Symmetric or Asymmetric: How do Sri Lanka's Bilateral Trade Balances Respond to Real Exchange Rate Changes?

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Abstract

This paper examines the impact of real exchange rate fluctuations on the trade balance between Sri Lanka and its major trading partners using the Non-linear Auto Regressive Distributed Lag model. Analysing data from the first quarter of 2007 to the fourth quarter of 2022, covering 10 trading partners, the study reveals varied reactions in the trade balance to real exchange rate depreciation versus appreciation, supporting an asymmetric effect. While some results align with conventional exchange rate theory, showing a positive long run effect of real depreciation, others indicate only a short run effect. The mixed empirical findings underscore the lack of uniformity in the relationship between real exchange rates and trade balances, which can be attributed to differences in the composition of traded goods. Given these asymmetries, it is evident that exchange rate policy alone has limited capacity to enhance the overall trade balance of the country. Therefore, adopting a comprehensive policy package to ensure Sri Lanka's global competitiveness is imperative to effectively address the multifaceted nature of trade dynamics.

Key Words: *Real Exchange Rate, Bi-lateral Trade Balance, Non-Linear Model, Asymmetric Effects*

JEL Classification*: C51; F31*

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1. Introduction

Exchange rate volatility presents a significant challenge to external trade, prompting policymakers, researchers, and stakeholders to scrutinise its correlation with external trade. Despite extensive theoretical and empirical research, findings remain inconclusive and ambiguous regarding the impact of currency depreciation on the trade balance. Nonetheless, certain studies utilising non-linear models have identified significant long term effects of depreciation on trade balance (Bahmani-Oskooee and Fariditavana 2015, Bahmani-Oskooee et al. 2016).

The link between exchange rate fluctuations and trade balance has important implications for a small open economy like Sri Lanka. There is a renewed interest in Sri Lanka to comprehend the effects of such changes on the trade balance due to the recent considerable depreciation of the Sri Lankan rupee against the US dollar. Therefore, the purpose of this study is to reevaluate the relationship between exchange rate volatility and trade balance in Sri Lanka.

Sri Lanka was on the fixed exchange rate regime at the time of gaining independence in 1948 and moved to the flexible exchange rate regime, passing several intermediate steps. Since the 1980s, Sri Lanka's external sector has been relaxed and hence this provided a valuable opportunity to examine the relationship between exchange rate fluctuations and external trade. Numerous studies that have looked into this matter, have produced ambiguous results (Vijayakumar 2014, Perera 2011, Alawattage 2009). One common feature of all these studies is that they assume a linear relationship among the variables.

Following research by Bahmani-Oskooee and Fariditavana (2015), this study attempts to apply a non-linear model to estimate the link between exchange rate fluctuation and the trade balance using quarterly data from 2007 to 2022[3] for Sri Lanka and its ten major trading partners. The main contribution of this paper to the existing literature is its attempt to use a non-linear model to examine the relationship between real exchange rate fluctuations and trade performances with the ten largest trading partners of Sri Lanka. Previous studies that have investigated the impact of the real exchange rate on Sri Lanka's trade balance assumed the link between the two is symmetric, which in this study we relaxed using a non-linear model. This enables us to ascertain whether the trade balance is affected by real exchange rate fluctuations in a symmetric or asymmetric manner. In addition, this study employs the bilateral trade balance and the exchange rate between Sri Lanka and its major ten trading partners to mitigate the aggregate bias and enhance the validity of the findings. The findings of the study corroborate the asymmetric effect by indicating that countries respond differently to real exchange rate depreciation than to real exchange rate appreciation.

The rest of the paper is structured as follows: a summary of the empirical research and theoretical background is provided in Section 2. The trade flows and exchange rate policy in Sri Lanka are described in Section 3. Section 4 presents the methodology and model specification. The empirical results and findings are discussed in Section 5, followed by a conclusion in Section 6.

[3] The Central Bank of Sri Lanka reclassified trade data in 2010 and retroactively adjusted figures from 2007; this is why the data from the first quarter of 2007 was chosen. Re-exports and re-imports from 2007 onward were not included in this upgrade.

2. Literature review

Many scholars focused their efforts on examining how exchange rate policies affect net exports and economic growth, particularly when exchange rates became extremely volatile with the adoption of the floating exchange rate regime. Theoretical aspects and the empirical regularity of the J-curve and the Marshall-Lerner condition are crucial concepts in these studies.

The Marshall-Lerner condition (after Alfred Marshall and Abba P. Lerner) is a criterion that determines whether a country's balance of trade will improve or worsen in response to a change in the exchange rate. It is based on the idea that a depreciation of the currency will lead to an improvement in the balance of trade if the sum of the price elasticities of demand for the country's exports and imports is greater than one. In other words, if the demand for a country's exports and imports is more sensitive to changes in price than the supply of these goods, the balance of trade will improve after the currency depreciates. The J-curve refers to the phenomenon in which a country's balance of trade initially worsens after it devalues its currency or otherwise reduces its trade barriers. This happens because the weaker exchange rate makes imports more expensive, while exports become cheaper and more competitive in the global market. As a result, demand for the country's exports may increase, leading to an improvement in the balance of trade over time. The improvement in the balance of trade is represented by the upward slope of a pattern that resembles the letter J, hence the J-Curve phenomenon. Accordingly, devaluation has two direct effects on trade balance i.e., the price effect and the volume effect. The price effect contributes to worsening the trade balance as exports become cheaper when measured in foreign currency, and imports become expensive when measured in the home currency. On the other hand, the volume effect contributes to improving the trade balance, as exports become cheaper, encouraging an increased volume of exports while imports become more expensive, thereby leading to a decreased volume of imports. The net effect depends upon whether the volume or price effect dominates. Further, in the medium to long run, when the country's exports are cheaper in foreign currency terms, foreign demand increases and local consumers also purchase less of the more expensive imports and try to substitute them with comparable local goods, resulting in an improvement in the trade balance.

The link between exchange rate fluctuations and trade performance has been investigated by many researchers using different econometric techniques and models in both multi-country panel regressions and individual-country studies. The empirical results of these studies are mixed. Several studies substantiate the significant relationship between exchange rate depreciation and the trade balance. Waliullah et. al (2010) examine the short and long run relationship between the trade balance, income, money supply, and real exchange rate in the case of Pakistan's economy using the bounds testing approach. Their results indicate that there is a stable long-run relationship between the trade balance and the considered variables. Similarly, Ncube and Ndou (2013) compare the effects of exchange rate appreciation on the trade balance of South Africa using recursive and sign-restriction vector autoregressive models. Their findings suggest that the trade-weighted exchange rate appreciation shocks worsen the trade balance as a percentage of GDP for longer periods than contractionary monetary policy shocks. The findings of Lal and Lowinger (2002) also confirm the proposition that a country's trade balance worsens immediately following currency depreciation but improves in the long run.

Furthermore, Stucka (2004) estimates the trade balance response to permanent domestic currency depreciation in Croatia for the period of 1994 Q1 - 2002 Q1, using three distinct econometric

techniques; the Autoregressive Distributed Lag (ARDL), the Bewley type ARDL approach, and the ARDL with instrumental variables approach. He concluded that an equilibrium trade balance is improved by 0.94 percent to 1.3 percent on average by a 1 percent permanent depreciation and J-curve evidence is also discovered. Nadenichek (2006) examines the dynamic response of the trade balance to changes in the real exchange rate between the USA and other G-7 countries, employing a partially identified structural vector error correction model. In five out of six country pairings, the results provide evidence in support of a J-curve pattern. Michael (2011) determines the impact of foreign exchange dynamism on Nigeria's export performance. Results from the chi-square analysis indicate that fluctuations in the Naira exchange rate affect non-oil exports. It suggests that to reduce the impact of the fluctuations on non-oil export, monetary authorities in Nigeria should stabilise the Naira exchange rate through monetary and fiscal policies. Truong and Vo (2023) investigate the asymmetric effects of the exchange rate on the trade balance of Vietnam for the period from January 2010 to June 2020 using the non-linear ARDL bound testing approach. The empirical findings confirm that the exchange rate has asymmetric effects on the trade balance in both the long run and short run. Tarawalie and Kpana (2022) investigate the effects of monetary policy and exchange rate fluctuations on the trade balance in Sierra Leone using the ARDL bound testing framework for 1980 - 2020. The long-run results reveal that money supply, real effective exchange rate (REER), and real GDP are the main factors influencing trade balance in Sierra Leone, and money supply and REER have negative effects on trade balance.

Chowdhury et al. (2014) examine the relationship between the exchange rate and trade balance in Bangladesh and find that the real exchange rate is an important variable to the trade balance, and devaluation will improve trade balance in the long run, which is consistent with Marshall-Lerner condition. Tiwari and Shahbaz (2011) examine the effect of India's exchange rate with the USA on the Indian trade balance, using the ARDL bound testing approach to cointegration and for dynamic analysis of Impulse Response Functions (IRFs) and Variance Decompositions (VDs). They conclude that the J-curve is validated in the case of India with the USA.

Arize et al. (2000) investigate the impact of real exchange rate volatility on the export flows of 13 less developed countries over the period of 1973 - 1996 using quarterly data and according to their results, there is a negative and statistically significant long-run relationship between export flows and exchange rate volatility in each of the 13 countries. Yuen-Ling et al. (2008) also find that there exists a long-run relationship between trade balance and exchange rate in the case of Malaysia.

Conversely, there exists another strand of literature that argues for the weak relationship between exchange rate fluctuations and trade balance. Using quarterly data for the period 1971 Q1 - 1994 Q4, Bahmani-Oskooee (2001) found weak statistical evidence between changes in exchange rate and the trade balance with respect to 11 Middle Eastern countries. Al-Shammari and Al-Salman (2010) investigate the impact of real exchange rate volatility on Kuwait's bilateral trade volume with its major trading partners, using an augmented gravity model including country specific fixed effects as well as time effects for the period of 1990 - 2005. According to their findings, there is a statistically significant influence of exchange rate variation for Kuwait's trade balance, nevertheless, the magnitude is small, with an upper limit of 2 percent. They conclude that the trade flows between Kuwait and its major trading partners are not so sensitive to variations in exchange rates.

Moreover, Ahmad and Yang (2004) do not find evidence to support the worsening of the trade balance in the short run as suggested by the J-curve concept. Similarly, a study on 5 countries in ASEAN and Japan by Liewa et al. (2003) for the period from 1986 to 1999 has shown that the trade balance in these countries is affected by real money rather than by the nominal exchange rate and conclude that previous studies had exaggerated the significance of exchange rate fluctuations in trade balances. Bhat and Bhat (2021) examine the asymmetric impact of exchange rate changes on the trade balance in India using the Non-linear Autoregressive Distributed Lag (NARDL) model for the period February 1996 - April 2017. The results indicate that in the short run, currency appreciation deteriorates the trade balance and currency depreciation improves it, and in the long run, a similar response is observed. The outcome of this result refutes the J-Curve phenomenon in the case of India.

Keho (2021) examines the asymmetric impact of real exchange rate on the trade balance in Cote d'Ivoire, employing the non-linear ARDL model over the years 1975 - 2017. The results show that trade balance responds asymmetrically to the REER changes in the long run, while the short run effect is symmetric. Furthermore, the estimations show that trade balance reacts more strongly to REER depreciations than to appreciations. Duasa (2007) examines the short run and long run relationships between trade balance, RER, income, and money supply in Malaysia. Using the ARDL co-integration approach, he finds a positive but statistically insignificant relationship between the trade balance and exchange rate. The money supply and domestic income have a strong negative and positive impact on the trade balance (consistent with the monetary approach and absorption approach, respectively). The results imply that the Marshall-Lerner condition does not hold up in the long run for Malaysia and that the country's trade balance should be examined from both an absorption and monetary perspective when formulating policies. Catalbas (2016) examines the relationship between nominal exchange rate and import and export in Turkey using the VAR model on three-month data. The results show that the exchange rate does not have a significant effect on the export, import and trade balance. He concludes that import restrictions would adversely affect exports.

A few studies have examined this issue in the context of Sri Lanka. Wignaraja (1998) examined the macroeconomic determinants of manufactured export performance of Sri Lanka using the Cointegration Test and the Error Correction Model (ECM). The study finds weak support for the hypothesis that export performance is expected to be positively affected by the REER. Moreover, Perera (2009) examines the impact of the real depreciation of the Sri Lankan Rupee on the trade balance in the short run and the long run employing bilateral trade data between Sri Lanka and its six major trading partners using the ARDL model. The results reveal that there is no evidence for the J-curve phenomenon in the trade balance between Sri Lanka and its trading partners, and there is no any specific pattern in response to the depreciation of the real exchange rate. Weliwita and Tsujii (2000) investigate how responsive is Sri Lanka's trade imbalance to devaluation using data from 1978 Q1 - 1997 Q4. The findings show that the trade imbalance kept going in the wrong direction despite continuous devaluation, indicating that the exchange rate policy was unable to create a favorable balance of trade position. Alawattage (2005) investigates how well the exchange rate policy of Sri Lanka contributes to its external competitiveness using quarterly data covering the period 1978 Q1 - 2000 Q4. The results indicate a muddled J-Curve phenomenon and show that the REER has no significant effect on improving the trade balance, especially in the near run. The cointegration tests indicate a long term relationship between trade balance and REER, but the impact on trade balance improvement over time is negligible.

Using the ARDL model, Abbbucker et al. (2021) investigate the relationship between the exchange rate and trade balance in Sri Lanka for the period of 1977 - 2019. The research findings suggest that the exchange rate has an adverse impact on the trade balance in the long run and conclude that the results are consistent with the J-Curve phenomenon and that the Marshall Lerner condition exists in Sri Lanka. Vijayakumar (2014) examines the effects of the exchange rate on the trade balance of Sri Lanka based on the two-country model involving trade between Sri Lanka and the USA. The results suggest that the REER has a significant positive influence on the trade balance both in the short run and the long run but there is no evidence for the J-curve effect. Chamindani (2017) investigates the determinants of manufacturing exports in Sri Lanka with specific emphasis on the impact of the REER for the period of 1970 - 2014 using ARDL model. The results suggest that REER is a key determinant of exports of Sri Lanka. Wimalasuriya (2007) examines exchange rate pass-through in Sri Lanka using monthly data from 2000:10 to 2005:12. The results of the VAR approach show that import prices react to changes in the exchange rate by a magnitude comparatively and considerably greater than that of export prices. This suggests that changes in the exchange rate have a major impact on the trade balance. Athukorala (2017) examines the determinants of exports in Sri Lanka using reduced form equation for the period 1970 - 2015. Results indicated that the RER is the most important determinant of export performance. Further, Rajakaruna (2017) investigates the factors that affect exchange rate fluctuations in Sri Lanka with monthly data for the period 2001 - 2010. The results of the Multiple Regression Model indicate that there is a negative relationship between exchange rate and terms of trade.

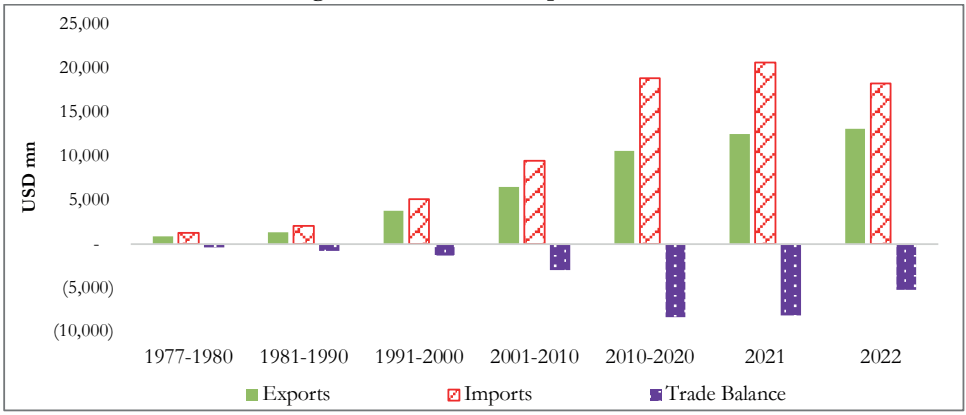
3. External trade performance and exchange rate policy in Sri Lanka

Sri Lanka liberalised its economy in 1977 well ahead of the rest of South Asian countries. Significant gains in international trade and trade openness were immediately realised as a result of the implementation of liberal economic policies, such as private sector-driven development, export-led growth, and encouragement of Foreign Direct Investment (FDI). Trade openness, which accounted to 36.4 percent in 1977 nearly doubled to 72.2 percent by 1979. Similarly, exports as a percentage of GDP, which was 18.7 percent in 1977 increased significantly to 29.2 percent by 1979 (Central Bank of Sri Lanka, 2017). Overall, manufactured export performance was positively related to an outward-oriented trade regime during the first two decades of post-liberalisation reforms (Wignaraja, 1998).

Further, with the trade liberalisation policies, a series of unilateral measures were implemented to simplify a country's tariff structure to a large extent. Export industries were supported with generous incentives made available in the form of tax concessions, duty-free imports of raw materials and investment goods, and institutional developments. With these developments, Sri Lanka's export composition was changed from primarily an agriculture-based export structure to a more value-added labour-intensive product structure. Although the composition of exports has changed, the export sector's low product diversification is still evident in the concentration of exports on two traditional products: garments and tea, which together account for more than half of the total export basket. In addition, even though industrial exports accounts for around 77 percent of total exports, high-tech exports are thought to make up less than 1 percent of total manufactured exports enabling competitors to imitate Sri Lankan export products easily (Central Bank of Sri Lanka, 2017). The export sector exhibits a lack of diversification in terms of markets as well. Europe and the USA continue to account for approximately two-thirds of total exports.

Although merchandise exports stagnated in past several years, they rebounded in 2017 and 2018. The main drivers of the growth in export earnings were the establishment of new trade relations, conducive external trade policies, strong institutional support, and the flexible exchange rate policy maintained by the Central Bank. Merchandise exports were severely impacted due to the containment measures taken during the Covid-19 pandemic in 2020, however, recovered faster than anticipated to pre-pandemic levels. Increasing trend in imports also reversed in 2020 due to the restrictions imposed on non-essential imports by the Government, low fuel prices in the international market, and a reduction in importation of intermediate goods with subdued economic activity in the country. However, once domestic activities resumed in 2021 and input demand soared, import expenditure increased significantly. The deficit in the trade account, which continuously recorded a deficit since 1978 with the introduction of open economic policy in the country narrowed by almost half to US dollars 5.2 billion in 2022 compared to US dollars 10.3 billion recorded in 2018 (CBSL, 2023).

Figure 1: External sector performance



Source: Central Bank of Sri Lanka

In terms of regional competitors, external trade of Sri Lanka has been lagging as compared to its regional counterparts during the period from 2000 to 2017 according to the Export Value Index of the World Bank. Sri Lanka has only increased its exports by 2.1 times, while Vietnam and India have increased by 14.8 times and 7.1 times, respectively (World Bank, 2019). Overall, the South Asian region is one of the least integrated regions in the world, accounting for less than 5 percent of intra-regional trade, although these countries have become increasingly trade-oriented in recent decades, with substantial potential for further trade gains, both intra-regionally and globally (Raihan, 2015). The region has lagged substantially behind the other regions across the globe, particularly Southeast Asia and East Asia.

The exchange rate policy in Sri Lanka has undergone several changes over the years in response to various economic and external factors. At the time of gaining independence from the British in 1948, Sri Lanka had a fixed exchange rate regime. The exchange rate was pegged to the Indian rupee, and currency was issued and managed by a Currency Board. The Currency Board was replaced by the Central Bank in 1950 aiming to stabilise the domestic and external values of the rupee and promoting economic growth. In 1951, Sri Lanka shifted to a managed float exchange rate system, where the Central Bank intervened in the foreign exchange market to stabilise the currency. By the mid-1960s, the country faced

a balance of payments crisis, driven by low export prices and a high volume of imports leading to force Sri Lanka to devalue the rupee in order to maintain export competitiveness. In 1968, a dual exchange rate system was introduced with one official rate applicable to essential imports and non-traditional exports, and another higher official rate applicable to all other exports and imports, aiming at export diversification and import compression. In 1977, as part of the liberalisation reforms package, the dual exchange rate system was eliminated and the new unified exchange rate was adjusted to reflect foreign exchange market condition. The rupee was initially allowed to float following the unification with limited intervention by the Central Bank. However, interventions soon intensified, particularly during the first half of 1980 and the float was abandoned in November 1982 (Jayasuriya, 2004). The Central Bank's role shifted to managing excessive volatility and intervening when necessary to maintain stability.

By the year 2000, Sri Lanka had experienced a significant decline in its official international reserves, as a result of the notable rise in expenditure on imports. The increased demand for foreign exchange placed tremendous pressure on the exchange rate. Within the managed floating exchange rate regime, this naturally resulted in increased pressure on international reserves. In order to defend the managed float, the Central Bank raised its policy interest rates to unprecedented levels, but this move ultimately proved to be costly and ineffective, which largely contributed to the only negative annual real GDP growth rate of the country's history. This prompted the Central Bank to revisit its exchange rate policy (Weerasinghe, 2017). In 2001, the Central Bank took a major step towards liberalising the foreign exchange market by allowing commercial banks to determine the exchange rate (independent float). With this move, the Central Bank stopped buying or selling foreign exchange at preannounced rates but reserved the right to intervene in the market to buy and sell foreign exchange at or near market prices, as and when it deemed necessary, depending on the movements of the exchange rate.

The Central Bank was compelled to stop intervening in the foreign exchange market to support the exchange rate in February 2012 due to an increasing current account deficit and a swift reduction in foreign exchange reserves. But starting in the fourth quarter of 2013, the Central Bank started to stabilise the currency rate again by using foreign exchange reserves accumulated from the issuance of sovereign bonds. Because of the continuous stability of the nominal exchange rate and domestic inflation that is higher than that of the trading partner countries, the real exchange rate appreciated by approximately 22 percent between 2005 and 2014 when compared to the previous five years, eroding the competitiveness of export-oriented and import-competing production in the economy. In early September 2015, the Central Bank allowed greater flexibility in the determination of the exchange rate. As a result, the currency depreciated by 6.5 per cent against the US dollar between the third quarter of 2015 and the second quarter of 2016, while real depreciation (as measured by the 24-currency real exchange rate index) accounted for 4.2 percent. The Central Bank was moving toward a flexible exchange rate regime in 2016 (ADB, 2017). The Central Bank intervened in the domestic foreign exchange market to avoid large volatility in the exchange rate.

In March 2022, the exchange rate was allowed to be determined by the market, leading to a significant depreciation. In this situation, to reduce the significant volatility driven by excessive speculations and its spillover effects on the economy, a variation band was introduced in May 2022, by announcing the band daily. Under this, a middle exchange rate was announced by the Central Bank based on the weighted average spot market exchange rate of the USD/LKR interbank transactions, with a variation margin on either side of the middle spot exchange rate. However, the Central Bank withdrew from announcing the

guideline band entirely in March 2023. The evolution of exchange rate policy in Sri Lanka reflects the country's efforts to balance economic stability, export competitiveness and inflation management in a changing global economic landscape.

4. Methodology and Model Specification

4.1 Estimated model

Assuming the domestic country to be Sri Lanka and the foreign country to be her trading partner j, following Bahmani-Oskooee and Fariditavana (2015), we adopt the following model in log-linear form as in Equation (1).

$$LnTB_{j,t} = \propto_0 + \propto_1 LnY_t^{SL} + \propto_2 LnY_{j,t} + \propto_3 LnREX_t + D1 + \varepsilon_t \quad (1)$$

Where TBj is a measure of trade balance defined as the ratio of Sri Lanka's imports from country *j* to its exports to country *j* [4]. Y^{SL} is a measure of Sri Lanka's real income in index form, while Y_{jt} represents the real income of trading partner j. REX_j is the real bilateral exchange rate between Sri Lanka and its trading partner j.

However, since data consists of stationary and non-stationary series, equation 1 is then converted to the error correction version of the original model. The ECM not only addresses the non-stationarity issue but also estimates the long-run effect of exchange rate fluctuations on the trade balance.

$$\Delta LnTB_{j,t} = \beta_0 + \sum_{t=1}^{n1} \beta 1, i\, \Delta\, LnTB_{j,t-i} + \sum_{t=0}^{n2} \beta 2, i\, \Delta\, LnY_{t-i}^{SL} + \sum_{t=0}^{n3} \beta 3, i\, \Delta\, LnY_{j,t-i} + \sum_{t=0}^{n4} \beta 4, i\, \Delta\ \ LnREX_{t-1} + \gamma_0 LnTB_{j,t-1} + \gamma_1 LnY_{t-1}^{SL} + \gamma_2 LnY_{j,t-1} + \gamma_3\, LnREX_{t-1} + \mathrm{D}_1 + \epsilon_1 \quad (2)$$

With the aim of capturing the asymmetric effect of exchange rate changes on the trade balance, equation (2) is then modified as follows.

$$\Delta LnTB_{j,t} = \beta_0 + \sum_{t=1}^{n1} \beta 1, i\, \Delta\, LnTB_{j,t-i} + \sum_{t=0}^{n2} \beta 2, i\, \Delta\, LnY_{t-i}^{SL} + \sum_{t=0}^{n3} \beta 3, i\, \Delta\, LnY_{j,t-i} + \sum_{t=0}^{n4} \beta 4, i\, \Delta\ POS_{t-i} + \sum_{t=0}^{n5} \beta 5, i\, \Delta\, NEG_{t-i} + \gamma_0 LnTB_{j,t-1} + \gamma_1 LnY_{t-1}^{SL} + \gamma_2 LnY_{j,t-1} + \gamma_3\, POS_{t-1} + \gamma_4\, NEG_{t-1} + \mathrm{D}_1 + \epsilon_1 \quad (3)$$

[4] In the literature there are studies that define trade balance as a ratio of exports over imports (Brada et al., 1997 and Bahmani-Oskooee and Alse, 1994).

POS_t represents exchange rate depreciations and NEG_t represents exchange rate appreciations. As it has been mentioned in Shin et al. (2014), equation (3) is named as Non-linear Auto Regressive Model, which allows to capture the asymmetric effect of exchange rate fluctuations on the trade balance.

The dependent variable, trade balance (TB), is defined as the ratio of Sri Lanka's exports to country *j* over its imports from the same country, measured in US dollars in current terms. The reason for using the ratios in this study is that it can express the trade balance in the logarithm. Thus, the first differenced variables reflect the rate of change in each variable. Further, ratio measures remain unchanged whether the trade balance is expressed in real or nominal terms. LNY^{SL} and LNY_j represent the economic activity of Sri Lanka and its trading partners, respectively. The industrial production index of each country is used as the measure of economic activity except for Sri Lanka, USA, and China. For the latter three countries, Real GDP is converted into an index (2007 = 100). The bilateral real exchange rate (REX) is defined as NEX * Pi / P_{SL}, where P_i is the Consumer Price Index (CPI) in the county *i*, P_{SL} is the CPI in Sri Lanka and NEX is the bilateral nominal exchange rate (period average) defined as the number of Sri Lankan rupees (SLR) per unit of currency of country *i*. An increase in REX reflects the real depreciation of the SLR against the currency of country *i*. All variables in the models other than the dummy variable are used in natural logs.

It is observed that if Y^{SL} raises imports, $\propto_1$ is expected to be negative. However, if the increase in Y^{SL} is due to an increase in the production of import substitute goods, $\propto_1$ is expected to be positive. The estimated value of $\propto_2$ is anticipated to be positive due to the increase in foreign income and the demand for Sri Lanka's exports. However, if the increase in foreign income is due to an increase in the production of substitutes for Sri Lankan exports, exports of Sri Lanka will reduce, resulting $\propto_2$ being negative. If real depreciation, i.e., an increase in REX_j is to increase exports and decrease imports, the estimate for $\propto_3$ should be positive. Finally, D1 is expected to have a negative relationship since the global financial crisis caused fewer exports.

Variables and their expected signs are presented in Table 1.

Table 1: Descriptions of variables

Variable	Definition	Expected sign
LNY^{SL}	Sri Lanka's economic activity is represented by real GDP which is converted into an index (2007 Q1 = 100)	+/-
LNY_j	The economic activity of country j is represented either by the Industrial Production Index or an index derived from real GDP	+/-
LNREX	Bi-lateral real exchange	+
D1	Dummy variable to capture the global financial crisis	-

4.2 Data

This study covers 10 trading partner countries of Sri Lanka, which account for around 60 per cent of Sri Lanka's total trade during the period from 2007 Q1 to 2022 Q4.

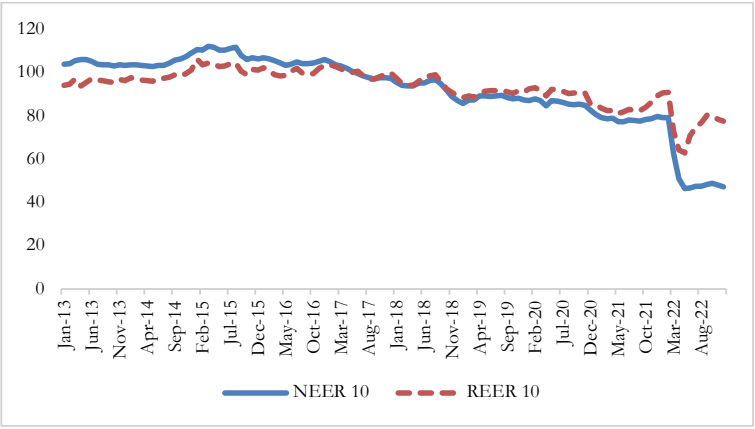
Table 2: Sri Lanka's trade with major trading partners in 2022

Country	Value in USD million			Share (%)		
	Exports	Imports	Total Trade	Exports	Imports	Total Trade
India	860	4,738	5,598	6.6	25.9	17.8
China	255	3,285	3,540	1.9	18.0	11.3
United States of America	3,321	433	3,754	25.3	2.4	12.0
United Kingdom	963	243	1,206	7.3	1.3	3.8
Germany	742	286	1,028	5.7	1.6	3.3
Malaysia	66	969	1,035	0.5	5.3	3.3
Singapore	131	871	1,002	1.0	4.8	3.2
Italy	641	289	930	4.9	1.6	3.0
Japan	231	252	483	1.8	1.4	1.5
Hong Kong	168	247	415	1.3	1.3	1.3
World	13,106	18,291	31,397	100.0	100.0	100.0

Source: Central Bank of Sri Lanka

The data is obtained from IMF - International Financial Statistics, except data for Sri Lanka, which are obtained from the Annual Reports of the Central Bank.

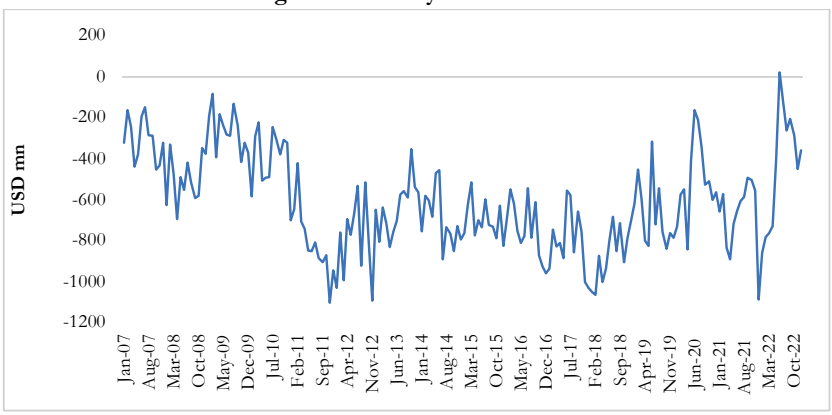
Figure 2: Monthly exchange rates



10-currency Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER) are depicted in Figure 2.

Both NEER and REER indices underwent substantial downward adjustment in early 2022, reflecting the nominal depreciation of the Sri Lanka rupee against the selected major currencies.

Figure 3: Monthly trade balance



As depicted in Figure 3, Sri Lanka's external trade balance continued to record a deficit, except June 2022.

5. Empirical results and findings

This study re-examines the link between real exchange rate fluctuations and the trade balance in the context of Sri Lanka. Both linear and non-linear models are estimated for 10 major trading partners of Sri Lanka. These 10 trading partners contribute to around 60 per cent of the total trade in Sri Lanka. This paper uses quarterly data spanning from 2007 to 2022 to estimate each model with each trading partner and the optimal model for each trading partner is selected based on the Schwartz selection criterion.

The ARDL setup is allowed to use variables of different orders of integration (less than I (2)). Therefore, to identify the order of integration of the variables, a group unit root test is performed for each country case, and results, which confirmed that none of the variables are of I (2), are given in Appendix table A.1.

Further, to test for the existence of a long-run relationship among the variables in concern, the bound test is used. The bound F test statistics for both models under each country case exceed the upper bound critical value (Appendix table A.2), confirming the existence of a cointegration relationship among the variables of interest.

The estimated results of the linear and non-linear models are given in Table 3 and Table 4, respectively. In order to increase the reliability of these results, standard diagnostic tests are carried out. The errors of the models are serially uncorrelated and normally distributed. The standard errors of all models are corrected for heteroscedasticity. The cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) suggest that the estimates of both models are stable.

Table 3: Long run and short run estimation results of linear specification (ARDL)

	World	India	China	USA	Singapore	UK	Japan	Germany	Italy	Malaysia	Hong Kong
Long run estimations											
Rex	0.07	0.83	-1.29	-0.23	-0.56	0.21	0.89	1.21**	0.82	-0.34	-0.39
	[1.02]	[1.47]	[-1.45]	[-0.23]	[-0.31]	[0.58]	[1.21]	[2.18]	[1.80]	[-0.27]	[-0.28]
Y^d	-5.58***	-6.08**	-9.21*	-7.45	-10.13*	-0.25	-18.35**	0.36	-0.28	-4.56*	-18.55**
	[-4.72]	[-2.00]	[-1.92]	[-1.53]	[-1.69]	[-0.36]	[-2.45]	[0.45]	[-0.14]	[-1.69]	[-2.04]
Y^i	-0.31***	-0.1	-4.21	-3.30***	1.02	-1.36***	-7.62**	1.93*	-1.39	-3.23***	3.58**
	[2.93]	[-0.55]	[-1.49]	[-3.63]	[1.39]	[-2.77]	[1.21]	[1.85]	[-0.94]	[-3.37]	[3.01]
Short run estimations											
Coint_Eq	-0.59***	-0.63***	-0.86***	-1.01***	-0.73***	-1.08***	-0.56***	-0.66***	-0.39***	-0.56***	-0.70***
	[6.56]	[-5.78]	[-7.38]	[-7.80]	[-6.50]	[-8.62]	[-5.83]	[-3.67]	[-4.00]	[-4.15]	[-4.01]
DTB(-1)							0.24**	0.13		-0.08	-0.42**
							[2.06]	[0.76]		[-0.57]	[-2.27]
DTB(-2)							0.11	0.16		-0.21*	-0.01
							[0.90]	[1.06]		[-1.72]	[-0.05]
DTB(-3)							0.44***	-0.21			0.21
							[3.34]	[-1.63]			[1.58]
DRex	-0.19		-0.25	1.99*		-0.55		0.41			
	[-1.34]		[-0.27]	[1.70]		[-1.07]		[0.92]			
DRex(-1)			3.02***	1.74		0.85		0.43			
			[3.19]	[1.41]		[1.31]		[0.83]			
DRex(-2)				1.2		-0.51		-1.49**			
				[0.59]		[-0.63]		[-2.41]			
DRex(-3)				3.68*		-1.92**					
				[1.91]		[-2.47]					
DY^d	-1.59***	-0.29	-0.85	-0.89	-2.49**		-3.28***		0.56***		-0.11
	[-5.49]	[-0.74]	[-1.13]	[-0.71]	[-2.39]		[-3.48]		[2.74]		[-0.11]
$DY^d(-1)$	2.17***	3.03***	6.33***	2.15**			1.18				10.33***
	[3.21]	[4.09]	[5.10]	[2.06]			[0.70]				[3.96]
$DY^d(-2)$	0.83***	1.34***	2.36***				-0.88				6.13***
	[2.97]	[2.92]	[2.97]				[-0.58]				[2.90]
$DY^d(-3)$							-1.66*				2.50**
							[-1.86]				[2.16]
DYj	2.17***		-1.06	4.02		1.49*	2.23			-0.71	-2.22
	[3.21]		[-0.73]	[1.26]		[1.92]	[0.98]			[0.50]	[-0.85]
DYj(-1)			3.12*	12.09***						-2.92**	
			[1.89]	[3.62]						[-2.03]	
DYj(-2)			1.95							-1.98	
			[1.13]							[-1.42]	
DYj(-3)			6.21***								
			[3.78]								

Note: ***, ** and * represent significance level of 1%, 5% and 10%, respectively.
Source: Author's estimation

Upon reviewing the findings of the linear ARDL model (Table 3), it becomes evident that there is no significant impact from fluctuations in the real exchange rate on Sri Lanka's trade balance, neither in the short run nor in the long run. When analysing bilateral exchange rates and trade balances, notable correlations emerge in the short term for Germany, China, the USA, and the UK. However, these associations tend to dissipate over time, except for Germany, where the effects remain in the long run.

Table 4: Long run and short run estimation results of the non-linear specification (NARDL)

	World	India	China	USA	Singapore	UK	Japan	Germany	Italy	Malaysia	Hong Kong
Long run estimations											
Rex_P	0.04	1.85***	-1.30	1.87	-5.82	-0.24	0.32	2.26***	0.64	-0.97	-0.40
	[0.32]	[3.02]	[-1.30]	[0.93]	[-1.17]	[-0.33]	[0.43]	[4.78]	[1.04]	[-0.61]	[-0.28]
Rex_N	0.18**	0.35	-1.33	2.55	-0.13	-0.19	1.03	1.23***	0.71	0.03	0.23
	[2.29]	[0.55]	[-0.89]	[1.17]	[-0.04]	[-0.39]	[1.48]	[3.93]	[1.04]	[0.02]	[0.13]
Y^d	-5.49***	0.76	0.53	-7.3	-21.8	0.89	-25.43***	1.73*	2.24***	-4.98*	-22.31**
	[4.31]	[-1.05]	[0.94]	[-1.19]	[-1.66]	[1.09]	[-3.40]	[1.90]	[2.86]	[-1.70]	[-2.22]
Y^f	0.02	-1.10*	-6.38*	-4.19	7.05	-1.06	-4.11	-1.65	-1.67*	-1.65	4.18**
	[0.07]	[-1.99]	[-1.80]	[-1.19]	[1.36]	[-1.08]	[-1.30]	[-1.51]	[-1.73]	[-0.74]	[2.16]
Short run estimations											
Coint_Eq	-0.62***	-0.62***	-0.88***	-0.87***	-0.53***	-1.14***	-0.57***	-1.08***	-0.60***	-0.54***	-0.71***
	[-6.79]	[-6.74]	[-7.08]	[-5.52]	[-4.69]	[-6.04]	[-6.29]	[-6.32]	[-6.85]	[-4.27]	[-4.16]
DRex_P	-0.08		2.57*	4.00**	-4.36	1.13		2.76***	1.72**		
	[-0.29]		[1.90]	[2.46]	[-1.68]	[1.08]		[3.74]	[2.65]		
DRex_P(-1)	-0.1			1.05	-5.31	-0.34		-2.10**	0.75		
	[-0.59]			[0.52]	[-1.05]	[-0.31]		[-2.37]	[1.18]		
DRex_P(-2)	-0.21			-2.95	8.60*	3.17***		-0.8	1.51**		
	[-0.70]			[-1.51]	[1.74]	[3.06]		[-1.01]	[2.24]		
DRex_P(-3)	-0.03			-5.36*		-0.29		-2.55**			
	[-0.17]			[-1.88]		[-0.20]		[-2.22]			
DRex_N	-0.08		-5.62***	1.85	7.95	-1.75*		-1.59**	-1.10**		
	[-0.25]		[-3.37]	[0.54]	[1.67]	[-1.84]		[-2.38]	[-2.04]		
DRex_N(-1)	-0.21			-3.14	10.88*	1.19		0.67	-0.26		
	[-1.16]			[-0.84]	[1.99]	[1.26]		[0.89]	[-0.44]		
DRex_N(-2)	1.09***			11.91***	-12.51**	-1.92		-1.90**	-1.20***		
	[3.45]			[2.76]	[-2.25]	[-1.50]		[-2.12]	[-2.88]		
DRex_N(-3)	-0.68***			8.68**		-2.64**		1.01			
	[3.54]			[2.24]		[-2.24]		[-1.08]			
DY^d	-1.48***	0.29	0.35	0.92	-4.36		-4.03***				-0.4
	[-5.23]	[0.85]	[0.41]	[0.70]	[-1.68]		[-4.22]				[-0.38]
DY^d(-1)	2.31***	2.50***	0.44	3.92***			3.56*				12.00***
	[4.42]	[4.17]	[0.36]	[3.01]			[1.94]				[4.16]
DY^d(-2)	0.85***	1.27***	-1.7				0.20				6.76***
	[3.12]	[3.00]	[-1.41]				[0.14]				[3.03]
DY^d(-3)			-1.43*				-1.34				2.63**
			[-1.78]				[-1.58]				[2.25]
DYj	2.43***		-0.48	1.68		0.95	4.05*	-0.49		-0.13	-1.66
	[3.91]		[-0.31]	[0.53]		[1.23]	[1.86]	[-0.48]		[-.09]	[-0.64]
DYj(-1)			4.33**	11.70***				3.51***		-3.26**	
			[2.51]	[3.34]				[2.99]		[-2.30]	
DYj(-2)			2.20	7.87*				1.64		-2.17	
			[1.32]	[1.99]				[1.54]		[-1.58]	
DYj(-3)			6.44***					2.93***			
			[3.90]					[2.73]			
DTB(-1)	-0.16			-0.36***	-0.24**	0.20	0.25**	0.26*		-0.10	-0.41**
	[-1.63]			[-2.82]	[2.10]	[1.09]	[2.20]	[1.85]		[-0.68]	[-2.29]
DTB(-2)				-0.22**		-0.01	0.17	0.40***		-0.22*	-0.01
				[-2.09]		[-0.05]	[1.46]	[3.30]		[-1.90]	[-0.06]
DTB(-3)						0.26**	0.46***				0.19
						[2.19]	[3.69]				[1.50]

Note: ***, ** and * represent significance level of 1%, 5% and 10%, respectively.
Source: Author's estimation

The analysis of the non-linear models demonstrates a clear asymmetry in the impact of real exchange rate fluctuations on the trade balance. While there is no significant evidence supporting the hypothesis that real exchange rate depreciation enhances the overall trade balance, it is evident that real exchange rate appreciation positively affects the trade balance both in the short run and in the long run. This

underscores Sri Lanka's heavy reliance on imported intermediate goods and raw materials for production and exports. Consequently, while real depreciation may enhance the competitiveness of domestic producers, this advantage could be offset by rising import prices. On the other hand, when the exchange rate appreciates, it can lower the prices of imported raw materials and intermediate goods, which might help improve the trade balance to some extent. These findings are further examined by analysing bilateral real exchange rates and trade balances of the ten selected countries. The non-linear specifications of these countries highlight the asymmetric effects of exchange rate changes on bilateral trade balances with Sri Lanka. In most cases, changes in bilateral real exchange rates significantly influence respective trade balances in the short term, except for Germany and India. Specifically, significant coefficients for either real exchange rate depreciation (POS) or appreciation (NEG) are observed in the short term for Germany, the USA, China, Singapore, the UK, and Italy. This impact persists in the long run only in the case of Germany. Meanwhile, for India, a significant relationship between exchange rate movements and the trade balance is only found in the long run. Nevertheless, three out of ten trading partners, i.e., Japan, Malaysia, and Hong Kong, yield no significant evidence to support the hypothesis explaining the link between exchange rate changes and the trade balance under either linear or non-linear models. Therefore, the remainder of the analysis mainly focuses on the seven trading partners of Sri Lanka that exhibit some form of relationship between real exchange rate changes and the trade balance in either the linear or non-linear models.

India stands as a prominent trading partner for Sri Lanka, contributing to 17 percent of total trade. According to linear model estimates, the bilateral real exchange rate exhibits no significant short run or long run effects on the trade balance. However, non-linear specifications indicate that the depreciation of the real exchange rate notably boosts the India-Sri Lanka trade balance in the long run. Conversely, real appreciation shows no significant impact, indicating an asymmetric effect of bilateral real exchange rate fluctuations on the trade balance between India and Sri Lanka.

China ranks as Sri Lanka's second largest trading partner. However, neither the linear nor the non-linear specifications support the existence of a link between the exchange rate and the trade balance in the long run. Nevertheless, both models indicate a significant impact of the real exchange rate on the bilateral trade balance in the short run. Further, evidence from the NARDL suggests that real exchange rate depreciation has a notably positive effect on the China-Sri Lanka trade balance, while real exchange rate appreciation exerts a significantly negative and comparatively larger impact on the bilateral trade balance in the short run.

Although long run estimates indicate no significant impact of the bilateral real exchange rate on the trade balance between the USA and Sri Lanka, short run specifications reveal that real exchange rate depreciation significantly influences the trade balance. Specifically, in the short run, real exchange rate depreciation bolsters the trade balance, while real appreciation weakens it. Even though the impact of depreciation is slightly larger than that of real exchange rate appreciation, the symmetry test failed to confirm the asymmetric impact of changes in the bilateral real exchange rate on the Sri Lanka trade balance.

The bilateral real exchange rate also affects the Singapore-Sri Lanka trade balance in the short run, as indicated by the results of the non-linear specification. However, contrary to previous findings, it is observed that real exchange rate appreciation significantly boosts the trade balance, while real exchange

rate depreciation has a notable negative impact. This distinction may be attributed to the inelastic nature of imports to Sri Lanka from Singapore. Approximately 60 percent of imports from Singapore consist of petroleum products, which remain insensitive to price changes under any circumstance. Consequently, currency depreciation could worsen the Singapore-Sri Lanka trade balance, whereas currency appreciation would enhance it.

Germany, Sri Lanka's fourth largest export destination, stands out as the sole country demonstrating a significant relationship between the bilateral exchange rate and the trade balance, evident in both short run and long run scenarios, and under both linear and non-linear specifications. Consequently, fluctuations in the bilateral real exchange rate positively impact on the trade balance, with currency depreciation exerting a larger influence than appreciation. This observed asymmetry may be attributed to the nature of the traded goods between the two countries.

The findings also indicate a significant relationship between the real exchange rate and the UK-Sri Lanka trade balance in the short run, as evidenced by the non-linear specification. According to the analysis, real exchange rate appreciation would unfavorably affect the UK-Sri Lanka trade balance in the short run, while real exchange rate depreciation would yield a positive impact. Furthermore, the results unveil the presence of asymmetric effects stemming from real exchange rate fluctuations on bilateral trade balances between Italy and Sri Lanka.

These models also uncover additional significant features. It is evident that the impact of Sri Lankan income on the trade balance is negative, as anticipated. However, when examining each bilateral trade balance, negative relationships are observed in the models pertaining to Japan, Malaysia, and Hong Kong, while contrasting results are noted in the case of Italy. The relationship between trading partners' income and the trade balance presents mixed outcomes. Specifically, the models concerning India, China, and Italy reveal significant negative relationships between each country's income and the respective trade balances, whereas for Italy, the link between trading partners' income and the trade balance is found to be positive.

6. Conclusion

The link between exchange rate fluctuations and the trade balance carries significant implications for an economy, particularly for small open economies like Sri Lanka. Despite numerous studies in the literature investigating this issue, findings have often been ambiguous. Against this backdrop, this paper aims to provide new insights into the relationship between exchange rate fluctuations and the trade balance, employing a non-linear modeling technique. This approach enables the identification of any asymmetry between the effects of currency depreciation and appreciation on the trade balance.

To investigate the impact of real exchange rate fluctuations on the trade balance in Sri Lanka and its ten major trading partners, this paper employs both linear and non-linear models using quarterly data spanning from 2007 to 2022. The findings lend support to the hypothesis favoring non-linear models over linear ones for a deeper understanding of the link between exchange rate fluctuations and the trade balance. The results reveal a long run enhancement of Sri Lanka's trade balance following real exchange rate depreciation in the cases of Germany and India. In the short run, a significant improvement (or deterioration) of the bilateral trade balance is observed following real exchange rate depreciation (or appreciation) in the cases of the USA, UK, China, Germany, and Italy. Additionally,

the results confirm the presence of asymmetry between the effects of currency appreciation and depreciation on the trade balance. However, the three trading partners do not provide evidence to support the hypothesis explaining the significant link between currency fluctuations and the trade balance under either linear or non-linear specifications.

In sum, the impact of currency fluctuation on trade balance, in the context of Sri Lanka, is more prevalent in this study than has been found in previous studies which used linear specifications. Results relating to some countries provide support for the conventional wisdom of exchange rate theory, implying that the long run effect of a real depreciation has been positive in the long run. Further, it is found that countries have different reactions to real exchange rate depreciation as compared to real exchange rate appreciation supporting the asymmetric effect.

Nevertheless, the mixed empirical results suggest that there exists no single pattern of real exchange rate-trade balance relationship between countries mainly due to the structure of the goods that are traded between countries. In line with these results, it is evident that the exchange rate policy alone has limited capacity to enhance the overall trade balance. Therefore, adopting a comprehensive policy package aimed at ensuring Sri Lanka's global competitiveness is imperative to address the multifaceted nature of trade dynamics. Such a policy package should include measures to diversify export products, improve trade infrastructure, strengthen trade relationships, enhance productivity, and foster innovation. Additionally, it should implement supportive macroeconomic policies to create a stable economic environment conducive to sustainable trade growth.

In this study, our analysis is confined to Sri Lanka's top ten trading partners in its external trade. While these partners represent a significant share of the country's international trade, they may not fully capture the complexity of global trade dynamics. This limitation could potentially overlook crucial indirect effects or dependencies on other countries or regions. To address this, future research could expand the scope by including a broader range of trading partners for a more comprehensive analysis.

Moreover, it is important to acknowledge that different industries may react differently to exchange rate fluctuations. While detailed product-level data could offer valuable insights, obtaining and processing such data presents resource-intensive challenges. Besides, this study focuses on a limited set of variables, namely real GDP and bilateral real exchange rate, without taking into account of other potentially influential factors such as political stability or non-tariff barriers. Additionally, changes in monetary and fiscal policies throughout the study period may have influenced the trade balance independently of exchange rate fluctuations. Future studies could address this by considering a wider array of factors and their impacts on trade dynamics.

Furthermore, this analysis does not differentiate between various exchange rate regimes in Sri Lanka, which could affect trade dynamics differently. Exploring these differences could provide deeper insights into the relationship between exchange rate fluctuations and trade balances.

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Appendices

Table A.1: Time series properties of the data

Trade Partner	ADFH0 : Xt ~ I(1) H0 : Xt ~I(0) With trend				ADFH0 : Xt ~ I(1) H0 : Xt ~I(0) First difference			
	TB	Rex	Y^d	Y^i	TB	Rex	Y^d	Y^i
World	-4.12***	-2.48	-14.91***	0.94	-7.15***	-5.87***	-10.88***	-4.83***
India	-4.91***	-3.02	-14.91***	-2.81	-7.13***	-6.31***	-10.88***	-13.30***
China	-7.31***	-4.22***	-14.91***	-4.58***	-9.28***	-9.68***	-10.88***	-10.98***
USA	-3.30*	-2.38	-14.91***	-3.75**	-8.81***	-6.52***	-10.88***	-19.73***
Singapore	-6.48***	-2.99	-14.91***	-3.25*	-12.68***	-9.01***	-10.87***	-9.27***
UK	-6.19***	-2.84	-14.91***	-4.26***	-6.80***	-6.42***	-10.88***	-9.22***
Japan	-1.67	-2.07	-14.91***	-3.14	-7.74***	-6.25***	-10.88***	-4.51***
Germany	-3.68**	-2.25	-14.91***	-2.79	-8.20***	-7.99***	-10.87***	-7.55***
Italy	-2.64	-2.32	-14.91***	-3.37*	-14.39***	-7.76***	-10.87***	-3.67**
Malaysia	-1.94	-2.67	-14.91***	-2.70	-8.22***	-8.67***	-10.87***	-8.38***
Hong Kong	-6.26***	-3.58**	-14.91***	-0.15	-7.21***	-9.34***	-10.87***	-3.37*

Note: ***, **, and * represent significant level of 1%, 5% and 10%, respectively.

Source: Author's estimation

Table A.2: Results of the bounds tests for cointegration

Trade Partner	F-Statistic
World	8.31***
India	7.86***
China	9.19***
USA	12.986***
Singapore	4.02***
UK	6.59***
Japan	7.22***
Germany	7.17***
Italy	8.60***
Malaysia	4.54***
Hong Kong	3.03***

Notes: ***, **, * indicates significance at 1%, 5%, and 10%, respectively.
Critical values for 60 observations at 1%, 5%, and 10% significance levels are 5.676, 4.314 1, and 3.712, respectively.