Exchange Rate, Trade Balance And Growth In Nigeria: An Asymmetric Cointegration Analysis

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EXCHANGE RATE, TRADE BALANCE AND GROWTH IN NIGERIA: AN ASYMMETRIC COINTEGRATION ANALYSIS

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ABSTRACT

Background and Statement of the Problem: It has been established that countries with high political and economic risks will draws investment funds away prospective investors from other countries, thus, such countries are at greater risks of loss of confidence in her currency stability and movement of capital to more stable economies. The aforementioned problems may discourage growth, macroeconomic stability, human capital development and institutional changes. Thus, there is the need to investigate the asymmetric cointegrating relationship, if any among the rate of exchange, trade balance and growth in Nigeria. Research Methodology and Data: With the primary assumption of the likelihood of an asymmetric adjustment process in the disequilibrium, the study deployed the M-TAR (Momentum - Threshold Autoregressive) and the TAR (Threshold Autoregressive) models. Annual data on imports, exports, domestic real income, world real income, domestic consumer price index and US consumer price index were used and this comes from the World Bank Development Indicators for the period 1960-2016 and all data are denominated in US-Dollars. Research Findings: The result shows that for the TAR model, cointegration exists among the three variables (economic growth, balance of trade and real exchange rate). An asymmetric adjustment disequilibrium process also exists. The point estimates suggest that the adjustment speed is lower when the balance of trade is worsens. The asymmetric ECM suggests that trade balance, real exchange rate and growth respond to disequilibrium and that the coefficient of domestic income and exchange rate are negative and that of foreign income is positive and statistically significant. Policy Implication: Government of Nigeria should concentrate her policy efforts towards import substitution strategy that will facilitate the production of currently imported goods locally, thereby creating sustainable employment and development of industrial manufacturing sector in Nigeria.

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Keywords: Exchange Rate, Trade Balance, Asymmetric Cointegration
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INTRODUCTION

The increasing demand of imported goods in Nigeria has continued to create an untold hardship on the masses thereby causing a depreciation of the currency in recent times. In addition, the incessant current account deficits over the years which require a country to demand for more foreign currency than it receives through sales of exports also have a consequential effect on the economy. Amongst the consequential effects of this practice includes but not limited to; depreciation of the currency, trade diversion, job loss in the

home country of the importing country, low per capita income, and reduced living standard of the citizens. This suggests that trade balance and exchange rates volatility may hinder inclusive growth.

One important factor that draws investment funds away from other countries is when a country is perceived to be exposed to high political and economic risks. Thus, countries with political turmoil can lead to loss of confidence in her currency stability and movement of capital to more stable economies. The aforementioned problems may discourage inclusive growth, macroeconomic stability, human capital development and structural changes. The need therefore arises for the investigation into the nature of the relationship among the rate of economic growth, balance of trade and the exchange rate in Nigeria. Over the years the J-curve phenomena have been examined, but with mixed findings. Studies have either provides support for the validity of the J-Curve and others not finding support for validity of the J-Curve in Nigeria. Other researches on the J-Curve concentrated on symmetric cointegrating relationship (Onafowora 2003, Ahmad and Yang 2004, Kamoto 2006, Petrovic and Gligoric 2009, Pham 2012, Abebe 2014). They largely did not factor in the existence of asymmetric cointegrating relationship. This constitutes the main literature gap to be filled with respect to the J-curve in Nigeria.

This research therefore examines asymmetric cointegrating relationship advocated by (Enders and Siklos 2001) which overcame the over-rejection issue associated with the symmetric cointegrating relationship. Second, the study examines the nonlinear nature of the causality connectedness among income (foreign and domestic), rate of exchange and the balance of trade In Nigeria.The justification for the asymmetric cointegration approach in Nigeria is borne out of the under-developed and imperfect market system (Okpara 2010). In view of the recent growth in Nigeria's trade balance, exchange rate and growth, this study sought to provide answers to the following questions concerning the J-curve relationship; (i) Is there a long-run relationship for the J-curve relationship? (ii)Does asymmetries cointegration exist for the J-curve relationship in Nigeria? (iii)Is there a nonlinear causality between trade balance, exchange rate, domestic and foreign income?

Asides from the introduction, this paper is divided into four other sections. Section two provides a brief review of the literature. Section three centres on the data, methodology and results. Section four is devoted to sensitivity analysis, while the last section concludes the study.

REVIEW OF LITERATURE

There are plethoras of studies on the relationship among changes in exchange rate, trade balance and the growth of the economy. Such studies tested different theoretical models such as the J-curve and the Marshall-Lenner conditions in different context particularly in developing countries. The findings of the various empirical studies have been mixed and inconclusive. For instance, the finding of (Onafowora 2003) on the test of the plausibility of J-curve in Asia reveals long run steady-state cointegration among real foreign income, real exchange rate, real trade balance, and real domestic income. A similar study that employed cointegration in a country specific context in China by (Ahmad and Yang 2004) indicate insignificant pass through of real devaluation to trade balance in China's bilateral trade with G-7 countries.

Apart from testing the J-curve in the Asian context, (Kamoto 2006) examine the J-curve effect on trade balance in Malawi and South Africa. The result of the vector error correction model indicates that South Africa trade balance initially deteriorate but improve in the long run following real depreciation of the Rand. This finding supports the plausibility of the J-curve hypothesis in South Africa. The findings of the error correction model and vector autoregressive model estimations in the work of (Petrovic and Gligoric 2009) provided strong evidence supporting the J-Curve hypothesis in the Serbian economy. The study by Egwaikhide, Chete and Falokun (1994) examined the quantitative effects of exchange rate depreciation on inflation, government revenues, expenditures and money supply in Nigeria. With reference to exchange rate, the study reveals that the parallel market exchange rate appears to correlate with inflation more when compared with the official rate. The major weakness of the study has to do with the sample size used for the estimate which might have weaken the results obtained from the cointegration and error correction technique estimation of the structural equations as this methodology generally requires a large sample size to draw solid inferences for policy simulations.

Specifically, Eme and Johnson (2011) investigate the possible direct and indirect relationship between exchange rates and GDP growth in Nigeria for the period 1986 to 2010. The relationship is derived using a simultaneous equations model within a fully specified macroeconomic model. The estimated results suggest that there is no evidence of a strong direct relationship between changes in exchange rate and output growth. On their own part, Adeyemi, Ogundipe, Ojeaga and Ogundipe (2013) investigate the impact of currency devaluation on Nigeria trade balance using the Johansen co-integration and variance decomposition analyses from 1970-2010. The empirical results indicate that there exist a long-run stationary relationship between trade balance and its determinants-domestic income, domestic and foreign money supply, domestic interest rate and nominal exchange rate as employed in the study. Their major findings show that exchange rate induce an inelastic and significant effect on trade balance in the long run. Also, there is no short run causality from exchange rate to trade balance as money supply volatility contributes more to variance in trade balance than exchange rate volatility.

Following this line of argument, Martins and Olarinde(2014) examine the impact of exchange rate depreciation on the balance of payments (BOP) in Nigeria over the period 1961–2012. The analysis was based on a multivariate Vector Error Correction framework. A long-term equilibrium relationship was found between BOP, exchange rate and other associated variables. The empirical results are in favour of bidirectional causality between BOP and other variables employed. Odongo and Kalu (2013) analyze the intertemporal causal relationships between the real exchange rate and trade balance and cross-border capital flows in Africa. Annual data of nine major African countries for the period 1993–2009 were employed. Their findings lend support to the classical balance of trade theoretical view in which the net effect of a depreciation of the domestic currency is an improvement in the domestic country's balance of payments position in the short-run.

Furthermore, Odusola and Akinlo (2014) explore the link among the naira depreciation, inflation, and output in Nigeria. Evidence from their study reveals the existence of mixed results on the impacts of the exchange rate depreciation on the output. Results from the contemporaneous models also showed a contractionary impact of the parallel exchange rate on the output but only in the short term. Besides, official exchange rate shocks were followed by increases in prices, money supply, and parallel exchange rate.

In examining the determinants of trade balance changes in Pakistan, Uzma, Shamsa, Samina, Nazish, Amna and Rahat (2015) find that convergent or divergent dynamics of imports and exports are the first causes of trade balance changes. Everything that impact asymmetrically on imports and exports such as GDP and inflation can impact the trade balance. They establish a weak correlation between exchange rate and balance of trade.In addition, Pham (2012) examines the impact of exchange fluctuation on trade balance in both short and long run. The findings from the ARDL results show that trade balance improved with real exchange depreciation. Similar finding is documented in a more recent study on the test of J-curve in Ethiopia by (Abebe 2014). The finding indicates that real devaluation of exchange rate led to the development of trade in Ethiopia.

Also for Bangladesh, Khanom, Emu, Uddin and Farhana (2014) ascertain the relationship between the exchange rate and trade balance for the period 1973 to 2011. Their results from the estimate reveal the existence of direct relationship between trade balance and exchange rate. They conclude that the real exchange rate is an important variable to the trade balance, and devaluation will improve trade balance in the long run, thus consistent with Marshall-Lerner condition. Wanhui-Jiang (2014) investigates the effect of nominal RMB exchange rate volatility on economic growth in China from 1981 to 2012. The paper concludes that in the long run, exchange rate change has a positive impact on import and export trade. In a more resent study, Augustine, John, and Emmanuel (2017) examine the impact of real effective exchange rate on the trade balance of eight countries in the context of several nonlinear techniques. The results from the asymmetric model for long-run cointegration analysis, short-run analysis and half-lives provide evidence indicating that exchange rate depreciation has significant effects on the trade balance.

By and large, the plausibility of the J-curve in developing countries context is plausible. But there is need to investigate further whether trade creation and development that arise due to currency devaluation translate to inclusive growth which may show in the pattern of employment, equity distribution of resources, reduction in poverty and better standard of living for the populace. It is against this backdrop that this paper examines the impact of exchange rate on trade balance and inclusive growth in Nigeria.

DATA, METHODOLOGY AND RESULTS

In this section, the Enders and Siklos (2001) approach is deployed in the examination of the nexus between foreign exchange rate, trade balance and economic growth in the context of the Nigerian economy. The trade balance data which is defined as the proportion of exports to imports (X/M) is adopted as a veritable empirical measure of the trade balance-exchange rate relationship. According to Bahmani-Oskooee (1985), ithas the advantage of being interpretable both as nominal or real trade balance. It also resolves the problematic use of log form in case of a trade deficit. Other variables used are the real exchange rate (RER), the domestic real income (GDP) and the world real income (USGDP). The computation of the bilateral real exchange rate is arrived at thus: (i) calculate the domestic nominal exchange rate as a proportion of the United States consumer price index and (ii) multiply the result in (i) by the domestic nominal exchange rate. The annual data on imports, exports, domestic real income, world real income, domestic consumer price index and US consumer price index comes from the World Bank Development Indicators for the period 1960-2016 and all data are denominated in US-Dollars. The criteria for choosing

the time frame is based on the level of capital and financial market deepening, data availability and the operation of the flexible exchange rate regime by the Central bank of Nigeria (Ahmad, Pentecost and Harvey 2011).

The study begins the analysis, by testing for the order of integration of the variables listed above using the Ng-Perron NP (2001), Augmented Dickey–Fuller ADF (1979) and the Phillips and Perron PP (1988) and on each series.

The ADF, PP and the NP procedures test the null hypothesis of a unit root. The results from the ADF, PP and NP, unit root tests are shown in Table 1 and indicate that all the variables are non-stationary I(0) at levels, but stationary at first differences I(1). Consequently, the test of possible long-run co-integrating connection among the variables is conducted. Thus, the first stage is to perform a long –run regression on the model specified in equation (1);

$$X/M_t = \alpha_0 + \alpha_1 RER_t + \alpha_2 GDP_t + \alpha_3 USGDP_t + \varepsilon_t \qquad (1)$$

where (X/M) is the ratio of exports to imports, RER represents the real exchange rate, GDP the domestic real income and USGDP the world real income, α_0 to α_3 are parameters, ε_t is theresidual showing the disequilibrium between the variables.

After the determination of the long-run co-integration regression, the next phase is the conduct of stationarity test on the residual seriesε_t. The cointegration test in Table 2, rejects the null hypothesis of no cointegration at the 1 per cent level of significance.

TABLE 1: UNIT ROOT TESTS

Variables	ADF	PP	NP
X/M	-0.043	-0.961	-0.966
ΔX/M	-7.904***	-18.979***	-15.727***
RER	-2.246	-2.454	-2.172
ΔRER	-6.172***	-6.163***	-3.651***
GDP	-1.070	-1.353	-1.159
ΔGDP	-5.324***	-5.367***	-3.474***
USGDP	-2.048	-1.269	-1.251
ΔUSGDP	-5.073***	-5.092***	-3.424***

Notes: In this paper for the NP test we use the test statistic MZt.
Proper lag length for each test was chosen by AIC
**** Indicates significance at the 1% level.*
*** Indicates significance at the 5% level.*

The standard (Dickey and Fuller 1979)

$$\Delta\hat{\varepsilon}_t = \rho\hat{\varepsilon}_{t-1} + \upsilon_t \qquad (2)$$

Where $\{\varepsilon_t\}$ is the residual of the regression obtained from equation (1). This value is assumed to have a constant variance together with zero mean. It is referred to as 'white noise'. Theυ_t isthe identically distributed disturbance with zero mean and is considered to be independent. Where the null hypothesis of $\rho = 0$ is rejected, then the $\{\varepsilon_t\}$ considered to be is stationary.

The estimated parameters of long-run equationis presented in equation 2. The test adopts a symmetric adjustment process around the disequilibrium. However, if the equilibrium adjustment response among the variables (real exchange rate, trade balance, foreign and domestic income adjustments) is asymmetrical, then the equation (2) becomes mis-specified.

TABLE 2: ESTIMATED PARAMETERS OF LONG-RUN EQUATION FOR MODEL 1

$X/M_t = -19.069 + 0.017RER_t - 0.976GDP_t + 2.413USGDP_t + \hat{\varepsilon}_t$ ADF

-5.35*** 0.139 -1.786* 3.731*** -5.595***

***, ** and * Indicates significance at the 1%, 5% and 10% levels.*

In a developing country like Nigeria, the possibility of an asymmetric adjustment process is high. Consequently, the Threshold Autoregressive (TAR) and Momentum-Threshold Autoregressive (M-TAR) models are applied (Engle and Granger, 1987; Enders and Siklos2001).

The disequilibrium response to either negative or positive move away from the threshold is captured by the Engle and Granger (1987) TAR model as stated in equation (3) and (4):

$$\Delta\hat{\varepsilon}_t = I_t\rho_1\hat{\varepsilon}_{t-1} + (1 - I_t)\rho_2\hat{\varepsilon}_{t-1} + \upsilon_t \quad (3)$$

WhereI_t is the Heaviside indicator such that

$$I_t = \begin{Bmatrix} 1\ if\ \hat{\varepsilon}_{t-1} \geq \tau \\ 0\ if\ \hat{\varepsilon}_{t-1} < \tau \end{Bmatrix} \quad (4)$$

ρ_1 is taken as the rate of adjustment value if the lagged $\hat{\varepsilon}_{t-1}$ is above the long-run equilibrium value. If however, the lagged $\hat{\varepsilon}_{t-1}$ is lower than the long-run equilibrium value then the adjustment rate is taken to be ρ_2.

The M-TAR model is utilised where the rate of adjustment is skewed to one direction that is when the adjustment rate moves more in one direction than the other. In this case, the adjustment speed rests on whether $\Delta\hat{\varepsilon}_{t-1}$ is decreasing or increasing. The M-TAR model as designed by Enders and Siklos (2001) is presented in equation (5) and (6) as:

$$\Delta\hat{\varepsilon}_t = M_t\rho_1\hat{\varepsilon}_{t-1} + (1 - M_t)\rho_2\hat{\varepsilon}_{t-1} + \upsilon_t \quad (5)$$

WhereM_t is the Heaviside indicator such that

$$M_t = \begin{Bmatrix} 1\ if\ \Delta\hat{\varepsilon}_{t-1} \geq \tau \\ 0\ if\ \Delta\hat{\varepsilon}_{t-1} < \tau \end{Bmatrix} \quad (6)$$

Where τ is the endogenously determined value of the threshold which is calculated using the (Chan 1993) technique. The $(\hat{\varepsilon}_t)$ and $(\Delta\hat{\varepsilon}_t)$ values for the TAR and the M-TAR models

respectively are arranged in an ascending order excluding both the largest 15% and the smallest 15%. The τ value which yields the smallest residual sum of squares over the balance of 70% is selected as the consistent estimate. The necessary stationarity condition for $\hat{\varepsilon}_t$are according to Petrucelli and Woolford (1984) is $\rho_1 < 0, \rho_2 < 0$ and $(1+\rho_1)(1+\rho_2) < 1$.

Indeed, the impact of the variances of the positive as against the negative stages of changes in disequilibrium on the behaviour of the variables (domestic and foreign income, real exchange rate and trade balance) lend itself to the use of MTAR model. If $|\rho_1|>|\rho_2|$, then reduction in $\Delta\hat{\varepsilon}_{t-1}$ tend to persist and quick return to the threshold. On the other hand, an increase in $\Delta\hat{\varepsilon}_{t-1}$ manifests in $|\rho_1|<|\rho_2|$ and movement away from the threshold.

Where the error terms in TAR (equations (3) and M-TAR (equation 5) are serially correlated, Enders and Siklos (2001) proposed that, they are supplanted by equation (7) for TAR and equation (8) for M-TAR:

$$\Delta\hat{\varepsilon}_t = I_t\rho_1\hat{\varepsilon}_{t-1} + (1-I_t)\rho_2\hat{\varepsilon}_{t-1} + \sum_{i=1}^{P}\beta_i\Delta\hat{\varepsilon}_{t-i} + \upsilon_t \qquad (7)$$

$$\Delta\hat{\varepsilon}_t = M_t\rho_1\hat{\varepsilon}_{t-1} + (1-M_t)\rho_2\hat{\varepsilon}_{t-1} + \sum_{i=1}^{P}\gamma_i\Delta\hat{\varepsilon}_{t-i}\,\upsilon_t \qquad (8)$$

The null hypothesis for both models is that$H_0: \rho_1 = \rho_2 = 0$. The *F*-statistic in this case may not be consistent with the standard distribution. In which case, the TAR model tables (ϕ_u^*) table and the M-TAR model table (ϕ_u) provide the basis for comparison with the Monte Carlo simulation computed values (Enders and Siklos 2001).

Testing for asymmetric adjustment is possible if the study rejects the null hypothesis. For symmetric adjustment, the *F*-statistic for the null hypothesis is $H_0: \rho_1 = \rho_2$which is compared to the standard *F*-distribution. The use of the TAR or M-TAR model is necessary in this case, because both tests suggest evidence of asymmetries, thus, the AIC with the lowest value was used and the AIC is in support of the TAR model.

The result of the asymmetric cointegration tests conducted on the estimation of equations (3) and (5) is reported in Table 3.

TABLE 3: ESTIMATES FOR ASYMMETRIC COINTEGRATION

Parameters	TAR	MTAR
	Consistent (ϕ_u)	Consistent (ϕ_u^*)
p_1	-0.867(4.50***)	-0.926(4.21***)
p_2	-0.429(1.83*)	-0.518(2.53**)
Tests		
$H_0: F(p_1 = p_2 = 0)$	10.482*	10.258*
$H_0: F(p_1 = p_2)$	2.684**	2.348*
$Threshold\ \tau$	0.379	0.199

AIC	122.326	122.666
H_0: $noserialcorrelation Q_{LB}(4)$	6.238(0.18)	6.489(0.17)

Note: Critical values are obtained from (Wane et al. 2004).
****, ** and * signify statistical significance at the 1, 5 and 10 per cent levels, respectively.*

The null hypothesis of no cointegration for both the TAR and the MTAR model is rejected given that at the 10 per cent statistical significance level, the calculated *F*-statistic (10.482) is greater than the critical value (8.98) for TAR, and (10.258) is greater than the critical value of (9.85) for the MTAR. However, using the AIC to determine the best adjustment mechanism, the test is in favour of the TAR because it has the lowest value. The null hypothesis of symmetric conitegration under the TAR model is also rejected at the 5 per cent statistical significance level (see column 2). This means that the TAR model is accepted because of the evidence of asymmetric and symmetric cointegration.

In line with the a-priori expectation with respect to the stationarity of the error term, ρ_1 and $\rho_2$have negative values. Also, $|\rho_1|>|\rho_2|$ in the TAR model, this shows that the rate of correction of the disequilibrium is faster when trade balance, exchange rate domestic income and foreign income are increasing, than when the rate is declining.

The asymmetric version of the error correction model (ECM) is formulated as equation (9) because cointegration among the variables has been established, in addition to the clear evidence of asymmetric adjustment under the TAR model:

$$\Delta\frac{X}{M_t} = \rho_{11} I_t \hat{\varepsilon}_{t-1} + \rho_{12}(1-I_t)\hat{\varepsilon}_{t-1} + \sum_{i=1}^{P} \delta_k \Delta RER_{t-i} + \sum_{i=1}^{P} \eta_k \Delta GDP_{t-i} + \sum_{i=1}^{P} \propto_k \Delta USGDP_{t-i} \quad (9)$$

The TAR model in equation (9) describes the dynamic relationship among the variables. The ECM represented by the parameters ρ_{it} captures the speed of adjustments back to the equilibrium. The speed of adjustment for any positive deviation from long-run equilibrium (depending on the attractor indicator) is denoted by ρ_{11}. In the same vein, the of speed of adjustment of any negative deviations as defined by the attractor indicator, is known as ρ_{12}.

The result of the asymmetric error correction model under the TAR specification is presented in Table 4.

TABLE 4: NON-LINEAR ERROR CORRECTION MODELS

Variables	Coefficient	t-test
C	0.631	1.345
ρ_{11}	-0.387	-4.192***
ρ_{12}	-0.192	-2.568***
ΔX/M(-1)	0.964	1.479
ΔRER(-1)	-0.576	-4.217***
ΔUSGDP(-1)	0.664	3.173**
ΔGDP	-0.489	-2.938**

Note:ρ_{11} and ρ_{12} are the error correction terms for negative and positive residuals respectively.,**,*** designates significance at the 10%, 5% and 1% levels.*

With the TAR model, the speed of adjustment is very high when it is positive. The correction back to equilibrium is about 38.7%. The adjustment back to equilibrium is only 19.2% when it is negative. The coefficient of real exchange rate is negative and significant, this is in conformity with theory, because in the short run exchange rate depreciation worsen the trade balance and in the long run, the trade balance improves.

However, the domestic income is statistically significant, but worsens in the short-run; this implies that an increase in Nigerian real income increases the level of import. Thus, for inclusive growth to be achieved in Nigeria there is the need for increase in the production of import-substituted goods. The coefficient for foreign income is positive and significant. This implies that increase in real income can be ascribed to rise in the level of imports in Nigeria.

SENSITIVITY ANALYSIS

A sensitivity analysis is a method of checking how different values of explanatory variables affect the dependent variable under varying sets of assumptions. In this section, the study a sensitivity analysis is conducted in order to validate the results of the long-run regression and asymmetric cointegration tests earlier presented.

The use of annual data is fraught with trending issues, particularly autocorrelation between the variables. For this study, in order to account for the business cycle behaviour, the output gap is utilised as a replacement for the Gross Domestic Product (GDP). Equation (1) is therefore modified and presented as equation (10):

$$\frac{X}{M_t} = \alpha_0 + \alpha_1 RER_t + \alpha_2 GDPGAP_t + \alpha_3 USGDPGAP_t + \varepsilon_t \qquad (10)$$

Where$\frac{X}{M}$ remains the ratio of exports to imports. RER is represents the real foreign exchange rate, GDPGAP is the output gap of the domestic real income and USGDP the output gap of the world real income. The parameters are depicted by α_0 to α_3. The disequilibrium between the variables (trade and real exchange rate, output gap of the domestic income and output gap of the world income are denoted by the residual -ε_t.The results are presented in Table 5.

TABLE 5: ESTIMATED PARAMETERS OF LONG-RUN EQUATION FOR MODEL 10

$X/M_t =$ 0.05 + 0.26RER_t + 0.01$GDPGAP_t$ + 0.06$USGDP_t$ + $\hat{\varepsilon}_t$ADF
0.07 1.82* 0.96 1.50-4.286***

****, ** and * Indicates significance at the 1%, 5% and 10% levels.*

The basic assumption in the evaluation of equation (10) is of a symmetric adjustment process around the disequilibrium. However, an asymmetric adjustment in response to disequilibrium among the variables will render the model mis-specified. Given the high

possibility of an asymmetric adjustment process in developing country like Nigeria, the TAR and M-TAR techniques are deployed (Enders & Siklos, 2001) are examined. Equation (3) and (5) also lend themselves to use in this respect. The test result from the estimation of equations (3) and (5) for trade balance, real exchange rate, output gaps for domestic and the world, using asymmetric cointegration adjustment process is presented in Table 6.

TABLE 6: ESTIMATES FOR ASYMMETRIC COINTEGRATION USING OUTPUT GAP

Parameters	TAR Consistent (ϕ_u)	MTAR Consistent (ϕ_u^*)
p_1	-0.619(3.68***)	-0.271(2.09*)
p_2	-0.148(0.96)	-0.844(3.04**)
Tests		
$H_0: F(p_1 = p_2 = 0)$	10.56*	6.42
$H_0: F(p_1 = p_2)$	4.65***	3.72**
$Threshold\ \tau$	0.44	-0.09
AIC	117.12	118.04
$H_0: no\ serial\ correlation Q_{LB}(4)$	6.72(0.15)	2.67(0.61)

Note: Critical values are obtained from (Wane et al. 2004).
****, ** and * indicate statistical significance at the 1, 5 and 10 per cent levels, respectively.*

The null hypothesis of no cointegration for the TAR mode is rejected given that at the 10 per cent statistical significance level, the calculated *F*-statistic (10.56) is greater than the critical value (8.98). The null hypothesis of symmetric conitegration under the TAR model is also rejected at the 1 per cent statistical significance level (see column 2).

The study does not reject the null hypothesis of the MTAR model because at the 10 per cent statistical significance level, the critical value (9.85) is greater than the calculated *F*-statistic (6.42). In effect, cointegration exists among the variables. Also, at the 10 per cent level of statistical significance, the null hypothesis of symmetric cointegration is not rejected. This means that the TAR model is accepted because of the evidence of asymmetric and symmetric cointegration.

In line with the a-priori expectation with respect to the stationarity of the error term, ρ_1 and ρ_2 have negative values. Also, $|\rho_1|>|\rho_2|$ in the TAR model, this shows that the rate of correction of the disequilibrium is faster when trade balance, exchange rate output gaps for domestic and foreign economy are increasing. The rate is slower when rate when they are declining.

Since, cointegration is established among the variables (trade balance, exchange rate, output gaps of domestic income and foreign income) in addition to the clear evidence of asymmetric adjustment provided under the TAR model, the study therefore suggests that

the results are in conformity with the earlier results presented when the domestic and foreign income were used in place of their output gaps.

CONCLUSIONS

This research investigated the relationship trade balance, exchange rate, output gaps of domestic income and foreign income. It reviewed the underlining assumption of symmetrical adjustment process in the event of disequilibrium especially based on long run relationship. Given that the possibility of an asymmetric adjustment process is high in a developing country like Nigeria the study deployed the Threshold Autoregressive (TAR) and Momentum-Threshold Autoregressive (M-TAR) cointegration technique as recommended by Engle and Granger (1987) and Enders and Siklos (2001).

The study examined asymmetric variations in the process of adjustment of real exchange rate, trade balance, and economic growth from the equilibrium. Using the TAR and M-TAR techniques, the study reports that real exchange rate, trade balance, and growth are cointegrated. The process of adjustment is also found to be asymmetric. Indeed, the rate of correction of the disequilibrium is faster when trade balance, exchange rate domestic income and foreign income are increasing than when they are reducing. In order to validate result, the research performed a sensitivity analysis by the output gap with Gross Domestic Product (GDP). The result obtained confirms the asymmetric nature of the adjustment process earlier results earlier reported. The point estimates obtained also confirm that when trade balance is improving, the adjustment speed is higher than trade balance is getting worse. In the long-run however, the asymmetric ECM suggests that trade balance, real exchange rate and growth respond to disequilibrium. In addition, we found that the coefficient of domestic income is negative and that of foreign income is positive and statistically significant and real exchange rate is negative and significant.

The implication of this result for policy formulation is that government should concentrate her policy efforts towards import substitution strategy such that goods that can be produced locally would not be imported. This import substitution strategy can help create sustainable employment and development of industrial manufacturing sector in Nigeria that can often serve as engine of growth and development. This may facilitate inclusive growth process in Nigeria. However, government can make foreign exchange available particularly for goods and services that cannot be produced locally in the short and medium terms. In the same vein, the current tight exchange rate policy by the government through the Central Bank of Nigeria should be maintained. However, it may be relaxing in the long run when necessary and effective institutions that can ensure efficient and optimal allocation of foreign exchange by the private sector are in place.

ENDNOTES

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