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Relative responses of trade in goods and services to currency devaluation: Evidence from Ethiopia

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A R T I C L E I N F O

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A B S T R A C T

Lack of hard currency is one of the key growth barriers in emerging countries, as imports vastly outstrip exports. In response, governments in these countries usually undertake a variety of policy packages, including the devaluation of the domestic currency. Despite these efforts, there have been no discernible adjustments to foreign balance. This study examines whether the response to devaluation differs significantly between the goods and services trade in Ethiopia. We estimate the long- and short-run elasticities of the disaggregated trade indicators using an autoregressive distributed lag (ARDL) and error correction mechanisms. The empirical results confirm a significant difference between the goods and service sectors in terms of their responses to the devaluation policy in the long and short run. The estimated long-run elasticities of devaluation are only statistically significant for service imports and trade balances with negative signs. The remaining sectors did not show any significant relationships. In addition, we obtain meaningful short-run elasticities for service imports, goods exports, and total exports, all of which have a negative sign. Domestic inflation accounted for a large portion of the short-run import dynamics, output growth, and FDI, which contributed significantly to long-term export performance. The current study reveals that the government should not rely exclusively on the devaluation policy to bridge its external imbalances, and should see alternative and more effective policy mixes to alter the demand and supply sides of foreign trade.

1. Introduction

The relative value of a domestic currency and its dynamics are important and closely monitored variables because of their impact on both the internal stability of the economy (e.g., price stability, domestic money demand, and economic growth) and external stability (e.g., a sustainable balance of payment) [1–3]. Many governments in LDCs place their faith in exchange rate policy to achieve their goal of redressing imbalances in the external sector. However, regardless of the policies implemented, most LDCs have not significantly bridged the foreign currency gaps [4]. Therefore, the issue of exchange rate devaluation remains debatable regarding its effect on economic growth, current account balance, internal consumption, and exports of goods and services. Given the pegged exchange rate, many assume that devaluing the domestic currency can help replenish foreign exchange reserves when they are low. The argument is simple: It is all about selling more abroad while importing less to raise net foreign exchange receipts. However, one should also consider a well-known precondition known as the Marshall-Lerner condition (MLC). While it is generally true that export volume increases with devaluation measures, there is also a reduction in the amount of foreign exchange earned from each unit of

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exports, as devaluation of the domestic currency reduces the value of exports [5]. Therefore, the net effect can only be as intended (an increase in the foreign exchange value of net exports) if the quantity effect of devaluation outweighs the price effect. Specifically, either an increase in export quantity or a decrease in import quantity should dominate a decrease in price. In other words, the two elasticities should sum to greater than unity in absolute terms:

The last statement also raises a question, especially for developing countries, for two reasons: On the one hand, because most of their export contents are simple agricultural products, where the demand for such items is inelastic, they may not meet the export side of the MLC. The import side of the MLC can be satisfied, but this is costly. This argument is based on the fact that many raw materials needed for investment are imported from developed nations. The devaluation policy would cause domestic investment to deteriorate as the price of imported raw materials increases [6,7]. Thus, given that the devaluation measures fail to affect foreign demand for domestic goods on the one hand while causing domestic demand to shift towards domestic goods as well as negatively affecting domestic investment by causing imported inputs to be costly, the net effect would be domestic inflation [8] and national output shrinkage.

Notwithstanding ongoing debates about the possible consequences of devaluation, Ethiopia has been devaluing its currency (ETB) for the last three decades. To boost exports, the country applied devaluation measures since its shift from a fixed exchange rate regime to managed floating in 1992. In nominal terms, the value of ETB per USD fell by around 206 percent between 1992 and 2002, 107 percent between 2002 and 2012, and 147 percent between 2012 and 2021. Stated differently, from only 2.07 ETB per unit of USD in 1991, it became more than 50 ETB per unit of USD in 2022. However, contrary to expectations, a country's external balance deteriorates (see Fig. 4). For instance, as per the UNCTAD reports, the current account balance has deteriorated by about 14 percent between 1992 and 2002, 2153 percent between 2002 and 2012, and 200 percent between 2011 and 2021.

Each devaluation measure implemented by the Ethiopian government reflects two opposing perspectives. From one perspective, international financial institutions (IMF and WB) have maintained that Ethiopia needs to apply further devaluation measures to gain external competitiveness. According to the IMF's most recent country report, overvaluation of the ETB is the cause of the country's foreign currency deficit [9]. Consequently, further devaluation will lessen forex demand and boost a country's external competitiveness. Nonetheless, several domestic researchers view the government's devaluation actions as unwise and premature [4]. Doubts emerge about the effectiveness of the policy because of the widely established argument that devaluation is less likely to improve external balance and is more likely to be inflationary as well as contractionary. In addition, many studies in Ethiopia link inflation to exchange rate dynamics [10,11]. The IMF also acknowledged the potential inflationary effects of devaluation and advised that devaluation should be supported by strict monetary policy, as doing so would lower the demand for foreign exchange while increasing the supply from additional exports [9]. However, the explanation is vague regarding how devaluation measures affect the supply side. Other scholars see the devaluation measures as necessary and the "right intervention" for two primary reasons [12]. On the one hand, there is a persistent gap between the official exchange rate and the parallel rate, which results in a considerable premium between the two. However, the real exchange rate was higher than that of its nominal counterpart. Both pieces of evidence imply that the domestic currency was overvalued.

Despite the widespread use of devaluation measures and the theoretical underpinnings that motivate them, inconclusiveness regarding the anticipated effect of devaluation persisted in the empirical world, warning that it could be country- and sector-specific. For instance, Villanueva et al. [13] documented a domestic demand contraction after devaluation in Spain. Taye [12] identified a link between each devaluation measure and stagflation, thereby sterilizing its effects in Ethiopia. Similarly, based on an empirical study of the CFA-franc zone, Bouvet et al. [3] pointed out that the devaluation effect significantly varied across member countries, having a sound effect only on three of the 14 countries in the group. Likewise, Perez & Matsaganis [14] documented the absence of a meaningful relationship between devaluation and export growth in South Africa. In direct contrast to the MLC, Woldie and Siddig [4] indicated that Ethiopia's devaluation strategy is only effective in the short run (SR) by enhancing export competitiveness while being contractionary in the long run (LR). Similarly, studies have reported mixed findings when examining asymmetric (nonlinear) relationships between the two variables. For instance, Nasir and Leung [15] found an asymmetric J-curve effect of devaluation on the USA's current account. However, Nathaniel [16] documented that devaluation did not boost competitiveness in Nigeria. Again, from disaggregated data, Yousef [17] found that the effect of devaluation systematically varies between industrial exports and other exports, where it has been effective in the former case for selected African countries. The empirical findings presented here imply that policy effectiveness depends on country-specific realities, and hence, separate treatment should be given to countries in various contexts.

Furthermore, apart from empirical inconsistency, previous studies have generally employed either exports [14,17–19] or balance of payments [1,7,16,20–22] to gauge the success of devaluation strategies. Consequently, they disregarded Cheng's [22] concern that the transmission channel for goods and services trade may differ substantially, resulting in distinct responses from the two sectors following devaluation. Determining the devaluation strategy at the disaggregated level (looking at imports and exports separately) may also shed more light on how each variable reacts.

This study contributes to literature in several ways. First, by providing country-specific evidence, this study contributes to ongoing debates on devaluation and the external balance nexus. Second, in addition to taking the trade balance as a single variable, this study separately measures the relative responses of exports and imports to devaluation measures. Finally, given that the underlying transmission mechanism from devaluation could vary between trade in goods and services [22,23], this study separately tests the individual responses of merchandise trade and service trade in Ethiopia to currency devaluation. To that end, because a separate examination of the product and service sectors is uncommon in the literature, especially in LDCs, the findings of this study will point the way forward for future policies regarding how to boost foreign competitiveness and which sectors to target. Consequently, this study aims to answer the following research questions. (i) What is the relative impact of devaluation on exports and imports? (ii) Does the response to the devaluation policy vary significantly between the goods and service sectors?

The remainder of the paper is organized as follows: Section two discusses the data and key methodologies, including the econometric techniques adopted. Section three presents a detailed discussion of the findings. The last section presents concluding remarks and possible policy implications of the study.

2. The data and methods

Regarding data type, this study used time series data for 32 years (1990–2021) obtained from international sources. This sample size was selected based on the availability of data for the entire time horizon for each of the variables included in the model while considering their sufficiency. The source of the data differs depending on the variables. GDP (both domestic and global) was obtained from the World Development Indicator (WDI) of the World Bank (WB), trade data such as exports and imports (both goods and services), the balance of payments were obtained from the United Nations Conference on Trade and Development (UNCTAD), the real effective exchange rate was obtained from the International Monetary Fund (IMF), and inflation data were obtained from the World Bank (WB).

2.1. Trends of key variables

Fig. 1 through 4 depict the dynamics of the key macroeconomic variables in Ethiopia between 1990 and 2021. The year 1991 was an important reference point in Ethiopia for many macroeconomic variables, as it was a time when complete paradigm shifts (from command economics to a relatively market-based economy) were undertaken in terms of state ideology. This time was associated with various policy reforms, such as the private sector being allowed to engage in many sectors, including foreign firms. In addition, the country allowed its currency to devalue, shifting from a fixed exchange rate regime to a managed floating regime. Most of the policy reform was associated with the so-called structural adjustment program advocated by the IMF and the WB, and Ethiopia was kin to follow what has been prescribed to qualify for the Highly Indebted Poor Country (HIPC) initiative as well as the Multilateral Debt Relief Initiative (MDRI). The government believed that exchange rate policy could solve the chronic problem of imbalances in the foreign sector by facilitating the export sector.

Therefore, to see the big picture of the export sector in Ethiopia and how it has responded to the ongoing exchange rate policy, trade in goods and trade in services are separately reported. In addition, both exports and imports of services (Fig. 1), exports and imports of goods (Fig. 2), and total exports and imports (Fig. 3) are reported. It is because of the claim in the literature that any policy affects exports and imports significantly differently, as the underlying assumptions of the two variables are different.

Fig. 1 illustrates how the import and export trends for services are remarkably dissimilar to those for goods. The gap between service imports and exports was nearly negligible until 2006, and the two variables showed a slightly growing trend from 1992 to 2006. Yet, since 2006, service imports have taken the lead, while the business cycles of the two variables were broadly comparable. As the two variables took separate paths between 2013 and 2018, the difference between the two also grew over that time. Following the COVID-19 outbreak, both sectors saw a decline in 2020 before it reappeared in 2021.

However, the goods sector contributes uniquely to existing foreign imbalances in the country. As shown in Fig. 2, although imports of goods dominated their export counterparts throughout the sample period, the gap has been relatively narrow since 2003 while recording similar trends in terms of how the two variables grow from year to year. However, the data-generating process of the two variables has taken a new turn since 2004, following the fact that imports of goods started growing at an increasing rate while exports grew as usual. Therefore, the gap between the two has widened since 2004. This dynamic was irrespective of the devaluation measure, which was hoped to correct the situation.

Another significant difference between the two variables was that the export of goods was more resilient to the COVID-19 shock than the import of goods. The nature of the nation's exports might explain the predicament. Since agricultural products (like coffee)

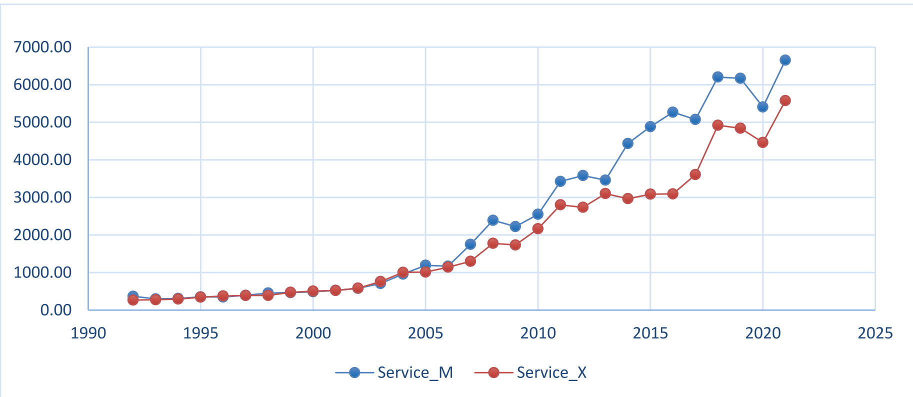

Fig. 1. Dynamics of service trade (between 1990 and 2021).
Source: UNCTAD (2023)

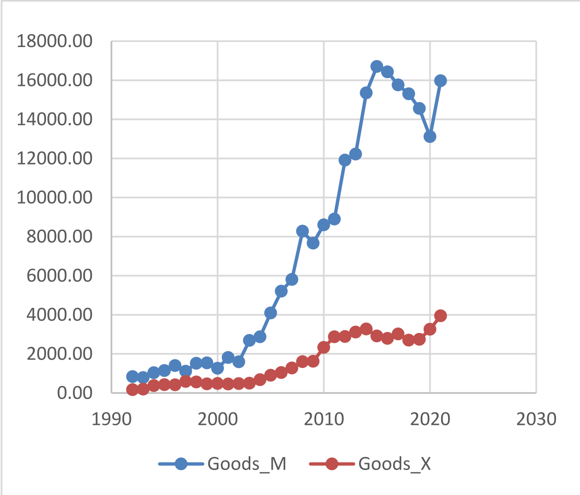

Fig. 2. Dynamics of Merchandise Export and import (between 1990 and 2021).
Source: UNCTAD (2023)

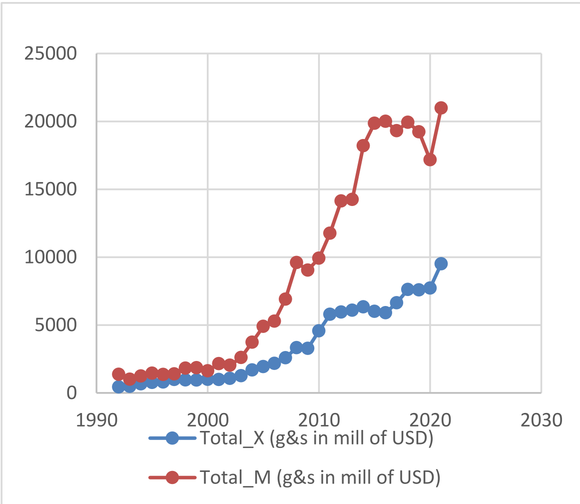

Fig. 3. Dynamics of Export and import (goods and services between 1990 and 2021).

make up the majority of exports of goods, the lockdown situation might boost demand for them in the international market. On the other hand, the so-called "stay home" orders wouldn't have resulted in a drop in supply because the majority of agricultural exports were produced in a typical rural area. Its component contains industrial imports and machinery that cannot be ordered during the closure time, which may explain why it is susceptible to shock on the import side.

The dynamics of the entire trend of exports and imports of goods and services (see Fig. 3) are similar to those of trade in goods. In other words, the behavior of total trade is a duplicate of the behavior of goods trade, in which the goods sector predominated over the service sector. The trend offers us two distinct narratives. On the one hand, due to the nature of the products the nation has been exporting (agricultural commodities, which are inelastic to price and income changes), it has been theoretically demonstrated that the devaluation measures have no power to affect the export sector. The import dynamics, however, ran counter to both assumptions and hypotheses. We anticipate that when the value of domestic currency falls, imports will become more expensive, and the volume of imports will decrease. Fig. 3 shows that, in contrast, Ethiopia's imports have been rising even faster than before, regardless of changes in the country's currency.

Similarly, Fig. 4 displays the developments in the balance of payments (BoP) between 1990 and 2021. As a result, the country's BOP was marginally positive until 1994. However, it has gotten worse throughout the course of the majority of the sample periods since 1994. The dynamics of the BOP and the dynamics of trade in products are mutually exclusive (see Figs. 2 and 4). For instance, the BOP's peaks and valleys in 2016 and 2020 coincided with the peaks and valleys of the trade in products during those years. It suggests that the dynamics of trade predominantly explained the dynamics of the country's BOP, which is simply one factor in the BOP record in products.

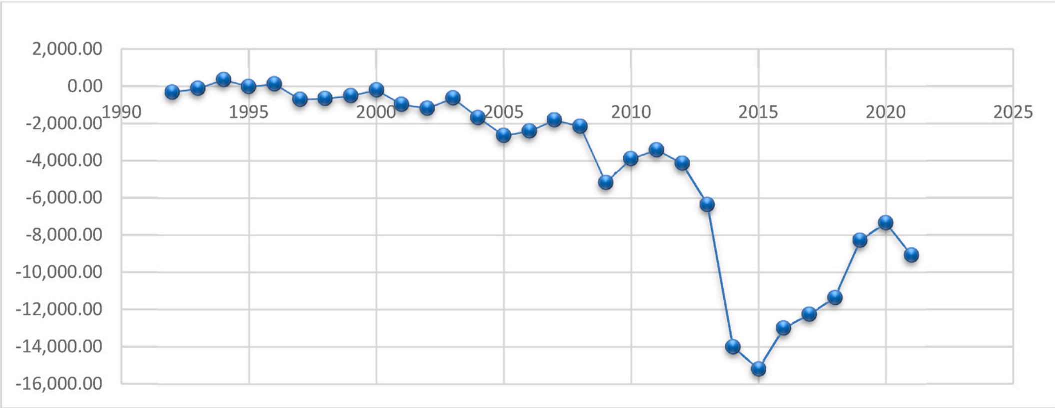

Fig. 4. Balance of payment (BOP) dynamics between 1990 and 2021..
Source: IMF (2023)

2.2. *Theoretical framework*

The theoretical underpinnings of the relationship between currency devaluations and foreign competitiveness date back to Keynesian small open economy macroeconomic modeling [24]. The work of Mundell [25] and Fleming [26], which is common in the literature by the name 'Mundell-Fleming' model, has been used as a workhorse in macroeconomic and foreign trade policies. Mundell-Fleming model using the Hicksian IS-LM framework, identifies two equilibrium conditions to be met for the overall market to be at equilibrium: the goods market (IS) and the money market (LM). The goods market is given by $y = A(y_d, r) + NX(e, y, y*)$, where y is aggregate demand representing the common open economy national account identity; A is domestic absorption; and y_d and r, respectively, are disposable income and interest rate. Whereas, our interest here is net export (*NX*), which is composed of export $X(e, y*)$ and import $M(e, y)$. Here, it expresses export as a function of exchange rate and foreign income and import as a function of exchange rate and domestic income.

On the other hand, the money market equilibrium (*LM*) is given by $m/_p = l(r, y)$, where m/p is the real money balance, which is the function of interest rate (r) and income (y). Thus, for the overall market to be at equilibrium, the two markets (the goods market and the money market) need to be at equilibrium simultaneously. This model has been applied in different contexts, such as with the assumption of perfect capital mobility and fixed vs. floating exchange rate systems, and its end result greatly depends on the assumptions we make. Mundell [27] documented the relative importance of fiscal and monetary policies under the two exchange rate regimes while considering perfect capital mobility. These works had a significant impact on how little room there is for monetary policy with a fixed exchange rate, even in Keynesian settings [28,29].

Those efforts led to the end of the fixed exchange rate regime in LDCs, and devaluation was widely accepted as a way to correct imbalances in the foreign sector. It was believed that devaluation would increase foreign demand for domestic products while decreasing domestic demand for imported goods [30]. However, the devaluation theories are predicated on the idea that both domestic and international supplies are elastic to changes in price [31]. For instance, rising overseas demand after a devaluation was assumed to boost domestic production.

The Marshall-Lerner condition (MLC), which is based on the well-known works of Marshall and Lerner, was followed by the introduction of additional prerequisites for the improvement of the balance of payments following an adjustment to the exchange rate [28,30–32]. MLC suggests that for the devaluing country to benefit from devaluation, the sum of the price elasticity of foreign demand for exports and the price elasticity of domestic demand for imports must be greater than one on an absolute basis [24,32,33]. The MLC begins with the balance of payment (B) equation ($B = X - eQ$), where B is BoP; X is export, eQ is the value of import in domestic currency units while e is exchange rate (birr per unit of USD). With little mathematical manipulation, MLC is given as $\frac{dB}{de} \cdot \frac{e}{X} = |\eta_X + \eta_M| - 1$, where η_X and η_M respectively are the price elasticity of foreign demand for exports and the price elasticity of domestic demand for imports. Thus, this condition states that unless $|\eta_X + \eta_M| > 1$, the current account balance will not improve following devaluation measures. Again, MLC is built upon two key assumptions – free mobility of capital and substitutability of financial assets. Carnevali et al. [34] pointed out that the MLC will hold only if the two assumptions hold, while both assumptions are hard to satisfy in the LDCs.

Given the Mundell-Fleming type of economy with a fixed exchange rate, the Shieh [35] model stresses that devaluation will only produce a positive impact by improving the balance of payments if the central bank does not follow a tight monitoring policy. As a theoretical response to the "Cooper Paradox" [36], he mathematically proved that devaluation would end up in depression by reducing the real money supply and domestic absorption, given that the tight money effect is present. Later, the devaluation policy faced another theoretical challenge regarding its immediate and long-term effects on BOP. The "J-curve effect" came into play by arguing that countries trying to correct their external balances through devaluation could face a worse effect before it got better [37]. Due to the sticky domestic currency prices of exports—whether cost-based or governed by longer-term contracts—export prices in foreign currencies decline. The balance of payments deteriorates until favorable volume benefits offset unfavorable price effects. Stated differently, it argues that the MLC will only meet in the LR [38]. The J-curve hypothesis emphasizes that if the current account is in deficit before the devaluation, as would typically be the case resulting from the adjustment lags, devaluation will widen the deficit in the home currency since imports grow by a larger proportion than exports [39]. Furthermore, Wijnbergen [40] identified three possible cases where devaluation would lead to contractions in the aggregate supply: first, if its effect on the domestic currency value of imports of intermediate input is significantly large; second, if domestic real wages are indexed to CPI, which would lead to an increase in labor costs; and third, if local prices increase in line with the exchange rate, the supply of loans will decrease as the monetary base shrinks, resulting in a high-interest rate.

2.3. The model

In this study, we considered aggregate variables such as trade balance (TB) and total exports and imports as well as disaggregated variables such as trade in goods and trade in services to understand whether there were any significant differences between the two in terms of responding to the policy measures adopted. Critics have pointed out that an aggregated approach, such as TB, fails to account for the dynamic responsiveness of each variable (exports and imports) to policy changes [22]. Similarly, the dynamic effect of devaluation on a supply- and demand-side variables of trade in goods and trade in services could differ significantly [22,41,42]. To account for both arguments, this study uses seven separate equations to estimate: (1) imports in services, (2) exports in services, (3) exports in services, (4) exports in goods, (5) total imports (both goods and services), (6) total exports in services, and (7) trade balance.

Various empirical evidences have been consulted for the appropriate model specification for each equation. Accordingly, a significant number of texts use the exchange rate and domestic income as the sole explanatory variables for the import equation (see Cheg [22]; Bahmani et al. [5]), whereas the export dynamics is modeled as a function of foreign income besides, the exchange rate and domestic income (see Cheg [22]; Bahmani et al. [5]). Moreover, the equation for trade in goods and trade in services do not see significant differences in terms of the variables that determine them [43,44]. Both the goods and service trade theories stem from the same theoretical basis. The variable selection in the above literature is based on the Marshall-Lerner condition on its primary targets for estimating elasticities. The Marshall-Lerner condition establishes a connection between export and import demand elasticity and purchasing power parity, which links exchange rates to price levels. Policymakers and businesses rely on these variables to grasp trade dynamics and make well-informed choices regarding trade policies and strategies.

Nonetheless, there is growing evidence that domestic inflation, particularly in LDCs, may have a considerable impact on a country's import and export dynamics, especially in the SR [45,46]. Since consumer goods make up the majority of imported goods, governments in LDCs may want to consider buying more of them from other countries to help control the rise in domestic prices [46]. This is especially true in Ethiopia, where the government uses strategies to increase imports during periods of high inflation by either engaging directly in import activities (such as importing sugar, food oil, wheat, and related items) or by creating favorable conditions for the private sector to import the necessary goods, such as by setting up the forex. Likewise, inflation may restrict the volume of goods available for exports by encouraging exporters to sell their goods domestically or by increasing the cost of exportable goods in the international market [47–49]. This predicament is particularly significant for nations that export basic goods such as food and whose macroeconomic conditions are unstable.

Similarly, the volume of the FDI influx has had a substantial impact on a country's international trade structure. In recent decades, there has been much interest in the role of FDI in international trade with LDCs [50,51]. There have been significant productivity spillovers from FDI that may impact import and export arrangements. According to Zhang and Song [52], FDI is the primary driver of the industrial exports of most LDCs. This assertion was based on the observation that most foreign companies operating in the production sector export their outputs, increasing the nation's export volume. Therefore, inflation and FDI are considered additional and meaningful explanatory variables in this study. Thus, in this study, real GDP was considered a proxy for domestic income, while the per capita income of OECD member countries was considered a proxy for world income, as they contain a significant share as a destination for goods shipped from Ethiopia. Following Cheg [22] the following equations are specified.

$$\ln M_t^s = \alpha_0 + \alpha_1 \ln reer_t + \alpha_2 \ln Y_t + \alpha_3 \ln fdi_t + \alpha_4 \ln cpi_t + \varepsilon_{1t} \tag{1}$$

$$\ln E_t^s = \beta_0 + \beta_1 \ln reer_t + \beta_2 \ln Y_t + \beta_3 \ln Y_t^* + \beta_4 \ln fdi_t + \beta_5 \ln cpi_t + \varepsilon_{2t} \tag{2}$$

$$\ln M_t^g = \delta_0 + \delta_1 \ln reer_t + \delta_2 \ln Y_t + \delta_3 \ln fdi_t + \delta_4 \ln cpi_t + \varepsilon_{3t} \tag{3}$$

$$\ln E_t^g = \varphi_0 + \varphi_1 \ln reer_t + \varphi_2 \ln Y_t + \varphi_3 \ln Y_t^* + \varphi_4 \ln fdi_t + \varphi_5 \ln cpi_t + \varepsilon_{4t} \tag{4}$$

$$\ln M_t^T = \varphi_0 + \varphi_1 \ln reer_t + \varphi_2 \ln Y_t + \varphi_3 \ln fdi_t + \varphi_4 \ln cpi_t + \varepsilon_{5t} \tag{5}$$

$$\ln E_t^t = \lambda_0 + \lambda_1 \ln reer_t + \lambda_2 \ln Y_t + \lambda_3 \ln Y_t^* + \lambda_4 \ln fdi_t + \lambda_5 \ln cpi_t + \varepsilon_{6t} \tag{6}$$

$$\ln TB_t = \gamma_0 + \gamma_1 \ln reer_t + \gamma_2 \ln Y_t + \gamma_3 \ln Y_t^* + \gamma_4 \ln fdi_t + \gamma_5 \ln cpi_t + \varepsilon_{7t} \tag{7}$$

Where, *ln* refers natural logarithm, the RHS variables in equations (1) and (2) are service import and exports respectively; equations (3) and (4) are goods import and export respectively, equations (5) and (6) represent total import and export respectively, and equation (7) is trade balance. The superscript s, g, and T are services, goods, and Total respectively; whereas REER is real effective exchange rate; Y_t is domestic income in real terms; Y_t^* is foreign income; α_j, β_j, δ_j, φ_j, φ_j λ_j, and γ_j are the unknown coefficients (elasticities) to be estimated and ε_j is a white noise disturbance term.

2.3.1. Autoregressive distributed lag (ARDL) model

To estimate the seven equations, we performed a cointegration test using the ARDL bound approach, following Pesaran et al. [53]. ARDL was chosen because of its popularity in the literature for the estimation of cointegrated time-series variables. It is a re-parameterization of the error correction representation of Engle and Granger [51], and the presence of the LR equilibrium relation can be tested using the EC representation. The cointegration test through the ARDL approach has become the workhorse of present-day time series modeling as compared to the Engel-Granger "two-step" procedures [54] as well as Johansen's approach [55] for various reasons. First, the ARDL method is more appropriate in the small-sample case because it is more conservative and does not reject the 'no cointegration hypothesis, given that it does not exist in the small-sample case [56]. Second, the model is less restrictive regarding the order of integration that the variables could follow. That is, contrary to the Engel-Granger approach, it does not require all variables to possess the same order of integration. The only requirement in ARDL is that all variables need to have a single unit root at most. However, some variables can be stationary at their level form, whereas most macroeconomic variables can easily qualify. Third, as opposed to other methods, such as Engel and Granger, which can only allow for a shared lag length that minimizes the information criteria, the ARDL approach permits the separation of the optimal lag lengths for each variable [54]. Thus, equations (8)–(14) are allowed to differ for each variable in the equation, and the process could provide more parsimonious results.

In light of this, we have chosen the ARDL technique for cointegration because it would allow us to freely select the dynamic lag and the SR feedback of the lagged response variables [53]. We revised equation (1) through (7) as follows to reflect a conditional (unrestricted) error-correction specification:

$$\Delta \ln M_t^s = \alpha_0 + \sum_{i=1}^{p_{11}} \alpha_{1i} \Delta \ln M_{t-i}^s + \sum_{j=0}^{p_{12}} \alpha_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{13}} \alpha_{3j} \Delta \ln Y_{t-j} + \sum_{j=0}^{p_{14}} \alpha_{4j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{15}} \alpha_{5j} \Delta \ln cfi_{t-j} + \varphi_{10} \ln M_{t-1}^s + \varphi_{11} \ln reer_{t-1} + \varphi_{12} \ln Y_{t-1} + \varphi_{13} \ln fdi_{t-1} + \varphi_{14} \ln cpi_{t-1} + \varepsilon_{1t} \tag{8}$$

$$\Delta \ln E_t^s = \beta_0 + \sum_{i=1}^{p_{21}} \beta_{1i} \Delta \ln E_{t-i}^s + \sum_{j=0}^{p_{22}} \beta_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{23}} \beta_{3j} \Delta \ln Y_{t-j} + \sum_{j=0}^{p_{24}} \beta_{4j} \Delta \ln Y_{t-j}^* + \sum_{j=0}^{p_{25}} \beta_{5j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{26}} \beta_{6j} \Delta \ln cpi_{t-j} + \varphi_{20} \ln E_{t-1}^s + \varphi_{21} \ln reer_{t-1} + \varphi_{22} \ln Y_{t-1} + \varphi_{23} \ln Y_{t-1}^* + \varphi_{23} \ln fdi_{t-1} + \varphi_{24} \ln cpi_{t-1} + \varepsilon_{2t} \tag{9}$$

$$\Delta \ln M_t^g = \delta_0 + \sum_{i=1}^{p_{31}} \delta_{1i} \Delta \ln M_{t-i}^g + \sum_{j=0}^{p_{32}} \delta_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{33}} \delta_{3j} \Delta \ln Y_t + \sum_{j=0}^{p_{34}} \delta_{4j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{35}} \delta_{5j} \Delta \ln CPI_{t-j} + \varphi_{30} \ln M_{t-1}^g + \varphi_{31} \ln reer_{t-1} + \varphi_{32} \ln Y_{t-1} + \varphi_{33} \ln fdi_{t-1} + \varphi_{34} \ln cpi_{t-1} + \varepsilon_{3t} \tag{10}$$

$$\Delta \ln E_t^g = \theta_0 + \sum_{i=1}^{p_{41}} \theta_{1i} \Delta \ln E_{t-i}^g + \sum_{j=0}^{p_{42}} \theta_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{43}} \theta_{2j} \Delta \ln Y_{t-j} + \sum_{j=0}^{p_{44}} \theta_3 \Delta \ln Y_{t-j}^* + \sum_{j=0}^{p_{45}} \theta_{4j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{46}} \theta_{5j} \Delta \ln cpi_{t-j} + \varphi_{40} \ln E_{t-1}^g + \varphi_{41} \ln reer_{t-1} + \varphi_{42} \ln Y_{t-1} + \varphi_{43} \ln Y_{t-1}^* + \varphi_{44} \ln fdi_{t-1} + \varphi_{45} \ln cpi_{t-1} + \varepsilon_{4t} \tag{11}$$

$$\Delta \ln M_t^T = \varphi_0 + \sum_{i=1}^{p_{51}} \varphi_{1i} \Delta \ln M_{t-i}^{Tg} + \sum_{j=0}^{p_{52}} \varphi_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{53}} \varphi_{3j} \Delta \ln Y_t + \sum_{j=0}^{p_{54}} \varphi_{4j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{55}} \varphi_{5j} \Delta \ln cpi_{t-j} + \varphi_{50} \ln M_{t-1}^T + \varphi_{51} \ln reer_{t-1} + \varphi_{52} \ln Y_{t-1} + \varphi_{53} \ln fdi_{t-1} + \varphi_{54} \ln cpi_{t-1} + \varepsilon_{5t} \tag{12}$$

$$\Delta \ln E_t^T = \lambda_0 + \sum_{i=1}^{p_{61}} \lambda_{1i} \Delta \ln E_{t-i}^T + \sum_{j=0}^{p_{62}} \lambda_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{63}} \lambda_{2j} \Delta \ln Y_{t-j} + \sum_{j=0}^{p_{64}} \lambda_3 \Delta \ln Y_{t-j}^* + \sum_{j=0}^{p_{65}} \lambda_{4j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{66}} \lambda_{5j} \Delta \ln cpi_{t-j} + \varphi_{60} \ln E_{t-1}^T + \varphi_{61} \ln reer_{t-1} + \varphi_{62} \ln Y_{t-1} + \varphi_{63} \ln Y_{t-1}^* + \varphi_{64} \ln fdi_{t-1} + \varphi_{65} \ln cpi_{t-1} + \varepsilon_{6t} \tag{13}$$

$$\begin{aligned}\Delta \ln TB_t = \gamma_0 + \sum_{i=1}^{p_{71}} \gamma_{1i} \Delta \ln E^T_{t-i} + \sum_{j=0}^{p_{72}} \gamma_{2j} \Delta \ln reer_{t-j} + \sum_{j=0}^{p_{73}} \gamma_{2j} \Delta \ln Y_{t-j} \\ + \sum_{j=0}^{p_{74}} \gamma_3 \Delta \ln Y^*_{t-j} + \sum_{j=0}^{p_{75}} \gamma_{4j} \Delta \ln fdi_{t-j} + \sum_{j=0}^{p_{76}} \gamma_{5j} \Delta \ln cpi_{t-j} + \varphi_{70} \ln TB_{t-1} \\ + \varphi_{71} \ln reer_{t-1} + \varphi_{72} \ln Y_{t-1} + \varphi_{73} \ln Y^*_{t-1} + \varphi_{74} \ln fdi_{t-1} + \varphi_{75} \ln cpi_{t-1} + \varepsilon_{7t}\end{aligned} \quad (14)$$

Where equation (8) through (14) represent the Error Correction representation version of equation (1) through (7), p_{jk} is an optimum lag of variable k in the jth equation to be determined using information criteria (AIC and SIC …), Δ is a first difference notation, φ_{j0} (where j = 1,2,..7) represents the speed of adjustment, φ_{ji} (where, j = 1,2,..,7 and i = 1, 2, …k) represents the LR coefficient

2.4. The stationarity issues

It is fairly familiar knowledge that we most often obtain a high correlation between or among time-varying economic variables to which we cannot attach any physical significance, while under the ordinary statistical test available to us, we fail to reject the relationship. One begins to doubt the serious arguments that are occasionally advanced based on the correlations between time series when such nonsensical correlations are observed. This issue arises when empirical studies on time series incorrectly assume stationarity, leading to the possibility that when those variables are regressed on another one, one could end up with a high coefficient, even though there are no significant relationships between the variables. This type of problem is 'spurious regression problem,' which can persist in non-stationary time series even if the sample is large. Through Monte Carlo experiments, Granger and Newbold [57] demonstrated that the usual t-statistics from OLS regression provide counterfeit results. Given a sufficiently large dataset, we can almost always reject the null hypothesis of the test that β = 0, even though β (the coefficient that links the two non-stationary variables) is zero. Here, the OLS estimate does not converge to any well-defined population parameters. However, Phillips [58] later provided an asymptotic conjecture that explained Granger and Newbold [57] results. He demonstrated that any two variables produced from the random walk model, yt and xt, are first-difference stationary processes and that OLS estimator does not adhere to its typical asymptotic features when they are integrated of order one (I (1)). Because yt and xt are covariance stationary, OLS regression appears to be feasible option. However, if the two variables are cointegrated, the simple regression of yt on xt is misspecified.

Hence, the time series data should be stationary to prevent erroneous conclusions from a non-stationary regression. Hence, before estimating, a formal test for stationery is mandatory to decide on the appropriate model to be employed. The Dickey-Fuller and Philips-Perron unit root tests have gained popularity among time series econometricians in the past few years as stationarity test methods.

2.4.1. The unit root test

The bulk of time series variables in economic and financial data exhibit trending behavior over time—the so-called unit root issue. An essential econometric task is to identify the shape of the trend in the data and transform it into a stationary form before the analysis. If the data are trending, trend removal is necessary. First-differencing and time-trend regression are frequently used techniques for trend removal or de-trending. The first difference is acceptable for the I(1) time series, but the I(0) trend-stationary time series should use time-trend regression. Unit root tests assess whether trending data should be initially differenced or regressed on deterministic functions of time to stabilize the data. Unit root tests can be performed in various ways, and most of them are valid if the time series can be identified by AR (1) with white noise errors. The augmented Dickey–Fuller (ADF) test was adopted in this study because of its popularity and consistency among researchers. Assuming that the dynamics in the data have an ARMA structure, ADF compares the null hypothesis that a time series contains a single unit root, I(1), to the alternative that it is I(0). In calculating the test regression, we use equation (15):

$$y_t = \beta D_t + \Phi y_{t-1} + \sum_{j-1}^{p} \gamma_j \Delta y_{t-j} + \varsigma_t \quad (15)$$

Where, D_t is a vector of deterministic terms (constant, trend etc.). The p lagged difference terms, Δy_{t-j}, are used to approximate the ARMA structure of the errors, and the value of p (where the maximum lag length p can be estimated empirically) is set so that the error ς_t is serially uncorrelated, having a constant variance. The specification of the deterministic terms depends on the assumed behavior of y_t under the alternative hypothesis of trend stationarity. Under the null hypothesis, y_t is I(1) which implies that $\Phi = 1$. Alternatively, the more general and robust ADF (augmented Dick-Fuller) test regression where both drift and trend are included, can be formulated as shown in equation (16);

$$\Delta y_t = \beta_0 + \beta_1 t + \varphi y_{t-1} + \sum_{j-1}^{p} \gamma_j \Delta y_{t-j} + \varsigma_t \quad (16)$$

Where $\varphi = \Phi - 1$. Under the null hypothesis, Δy_t is I(0) which implies that $\varphi = 0$. The ADF t-statistic is then the usual t-statistic for testing $\varphi = 0$. The null hypothesis of ADF (equation (16)) is $\varphi = 0$ against the alternative hypothesis that $\varphi < 0$. Where, $\varphi = \Phi - 1$. A rejection of this hypothesis means that the time series is stationary or does not contain a unit root while not rejecting means that the time series is non-stationary.

In addition to the Dickey-Fuller's procedure, we employ the Philips-Perron [58] method, in equation (17), for robustness. In the Phillips–Perron procedure the following regression equation is fitted

$$y_t = \alpha + \rho y_{t-1} + \varepsilon_t \tag{17}$$

Where, ε_t is an iid process with $\varepsilon_t \sim N(0, \sigma^2)$ and ρ is the autocorrelation parameter which is estimated through the equation $(\widehat{\rho}_n = \sum_{t=1}^{p} y_t \cdot y_{t-1} / \sum_{t=1}^{p} y_t^2)$ and it uses the corollary that if $|\rho| < 1$, then, $\sqrt{n}(\widehat{\rho}_n - \rho) \sim N(0, 1 - \rho^2)$ and since the resulting distribution has a zero variance for $|\rho| = 1$, the value of $\widehat{\rho}_n$ from OLS will converge to unity. Thus, Phillips-Perron procedure presented in equation (17), tests a null hypothesis of the form $H_0 : \rho = 1$ against its stationary alternative.

3. Findings and discussions

To ensure the underlying assumption of time series data, it is customary to test the stationarity of the data before estimation. We adopt two commonly used unit root test procedures – Dickey-Fuller and Philips-Perron unit root test methods.

3.1. Pre-estimation tests (unit root test and cointegration tests)

Where, τ refers to without drift and trend terms, τ_μ is constant (drift) included, τ_T is time trend included, I(1) implies the data under question is integrated of order one. I.e., it has one-unit root; I(0) implies the variable has no unit root (it's stationary); lnX implies variables at their level form while DlnX implies variables at their first difference form. And the reported figures are test statistic.

According to Table 1, except for FDI and CPI, the remaining variables are integrated of order 1. Their data-generating process contains a single unit root, whereas taking the first difference avoids the unit root. Moreover, the figures are highly consistent between the two procedures (ADF and PP). As the critical values created for the trend and drift options are larger in absolute terms than those without trend and drift, adding them in both tests facilitated the stationarity procedures for all variables under examination.

Table 2 is based on Pesaran et al. (2001)'s ARDL bound test approach to cointegration. The F-statistic and the t-statistic as well as their respective upper and lower bounds (critical values) were reported in Table 2. The null hypothesis to be tested is $H_0 : \varphi_{j0} = 0, \forall j = 1, 2, .., 7$ against its alternative that $H_a : \varphi_{j0} \neq 0, \forall j = 1, 2, ..., 7$, where, φ_{j0} is coefficients of the one period lagged dependent variable obtained from equation (8) to equation (14). The Rejection of the null implies that the variables have at least one co-integrating equation, and the decision rules are that the F-statistic must be greater than the lower bound and should not fall between the two critical values. This would make the test result indeterminate. Accordingly, given the conventional 5 percent level of significance, Equation 8 through 14 were separately checked for their cointegration, and the results revealed that all equations under consideration are cointegrated. That is, they have LR equilibrium.

Table 1
Unit root test results.

Variables	Dickey-Fuller				Phillips-Perron			
	τ	τ_μ	τ_T	I~(?)	τ	τ_μ	τ_T	I~(?)
$\ln M^s$	3.746	0.006	−2.476	I(1)	0.393	0.023	−10.157	
$D\ln M^s$	−3.557	−5.626	−5.610		−19.615	−26.108	−25.836	I(1)
$\ln X^s$	4.797	−0.276	−2.293	I(1)	0.421	−0.102	−9.679	
$D\ln X^s$	−3.188	−5.617	−5.514		−16.418	−26.727	−26.718	I(1)
$\ln M^g$	2.730	−0.977	−1.427		0.333	−0.834	−6.329	
$D\ln M^g$	−5.392	−7.589	−7.874	I(I)	−39.934	−46.019	−46.372	I(1)
$\ln X^g$	3.063	−1.669	−1.829		0.412	−1.812	−8.611	
$D\ln X^g$	−3.290	−4.148	−4.200	I(I)	−15.621	−23.037	−25.019	I(1)
$\ln M^T$	3.055	−0.394	−1.766		0.310	−0.322	−8.194	
$D\ln M^T$	−4.116	−6.014	−6.038	I(I)	−25.360	−31.100	−30.502	I(1)
$\ln X^T$	4.745	−1.075	−1.477		0.382	−0.742	−6.914	
$D\ln X^T$	−2.676	−4.360	−4.379	I(1)	−11.458	25.034	−26.367	I(1)
$\ln TB$	0.285	−2.370	−3.694		0.064	−11.501	−17.522	
$D\ln TB$	−6.040	−5.907	−5.737	I(1)	−27.227	−27.169	−26.840	I(1)
$\ln Y$	10.060	1.066	−1.355		0.091	0.338	−3.318	
$D\ln Y$	−1.814	−3.873	−4.202	I(1)	−3.609	−20.233	−21.163	I(1)
$\ln Y*$	8.427	−0.588	−2.207		0.028	−1.158	−6.845	
$D\ln Y*$	−2.024	−5.877	−5.918	I(1)	−20.366	−21.924	−21.940	I(1)
$\ln reer$	−1.081	−4.710	−6.666		−0.226	−17.305	−15.746	I(0)
$D\ln reer$	−9.328	−9.090	−8.459	I(1)	–	–	–	
$\ln fdi$	0.564	−4.029	−4.980	I(0)	0.496	−7.338	−14.828	I(0)
$\ln cpi$	−2.003	−3.535	−4.238	I(0)	−6.702	−19.071	−23.605	I(0)

Table 2
ARDL Bounds Test results.

Equation	1	2	3	4	5	6	7
F-stat	8.679	9.667	6.859	17.481	9.210	7.665	3.080
Upper CVs	3.99	3.99	3.99	3.99	3.99	3.99	3.99
Lower CVs	2.75	2.75	2.75	2.75	2.75	2.75	2.75
t-stat	−4.732	−5.855	−5.124	−6.232	−4.582	−4.874	−4.190
Upper CVs	−4.04	−4.04	−4.04	−4.04	−4.04	−4.04	−4.04
Lower CVs	−2.57	−2.57	−2.57	−2.57	−2.57	−2.57	−2.57
Decision	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0	Reject H_0

3.2. Discussions on the LR and SR coefficients (elasticities)

After testing for cointegration, we estimated the LR parameters (elasticities) of each variable for all 7 equations specified in Section (2.2.1). The results were compared and contrasted with the conventional expectations of currency devaluation. That is, whether foreign expenditure switches towards domestic goods and household expenditure is cut on foreign goods (decrease in imports), both ways work towards improving the trade balance. In addition, we also aim to check whether the LR and SR responses to the devaluation policy vary significantly across the goods and service sectors, as well as between imports and exports. With the stated objectives, we employed a restricted error-correction model to estimate the speed of the adjustment parameters, LR parameters, and SR dynamics. We report the LR coefficients in Table 3, along with the adjustment parameters, and Table 4 contains the SR estimates. To ensure model parsimony, we avoided insignificant variables and re-estimated the model as suggested by Cheng [22]. The models pass various post-estimation diagnostic tests, such as the Breusch-Pagan/Cook-Weisberg test for heteroscedasticity, the Ramsey RESET test for model specification, and the Breusch-Godfrey LM test for autocorrelation of the error term (see Table 6). In all cases, we failed to reject the null hypothesis, which fulfills the classical assumptions. To test the direction of causation between the exchange rate and trade variables (see Table 5), the Granger causality test was employed, which indicates that causation runs from the exchange rate to the trade variables for most of the trade variables, while no evidence is found concerning reverse causality. To check whether the parameter of each equation was stable over the sample periods, cumulative sum (CUSUM) square tests were employed (see Fig. 5), which proved that all estimated parameters were dynamically stable.

As a result, the coefficient of a one-period lagged error term ($\varepsilon_{j(t-1)}$) in equation 8 through 14 is found to be negative and statistically significant at 5 % levels of significance (see Table 3). Both behaviors are desirable and provide additional evidence that the equations' LR equilibria exist. Six of the seven equations showed an overall adjustment of more than 50 % each year, which suggests that deviations in any equation will be corrected in less than two years. Although uncommon in most literature, the error correction term (ECM) for import of goods (column (3) of Table 3) has assumed a value less than the negative one (−1.301). Two types of studies were observed. Some studies silently interpreted the speed of adjustment as convergent, given that it is negative, without giving due attention to its magnitude [59]. Other scholars have emphasized both the sign and magnitude of the ECM. For instance, Keele et al. [60] reported that an ECM with a value less than one should be interpreted as oscillatory convergence. Keele et al. [60] delineated that, though ECM commonly rage between −1 and 0, it may strictly lie between −1.0 and −2.0. When this occurs, the approach to equilibrium oscillates, with the dependent variable correcting for more than 100 % of the equilibrium error in the subsequent period. However, overcorrection gradually decreases, leading to a slow return to equilibrium. This conclusion is supported by other studies [61,62].

Table 3
Estimated LR parameters.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln *Y*	0.941[b]	1.079[a]	0.230	0.974[c]	0.514	1.048[b]	0.347
	(0.333)	(0.216)	(0.249)	(0.503)	(0.590)	(0.480)	(0.327)
ln *Y*∗		0.971[b]		−1.656[c]		−0.374	−0.334
		(0.443)		(0.832)		(0.757)	(0.736)
ln *reer*	0.360	−0.428[b]	0.265	−0.570	0.332	−0.171	−0.625[b]
	(0.336)	(0.183)	(0.195)	(0.423)	(0.352)	(0.393)	(0.271)
ln *fdi*	0.128[c]	−0.0438	0.111[b]	0.276[a]	0.419[b]	0.113[c]	−0.110[c]
	(0.061)	(0.0358)	(0.0393)	(0.089)	(0.182)	(0.0587)	(0.0587)
ln *cpi*	0.0054[a]	0.0039[a]	0.0601	0.030	0.023	0.014	0.001
	(0.0018)	(0.0013)	(0.0012)	(0.501)	(0.096)	(0.3300)	(0.002)
ECM (−1)	−0.722[a]	−0.721[a]	−1.301[a]	−0.505[a]	−0.445[b]	−0.531[a]	−0.772[a]
	(0.152)	(0.123)	(0.254)	(0.0811)	(0.172)	(0.137)	(0.192)

Standard errors in parentheses.
Note: the seven equations are equations that we specify in our ARDL model above (see equation 8 through 14) where columns (1) & (2) are service import and export respectively; columns (3) & (4) are goods import and export respectively; columns (5) & (6) are total import and export respectively, and column (7) refers trade balance. ECM (−1) is the error correction term.
[a] $p < 0.01$.
[b] $p < 0.05$.
[c] $p < 0.1$.

Table 4
Short run Dynamics.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$D \ln M^g_{t-1}$			−0.226				
			(0.147)				
$D \ln M^T_{t-1}$					−0.201		
					(0.150)		
$D \ln Y_{t-1}$		−0.032	1.731*		1.228*		
		(0.451)			(0.582)		
$D \ln Y^*_{t-1}$		−1.474***		2.005**			
		(0.383)	(1.165)	(0.760)			
$D \ln reer$	−0.519*			−0.211		−0.236	
	(0.272)			(0.242)		(0.254)	
$D \ln reer_{t-1}$				−0.531***		−0.205**	
				(0.114)		(0.094)	
$D \ln fdi$	−0.055**	0.051**	−0.074**	−0.044	−0.093**		0.093***
	(0.024)	(0.019)	(0.029)	(0.028)	(0.035)		(0.040)
$D \ln fdi_{t-1}$					0.065**		
					(0.025)		
$D \ln cpi$			0.212**	−0.010***	0.005***	−0.003	
			(0.098)	(0.002)	(0.001)	(0.01)	
$D \ln cpi_{t-1}$			0.444***	−0.005***	0.003**	−0.002***	
			(0.115)	(0.001)	(0.001)	(0.001)	
C	−6.245**	−8.081***	−6.467**	0.399	0.516	−3.006*	0.610
	(2.238)	(1.623)	(2.439)	(1.231)	(2.238)	(1.524)	(1.149)
N	32	32	32	32	32	32	32
R^2	0.687	0.719	0.691	0.879	0.778	0.726	0.470

Standard errors in parentheses.
***$p < 0.01$.
**$p < 0.05$.
*$p < 0.1$.

Each sector reacted differently to devaluation in both the LR and SR. The immediate response of each variable to the evaluation measures was weaker. As Table 4 shows, service imports, goods, and total exports responded negatively and significantly, partially supporting the J-curve hypothesis. However, in the remaining cases, the exchange rate coefficient was statistically insignificant. Contrary to the J-curve effect, in the LR, the responses were either negative or statistically insignificant. For instance, devaluation hurts service exports and trade balances (TB) with estimated coefficients that are statistically significant at the 5 % level (see Table 3). However, the remaining five equations (service imports, merchandise imports and exports, and total exports and imports) do not react meaningfully to devaluation measures in the LR. Another paradoxical result of the estimates is that, ignoring the level of significance, the exchange rate coefficients (LR elasticities) associated with all types of imports (goods, services, and total) are positive, while the export coefficients are all negative. Furthermore, although devaluation fails to be statistically significant at the conventional level for total exports and imports, it causes TB to deteriorate. Given its simplicity, this finding warns that devaluation measures will not be sufficient to cure imbalances in the external sector, both in the LR and SR. It has received more attention since the goods sector (both imports and exports) is less responsive to the devaluation policy, although it makes a dominant contribution to overall trade. In this regard, Mundell's [27,63] arguments lend support to our findings that policy effectiveness could be a function of norms governing public policy, the rate at which domestic price levels adjust in response to demand shocks, and the level of capital mobility.

Various empirical studies support this finding. From the computable general equilibrium (CEG) exercise, Woldie & Siddig [4] reported that the LR effect of devaluation on exports was weak and inflationary in Ethiopia and warned that any positive role could only be at the expense of household welfare deterioration. This contraction could be attributed to the rise in the cost of imported raw materials and the decline in domestic investment. On the other hand, Taye [12] argues that in terms of improved trade balance, a positive outcome could be obtained from the devaluation exercise and may not be desirable, as it is more likely to result in decreased imports than increased exports. Again, Bouvet et al. [3] underline that devaluation in Africa fails to produce the intended outcomes, as it fails to satisfy the two conditions proposed by Reinhart [64]. For the devaluation measures to be translated into improvements in TB, first, nominal devaluations need to be translated into real devaluations. Second, demand and supply systems must respond to changes in relative prices. In Ethiopia, neither criterion has been met. On the one hand, despite the devaluation measures, the real effective exchange rate has been declining, and the premium between the official and parallel exchange markets has been growing. On the other hand, owing to the nature of the goods Ethiopia exports, foreign demand structures fail to adjust to the relative price shift.

The SR impact of domestic income is statistically meaningful only in two cases (service imports and total imports). Both coefficients are positive and significant at the 10 % level. This result could imply that a rise in domestic income would immediately boost the demand for imported goods. This is conventionally what we expect, given that most consumer durables are imported from outside, whose demand is directly linked to domestic income. In addition, the role of domestic income was as anticipated, having positive signs, and being statistically significant in most cases. Its LR impact is stronger in exports than in imports, and in the service sector than in the goods sector. While TB, goods imports, and total imports are not statistically significantly affected by the level of domestic income, the remaining coefficients are statistically meaningful. As per the degree of responsiveness, both service and total exports were highly responsive to income changes, as their estimated LR elasticities were larger than unity.

On the other hand, we include foreign income in the export equations, based on theoretical justification. Accordingly, the LR boosts service exports and hurts goods exports. Its effect in the service sector is relatively strong, as it is statistically significant at the conventional 5 % level, whereas in the goods sector, it is significant only at the 10 % level. On the other hand, no significant influence was observed in the total exports of goods and services and in TB. However, in the short run, only service and goods exports responded meaningfully to the changes in foreign income. The immediate impact of foreign income is negative in service exports, whereas it is positive and significant in goods exports. No SR relationship was observed in the remaining cases. This finding was expected. Exports in Ethiopia are less responsive to income changes, because most of their components are primary products.

FDI is a significant predictor of Ethiopia's foreign trade dynamics. In contrast to previous empirical studies, we consider FDI a potential predictor of foreign trade in Ethiopia. Owing to its rarity, we carefully investigated cross-checks before approving it as a candidate. We evaluated Granger causality and model specification checks in addition to empirical support, and the variables passed all the pre- and post-estimation tests. Accordingly, the estimated results imply that FDI is among the predictors that explain most of the response variables considered in this study, especially in the long-run. The estimated LR coefficients are all statistically significant at least at the 10 % level, except for insignificant service exports. Except for TB, all estimated coefficients that are significant are positive. The elasticities are stronger in the goods sector than in the service sector. This finding confirms the empirical results of Zhang [51] and Zhang & Song [52]. The authors argue, raising various points through which FDI would affect the hosts' export performance. First, mobilization of the domestic workforce, technology transfer, and imported foreign currencies would directly affect production capacity and, hence, the level of exports in the host countries. Second, by establishing a distribution network, staying up-to-date with swift changes in consumer tastes, mastering the intricacies of industrial norms and safety standards, and creating a new product image, foreign companies through FDI can support indigenous firms and, hence, exports. However, for exporters from underdeveloped countries, the lack of these abilities is an obstacle in accessing the global market. An additional unique feature of FDI is that its immediate (SR) impact remains highly significant, but negative in five of the seven cases. That is, only service exports and TB respond positively to changes in FDI in the short run. This could be a result of the fact that there could be considerable time lags between foreign firms' efforts to influence the hosts' export structure through technology transfer and their efforts to find markets for local firms in the foreign market, making the immediate effect unfavorable.

Another intriguing finding is the effect of domestic inflation on foreign trade. According to our estimates, domestic inflation plays a significant role in determining exports and imports in SR. The variables were positive but insignificant determinants of the LR path for each variable, except for trade in services (imports and exports). In the latter case, the effect is positive and statistically significant. However, the SR inflation coefficient has important implications. Its coefficient becomes significantly positive for both goods and total imports. However, the estimated elasticities are negative for exports (goods and total exports). Although there is no SR impact on the service trade or the trade balance, the rest of the results could imply that while there is no LR effect of domestic inflation, in the SR, it may result in significant engagements in imports as part of the stabilization plan for domestic prices. This result supports the results of earlier empirical investigations. For instance, Okpe and Ikpesu [46] connected Nigeria's rising food imports with rising inflation. In addition, Istiqomah [45] recognizes that inflation has a detrimental impact on export performance.

4. Conclusions

This study addresses the ongoing empirical debate regarding the relationship between currency depreciation and trade performance. It contributes to the trade literature by measuring the relative responses of various disaggregated trade variables to devaluation policies in Ethiopia. In the framework of the ARDL bound test approach to cointegration and error correction modeling, we estimated the long- and short-term responses of imports and exports of goods, services, and trade balances to devaluation. As part of the pre-estimation diagnostics, we employed ADF and PP stationarity tests on the variables involved in the model, as the tests ensured that all variables were either I (0) or I (1). In addition, the cointegration test using the ARDL bound approach to each equation revealed the presence of a LR equilibrium relationship in all cases. However, before interpretation, post-estimation diagnostic checks, such as the model specification test and tests related to the estimated residual, ensure the absence of any form of violation of conventional econometric assumptions. Furthermore, to rationalize each variable as a predictor of the trade model, we employed the Granger causality test, and the result implied that Granger causality runs from each predictor to the trade variables and, in some cases, it could be bidirectional.

As per the estimated LR and SR elasticities, various trade variables (service imports and exports, goods imports and exports, and trade balances) responded considerably differently to the devaluation measures both in the long- and short-runs. Being negative, the short-term response of imports and exports to devaluation is partially in line with the J-curve hypothesis. However, being either negative or statistically weak, all forms of the export sector stand in sharp contradiction to conventional small open economy macroeconomic theory and the J-curve effect. Thus, in either case, the finding implies that devaluation is not a sufficient policy option to boost the export sector and improve the country's foreign imbalances. Rather, Ethiopia could benefit from accelerated domestic output growth and FDI attraction since positive feedback is identified from the two variables. This empirical finding will have a profound contribution to the ongoing policy dialogues concerning LDCs' trade competitiveness, as it prompts the need for evaluation of policy effectiveness at the disaggregated level, as well as the need for more robust policy mixes to bridge the gap in the external sector rather than solely relying on the devaluation strategy.

5. Limitation of the paper

Our finding is based on a linear ARDL model for a sample of 32 years gathered from a single country (Ethiopia). Thus, the linearity assumption, small sample size, and missed cross-sectional aspects are limitations of our study. Hence, future researchers could advance the knowledge if they focus on the asymmetric linkage between trade variables and exchange rate dynamics, taking into account multiple country cases and a relatively longer period.

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Ethics approval

Not applicable.

Data availability

The data that has been used in this study is found on Mendeley with the following link: https://data.mendeley.com/datasets/v5pbkj7yzb/1.

CRediT authorship contribution statement

Amsalu Dachito Chigeto: Writing – review & editing, Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

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

APPENDIX

Table 5
Granger causality test results

Equation (5)	Chi^2 (*prob.*)	Equation (6)	Chi^2 (*prob.*)	Equation (7)	Chi^2 (*prob.*)
$\ln Y \Rightarrow \ln M^T$	9.0799** (0.011)	$\ln Y \Rightarrow \ln E^T$	0.88021 (0.644)	$\ln Y \Rightarrow \ln TB$	4.3014 (0.116)
$\ln M^T \Rightarrow \ln Y$	0.58958 (0.745)	$\ln E^T \Rightarrow \ln Y$	2.9246 (0.232)	$\ln TB \Rightarrow \ln Y$	0.25637 (0.880)
$\ln reer \Rightarrow \ln M^T$	13.494*** (0.001)	$\ln Y* \Rightarrow \ln E^T$	2.0776 (0.354)	$\ln Y^* \Rightarrow \ln TB$	7.4345** (0.024)
$\ln M^T \Rightarrow \ln reer$	2.9772 (0.226)	$\ln E^T \Rightarrow \ln Y*$	5.6264* (0.060)	$\ln TB \Rightarrow \ln Y^*$	0.43523 (0.804)
$\ln cpi \Rightarrow \ln M^T$	5.1465* (0.076)	$\ln reer \Rightarrow \ln E^T$	2.1511 (0.341)	$\ln reer \Rightarrow \ln TB$	11.186*** (0.004)
$\ln M^T \Rightarrow \ln cpi$	0.35252 (0.838)	$\ln E^T \Rightarrow \ln reer$	9.4121*** (0.009)	$\ln TB \Rightarrow \ln reer$	2.1681 (0.338)
$\ln fdi \Rightarrow \ln M^T$	10.118*** (0.006)	$\ln cpi \Rightarrow \ln E^T$	15.522*** (0.000)	$\ln cpi \Rightarrow \ln TB$	6.6717** (0.036)
$\ln M^T \Rightarrow \ln fdi$	0.18026 (0.914)	$\ln E^T \Rightarrow \ln cpi$	7.0967** (0.029)	$\ln TB \Rightarrow \ln cpi$	3.016 (0.221)
		$\ln fdi \Rightarrow \ln E^T$	7.5485 (0.023)	$\ln fdi \Rightarrow \ln TB$	2.3841 (0.304)
		$\ln E^T \Rightarrow \ln fdi$	1.7731 (0.412)	$\ln TB \Rightarrow \ln fdi$	14.992*** (0.001)

P-values in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1. The null hypothesis claims absence of causality and rejecting the null implies the presence of Granger causality between the two variables.

Table 6
Diagnostic checks

Null hypothesis	Test statistic						
	1	2	3	4	5	5	7
Constant variance	0.38 (0.537)	0.36 (0.551)	1.46 (0.226)	0.96 (0.328)	0.07 (0.785)	0.54 (0.464)	0.06 (0.800)
No omitted variables	1.48 (0.260)	0.29 (0.835)	0.27 (0.846)	0.24 (0.867)	0.55 (0.657)	0.82 (0.508)	1.02 (0.409)
No serial correlation	0.033 (0.856)	0.031 (0.861)	2.856 (0.091)	5.948 (0.015)	0.864 (0.353)	0.870 (0.351)	0.012 (0.915)

P-values in parentheses; the diagnostic test is performed on the seven equations separately and failure to reject the null implies absence of violations of assumptions under consideration.

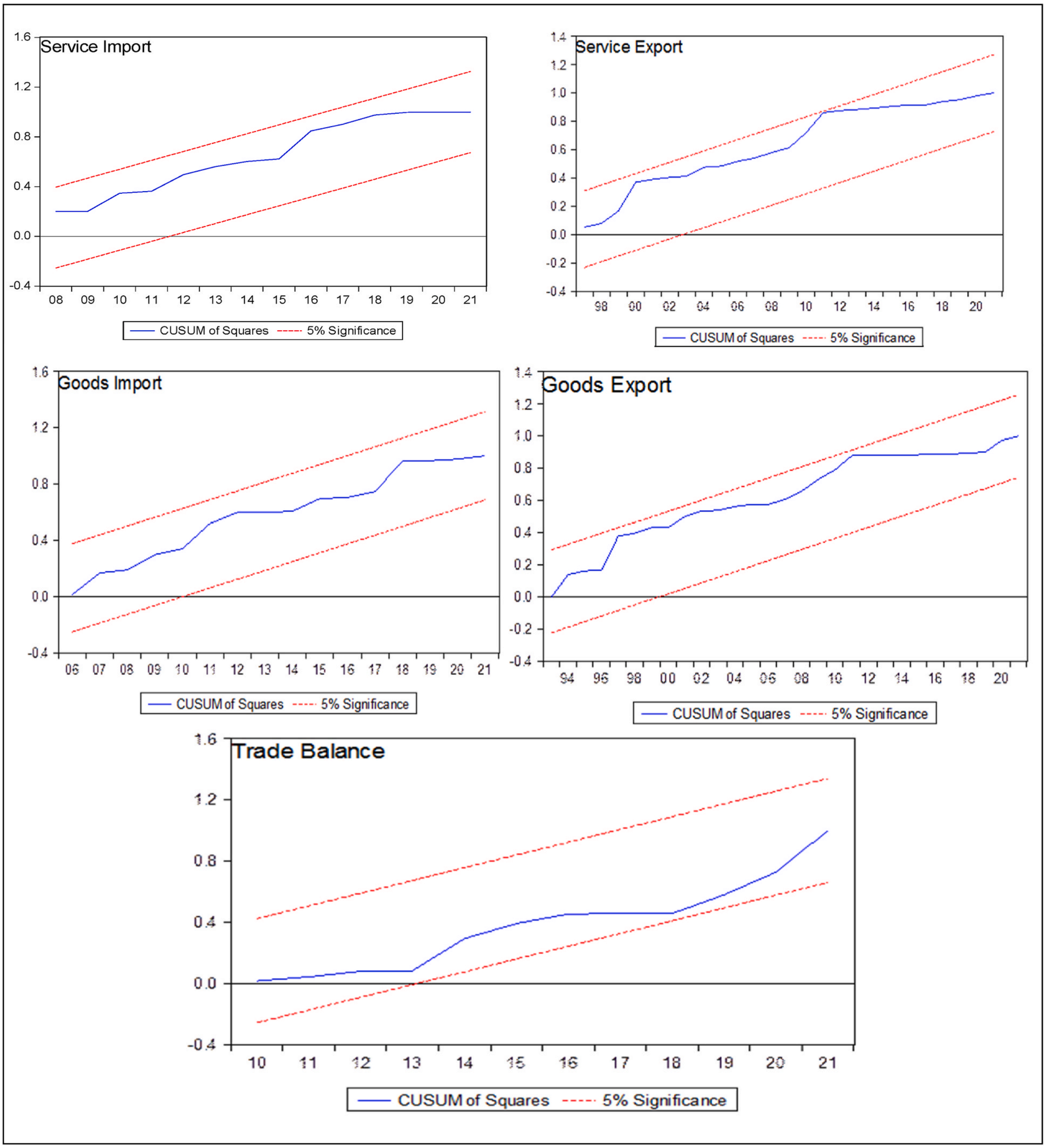

Fig. 5. CUSUM Square graphs.

References

[1] F.B. Hunegnaw, S. Kim, Foreign exchange rate and trade balance dynamics in East African countries, J. Int. Trade Econ. Dev. 26 (2017) 979–999, https://doi.org/10.1080/09638199.2017.1327611.

[2] A. Elias, A. Dachito, S. Abdulbari, The effects of currency devaluation on Ethiopia ' s major export commodities : the case of coffee and khat : evidence from the vector error correction model and the Johansen co-integration test the effects of currency devaluation on Ethiopia ' s major exp, 27, https://doi.org/10.1080/23322039.2023.2184447, 2023.

[3] F. Bouvet, R. Bower, J.C. Jones, Currency devaluation as a source of growth in Africa: a synthetic control approach, E. Econ. J. 48 (2022) 367–389, https://doi.org/10.1057/s41302-022-00211-4.
[4] G.A. Woldie, K. Siddig, Macroeconomic and distributional impacts of exchange rate devaluation in Ethiopia: a computable general equilibrium approach, Heliyon 5 (2019) e02984, https://doi.org/10.1016/j.heliyon.2019.e02984.
[5] M. Bahmani, H. Harvey, S.W. Hegerty, Empirical tests of the Marshall-Lerner condition: a literature review. https://doi.org/10.1108/01443581311283989, 2013.
[6] P. Rathgeb, A. Tassinari, How the Eurozone disempowers trade unions: the political economy of competitive internal devaluation, Socio. Rev. 20 (2022) 323–350, https://doi.org/10.1093/ser/mwaa021.
[7] E. Berbenni, External devaluation and trade balance in 1930s Italy, Struct. Change Econ. Dynam. 57 (2021) 93–107, https://doi.org/10.1016/j.strueco.2021.02.001.
[8] R.S.M. Ribeiro, J.S.L. McCombie, G.T. Lima, Some unpleasant currency-devaluation arithmetic in a post Keynesian macromodel, J. Post Keynes. Econ. 40 (2017) 145–167, https://doi.org/10.1080/01603477.2016.1246949.
[9] IMF, Federal democratic republic of Ethiopia: the 2019 article IV consultation and requests for three-year arrangements under the extended credit facility and the extended Fund facility, IMF Country Report (2020) 1–121.
[10] T.T. Biresaw, Determinant and impact of dynamic inflation in Ethiopia, J. Chem. Inf. Model. 53 (2013).
[11] H.K. Taye, The impact of devaluation on macroeconomic performance, J. Pol. Model. 21 (1999) 481–496, https://doi.org/10.1016/S0161-8938(97)00110-5.
[12] H.K. Taye, The impact of devaluation on macroeconomic performance, J. Pol. Model. 21 (1999) 481–496, https://doi.org/10.1016/S0161-8938(97)00110-5.
[13] P. Villanueva, L. Cárdenas, J. Uxó, I. Álvarez, The role of internal devaluation in correcting external deficits: the case of Spain, Struct. Change Econ. Dynam. 54 (2020) 282–296, https://doi.org/10.1016/j.strueco.2020.03.008.
[14] S.A. Perez, M. Matsaganis, Export or perish: can internal devaluation create enough good jobs in southern europe? S. Eur. Soc. Polit. 24 (2019) 259–285, https://doi.org/10.1080/13608746.2019.1644813.
[15] M.A. Nasir, M. Leung, US trade deficit, a reality check: new evidence incorporating asymmetric and non-linear effects of exchange rate dynamics, World Econ. 44 (2021) 818–836, https://doi.org/10.1111/twec.12986.
[16] S.P. Nathaniel, Does exchange rate have asymmetric impact on trade balance? Fresh insights from combined cointegration, Studies in Business and Economics 15 (2020) 259–269, https://doi.org/10.2478/sbe-2020-0019.
[17] T.T. Yousef, Impact of Devaluation on Industrial Exports in Saudi Arabia : J-Curve Hypothesis, Munich Personal RePEc Archive, 2021.
[18] D. Kohn, F. Leibovici, M. Szkup, Financial frictions and export dynamics in large devaluations, J. Int. Econ. 122 (2020) 103257, https://doi.org/10.1016/j.jinteco.2019.103257.
[19] O.B. Muoneke, K.I. Okere, F.C. Onuoha, Extreme exchange rate dynamics and export trade in the selected oil-exporting countries in Africa. Multiple asymmetric threshold non-linear ARDL approach, J. Int. Trade Econ. Dev. (2022), https://doi.org/10.1080/09638199.2022.2139405.
[20] G. Kamugisha, J.E. Assoua, Effects of a devaluation on trade balance in Uganda: an ARDL cointegration approach, Int. J. Econ. Finance 12 (2020) 42, https://doi.org/10.5539/ijef.v12n7p42.
[21] Z. Khan, A. Ali, S. Ali, Impact of devaluation on balance of trade: a case study of Pakistan economy, Asian J. Econ. Model. 4 (2016) 90–94, https://doi.org/10.18488/journal.8/2016.4.2/8.2.90.94.
[22] K.M. Cheng, Currency devaluation and trade balance: evidence from the US services trade, J. Pol. Model. 42 (2020) 20–37, https://doi.org/10.1016/j.jpolmod.2019.09.005.
[23] J. Marquez, Estimating elasticities for U.S. trade in services, Econ Model 23 (2006) 276–307, https://doi.org/10.1016/j.econmod.2005.11.003.
[24] M.O. Adebayo, View of currency devaluation: a review, Chiang Mai University Journal of Economics 25 (2021) 15–35.
[25] R.A. Mundell, The international disequilibrium system, Kyklos 14 (1961) 153–172, https://doi.org/10.1111/j.1467-6435.1961.tb02451.x.
[26] J.M. Fleming, Domestic Financial Policies under Fixed and under Floating Exchange Rates, vol. 9, Staff Papers - International Monetary Fund, 1962, pp. 369–380.
[27] R.A. Mundell, Capital mobility and stabilization under fixed and flexible exchange rates: a comment, Can. J. Econ. Polit. Sci. 30 (1963) 413–421, https://doi.org/10.2307/139707.
[28] N.R. K, P.I. Putri, Mundell-fleming model: the effectiveness of Indonesia's fiscal and monetary policies, Jejak 10 (2017) 223–235, https://doi.org/10.15294/jejak.v10i1.9137.
[29] K. Kohler, Currency devaluations, aggregate demand, and debt dynamics in economies with foreign currency liabilities, J. Post Keynes. Econ. 40 (2017) 487–511, https://doi.org/10.1080/01603477.2017.1368027.
[30] G. Gandolfo, International finance and international macroeconomics: an overview. https://doi.org/10.1007/978-3-662-49862-0_1, 2016.
[31] E. Carnevali, G. Fontana, M.V. Passarella, Assessing the Marshall-Lerner condition within a stock-flow consistent model, Camb. J. Econ. 44 (2020) 891–918, https://doi.org/10.1093/cje/bez060.
[32] M.M. Mwito, R. Njeri Muhia, S. Kiprop, L. Kibet, Does the marshall-lerner condition hold for Kenya'S bilateral trade? A dynamic panel data approach, Eur. J. Bus. Soc. Sci. 4 (2015) 40–58.
[33] A.A. Shahzad, B. Nafees, N. Farid, Marshall-Lerner condition for South Asia: a panel study analysis, Pakistan Journal of Commerce and Social Sciences (PJCSS) 11 (2017) 559–575.
[34] E. Carnevali, G. Fontana, M. Veronese Passarella, Assessing the Marshall–Lerner condition within a stock-flow consistent model, Camb. J. Econ. 44 (2020) 891–918, https://doi.org/10.1093/cje/bez060.
[35] Y. Shieh, The tight money effect of devaluation: an alternative interpretation of contractionary devaluation, J. Appl. Bus. Econ. 4 (2009) 1–7.
[36] C.-Y. Wang, L.F.S. Wang, Currency devaluation and the Cooper paradox in the open-economy macro-disequilibrium model, Weltwirtsch Arch 121 (1985) 628–637, https://doi.org/10.1007/BF02705869.
[37] H.W. Arndt, G. Dorrance, The J-Curve, Aust. Econ. Rev. 20 (1987) 9–19, https://doi.org/10.1111/j.1467-8462.1987.tb00653.x.
[38] J. Adams, A. Metwally, Testing for the Marshall–Lerner condition in Egypt: an empirical analysis, African J. Econ. Manag. Stud. 12 (2021) 151–170, https://doi.org/10.1108/AJEMS-01-2020-0001.
[39] M. Bahmani-Oskooee, H. Fariditavana, Nonlinear ARDL approach, asymmetric effects and the J-curve, Journal of Economic Studies 42 (2015) 519–530, https://doi.org/10.1108/JES-03-2015-0042.
[40] S. Van Wijnbergen, Exchange rate management and stabilization policies in developing countries, J. Dev. Econ. 23 (1986) 227–247, https://doi.org/10.1016/0304-3878(86)90117-3.
[41] B. Hoekman, P. Braga, Protection and trade in services : a, Survey * 308 (1997) 285–308.
[42] F. Kimura, H. Lee, The gravity equation in international trade in services. https://doi.org/10.1007/s10290-006-0058-8, 2006.
[43] K.M. Cheng, Currency devaluation and trade balance: evidence from the US services trade, J. Pol. Model. 42 (2020) 20–37, https://doi.org/10.1016/j.jpolmod.2019.09.005.
[44] J. Marquez, Estimating elasticities for U.S. trade in services, Econ Model 23 (2006) 276–307, https://doi.org/10.1016/j.econmod.2005.11.003.
[45] N.A. Purusa, N. Istiqomah, Impact of FDI , COP , and Inflation to Export in Five Asean Countries, vol. 19, 2018, pp. 94–101, https://doi.org/10.23917/jep.v19i1.5832.
[46] A.E. Okpe, F. Ikpesu, Effect of inflation on food imports and exports, J. Develop. Area. 55 (2021) 1–10, https://doi.org/10.1353/jda.2021.0075.
[47] W. Baer, Topical review the inflation controversy Latin America : a survey, Lat. Am. Res. Rev. 2 (1967) 3–25.
[48] I.S. Chaudhry, A. Iqbal, M. Umar, M. Faheem, Impact of monetary policy on inflation and investment in Pakistan: a time series analysis, Journal of Accounting and Finance in Emerging Economies 7 (2021) 931–943, https://doi.org/10.26710/jafee.v7i4.2079.
[49] M. Azam, S. Khan, Threshold effects in the relationship between inflation and economic growth: further empirical evidence from the developed and developing world, Int. J. Finance Econ. 27 (2022) 4224–4243, https://doi.org/10.1002/ijfe.2368.

[50] S. Sun, How does FDI affect domestic firms'exports? Industrial evidence, World Econ. 32 (2009) 1203–1222, https://doi.org/10.1111/j.1467-9701.2009.01175.x.

[51] K.H. Zhang, How does FDI affect a host country's export performance? The case of China, in: International Conference of WTO, China and the Asian E Conomies, 2005, pp. 25–26.

[52] K.H. Zhang, S. Song, Promoting exports: the role of inward FDI in China, China Econ. Rev. 11 (2001) 385–396, https://doi.org/10.1016/S1043-951X(01)00033-5.

[53] M.H. Pesaran, Y. Shin, R.J. Smith, Bounds testing approaches to the analysis of level relationships, J. Appl. Econom. 16 (2001) 289–326, https://doi.org/10.1002/jae.616.

[54] R.F. Engle, C.W.J. Granger, Co-integration and error correction: representation , estimation , and testing, Econometrica 55 (1987) 251–276. Published by: The Econometric Society Stable URL: http://www.jstor.org/stable/1913236.

[55] S. Johansen, Identifying restrictions of linear equations with applications to simultaneous equations and cointegration, J. Econom. 69 (1995) 111–132, https://doi.org/10.1016/0304-4076(94)01664-L.

[56] S. Jordan, A.Q. Philips, Cointegration testing and dynamic simulations of autoregressive distributed lag models, STATA J. 18 (2018) 902–923, https://doi.org/10.1177/1536867x1801800409.

[57] C.W.J. Granger, P. Newbold, Spurious regressions in econometrics, J. Econom. 2 (1974) 1–10.

[58] P.C.B. Phillips, Understanding spurious regressions in econometrics, J. Econom. 33 (1986) 311–340, https://doi.org/10.1016/0304-4076(86)90001-1.

[59] M. Wolde, L. Sera, T.M. Merra, Causal relationship between income inequality and economic growth in Ethiopia, Cogent Economics and Finance 10 (2022), https://doi.org/10.1080/23322039.2022.2087299.

[60] L. Keele, S. Linn, C.M.L. Webb, Treating time with all due seriousness, Polit. Anal. 24 (2016) 31–41, https://doi.org/10.1093/pan/mpv031.

[61] D.R. Capozza, P.H. Hendershott, C. Mack, An anatomy of price dynamics in illiquid markets: analysis and evidence from local housing markets, R. Estate Econ. 32 (2004) 1–32, https://doi.org/10.1111/j.1080-8620.2004.00082.x.

[62] Modupe O. Abifarin, Audu Isah, Yisa Yakubu, Rasheed A. Adeyemi, Stabilizing error correction mechanism in the presence of explosiveness, Asian Journal of Probability and Statistics 26 (2024) 50–63, https://doi.org/10.9734/ajpas/2024/v26i1584.

[63] D. Jena, A. Barua, Trade, governance and income convergence in the European Union: evidence on the "theory of relative backwardness,", Research in Globalization 2 (2020) 100013 https://doi.org/10.1016/j.resglo.2020.100013.

[64] C.M. Reinhart, Devaluation, Relative Prices, and International Trade: Evidence from Developing Countries, vol. 42, Staff Papers - International Monetary Fund, 1995, p. 290, https://doi.org/10.2307/3867574.