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The exchange rate, income, trade openness and the trade balance: longitudinal panel analysis for selected SSA countries

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Abstract

Purpose – Motivated by recent rapid exchange rate depreciations, shrank economic growth, high inflation, and persistent trade deficits, this study examines the trade balance (TB) in the face of the recent dynamics of the stated macroeconomic factors, which are also important determinants of the TB. The symmetric test of the J-curve phenomenon for the selected Sub-Saharan African (SSA) countries is revisited in this regard. The study uses panel data from 1970 to 2020 for ten of these countries for the longitudinal panel analysis with the TB as the dependent variable and the real exchange rate, foreign and domestic national incomes, and trade openness as the set of independent variables.

Design/methodology/approach – Because the underlying data set involves a heterogeneous panel of relatively short N and long T, the pooled mean group (PMG) and mean group (MG) heterogeneous panel models are employed based on the Hausman test for parameter consistency in heterogeneous panels.

Findings – The findings largely support the domestic income growth– TB worsening and the foreign income growth– TB improvement hypotheses. Trade openness is found to mostly augment the TB performance of the countries. The results also validated the J-curve effect for only 3/10 and 2/10 countries in the PMG and MG models, respectively. The divergence for most of the countries is attributed to possible import compression and institutional structure of SSA countries.

Practical implications – Given the favorable effects of trade openness on the TB performance of SSA countries, it is recommended that SSA countries place much emphasis on import-substitution industrialization and value addition to their natural resources as well as investment-driven growth policies to improve the competitiveness of their exports and reverse the chronic deficits in their TBs.

Originality/value – This paper is unique for invoking heterogeneous panel models to analyze the TB in light of recent dynamics of its determinants, as well as providing an update on the symmetric test of the J-curve phenomenon for the selected SSA countries.

Keywords Macro-factors, Trade balance, Longitudinal panel analysis, SSA

Paper type Research paper

1. Introduction

Exchange rate stability is one of the most important economic policy issues that attracts greater attention among economists. This is because just like inflation and interest rates, the exchange rate affects the activities of economic agents such as households, investors, and governments. One of the most critical roles of the exchange rate is the fact that it determines

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to a large extent the balance of trade position of a country. Most especially in this era of globalization and trade liberalization among countries, the issue of the exchange rate is widely debated among researchers and economic actors. One of such discussion is the J-curve phenomenon based on the Marshal Lerner condition, which states that devaluation/depreciation only improves trade balance (TB) if and only if the sum of the price elasticities of demand for imports and exports is greater than one in absolute terms (Hussain and Haque, 2014). Without recourse to the time scale, economic theory predicts that a depreciation/devaluation of a country's currency should ultimately improve the TB as it increases import prices and decreases export prices (Bahmani-oskooee and Gelan, 2012a, b).

Since the transition from a fixed to a floating exchange rate regime in the late 1970s to the early 1980s, African countries have had to contend with rapidly depreciating currencies (Ahmad and Pentecost, 2020). The weak currency phenomenon is a feature of the African economy so much such that countries such as Zimbabwe have in recent times replaced the Zimbabwean dollar with the United States dollar. At the same time, most of these African countries have had to contend with balance of payment problems over the years. Most researchers have attributed the adverse balance of payment situation in Africa to under-industrialization most especially export-oriented industrialization (Mendes *et al.*, 2014; Abdel-Salam, 1966; Chong and Zanforlin, 2007). From the point of view of economic theory, net export is an integral component of the national economy, and therefore, works that seek to improve the balance of payment and or current account position of African countries must be given greater attention at this point in time. It is important to allude at this point that several works have been done in Africa regarding the relationship between devaluation/depreciation and the TB. For instance see Bahmani-Oskooee and Gelan (2012a, b), Anning *et al.* (2015), Adeniyi *et al.* (2011), among others. In fact, recent literature has even moved from a symmetric to an asymmetric investigation of the J-curve phenomenon in Africa. As examples of asymmetric investigations of the J-curve in the literature, one can refer to Mwito *et al.* (2021), Bahmani-Oskooee and Arize (2020), Arize (2019), etc. Alas, these numerous works (whether symmetric or asymmetric) have not produced conclusive evidence in support or otherwise of the J-curve phenomenon, especially for African countries. Consequently, the import of the J-curve theory for exchange rate policy formulation remains vague for these countries. The literature has attributed the inconclusive evidence for or against the existence of the J-curve to the following.

First, the assumption underlying the J-curve that there exists short-run inelastic response of import volumes to import prices may not be a tenable assumption at least for the countries in the panel and for the time period under consideration. In this regard, it is possible that immediate import compression following exchange rate depreciation/devaluation is the dominant force characterizing the TB in these countries. This could explain the finding of less evidence in support of the falling part of the J-curve.

The second reason that could justify these findings is the argument offered by Nelson and Plosser (1982) to the effect that the earlier works that support the existence of the J-curve could have been spurious because the methods used then could not deal with the unit root properties of the underlying variables, a situation which modern studies have found to be typical of most economic data.

Yet, efficient exchange rate, trade, and income policy formulation is critical for African countries because these countries not only have to grapple with significant fiscal slippages and escalating public debts but are also very characteristic of long-term chronic deficits on their balance of payments. Consequently, the African continent, despite being rich in natural resources, continues to face losses in terms of the benefits of international trade. The corollary of which is low economic growth and a deterioration in the living standards of the people (Safaeimanesh and Jenkins, 2021).

On account of the inconclusive outcome in the literature and the apparent exchange rate shock, contraction in economic growth and decreased trade volumes in most African countries largely occasioned by the coronavirus disease 2019 (Covid-19) pandemic, the current study aims to analyze the effects of these important macroeconomic factors on the TB positions of a selected few of these countries in a longitudinal panel framework. The symmetric test of the J-curve will be revisited in this regard. With almost 5 decades of country-level data coverage on the key variables, the longitudinal analysis is conducted using the panel ARDL method through the MG and the PMG models based on the outcome of the stationarity tests. This framework uses a relatively large N but longer T to enable a panel analysis that takes the dimension of a time-series analysis and thus gives more meaning to the short- and long-run differentiation of the phenomenon under consideration (Pesaran *et al.*, 1999). Unlike the time-series version of the ARDL model, the panel ARDL model can be estimated using different techniques. These include the pooled mean group (PMG), mean group (MG) and dynamic fixed effects (DFE) estimation techniques. The PMG method assumes long-run homogeneity and short-run heterogeneity in the impacts of the independent variables on the dependent variable. The MG method assumes both short-run and long-run heterogeneities in the model.

On the specific subject matter, the current study is a panel with small N and long T as opposed to the generalized method of moments (GMM) example of Hussain and Haque (2014), which used large N and small T as per the dictates of the GMM models to investigate the J-curve in Africa. Therefore, in addition to focusing on the balance of payment positions of the countries in response to recent dynamics in macroeconomic factors, the current study also provides insights into determining whether the selected African countries are stuck in the short-run phase of the Marshall–Lerner condition. The condition has contributed to a negative portrayal of their balance of payment during the period under consideration. The rest of the study is organized as follows. The second section deals with the literature on the subject matter mostly those related to the Marshall–Lerner condition. The third section deals with the methods and source of the data. The fourth section deals with the estimation strategies. The fifth section entails the empirical findings and the discussions, and the sixth section concludes with some policy recommendations.

2. The literature

Developed independently by Marshall (1949) in his classical work entitled "The pure theory of foreign trade: the pure theory of domestic values" and Abba Lerner (1903–1982), the Marshal–Lerner Condition establishes the circumstances under which depreciation and or devaluation improves a country's balance of payment or current account. This condition dictates that, in absolute terms, the price elasticities of imports and exports must sum to more than unity in order for depreciation/devaluation to improve the balance of payment position of a country (Shea, 1979). What this means is that import and export elasticities must be the overriding consideration for a successful devaluation policy in a particular country. This perhaps explains why some countries are successful at devaluation and others are not.

The TB, being the absolute difference between the absolute values of a country's export and import, the standard economic theory postulates that, following a currency depreciation/devaluation, export prices fall leading to an increase in the volume of export and import prices rise, leading to a decline in the volume of imports (Sohmen, 1958). Since the exchange rate has to do with the price of a country's currency in terms of foreign currencies, it is only natural that there have to be commensurate adjustments in the volumes of imports and exports, which are indicators of international relations for depreciation or devaluation to be beneficial.

Mathematically, the intuition behind the Marshall–Lerner condition is presented as follows:

$$TB = X - eM \tag{1}$$

Where TB is the trade balance, X is the value of exports, M is the value of imports, and e is the exchange rate, which is the price of imports in terms of foreign currency say the dollar. Following simple rules of differentiation, we take the derivative of the TB with respect to the exchange rate to arrive at equation (2).

$$\frac{dTB}{de} = \frac{dX}{de} - e\frac{dM}{de} - M\frac{de}{de} \tag{2}$$

Simplifying equation (2) by way of economic intuitive manipulations, we obtain equation (3), which is an expression of the derivative of the TB with respect to the exchange rate in terms of export and import elasticities.

$$\frac{dTB}{de} = M\left(\left[\frac{dX}{de}.\frac{e}{X}\right]\frac{X}{eM} - \left[\frac{dM}{de}.\frac{e}{M}\right] - 1\right) \tag{3}$$

Equation (3) brings us closer to establishing the critical role of the exchange rate in determining the balance of payment position of a country. Replacing the elasticity expressions with their contracted denotations, we arrive at equation (4).

$$\frac{dTB}{de} = M\left(\varepsilon_x\frac{X}{eM} - \varepsilon_m - 1\right) \tag{4}$$

Adding and subtracting eM to the numerator of the first term of equation (4) gives:

$$\frac{dTB}{de} = M\left(\varepsilon_x\frac{X - eM}{eM} + \frac{\varepsilon_x eM}{eM} - \varepsilon_m - 1\right) \tag{5}$$

If $X - eM = 0$ equation (5) simplifies to give equation (6), which is a key expression for analyzing the balance of payment position of a country.

$$\frac{dTB}{de} = M(\varepsilon_x - \varepsilon_m - 1) \tag{6}$$

From equation (6), when the absolute price elasticities of exports and imports sum to more than 1, TB rises which is the Marshall–Lerner condition. If net exports are positive, i.e. X-M > 0, then exchange rate depreciation improves the TB irrespective of whether the sum of the price elasticities of exports and imports is greater, less, or equal to unity in absolute terms. On the other hand, if net exports are negative, i.e. X-M < 0, then the sum of the price elasticities of imports and exports must necessarily sum to more than 1 before exchange rate depreciation/devaluation impacts positively on the TB. This is so because the initial harmful price effect in this instance is big and the corresponding quantity change has to be bigger to be commensurate with the price effect.

On the empirical front, several works have been done to ascertain the existence of the J-curve in so many countries. Whereas the following works found evidence to support the J-curve: Tripti and Bandyopadhyay (2016) for India and the South Asian Association for Regional Cooperation (SAARC), Adeniyi *et al.* (2011) for Nigeria, Kyophilavong *et al.* (2013) for Laos, Hussain and Haque (2014) and Siklar and Kecili (2018) for Turkey, Mwito *et al.* (2020) for Kenya, Amusa and Fadiran (2019) for South Africa and Lira and Lal and Lowinger (2000).

The following works found no evidence to support the existence of the J-curve: Khatoon and Mahbubur (2009) for Bangladesh, Awan *et al.* (2012) for Pakistan, Serdar and

Hakan (2017) for Brazil and USA, Bahmani-oskooee and Gelan (2012a, b) for Africa, Yılmaz *et al.* (2017) and Horata (2019) for Turkey, Anning *et al.* (2015) and Canipe (2012) for Ghana, Trabelsi and Jelassi (2016)) for Tunisia.

3. Methods and sources of data

This study employs panel data from 1970 to 2020 to analyze the impact of exchange rate depreciation/devaluation on the TB of the selected Sub-Saharan African (SSA) countries. These countries are selected based on the ready availability of longitudinal data for the variables of interest and the volatile exchange rate environment of these countries especially at the onset of the COVID-19 pandemic. The natural logarithm of the ratio of exports (X) to imports (M) i.e. ln(X/M) constitutes the dependent variable and the regressors are the official exchange rates of the countries relative to the dollar, the natural logarithm of foreign (China) and domestic gross domestic products and trade as a percentage of the gross domestic products of the countries. Data on all variables are sourced from the World Bank's World Development Indicators (WDI) database. Foreign and domestic gross domestic products as well as trade openness are included as regressors because they are important driving factors of the TB of countries. The gross domestic product of China is used to represent foreign national income in this study because China is currently considered the largest trading partner of most SSA countries with estimated trade of over 15%.

4. Estimation strategy

To analyze the short-run and long-run effects of real exchange rate including other independent variables on the TB of the various countries in the panel, this study adopts the panel autoregressive distributed lag (ARDL) model proposed by Pesaran and Smith (1995) and Pesaran *et al.* (1999). The functional form of which is specified in equation (7):

$$\Delta y_{it} = \theta_i \left[y_{it-1} - \lambda_i' X_{it} \right] + \sum_{j=1}^{p-1} \phi_{i,j} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \alpha_{i,j}' \Delta X_{i,t-j} + \varphi_i + \mu_{i,t} \tag{7}$$

Equation (7) is re-parameterized to incorporate the variables of interest to arrive at the operational model for estimation as specified in equation (8):

$$\Delta TB_{it} = \begin{bmatrix} TB_{it} - \lambda_1 trade_{it} \\ TB_{it} - \lambda_2 fgdp_{it} \\ TB_{it} - \lambda_3 dgdp_{it} \\ TB_{it} - \lambda_4 exch_{it} \end{bmatrix} + \sum_{j=1}^{p-1} \phi_{i,j} \Delta TB_{i,t-j} + \sum_{j=0}^{q-1} \begin{bmatrix} \alpha_{1i} \Delta trade_{i,t-j} \\ \alpha_{2i} \Delta fgdp_{i,t-j} \\ \alpha_{3i} \Delta dgdp_{i,t-j} \\ \alpha_{4i} \Delta exch_{i,t-j} \end{bmatrix} + \varphi_i + \mu_{i,t} \tag{8}$$

Where TB_{it} is the TB of country i at time t calculated as the natural logarithm of the ratio of the value of a country's export to the value of imports, trade = trade openness, fgdp = foreign income, dgdp = domestic income and exch = real exchange rate of each country relative to the US dollar. φ_i is the cross-country heterogeneity, and μ_{it} is the panel idiosyncratic error term, which is assumed to be iid, i.e. $\mu_{it} \approx N(0, \sigma^2)$.

5. Empirical results and discussions

First-generation tests of unit root are adopted for this study based on the outcome of Pesaran's tests for cross-sectional dependence among the countries in the panel considering the variables as a group. The results of Pesaran's test for cross-sectional independence are reported in Table 1. From the table, it can be observed that the test statistic of Pesaran's test of cross-sectional independence is 1.440 with an associated p-value of 0.1497, which is higher

than even the 10% level of significance leading to the acceptance of the underlying null hypothesis of cross-sectional independence. The absence of cross-sectional dependence among the African countries in this regard is attributed to the fact that Africa is the region with the least intra-regional trade estimated at just above 13% as against the estimated 60%, 40% and 30% intra-regional trade for Europe, North America, and Association of Southern East Asian Nations (ASEAN), respectively. This is a disturbing phenomenon, and it can only be hoped that the introduction of the African Continental Free Trade Area (AFCFTA), which has since been ratified by over 31 AU member countries, would be a game changer that reverses this narrative and improve intra-regional trade in Africa.

Because the panel ARDL is the panel version of the time-series ARDL, it is critical to ensure that none of the variables under consideration is integrated of order two, i.e. I(2). Against this backdrop, the empirical section of this study begins with a unit root test on all the variables using both the Im–Pesaran–Shin (IPS) test, proposed by Pesaran *et al.* (1997), and Levin–Lin–Chu (LLC) test of a unit root in panel data proposed by Levin *et al.* (2002). The null hypothesis underlying both tests is that the series has a unit root. It is also imperative to note that both tests are first-generation tests of a unit root in panel data applicable when there is cross-sectional independence among the subjects in the panel (Barbieri, 2009). The results of the IPS and the LLC tests for unit roots are reported in Table 2.

As it is obvious from Table 3, the null hypothesis of the presence of unit root is rejected for all the variables after the first difference for both IPS and LLC. This implies that all the variables to be used for the estimation are at most integrated of order one, i.e. I (1). This is an indication that estimating the underlying model with the panel ARDL model will not produce spurious results.

Unlike the time-series version of the ARDL model, the panel ARDL model can be estimated using different techniques. These include the PMG, MG and DFE estimation techniques. The PMG method assumes long-run homogeneity and short-run heterogeneity in the impacts of the independent variables on the dependent variable. The MG method assumes both short-run and long-run heterogeneities in the model. Although the DFE method is similar in spirit to the PMG model, the former imposes prior equality restrictions on the slope coefficients and error variances across all the cross-sectional units in the panel. Although all three models used for panel ARDL estimation have their underlying assumptions, the choice of which model to specify at any given point in time depends highly on the outcome of the Hausman test proposed by Hausman (1978). Between the PMG and the MG, the null hypothesis underlying the Hausman test is that the PMG is appropriate and between the MG and the DFE, favors the MG model. The results of the Hausman tests for deciding between the PMG and MG are reported in Table 3.

From Table 3, it can be seen that at the 5% level, the null hypothesis of PMG model cannot be rejected but at the 10% level, the null hypothesis of PMG has been rejected in favor of the MG model. This conclusion has led to the estimation of both PMG and MG models as reported in Tables 4 and 5 respectively.

Before reporting the results for the PMG and the MG models, we consider it important to report the descriptive statistics of the variables. This is reported in Table 4.

From the table, the following observations can be made:

Table 1.
Test of cross-sectional independence

Summary of test	Test statistic
Pesaran's test of cross-sectional independence	1.440 (0.1497)

Source(s): Authors' construct

Variables	Im–Pesaran–Shin				Levin–Lin–Chu			
	I (0)		I (1)		I(0)		I(1)	
	I.C.	I.C.& Tr	I.C.	I.C. & Tr	I.C.	I.C.& Tr	I.C.	I.C. & Tr
LNTB	−2.274**	−1.946**	−13.743***	−12.510***	−2.304**	−3.087***	−12.152***	−9.968***
EXCH	4.013	1.120	−10.247***	−9.490***	3.407	0.259	−9.716***	−9.145***
TRADE	−0.565	−0.143	−12.120***	−10.522***	−0.580	−0.518	−10.761***	−8.658***
LNFGDP	−0.349	1.541	−8.886***	−7.202***	−5.926***	5.417	−40.190***	−4.296***
LNDGDP	2.129	−0.723	−10.594***	−9.314***	−1.713*	−2.129***	−10.122***	−8.552***

Note(s): *, ** and *** denote the absence of unit root at 10%, 5 and 1% significance levels, respectively
Source(s): Authors' construct

Table 2.
Results of the Im–Pesaran–Shin and Levin-Lin-Chu unit root tests

(1) For the 10 Sub-Sahara African countries included in the study, each variable consists of 450 observations for a total of 2,250 observations.

(2) The average TB for all the countries is a deficit of −0.250, which reflects the persistent balance of payment deficit phenomenon in Africa (Osakwe, 2007; Høst-Madsen, 1967), which partly motivated this study. The average higher units of the selected countries' currencies that is required for a unit of the US dollar is indicative of the widespread currency depreciation phenomenon in Africa. For economies that depend heavily on imports, exchange rate depreciation is directly related to the price level because the depreciation though is expected to promote exports and increases the average price of imported goods and services (Meniago and Eita, 2017) (Meniago and Eita, 2017). Of particular interest is the huge deviation from the mean of the exchange rate of the African countries included in the panel.

(3) Another variable of interest is the trade openness which has a mean value of 65.64%, a standard deviation of 23.75%, minimum and maximum values of 6.32 and 131.49%, respectively. As observed in Oloyede *et al.* (2021), the countries in the Economic Community of West African States (ECOWAS) and the South African Development Community (SADC) have their economies positively impacted by trade openness although the findings are not necessarily significant.

The results of the PMG model are reported in Table 4 and from the table, it can be seen that there is a long-run positive effect of the exchange rate on the TB of all the countries in the panel. This finding is consistent with the predictions of the J-curve analysis, which holds that the TB or the current account position of a country improves in the long-term following exchange rate depreciation. The finding is also consistent with the findings of Mwito *et al.* (2020) for Kenya and Amusa and Fadiran (2019) for South Africa in their time-series analysis. However, the results also indicates that there exist short-run positive effects of the exchange rate on the TB of seven of the countries in the panel (Ghana, Kenya, South Africa, Senegal, Ivory Coast, Gabon and Botswana) whereas for three of the countries (Cameroon, Burkina Faso and Gambia), exchange rate depreciation leads to a short-run deterioration in their TBs. For the three countries, the short-run adverse effects of exchange rate depreciation, coupled with the long-run positive effects of exchange rate depreciation on their TBs, indicate the presence of the J-curve effect in these countries. Specifically, this effect can be observed in

Test summary	χ^2 statistic
Cross-section random	8.71* (0.069)

Table 3. Hausman test

Note(s): *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. p-values in parentheses
Source(s): Authors' construct

Variable	Observation	Mean	Std. dev	Min	Max
TB	450	−0.250	0.571	−2.269	0.919
Rexch	450	230.24	238.91	0.0001	732.40
Trade	450	65.64	23.75	6.32	131.49
DGDP	450	2.88e+10	6.45e+10	1.12e+08	4.16e+11
FGDP	450	3.20e+12	3.31e+12	2.45e+11	1.15e+13

Table 4. Descriptive statistics of the variables

Source(s): Authors' construct

Dep. var: TB												
LR	REXCH	0.0003 (0.116)										
	LNFGDP	0.132*** (0.004)										
	LNDGDP	−0.322*** (0.000)										
	TRADE	−0.002** (0.034)										
Panel		Ghana	Kenya	SA	Senegal	Ivory	Gabon	Botswana	Cameroun	BF	Gambia	
SR	ΔREXCH	0.243** (0.031)	0.007 (0.563)	0.029 (0.135)	0.001 (0.164)	0.0001 (0.705)	0.0004 (0.407)	0.102 (0139)	−0.0003 (0.378)	−0.001* (0.091)	−0.006 (0.412)	
	ΔLNFGDP	−0.428 (0.519)	3.218** (0.037)	0.928** (0.017)	−0.325 (0.354)	0.584 (0.201)	0.358 (0.684)	1.573** (0.036)	0.495 (0.436)	−0.697 (0.309)	0.129 (0.800)	
	ΔLNDGDP	0.038 (0.822)	−0.355 (0.528)	0.292** (0.034)	0.143 (0.519)	0.145 (0.364)	0.759*** (0.000)	0.520** (0.034)	−0.198 (0.312)	−0.532** (0.021)	−0.256** (0.020)	
	ΔTRADE	−0.001 (0.664)	0.007 (0.396)	−0.003 (0.314)	−0.0001 (0.993)	0.003 (0.274)	0.008** (0.017)	0.0004 (0.894)	0.004 (0.147)	0.025*** (0.000)	−0.003** (0.030)	
ECT		−0.181* (0.067)	−0.27*** (0.002)	−0.58*** (0.000)	−0.22*** (0.009)	−0.65*** (0.000)	−0.25*** (0.001)	−0.181*** (0.005)	−0.29** (0.017)	−0.080* (0.050)	−0.19** (0.012)	

Note(s): $*p < 0.05$, $**p < 0.01$, $***p < 0.001$. *p*-values in parentheses
Source(s): Authors' construct

Table 5.
Estimates of the PMG Panel ARDL model

Cameroon, Burkina Faso and Gambia. Contrary, the J-curve effect does not hold for the rest of the seven countries in the panel since exchange rate depreciation positively impacts their TB both in the short and the long run.

Another variable of interest is the effect of foreign national income on the TB of the 10 SSA countries in the panel. It can be seen from the table that the effect is positive and highly significant in statistical terms in the long run. However, in the short term, the results reinforce the long-run results in six (Kenya, South Africa, Ivory Coast, Gabon, Cameroon and Gambia) out of the ten countries in the panel giving credence to the import propensity theory that contends that when income increases, people are disposed to increase their import of foreign goods and services. Therefore, when the income of Chinese citizens increases, they are expected to purchase more goods and services from Africa, thereby increasing the export of African countries leading to improvement in their TBs in both short and long term. These findings are in line with the findings of Hussain and Haque (2014) and Siklar and Kecili (2018) for Turkey, Mwito *et al.* (2020) for Kenya, Amusa and Fadiran (2019) for South Africa and Lira and Lal and Lowinger (2000).

Moreover, the results further suggest that an increase in the domestic income of the various countries worsens the TB in the long run. However, in the short run, only four (Kenya, Cameroon, Burkina Faso, and Gambia) results of the ten countries in the panel validate the long-run finding. These findings are consistent with the *a priori* expectations of the study and economic theory (the import propensity theory) as well. Because an increase in domestic income is expected to trigger much more demand for imports and this could worsen the TB as the volumes of imports exceed exports in that scenario. These results are also in line with the findings of Tripti and Bandyopadhyay (2016) for India and SAARC, Adeniyi *et al.* (2011) for Nigeria, and Kyophilavong *et al.* (2013) for Laos. However, for six of the countries (Ghana, South Africa, Senegal, Ivory Coast, Gabon, and Botswana), the findings in terms of signs run contrary to the expectations of the study and the import propensity concept.

The final variable of interest in the model is the trade openness which is found to have a negative and statistically significant effect on the long-run TB of all the countries in the panel over the long run. This finding is reinforced by the short-run negative and statistically significant effects of trade on the TB of four of these countries. Although these findings sound economically counter-intuitive, it should not be surprising in the context of Africa since trade openness policies or measures do not usually favor African countries. The Economic Partnership Agreement (EPA) is a typical example in this regard, where liberalization has only offered an avenue for advanced economies to dump their goods in African markets and cause a net negative effect of trade liberalization on their TBs. On the contrary, the short-run results reveal further that, increase in trade by way of trade openness is found to have short-run positive effect on the TB of six (Kenya, Ivory Coast, Gabon, Botswana, Cameroon and Burkina Faso) of the ten countries in the panel albeit the findings are not statistically significant for some of the countries.

Considering the error correction terms of the PMG model, it can be seen that the coefficients for all the countries are appropriately signed and statistically significant. These error correction coefficients show the speed of adjustment to long-run equilibrium of the individual country models following short-run shocks. While these speeds of adjustments are slow for most of the countries, they are quite high for other countries in the panel.

Because the null hypothesis of PMG underlying the Hausman test is rejected at the 10% level in favor of the MG model, this study estimates both models to assess the effects of exchange rate depreciation/devaluation on the TB of the ten countries in the model. Both models are fitted because they have different underlying assumptions and with the outcome of the Hausman test not leading to a clear rejection of one in favor of the other, it is important to report the results of both studies. Accordingly, the results of the MG-ARDL model are reported in Table 6.

Table 6.
Estimates of the MG Panel ARDL model

						Panel					
Dep. var: TB		Ghana	Kenya	SA	Senegal	Ivory	Gabon	Botswana	Cameroon	BF	Gambia
LR	REXCH	0.145*** (0.001)	−0.011 (0.622)	−0.021 (0.415)	−0.0001 (0.855)	−0.0002 (0.935)	0.0002 (920)	0.058 (0.732)	0.0004 (0.224)	−0.001** (0.010)	−0.027*** (0.006)
	LNFGDP	−0.182 (0.354)	0.462 (0.656)	0.297* (0.095)	0.207 (0.356)	0.257*** (0.000)	0.098 (0.841)	−0.360 (0.666)	−0.232** (0.029)	0.599*** (0.000)	0.349 (0.116)
	LNDGDP	0.022 (0.898)	−0.770 (0.327)	−0.533** (0.010)	−0.570* (0.091)	−0.473*** (0.000)	0.030 (0.965)	0.207 (0.682)	0.265* (0.095)	−0.462** (0.029)	0.008 (0.976)
	TRADE	0.0002 (0.952)	−0.033 (0.194)	−0.003 (0.440)	−0.010*** (0.000)	−0.002 (0.113)	−0.007 (0.469)	−0.004 (0.613)	−0.005* (0.066)	0.015*** (0.001)	0.006 (0.127)
SR	ΔREXCH	−0.016 (0.913)	0.016 (0.281)	0.037 (0.113)	0.0004 (0.397)	0.0001 (0.650)	0.0006 (0.252)	0.111 (0.208)	−0.001* (0.082)	−0.001 (0.327)	0.005 (0.563)
	ΔLNFGDP	−0.553 (0.466)	3.446* (0.068)	0.871** (0.056)	−0.537 (0.158)	0.509 (0.303)	0.855 (0.391)	1.830* (0.062)	0.699 (0.245)	−0.490 (0.485)	−0.229 (0.648)
	ΔLNDGDP	−0.069 (0.717)	0.280 (0.711)	0.322** (0.043)	0.181 (0.448)	0.249 (0.151)	0.754*** (0.001)	0.607** (0.047)	−0.374** (0.056)	−0.366 (0.115)	−0.205* (0.090)
	ΔTRADE	−0.001 (0.707)	0.013 (0.235)	−0.003 (0.294)	0.003 (0.157)	0.002 (0.338)	0.009** (0.021)	0.001 (0.753)	0.007*** (0.019)	0.015** (0.021)	−0.004** (0.012)
ECT		−0.65*** (0.000)	−0.35*** (0.005)	−0.54*** (0.000)	−0.55*** (0.000)	−0.81*** (0.000)	−0.43*** (0.003)	−0.34** (0.007)	−0.67*** (0.000)	−0.68*** (0.000)	−0.37*** (0.001)

Note(s): $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$, *p*-values in parentheses
Source(s): Authors' construct

It can be seen from the table that, in the long run, the effect of exchange rate depreciation/devaluation on the TB is positive for four of the ten countries in the panel. This reinforces the long-run findings of the PMG-ARDL model and a justification for the long-run positive effect of the real exchange rate on the TB of some countries. However, no evidence is found from the MG model to support the long-run improvements in the TB of six of the countries in the panel following exchange rate depreciation. The short-run results suggest that while exchange rate depreciation/devaluation improves the short-run TB of seven of the countries in the panel (Kenya, South Africa, Senegal, Ivory Coast, Gabon, Botswana, and Gambia), it adversely affects the TB of three of the countries (Ghana, Cameroon, and Burkina Faso) although the findings are not significant for some of the countries. Combining the short- and long-run results of the MG model, it can be seen that the J-curve phenomenon holds for only Ghana and Cameroon.

Differences in institutional structure could account for the differences in findings across the countries. Although no works have linked the performance of the TB of any African country or group of them to their institutional quality, Abreo *et al.* (2021) found evidence in support of a significant link between institutional quality and Colombian export performance. Given that African countries are similar to Latin American countries in terms of their institutions, it may be plausible to attribute the differences in findings among the countries to the heterogeneous strength of their underlying social and economic institutions, e.g. differences in Central Bank independence across the countries.

Regarding the long-run effect of foreign national income in the MG model, it can be seen that consistent with the long-run findings from the PMG model, an increase in foreign national income positively impacts the TB of at least six of the countries in the panel albeit some are statistically insignificant. The justification for this phenomenon is thoroughly demonstrated in the discussions under the PMG model. In the short run, an increase in the foreign income leads to a short-run improvement in the TB of at least six countries in the panel. This is in line with the findings of the PMG model as well as the long-run results of the MG model and the justification has been given under the explanation for the PMG findings.

The next variable is domestic national income and again, similar to the PMG findings there exist a negative effect of domestic national income on the TB of at least five (Kenya, South Africa, Senegal, Ivory Coast and Burkina Faso) of the ten countries. Although some of the findings are not statistically significant, they are consistent with the *a priori* expectations and the findings of some empirical works, one can refer to Tripti and Bandyopadhyay (2016) for India and SAARC, Adeniyi *et al.* (2011) for Nigeria, Kyophilavong *et al.* (2013). In the short run, the results of the MG model further show a mixed finding regarding the impact of domestic income on the TB of the countries in the panel. In particular, increase in domestic income of the countries are found to adversely affect the TB in four countries (Ghana, Cameroon, Burkina Faso, and Gambia) albeit the findings are not significant for Ghana and Burkina Faso. It is, however, consistent with the *a priori* expectations as well as economic theory. For the rest of the six countries, increase in domestic income are found to have positive effects on the TB, a finding which is counter-intuitive.

The last variable is trade openness, which has a positive effect on the TB for only three of the countries and just like the PMG long-run findings, a negative effect on the TB of seven of the countries in the panel and same justification as in the PMG model. It could also be attributed to the low level of intra-regional trade among African countries, a situation which informed the establishment of the AFCFTA [1], which is expected to change this narrative and improve trade among African countries. In the short run, the effects of trade-on-TB also reveal mixed results. The effects are positive for some countries and negative for others, a situation which is attributed to the heterogeneity in the way the various countries react to trade liberalization policies.

The error correction terms (ECTs) are appropriately signed and significant for all the countries and the same conclusions from the PMG model are observed for the speed of adjustments in the MG model.

6. Conclusions and policy directions

This study analyses the effect of the exchange rate depreciation/devaluation, trade openness as well as domestic and foreign incomes on the TB of Sub-Saharan African countries based on data from ten of these countries. Within this framework, the symmetric test of the J-curve effect is revisited for the selected SSA countries.

The findings point to the existence of the domestic income growth–TB worsening and the foreign income growth–TB performance improvement hypotheses in Sub-Sahara Africa at least for the ten countries selected for the longitudinal panel analysis. Further, the findings from the PMG model reveal that J-curve effect exist for three (Cameroon, Burkina Faso and Gambia) out of the ten countries in the panel for a possible extrapolated figure of about 14/46 countries with J-curve effect in SSA. For the rest of the countries, it is found that exchange rate depreciation leads to short-run improvements in their TBs. The number of countries with the J-curve effect decreased to only two (for a possible extrapolated figure of about 10/46 SSA countries) when the MG model is employed for the analysis. With rapid depreciating currencies as a major feature of most African countries, the existence of the J-curve effect in most of these countries was highly expected in this study. However, the lack of enough evidence to support the existence of the J-curve effect could be attributed to the following reasons.

First, the assumption of a short-run inelastic response of import volumes to import prices may not be a tenable assumption at least for the countries in the panel and for the time period under consideration. In this regard, it is possible that immediate import compression following exchange rate depreciation/devaluation dominates as the force characterizing the TB in these countries. This could explain the finding of less evidence in support of the falling part of the J-curve.

The second reason that could justify these findings is the argument offered by Nelson and Plosser (1982) to the effect that the earlier works that support the existence of the J-curve could have been spurious because the methods used then could not deal with the unit root properties of the underlying variables, a situation which modern studies have found to be typical of most economic data.

Based on these findings, it is identified that the unfavorable balance of trade phenomenon in African cannot be entirely due to exchange rate disadvantages but the relative value of the exports vis-a-vis imports especially when trading with much more industrialized countries. Since the estimates indicate trade openness favors the TB performance of these countries, it is recommended that SSA countries prioritize import-substitution industrialization and value addition to their natural resources. Additionally, implementing investment-driven growth policies that enhance the competitiveness of their exports can help reverse the chronic deficits in their TBs.

Note

1. With the Secretariat in Accra, Ghana, the AFCTA is a free trade area that was established in 2018 and began trading on January 1, 2021. It was founded by the African Continental Free Trade Agreement, which brought together 54 of the African Union's 55 member countries. Since the founding of the World Trade Organization, the free-trade area has grown to be the world's largest in terms of the number of nations that participate.

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