

“Commodity price volatility and economic growth in Africa: the mitigating role of trade policy”

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ARTICLE INFO	Adeyemi Ogundipe (2020). Commodity price volatility and economic growth in Africa: the mitigating role of trade policy. <i>Problems and Perspectives in Management</i> , 18(3), 350-361. doi: 10.21511/ppm.18(3).2020.29
DOI	http://dx.doi.org/10.21511/ppm.18(3).2020.29
RELEASED ON	Monday, 05 October 2020
RECEIVED ON	Monday, 16 September 2019
ACCEPTED ON	Wednesday, 22 July 2020
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JOURNAL	"Problems and Perspectives in Management"
ISSN PRINT	1727-7051
ISSN ONLINE	1810-5467
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

55



NUMBER OF FIGURES

0



NUMBER OF TABLES

3

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BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

Received on: 16th of September, 2019
Accepted on: 22nd of July, 2020
Published on: 5th of October, 2020

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Conflict of interest statement:
Author(s) reported no conflict of interest

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COMMODITY PRICE VOLATILITY AND ECONOMIC GROWTH IN AFRICA: THE MITIGATING ROLE OF TRADE POLICY

Abstract

The extreme volatile behavior of Africa's output and consumption is strongly related to the extent of exposure to external shocks in its trade earnings. The volatility of export earnings inherent in African economies depicts trade and export structure not diversified, and the need for development managers in easing the over-arching dependence on commodity exports earnings as a major source of budget financing. This study investigates the effect of commodity price volatility on real GDP using a longitudinal data covering fifty-three African commodity-dependent countries for the period 1970–2017. The theoretical framework is premised on the neoclassical growth model, and the system generalized method of moments (SGMM) estimation technique was adopted. The results from the estimation procedure indicate a negative contemporaneous relationship between commodity price volatility and growth. However, the intervention of policy instruments such as contrasting openness degree signals short-run relief for commodity export-dependent economies, as trade policy mitigates the adverse effect of commodity price volatility on growth.

Keywords

commodity price, volatility, trade policy, dynamic panel, Africa

JEL Classification

Q02, E32, R38

INTRODUCTION

Price and earnings fluctuations associated with commodity exports placed severe impediments on the foreign earnings stability of developing African economies (Van der Ploeg & Poelhekke, 2009; McGregor, 2017). The sale of commodities generates the bulk of revenue to the government and foreign currency for financing the expanding consumer imports. It implies that whatever happens to the price of commodities matters a great deal for foreign exchange earnings and growth potentials in commodity-dependent economies (Ogundipe, Adu, Asaleye, & Ogundipe, 2019). The African economies depend largely on commodity export with low demand and price elasticities, resulting in price earning instability (UNCTAD, 2017a). Over time, African economies are embarking on measures to foster commodity export, neglecting production and export of manufacturers whose prices are higher, preferable, and with high responsiveness of change in demand to income and prices (Awel, 2012; Emara, Simutowe, & Jamison, 2015).

Though the removal of trade barriers yielded improvement in the region's export performance in the last two decades, however, appreciable diversification in export structure has not happened (UNCTAD, 2018; Hesse, 2008; Oliveira, Jegu, & Santos, 2020). According to 2008

UNCTAD report, the share of Africa in world exports fell from 6% to 3% in the period 1980–2007. The report identified that African economies might not be prepared to leverage on the commodity booms due to its weak supply responses. Statistics have shown that forty-six of the fifty-three developing African nations receive over 65 percent of foreign earnings from commodity exports. Of all the sixty-five economies in the world receiving over 65 percent from primary commodity exports, forty-six nations are from developing Africa, representing about 71 percent (Ogundipe, 2016; UNCTAD, 2018). This trade structure, coupled with Africa's structural inefficiencies, accounts for the region's backwardness in all indices of economic transformation and human development.

Africa's trade performance reveals two issues of critical attention; hence, necessitating the relevance of appropriate trade policy intervention in managing Africa's continued macroeconomic misalignment arising from incessant commodity price volatility. First, more than other regions of the world, Africa's export earning is largely dependent on the export of commodities. Also, its non-fuel commodity exports exhibit high price volatility and the secular decline in real prices. Second, most African economies rely heavily on imports of food and consumer goods; unfortunately, this has witnessed price hikes in the last two decades (UNCTAD, 2017a; Huerta et al., 2017). Therefore, the continent has been caught in a downward spiral where such dependence and its attendant ramifications have become a structural feature of many African economies. On the one hand, commodity exports are not generating sufficient savings for investment and the development of human and physical infrastructure. On the other hand, rising food and consumer goods import bills and expanding budgetary financing make the economies susceptible to external borrowing and deepen the macroeconomic crisis (Ogundipe et al., 2019; Djordjevic, 2019). Hence, following years of neglect and the inability of policy managers to translate the economies dynamically, the erstwhile commodity trap in which these countries are caught has essentially become a poverty trap.

The experience among commodity-dependent African economies suggests that policy actions should take into cognizance the characteristics of the specific commodities, associated trends in the world market, and initiate domestic processing strategies (Nkurunziza, Tsowou, & Cazzaniga, 2017). In the same manner, the variety of mutually reinforcing instruments (such as trade policies to protect domestic producers) must be applied simultaneously. The implementation of the duo approach is required to address the structural constraints of African economies. These strategies are needed to encourage the development of a stable, transparent, and predictable framework necessary for the success of diversification efforts in the medium to long run (Bidarkota & Crucini, 2000; UNCTAD, 2017b).

Given the position of African economies, concerning the negative effects of food price volatility on food security and economic welfare, there is a need to build a dynamic economy in addressing the widening threat of unemployment. This can be achieved via urgent attention by the policymakers in launching several initiatives to affect timely and coordinated responses to the volatility menace in the short run since structural transformation takes a longer period. A prominent short-run policy option and actions to mitigate the adverse effect of price volatility, reinforce domestic food sufficiency and strengthen the growth potential of the economy will be an import restriction via several measures including outright restriction, imposition of tariffs and quotas to reduce foreign dominance of food and consumer products. In line with industrialization policies, this will enable African economies to mitigate the adverse effect of primary commodity dependence in the short to medium term and drastically reduce dependence in the long run due to diversification and expansion of the export base.

1. LITERATURE REVIEW

The issue of volatility in the commodity market is not a new phenomenon, though it is characterized

by extreme volatility (Cespedes & Andres, 2012; Ogundipe et al., 2019). There have been several efforts to address and contain volatility following the establishment of price stabilization schemes by

the United Nations. Besides, several international commodity agreements were adopted with the sole aim to stabilize prices; such include international agreements on sugar, coffee, cocoa, and natural rubber established in 1954, 1962, 1972, and 1980, respectively (UNCTAD, 2017a; Ferraro & Peretto, 2017).

The recent commodity price booms, and the financialization of commodities have led to a broad-based and heightened volatility in prices (Da, Zhi, Tang, & Tao, 2019). It is good news for commodity-exporting nations, but for African commodity-exporting nations who also extensively depend on food and consumer goods exports, the situation seems double jeopardy (UNCTAD, 2017a; Emara et al., 2015; Oliveira et al., 2020). The rising food import bill necessitates the need for African development managers to implement trade policies (in addition to complementary economic policies) that will gradually transform the economy structurally to a less import-dependent one by encouraging import substitution policies (Collier, 2012; Ge & Tang, 2020).

It becomes clear from the foregoing that extensive studies have occupied the literature on the impact of commodity price volatility on macroeconomic fluctuations (Bhattacharyya & Williamson, 2013; Hongzhi, 2010; Roubini & Setsar, 2004; Gubler & Hertweck, 2011; Ocran & Biekpe, 2007; Hnatkovska & Loayza, 2003; Cavalcanti et al., 2009; G. Ramey and V. Ramey, 1995). The majority of these studies, including the limited empirical evidence from developing Africa (Jean, 2010; Deaton, 1993; Ntsama, 2010; Ghoshray, 2013; Awel, 2012; Uman & Abdulhakeem, 2010; Arezki & Nabli, 2000; Nkurunziza & Tsowou, 2015) have limited their studies to examine the impact of commodity price on long-run growth and macroeconomic aggregates. While these studies discussed the adverse effect of price volatility on growth extensively, the question of what policies to adopt in avoiding the pitfalls and improve the chances of the prosperity of developing African economies remain unattended to. The submissions in these studies were hinged on the fact that government has a critical role in macroeconomic management and in encouraging and promoting horizontal and vertical diversification towards higher value-added products through an integrated program of 'supply-side

responses' such as the provision of fiscal and other incentives, external services, trade facilitation, market research, and quality control. Therefore, it is essential not only to adapt macroeconomic policies to deal with structural constraints faced by African economies but also to build up and reinforce institutional capacities.

Several independent studies opined that preventing commodity prices from fluctuating will be an impossible task rather commodity-dependent economies should accept volatility and develop an effective coping strategy by designing structural economic policies that mitigate its impact on macroeconomic aggregates (Da et al., 2019; Ge & Tang, 2020; Castle, David, & Oleg, 2016). The volatility-growth discussion among commodity-dependent exporting countries has attracted a vast literature debate; this basically succeeds in the influential seminar of G. Ramey and V. Ramey (1995). A prominent assertion made by Blattman, Hwang, and Williamson (2007) indicates that incessant commodity price changes cause terms of trade volatility, which ultimately affect foreign investment and economic growth. In the words of Aghion et al. (2009), the effect can be more severe in economies whose capital market is relatively weak. According to Greenaway (2001), growth and investment are negatively impacted by terms of trade and real exchange rate instability. In furtherance, the empirical studies by Cavalcanti (2011), Van der Ploeg and Poelhekke (2009, 2010) suggest that the adverse effect of price volatility on growth depends on a country's structural development. These studies provided a clear implication of volatile commodity prices on growth, investment, and exchange stability but absolutely silent on the predictability of commodity cycles, which is necessary to modulate the excessive impact on macroeconomic instability.

An independent study conducted by Prebisch and Singer in the 1940s suggests that terms of trade for commodity-exporting developing economies deteriorated continually. The dichotomy in terms of trade between the manufactures and commodity-dependent economies was hinged on labor market structural differences. A similar theoretical alignment proposed by Harberger-Laursen-Metzler hypothesis related to the deterioration of current account and decline in national saving to

the temporal worsening of terms of trade (Miształ, 2010; Turnovsky, 1997; Chowdhuny, 2003).

Deaton (1993) investigated the effect of commodity prices on the GDP of selected African countries using vector autoregressive method. The result yields a positive association between GDP dynamics and commodity prices. The behavior of each country with commodity prices could not be ascertained since the study considered only two decades or four quinquennia observations. However, the result from pooling the data suggested that economic growth and commodity prices are related over a longer span, with GDP and commodity prices linked over quinquennia or decades, rather than over shorter periods. The study also examined whether commodity price booms led to debt and inflation; and found that countries that experienced commodity price booms in the late 1970s accumulated a great deal of long-term external debt in the 70s and 80s. Surprisingly, African countries that experienced no such boom with those experiencing declining commodity prices were also heavily trapped in external debt in the same period. Also, the author's empirical analyses posited that commodity price increases generate inflation for commodity-exporting countries.

A similar study by Ntsama (2010) used the South African macroeconomic data, and assessed business cycle fluctuation through a dynamic stochastic general equilibrium model (DSGE) estimated using the Bayesian technique. The study posits that export demand shocks are significant drivers of real GDP growth rates, investment, consumption, and trade balance to GDP ratio. The evidence was previously espoused by Dehn (2000). He examines the growth-induced effect of commodity price shocks in SSA. The study posits no evidence of a positive long-run impact on growth. This implies that trade shocks not necessarily yield sustainable income growth; whereas, a negative and significant growth effect follows a negative price shock.

The great merit of these studies is that they established the adverse effect of commodity price volatility on macroeconomic planning, investment, consumption expenditure, and long-run growth in Africa, which supports the practical experiences in commodity-dependent African economies. However, the studies could not suggest a predicta-

ble pattern of price movements or stabilization policies capable of absorbing price shocks and limiting its pass-through to macroeconomic aggregates.

Cross-country evidence conducted by G. Ramey and V. Ramey (1995) assesses the volatility-growth nexus in a sample of 92 countries. The study suggests that lower growth rates are associated with countries with higher volatility. Likewise, an empirical study by Addison and Ghoshray (2013) found that shocks in commodity prices yielded an asymmetric response of GDP per capita growth in SSA. The work of G. Ramey and V. Ramey (1995) and Addison and Ghoshray (2013) differ slightly due to changes in the choice of control variables adopted. This could have accentuated the conflicting evidence, as most extant studies adopted a linear model. This debate will be further examined using the business cycle atheoretical statistics developed by the New Keynesian School in describing the volatility phenomenon in Africa.

Uman and Abdulhakeem (2010) examine the impact of oil price shocks on macroeconomic fluctuation in Nigeria using a vector autoregressive (VAR) model. The result shows a significant impact on unemployment, money supply, and real GDP following changes in oil prices. It implies that highly volatile and exogenous price shocks significantly influence macroeconomic aggregates. The susceptibility to external shocks affect economic performance and makes macroeconomic management cumbersome. Awel (2012) also examines the relationship between terms of trade volatility and economic growth using the generalized method of moments for African economies. The GMM controls for biases associated with endogeneity. The study found that net barter and income terms of trade and their volatilities have a significant positive and negative effect on economic growth.

According to the empirical study by Arezki and Nabli (2012), rich Middle East economies and Northern Africa are known to exhibit extreme macroeconomic fluctuations and non-equitable economic growth. In line with this, Demachi (2012) assesses the macroeconomic effect of oil price and oil price volatility for the period 1970–2011 using a structural vector autoregression model. The study found that the Nigerian economy was highly susceptible to oil price volatility.

Similarly, an empirical investigation by Olotu, Nsonwu, and Jegbefunwem (2013) revealed that both external and country-specific shocks drove movement in Nigeria output growth. Among these external shocks, oil price shocks and terms of trade shocks were most critical. In the same vein, Oriakhi and Osaze (2013) concluded that oil price volatility significantly impacted macroeconomic aggregates and real GDP growth in Nigeria. Besides, similar studies from Nigeria (Omojolaibi, 2013; Iwayemi & Fowowe, 2011; Olayeni, 2011; Alege, 2008; Omisakin, 2008; Olomola, 2006; Olomola & Adejumo, 2006; Ayadi, 2005; Ayadi et al., 2000; Akpan, 2009; Aliyu, 2009) have all addressed the question of how much variability in macroeconomic aggregate is due to commodity prices (oil price shocks). These studies jointly emphasized that macroeconomic instability in Nigeria can be attributed to its circumstance as a mono-cultural economy and predominantly from terms of trade shocks.

2. METHODOLOGY

2.1. Data and variables

The price volatility was derived from the index of commodity prices. The index comprises an average of export prices of commodities. The annual international commodity prices used in deriving the index were sourced from United Nations Conference on Trade and Development (UNCTAD) database for the period 1970–2017. The volatility of the commodity prices was obtained by calculating the standard deviation of periodic changes in the commodity price index. Other variables in the models are sourced from the International Financial Statistics of IMF, World Development Indicators of World Bank, and United Nations on Conference and Development. The other explanatory variables in the study include:

a. Financial development: as indicated by the empirical study of Fatas (2002), relatively poor countries with a lower degree of financial development tend to witness incessant business cycles or growth volatility. This justifies the inclusion of the level of financial depth in estimating the effect of commodity price volatility in developing African economies.

- b. Education: the empirical study of Hnatkovska and Loayza (2003) emphasized the relevance of human capital in the volatility-growth nexus. Higher long-run growth to occur alongside price volatility (as witnessed in developing Africa) requires the ability to conduct countercyclical education and innovation expenditures.
- c. Institutional development: the inclusion of a measure of institutional quality follows a theoretical stand by Deaton and Miller (1996) who argued that commodity price shocks impact investment, and growth is highly conditional on national institutions. Likewise, Hnatkovska and Loayza (2003) suggest that well-developed financial markets and sound government institutions are necessary for the positive relationship between volatility and long-run growth.
- d. External debt: the choice of the volume of debt stock is relevant in examining the long-run growth trend of developing African economies. Foreign exchange income instability associated with extreme commodity dependence has placed many African economies among the heavily indebted poor countries (HIPC). The dwindling export earnings posed a serious challenge in debt servicing, which ultimately hurts long-run growth potentials.

2.2. Model specification

An abridged version of the Solow production function widely used in the literature (Rasche & Tatom, 1997; Fosu, 1990 and Smyth, 1993) can be illustrated as:

$$Y_{i,t} = AK_{i,t}^{\alpha}L_{i,t}^{\beta}e^{\lambda}, \quad (1)$$

where $Y_{i,t}$ is output per capita, A is the total factor productivity (Solow residual), K is capital stock, and L is labor force, α and β are the elasticities, e is exponential function and λ is a series comprising some negative integers. It is necessary to note from equation 4 that A is not fixed but varies with different production functions based on the factors being studied.

The study proceeds by examining the linear regression of the growth rate of Per Capita GDP on

commodity price volatility in selected African countries.

$$gr_{i,t} = kap_{i,t}^{\beta_1} lab_{i,t}^{\beta_2} e^{\beta_3 cp_vol_{i,t}} \tag{2}$$

The linear growth regression is represented by:

$$\ln gr_{i,t} = \beta_0 + \beta_1 \ln kap_{i,t} + \beta_2 \ln lab_{i,t} + \beta_3 cp_vol_{i,t} + \varepsilon_{i,t}, \tag{3}$$

where $gr_{i,t}$ represents the average growth rate of real GDP, $kap_{i,t}$ is the stock of capital, $lab_{i,t}$ is labor force, $cp_vol_{i,t}$ is commodity price volatility, $\varepsilon_{i,t}$ is the regression residual, i is the country index and t is the time space. To avoid taking a logarithm of negative integers, the study simply adopts a simple logarithm rule such that $\ln(e^x) = x$ given that $x > 0$.

The study assesses the volatility and growth relationship following the inclusion of relevant variables capable of defining the growth path. The growth model is represented as follows:

$$\ln gr_{i,t} = \beta_0 + \beta_1 \ln kap_{i,t} + \beta_2 \ln lab_{i,t} + \beta_3 cp_vol_{i,t} + \sum_{i=4}^7 \beta_i (\ln X)_{i,t}' + \varepsilon_{i,t}, \tag{4}$$

where $X'_{i,t}$ is a vector of four control variables described in section 3.1

The control variables were employed in the spirit of Levine and Renett (1992), Hnatkovska and Loayza (2003) that suggest that these variables serve a robust role in the empirical growth model. The study also extends the volatility-growth argument by showing the stability of the model in terms of size and significance in response to trade policy intervention.

The corresponding regression equation is given by:

$$\ln gr_{i,t} = \alpha_0 + \alpha_1 \ln kap_{i,t} + \alpha_2 \ln lab_{i,t} + \alpha_3 cp_vol_{i,t} + \alpha_4 cp_vol_{i,t} \cdot policy + \sum_{i=5}^8 \alpha_i (\ln X)_{i,t}' + \varepsilon_{i,t}, \tag{5}$$

where $policy$ represents, in turn, trade policies that are likely to affect the level of the long-run growth rate through their influence on commodity price volatility. The trade policy is captured using the degree of trade openness. The interaction variable in the study is constructed along policy path, as both theoretical and empirical literature have confirmed that the strength and effectiveness of policy management influence the extent to which commodity price volatility impacts long-term growth.

Table 1. Description of the variables used in the estimation

Source: Compiled by the author.

Variable	Definition	Source	Measurements
Real GDP	Growth rates of GDP	World Development Indicators, 2018	Constant \$US
Commodity price volatility	Standard deviation of the index of 48 exportable African commodities	United Nations conference on trade and development	Index
Financial development	The average ratio of domestic private credit to GDP	World Development Indicators, 2018	Constant \$US
Education (enrolment)	The total enrolment in Primary, secondary and tertiary institutions	World Development Indicators, 2018	Number
External debt stock	Ratio of debt stock to GDP (to capture the extent of indebtedness)	International Financial Statistics of IMF, 2018	Constant \$US
International trade openness	The ratio of real exports plus imports to GDP	International Financial Statistics of IMF, 2018	Percentage
Institution	Computed as the average of the six governance indicators by the World Bank; these indicators include control of corruption, rule of law, government effectiveness, regulatory quality, voice and accountability, and prevalence of violence and crisis	World Governance Indicators (WGI), 2017	Estimate
Labor	Total labor force	World Development Indicators, 2018	Number
Capital	Gross fixed capital formation	World Development Indicators, 2018	Constant \$US

2.3. Estimation technique

To provide empirical test of the hypotheses, the study adopted the system generalized method of moments in estimating equations specified. The choice of the estimation technique is relevant, as it handles the endogeneity problem inherent with the long-run growth model. In the words of Arrelano and Bond (1991), the model is transformed into its first difference. This enables efficient parameter estimation, especially in a dynamic panel data model. The system used lagged levels of variables as instruments for the endogenous variables. According to Blundell and Bond (1998), Bond and Windmeijer (2000), the first difference GMM estimator usually produces poor finite sample properties. This makes the instruments weak predictors of the endogenous changes. Following this shortcoming, the use of an extra moment condition dependent on the initial observation's stationary conditions was proposed. The resulting procedure is the system GMM estimator, which possesses better finite sample properties. The procedure is void of bias and produces a better root mean square error than the difference GMM. The performance of the system GMM in handling the panel data model makes it an estimator of choice in this study.

3. DISCUSSION OF RESULTS

3.1. Commodity price volatility and growth

The generalized methods of moments are classified into difference GMM, system GMM without collapsed instruments, and system GMM with collapsed instruments. The regression results from the difference GMM estimation reveals that a 100% change in commodity price volatility brings about 3.4 percent significant reduction in real GDP; the response of real GDP to capital stock and labor became weakened, being about 4.5% and 15.7% respectively. The system GMM without collapsed instrument shows a response of 3.5% in real GDP to a 100% change in commodity price volatility, whereas the system GMM with collapse instruments shows about 4.2% change in real GDP arising from a 100% change in commodity price volatility. Among the different estimators considered, the system GMM is considered most

appropriate, as it can handle possible endogeneity problems inherent in the model. Also, in the class of GMM estimators, the estimator with collapse instruments is most desirable because it curtails the challenge of instrument proliferation.

Table 2 presents commodity price volatility-growth with control variables. The inclusion of the control variables was necessary to determine the effect of standard determinants of growth in the model. Aside from the OLS, the static and the dynamic panel estimation processes supported the evidence that commodity price volatility influences real GDP inversely. The OLS and the static regression result show that all the explanatory variables are statistically significant in explaining changes in real GDP. The stock of capital, labor force, enrollment (education), external debt, financial depth, and institutions exert a positive influence on real GDP. The fixed effect specification seems efficient and reliable following the Hausman test.

The collapse system GMM model shows that about 3.8% variation in real GDP was induced by a 1% change in commodity price volatility. This implies that commodity price volatility exerts a contemporaneous inverse effect on growth in commodity-dependent African economies. This is consistent with empirical findings from Marcello (2012), Awel (2012), and Uman and Abdulhakeem (2010). This evidence has not been far-fetched considering the growth experiences in African-commodity dependent economies. The overdependence on commodity for fiscal budgetary allocation and spending, coupled with the incessant fluctuations associated with the commodity exports has created a great concerns for macroeconomic management. In situation of negative price volatility, macroeconomic management suffers severe drawbacks, as falling prices results in significant fall in export earnings which makes financing the widened import bills and large government expenditure become problematic. The resulting distortion often plunge the economies into recession, and the vicious cycle continues until a significant expansion of export basket is achieved.

The stock of capital and labor force exerts an inelastic variation on real GDP, that is, a 1% change in capital and labor force brings about 4.5% and 11.3% in real GDP. Similarly, enrollment (proxy for education) was found to be statistically signif-

Table 2. Commodity price volatility-growth (control variables) regression

Source: Computed using Stata 11.0.

Variables	OLS	Static panel regression		Difference GMM	SYSTEM GMM	
	Lgdp	Fixed effect	Random effect	lgdp	a	B
		Lgdp	Lgdp		Lgdp	Lgdp
Lgfcf	0.454*** (0.0180)	0.151*** (0.0134)	0.168*** (0.0135)	0.0558*** (0.00466)	0.0613*** (0.00602)	0.0456** (0.0178)
Llab	0.293*** (0.0185)	1.157*** (0.0523)	0.947*** (0.0433)	0.192*** (0.0200)	0.0374*** (0.0126)	0.113*** (0.0274)
comp_vrn	0.405*** (0.151)	-0.138** (0.0585)	-0.124** (0.0594)	-0.00763** (0.00377)	-0.0143*** (0.00372)	-0.0377*** (0.0144)
lenrol	0.178*** (0.0391)	0.162*** (0.0304)	0.228*** (0.0290)	0.0181 (0.0132)	0.0494*** (0.0172)	0.174*** (0.0335)
lextdebt	0.169*** (0.0179)	0.0731*** (0.00843)	0.0706*** (0.00854)	0.0151*** (0.00161)	-0.00815*** (0.00231)	-0.0238** (0.00944)
lfidept	0.167*** (0.0212)	0.00536 (0.0129)	0.0129 (0.0130)	-0.0236*** (0.00788)	-0.0491*** (0.00501)	-0.0262* (0.0236)
Inst	0.119*** (0.0396)	0.231*** (0.0203)	0.186*** (0.0194)	0.00128 (0.00175)	0.00923*** (0.00159)	-0.000214* (0.00558)
l2.lgdp	-	-	-	-	-	0.890*** (0.0199)
Time dummy	Yes	Yes	Yes	Yes	Yes	No
l.lgdp	-	-	-	0.797*** (0.0118)	0.942*** (0.0124)	-
Constant	3.246*** (0.262)	-0.914 (0.686)	1.671*** (0.576)	0.167 (0.192)	-0.414** (0.180)	1.984 (1.698)
Observations	1,825	1,825	1,825	1,752	1,803	1,763
R-squared	0.794	0.677	-	-	-	-
Number of id	-	44	44	44	44	44
F-stat (Wald χ^2 test)	-	-	-	377448.79	265813.23	50585.68
F-stat (p-values)	0.0000	0.0000	0.0000	0.0000	0.000	0.0000
Sargan	-	-	-	0.9789	0.9996	0.0000
Hansen	-	-	-	-	-	0.2580
AR(1)	-	-	-	0.0002	0.0002	0.200
AR(2)	-	-	-	0.0158	0.0095	0.000
No. of instruments	-	-	-	91	133	19

Note: 'a' is the Arellano-Bond system GMM estimates, 'b' is the Roodman's Xtabond2 estimates, ***, **, and * imply 1%, 5%, and 10% levels of significance, respectively. Standard errors are in parentheses.

icant, resulting in about 17.4% variation in real GDP. This implies that a hundred percent investment in education causes about 17.4% in real GDP. On the other hand, external debt stock, financial depth, and institutions exert an inverse influence on real GDP. A 1% change in external debt culminates into 2.4% reduction in real GDP. This portrays the present reality as external debt posed a serious economic problem and leakages in the form of loan servicing and principal repayment. The situation is progressively thorny for developing African nations because a huge proportion of debts obtained were used to finance consumption, recurrent expenditure stocks, and fictitious projects rather than channeling the funds to invest-

ment projects capable of stimulating growth, sustaining its servicing and eventually repaying the initial principal. Conversely, several developing African economies possess several ranges of the debt portfolio and, in most cases, over-hanged as fresh debt portfolios are acquired to service and repay the existing ones.

In the same manner, a 1% change in financial depth results in about 2.6% change in real GDP. This implies that the impact of financial strength on growth exhibits decreasing returns to scale, a hundred percent advancement in the strength of the financial system in Africa causes growth to improve by 2.6% above its preceding level. The quality of in-

Table 3. Commodity price interacted with trade openness

Source: Computed using Stata 11.0.

Variables	SYSTEM GMM		SYSTEM GMM	
	a	B	a*	b*
	Lgdp		Lgdp	Lgdp
L.lgdp	0.942*** (0.0124)	–	0.928*** (0.0258)	–
Lgfcf	0.0613*** (0.00602)	0.0456** (0.0178)	0.0618*** (0.00669)	0.00742 (0.00833)
Llab	0.0374*** (0.0126)	0.113*** (0.0274)	0.0496** (0.0246)	0.0521 (0.0465)
comp_vrn	–0.0143*** (0.00372)	–0.0377*** (0.0144)	–	–
Lenrol	0.0494*** (0.0172)	0.174*** (0.0335)	0.0528*** (0.0168)	0.139*** (0.0220)
Lextdebt	–0.00815*** (0.00231)	–0.0238** (0.00944)	–0.00666** (0.00277)	–0.0376*** (0.00911)
Lfidept	–0.0491*** (0.00501)	–0.0262 (0.0236)	–0.0480*** (0.00520)	–0.0318*** (0.0112)
Inst	0.00923*** (0.00159)	–0.000214 (0.00558)	0.00985*** (0.00170)	0.0138*** (0.00431)
comp_vrn_opn	–	–	–0.0137** (0.00683)	–0.0201*** (0.00614)
L2.lgdp	–	0.890*** (0.0199)	–	0.928*** (0.0254)
Time dummy	Yes	No	Yes	Yes
Constant	–0.414** (0.180)	1.984 (1.698)	–0.355* (0.183)	–2.834* (1.476)
Observations	1,803	1763	1,803	1,764
Number of id	44	44	44	44
F-stat (Wald χ^2 test)	265813.23	50585.68	563123	32657.7
F-stat (p-values)	0.0000	0.0000	0.0000	0.0000
Sargan	0.9996	0.0000	0.9754	119.48
Hansen	–	0.2580	–	0.0290
AR(1)	0.0002	0.2000	0.0002	0.1730
AR(2)	0.0095	0.0000	0.0119	0.0000
No. of instruments	133	19	133	24

Note: 'a' is the Arellano-Bond system GMM estimates, 'b' is the Roodman's Xtabond2 estimates, a* and b* are the Arellano-Bond system GMM estimates and Roodman's Xtabond2 estimates with interaction variables, ***, **, and * imply 1%, 5%, and 10% levels of significance, respectively. Standard errors are in parentheses.

stitutions exerts a negligible variation on growth, as real GDP varies by only 0.02% to a 1% change in institutions. This implies that the weak institutional arrangement in developing Africa transcends into an inverse impact on real GDP.

3.2. The role of trade policy on commodity price volatility-growth relationship

Here, the study examines the role of trade policy on the contemporaneous effect of commodity price volatility on real GDP. This is accomplished by developing an interaction term by a simple

multiplicative procedure involving commodity price volatility and the indicator of trade policy.

Table 3 presents the result examining the role of trade policy on commodity price volatility-growth relationship. The nature of trade policy adopted influences the impact of price volatility on real GDP; a trade policy regime that is inward-oriented or discourages excessive imports will likely mitigate the effect of commodity price volatility. On the other hand, when an economy is extensively opened, it discourages domestic industrialization, hence heavy reliance on imports for food and intermediate goods. For an export- and im-

port-dependent economy, rising commodity prices ultimately culminates into rising food import bills. It implies that the foreign earnings obtained from episodes of commodity price boom are used in offsetting rising import bills; the extent of this offset depends on the import dependence of the commodity-dependent economy. The evidence from the estimation processes shows that the in-

teraction term tones down the effect of commodity price volatility on real GDP, though not as drastic as seen in some interaction variables used adopted by Ogundipe (2016). The inclusion of the interaction of openness degree throttle the effect of commodity price volatility on real GDP from about 3.8% to 2.01%; the other explanatory variables in the model sustains their signs and magnitudes.

CONCLUSION

The study investigates the effect of commodity price volatility on real GDP using a longitudinal data covering fifty-three African commodity-dependent countries for the period 1970–2016. The study adopted the neoclassical growth model and estimated the model using the System-GMM technique of estimation. The theoretical framework was based on the Lewis model and the Prebisch-Singer hypothesis. The empirical model was constructed based on the Solow production function and augmented with variables relevant to the study. The data used were sourced from the WDI and UNCTAD database. The volatility series for commodity prices was generated as the standard deviation of changes in the annual commodity price index.

The result from the estimation procedure indicates a negative contemporaneous relationship between commodity price volatility and growth. This confirms the prominent Prebisch-Singer hypothesis that commodity-dependent exporting countries tend to experience worsening macroeconomic conditions in the long run. However, the interaction of trade openness signals some relief for commodity export-dependent economies, as trade policy mitigates the adverse effect of commodity price volatility on growth in Nigeria. In terms of trade restrictions and tariffs, this helps to strengthen the domestic sustainability of an economy, making the economy less susceptible to external shocks. The evidence suggests that these economies might mitigate the adverse effect of volatility on macroeconomic aggregates given commodity proceeds are properly channeled and that trade policies are structured towards internal substitution of dominant import goods.

AUTHOR CONTRIBUTIONS

Conceptualization: Adeyemi Ogundipe.

Formal analysis: Adeyemi Ogundipe.

Methodology: Adeyemi Ogundipe.

Project administration: Adeyemi Ogundipe.

Software: Adeyemi Ogundipe.

Validation: Adeyemi Ogundipe.

Writing – original draft: Adeyemi Ogundipe.

Writing – review & editing: Adeyemi Ogundipe.

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