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Devaluation, goods price variation and trade flows

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Aim: The study evaluated the impact of devaluation and goods price variation on trade flows in a sample of 47 countries consisting of developing and developed nations from 1990 to 2023.

Design/Research methods: The estimation techniques adopted in this work are the Panel Structural VAR (PSVAR), GARCH, and panel non-linear ARDL (PNARDL) methods. Unlike other traditional estimation techniques, the Panel SVAR, GARCH, and NARDL produce enhanced results. The Panel SVAR model with variance decomposition and the relevant impulse response functions were estimated to check for the interaction between variables, and also, it captures the contemporaneous effect of the changes in variables. As a result, the NARDL method was used to determine the short and long-run asymmetries. The volatility that is present in the data set was also successfully captured by Panel-GARCH/GJR-GARCH model estimation for both developing and developed countries with trade flow as the dependent variable.

Conclusion/findings: The results established that both the positive and negative devaluation shocks positively but insignificantly impacted trade flows in developing countries. Goods price variability had significant positive effects on trade flows. A 1% rise in the positive shock to price variation resulted in a 0.29% rise in trade flows while a similar percentage decrease in goods price variability resulted in 0.01% rise in trade flows respectively. With the panel-GARCH results, the magnitude of the impact of devaluation on trade is near zero even though it was a positive effect. There was a convergence in the results concerning goods price variation since both the GARCH (1,1) and the GJR GARCH reported a positive impact of devaluation on trade flow. Nevertheless, we obtained a divergence in the results concerning goods price variation because, while in the GARCH (1.1), goods price variation had a positive impact on trade flow, using the GJR-GARCH, it had a negative impact. The condition of this indeterminate outcome may be attributed to the onset of globalization which has eroded some of the trade restrictions that the developing countries have used over the years to protect their infant industries. Also, while the GARCH (1,1) reported symmetric shock to trade flows, the GJR-GARCH reported asymmetric shocks. The good news is that these shocks are not permanent in developing economies. For the developed countries, the findings indicated a positive impact of devaluation on trade flow. This could be because the developed countries are mainly export-oriented as such, and a slight reduction in the

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exchange rate generated a significant positive impact on their trade flow. Whereas, only 34% disequilibrium error in trade flows of developing countries was corrected in the long-term period, 54% disequilibrium in trade of developed economies was restored in the long run when the destabilizing effect on trade flow occurred as a result of devaluation and price variations in developed economies.

Originality/value of the article: The research contributed to the empirical literature on currency devaluation, goods price variation and trade flows between trading partners. In particular, the research established that the impact of goods price variation on trade flow was insignificant in developed economies compared to the significant effect of price variation on trade in developing nations and this was attributed to high inflation rate in these countries. There is a negative outcome for the impact of devaluation on trade flow in developing countries. There is a substantial positive nexus between exchange rate devaluation and trade flow. Perhaps, the developed countries should have planned devaluation to achieve a further improvement in their trade flow position given their strong production and industrial base.

Policy implications of the research: based on the researching findings and the contributions of the study to current knowledge on the subject of currency devaluation and variation in the prices of goods and their established effects on the volume of trade in different countries, the well-managed inflation rate and exchange rate policies of the developed economies have made it almost impossible for them to experience variations in their prices of imports and exports. Policymakers in these countries are therefore advised to hold on to their current policies of non-volatility in their exchange rate as well as their inflation rates. In contrast, the monetary policy managers of the developing countries should complement policies of exchange rate devaluation with other economic enabling indices such as substantial improvement in the competitiveness of their industrial projects, a dynamic and vibrant economic environment where the inflation rate is at a very low level, as well as improvement of the level of productivity. In addition, policymakers in developing countries should ensure they implement policies that are anti-price racketeering by producers by making sure to keep their interest rates low and stable.

Keywords: Devaluation, Trade Flows, Inflation Rate, Policymakers in Developing Countries, Developed Countries
JEL: F31, F13, F14

1. Introduction

In emerging nations' economies, particularly in Africa, and most developing nations of other regions, trade continues to be crucial. This is because it is the driving force behind the modern commercial world, as firms from different countries attempt to profit from wider markets rather than limiting themselves to their local borders. Trade policies of most developing countries in the late 1960s till date had been export promotion policies. However, the exports of sub-Sahara Africa (SSA) countries have been primary products and raw materials. Trade flows are concerned with the movements of imports and exports, their constituent and directions which help to analyze the form of trade, direction of flow, value and supply chains, concentration or the degree of diversification of countries' economies, and improvements needed in a given sphere of the economy (Bajracharya et al. 2019). The SSS's trade and exchange rate policies have recently focused on integrating the continent's economy into the global market to increase competitiveness. Atimu and Luo (2019) noted that the oil shock, the slow growth in the world trade in primary commodities, institutional weakness, political instability, civil wars, trade restrictions, and persistent rise in prices of imported manufactured goods were factors identified to be responsible for the low export in SSA countries. In the less developed countries (LDCs), the share of merchandise exports has experienced about one percent growth between 2011 and 2021. The global trade flows both in developed and developing countries experienced poor growth owing to the global covid-19 pandemic especially the LDCs (Smith 2022).

According to Rotimi and Ngalawe (2020), pressure is mounting on African nations like Nigeria, Angola, Cote d'Avore, and others due to the drop in oil prices to devalue their currencies because its dwindling export revenue has resulted in less foreign exchange reserves thereby curbing their monetary authorities' ability to support their currencies. For example, according to the Nigeria Central Bank report (2022), Nigeria (*naira)* will depreciate further than it is for now because of the effect of corona virus which has further impacted oil revenue which is the main source of Nigeria's foreign reserve earnings. On his part, Olayande (2020), in Nigeria, the exchange rate and domestic product prices are directly correlated through import

prices, whereas the relationship is indirectly correlated through import prices of intermediary goods (raw materials). This is because lower import prices result from domestic currency appreciation, and higher import prices result from domestic currency depreciation or devaluation, which are then passed on to local consumers (Tella et al. 2018). Yakubu et al. (2019) contend that international trade flows guarantee the effective use of resources, increasing consumption, and the welfare and well-being of every citizen of the trading countries. Good price variation refers to the difference in price items from estimated and actual prices, which is required to complete the work as per the technical specification. It measures the variation between the expected price by the trader and the price of the items sold arising from movements in the underlying market (Fiankor 2022, Antwi et al. 2021). In essence, trade flows refer to the movement of imports and exports, along with their constituent parts and directions.

African nations display low levels of development in terms of favorable trade balance, moderate inflation, stable exchange rates, GDP growth rate, etc. The majority of nations today acknowledge that competitive exchange rates are a key macroeconomic tool for assuring low inflation rates, encouraging exports, and boosting economic growth. With its growth act, South Africa, for instance, seeks to encourage more active monetary policy interventions to achieve growth and job targets through a more competitive exchange rate and a lower cost of capital (Patel 2021). The ongoing currency devaluation in the importing nations has compelled exporters to raise product prices over what they had originally projected for the nation. For the following reasons, it is crucial to understand how trade flows are influenced by goods price variation and the devaluation of currencies. Nonetheless, Chen et al. (2020) assert that it might be challenging for exporters to move their production upward if adjustment costs are significant, leaving them with the choice of raising prices. The manufacturing industry has noted the role of distance in justifying how goods prices vary when traded between multiple destinations. The majority of African economies, according to a World Bank report from 2022, are marked by low manufacturing productivity, inflationary pressure, expanding debt load, underutilization of resources, unfavorable trade balances, and instability in macroeconomic variables. Additionally, there has not been consensus on the precise

link between exchange rate depreciation, changes in product prices, and total trade flow.

Furthermore, interdependence among African member nations has increased recently (Ogunjuiba 2021). The rippling effects of exchange rate volatility on the growth of global trade through inflation stand out among them (Mahawiija et al. 2020; UN-WESP 2020; Bostan et al. 2018). It may seem apparent to create economies that are unrelated to the price of fundamental goods, which are prone to large price swings, but wanting and having a manufacturing and export-oriented economy are two wholly different things. Given the aforementioned, the issue that has to be investigated is how exchange rate depreciation and product price variation affect international commerce in all nations. Going forward, the many questions regarding the relationship between devaluation and goods price variation on trade flow remain unanswered, including the following: What is the effect of exchange rate devaluation and goods price variation on trade flow in developing countries? ii. What is the effect of exchange rate devaluation and goods price variation on trade flow in developed countries? Hence, the objective of the paper is to determine how changes in product prices and currency rates have affected trade flows in developing and developed economies of the world.

The research hypotheses include: *Hypothesis one* is that there is no substantial positive interactive correlation between currency devaluation and goods price variation on trade flow in developing countries. *Hypothesis two* is that there is no substantial positive interactive correlation between currency devaluation and goods price variation on trade flow in developed countries.

The dynamic interactive effect of currency devaluation and goods price variation on trade flow represents a cardinal economic issue in any economy especially developing economies such as those in the African continent. For instance, the majority of developing nations use different exchange rate regimes, such as fixed exchange rate, floating exchange rate, and intermediate exchange regimes; as a result, there will inevitably be variations in how devaluation and changes in the price of goods affect their economies. Further supporting the need for a broader viewpoint in the assessment of the transmission of exchange rate variations into imported and domestic prices is the ongoing occurrence of significant exchange rate fluctuations across emerging economies that rely heavily on imported inputs (Tella et al. 2018).

The study is significant first to policy makers especially the central banks and/or other monetary authorities of different countries because a knowledge of the shared effect of devaluation and goods price variation on trade flow enables the governments of various countries to formulate a feasible and proactive response to the likely consequence(s) of devaluation and goods price variation on trade flow. A sample of countries from both the developing and developed economies is selected for the study covering a period from 1990 to 2023 this is to enable the emergence of a reasonable trend in the analysis. A trend analysis of the selected variables of the study for both the developed and developing countries is succinctly reviewed and presented. This research work is subdivided into five sections. Section two examined the theoretical and empirical kinds of literature. Section three provides a discussion on the estimation techniques and data measurement while section four analyzes the results. Section five provides some concluding remarks.

2. Literature review

The belief that a weaker currency is a panacea to the unfavorable trade balance, low export revenues, and high trade deficits is the theoretical starting point for research on the nexus between devaluation and trade flow (Kwame, Omane-Adjepon 2017). Nonetheless, some assumptions must be made to determine if devaluation positively or negatively impacts trade flow or BOP. For instance, the elasticity hypothesis, Marshal-Lerner condition, and absorption theory all concur that a country will only benefit from exchange rate devaluation if its export demand is smaller than unity. While the J-curve effect and expenditure switching theory substantiate that exchange rate devaluation can only benefit an economy if its citizens are willing to move their consumption to locally produced items (Umoru 2022). It should be remembered that there is always a delay before consumption shifting occurs. Based on the aforementioned assumption, it is anticipated that our analysis will reveal whether devaluation has a favorable or negative effect on trade flow, particularly considering the number of nations involved and the time.

The imperfect substitution theory, Keynesian theory, and neo-classical theory are three of the main explanations for the import demand function. These theories place a strong emphasis on how income, pricing, and exchange rates affect trade (Hong 1999, as cited in Vacu, Odhiambo 2020). Besides the broader framework of policy, changes in the movement of fundamental shocks and/or policy regimes may be the only reason for oscillations in exchange rate movement, namely, devaluation, and revaluation (Al-Sadiqi et al. 2021). The gravity theory has been used to analyze the effects of exchange rate devaluation on trade flow more frequently than any other theory (Yakubu et al. 2019). With gravity models, economic proximity is determined by trade costs and relative size is determined by current GDP; the more economically remote a region is, the higher the trade cost.

According to Vacu and Odhiambo (2020), the imperfect substitution theory emphasizes the significance of how income and price affect import demand. According to Shuaibu and Fatai (2014), the comparative advantage focuses on how relative import prices affect the volume and flow of global trade. According to the J-curve theory, trade imbalance will at the outset get worse following currency devaluation. This hypothesis posits that there is a lag time before imports and exports may react to specific changes. This indicates that if the price of exportable commodities rises, the quantity of the goods must also change. Theoretically, (exchange rate depreciation) is anticipated to improve the country's trade balances. In a similar vein the relationship between goods price variation and trade flow is hinged on the fact that an increase in prices, mainly due to exchange rate devaluation ultimately leads to more goods being bought because consumers know that the value of their money will reduce in the future, this causes GDP to increase in the short-term. However, in the long run, the result is mixed (Agboola, Melimed 2012). In the past, some economists have argued that differences in goods prices between nations may not be sustainable over the long term because market forces will eventually equalize them and engineer a change in the nation's exchange rate based on the law of one price. This theoretical position assumed a complete exchange rate pass-through (ERPT). However, research by Kassi et al. (2019) has demonstrated that ERPT is imperfect and that it varies from country to country when taking into account the size and level of economic openness based on the basic connection between changes in

the exchange rate and price of goods. Also, Ge and Tang (2020) on their part found that commodity positive price variation can be considered a leading indicator of gross domestic product growth rate because increasing commodity prices indicate a stronger future economy. On the premise above, we export goods price variation to be either positively or negatively correlated with the gross domestic product growth rate.

Although there is a wealth of empirical review on the link between exchange rate devaluation and trade flows describing the impact of cost and currency devaluation on import and export prices, earlier research has generated mixed results on the magnitude of the impact of currency devaluation (Antwi et al. 2021). According to Sharify, Omran, and Ahangarece (2017), currency devaluation affects local product pricing via imported items. The value of imported intermediate inputs had an impact on the total cost of goods regardless of how the exchange rate changed the costs of imported items in domestic currencies. Ji (2022) created a more sophisticated model to examine the degree of transmission of exchange rate variation to domestic pricing. According to Emlinger & Guimbard (2021) and Fiankor, Curzi, & Olper (2021), bilateral trade and tariff agreements have a favorable impact on the fluctuation in the price of commodities. Regarding the economic effects on commodity exporters, the source of price variation is important. In particular, good prices variation supported by unanticipated variations in global activity (demand) has a significant impact on exporters' real activity, in contrast to those supported by unanticipated variations in global goods production (supply). According to an IMF report (2022), this effect is typically more pronounced for oil exporters than for exporters of other commodities. With rare exceptions, domestic economic performance indicators for commodity exporters tend to fluctuate in tandem with changes in goods prices, strengthening during upswings and suffering during downswings. Additionally, lengthier cycles and/or cycles with steeper price fluctuations than average tend to amplify the differences in economic performance between downswings and upswings.

Brandi and Schmitz (2015) examined the role of trade finance in trade flows of developed, emerging, and non-industrialized countries with an emphasis on trade openness as a driver for international trade. They deployed two-stage instrumentation approaches to analyze data on trade openness and trade finance for eight years period and their study revealed that trade finance and trade openness promote trade in

different countries. In a related study, Abubakar, Abaukaka and Momoh (2021) utilized fully modified least squares (FMOLS) and documented the relevance of free trade to enhance economic growth by focusing on export activities. In an attempt to determine the ratio and time path of the trade movements and variation in the exchange rates and changes in the price level as factors that promote trade flows in developing countries; Lukman and Kibria (2021) using the Almon procedure discovered the effectiveness of lag effect of the prices exchange rate as major causal factor of trade flows in the premise of developing countries. Simakovaa and Stavareka's (2014) reported that the majority of product categories have long-term relationships with currency rates. Depreciation has a favorable impact on the majority of categories. The short-term coefficients nearly completely lack any correlation.

Mehtiyev, Magda, and Vasa (2021) reported that the exchange rate has a big impact on global trade. Hence, currency strength is significantly influenced by export volume. The study advised that a country's export level should be diversified and invested in a wide variety of businesses. Governments should therefore get involved in overseeing and motivating investors in various industries with growth potential. Tarasenko (2021), citing Dell'Araccia (1999), concluded that between 1975 and 1994, bilateral commerce between the 15 EU countries and Switzerland was negatively impacted by volatility in both nominal and real exchange rates. According to Sugiharti et al. (2020), and Tarasenko (2021), volatility had a detrimental effect on trade flows when it came to imports of machinery and transportation equipment. Using the unit root test and co-integration, Kalyoncu et al. (2008) referenced in Khan, et al. (2022), conducted research in over 23 OECD nations to examine the link between currency devaluation and production growth. The results indicated that nine (9) out of 23 countries have a link between depreciation and output in the long run, but only three of those three countries, or 3 out of 9 had a positive impact on output growth, meaning that depreciation only boosts output growth in those three nations. Karahan (2021) cites Di'Nino et al. (2011) who concluded that there is a favorable correlation between exchange rate devaluation and economic development. The authors also discovered that devaluation tends to be contractionary over the long term for non-OECD economies.

On the other hand, studies on the causes and impacts of goods price variation on trade flow are scarce. However, studies on goods price variation and its impact on socioeconomic magnitudes are usually undertaken within the following cycles. "Pro-cyclical," "non-cyclical" and "counter-cyclical" describe the direction of correlation with trade flow. Asymmetric goods price variation occurs when both price slippage and price improvements are passed to the customer without restriction; however, an asymmetric goods price variation occurs when price improvements are passed to the customer with some level of restriction but price slippage is not. Anis and AlaaElDin (2023) claim that more stable currency rates aided in boosting commerce in nations where trade flows were negatively impacted. Using data covering the years 1995 to 2014, Flach and Grag (2019) reported findings that link business innovation behavior to competitiveness. Fitzgerald and Haller (2014), cited by Corsetti, Crowley and Han (2018) found that the relative markups between the domestic and international markets move in lockstep with the exchange rate for exporters issuing invoices in local currency. Additionally, questions about export pricing have been included in a few generic studies about price-setting behavior. According to a 2018 study by Corsetti et al., three-quarters of exporters price to market when setting prices for their products. The most crucial variables in determining price inside markets are said to be exchange rate fluctuations and transportation expenses. In addition, Goldberg and Tille (2008), referenced in Shafiezadeh, Tayebi, and Saadat (2019), use data from 24 countries to show the "coalescing" effect, in which businesses choose an invoice currency to "minimize price movements relative to their competitors." To keep their prices competitive with domestic US businesses, exporters to the US sometimes choose to issue invoices in US dollars. Similar to this, companies that export similar products, including commodities, settle on a single currency, which is typically the US dollar.

Few surveys have taken into account the decisions made by businesses regarding the currency of invoices. Using data from a study of Swedish exporters, Amiti, Itskhoki, and Konings (2020) conclude that both the purchase price and the invoice's currency are susceptible to negotiation between the importer and the exporter. Additionally, they discover that exports to significant nations and substantial orders are more likely to be invoiced in local currency. According to Lynnet, Martin, and

Mejean's (2020) analysis of a survey of manufacturers in the euro area, big businesses are more likely to invoice in foreign currencies and hedge against exchange rate risk. Evidence for New Zealand indicates that exporters' hedging tactics alter over time and are correlated with perceptions of currency rate drive at the very least, for those to Australia (Ingrst, Zaborsky 2020). Berman et al. (2021) found that short and long-run pass-throughs differ by the currency of the invoice. According to Boz et al (2020), higher-performing enterprises absorb exchange rate variations in their limits. They discover that business characteristics play a relatively little role within currency groups. That is to say, the disparities in pass-through observed by business type may be directly attributed to the decision of invoice currency, with higher-performing enterprises choosing to invoice in local currency. Bai, Alemu, Block, Headey, and Masters (2021) looked into how product pricing varied across businesses, within firms, and between destinations, they discovered that exporters set higher prices in richer and farther-off markets. These findings support model assumptions that firms compete on quality and provide vertically differentiated product variants.

Abbott and Seddighi (1996) cited in Obi (2022) revealed that import demand is significantly influenced by both the spending components and relative import pricing. The findings also showed that the relative relevance of the various income components varied, with private expenditure standing out as the most important variable. Other recent studies on the link between goods price variation and trade flows include (Kamal 2021; Emlinger, Guimbard 2021; Hillen, Cramon-Taubadel 2019). Martin (2012), cited by Fiankor (2023), suggests several mechanisms via which trade partners can induce price variety in gods which include: The first mechanism is a quality-sorting or selection effect. The second mechanism, according to Miliokovic and Gomez (2019), is a demand-driven composition effect, also referred to as the Alchian and Allen "shipping the good apples out" effect. It asserts that greater per-unit trade costs-in this case, per-unit transportation costs tend to lower the relative price of high-quality goods in comparison to lower-quality goods subject to the same costs. Prices at the company level rise with distance because better products cost more. Accordingly, companies might use price discrimination and higher markup when exporting to far-of nations which would raise the cost. This occurs logically if the elasticity of product demand decreases with distance. In models of continuous

elasticity of substitution (CES) with additive transportation costs, this is the case (Martin 2012). Prices include a markup component that reflects a firm's capacity to establish a price above marginal cost unless there is perfect competition. In trade models, which often assume monopolistic competition, markups are an integral part of export pricing.

Melitz and Ottaviano (2008) build on Melitz's (2003) set up by utilizing linear demand to incorporate endogenous differences in markups between destinations that react to the level of market rivalry. They demonstrate how stiffer competition in larger marketplaces manifests itself in the presence of more and larger rival enterprises, which results in lower markups and pricing. Chen and Juvenal (2022) demonstrate in a recent contribution that exporters' prices discriminate based on quality and establish greater markups and consequently higher prices in more distant nations. In sum, the literature does not seem to have reached a consensus on the effects of exchange rate volatility on trade. According to the conventional wisdom regarding the impact of uncertainty on commerce, increased exchange rate volatility serves as a deterrent to trade, reducing trade volume and eroding profits. In light of this, Dell'Araceia (1999), who was quoted in Tarasenko (2021), concluded that the fluctuation of exchange rates harmed bilateral commerce between the fifteen (15) EU countries and Switzerland from 1975 to 1994. Moreover, this study covers a population gap as previous research on exchange rate devaluation, goods price variation, and gross domestic product growth rate have been conducted using a handful of developed and developing economies. In sum, the relationship between goods price variation and trade flow is mixed, although there is a general expectation that an increase in import price will reduce trade flow between one country and the rest of the world while a decrease in import prices will encourage more trade flow between a country and its trading partners (Tang, Wei 2009). Specifically, Lewis (2017) noted that if local prices do not respond to exchange rates, neither will trade flow hence, he observed that sticky prices, strategic complementariness, and imported intermediaries can reduce trade flow. This present research has expanded the number of countries and also, increased the data range from 1990 to 2023. Given the use of interactive variables, it is evident that a new insight was brought to bear in this research work. On the above premise, this study remains profound to governments, institutions, and policymakers.

3. Methodology

The estimation techniques implemented in this work are the Panel SVAR, and non-linear ARDL (NARDL) methods. Unlike other traditional estimation techniques the Panel SVAR, and NARDL yields better results. The SVAR model was used to check for the interaction between variables. Hence, each equation in the SVAR has the same number of variables on the right-hand side. The volatility that is present in the data set was also effectively captured and analyzed with the aid of the ARCH/GARCH models' estimation. The usefulness of the non-linear ARDL estimation technique was the fact that it determines the short and long-run asymmetries. In addition, variables need not be integrated of the same sequence while estimating a NARDL model (Pesaran et al. 2001; Shin et al. 2014). In what follows, the functional form of our model specification relates our dependent variable to the independent variables as follows:

$$TFlow = f(ERD, GPV) \tag{3.1}$$

The empirical equation measuring the dynamics of exchange rate devaluation (ERD) and goods price variation (GPV) on trade flows (TFlow) was specified as:

$$TFlow = \emptyset_o + \emptyset_1 ERD + \emptyset_2 GPV + u_t \tag{3.2}$$

The specification in equation (3.2) is a representation of the long-run dynamics while equation (3.3) provides the corresponding short-run version of the model:

$$\Delta TFlow = \emptyset_o + \sum_{i=1}^{p} \emptyset_1 \Delta TF_{t-1} + \sum_{i=1}^{p} \emptyset_2 \Delta ERD_{t-1} + \sum \emptyset_3 \Delta GPV_{t-1} \tag{3.3}$$

The short-run dynamics were modified via a one-period lagged error to demonstrate empirical findings that show a co-integration relationship between the variables (trade flow, exchange rate devaluation, and GPV). Additionally, if there is a decrease in the exchange rate and goods price variation, the coefficient of sign of lagged error is negative and significant. Accordingly, the non-linear impact of exchange rate devaluation and goods price variability can be ascertained via positive and negative changes. This is modeled as in the following equations:

$$ERD_t^+ = \sum_{j-1}^{t} \Delta ERD_j^+ = \sum_{j-1}^{t} \max(\Delta ERD_{j,0}) \tag{3.4}$$

$$ERD_t^- = \sum_{j-1}^{t} \Delta ERD_j^- = \sum_{j-1}^{t} \min(\Delta ERD_{j,0}) \tag{3.5}$$

$$GPV_t^+ = \sum_{j-1}^{t} \Delta ERD_j^+ = \sum_{j-1}^{t} \max(\Delta GPV_{j,0}) \quad (3.6)$$

$$GPV_t^- = \sum_{j-1}^{t} \Delta GPV_j^- = \sum_{j-1}^{t} \min(\Delta GPV_{j,0}) \quad (3.7)$$

Equation (3.8) represents the bond test methodology of Shan et al. (2022) that was deployed to ascertain the significance or otherwise of asymmetry in the relationship between trade flows, variation in prices of goods, and currency devaluation.

$$\Delta TFlow_t = \emptyset_o + \sum_{i=1}^{p} \emptyset_1 \Delta TFlow + \sum_{i=1}^{p} \emptyset_2 \Delta ERD^{+}_{t-1} + \sum_{i=1}^{p} \emptyset_3 \Delta ERD^{-}_{t-1} + \sum_{i=1}^{p} \emptyset_4 \Delta GPV^{+}_{t-1} + \sum_{i=1}^{p} \emptyset_5 \Delta GPV^{-} + u_t \quad (3.8)$$

The methodology of a panel structural VAR model entails the estimation of the following simultaneous equations:

$$LTFlow = \emptyset_0 + \sum_{j=1}^{p} \emptyset_{11}^{ij} LERD_{t-1} + \sum_{j=1}^{p} \emptyset_{12}^{ij} LGPV_{t-1} + \sum_{j=1}^{p} \emptyset_{13}^{ij} LTFlow_{t-1} + e_t^{TFLOW} \quad (3.9)$$

$$LERD = \emptyset_0 + \sum_{j=1}^{p} \emptyset_{11}^{ij} TFlow_{t-1} + \sum_{j=1}^{p} \emptyset_{12}^{ij} LGPV_{t-1} + \sum_{j=1}^{p} \emptyset_{13}^{ij} LERD_{t-1} + e_t^{ERD} \quad (3.10)$$

$$LGPV = \emptyset_0 + \sum_{j=1}^{p} \emptyset_{11}^{ij} LERD_{t-1} + \sum_{j=1}^{p} \emptyset_{12}^{ij} LTFlow_{t-1} + \sum_{j=1}^{p} \emptyset_{13}^{ij} LGPV_{t-1} + e_t^{GPV} \quad (3.11)$$

The uniqueness of the short-run SVAR model emanates from the fact that it has a contemporaneous effect meaning that changes have an immediate and long-run impact. Exchange rate devaluation (ERD) was calculated as the ratio of the difference between current and previous exchange rates to the current rate. Goods price variation (GPV) was arrived at by calculating the ratio of the difference between current and last year's inflations to current inflation (IMF 2022). Trade flow (TFlow) represents the movement of imports and exports and the data for trade flow was captured using the balance of trade value.

4. Results

In this section, all the data generated were presented and discussed in detail. Specifically, the descriptive statistics for the analysis were presented and discussed first. This was followed by the presentation and analysis of the unit root test results.

The co-integration test results were thereafter analyzed as well, the NARDL, GARCH, and PSVAR for both the developing and developed countries were all presented and discussed. The stated hypotheses were tested based on the data analyzed in the work before a comparative analysis and policy implication of our results was articulated. The combined descriptive statistics for the developing countries are as presented in Table 1 below. From Table 1 above, it was observed that trade flow has the lowest mean of -1.34, while exchange rate devaluation has the highest mean value of 301.45. Again, trade flow has the highest standard deviation value of 1.4510. Finally, a country-by-country analysis is presented in Table 2.

Table 1. Combined summary statistics for developing countries

Statistics	ERD	GPV	TFlow
Mean	301.4529	37.37005	-1.340900
Median	57.43000	0.720000	-5.350800
Maximum	4217.980	23773.10	5.801000
Std. Dev.	491.2125	748.1807	1.451000
Skewness	3.412288	30.47317	-3.407633
Kurtosis	19.53362	961.9981	33.79191
Jarque-Bera	14077.17	40629238	43761.94
Probability	0.000000	0.000000	0.000000
Sum	318334.3	39462.77	-1.421200
Sum Sq. Dev.	2.5508000	5.9108000	2.222300
Observations	1056	1056	1056

Source: Authors' results using E-views 10.

Table 2. Country summary statistics for trade flows of developing countries

Country	Mean ('m)	Max('m)	Min. ('m)	Std. Dev. ('m)	Skew.	Kurt.
Angola	7100	26000	-3500	8540	0.749821	2.194757
Belarus	-732	4000	-7500	2140	-1.002906	5.648684
Botswana	74.333	1800	-2300	1020	-0.546429	2.664437
CAF	-189	2.8	-470	151	-0.537881	1.842433
Cameroon	-394	430	-1600	598	-0.305019	1.724911
Chad	-426	670	-2000	540	-0.714692	4.348002
Chile	-1050	24000	-150000	27700	-4.898656	27.18320
DR Congo	-702	590	-2300	920	-0.240803	1.678276
Guinean	5830	58000	-6000	11600	3.364213	14.71194
Ethiopia	-5280	-280	-14000	4720	-0.536617	1.826580
Gabon	2780	6000	-52	1780	0.316754	1.841602
Ghana	-2280	-520	-6300	1710	-0.791343	2.357406
India	-42000	-3500	-140000	38700	-0.764027	2.480179
Ivory Coast	1100	16000	-460	2780	4.892981	26.69656

Table 2. Cont. …

Country	Mean (‘m)	Max(‘m)	Min. (‘m)	Std. Dev. (‘m)	Skew.	Kurt.
Kenya	-3850	280	-11000	3560	-0.459953	1.662979
Lesotho	-944	-460	-1700	288	-0.537786	3.059922
Madagascar	-629	-49	-2100	538	-1.160789	3.735002
Malaysia	21100	51000	-3500	14900	-0.091874	2.243760
Mexico	-13400	23000	-43000	11500	0.750131	5.504104
Morocco	-6590	-1100	-15000	5160	-0.287809	1.437925
Mozambique	-2740	-630	-8700	2490	-1.176379	2.968938
Namibia	-972	310	-3100	1000	-0.769882	2.296828
Niger	-863	-130	-2600	768	-0.545972	1.890548
Nigeria	2690	24000	-32000	14500	-0.634490	3.200448
Pakistan	-13700	-410	-41000	12000	-0.727822	2.435242
Poland	627	40000	-29000	14600	0.875608	3.702339
Rwanda	-764	-210	-1700	539	-0.516674	1.618509
Senegal	-1500	-280	-3700	1110	-0.405750	1.746594
South Africa	2700	26000	-8500	6570	1.335845	6.416616
Tanzania	-1520	150	-4800	1340	-1.180996	3.464232
Thailand	13400	57000	-12000	19700	0.834013	2.723059
Zambia	213	3900	-1200	965	2.152571	8.422156

Source: Authors’ results using E-views 10.

Table 3. **Combined summary statistics for developed countries**

Statistics	ERD	GPV	TFlow
Mean	112.8878	-0.068552	1.641000
Median	8.434800	0.010000	5.100900
Maximum	1403.180	35.89850	2.601100
Minimum	0.499800	-31.10280	-1.601200
Std. Dev.	262.7390	3.322112	9.321000
Skewness	3.452437	0.542506	-10.04995
Kurtosis	13.79723	63.02417	184.8150
Jarque-Bera	3387.809	74334.11	690126.7
Probability	0.000000	0.000000	0.000000
Sum	55879.45	-33.93330	8.111200
Sum Sq. Dev.	34101704	5451.996	4.292400
Observations	1056	1056	1056

Source: Authors’ results using E-views 10.

The combined descriptive statistics for the developed countries are presented in Table 3. From Table 3, it can be seen that exchange rate devaluation had the highest mean value of 113 while goods price variation had the lowest value of -0.07. As well, trade flow has the highest standard deviation of 9.3210 while goods price variation

has the lowest standard deviation, a value of 3.32. Equally, the country-by-country statistics are presented in Table 4.

Table 4. Country summary statistics trade flow of developed countries

Country	Mean (‘m)	Max(‘m)	Min. (‘m)	Std. Dev. (‘m)	Skew.	Kurt.
Australia	2260	91000	-28000	25800	1.972744	6.529587
Austria	1180	4600	-4500	2870	-0.609273	2.029721
Canada	2390	46000	-39000	28500	-0.014893	1.612465
Denmark	15500	38000	3300	7900	0.718914	3.009386
Finland	4450	14000	-8300	6550	-0.070006	1.594729
France	-7250	44000	-110000	35000	-0.619914	3.314081
Germany	129000	260000	-11000	101000	-0.093378	1.370017
Iceland	89.309	1400	-2900	1020	-0.980581	4.037148
Ireland	6330	220000	-26000	39000	5.196315	29.11856
Japan	64500	220000	-1600000	305000	-5.116136	28.47334
Korea Rep	30800	110000	-22000	35000	0.640156	2.351794
Norway	31800	110000	-2900	26600	0.925115	3.414760
Spain	-20200	39000	-150000	47200	-1.204963	4.079054
Sweden	19000	31000	70	8380	-0.430256	2.432380
UK	-33800	8300	-110000	24300	-0.663925	4.128696

Source: Authors’ results using E-views 10.

Table 5 displays the panel unit root test for developing countries. Only the first difference results are reported for the sake of brevity especially when none of the variables at the level was found to be stationary.

The results for the panel unit root test for the developed countries are in Table 6 below: just like the case of developing countries, no variable was stationary at level. Hence, only the first difference test results are reported.

From Table 7 it can be observed that the variables of developing countries show evidence of on high degree of co-integration among themselves. Similarly, Table 8 reveals that the variables of developed countries show signs of a high degree of co-integration among themselves.

Table 5. Unit root test results for developing countries

Goods Price Variation (First Difference)			
Null: Common Unit Root			
Method	Statistic	Prob.**	Cross-section
Levin, Lin & Chu t*	45.8840	0.0000	47
Breitung t-stat	-5.48271	0.0000	47
Null: Individual Unit Root			
Im, Pesaran and Shin W-stat	-25.064	0.0000	47
ADF - Fisher Chi-square	742.470	0.0000	47
PP - Fisher Chi-square	973.910	0.0000	47
Exchange Rate Devaluation (First Difference)			
Null: Unit root (assumes common unit root process)			
Method	Statistic	Prob.**	Cross-section
Levin, Lin & Chu t*	-10.9188	0.0000	47
Breitung t-stat	1.65993	0.9515	47
Null: Individual Unit Root			
Im, Pesaran and Shin W-stat	-15.2852	0.0000	47
ADF - Fisher Chi-square	343.854	0.0000	47
PP - Fisher Chi-square	327.682	0.0000	47
Trade Flow (First Difference)			
Null: Common Unit Root			
Method	Statistic	Prob.**	Cross-section
Levin, Lin & Chu t*	-3.40867	0.0003	47
Breitung t-stat	10.46414	0.0000	47
Null: Individual Unit Root			
Im, Pesaran and Shin W-stat	-9.87614	0.0000	47
ADF - Fisher Chi-square	116.458	0.0000	47
PP - Fisher Chi-square	102.088	0.0000	47

Source: Authors' results using E-views 10.

Table 6. Unit root test results for developed countries

Goods Price Variation (First Difference)			
Null: Common Unit Root			
Method	Statistic	Prob.**	Cross-section
Levin, Lin & Chu t*	-20.4844	0.0000	15
Breitung t-stat	-15.0684	0.0000	15
Null: Individual Unit Root			
Im, Pesaran and Shin W-stat	-18.3357	0.0000	15
ADF - Fisher Chi-square	282.030	0.0000	15
PP - Fisher Chi-square	365.122	0.0000	15
Exchange Rate Devaluation (First Difference)			
Null: Common Unit Root			
Method	Statistic	Prob.**	Cross-section
Levin, Lin & Chu t*	-11.0822	0.0000	15
Breitung t-stat	-1.98587	0.0235	15
Null: Individual Unit Root			
Im, Pesaran and Shin W-stat	-9.08880	0.0000	15
ADF - Fisher Chi-square	133.131	0.0000	15
PP - Fisher Chi-square	133.927	0.0000	15
Trade Flow (First Difference)			
Null: Common Unit Root			
Method	Statistic	Prob.**	Cross-section
Levin, Lin & Chu t*	-3.40867	0.0003	15
Breitung t-stat	3.46414	0.9997	15
Null: Individual Unit Root			
Im, Pesaran and Shin W-stat	-10.3564	0.0000	15
ADF - Fisher Chi-square	120.335	0.0000	15
PP - Fisher Chi-square	190.348	0.0000	15

Source: Authors' results using E-views 10.

Table 7. Panel co-integration test result for developing countries

Alternative hypothesis: Within-dimension				
Methods	Statistic	Prob.	Weighted Statistic	Prob.
v-Statistic	12.74416	0.0000	-3371947	0.0050
rho-Statistic	-9.972418	0.0000	-9.877406	0.0000
PP-Statistic	-8.982598	0.0000	-21.33416	0.0000
ADF-Statistic	-11.56173	0.0000	-42.96328	0.0000

Alternative hypothesis: Between-dimension		
Methods	Statistic	Prob.
Group rho-Statistic	-3.771970	0.0001
Group PP-Statistic	-12.54671	0.0000
Group ADF-Statistic	-13.71023	0.0000

Source: Authors' results using E-views 10.

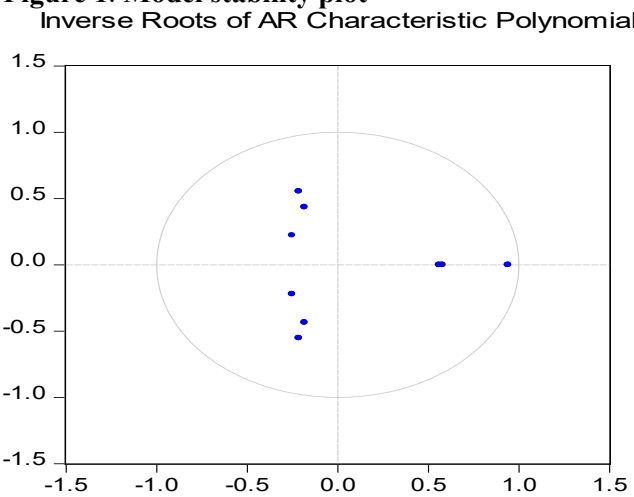
Table 8. Panel co-integration test results for developed countries

Alternative hypothesis: Within-dimension				
Methods	Statistic	Prob.	Weighted Statistic	Prob.
v-Statistic	-0.155557	0.5618	-10.981288	0.0000
rho-Statistic	-8.298413	0.0000	-24.111996	0.0000
PP-Statistic	-10.64261	0.0000	-56.15652	0.0000
ADF-Statistic	-10.77728	0.0000	-69.27505	0.0000
Alternative hypothesis: Between-dimension				
Methods	Statistic		Prob.	
Group rho-Statistic	-16.668485		0.0000	
Group PP-Statistic	-23.48806		0.0000	
Group ADF-Statistic	-52.45466		0.0000	

Source: Authors' results using E-views 10.

All our inverse roots are within the unit circle. This substantiates the stability of the estimated parameters.

Figure 1. Model stability plot



Source: Authors' results using E-views 10.

Table 9 shows the estimated output of the impact of currency devaluation and goods price variation on trade flow in developing countries. It was observed that none of the independent variables exerted a significant relationship on trade flow. This above scenario has been demonstrated by the studies of Alleh et al. (2014) who noticed that when panel data from developing countries are involved, especially given

the economic stage of the countries, the outcome may not indicate a clear result of exchange rate devaluation given that both the positive and negative impacts may be insignificant. The error correction coefficient only explain 34% disequilibrium error in trade flows of developing countries due to devaluation and goods price variability will be corrected in the long-term period. Goods price variability had significant effects on trade flows. A 1% rise in the positive shock to price variation resulted in 0.29% rise in trade flows while similar percentage decrease in goods price variability resulted in 0.01% rise in trade flows respectively. The significant effect of price variation on trade can be explained by high inflation rate in these countries.

Table 9. **Non-linear ARDL results for developing countries**

TFlow	Coefficients	z	P>|z|	[95% Conf.	Interval
Δ ERD+	0.051897	0.327	0.656	-0.18406	0.080263
Δ ERD-	0.289356	0.721	0.473	-0.50015	1.078863
Δ GPV+	0.290482	9.423	0.000	-0.01755	0.011342
Δ GPV-	0.015930	7.521	0.000	-0.04562	0.026556
ECT	-0.34720	-14.52	0.000	-0.02714	0.015676
ERD+	0.003629	0.051	0.000	-0.01043	0.003169
ERD-	0.001813	0.601	0.545	-0.00769	0.004063
GPV+	0.005535	2.436	0.005	-0.03061	0.019541
GPV-	0.000724	2.975	0.001	-0.00273	0.004178
_CON	0.126815	10.46	0.000	-0.41878	0.672411
(Dependent variable: trade flows)					

Source: Authors' results using E-views 10.

Table 10 illustrates the nexus between devaluation and goods price variation on trade flow for developed nations. It can be noticed that exchange rate devaluation (both positive and negative shocks) are significant in the short-run, while in the long-run, positive shock to devaluation still passed significance test at 1% level. This means that a percent increase in devaluation led to a 0.022958 increase in trade flow. This is because for most developing countries that specialized in trading primary goods and other mineral resources such as crude oil, a reduction in the value of their currency leads to more monies from trade. This corroborates the policy finding of Fatum, et al (2018). In the long run, a trade effect of devaluation was insignificant. Price variability proved to be insignificant in line with Adeyemi and Ajibola (2019). For the developed

countries, the findings indicated a positive impact of devaluation on trade flow, this is because the developed countries are mainly export-oriented as such, and a slight reduction in the exchange rate will result in a significant positive impact on their trade flow. This position has been articulated by similar findings obtained by Fatum et al. (2018) and Ulasan et al. (2018). The error correction value of -0.543562 indicates that 54% disequilibrium was restored in the long run when there is a destabilizing effect on trade flow as a result of devaluation and price variations.

Table 10: **Non-linear ARDL results for Developed Countries**

TFlow	Coefficients	z	P>|z|	[95% Conf.	Interval
Δ ERD+	0.022395	11.93	0.000	-0.00034	0.04513
Δ ERD-	0.016961	24.89	0.000	-0.0166	0.050536
Δ GPV+	0.079447	0.960	0.337	-0.08258	0.241478
Δ GPV-	0.0871233	0.970	0.334	-0.08949	0.263733
ECT	-0.543562	-92.65	0.000	-0.70911	0.0604
Δ ERD+	0.097418	-13.82	0.000	-0.01266	0.005178
Δ ERD-	-0.0027423	-0.590	0.552	-0.01178	0.006293
Δ GPV+	0.036981	1.812	0.070	-0.0003	0.007698
Δ GPV-	0.000695	-1.013	0.312	-0.00204	0.000653
_CONS	9.121497	1.650	0.099	-1.70757	19.95056
(Dependent variable: trade flows)					

Source: Authors' results using E-views 10

Table 11 represents the GARCH (1, 1) and Table 12 presents the GJR- GARCH estimations for trade flow. From the GARCH result presented in Table 11 for developing countries, it can be seen that a one percent increase (positive shock) in devaluation resulted in a 0.00872 increase in trade flow. This magnitude of the impact is near zero even though it is a positive effect. A percentage increase (positive shock) in goods price variation stimulated a 0.021456 percent increase (positive shock) in trade flow. This supports the theoretical and empirical findings of Mouvou and Ngalali (2021). On the other hand, goods price variation had a positive effect on trade flows from the standpoint of both the IMF (2022) and the World Bank (2020). However, from the coefficient values, it can be seen that the positive effect is very minimal (0.0214). From the variance equation, it can be seen that the shock is not persistent or permanent because the addition of both the ARCH lag 1 and GARCH lag1 values, That is, (0.819736 + 0.0667744 = 0.8865104) is less than 0.5. This means

that the shocks will die out over time. We may however note that there exists a symmetric shock because both values of ARCH L1 and GARCH L1 which are statistically significant at less than 1% are positive.

Table 11. GARCH results for developing countries

Estimations obey Gaussian distribution			Wald chi2(3) = 5453.50		
Log-likelihood = 303.05			Prob > chi2 = 0.3220		
Variables	Coefficient	z	p>|z|	[95% Conf. Interval]	
ERD	0.00872	11.76	0.000	-0.0009121	-0.0008636
GPV	0.021456	15.86	0.000	0.0000361	0.0000463
_CONS	25.75088	21.305	0.000	25.75049	25.75127
ARCH(-1)	0.819736	34.09	0.000	4.542627	5.096845
GARCH(-1)	0.0067744	9.08	0.000	0.0053127	0.008236
_CONS	0.0000109	4.91	0.000	6.57E-06	0.0000153
(Dependent variable: trade flows)					

Source: Authors' results using E-views 10.

From Table 12 which presents the GJR GARCH results, with trade flow as our dependent variable it may again be noticed that both of our independent variables are statistically significant at less than 1%, indicating that a one percent increase (positive shock) in devaluation stimulated to a 0.001037 percent increase (negative shock) in trade flow. While a one percent increase (positive shock) in goods price variation generated a 0.001906 increase (negative shock) in trade flow. As shown above, there is a convergence between the findings using both the GARCH (1,1) and the GJR GARCH for the impact of exchange rate devaluation on trade flow. Nevertheless, there is a divergence in the results concerning goods price variation because, while in the GARCH (1.1), goods price variation had a positive impact on trade flow, on the hand, using the GJR- GARCH, it had a negative impact. The condition of this indeterminate outcome may be because most developing countries have not benefited from trading with the developed countries in line with similar findings obtained by Logan (2017). One may add that the onset of globalization has eroded some of the trade restrictions that the developing countries have used over the years to protect their infant industries. The activities of developed countries that flooded the third world countries with cheap goods have harmed trade flow between North and South, thereby ceiling the position of the developing nations to be more dependent on the developed counties for all their imports.

From the variance equation, it can be seen that the p-values of ARCH lag 1, TARCH lag 1, and GARCH lag 1 are all statistically significant at less than one (1%) percent, but the shocks are not persistent but temporary because the addition of the values of both RCH lag 1, TARCH lag 1, and GARCH lag 1 that is (-0.10516 + -0.24985 + 0.96866 = 0.61365) is far less than one (1), this means that the shocks have long-lasting effects on developing countries' trade flows. However, one may observe there exists an asymmetric shock because both the ARCH lag 1 and TGARCH lag 1 show negative and statistically significant values.

Table 12. **GJR-GARCH results for developing countries**

Estimations obey Gaussian distribution			Wald chi2(3) = 62021.06		
Log-likelihood = -291.79343			Prob > chi2 = 0.0000		
Variables	Coef.	z	p>|z|	[95% Conf. Interval]	
ERD	0.001037	122.02	0.000	-0.0001	-0.000102
GPV	-0.001960	-242.57	0.000	-0.00001	-8.12E-06
_CONS	25.85709	62.60	0.000	25.8552	25.85902
ARCH (-1)	-0.10516	-2.62	0.009	-0.00902	-0.00130
TARCH(-1)	-0.24985	-266.07	0.000	-1.25905	-1.24064
GARCH(-1)	0.96866	499.6	0.000	1.26368	1.27363
_CONS	-0.00142	-35.82	0.000	-0.00214	-0.00069
(Dependent variable: trade flows)					

Source: Authors' results using E-views 10.

Table 13 presents the panel GARCH (1,1) and Table 14 contains the GJR-GARCH estimation for developed countries with trade flow as the dependent variable. From the 13 which depicts the panel GARCH with trade flow as the dependent variable in the case of the developed economies, one must again note that only exchange rate devaluation is passed significance test at 5% while goods price variation is not statistically significant. This indicates that a percentage rise (positive shock) in devaluation led to a 0.0125 percent increase (positive shock) in trade flow. The outcome of the results from the GARCH (1,1) to trade flow amplifies the position of Wayyudi and Sari (2019) which indicates that exchange rate devaluation is favorable to trade flow. By implication, exchange rate devaluation is beneficial to exporting economies, unlike import-dependent developing countries. Again, the impact of goods price variation was found to be insignificant. Concerning the variance equation, it can be seen that only ARCH lag 1 is significant at 5% while GARCH lag 1 is not significant at 5%. However, the value of ARCH lag 1 which is 1.486341 is greater

than one (1). This means that the shocks are transitory. It also indicates a symmetric shock.

Table 13. GARCH results for developed countries

Estimations obey Gaussian distribution			Wald chi2(3) = 493.35		
Log-likelihood = 1431.65			Prob > chi2 = 0.0000		
Variables	Coefficient	z	p>|z|	[95% Conf. Interval]	
ERD	0.0125	22.16	0.000	9.33E-06	0.0000111
GPV	0.1306	0.100	0.918	-0.001779	0.001976
_CONS	28.12774	41.905	0.000	28.12746	28.12803
ARCH (-1)	1.486341	17.2	0.000	1.308738	1.663944
GARCH(-1)	0.008428	1.51	0.131	-0.002521	0.019377
_CON	0.0000121	10.82	0.000	9.88E-06	0.0000143
(Dependent variable: trade flows)					

Source: Authors' results using E-views 10.

From the GJR GARCH estimates presented in Table 14, it can be seen that again only exchange rate devaluation exhibits a statistically significant relationship at less than 1% while goods price variation is not statistically significant. It shows that a percentage rise (positive shock) in devaluation induced a 0.00001 percent increase (positive shock) in trade flow. The GJR-GARCH is in complete agreement with the GARCH (1.1) version because the probability value of exchange rate devaluation is highly significant while that for goods price variation is not statistically significant, clearly in support of our earlier disposition that exchange rate devaluation is beneficial to economies that are export-oriented, while the incidence of goods price variation is of no serious consequence in the developed economies due to low inflation rate.

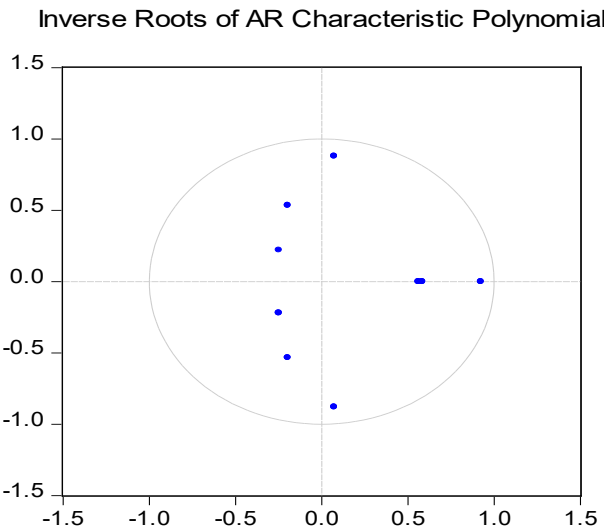
From the variance equation, one may notice that the p-value of ARCH lag 1, TACH lag 1, and GARCH lag 1 are statistically significant at 1%. It can also be seen that the shocks are long-lasting because of the addition of the values of ARCH lag 1, TARCH lag 1, and GARCH lag 1 which is (0.024611-0.192574+ 0.9462327 = 0.778364) which is lesser than one (1), meaning that the shocks are exceedingly persistent. It can also be noticed that the shock is symmetric because the positive signs are more than the negative sign.

Table 14: **GJR-GARCH results for developed countries**

Estimations obey Gaussian distribution			Wald chi2(3) = 315.00		
Log-likelihood = 1472.36			Prob > chi2 = 0.0000		
Variables	Coefficient	z	p>|z|	[95% Conf.	Interval]
ERD	0.00001	17.75	0.0000	0.00001	0.00001
GPV	0.00006	1.657	0.1090	-0.00013	0.00001
_CONS	28.12564	23.305	0.0000	28.12548	28.12581
ARCH(-1)	0.024611	15.75	0.0000	1.685061	2.164161
TARCH(-1)	-0.192574	-24.28	0.0000	-1.155485	-0.429664
GARCH(-1)	0.9462327	19.09	0.0000	0.209374	0.2830908
_CONS	2.19E-08	25.101	0.0000	-6.22E-08	1.06E-07
(Dependent variable: trade flows)					

Source: Authors' results using E-views 10.

Figure 2. **Model stability plot**



Source: Authors' results using E-views 10.

Figure 2 shows the VAR system is stable. The estimates and interpretation of the variance decomposition of trade flow on both exchange rate devaluation and goods price variation are presented in Table 16. From Table 16 which depicts the variance decomposition of trade flow on shocks 1, 2, and 3 it can be observed that in the case of variance decomposition of trade flow (own shock) in the short-run, it accounted for about 99.9% of shocks in themselves. This can be seen from shock 1, which is

normally referred to as own shocks. While on the long run, still it accounted for about 99.8% of the total shock in itself. This means that both exchange rate devaluation and goods price variation accounted for less than 1% of the total shock in trade flow both in the short-run and in the long-run within the period under review. From the variance decomposition of exchange rate devaluation which is represented by a 1st difference of ERD, it can be observed that in the short-run exchange rate devaluation accounted for about 99.9% of the total shock on itself, it also accounted for about 97.8% of the total on itself on the long-run. This means that both trade flow and goods price variation accounted for only about 2.2% of the total shock of exchange rate devaluation.

From the variance decomposition of goods price variation, it can be seen that in the short-run goods price variation accounted for about 99.9% of the total shocks in itself. This can be seen from shock 3 in the variance decomposition of goods price variation. Equally, in the long-run goods price variation still accounted for about 99.9% of the total shocks in itself. Trade flow and exchange rate devaluation accounted for less than 1% of the total shock in goods price variation in the long run. It is noticed that the effect of shock 2 and shock 3 that is ERD and GPV one marginal throughout the horizon of our analysis. Equally shock 3 had the least impact on shock 1 all through. The result further confirms that ERD and GPV have very little implication or positive impact on trade flow among the developing country. It means that ERD will not lead to a significant increase in trade flow because they mainly import-reliant economies. This is in line with the findings of Adeyemi and Ajibola (2019) and Vacu et al. (2020). What is noticed is that each variable individually had over 98% shock on itself both in the short-run and in the long-run, which is in line with the a priori expectation of this study.

Table 16. Variance decomposition results

Variance Decomposition of TFlow				
Period	S.E.	Shock1	Shock2	Shock3
1	0.850207	100.0000	0.000000	0.000000
2	1.243073	99.97511	0.024838	5.18E-05
3	1.258729	99.89100	0.108614	0.000388
4	1.258771	99.88735	0.111716	0.000939
5	1.342714	99.89231	0.106649	0.001045
6	1.490576	99.90719	0.091872	0.000937
7	1.513582	99.87988	0.119031	0.001085
8	1.513810	99.87663	0.122037	0.001333
9	1.534888	99.87814	0.120427	0.001432
10	1.596040	99.88652	0.112099	0.001381
Variance Decomposition of ERD				
Period	S.E.	Shock1	Shock2	Shock3
1	74.60213	0.067783	99.93222	0.000000
2	76.13236	0.495194	99.50459	0.000219
3	76.51915	1.103041	98.89609	0.000871
4	77.39326	1.157866	98.83935	0.002780
5	77.73884	1.549857	98.44708	0.003065
6	77.76508	1.607248	98.38954	0.003210
7	77.88980	1.888079	98.10858	0.003346
8	77.90711	1.909844	98.08677	0.003389
9	77.98769	2.112356	97.88424	0.003403
10	77.98857	2.112925	97.88366	0.003413
Variance Decomposition of GPV				
Period	S.E.	Shock1	Shock2	Shock3
1	76.8599	6.49E-05	1.79E-05	99.99992
2	76.9329	0.019860	0.001832	99.97831
3	79.7727	0.019955	0.005230	99.97482
4	72.6688	0.020219	0.009528	99.97025
5	71.3393	0.028346	0.010673	99.96098
6	70.6998	0.039222	0.011207	99.94957
7	70.5828	0.039542	0.011489	99.94897
8	70.4117	0.039649	0.011611	99.94874
9	70.3304	0.041976	0.011694	99.94633
10	70.2549	0.047468	0.011714	99.94082

Source: Authors' results using E-views 10.

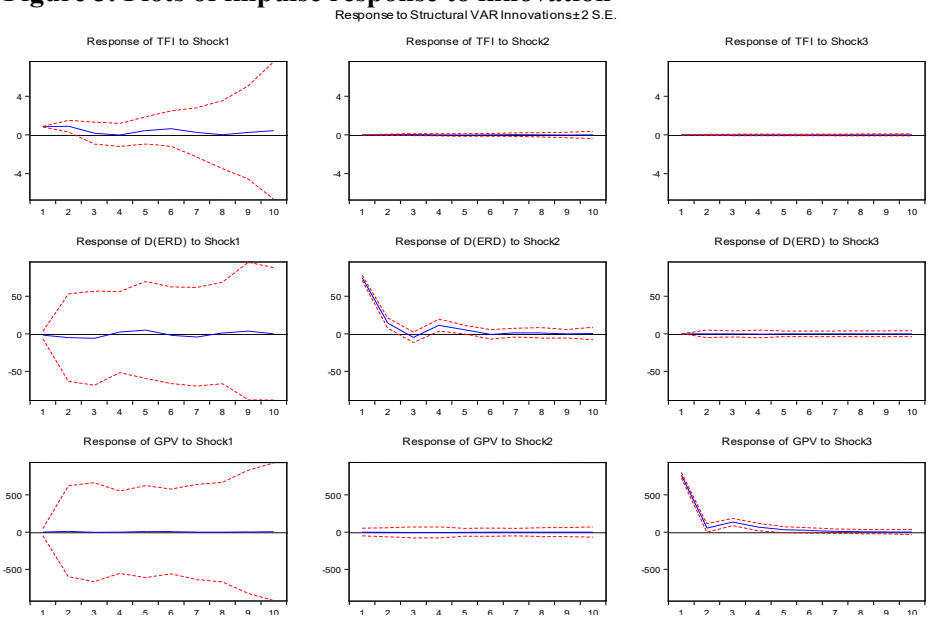
From Figure 3, it can be seen that the response of trade flow to shock one which is its own shock is positive, although, it initially started above the mean line but fell to the mean line, occasionally moving above the mean line. From figure 3 (b2) which is the response of trade flow to shock 2 (exchange rate devaluation), it can be

seen that virtually both the 95% confidence interval and the mean line rested together with little or no divergence. This means shock 2 had little or no shock on trade flow. Figure 3 (b1) shows the response of trade flow to shock 3 (goods price variation). It can be seen that again, goods price variation had no significant shock on trade flow within the period under review. The above impulse response of Shock 1 on itself as well as the responses from Shock 2 and 3 it will be safe to say that since the developing countries are not export-oriented it will not be beneficial for them to engage in currency devaluation. Figure 3(b4) which represents the response of ERD to shock 1(trade flow) devaluation line had a slight divergence from the mean line, although slightly moving above and below the mean line. For example, from period 1 to 3 it is below the main line, while from period 4 to 5 it is above the mean line, again from period 6 to 8 it is below the mean line while finally from period 8 to 10 it is above the mean line, hence, indicating both marginal positive and negative effects. From Figure 3(b5) which is the own response, it can be seen that from period 1 to 3 it is positive, slightly going below the mean line in period 3 b4 and moving up in period 4 before lying on the mean line from period 6 to 10. From Figure 3 (b6) which shows the response of ERD to shock 3 (goods price variation) the ERD line lies completely on the mean line, meaning that, goods price variation had little or no shock on exchange rate devaluation. The implications of the responses of ERD to both shock 1 and shock 3 is that trade flow responded both positively and negatively to innovations in devaluation. Hence, it is clear that just engaging in currency devaluation may not lead to a positive trade balance as propounded by IMF and the World Bank because exchange rate devaluation could result in a negative trade balance as earlier reported by Umoru (2022). On the other hand, goods price variation had no significant impact on exchange rate devaluation.

From Figure 3 (b7) one may observe that goods price variation exhibited little or no response to the shock of trade flow, with the goods price variation line lying completely on the mean line although with the 95% confidence interval lines well above $^{+}_{-}$ 500. From Figure 3(b8), it can be seen that goods price variation exhibited little or no response to the shock of exchange rate devaluation. This is because the goods price variation line is lying on the mean line with very little divergence from the 95% confidence interval lines. Finally, figure 3 (b9) which is its own shock,

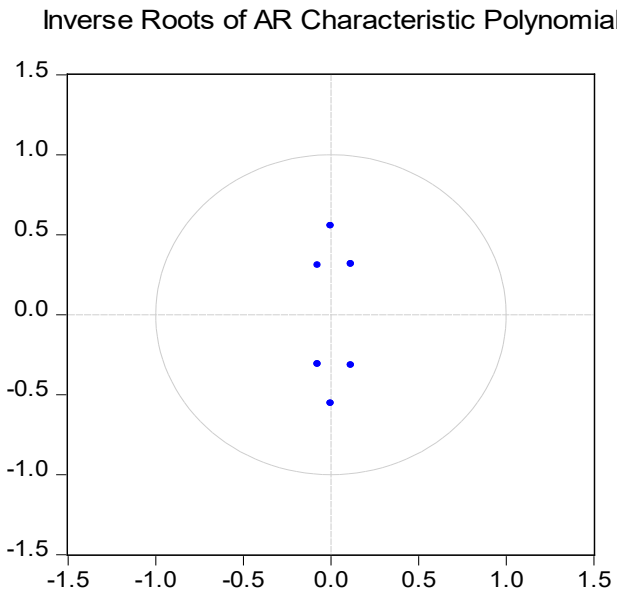
indicates a positive but downward-sloping response from period 1 to 2, it briefly moved – up from the mean line before resting on the mean line from period 4 to 10. For the response of goods price variation to shocks from trade flow and devaluation, there is no noticeable impact because goods price variation is a function of an inefficient economic arrangement and not necessarily due to innovations in trade flow or exchange rate devaluation. The estimates for the PSVAR concerning developed countries are presented below from Table 3 (a) to 3(d) as well as Figures 3(a) to 3(b).

Figure 3. Plots of impulse response to innovation



Source: Authors' results using E-views 10 software.

Figure 4. Model stability plot



Source: Authors' results using E-views 10.

Figure 4 confirms model stability. This is a confirmation of stationary variables. The estimates and interpretation of the variance decomposition of trade flow on both exchange rate devaluation and goods price variation are presented below. From Table 18 above which represents the variance decomposition of trade flow on shock 1 (trade flow), shock 2 ERD, and shock 3 (goods price variation), it can be seen that on the short-run, shock 1 (trade flow) which is the own shock accounted for about 99.8% of the total shock on trade flow while shock 2 and 3 accounted for only about 1.2% of the total shock. The value remains the same even in the long run. From the variance decomposition of currency devaluation which is represented by the first difference ERD, it can be seen that trade flow accounted for about 97.7% of the total shock in the short-run while shock 2 and 3 ERD and goods price variation), accounted for only about 2.3%. However, in the long-run trade flow (shock1) accounted for 98.9% of the total shock in exchange rate devaluation while shocks 2 and 3 accounted for only about 1.1%. Finally, from the variance decomposition of goods price variation (shock 3), it can be seen that trade flow (shock 1) accounted for about 42.96% while ERD (shock 2) accounted for about 52.68% respectively on the total shock on goods price

variation. Interestingly shock 3 which is its own shock could only account for about 4.36%. However, in the long-run trade flow (shock 1) accounted for about 98.37% of the total shock on goods price variation, while devaluation and goods price variation (own shock) contributed about 1.63%.

Conclusively, the response of trade flow to both shock 2 and shock 3 is quite interesting because it exhibited a reduction of the shock from both shock 2 and 3 from period 1 to 2 and remained permanent from period 3 down to end. This indicates that after achieving an initial increase after exchange rate devaluation, it remains unchanged in the long run. Nevertheless, the response by goods price variation to shock in exchange rate devaluation and trade flow, that ERD contributed approximately 53 % to the total shock in GPV while the own shock was just approximately 43%. However, the own shock rebounded to approximately 96% in the second period. It again increased to 98% in the third period and virtually remained so till period 10. The response to shock trade flow was 4.4% in the first period but that immediately reduced to 0.2% in period 2.

From Figure 5 it can be seen that the response of trade flow to shock 1 which is its own shock is positive, starting from period 1 but decelerating sharply up-till period 2 where it became negative, it reached its maximum negative in period 3 before moving up to rest on the mean line from period 5 to 10. A quick look at Figure 5(b2) which is the response of trade flow to shock 2 ERD shows the variance line virtually rested on the mean line all through. From Figure 5(b2), one may note that again the variance line rested on the mean line all through. It can be seen that the response of trade flow to shocks from exchange rate devaluation was marginally negative but it quickly increased to the mean line where it rested in the long run. Goods price variation did not show any effect. This is similar to the outcome of the research by Vacu et al. (2020).

Table 18. Variance decomposition for developed countries

Variance Decomposition of D(TFlow):				
Period	S.E.	Shock1	Shock2	Shock3
1	1.000941	99.81216	0.184364	0.003476
2	1.003574	99.81253	0.183975	0.003492
3	1.014543	99.81143	0.184945	0.003623
4	1.014764	99.81144	0.184924	0.003633
5	1.014918	99.81142	0.184942	0.003640
6	1.014927	99.81142	0.184941	0.003642
7	1.014929	99.81142	0.184941	0.003642
8	1.014930	99.81142	0.184941	0.003642
9	1.014930	99.81142	0.184941	0.003642
10	1.014930	99.81142	0.184941	0.003642
Variance Decomposition of D(ERD):				
Period	S.E.	Shock1	Shock2	Shock3
1	201.4189	97.73766	0.002465	2.259875
2	260.0060	98.56743	0.074492	1.358077
3	306.5953	98.85706	0.069239	1.073702
4	313.6113	98.89821	0.075252	1.026542
5	320.5114	98.93253	0.075749	0.991725
6	321.1709	98.93598	0.076319	0.987697
7	321.9233	98.93964	0.076419	0.983945
8	321.9829	98.93994	0.076470	0.983586
9	322.0558	98.94030	0.076481	0.983222
10	322.0614	98.94033	0.076486	0.983188
Variance Decomposition of GPV				
Period	S.E.	Shock1	Shock2	Shock3
1	4.787284	42.95850	52.67814	4.363367
2	19.74491	96.43801	3.295046	0.266947
3	29.44550	98.32104	1.557379	0.121576
4	29.74362	98.34907	1.531359	0.119575
5	29.95998	98.36962	1.512374	0.118010
6	29.96234	98.36976	1.512210	0.118031
7	29.96431	98.36994	1.512043	0.118021
8	29.96440	98.36994	1.512034	0.118025
9	29.96440	98.36994	1.512034	0.118025
10	29.96444	98.36994	1.512030	0.118025
Factorization: Structural				

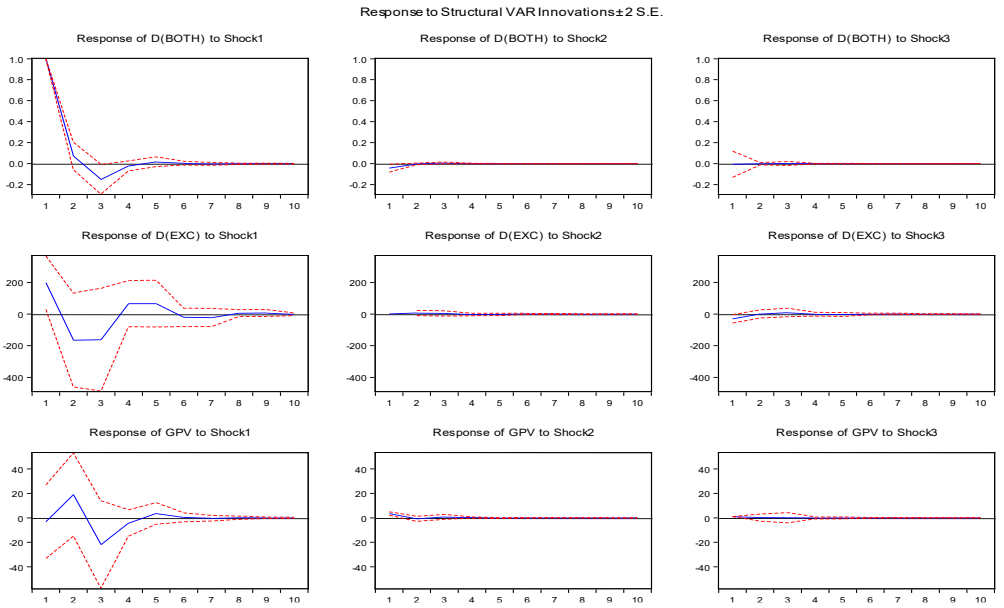
Source: Authors' results using E-views 10.

In Figure 5(b4), it can be seen that the variance line initially started positive in period 1, and became negative in period 1.5. It reached its maximum negative in period 2 and flattened out to period 3 where it started accelerating positively up till

period 4. It again flattered out positively until period 5 when it again decelerated to negative in period 6. It finally rested on the mean line from periods 8 to 10. Figure 5(b5) which represents the own response, clearly shows that the variance line rested on the mean line all through periods 1 to 10. From Figure 5(b6) we again notice that the response of ERD to shock 3 (goods price variation) started slightly negative in the first period but accelerated to the mean line in period 2 and rested on the mean line up till period 10. We, therefore, wrap up that the response of exchange rate devaluation to the shocks from both trade flow and goods price variation is insignificant; this is due to the stable economic conditions among the developed countries.

From Figure 5(b7), one may again notice that the response of goods price variation (shock 3) to trade flow (shook 1) depicted a situation where the variance line started slightly from a negative position but accelerated positively up till period 2. It decelerated negatively up till period 3 and again accelerated positively till it went above the mean line up till period 5. It finally rested on the mean line from periods 6 to 10. From Figure 5(b8), it can be seen that the variance line hovered slightly around the mean line from periods 1 to 4 before resting on the mean line from periods 4 to 10. Lastly, figure 5(b9), again showed a situation where the response to goods price variation (shock 3) to itself. The variance line almost completely rests on the mean line from period 1 through to period 10.

Figure 5. Plots of impulse response to innovation



Source: Authors' results using E-views 10.

Hypothesis testing based on empirical results

From the empirical results, the study hypothesis can now be tested adequately and findings documented.

Hypothesis one- We stated earlier that, *"there is no substantial positive interaction between currency devaluation and goods price variation on trade flow in developing countries."* From the results of our analysis using the GARCH (1.1), it can be seen that both of our independent variables have significant positive effects on trade flow. It was also discovered that both exchange rate devaluation and goods price variation exhibited a significant positive interaction with trade flow within the period under review. This is in line with similar studies by Mouvou and Ngalali (2021) and Porteous (2019). Equally, the ARCH equation further confirmed a symmetric relationship between exchange rate devaluation and goods price variation on trade flow. We also note from the ARCH lag 1 and GARCH lag1 that the relationship is persistent and large.

Also, from the GTR GARCH results presented in Table 12, exchange rate devaluation and goods price variation are significant at 1% indicating that there is a significant positive interaction between exchange rate devaluation and goods price variation on trade flow again from the ARCH lag I and GARCH lag I it is again discovered that the relationship is symmetric and persistent. In line with the findings of previous researchers such as Tarasenko (2021) and Vacu et al. (2020), using the Panel-NARDL estimates presented in Table 9 we observed that both the positive and negative impact of devaluation and goods price variation does not create any significant reaction in the dependent variables either on the long-run or within the short-run. This is in line with similar findings by Dzanan & Masih (2017) and Okonkwo (2019). However, using the PSVAR estimates it is again discovered that the independent variables devaluation and goods price variation had significant positive shock on trade flow within the period under investigation. This is also in line with recent studies by Sanedza and Diaba (2017). Conclusively we reject the null hypothesis which states that "there is a significant positive interaction between exchange rate devaluation and goods price variation on trade flow in developing countries.

Hypothesis Two- We stated earlier that *"there is no substantial positive interaction between currency devaluation and goods price variation on trade flow in developed countries."* From the result of our analysis using GARCH (1.1) estimates which have earlier been presented in Table 13, it is discovered that only one of our independent variables exchange rate devaluation is statistically significant and also exhibits a positive relationship with the dependent variable trade flow. Although the second independent variable goods price variation is not statistically significant, however, it also exhibited a positive relationship with trade flow. From the variance equation, it can be observed that the shock is persistent. This is in line with similar findings Bahmani-Oskooee and Aftab (2017) and Porteous (2019). Equally, from the GJR GARCH earlier presented in Table 14, we again notice that one out of our two independent variables is statistically significant, that is, exchange rate devaluation. It also exhibited a positive relationship with trade flow. From the variance equation, it can be seen that the shock is symmetric and persistent. Using the P-NARDL estimates presented earlier in table 5.4.2(b), it is noted that only exchange rate devaluation

(positive) is marginally significant, however, it exhibited a positive relationship with trade flow. This is according to earlier findings by Arise et al (2020). Either a positive or negative (increase or decrease) in goods price variation had no impact on trade flow within the period under review. However, in the short run, only goods price variation(positive) had a marginal statistical significance on trade flow, while in the long-run exchange rate devaluation(positive) had a positive impact on trade flow on the other hand goods price variation^{-} actually contributed negatively to trade flow. From the analysis using NARDL for developed countries one can conclude that the result is inconclusive in line with a similar conclusion by Vacu et al. (2020).

In sum, it can be observed from the GARCH analysis that our variables showed a mixed outcome for exchange rate devaluation and GPA on trade flow in the developing countries while the estimates also indicated a positive relationship in the case of developed countries. In the case of P-NARDL, the outcome was indeterminate because all our variables were not statistically significant using data from developing countries. On the other hand, data from the developed countries indicated a positive nexus between exchange rate devaluation and trade flow while it was indeterminate in the case of goods price variation. Finally, using estimates from PSVAR, it was discovered that the outcome is indeterminate in the case of developing countries. While in the case of the developed countries, the outcome is also indeterminate because, both or independent variables were statistically not significant

The policy implications for the developing countries are enumerated below: There is a negative outcome for the impact of devaluation on trade flow in developing countries. This is because using the three analytical tools adopted in this work, there is a negative relationship between devaluation and trade flow among the developing countries. In most cases exchange rate devaluation have failed to achieve its desired outcome, which is, a substantial improvement in the country's export that can lead to improvements in the country's balance of payment position. The reason is that developing countries are not importers of both commodity and investment goods, a currency devaluation will lead to higher prices for such imports and this will reduce their purchasing power, hence a reduction in trade flow which may lead to an adverse balance of payment position. In other words, most developing countries are largely import-consuming countries both in capital goods and consumer goods. This position

has been well adopted by former researchers such as Kumar et al. (2019) and Wahyudi and Sari (2019).

On the findings for the impact of goods price variation on trade flow, the relationship largely depicted a mixed outlook. This is confirmed by the positive result with estimates from GARCH while showing a negative outlook using the GJR GARCH. This mixed outlook is largely because a mild variation in the price of goods which is a component of inflation is beneficial to trade while galloping inflation is bad for trade. The position of this study is supported by similar findings by Logan (2017). In line with Oladunjoye et al. (2019) and King'Ola (2018), goods price variation exerted both a positive and a negative impact on trade flow in developing countries hence, policymakers in developing countries should ensure that adequate inflationary levels are put in place, which will encourage trade flow. Specifically, it is recommended that ensuring creeping inflation has been identified to be good for trade flow because hyperinflation will most likely exert an adverse effect on the flow of trade in developing countries. This can lead to hoarding and artificial scarcity which is not good for trade flow or a positive balance of trade.

A creeping inflation has been identified to be good for trade flow whereas a hyper-inflation will exert an adverse effect on the flow of trade in developing countries. Also, using the PNARDL estimates, it is observed that a positive increase in goods price variation leads to a positive impact on trade flow. This is because as largely industrialized and exporting economies, a positive variation in prices will be beneficial to their economy. This finding is in line with the findings by Kumar et al. (2019).

The policy implications with respect to the developed countries are enumerated below: Given the fact the most developed countries have a strong production and industrial base; it is not surprising that there is a positive nexus between exchange rate devaluation and trade flow. Perhaps, the developed countries should have planned devaluation to achieve a further improvement in their trade flow position. However, with the increased advancement by the developing countries, they should avoid cut-throat competition and currency devaluation among themselves. This is further buttressed by the findings of Fatum et al. (2018) and Wahyudi and Sari (2019). For the impact of goods price variation on trade flow among developed countries, it can

be observed that the impact is virtually insignificant. This is because, with their well-managed inflation rate and exchange rate, it is almost impossible for them to experience variations in their prices of imports and exports. Policymakers are therefore advised to hold on to their current policies of non-volatility in their exchange rate as well as their inflation rates.

5. Conclusion

The study empirically estimated the impact of devaluation and goods price variation on trade flow in 47 emerging and industrialized nations. Various conceptual studies, theoretical as well as empirical studies were reviewed in relation to the stated objective leading to the formulation of the different hypothesis that was tested in the study. The study found a significant negative trade effect of currency devaluation and a significant positive trade effect of price variability in the developing countries but a significant positive trade flow impact of devaluation and an insignificant trade effect of price variation in the developed countries. The analysis, findings, and policy implications gave credence to the fact that exchange rate devaluation policies had most often resulted adverse balance of trade position for developing countries especially the large import-dependent countries in sub-Sahara and Latin America, in contrast to all the advantages usually enumerated by the World Bank, IMF and other Western Economic grouping such as the European Union.

Goods price variation had a mixed outcome among the developing countries while it essentially had a mild positive relationship with trade flow among the developed countries. The monetary policy managers of the developing countries should ensure that their policies of exchange rate devaluation must be complemented with other economic enabling indices such as substantial improvement in the competitiveness of their industrial projects, a dynamic and vibrant economic environment where the inflation rate is at a very low level, and improvement of the level of productivity. This is because in the absence of industrialization, more economic woes are prevalent just like the case of Nigeria. This is a position earlier decried by Umoru (2022). Given the above scenario, policymakers should ensure they implement policies that are anti-

price racketeering by producers. The policy implication here is that the economic policymakers in the developing countries should ensure to keep their interest rates low and stable.

The developed countries should avoid cut-throat competition and currency devaluation among themselves because this may lead to unhealthy competition which is counterproductive to trade. Policymakers in developed countries are advised to hold on to their current policies of non-volatility in their exchange rate. In developing countries, policymakers are also advised to ensure that the flow of trade in their various economies is controlled, to prevent adverse trade positions for their countries. Although it has been variously argued that trade restriction hinders trade flow thereby reducing the benefits of trade accruing to developing countries, the empirical reality is that without a certain level of trade restriction, most developing countries may not be able to exit the circle of under-development. A good case study is the Chinese experience. As well owing to the higher productivity and economic competitiveness of the industrialized countries, it will be near impossible for most developing countries to achieve an equal or higher level of competition with the industrialized countries. It is also recommended that developing countries should increase the level of trade among themselves because this will serve as a useful avenue for them to interact and exchange ideas, as well as, enable them to conserve their scarce foreign earnings and attract higher revenues, global reach, government support and increase the standard and product life-cycle of their exports.

One of the fundamental limitations of this research is that the policy findings are restricted to the effect of selected variables (exchange rate devaluation and goods price variation) on trade flow. This work is also limited to the selected analytical tools that are used in estimating the effect of the independent variables on the dependent variables without inferring that other econometric analytical tools may not show a reasonable level effect of the independent variables on trade flows elsewhere. In addition, the study uses secondary data that are collected from various national and international data sources. These data are not devoid of paucity especially in the face of economic shocks, caused by the COVID-19 pandemic and the Russian- Ukraine war which dramatically altered major economic arrangements, trading relations as well as other socioeconomic data. On these bases, there is a need for future research

to be carried out with an expanded sample of both developing and developed countries; this will help to increase the robustness of further analysis especially when most of the countries selected for this study are from the SSA countries. In further research, more of the Asia emerging economies may be used. It is again observed that most sub-Sahara African countries used in this study still have colonial ties with their colonial masters who still dictate their trade policies as well as their exchange rate orientation e.g. the Francophone countries in Africa.

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