P)	55.2140***b	-47.6019***b	-43.5089***b	58.1205***b	67.2360***b	62.7714***b
3	**Unit root with cross sectional dependence (Ho: Panels contain unit root or they are homogenous)**						
	Pesaran CD Test [z(t-bar)]	-3.081***b	-4.052***b	-2.752***b	-1.886***b	-2.978***b	
4	**No unit root with common unit root process (Ho: All panels are stationary; Ha: Some panels are stationary)**						
	Hadri (2000) Lagrange	-21.3572***	-16.8746***	31.8933***	38.3923***	38.1130***	39.5084***
	Multiplier Stationarity test (z)	-1.7810b	-0.1675b	-0.5731b	0.4120b	-0.3534b	-1.2375b
	Remarks	Stationary Mixed	Stationary I(1)	Stationary I (1)	Stationary Mixed	Stationary I(1)	Stationary Mixed

Note: The asterisk (*** ** and *) denotes rejection of the null hypothesis at 1%, 5% and 10% level of significance, while a and b indicate stationarity at level and first difference respectively.

Source: STATA 15 output.

4.3 Results of Panel Cointegration Test

Given that there is no evidence of asymmetric effect in the models, the study estimated and presented only the cointegration results of the symmetric model as shown in Table no. 4.

Table no. 4 reveals the result of the cointegration test of the symmetric models. The information indicates that for the trade balance model (LTBAL Model), the results of the Kao test statistics are statistically significant at 1% significant level. However, the Pedroni and Westerlund statistics are not statistically significant at 1%, 5% or 10% levels. None of the tests showed significant results for exports model (LEXPT Model). However, the results of the imports model (LIMPT Model) show that three statistics proved significant (the ADF t value for both Kao and Pedroni test and the Modified Philip Perron t tests). On the basis of the results, the study concludes that there is evidence of long run cointegration among the variables in the models.

Table no. 4 – Cointegration Test Results (Symmetric Models)

	LTBAL MODEL	LEXPT MODEL	LIMPT MODEL
Kao Test Results			
Modified Dickey-Fuller t	-6.3727***	-0.6436	-0.8941
Dickey-Fuller t	-3.8520***	-1.1576	-1.3995
Augmented Dickey-Fuller t	-3.6274***	-1.5415	-1.7474*
Unadjusted modified Dickey-Fuller t	-6.7122***	-0.1282	0.3404
Unadjusted Dickey-Fuller t	-3.9012***	-0.8877	0.1168
Pedroni Test Results			
Modified Phillips-Perron t	0.1209	1.4778	1.7874**
Phillips-Perron t	-1.1177	0.7220	1.2315
Augmented Dickey-Fuller t	-0.9902	1.2219	1.6056*
Westerlund Test Results			
Gt	-3.138**	-2.598	-2.612
Ga	-6.769	-6.842	-6.197
Pt	-6.634***	-1.755	-2.990
Pa	-14.369**	-3.43	-6.906

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: extracted results from STATA

4.4 Results of Granger causality test

Table no. 5 contains the results of the Granger non-causality tests for the heterogenous panels developed by Juodis *et al.* (2021).

Table no. 5 – Panel Non-Causality Test Results

Causality Flow	Z stat	Prob. value	Decision
H_0: LTBAL does not Granger-cause LREER	1.21	0.225	Accept H_0
H_0: LREER does not Granger cause LTBAL	1.89	0.058*	Accept H_0
H_0: LREER does not Granger cause LIMPT	-2.09	0.036**	Reject H_0
H_0: LIMPT does not Granger cause LREER	-1.57	0.117	Accept H_0
H_0: LREER does not Granger cause LEXPT	-2.68	0.008***	Reject H_0
H_0: LEXPT does not Granger cause LREER	-5.25	0.000***	Reject H_0

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: extracted results from STATA

Table no. 5 demonstrates that a one-way causal relationship exists from the real effective exchange rate to imports. Exchange rate fluctuations concerning foreign trading partners' currency baskets can trigger changes in imports. A country's depreciating exchange rate can increase import costs relative to exports. Similarly, bidirectional causality is confirmed between the real effective exchange rate and exports, indicating that exchange rate fluctuations influence exports and vice versa. Currency devaluation can make exports more affordable, encouraging export sector investments. Conversely, improved export performance raises the local currency's value. Consequently, expansion in the region's export sectors contributes to exchange rate appreciation and alterations in the real effective exchange rate.

4.5 Effects of Exchange rate changes on trade balance among East Asian Countries

Table no. 6 displays the Hausman test outcomes investigating symmetric and asymmetric models on the exchange rate's impact on trade balance within East Asian nations. The test employs chi-square probabilities to identify the preferred estimator. The study favored PMG (pooled mean group (PMG) estimates due to its Hausman test probability value of 0.3313, compared to MG (mean group) and DFE (dynamic fixed effects) estimators. The PMG estimator maintains constant long-run coefficients across countries while allowing short-run coefficient variations. No asymmetry was detected in the exchange rate-trade balance relationship, supported by Wald test values (3.035 and 2.23) and associated probabilities (0.0673 and 0.1352). PMG findings revealed a significant positive impact of world real GDP on East Asian trade balance in the long run (5% significance level). A unit rise in WRGDP corresponds to a 2.047 trade balance increase, aligning with economic theory. A rise in global GDP would imply a boost in the aggregate demand for the export of the East Asian region, and hence promote positive trade balance, thus corroborating the findings of Hacker and Hatemi-J (2004). The massive boost in output of East Asian economies in the wake of the financial crisis witnessed in 1998/99 and 2008 could have accounted for this development. Trade openness displayed a positive, significant influence on trade balance in both short and long runs, with a near asymmetric long-run relationship at a 10% level of significance. The study highlighted a 21.2% yearly adjustment speed in initial distortions. It is noteworthy that most economies in the region increasingly opened up their economies to foreign trade in response to the requirement of membership of the Association of South East Asia (ASEAN) bloc. Given therefore that all the understudied economies are part of the ten-member regional trade arrangement (ASEAN-10), the positive result obtained clearly justifies this trend. The result also conforms with theoretical a priori expectation. Trade openness guarantees increased participation in foreign trade, which in turn fosters expansion in the tradable goods (export) sector and boosts total exports. This finding agrees with that of Bahmani-Oskooee and Kanitpong (2017), but disagrees with the findings of Chang *et al.* (2018). Exchange rate changes exhibited an insignificant negative effect on trade balance in the short run, but a positive impact in the long run, corroborating the findings of (Baharumshah, 2001) and Barkat *et al.* (2022) who confirmed the worsening impact of currency depreciation on trade balance in the short run but a positive impact in the long run in the GCC countries. An increase in the real effective exchange rate (coinciding with the concurrent depreciation) in the local currencies of most ASEAN countries in recent times rather worsened terms of trade for the home countries and exacerbated their trade balance in the short run, perhaps due to some perceived structural imbalances. In the long run however, the response of trade balance to exchange rate adjustments exceeds negative changes, thus confirming the validity of the J-curve hypothesis. Similarly, trade openness's positive and statistically significant influence on trade balance in the long run was emphasized. This implies that trade openness, world real GDP, and exchange rate collectively drive favorable trade outcomes in the long run in the region. These results provide insight into the intricate dynamics of exchange rate and trade balance relationships in the context of East Asian economies.

4.6 Effects of Exchange rate changes on exports among East Asian Countries

Table no. 7 presents the findings from the Hausman test analyzing the impact of exchange rate fluctuations on exports within East Asian nations. The PMG estimator is favored over MG. PMG estimates reveal that the coefficient of the real effective exchange rate (LREER) demonstrates a significant positive relationship at the 10% significance level. This suggests that changes in the real effective exchange rate favorably affect East Asian exports. This outcome implies the region's responsiveness to exchange rate shifts, making exports more affordable internationally. The real exchange rate notably promotes exports in East Asia, aligning with prior studies like Barkat *et al.* (2022), but contradicts Thorbecke (2011)'s finding, while Urgessa (2024) found no significant link between exchange rate changes and exports.

Moreover, the outcome indicates trade openness's (OPEN) substantial positive influence on East Asian exports in both short and long runs. This suggests that increased market access beyond domestic boundaries enhances demand for exports, subsequently boosting export supply. Additionally, heightened trade openness can grant firms access to cost-effective inputs, improving competitiveness in global markets. The results also underscore world real gross domestic product's strong positive influence on East Asian exports, indicating effective global demand for the region's exports. This study contributes to understanding the intricate relationship between exchange rate fluctuations and exports in East Asia, highlighting the significance of exchange rate dynamics and trade openness in driving export outcomes.

4.7 Effects of Exchange rate changes on imports among East Asian Countries

Table no. 8 presents the Hausman test result for impact of exchange rate changes on imports among East Asian countries. The estimations of both symmetric and asymmetric models of the relationship are shown. In comparing the estimates of the PGM and MG estimators, the study preferred the PMG estimates given the Hausman probability value of 0.6344. Taking into account the PMG and DFE estimations, the PMG estimates were again favored for both the symmetric and asymmetric models.

Table no. 6 – Impact of Exchange rate changes on trade balance among East Asian countries

Variables	MG Estimates (Symmetric)	PMG Estimates (Symmetric)	DFE Estimates (Symmetric)	MG Estimates (Asymmetric)	PMG Estimates (Asymmetric)	DFE Estimates (Asymmetric)
Ec	-0.547***	-0.212***	-0.434***	-0.494***	-0.342*	-0.432***
	(0.146)	(0.0797)	(0.0864)	(0.157)	(0.193)	(0.0875)
D.lLTBAL	0.000993	-0.00360**	0.00161	0.00102	0.00234**	0.00159
	(0.00165)	(0.00163)	(0.00113)	(0.00165)	(0.000916)	(0.00115)
D.LREER	-0.849	-1.653	-1.166*			
	(0.612)	(1.033)	(0.640)			
D.OPEN	-0.0177**	0.0124	-0.00150	-0.0324*	0.0403***	-0.00166
	(0.00766)	(0.00943)	(0.00464)	(0.0185)	(0.0138)	(0.00474)
D.LWRGDP	3.644**	5.316*	0.884	6.400	7.244**	1.088
	(1.817)	(3.189)	(3.036)	(5.157)	(2.960)	(3.071)
D.LREER_pos				1.184	2.192	0.709
				(2.817)	(1.847)	(1.311)
D.LREER_neg				-0.829	-1.288*	-0.320
				(0.688)	(0.730)	(0.877)
LREER	-1.543	2.041***	-0.120			
	(0.972)	(0.609)	(0.698)			
OPEN	-0.00834	0.0128***	-0.00429	0.0178	0.0238**	-0.00424
	(0.0230)	(0.00247)	(0.00358)	(0.0132)	(0.0110)	(0.00349)
LWRGDP	2.047**	3.612***	1.989***	2.274**	1.765***	1.992***
	(0.850)	(0.565)	(0.500)	(0.885)	(0.586)	(0.520)
LREER_pos				-4.732	-11.84**	-2.871
				(5.564)	(4.692)	(4.128)
LREER_neg				-3.438	-1.152	-2.818
				(2.721)	(2.745)	(3.023)
Constant	-7.961	-1.501***	-7.147**	-8.825*	-5.748*	-7.379***
	(6.373)	(0.496)	(2.968)	(4.505)	(3.309)	(2.784)
Hausman	PMG VS MG (chi2(3) =3.42)	PMG VS DFE (chi2(3) =2.05)		PMG VS MG (chi2(4) =21.25)	PMG VS DFE (chi2(4) =1.01)	
Prob>chi2	Prob>chi2 = 0.3313	Prob>chi2 = 0.5611		Prob>chi2 = 0.0003	Prob>chi2 = 0.9087	
Long-run Asymmetry (Wald Test)					chi2(1) =3.035	
Prob>chi2					Prob > chi2 =0.0673*	
Short-run Asymmetry (Wald Test)					chi2(1) =2.23	
Prob>chi2					Prob > chi2 =0.1352	

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.
Source: extracted results from STATA output

Table no. 7 – Impact of Exchange rate changes on exports among East Asian countries

Variables	MG Estimates (Symmetric)	PMG Estimates (Symmetric)	DFE Estimates (Symmetric)	MG Estimates (Asymmetric)	PMG Estimates (Asymmetric)	DFE Estimates (Asymmetric)
Ec	-0.225**	-0.182	-0.0276	-0.278**	-0.0602*	-0.0320
	(0.108)	(0.115)	(0.0261)	(0.137)	(0.0317)	(0.0224)
D.lLEXPT	-0.000112	-6.14e-05	-2.92e-05	-0.000132*	-8.27e-05	-6.07e-05
	(7.98e-05)	(0.000117)	(0.000109)	(7.79e-05)	(8.97e-05)	(0.000106)
D.LREER	0.571***	0.489***	0.207*			
	(0.0883)	(0.103)	(0.111)			
D.OPEN	0.0171***	0.0177***	0.00337***	0.0146***	0.0179***	0.00294***
	(0.00654)	(0.00671)	(0.000835)	(0.00495)	(0.00602)	(0.000826)
D.LWRGDP	0.783	0.943	3.111***	0.727	1.135	3.195***
	(0.697)	(0.726)	(0.550)	(0.706)	(0.695)	(0.538)
D.LREER_pos				0.264	0.341	0.631***
				(0.288)	(0.275)	(0.234)
D.LREER_neg				0.0715	0.0558	-0.144
				(0.135)	(0.0828)	(0.155)
LREER	-3.109	-0.0710	-2.601			
	(2.383)	(0.0764)	(4.091)			
OPEN	-0.0247	0.00227***	0.00704	0.0264	0.00512**	0.00762
	(0.0368)	(0.000326)	(0.0121)	(0.0205)	(0.00226)	(0.0104)
LWRGDP	4.197**	1.607***	0.671	2.263***	1.319***	0.105
	(1.911)	(0.0829)	(2.355)	(0.807)	(0.245)	(2.254)
LREER_pos				1.740**	5.075***	-20.01
				(0.849)	(1.872)	(18.30)
LREER_neg				-0.625	6.236***	15.03
				(4.070)	(1.800)	(12.37)
Constant	-3.712***	-2.157	0.256	-3.906**	-0.501*	0.143
	(1.067)	(1.431)	(0.876)	(1.606)	(0.285)	(0.694)
Hausman	PMG vs MG (chi2(3) =1.67)	PMG vs DFE (chi2(3) =0.01)		PMG vs MG (chi2(4) =46.71)	PMG vs DFE (chi2(4) =0.13)	
Prob>chi2	Prob>chi2 = 0.6434	Prob>chi2 = 0.9995		Prob>chi2=0.0000	Prob>chi2 =0.9980	
Long-run Asymmetry (Wald Test)					chi2(1) =0.19	
Prob>chi2					Prob > chi2 =0.6626	
Short-run Asymmetry (Wald Test)					chi2(1) =0.91	
Prob>chi2					Prob > chi2 =0.3401	

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors in parentheses.
Source: extracted results from STATA output

Table no. 8 – Impact of Exchange rate changes on imports among Eastern Asian countries

Variables	MG Estimates (Symmetric)	PMG Estimates (Symmetric)	DFE Estimates (Symmetric)	MG Estimates (Asymmetric)	PMG Estimates (Asymmetric)	DFE Estimates (Asymmetric)
Ec	-0.234***	-0.0672	-0.0762**	-0.0796***	-0.0858*	-0.0627**
	(0.0698)	(0.0463)	(0.0321)	(0.0208)	(0.0445)	(0.0257)
D.lLIMPT	2.17e-05	6.88e-05	6.69e-05	-0.000219***	-0.000152	-6.94e-05
	(5.32e-05)	(7.01e-05)	(0.000131)	(8.11e-05)	(0.000112)	(0.000119)
D.LREER	0.688***	0.620**	0.426***			
	(0.180)	(0.245)	(0.146)			
D.OPEN	0.0186**	0.0196***	0.00391***	0.0180**	0.0213***	0.00331***
	(0.00736)	(0.00616)	(0.00110)	(0.00818)	(0.00670)	(0.00106)
D.LWRGDP	0.297	0.657	3.085***	0.570	0.398	3.173***
	(0.853)	(0.811)	(0.729)	(0.907)	(0.921)	(0.690)
D.LREER_pos				0.561	0.181	0.738**
				(0.577)	(0.267)	(0.301)
D.LREER_neg				0.184	0.218	-0.101
				(0.219)	(0.225)	(0.199)
LREER	-0.507	-0.241	-0.184			
	(0.810)	(0.498)	(1.091)			
OPEN	-0.0334	-0.00425	0.00261	0.00134	0.00746**	0.00236
	(0.0434)	(0.0116)	(0.00500)	(0.0376)	(0.00357)	(0.00569)
LWRGDP	4.236***	2.071***	2.234***	2.431***	1.701***	1.652*
	(1.509)	(0.435)	(0.701)	(0.918)	(0.215)	(0.968)
LREER_pos				-8.460	6.130***	-14.87
				(14.98)	(1.499)	(9.700)
LREER_neg				3.441	6.283***	15.18**
				(4.761)	(1.610)	(7.730)
Constant	-5.577***	-1.005	-1.394	-1.619**	-1.090*	-0.746
	(1.055)	(0.707)	(1.090)	(0.697)	(0.585)	(0.869)
Hausman	PMG vs MG (chi2(3) =1.71)	PMG vs DFE (chi2(3) =0.01)		PMG vs MG (chi2(4) =5.26)	PMG vs DFE (chi2(4) =0.89)	
Prob>chi2	Prob>chi2 = 0.6344	Prob>chi2 = 0.9999		Prob>chi2 = 0.2617	Prob>chi2 = 0.9256	
Long-run Asymmetry (Wald Test)					chi2(1) =0.01	
Prob>chi2					Prob > chi2 =0.9384	
Short-run Asymmetry (Wald Test)					chi2(1) =0.01	
Prob>chi2					Prob > chi2 =0.9190	
Observations	120	120	.	120	120	.

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.
Source: extracted results from STATA output

Table no. 9 – Summary of PMG Estimates for the Three Models (Short-run and Long-run Estimates)

Variables		PMG Estimates for TBAL Model					PMG Estimates for EXPT Model					PMG Estimates for IMPT Model			
	ec	China	Hong Kong	Japan	South Korea	Ec	China	Hong Kong	Japan	South Korea	ec	China	Hong Kong	Japan	South Korea
Ec		-0.352**	-0.229***	-0.0341	-0.863***		0.00429	-0.518***	-0.106**	-0.110***		-0.0125	0.0311	-0.118**	-0.169**
		(0.166)	(0.0724)	(0.0455)	(0.188)		(0.0230)	(0.123)	(0.0504)	(0.0255)		(0.0387)	(0.0706)	(0.0597)	(0.0809)
D.lLTBAL		0.000678	-0.00329	0.000859	0.00512										
		(0.00124)	(0.00432)	(0.00133)	(0.00793)										
D.lLEXPT							0.000258*	-2.98e-05	-0.000227*	-0.000246					
							(0.000138)	(0.000141)	(0.000122)	(0.000154)					
D.lLIMPT												0.000136	0.000160	0.000119	-0.000140
												(0.000208)	(0.000190)	(0.000145)	(0.000226)
D.LREER		-0.368	-0.940**	0.0107	-1.957		0.3010	0.3230***	0.6380***	0.6950***		0.2690	0.2360*	0.6840***	1.2890***
		(1.728)	(0.420)	(0.759)	(1.525)		(0.365)	(0.0792)	(0.118)	(0.0864)		(0.583)	(0.124)	(0.170)	(0.139)
D.OPEN		0.00116	-0.000504	-0.0398	-0.0279		0.0327***	0.00114***	0.0230***	0.0141***		0.0268**	0.00298***	0.0307***	0.0180***
		(0.0331)	(0.00130)	(0.0252)	(0.0225)		(0.00694)	(0.000408)	(0.00437)	(0.00137)		(0.0108)	(0.000360)	(0.00609)	(0.00230)
D.LWRGDP		1.1830	2.2530*	7.4590**	7.6580		-0.3080	1.2110***	2.8840***	-0.0130		-0.0791	1.6470***	2.3100**	-1.251
		(6.436)	(1.219)	(3.695)	(10.67)		(1.321)	(0.262)	(0.682)	(0.615)		(2.100)	(0.349)	(0.949)	(0.955)
LREER	2.041***					-0.0710					-0.241				
	(0.609)					(0.0764)					(0.498)				
OPEN	0.0128***					0.00227***					-0.00425				
	(0.00247)					(0.000326)					(0.0116)				
LWRGDP	3.612***					1.607***					2.071***				
	(0.565)					(0.0829)					(0.435)				
Constant		-8.775*	-5.070***	-1.035	-21.89***		0.148	-6.341***	-1.213**	-1.222***		-0.0779	0.435	-1.833**	-2.546*
		(4.567)	(1.367)	(1.142)	(6.089)		(0.263)	(1.642)	(0.537)	(0.322)		(0.604)	(1.094)	(0.828)	(1.520)
Observations	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses.
Source: extracted results from STATA output

The study revealed that there is a no asymmetry both in the long-run and the short run relationships of exchange rate and import in the East Asian countries as evidenced by the Wald test values of 0.9384 and 0.919 respectively. In the short run, the result of the PMG estimator indicates that the real effective exchange rate has a positive and significant impact on imports in East Asian countries at 5% level of significance but negative and insignificant influence in the long-run. This conforms with Bahmani-Oskooee *et al.* (2020), Gbaka *et al.* (2023) and Yakub *et al.* (2019) but contrasts with the submission of Kearns and Patel (2016) and Adhikari (2018). This implies that real currency depreciation discourages the demand for import but only in the long-run. This further explains that real currency depreciation makes the imports very expensive to the East Asian countries. However, the elasticity of import demand in the face of this situation deters imports only in the long-term. It is worth noting that as a country's currency depreciates, imported items become more expensive, hence reducing their demand. This conforms with Bahmani-Oskooee *et al.* (2020), Gbaka *et al.* (2023) and Yakub *et al.* (2019) but contrasts with the submission of Kearns and Patel (2016) and Adhikari (2018) who also confirmed exchange rate fluctuations' significant impact on imports and exports. Additionally, in the short run, trade openness significantly boosts East Asian imports. In the long run, world real gross domestic product positively and significantly influences imports in the region at a 5% significance level, re-echoing Qamruzzaman (2023) and Usman and Bashir (2022)'s findings. The implication of the result is that increased world's real gross domestic product has resulted in increase in import demand, industrial capacity expansion, and potentially more advantageous trade policy.

Table no. 9 reveals that in the short run, the parameters (D.LREER) indicates that a 1% increase in real effective exchange rate (LREER) exert negative influence on trade balance by 0.94% for Hong Kong. This implies that it may raise the price of Hong Kong's exports to global customers. This conforms to the J-curve hypothesis of negative effect of exchange rate changes on trade balance in the short-run. The estimated short-run coefficients reveal that 1% increase in world real gross domestic product (D.LWRGDP) leads to 7.459% increase in trade balance for Japan. Also the coefficient reveals that a 1% increase in world real gross domestic product (D.LWRGDP) leads to 2.253% increase in trade balance for Hong Kong at 10% level of significance. This implies that as the world real GDP increases, global demand for goods and services may rise, which could lead to an increase in Japan's and Hong Kong's favorable trade.

Second, the estimated short-run model shows that a 1% increase in real effective exchange rate exerts 0.323%, 0.638%, and 0.695% increase in exports for Hong Kong, Japan, and South Korea at 1% level of significance. Similarly, positive changes in trade openness significantly influence the level of exports for all the countries (China, Hong Kong, Japan, and South Korea) as shown by their respective proportions (0.0327%, 0.00114%, 0.023%, and 0.0141%). This positive relationship between trade openness and exports indicates more opportunities for these countries to access larger markets and expand their customer base. With greater access to international markets, China, Hong Kong, Japan, and South Korea can increase their export volumes and boost their export performance. The positive influence of embracing trade openness on exports for China, Hong Kong, Japan, and South Korea indicates that these nations have reaped the benefits of expanding their economic engagement in global trade. This would help these countries to drive economic growth and create jobs. Similarly, a 1% increase in world real gross domestic product leads to 1.211% and 2.884% increase in exports for Hong Kong and Japan respectively.

Turning to the import model, a 1% increase in real effective exchange rate leads to 0.236%, 0.684%, and 1.289% increase in imports for Hong Kong, Japan, and South Korea. Furthermore, trade openness exerts significant positive influence on imports for all the countries (China, Hong Kong, Japan, and South Korea) in the short-run as shown by their respective proportions (0.0268%, 0.00298%, 0.0307%, and 0.018%). However, world real GDP exerts significant positive influence only for Hong Kong and Japan with 1.647% and 2.31% variations in imports respectively as a result of a percentage increase in world real GDP.

5. CONCLUSION

The study concludes that in East Asia, trade balance is significantly influenced by world income, trade openness, and real effective exchange rate. Long-term trade balance and exports benefit from real exchange rate depreciation. Trade openness and real effective exchange rate impact exports and imports across the region, especially in Hong Kong, Japan, and Korea in the short term. Yet, their currency depreciation deters long-term imports, offset by trade openness and world real GDP. World income shapes exports and imports for Hong Kong and Japan, while trade openness benefits all countries. The study confirms the validity of the Marshall-Lerner condition and J-curve hypothesis in East Asia.

5.1 Policy implications

The findings of the study have significant policy implications for the East Asian region. Policymakers should focus on maintaining favorable trade balances by closely monitoring and managing the real effective exchange rates. They should consider the potential benefits of controlled depreciation of currencies to boost exports and achieve favorable trade balances in the long run. Given that the currency depreciation/devaluation was found to be an effective trade-enhancing measure among the East Asian economies, maximization of potential gain from international trade could be optimized if this policy option is explored or sustained. Emphasizing trade openness remains crucial for most economies, especially Hong Kong, Japan, and Korea, in both short and long terms. To enhance exports and imports, policies should aim to stimulate world income growth, particularly for Hong Kong and Japan. Additionally, policy interventions aligning with the principles of Marshall-Lerner condition and J-curve hypothesis can enhance trade dynamics by promoting currency adjustments to improve trade balances.

5.2 Study Limitations

The study was limited by data availability that necessitated the choice of four countries which may limit the generalization of the findings to all developed and developing countries. The heterogeneity problem among the countries was also considered as another limitation. However, the challenge was addressed by studying the Asian countries, while utilizing an appropriate approach that could account for individual specific behavior of the countries being studied.

5.3 Recommendations

Based on the findings, this study recommends that countries in the region should be more open to global markets in order to take advantage of the rise in global income. Trade-growth pattern should equally be maintained in order to maximize the actual benefits from globalization. The policymakers should consider a controlled depreciation of their currencies to boost exports and achieve favorable trade balances in the long run. However, careful management is essential to prevent negative impacts on long-term imports. Given the significant role of trade openness in influencing trade balances and exports, governments should continue to prioritize policies that facilitate international trade through trade agreements, reduced tariffs, and streamlined customs procedures.

The study also recommends the adoption of policies aligned with the principles of the Marshall-Lerner condition and J-curve hypothesis. Timely and coordinated currency adjustments can enhance trade balances without severely affecting imports, while maintaining the current bilateral exchange rate policy of pegging domestic currencies to trading partners' currency values. Governments should implement targeted export promotion strategies, offer incentives to high-potential industries, invest in R&D, and enhance product quality and innovation. Ongoing monitoring of policy impacts on trade balances, exports, and imports is essential, with adjustments based on effectiveness assessments. Following these recommendations, East Asian economies can harness positive trade determinants for sustainable growth, improved trade performance, and enhanced regional cooperation.

5.4 Suggestions for Future Research

The study suggests more empirical studies on countries across regions and income groups in order to determine the true interactive effects of exchange rate changes on trade flows using panel data approach.

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