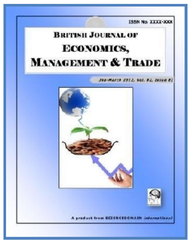

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Shock Transmission between Export Expansion and Technological Change in Developing Economies: Evidence from Nigeria

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Author's contribution

This whole work was carried out by author ARK.

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ABSTRACT

Nigeria export earnings especially from oil, makes up over 25% of its GDP and over 90% of its annual budget. This makes the economy an attractive case study in the field of trade. This study investigated the short-run shock transmission and long-run multiplier analyses between export expansion/growth and technological changes captured by the growth in total factor productivity (TFP) estimated for the aggregate economy. For the long-run analysis the study employed the Autoregressive Distributed Lag (ARDL), the Peseran et al. (2001) Bound Testing method of Cointegration analysis while Variance decomposition and Impulse Response function were used for the shock transmission analysis. Data of sectored export trade (oil, nonoil and manufacturing) and estimated TFP between 1973 and 2012 were used for both analyses. The results provided evidence to support the bi-directional causality between export expansion and technological growth discovered by previous studies. But the magnitude of impact runs from technological growth to export expansion. Also the variance decomposition revealed that a greater percentage of variations in export expansion in Nigeria can be traced to shocks in nonoil and manufactured exports. The poor structure of these two sectors' export trade had hindered the expansion of export in Nigeria leaving oil export (a wasted asset) to dominate. The ARDL analysis confirmed the weak immediate and long-run multiplier effect of technology growth on export expansion. It is therefore pertinent for the Nigeria government to put in place technological development strategies that will promote the nonoil sector of the economy if the economy is to enjoy and sustain the benefits of trade openness.

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Keywords: Aggregate total factor productivity; nonoil export; total export growth; variance decomposition; ARDL bound testing.

1. INTRODUCTION

Since many economies in the World are now open to international trade, scholars are interested in how this openness affects competition, technology transfer and technical change which is total factor productivity.

Export enables economic agents in a country to earn foreign exchange to embark on various economic activities especially production and consumption. Export expansion leads to growth through the stimulation of technical change and investment or by demand spill into other sectors of the economy. This means that export expansion accelerates the growth process which can lead to the diversification of the economy [1].

This implies that the diversification of a developing economy like Nigeria is necessary for sustaining development. [2] Opined that the promotion of exports had been a significant source of rapid productivity change through greater access to best practice technologies. But can this be categorically said of the Nigeria economy whose export trade has been dominated by a single export commodity – crude oil, for decades? This question justified the need for an explicit investigation into the cause – effect relationship between export trade in other sectors of the Nigeria economy and productivity change.

Productivity change in any developing economy measures technological change and it is captured by change in total factor productivity. The issue of productivity in any sector of the economy is critically in the growth and development process. [2] Noted that an increase in manufacturing productivity depends on the level of industrialization attained by a given country.

This study focuses on technological change in other sectors especially manufacturing sector productivity for the following reasons. Firstly, the Nigeria government has put in place various reforms to diversify economy, restructure the productive base of the economy with a view to enhancing efficiency and reducing its depending on oil exports. Secondly, there are some benefits that are expected to accrue from trade to a country's manufacturing sectors. These include greater efficiency in production through increased competition and specialization; and opportunities of exploiting economies of scale in a larger market.

This study therefore sees the need to investigate shocks or innovation transmission between export trade in the non-oil and especially manufacturing sector and productivity change in the economy. This will ascertain the sensitivity of these two variables to one another especially in this era of trade openness.

The paper is divided into five sections. The next section after introduction itemizes the specific objectives of this study. Section three gives a brief review of literature; section four discusses the data and the methodology, while section five discusses the trend in export trade in Nigeria over the years and presents the empirical results. The last section concludes the study and gives the policy implication of the findings.

1.1 Objectives of the Study

The specific objectives of the study are to:

(i) Study the trend of technological change, measured by the Total Factor productivity growth, in the Nigeria Economy.
(ii) Investigate the short-run shock transmission between technological change and export trade in oil and non oil sector using the variance decomposition analysis,
(iii) Estimate both the impact and equilibrium multipliers effects of technological change on export trade.

1.2 Literature Review

There have been many studies in the literature which have centered on the relationship between export and productivity, but they differ in approaches and results. Few of such studies are discussed in this study.

[3] In his work titled" Technical progress and the level of Technology in Asian countries" provided estimates of the TFP growth rate for 1970-1980 for several Asian economies using the Tonqvist index. He differentiated between the contributions of domestic and imported capital. His results indicated that productivity growth was positive in all economies considered. The contribution of TFP growth to overall growth in Taipei and Republic of Korea were very high, on the other hand, those of Hong Kong, China, Malaysia, Philippians, Singapore and Thailand are much lower. 3 indicated that in the cases of Hong Kong, China, Malaysia and Singapore these economies already have a high level of technology, and thus it is more difficult to realize productivity gain.

[4] In their work titled "Pattern of Total Factor Productivity in United State' used data of manufacturing survey in Malaysia from 1973-1989 and showed that TFP increased each year but its contribution to the manufacturing sector growth was still small. Further in the study, it was shown that TFP was larger in the foreign owned firm as compared to the local ones. They concluded that foreign investors had achieved higher benefits from technological progress in Malaysia.

The study carried out by [5] used a comparative analysis with firm level data from approximately 2700 manufacturing firm in five East Asian countries to explore the patterns of manufacturing productivity. The study focused particular attention on whether firms selected were able to compete in world markets and make appropriate investments that boost productivity or whether realization of higher productivity allows the firms to export their output. The study exploits the rich set of firm characteristics available in the data base to explore the source of export markets will make decisions that raise productivity. It is not simply that more productive firms select into exporting; rather, firms that explicitly target export markets consistently make different decisions regarding investment, training, technology and the selection of inputs and this raised their productivity. They also observed that there is high productivity among firms that are clearly integrated into broader markets (i.e. international market through exportation).

[5] Find out those most notable plants that exports are scattered across industries. Even exporter earns most of their revenues domestically; and productivity differs dramatically across plants within an industry. The work points to the importance of export cost in

segmenting markets and of efficiency differences across producers in generating heterogeneity in market power measured productivity and the ability to overcome geographic barriers. The work concluded that aggregate productivity rises as employment shifts from low productivity plants driven out by import competition to high productivity plant while enabling the highly productive to sell more abroad. This work concluded that the direction of causality is unidirectional from productivity to export.

[6] In his work title "Measuring Total Factor Productivity: Growth accounting for Bulgaria" examined how TFP measurement enables determination of the contribution of supply-side production factors to economic growth. He discovered that it is difficult to construct a production function with stable parameter. Mostly because there are typical developments of capital and labour during periods of economic growth, as well as due to the lack of sufficiently long and dependable data series. According to his work, the dynamics of total factor productivity growth are the main determinant of economic growth in Bulgaria. The low and unstable values of TFP in the years until 1997 determine the unstable development of the gross domestic product. But after the introduction of reform, there was corresponding in the rates of growth of total factor productivity. He concluded that total factor productivity development is the main driving force of economic growth.

[7] In his work "macroeconomic factors and total factor productivity in sub-Sahara Africa countries" explored the effects of macroeconomic factors on total factor productivity in 34 sub-Sahara African countries for the period between 1980 and 2002. The study revealed that external debt, inflation rate, agriculture value-added as percentage of GDP, lending rate and local price deviation from purchasing power parity are negatively related to total factor productivity. However, human capital, export-GDP ratio, credit to private sector as percentage of GDP, foreign direct investment as percentage of GDP have positive significant effect on total factor productivity. The work concluded that policies that reduce population growth rate and debt; facilitate greater openness, sound macroeconomic fundamentals, price stability, financial deepening and greater private participation would lead to higher total factor productivity in Sub-Saharan region.

[8] Studied the link between Export and total factor Productivity in Nigeria. The study investigated into the link between trade and productivity growth for the Nigerian economy with special attention to export-productivity nexus in the manufacturing sector. Being one the of such research of this nature in Nigeria, they used Engle Granger static procedure of co integration technique and error correction model in the analysis of the work which covered the period between 1970 and 2003. The study employed multivariate frame work by adding set of control variable which includes import growth, rate of foreign income, relative income and capacity utilization. The study revealed that there is bi-directional causality between Export and total factor productivity and this provide support for a link between export growth and productivity growth. They concluded that Nigeria should look inward rather than onward, to promote and develop manufacturing sector towards increasing production, not only for domestic consumption but for export since it is clear that increased productivity can increase export growth.

In another related study in Nigeria [9] empirically investigated the macroeconomic factors of manufacturing performance in Nigeria using co-integration and error correction model (ECM). He used set of variables such as rate of growth of gross domestic product, interest rate, banks' exchange rate, quantity of graduates, structural adjustment dummy and crisis dummy. [10] Concluded that long term equilibrium relationship exist between productivity and manufacturing sub-sector.

2. DATA AND METHODOLOGY

The study used two sets of data in its estimation. The Total factor productivity values for the Nigeria economy and sectored export values for oil, non-oil and manufacturing sectors for the period between 1973 and 2012. Data of export value are available in the Central Bank statistical bulletin, various issues. Data on the total factor productivity are not published; it was estimated using a selected methodology.

There are different methods for measuring TFP in the literature. These include the Divisia approach, aggregate production function approach, the growth accounting method etc. due to data availability, the study employed the Neoclassical and endogenous growth aggregate production approach. This approach is discussed as follows.

2.1 Measuring TFP

Both neoclassical and endogenous growth models employed the aggregate production function in measuring TFP. The method used the simple Cobb-Douglas aggregate production function. That is

$$Y = AL^{\alpha} K^{\beta} \text{.......(1)} \qquad \alpha + \beta = 1$$

Y is the total aggregate output, L is an index of aggregate labour input and K is an index of aggregate capital. A is not a pure number; it is often referred to as Solow's residual. Changes in A indicate shifts in the relation between aggregate inputs and outputs and in the aggregate model. These changes are assumed to be caused by changes in technology. Solving for A in equation 1, we have

$$A = \frac{Y}{L^{\alpha} K^{\beta}} \text{........(2)}$$

The growth rate of A in equation 2 measures the Total factors productivity (TFP) an index of Technological change in the economy. This is obtained by taking time derivatives of equation (2).

$$A = YL^{-\alpha} K^{-\beta}$$

$$\frac{\overset{*}{A}}{A} = \frac{\overset{*}{Y}}{Y} - \alpha \frac{\overset{*}{L}}{L} - \beta \frac{\overset{*}{K}}{K} \text{.........(3)}$$

The dot superscript denotes the time derivatives.

$$\alpha = \frac{wL}{Y}; \quad \beta = \frac{rK}{Y}$$

That is, the shares of output/income acquiring to labour and capital respectively, this implies that

$$\frac{wL}{Y}+\frac{rK}{Y}=1.......(4)$$ from equation 1.

This method was modified by [11] by utilizing the intensive form of the Cobb-Douglass production function with Hicks – Neutral technical change. That is.

$$Y = AK^{\alpha}h^{(1-\alpha)}..........(5)$$

Where Y is the national output per head, K is physical capital stocks per person, h is the number of units of labour input per person (reflecting human capital); A is the Technological progress (index of TFP).

According to [10,11], human capital contribution has been found to be negligible in developing countries and can easily be discountenanced in the estimation of TFP. Also, the elasticity of output with respect to capital was also found to be constant in developing countries and approaches 0.35 on the average. Equation 3 can therefore be re-written as

$$TFP=\frac{\Delta A}{A}=\frac{\Delta Y}{Y}-0.35\frac{\Delta K}{K}.........(6)$$

Data on Y are readily available in the CBN statistical bulletin while data on K are not published but estimated using the “permanent inventory method”. That is

$$K_t = I_t + (1-\delta)K_{t-1}.........(7)$$

Where I is gross investment, and δ is the rate of depreciation. Research showed that the rate of depreciation of a given capital is assumed to be 0.05. That is, full depreciation of a given capital must takes place within 20 years (6 for Bulgaria; [12] for Spain economy; [13] for the Philippines and [14] for a group of East countries).

2.2 Model Specification

The study uses two models following the specific objectives. The first model captures the shock transmission objectives and this uses the vector Auto regressive (VAR) techniques.

$$Z_t = \mu + \sum_{t=1}^{p}\beta_t Z_{t-1} + \varepsilon_t........(8)$$

Where Z_t is the vector of dependent variable. Here it is TFP and EXP.

EXP = Export growth in oil sector (OILEXP); non – oil sector (NOEXP) and manufacturing Sector (MNEXP).

An examination of the short-run dynamic properties of the relationship in equation (8) is supplemented by the forecast error variance decomposition and impulse response analyses.

The second model measures the long-run dynamics of the relationship between export trade and technological change. The model used the ARDL approach of cointegration regression, following the fact that all the variables are not integrated of the same order. The ARDL model is given as

$$\Delta TEXP_t = \mu_0 + \sum_{i=1}^{p} \alpha_1 \Delta OILEXP_{t-i} + \sum_{i=1}^{p} \alpha_2 \Delta NOEXP_{t-i} + \sum_{i=1}^{p} \alpha_3 \Delta MNEXP_{t-i} + \sum_{i=1}^{p} \alpha_4 \Delta TFP_{t=i} + \sum_{i=1}^{p} \alpha_5 \Delta TEXP_{t-i} + ...$$
$$... + \lambda_1 TEXP_{t-i} + \lambda_2 OILEXP_{t-i} + \lambda_3 NOEXP_{t-i} + \lambda_3 MNEXP_{t-i} + \lambda_4 TFP_{t-i} + \lambda_5 TEXP_{t-i} + e_t .....(9)$$

TEXP is the total export growth. All the variables are in their log forms.

In the above equation, the terms with the summation signs represent the error correction dynamics this is known as impact multiplier while the second part [terms with λs in equation (9)] correspond to the long run relationship referred to as equilibrium multiplier. The null hypothesis in (9) is $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$ which indicates the non-existence of the long run relationship. The ARDL method estimates $(p+1)^k$ number of regressions in order to obtain the optimal lags for each variable, where *p* is the maximum number of lags to be used and *k* is the number of variables in the equation. Since we are using annual data, 1 lag and 2 lags were tested as the lag (*p*) and the choice of the appropriate maximum lag length p was made based on Akaike and Schwatz information criteria. Also, the log transformation is imposed to reduce the problem of heteroskedasticity [15].

3. RESULTS AND DISCUSSION

3.1 Trend in Technological Growth

The study estimated total factor productivity (TFP) for the Nigeria economy between 1975 and 2012 using the method described in sections 4. TFP estimates and TEXP percentage growth rate for the period are presented in Table 1.

For easy interpretation, Figs. 1 and 2 present the trend in TFP growth and Total export growth respectively. The horizontal axis is the year; for space, the labeling is selected in two years with 1975 = 1.

As shown in the Fig. 1, TFP in Nigeria had been unstable over the years recording negative values between 1982 and 1984 and fluctuates all through the period. The lowest TFP growth ever recorded was -1.393 in 2005.

Between 1985 and 1999, TFP recorded an upward surge which not sustained. This trend indicates that technological growth had been poor and unstable for decades in Nigeria. The periods of negative TFP growth were the period when the per capita output growth (∆Y/Y) is lower than the growth in physical capital stock per head (∆K/K).

Table 1. Total export and technological growth in Nigeria 1975 – 2012

Year	TFPG	TEXPG	Year	TFPG	TEXPG	Year	TFPG	TEXPG

1975	0.042	-15.00%	1988	0.158	2.74%	2001	0.222	-4.00%
1976	0.037	37.06%	1989	0.341	85.85%	2002	0.102	-6.62%
1977	0.116	13.03%	1990	0.403	89.55%	2003	-0.058	77.02%
1978	0.06	-20.53%	1991	0.136	10.60%	2004	0.027	49.06%
1979	0.126	78.70%	1992	0.382	69.18%	2005	-1.393	57.44%
1980	0.182	30.91%	1993	0.251	6.40%	2006	-0.116	1.08%
1981	0.133	-22.30%	1994	0.026	-5.81%	2007	0.321	13.45%
1982	-0.097	-43.70%	1995	0.225	361.35%	2008	0.277	22.28%
1983	-0.319	20.88%	1996	0.287	37.75%	2009	0.14	-17.76%
1984	-0.477	21.13%	1997	0.115	-5.18%	2010	0.321	32.06%
1985	0.053	28.97%	1998	-0.1	-39.45%	2011	0.277	-7.23%
1986	0.262	-23.89%	1999	-0.122	58.14%	2012	0.14	0.00%
1987	0.333	240.34%	2000	0.306	63.65%			

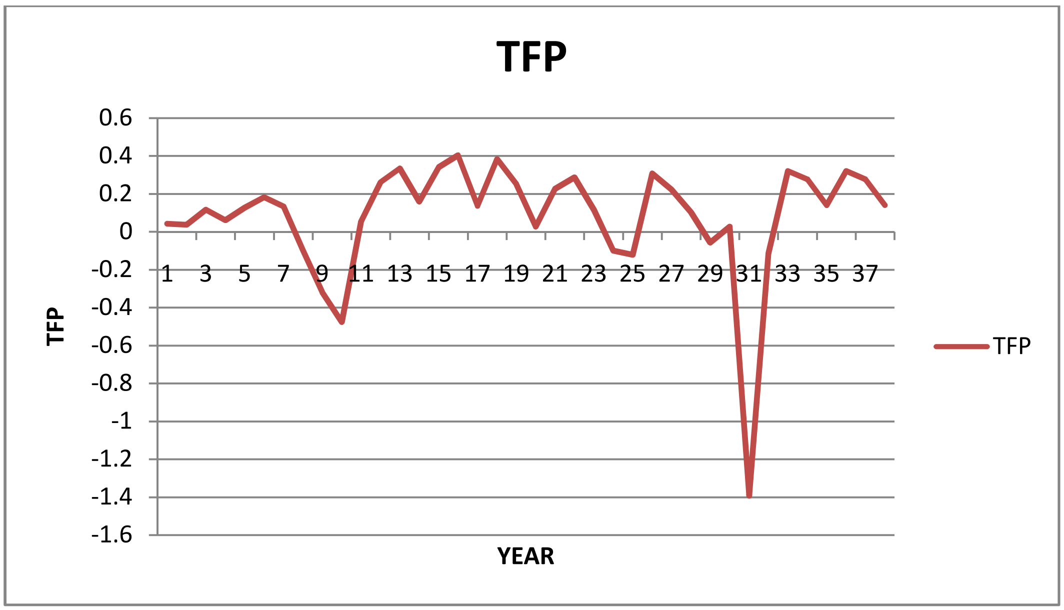


Fig. 1. Trend in Technological Changes in Nigeria 1973-2012

3.2 Trend in Export Trade

The growth in export in Nigeria as evidenced in Table 1 and Fig. 2 is also unstable. It fluctuates between positive and negative growth rates. It is observed in Table 1 that the period of negative growth rate in export corresponds with the period of negative or low technological growth. Also the period of positive growth in export corresponds with the period of positive technological growth. For instance the highest growth rate recorded in export trade was 361.35% in 1995 this also corresponds with high technological growth of 0.225. On the contrary the lowest growth recorded in export trade was -43.70% in 1982 corresponding to a negative technological growth of -0.097. This result thus suggests that growth in technology in an economy subsequently leads to export trade growth.

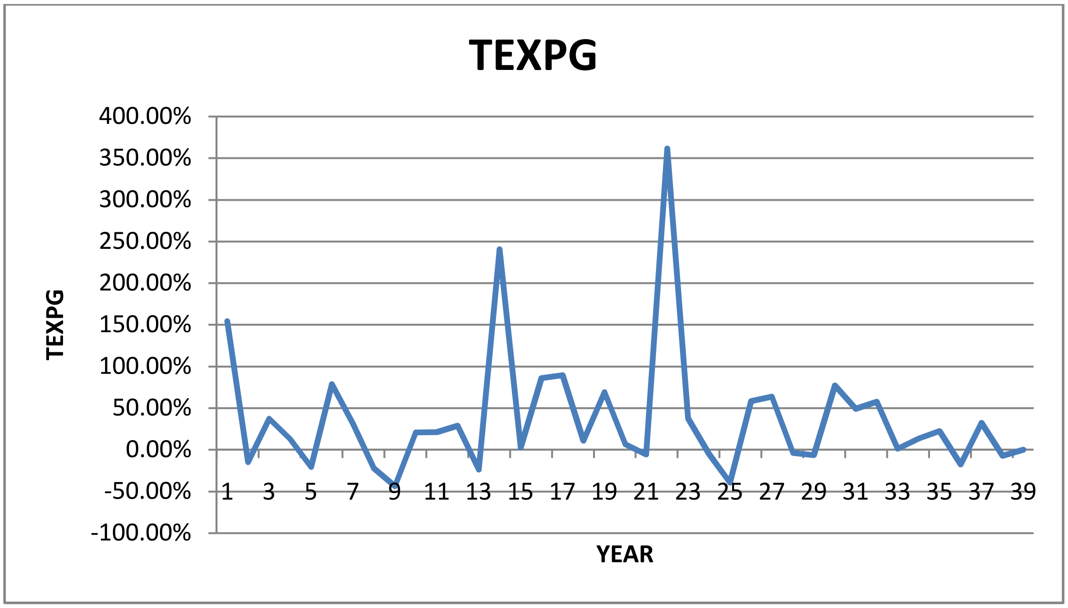


Fig. 2. % Growth rate of Total Export in Nigeria 1973-2012

3.3 Time Series Properties of Variables

Table 2 presents the time series properties of variables in the model. The study employed the Phillip Perron unit root test to test the and hence the level of integration of the variables.

Table 2. Unit root test on variables

Variable	PP test stat.	1% Critcal value	5% Critical value	Prob.	Integration
Mnexpg	-5.395644	-3.610453	-2.938987	0.0001	I(0)
Oilexpg	-3.508983	-3.610453	-2.938987	0.0129	I(0)
Noilexpg	-4.871584	-3.610453	-2.938987	0.0003	I(0)
Tfpg	-4.58639	-3.610453	-2.938987	0.0007	I(0)
D(Texp)	-7.168652	-3.615588	-2.941145	0	I(1)

Source: Computed from Data

The result showed that all the variables are integrated at their levels I(0) except total export (EXP) which is integrated of order one. I(I) This implies that the condition for cointegration using the Johannsen method is not met by the series. We resort to the Bound Testing method of Cointegration using the ARDL approach.

4. ARDL ANALYSES

The first step in our empirical analysis using the Bound Testing, ARDL method is to determine the direction of causality among the variables. This is done by conducting Granger Causality test on the variables. The result of this test is shown in Table 3. The result also determines the level of exogeneity of the variables thereby helping in the model specification.

Table 3. Granger causality test

Null hypothesis	Obs	F-Statistic	Prob.
NOEXP does not Granger Cause OILEXP	38	0.50831	0.6061
OILEXP does not Granger Cause NOEXP		12.4381	0.0000
TFP does not Granger Cause OILEXP	38	0.27846	0.7587
OILEXP does not Granger Cause TFP		0.5038	0.6088
TEXP does not Granger Cause OILEXP	38	4.3024	0.0219
OILEXP does not Granger Cause TEXP		1.49052	0.24
MNEXP does not Granger Cause OILEXP	38	1.30208	0.2856
OILEXP does not Granger Cause MNEXP		34.937	0.0000
TFP does not Granger Cause NOEXP	38	0.49282	0.6153
NOEXP does not Granger Cause TFP		0.05497	0.9466
TEXP does not Granger Cause NOEXP	38	9.26431	0.0006
NOEXP does not Granger Cause TEXP		1.58458	0.2202
MNEXP does not Granger Cause NOEXP	38	6.74671	0.0035
NOEXP does not Granger Cause MNEXP		4.17185	0.0243
TEXP does not Granger Cause TFP	38	0.40712	0.6689
TFP does not Granger Cause TEXP		0.91742	0.4095
MNEXP does not Granger Cause TFP	38	0.74818	0.4811
TFP does not Granger Cause MNEXP		0.33531	0.7175
MNEXP does not Granger Cause TEXP	38	2.75341	0.0784
TEXP does not Granger Cause MNEXP		40.4941	0.0000

The following inferences can be drawn from the Granger Causality test results:

There is unidirectional causality from nonoil expect to oilexport. Also there is unidirectional causality from nonoil export to total export; from manufacturing export to total export and; from oil export to total export. Also a bi-directional causality between TEXP and TFP is suggested by the result. The idea behind causality test is that, although regression analysis deals with the dependence of one variable on the other variable, it does not necessarily imply causation. In other words the existence of a relationship either the dynamic or equilibrium, between variables does not prove causality or the direction of influence. This result also confirms TEXP as more endogenous as specified in equation (9).

Equation 9 was estimated using a 1-equation Unrestricted VAR method. To implement the information criteria for selecting the lag-length in a time-effect way the lag structure was estimated. The result is presented in Table 4

Looking at the result in Table 4, virtually all criteria suggest a maximum of 2 lags for $\Delta TEXP$ .Also the LM test of serial correlation conducted on ARDL (1,1,1,1,1) showed the presence of serial correlation. At maximum of two lags the LM test rejects the hypothesis of serial correlation as shown in Table 5. Therefore ARDL(2,1,1,1,1) was preferred. The result is presented in Table 6.

Table 4. ARDL lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-539.1051	NA	1.60E+11	28.63711	28.85258	28.71377
1	-538.3637	1.248585	1.63E+11	28.65072	28.90929	28.74272
2	-531.4842	11.22450*	1.20e+11*	28.34127*	28.64293*	28.44860*

** indicates lag order selected by the criterion*

Table 5. VAR residual LM test

Lags	LM-Stat	Prob
1	1.930254	0.1647
2	5.347495	0.0208
3	20.38153	0

Table 6. Unrestricted ECM, ARDL(2,1,1,1,1,1,)

Dependent variable D(TEXP)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(TEXP(-1))	-0.34806	0.132861	-2.61975	0.0147
D(TEXP(-2))	-0.05937	0.122324	-0.48536	0.6316
D(OILEXP)	1.111968	0.062131	17.89706	0
D(NOEXP)	-5.97241	2.027109	-2.94627	0.0069
D(TFP)	-4023.27	146254.8	-0.02751	0.9783
D(MNEXP)	14.54874	8.452464	1.721242	0.0976
OILEXP(-1)	0.789981	0.27213	2.902955	0.0076
NOEXP(-1)	-11.599	2.505187	-4.63	0.0001
TFP(-1)	32975.08	162570.6	0.202835	0.8409
MNEXP(-1)	14.63819	10.62264	1.378018	0.1804
TEXP(-1)	-0.5793	0.264008	-2.19425	0.0377
C	14155.81	44269.33	0.319766	0.7518
R-squared	0.993749			

The result in Table 6 portrays both the short-run and long-run analyses. The ARDL test therefore established that there is a significant positive short-run relationship between TEXP and oil export and between TEXP and nonoil export. But the long run coefficient of nonoil export is negative. This is significant at 1% level of significance. The overall performance of the model is very good. The R^2 is 0.99, signifying that even though all the marginal effect of individual variable are not significant, about 99% of the changes in total export performance can be explained by joint variations in the all the variables in the model.

To test for the presence of cointegration in the model we conducted the Bound Test. This is to test whether the long-run coefficients are jointly zero. The result of the Wald Test is presented in Table 7.

Table 7. Wald test

Equation: Unresticted ECM			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	12.62939	(5, 25)	0
Chi-square	63.14693	5	0
Null Hypothesis: C(7) = C(8) = C(9) = C(10) = C(11) = 0			
Null hypothesis summary			
Normalized Restriction (= 0)		**Value**	**Std. Err.**
C(7)		-0.5793	0.264008
C(8)		0.789981	0.27213
C(9)		-11.599	2.505187
C(10)		32975.08	162570.6
C(11)		14.63819	10.62264

Restrictions are linear in coefficients

The value of our F-statistic is 12.629, and we have (k+1) = 5 variables in our model. The critical lower and upper bounds of the Pesaran et al. (2001), for the unrestricted intercept no trend case are 2.39 and 3.38 at 5% level; 3.06 and 4.15 at 1% level. As the value of our F statistic exceeds the upper bound at both the 5% and 1% significant levels, we can conclude that there is evidence of a long-run relationship between TEXP (total export), total factor productivity and the set of sectoral export variables.

We can therefore extract the long-run multiplier from the ARDL result. The long-run coefficients for OILEXP, NOEXP, TFP, and MNEXP are respectively

$$-\left(\frac{0.789981}{-0.5793}\right) = 1.3636 \quad and$$

$$-\left(\frac{-11.599}{-0.5793}\right) = -20.022$$

$$-\left(\frac{32975.08}{-0.5793}\right) = 56922.28$$

$$-\left(\frac{14.63819}{-0.5793}\right) = 25.268$$

We confirm a negative long-run relationship between TEXP and nonoil export, while a positive long run relationship exists between total export and total factor productivity. A reduction in total factor productivity will reduce total export performance. The same can be said of manufacturing export and total export.

5. SHOCK TRANSMISSION BETWEEN TECHNOLOGY GROWTH AND EXPORT TRADE GROWTH

Having suspected a bi-directional causality between TFPG and TEXPG and the existence of a long-run equilibrium relationship between them, the next analysis is the short-run shock transmission between the variables. This analysis is done using the variance decomposition and impulse analysis which are measures of short-run dynamics of the VAR. The results are presented in Tables 8 and 9.

Table 8. Variance decomposition of TEXP

Period	S.E.	TFP	NOEXP	OILEXP	MNEXP	TEXP
1	730654.6	6.652726	60.22055	33.09434	0.002504	0.029878
2	906965.7	4.91852	67.58335	25.73226	1.574323	0.191546
3	1421688	8.323377	71.98074	10.93957	2.451977	6.304336
4	2515054	11.42297	48.17591	4.485547	5.469193	30.44638
5	19046498	8.15213	40.78536	0.498356	3.318859	47.2453
6	86662591	14.01034	24.04883	0.647795	3.71969	57.57335
7	6.54E+08	6.925496	45.41166	0.737058	3.770668	43.15511
8	3.86E+09	12.69298	27.77501	0.294996	3.892348	55.34466
9	2.11E+10	6.079315	48.19828	1.18337	3.692998	40.84604
10	1.64E+11	11.85668	30.17092	0.12628	3.900087	53.94603

Table 9. Variance decomposition of TFP

Period	S.E.	TFP	NOEXP	OILEXP	MNEXP	TEXP
1	0.296741	100	0.0000	0.0000	0.0000	0.0000
2	0.318552	88.73899	10.87242	0.067414	0.239348	0.081824
3	0.393173	58.5716	16.03152	4.076976	10.88578	10.43412
4	0.550958	33.78806	10.15414	8.593686	16.24407	31.22004
5	7.027759	9.074782	40.54917	0.309932	3.554562	46.51155
6	21.03776	15.99523	19.31336	1.767127	3.691165	59.23311
7	245.1086	7.847544	42.39103	0.398282	3.80941	45.55373
8	1003.494	14.19017	23.60736	0.804758	3.844524	57.55319
9	8330.828	7.172701	44.56424	0.635726	3.775744	43.85159
10	45176.44	13.0022	26.89202	0.376666	3.883956	55.84516

5.1 Decomposition of Variations in Export Trade Growth

The variance decomposition here analyses the decomposition of the shocks received by export trade to its constituent sources. It is another way of describing causes and sources of variations or shocks to export trade.

The contribution of technological change (TFP) to shocks in export trade was about 6.6% in period one, it fluctuates a little to 4.5% in period two and gradually increased to about 11.4% in period four. It further fluctuates over the period.

The highest contribution was recorded in period 6 which was 14%. On the average, technological growth has not play any significant role in improving export trade in Nigeria.
The greater contribution to shocks in export trade is from the non-oil export. The contribution ranges between 30% and 70%. That means, the major problem in the export trade is caused by shocks to the non-oil export. This result supports the findings of past studies that the neglect of the non-oil sector has led to the poor performance of the export trade in Nigeria. The contribution of oil expert to shock in total export trade was about 33% in period 1 but drastically reduced over the years to almost zero in the period 10, this shows that the oil sector more or less dominates the export trade in Nigeria in the latter years.

5.2 Decomposition of Variations in Technological Growth

The result in Table 6 shows that the source of shocks to technological growth is distributed among the sectored export growth and feedback response from previous technological decay.

The feedback response diminishes rapidly between period 1 and period 10 giving way to shocks in export trade to affect technological growth. In period 1 about 11% of variations in technology came from shocks in nonoil export growth whereas the oil export was just 0.06%. the contribution of the nonoil export shock increases gradually to about 40% in period 5 and over the periods while that of oil export remains below 1%. The contribution of manufactured export to the shocks in technology about 11% in period 2 and fall to a stable 3% over the periods. On the average shocks to total export trade causes between 40% and 60% of the shocks in technological growth. It can therefore be concluded that shocks to export trade especially nonoil export is a major cause of the problem of poor technological growth in Nigeria.

5.3 Impulse Response Function of TEXP and TFP

Impulse response function is a method of analyzing the short run dynamics of relationships among a set of endogenous variables. Table 10 presents the result while the graph is presented Appendix. It traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. For example a shock to ith variable say TFP, directly affects the variable, and is also transmitted to all of the endogenous variables through the dynamic structure of the VAR. It is another way of saying how a particular variable does responds to shocks in other variables. Granger causality may not tell us the complete story about the interactions between the variables of a system. In applied work it is often of interest to know the response of one variable to an impulse in another variable in a system that involves a number of further variables.

Table 10. Response of TFP, response of TEXP

Period	TFP	TEXP	TFP	TEXP
1	0.308578	0	-312294	750922.5
2	0.102997	-0.04054	-328780	539435.7
3	0.00069	0.006462	-502124	661636.3
4	-0.00201	0.003231	-515938	676305.3
5	-0.00413	0.005163	-544350	711609.3
6	-0.00382	0.004988	-567759	742688.8
7	-0.00406	0.005301	-593692	776548.4
8	-0.00422	0.005517	-620480	811613.1
9	-0.00441	0.005772	-648567	848346.3
10	-0.00461	0.006032	-677904	886721.7

In Table 10 it is revealed that initially TFP shows very low but positive responses to shock in TEXP over the period. The response is less than 1% throughout the period. On the other hand the response of TEXP to one standard deviation shock in TFP is negative all through the period. The result of the impulse response function confirms that shocks are transmitted between total export growth and technological growth in the economy. Any shock to technological growth affects export performance and when export is not growing, total factor productivity declines.

6. CONCLUSION

This study investigated the short-run shock transmission and long-run multiplier analyses between export expansion/growth and technological changes captured by the growth in total factor productivity (TFP) estimated for the aggregate economy. From the results of the VAR and ARDL analyses the following inferences are drawn:

This result thus suggests that growth in technology in an economy subsequently leads to export trade growth. That means, poor technology growth generated poor export trade growth.

In Nigeria economy causality is stronger from technology growth to export growth. This is so as all the sectored export growth have high R^2 and F-statistic respectively.

The greater contribution to shocks in export trade is from the non-oil export. It can therefore be concluded that shocks to export trade especially nonoil export is a major cause of the problem of poor technological growth in Nigeria.

The oil sector more or less dominates the export trade in Nigeria in the latter years of the the period under study but the ARDL result shows that the oil export may not be sustained in the long-run.

Also the result of the long run ARDL model shows that in the long run, the non-oil export in general significantly stimulates export growth if improved upon in the short-run.

The dominance of oil export in the export sector is in Nigeria is alarming knowing very well that oil is a wasted asset. It is therefore pertinent for the Nigeria government to put in place technological development strategies that will promote the nonoil sector of the economy if the economy is to enjoy and sustain the benefits of trade openness.

COMPETING INTERESTS

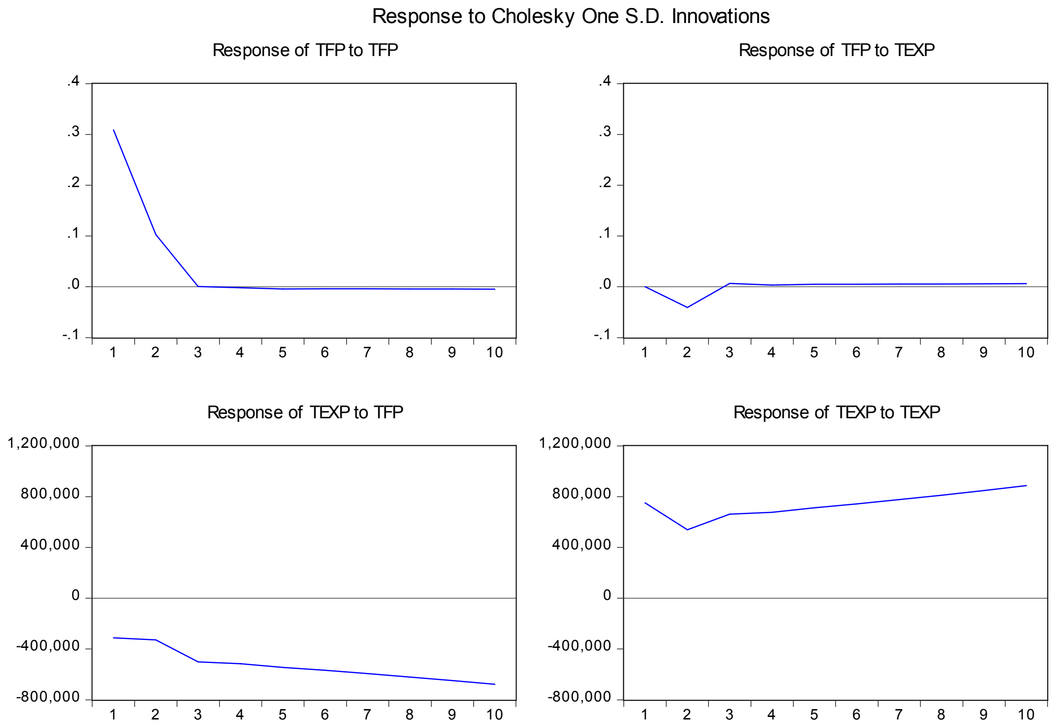
Author has declared that no competing interests exist.

REFERENCES

1. Orubu CO. An econometric analysis of foreign trade multipliers for the Nigerian economy, West African Economics Journal. 1988;4:45-58.
2. World Bank. The East Asian miracle: Economic Growth and Public Policy. Oxford, Oxford University Press; 1993.
3. Iketomo Y. Technical Progress and the Level of Technology in Asian Countries. The Developing Economies XXXIV-4; 1986.
4. Maison Abdullah, Arshard Marshidi. Pattern of Total Productivity Growth in Malaysia Manufacturing industries, 1973-1989. Srdang: University Pertanian, Malaysia; 1992.
5. Andrew BB, Journal E, Jensen JB, Kartuiu S. Plant and Productivity in International Trade; 2003. Accessed 23 December 2008. Available: http://home.uchicago.edu/-kortum/papers/aersubmit21103.
6. Kolayan G. Measuring Total Factor Productivity: Growth accounting for Bulgaria; 2005. Accessed 10 May 2010. Available: http://129.3.20.41/eps/paper05404.pdf.
7. Akinola AE. Macroeconomics Factors and Total Factor Productivity in Sub-Saharan African Countries. International Research Journal of Finance and Economics. Euro Journals publishing. Inc; 2006.
8. Ogunleye EO, Ayeni RK. The link between Export and Total Factor Productivity: Evidence from Nigeria. International Research Journal of Finance and Economics. Euro journals publishing, Inc. 2008;83-91.
9. Alao RO. Productivity in the Nigeria Manufacturing Sub-sector: An Error Correction Model. European Journal of Economics, Finance and Administrative Science; 2010. Available online at http://www.eurojournals.com.
10. Collins SM, Boswerth BP. Economic Growth in East Asia Accumulation versus Assimilation'. Brookings Papers on Economic Activity. 1996;2:132-146.
11. Iyoha MA, Oriakhi D. Explaining African Economic Growth Performance: The case of Nigeria. Revised interim report on Nigeria case of Nigeria for the African Economic Research Consortium; 2002.

12. Hernandez JA, Mauleon I. Estimating the capital stock, Working Paper, University de la Laguna; University de las Palmas de Gran Canaria; 2003.
13. Idris J. Determinant of Total Factor Productivity Growth in Malaysia, Journal of economic Cooperation. 2007;28:(3):34-48.
14. Cororation CB. Total Factor Productivity in the Philippines, *Philippine Institute for Development Studies.* Discussion Paper Series No. 2002-01 (Revised); 2002. Available:http://unpanI.un.org/intradoc/groups/public/documents/apcity/unpan005115.pdf.
15. Gujarati NG. Basic Econometrics, New Delhi, Tata McGraw-Hill Publishing Company Ltd. 2005;412.

APPENDIX



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