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Tax Revenue Performance, Trade Liberalization and Macroeconomic Variables in Sub-Saharan Africa

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Abstract

The dilemma of tax revenue performance, trade liberalization and macro- economic variables has been in existence based on the need to diversify the economy to find inclusive growth and economic stability which is difficult to achieve due to global economic meltdown and crashing stock, this study seeks to examine the relationship. This study utilized the periods 2005-2014 to determine the significant relationship between tax revenue performance, trade liberalization and macro-economic variables of 22 sub-Saharan African countries. Several tests were conducted. The descriptive statistics showed the nature of the data. The Unit root test examined the stationarity of the series. Long run co-integration test, the Vector error correction model was engaged to check for possible long or short run connection among the variables. The Granger causality test was applied to determine the shock impact of one variable on the other. The Serial correlation test was conducted using the Breusch-Godfrey Lm and the Breusch-Pagan-Godfrey techniques. The findings concluded that inflation, interest rate and trade openness had a short run relationship with tax revenue unlike exchange rate and unemployment. Also, all variables apart from exchange rate were positively related to the dependent variable coupled with the fact there existed a one-way causation with the absence of serial correlation and heteroskedasticity among the variables. The study recommends that the government implementing efficient and transparent collection of taxes to be held accountable to the public which would promote voluntary payment and implore policies to promote labour intensive programmes and infant industries which would lead reduce unemployment, lead to a developed market and boost the standard of living of its citizens.

Key Words: *Tax Revenue Performance, Exchange Rate, Interest Rate, Inflation Rate, Trade openness and Unemployment Rate.*

Introduction

The need for increased financing of social and economic infrastructure by African countries makes revenue generation, especially from taxation imperative has become manifest. This has accentuated the importance of improving the quality and scope of tax revenue. The momentum in across many developing countries has increased as reported by Drummond et al (2012) and IMF (2011). Rajaram (1994) supports the mobilization of tax revenue as an important policy objective.

The need to diversify the economies from oil, gas and other primary commodity base has become compelling. The significance of tax performance in African economies can therefore, not be, over-emphasized in view of the crash in oil and non-oil commodity prices, which have had a deleterious impact on exchange rates, inflation rates, interest rates and unemployment rates.

African countries in achieving the revenue generation objective are opening up their economies to more global trade. Such trade liberalization policies allow for the reduction in and removal of trade barriers. The policy of trade liberalization promotes the level of exports and the value of the exchange rate by relaxing tariff rate and opening up the national economy to global trade. Indeed, although the government cannot do much in the short run to change the structural determinants of the tax revenue it can address other factors that influence the performance of tax revenue including fiscal and monetary policies economic policies.

In shaping the direction and magnitude of government revenues, some findings in the literature ascribe roles to macro-economic policies. The variables that come to play in this global issue are real exchange rate, inflation rate, unemployment rate, interest rate (Agbeyegbe, Janet, and Asegedech, 2004). Since the countries are not in autarky, global economic decisions, policies and players affect these policy measures. The elimination of tariff and duties in the estimation of the World Trade Organization is expected to increase the incomes of developing countries and lift more than 200 million people out of poverty by about $500 billion by 2015 (WTO Addendum, April 2003).

The counter argument against trade openness is that since tariffs have been an important source of government revenue, its reduction or indeed outright elimination would have negative consequences for the fiscal stability of these countries. The consequent reduction in tax revenue could eventually result in reduced tax revenue unless appropriate measures are deployed to strengthen the domestic tax system.

Disaggregated findings abounds in the literature. Micah (2015), Sumera, Khuda, and Sarfraz (2012), Joseph and Ezra (2016) report a positive association between tax performance and trade liberalization. On the contrary, negative connection was, conveyed in similar researches by Nicholas and Robert (2012) and Jorgen (2004). The impact of trade liberalization, Exchange rate, inflation rate, unemployment and other macro-economic variables on tax performance is also mixed. The investigation of the trade liberalization impact by Sumera, Khuda, and Sarfraz (2012) finds that population and exchange rates have adverse relatedness with tax revenue. On the other hand, tax revenue has a positive affiliation with the trade share of GDP and trade openness.

The conflicting findings on trade liberalization, with other macro-economic variables and tax performance interconnection makes the investigation of the short run dynamics and the long run association in Africa necessary. The study covers majority of African countries: Kenya, Tanzania, Uganda, Liberia, Nigeria, Mali, Angola, South Africa, Namibia, Zambia, Cabo Verde, Botswana, Lesotho, Malta, Lebanon, Rwanda, Gabon, Egypt, Madagascar, Democratic Republic of Congo, Mauritius, and Algeria.

The rest of this study is in four parts. The next section covers the literature review. In the third section the methodology is presented. Section four is about the findings and discussions thereon. The conclusion and recommendations are contained in the last section.

Literature Review

In this section, the theoretical foundation of the research and the evaluation of previous researches in the literature are, presented.

Theoretical Review

The literature contain quite a number of theories on the subsisting affiliation between and taxation trade liberalizations in the context of macroeconomic milieu. The theory of taxation earlier propounded by Ibn Khaldun (1332-1406) was, espoused by Islahi (2006). This theory pinpoints two different influences of taxation on the revenue of the government: the arithmetic and the economic impacts. According to the theory, if the tax rate reduced, the consequential reduction in the tax revenue ensues. This is the arithmetic effect. The converse holds true in the case of a rise in tax rates. The positive effect of lowered tax rate on output and employment has been, advanced as the economic effect. The raising of tax rates leads on the other hand deleteriously affect the economy. This tax is, deployed as a tool to discourage the consumption of unethical or undesirable good also known as 'sin' tax. Where the tax rate is at a very high level, Islah (2006) observes that the adverse economic effect outstrips the positive arithmetic effect, resulting in declined tax revenue declines.

In the same disposition, the theory of comparative advantage assigns production and export to nations with higher levels of natural endowments or technological. The classical comparative advantage theory of David Ricardo developed in 1817 provide explanation for the engagement of countries in international trade notwithstanding the fact that such countries possess the absolute efficient advantage in producing all the goods better than workers in other countries. This theory states that a producer, operating at a lower relative marginal cost prior to trade, possess a production comparative advantage over another. Maneschi (1998) recommends the use of the opportunity cost of producing goods across countries.

The combined impact of the comparative advantage theory and the deduced Ibn Khaldun theory of taxation provide the basis for probing the link between tax revenue performance and trade openness in the context of macroeconomic variables in Sub-Saharan Africa. The next discussion is on the empirical review of previous works.

Empirical Review

Several econometric techniques have been deployed to investigate the nexus of trade openness and tax performance in the environment of changing macroeconomic variables. The outcomes are far from being conclusive. Several studies have applied the contribution of taxation to Gross Domestic product which have been modelled as the dependent variable together with disparate mixtures of independent variables. The 2000 study by Martinez-Vazquez and McNab which, covered both developing and developed economies modelled the ratio of tax revenue to GNP on trade openness and the countries per capita income. They report a statistically significant and positive influences for the explanatory variables.

A quick scrutiny of the literature on the macroeconomic determinants of taxation revenue performance will be in order before the study the review of the underlining theories and prior works. Some previous studies including Wonnacott and Lutz (1989) and Gupta (2007) explored the factors determining the effectiveness of the performance of tax revenue. Many issues have come to the fore in the literature including: the tax base erosion, trade reforms consequence, liberalization of international trade

The influence of the liberalization of trade of on tax revenue can be, measured directly and indirectly. In Ghana, domestic Value Added Tax grew by about 300 percent of GDP to about 4.4 percent of GDP in 201 (Harvey & Sedegah, 2011). In Uganda the average efficiency ratio of Value Added Tax was 0.21 between

1998/99 to 2011/12. This as reported by Gaalya (2015) is less than the average of 0.27 established by Ebrill, Stotsky and Gropp (1999) for sub-Saharan Africa. The research conducted by Cawley and Zake (2010) also show that between 1991/92 and 2011/12, direct taxes from income steadily rose from 0.9 percent to a high level of 4.1 percent of GDP.

On the other hand, decline in tax revenue has, been reported following the implementation of liberalization trade policies and the international trade tax system by countries. The position canvassed by Tanzi (1989) is that the traditional determinants of tax revenue alone will not suffice in providing a satisfactory explanation for the observed wide variations in tax ratios in several countries over short time periods. He suggested that macro-economic policy have had to play critical roles in accounting for these variations.

The review of the factors determining the level of revenue derived from import and international trade tax was, conducted by Ebrill et al (1999). He deployed an instrumental regression framework with fixed-effects. The finding of the 105 country-study covering 1980 to 1992 was that the reforms of tariff do not necessarily lead to reduction in the revenue from trade tax. They however reports that the depreciation in exchange rate is significantly connected to the achievement of higher trade tax revenues. This is in consonance with the Tanzi's hypothesis and in contradiction with the findings of Ghura (1998).

In 2004, Agbeyegbe, Janet, and Asegedech examined the macro-economic determinants of tax revenue performance in 22 countries in Sub-Sahara Africa, over 1980-1995. The study estimated a dynamic panel model specification by deploying a GMM instrumental estimation method. This technique was based on an orthogonal deviation transformation prior to the conduct of variable differencing. The result show that the liberalization of international trade when supplemented by proper exchange rate and monetary policy was of limited significance on the overall tax revenue. They also report lower overall tax revenue because of exchange rate appreciation and inflation rate increases, although the results vary by component of taxes.

Similar investigation was conducted by Khattry and Mohan (2002) of 80 economies, both industrialized and developing, spanning a 29-year period from 1970 to 1998. The study applied a fixed-effects regression framework and reports is a negative relationship between total tax revenue on the one hand and trade liberalization, international trade tax revenue on the other. They however, find no significant connection between trade tax revenue from international sources and the rate of exchange. The findings of Nicholas and Robert (2012) corroborates this. Using descriptive statistics, the report postulates that countries with lower restrictions had their tax revenue fell steadily as tariffs are set below 10%, and a steep decline if it fell below 5%. Specifically, over the period 1980-2002, Kenya's average rate of trade restrictions of –2.2% subdued revenue position.

The multiple regression technique adopted by Sumera, Khuda, and Sarfraz, (2012) in their own study adopted had mixed results. They report negative relatedness between population and exchange rates on the one part and revenue from tax. A positive linkage between tax revenue on the one hand and trade openness, trade share and GDP on the other. A comparative study using a simple linear regression model, find that by Hamad, Burhan, and Stabua (2014) report a positive and significant effect of trade openness on economic growth in Tanzania. This effect was relatively greater during the closed economy compared to the open economy period.

Micah (2015) also had related result, using time series data covering the period 1994 to 2012. His study employed the fixed and random effects models in order to establish the of tax revenue performance determinants. They report that tax revenue performance was positively influenced by the level of trade openness, proportion of industry to GDP and exchange rates. The foreign aid and share agriculture to GDP had negative influence on the performance of tax revenue. In a similar vein, the influence on tax revenue performance was negatively significant with respect to the contribution of agriculture to GDP and aids obtained from foreign sources. The critical finding of this study is that the liberalization of trade proxied by trade openness enhances tax revenue collection.

One of the channels through which this is transmitted is the Tanzi-Olivera effect also known as the Olivera effect or the O-T effect, in which during a period of high inflation in a country, a decline in the volume of tax and collection tax proceeds is recorded (Tanzi, 1977). Another channel is through the Excise duties on some products which may not be necessarily be adjusted in line with inflation (Tanzi 1989). The third impact is through high inflation rates, which may reduce the tax base given that economic agents, in order to protect the real value of their wealth may make portfolio investment adjustments. The exchange rate regime in operation in an economy determines its patterns of behavior Yoon (2009). An appreciation of the real effective exchange rate could raise imports and lower exports, thereby positively affecting tax revenue, given the greater dependence of tax receipts on import rather than export taxes. However, an overvaluation of the exchange rate could adversely affect overall economic activity, and thus lower tax revenue.

The impact of changes in interest rates on tax revenue-GDP ratio are ambiguous (McBride, 2012; Huang & Frentz, 2014). A regime of high interest rate levels would increase production costs, dampens investors' confidence and, reduce productivity. The consequential lowered profit leads to reduced taxable capacity and drop in tax revenue generated by government.

The consequence of all these macroeconomic performances leads to higher rates of unemployment and under-employment, which reduces the GDP. The Vicious cycle, which is expected to continue, is manifested in recurring practical scenarios of the Sub-Saharan African countries as exemplified by Nigeria, South Africa, Uganda, and Cameroon. The Nigerian economy went into recession with double quarters negative growth of -0.36 and -2.06 in Quarter 1 and Quarter 2 respectively in 2016 (Central Bank of Nigeria, 2016). Nigeria's GDP fell by about 1.24% to $296 billion dollars. It also dropped behind South Africa's economy, which in itself is also on the brink of economic recession.

The justification for this study has become manifest given the discrepancies in the literature. The next presentation is the methodology.

Methodology

This section consists of the source and description of data, model specification and the estimation procedure.

Data Source and Description

Tax ratio to Gross Domestic Product sourced from World development indicators 2015 represented tax revenue performance. The trade openness which is measured by the addition of the imports and export (both in current currency) divided by GDP (current local currency) was taken the World Bank Development Indicators (2015). Data on the rate of inflation, Interest rate, unemployment and official exchange rate were, also obtained from the same source. The decade long study between 2005 and 2014 covers major economic cycles in twenty- one countries in Africa. This time span is sufficiently wide enough for a wide-ranging evaluation of the impact of trade openness on the tax performance in the selected economies.

Model Specification

The model deployed in this research work to investigate the dynamic relationship among tax variable and the five main macroeconomic variables: the official Exchange rate (EXH) Openness (OPN), Inflation rate (INF) and Interest rate (IR) is adapted from Muibi and Sinbo (2013), and Arellano and Bover (1995). The initial regression model is specified as:

$$Txrgdp_{it} = \alpha_1 + \alpha_2(LnExrate)_{i,t} + \alpha_3\ Tradeop_{i,t} + \alpha_4\ Ifr_{i,t} + \alpha_5\ Ir_{i,t} + \alpha_6 Unemp_{i,t} + U_i + \gamma_i + ECT_{i,t} + \in_{i,t} \quad (1)$$

Where:

$Txrgdp$ = Tax ratio to Gross Domestic Product
Exrate = Exchange Rate
tradeop = trade openness
Ifr = Inflation rate
Ir = Interest rate
Unemp = Unemployment rate
U_i = Unobserved country effect
γ_i = Unobserved time effect
$\in_t$ = Error term
t = t-th time period; I = i-th Country
ECT_{t-1} = The error terms derived from the long term co-integration relationship.
$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$ = slope of the linear equation; $\alpha_2 < 0$, $\alpha_3 > 0$, $\alpha_4 < 0$, $\alpha_5 < 0$ and $\alpha_6 > 0$

The rationale for the use of the tax-ratio to GDP as the proxy for tax performance is because it gives a more accurate picture than just the absolute value for tax.

Model Estimation Procedure

A three-prong step was employed. The descriptive statistics were calculated to understand the nature of the series is the first approach which is also useful in determining the normality or otherwise of the variables. This is manifest by the *Jarque-Bera* values (Gujarati & Dawn, 2009). The determination of the stationarity of the variables is examined next using the Levin, Lin & Chu t*, Im, Pesaran and Shin W-stat, Adf-Fisher Chi-square and PP–Fisher Chi-square unit root tests are deployed.

Thereafter, the Kao panel co-integration test are deployed to ascertain the actuality or otherwise of a long-run connection amongst the series. One of the basic steps prior to the conduct of cointegration test is the selection of optimal lag length. This criterion is required because of the sensitivity of the test to the length of time lag.

The Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC) are techniques applied to fix the optimal lag length. Where the two criteria (SC and AIC) selects dissimilar optimal lag lengths, Koehler and Murphree (1988) advises that the SIC is to be preferred. The Vector Error Correction Model (VECM), which indicates the speed of short run correction is thereafter tested.

In order to establish the robustness of regression model, two post-estimation appraisals are conducted in the last phase. These are the autocorrelation (serial relationship between the variables), and heteroscedasticity tests. The computation of these tests are done using the version 8.0 of E-views software. The next presentation is on the results and discussions there on.

Findings and Discussions

Preliminary Analyses

The nature of the data have been evaluated in two parts. These are descriptive statistics and Unit root stationarity tests.

Descriptive Statistics

The summary of the descriptive statistics of the variables are, presented in Table 1.

Table 1: Descriptive Statistics of the Variables

Statistics	EXRATE	IFR	IR	TRADEOP	TXRGDP	UNEMPLOY
Mean	4.41	7.32	8.02	1.01	20.85	10.79
Median	4.46	6.75	5.94	0.79	18.67	8.35
Maximum	7.86	26.24	52.10	3.65	65.90	37.60
Minimum	-1.17	-1.41	-42.31	0.27	1.56	0.60
Std. Dev.	2.38	4.65	10.40	0.68	13.24	7.56
Skewness	-0/40	0.91	0.94	1.99	1.30	1.12
Kurtosis	2.30	4.21	8.46	7.03	5.00	3.72
Jacque-Bera	10.48	43.55	305.38	294.56	99.15	50.70
Probability	0.01	0.00	0.00	0.00	0.00	0.00
Sum	969.74	1611.17	1763.84	222.76	4586.73	2374.60
Sum Sq. Dev.	1,235.75	4,736.74	23,667.53	101.09	38,406.86	12,510.19
Observations	220	220	220	220	220	220

Source: Authors' computation (2016)

The evidence provided in Table 1 show significant trend variations in the variables given the large differences between the maximum and minimum values of the series. All the variables are positively skewed.

The value, exchange rate is platykurtic in nature because its kurtosis value is less than 3 which is the threshold for normal distribution. The variables, Inflation Rate, Interest rate, trade openness, tax ratio of gross domestic product and unemployment has values 4.21, 8.46, 7.03, 5.00, and 3.72. They are all more than three and are thus leptokurtic in nature which is indicative of an abnormal distribution.

The goodness of fit test (Jacque-Bera) statistic signposts the combined skewness and kurtosis standard. The Jarque-Bera p-values is indicative of the non-normality of the series. This however is most likely to happen in a panel data given the heterogeneity differentials in the various nations (Gujarati, 2010).

Notwithstanding, this study conducted the stationarity test so as to further confirm the stability and normality of the variables. The exercise is presented in the next section.

Unit Root - Stationarity Test Results

The panel unit root results is presented in Table 2

Table 2: Panel Unit Root Test Results

Series	Levin, Lin & Chu t*		Im, Pesaran and Shin W-stat		Equation Specification	Order of integration
	t-Statistic	Prob	t-Statistic	Prob		
IFR	-16.72	0.00	-8.28	0.00	Intercept	I(1)
IR	-19.86	0.00	-10.14	0.00	Intercept	I(1)
LNEXRATE	- 9.02	0.00	-3.79	0.00	Intercept	I(1)
TRADEOP	-13.23	0.00	-6.26	0.00	Intercept	I(1)
TXRGDP	-50.17	0.00	-15.64	0.00	Intercept	I(1)
UNEMPLOY	-13.17	0.00	-6.01	0.00	Intercept	I(1)

Series	ADF-Fisher Chi-square		PP – Fisher Chi-square		Equation Specification	Order of integration
	t-Statistic	Prob	t-Statistic	Prob		
INF	158.46	0.00	236.98	0.00	Intercept	I(1)
IR	183.53	0.00	278.45	0.00	Intercept	I(1)
LNEXRATE	86.74	0.00	111.64	0.00	Intercept	I(1)
TRADEOP	128.76	0.00	188.76	0.00	Intercept	I(1)
TXRGDP	181.06	0.00	237.56	0.00	Intercept	I(1)
UNEMPLOY	115.84	0.00	129.39	0.00	Intercept	I(1)

Source: Authors computation (2016)

Since the respective probability values of the variables are less than the 5% significance level, the result reported in Table 2 establishes the stationarity of all the variables at the first difference. In order to ascertain the existence or otherwise of long run relationship among the variables, the study conducted a panel co-integration test. The test entails both Pedroni (Engle-Granger Based) and Kao (Engle-Granger Based). This is, deployed in the next section after determining the optimal lag length.

Estimation Results

Optimal Lag Length Selection

The result of optimal lag length selection is presented in Table 3.

Table 3: Optimal Lag Length Selection Criteria

Lag length	LogL	LR	FPE	AIC	SC	HQ
0	-2,947.12	NA	57,781.05	27.99	28.09*	28.03*
1	-2,896.08	98.69	50,111.34*	27.85*	28.52	28.12
2	-2,862.18	63.63	51,158.71	27.87	29.11	28.37
3	-2,830.97	56.80*	53,642.13	27.91	29.73	28.65
4	-2,812.74	32.14	63,724.24	28.08	30.47	29.05
5	-2,801.24	19.62	80,877.78	28.32	31.27	29.51
6	-2,790.40	17.88	103,599.0	28.55	32.08	29.98
7	-2,768.26	35.26	119,654.3	28.69	32.78	30.34
8	-2,751.08	26.37	145,488.6	28.86	33.53	30.75

Source: Authors computation (2016)

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: -Hannan- Quinn information criterion

Different lag lengths were, selected in Table 3, by the different. The estimated co-integration, and long-run equation results is presented in the next section.

Panel Co-Integration Test Result

Two types of panel co-integration tests were conducted: The Pedroni (Engle-Granger Based) and Kao (Engle- Granger Based) methods. Seven component statistical results of the Pedroni (Engle-Granger Based) are shown in Table 4.

Table 4: Result of Panel (Engle-Granger Based) Test on both Intercept and Trend

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-2.02	0.98	-3.31	0.99
Panel rho-Statistic	3.61	0.99	4.46	1.00
Panel PP-statistic	-5.80	0.00	-6.01	0.00
Panel ADF-Statistic	-6.19	0.00	-1.07	0.14
Group rho- Statistic	6.83	1.00		
Group PP-Statistic	-6.70	0.00		
Group ADF-Statistic	-3.22	0.00		

Source: Authors' computation (2016)

Out of the seven results, the rho-statistic, and V-statistic statistic are not significant. The safe conclusion therefrom is that inflation rate, interest rate, trade openness, exchange rate, unemployment does not have a long run relationship with taxation. The confirmatory long run check using the Kao (Engle-Granger Based) test as reported in Table 5 however shows a diametrically different result.

Table 5: Kao Residual Cointegration Test Result

	T-Statistic	Prob.
ADF	12.51	0.00
Residual Variance	14.01	
HAC Variance	11.37	

Source: Authors' Computation (2016)

Given a baseline level of significance of 5%, the recorded probability value of 0.00 which is less than the baseline means that the inflation rate, interest rate, trade openness, exchange rate, unemployment are related to the tax ratio of GDP in the long run. This does not corroborate the results of Panel Engle-Granger test reported in Table 4.

With the conflicting results notwithstanding, the short run relationship will have to be determined. This is the next presentation.

Vector Error Correction Model Short –Run

After the evaluation of the Vector Auto-Regressive Model (VAR) through the integration of the multi-variate time series, and determining the short-term relationship, the Vector Error Correction model is estimated. The result is, presented in Table 6.

Table 6: Vector Error Correction Model (VECM) Result.

Error Correction:	D(TXRGDP)	D(IFR)	D(IR)	D(TRADEOP)	D (LNEXRATE)	D (UNEMPLOY)
CointEq1	-0.01	0.09	0.18	0.00	-0.00	0.00
Std Error	(0.01)	(0.01)	(0.02)	(0.00)	0.00	0.00
T-stat (Cal)	[-0.84]	[7.37]	[7.95]	[2.95]	[-0.89]	[0.44]

Source: Authors computation (2016)

The relationship of the variables with respect to tax ratio of GDP are also mixed. Given that the tabulated T-stats value (1.96) is greater than the calculated value *LNEXRATE* (0.89), *TXRGDP* (0.84), *UNEMPLOY* (0.44), these variables are not related to tax ratio of GDP in the short run. However, the contrary position holds for *IFR* (7.37), *IR* (7.95), and *TRADEOP* (2.95).

Regression Results

The normalization of the estimated vector error correction model regression was conducted by multiplying the values of the variables by minus one (-1). The effect is in Table 7.

Table7: Result of the Equation

VARIABLE	D(TXRGDP)	D(IFR)	D(IR)	D (TRADEOP)	D (LNEXRATE)	D (UNEMPLOY)
Coefficient	1.00	13.12	6.62	24.40	-4.38	2.26
Std Error		(1.20)	(0.64)	(13.33)	(4.13)	1.13
T-stat (Cal)		[10.91]	[10.37]	[1.83]	[-1.11]	[1.99]

Source: Authors computation (2016)

The estimated model is shown as below:

$$Txrgdp_t = +13.12Ifr + 6.62Ir + 24.40Tradeop - 4.38Lnexrate + 2.26Uenomploy \quad (2)$$

R-Squared: 0.36
Adjusted R-Squared: 0.31
F-Statistic: 8.57

The equation (2) shows inflation rate, interest rate and unemployment rate are positively related to the performance of tax revenue and trade openness but was against the apriori expectation. A negative affiliation however existed between exchange rate and the performance of tax revenue Furthermore, the R^2 being 36.00% explained the extent at which the variations in tax revenue performance was explained by inflation rate, interest rate, trade openness, exchange rate and unemployment rate while the remainders are other variables not included in the model. Lastly, the F-statistics reflects the statistically significance of the model because the F-cal is greater than the F-tabulated. In view of these conflicting results, alternative estimation techniques will have to be deployed. The first being Granger causality test.

Granger Causality Test

The result of the Granger Causality test is presented in Table 7. This is based on the Vector Error Correction Model (VECM).

The result of the pair-wise Granger Causality in 176 observations using level 2 degree of freedom, accepts the null hypothesis that IFR, IR, EXRATE, TRADEOP, UNEMPLOY does not cause TAXRGDP in sub-Sahara Africa Countries at Significant at 5 percent level. In other words the independent variables do not cause tax performance and vice-versa does not granger cause IFR, IR, EXRATE, TRADEOP, UNEMPLOY.

This implies that there is one-way causation between TAXRGDP and IFR, IR, EXRATE, TRADEOP, UNEMPLOY. Inflation rate, Interest rate, Exchange rate, Trade openness, and unemployment Granger causes Tax performance but Tax performance does not Granger cause Inflation rate, Interest rate, Exchange rate, Trade openness, and unemployment in Sub Sahara Africa. In the next section, the discussion of the findings is presented.

Table 8: Result of the Causality on Tax Ratio to Gross Domestic Product

Null Hypothesis: Obs	Prob.
TAXRGDP does not Granger cause IFR	0.69
IFR does not Granger cause TAXRGDP	0.86
TAXRGDP does not Granger cause IR	0.22
IR does not Granger cause TAXRGDP	0.91
TAXRGDP does not Granger cause LNEXRATE	0.84
LNEXRATE does not Granger cause TAXRGDP	0.34
TAXRGDP does not Granger cause TRADEOP	0.14
TRADEOP does not Granger cause TAXRGDP	0.43
TAXRGDP does not Granger cause UNEMPLOY	0.43
UNEMPLOY does not Granger cause TAXRGDP	0.26
All	0.49

Source: Authors computation (2016)

Degree of freedom 2
** Significant at 5 percent level

Post-Estimation Results

The post estimation results are reported in the next sub-sections

Serial Correlation Lm Test

The serial relationship between the variables is verified using the Breusch-Godfrey Serial Correlation LM test. The result is reported in Table 9.

Table 9: Result of Breusch-Godfrey Serial Correlation LM

F-statistic	0.05	Prob. F(2,211)	0.96
Obs*R-squared	0.10	Prob. Chi-Square(2)	0.95

Source: Authors computation (2016)

From the result in Table 9, the Null-Hypothesis cannot be rejected given that the probability value of the Observed R-Squared (0.95) is greater than the baseline value of 5% level of significance. Rather the study accepts absence of serial correlation between the variables. The model is therefore suitable for evaluation.

Breusch-Pagan-Heteroscedasticity Tests

The Ordinary Least Squares method is predicated in part on some assumptions. The absence of heteroscedasticity is one of them. Indeed, the statistical tests of significance of result of an OLS estimation may become invalid where the error term size is different across the independent variable values. The result presented in Table 10, (Heteroscedasticity) is measured using the Breusch Pagan test.

Table 10: Result of Breusch-Pagan-Godfrey Test

F-statistic	0.44	Prob. F(2,213)	0.82
Obs*R-squared	2.23	Prob. Chi-Square(2)	0.82
Scaled explained SS	25.23	Prob. Chi Square(5)	0.00

Source: Authors computation using (2016).

The probability value of the Obs* R-squared obtained from the estimation is 0.82. This is greater in value than the benchmark 5% level of significance. This implication of this is that the null heteroscedasticity

hypothesis (no presence of heteroscedasticity), is be accepted, i.e. it shows a very clear acceptance of the assumption of the homoscedasticity. This means that some of the variables are homoscedastic.

This notwithstanding, as advised by Johnson (1972), the OLS estimator is still not biased. It is however inefficient due to the fact that both the variance and covariance are underestimated. Consistent with this position, Fox (1997) and Gujarati & Porter (2009) had submitted that the validity of the model is not nullified because the unconditional variance is not affected although the sequence of conditional variances that changes. In effect unless the problem of unequal variance is severe, there is nothing to worry about.

Discussion of Findings

Dzingiari and Tambudzai (2014) focused on Zimbabweans tax performance from the years 1980 till 2012 while this paper researched on 22 sub-Saharan African countries but there was cohesion with the use of same tests in obtaining evidence used which were unit root test, co-integration test, vector error correction model and granger causality test. This paper was in support of tax performance being stationary at the first difference.

Gaalya (2015) author of trade liberalization and tax revenue performance in seven (7) African countries while this paper researched on 22 sub-Saharan African countries but both papers agreed that there was a negative relationship between exchange rate and tax revenue performance then for trade openness this paper settled with Mkubwa and Mtengwa (2014) with the conclusion that trade openness had a positive relation with tax revenue performance.

A well renowned author, Dhaneshwar (1998) concluded with the test results using a panel data from 39 countries covering 1985 till 1986 that inflation and trade openness will both significantly have an impact on tax revenue performance while this research paper went along with both variables showing trade openness having a positive relationship with the dependent variable.

Trade openness and tax revenue performance were at first order difference based on the application of the unit root test which corresponded with Mawejje and Munyambonera (2016) co-authors of tax revenue effects of sectoral growth and public expenditure in Uganda but they applied auto regression distribution Lag (ARDL) because all the variables implemented were not stationary at lag order 1 but this research paper went as far to run co-integration test and the vector error correction model test based on the satisfaction of the lag order 1 criterion from each of the variables.

The deduction of the authors in the paragraph above also correlated with the Scwartz information criterion being chose at level nil (0), but no short run relationship between trade openness and tax revenue performance. Also, there was no hetereskedasticity or serial correlation in both research papers based on the Breusch-Pagan and Breusch- Godfrey procedure.

Agbeyegbe, Woldemariam and Stosky (2004) co-authored the research paper, Trade Liberalization, Exchange Rate Changes, and Tax Revenue in Sub-Saharan Africa with the application of Generalized Method of Moment regressions to test this relationship Using a panel of 22 Sub-Saharan Africa countries over 1980–1996 stated that trade liberalization would promote tax performance which was in support in this research paper.

Sumera, Khuda and Sarfraz (2012) co-author of the well-known research paper, Estimating Impact of Trade Liberalization on Tax Revenue in Pakistan over 1975-2010 had tax revenue performance and trade liberalization being stationary at the first difference and similar views arose with trade liberalization having a positive relationship with tax revenue performance but argument was a result of the exchange rate travelling same direction with tax revenue performance and the usage of vector error correction model to

draw out the model estimation for this research meanwhile the co-authors applied the ordinary least square regression method.

Conclusion

The objective of this research paper was to empirically analyse the connection amongst trade liberalization, tax revenue performance and macro-economic factors in Africa. The result shows that inflation rate, interest rate, trade openness, unemployment rate had a positive relationship with tax revenue performance unlike exchange rate. Trade liberalization showed a short run relationship with tax revenue performance and also was not statistically significant unlike interest rate and inflation rate. Furthermore, exchange rate and unemployment reflected short run relationship but null statistical significance with tax revenue performance.

The recommendations of this paper is for government to implore polices for the efficient and effective collection and computation of tax levies which would be properly accounted for and stewardship being given to the public so as to gain the trust of the citizens and based on the transparency of the actions performed by the government it leads to the voluntary payment of tax levies to the government and saves the government the cost and time of having to perform back duty assessment based on tax evasion or settling tax appeal tribunal cases.

Also, technology and creative innovations is a core necessity which should be plugged into the manufacturing and agricultural sector extensively. Machines and loans based on little to nothing interest should be given to current and potential individuals in the agricultural sector so as to boost the produce which can be exported and also given as raw materials to the manufacturing sector which transforms it to a finished good which boost the value of the goods and more revenue is gotten from both sectors this way. The increase in production results in a developed market, boost in the foreign reserves, balance of payment, balance of trade and exchange rate.

Furthermore, programmes of labour intensive nature are recommended so as to improve the creative skills and broaden the knowledge levels of the active labour force. The increase in labour engenders greater production of exportable goods which may result in an upsurge in the standard of living of its citizen based on the efficient utilization of expanded tax revenue in the creation of social amenities and infrastructure.

Lastly, the establishment of infant industries should be encouraged using incentives including not only tax subsidy and tax holidays but also with amendments to the conditions granted to pioneer industries. Defaulters of policies made by the government should be dealt with and penalties should be communicated to curtail claims of ignorance among the public.

References

Cawley, G. & Zake, J. (2010) Tax Reforms, Uganda Economic Reforms: Insider Accounts. Oxford University Press, 103

Delessa D., (2014). Tax Reforms and Tax Revenues Performance in Ethiopia. *Journal of Economics and Sustainable Development.* 13 (5). N'Yilimon, N. (2014). Taxation and economic growth: An empirical analysis on dynamic panel data of WAEMU countries. University of Lome MPRA Paper No. 61370.

Dhaneshwar, G. (1998). Tax Revenue in Sub-Saharan Africa: Effects of Economic Policies and Corruption. *IMF Working Paper*, WP/98/135.

Dzingirai, C., &Tambudzai, Z. 2014. Causal relationship between Government Tax Revenue Growth and Economic Growth: A Case of Zimbabwe (1980-2012) *Journal of Economics and Sustainable Development* 17 (5).

Ebrill, L, Stotsky, J. & Gropp, R. (1999) Revenue Implication of Trade Liberalization. IMF Occasional Paper No. 180.

Gaalya, M.S. (2015) Trade Liberalization and Tax Revenue Performance in Uganda. *Modern Economy*, **6**, 228-244. http://dx.doi.org/10.4236/me.2015.62021

Gaalya, M.S. (2015). Trade liberalization and tax revenue performance in Uganda. *Modern Economy*, 6, 228-244. http://dx.doi.org/10.4236/me.2015.62021

Grace, N.O. David O.A.,& Oliver, O. 2016. Empirical Analysis of Effect of Tax Revenue on Economic Development of Nigeria. *International Journal of Asian Social Science*, 6(10): 604-613

Gujarati, D.N. & Porter, D.C. (2009) Basic Econometrics, published by McGraw- Hill/Irwin, New York.

Gupta, A. (2007) Determinants of Tax Revenue Efforts in Developing Countries. IMF Working Paper No. WP/07/184.

Hamad, M.M., Burhan, A.M., & Stabua, A.B. 2014. The impact of Trade Liberalization on Economic Growth in Tanzania. *International Journal of Academic Research in Business and Social Sciences 5(4)* DOI: 10.6007/IJARBSS/v4-i5/879 URL: http://dx.doi.org/10.6007/IJARBSS/v4-i5/879

Harvey, S. and Sedegah, K. (2011) Import Demand in Ghana: Structure, Behaviour and Stability. AERC Research Paper No. 233.

Hilda M.A., (2014). The effect of tax incentives on economic growth in Kenya. *A research project submitted in partial fulfilment of the requirements for the award of the degree in Masters of science in finance, university of Nairobi.*

Huang, Chye-Ching, and Nathaniel Frentz. 2014. "What Really is the Evidence on Taxes and Growth." Washington, D.C: Center on Budget and Policy Priorities.

James, A., & Moses, A., (2012). Impact of tax administration on government revenue in a developing economy – A case study of Nigeria. *International Journal of Business and Social Science.* 8 (3).

John, A.T., (2007). Is Tax Policy Retarding Growth in Morocco? Online at http://mpra.ub.uni-muenchen.de/6011/ . MPRA Paper No. 6011.

Joseph M., & Ezra, F.M. (2016). Tax Revenue Effects of Sectoral Growth and Public Expenditure in Uganda. *Economic Policy Research Centre*. Research Series No. 125

Kazman, S.B. (2014). Exploring the Laffer curve: Behavioral responses to taxation. UVM Honors College Senior Theses, Paper 8

Keho, Y. (2013). The structure of taxes and economic growth in Cote d'ivoire: An econometric investigation *Journal of Research in Economics and International Finance*, 2(3), 39-48.

Lisa k., (2007). Tax policy challenges facing developing countries: A case study of Uganda

Martinez-Vazquez, J. and McNab, R. (2000) Tax Reform in the Tax Reform Experiment in Transitional Countries. International Centre for Public Policy, Andrew Young School of Policy Studies, Georgia State University, Atlanta

McBride, William. 2012. "What Is The Evidence on Taxes and Growth." Special Report No. 207. Washington, D.C: The Tax Foundation.

Muibi, S.O. & Sinbo, O.O. (2013) Macroeconomic Determinants of Tax Revenue in Nigeria (1970-2011) *World Applied Sciences Journal* 28 (1), 27-35, ISSN 1818-4952 DOI: 10.5829/idosi.wasj.2013.28.01.1189

N'Yilimon, N. (2014). Taxation and economic growth: An empirical analysis on dynamic panel data of WAEMU countries. University of Lome MPRA Paper No. 61370.

Nathaniel, E.U., Emmanuel, O.N & Gladys, C.A. (2012). Lost Revenue Due to Trade Liberalization: Can Nigeria recover her own? *European Journal of Business and Management* 10 (4).

Nicholas, C. & Robert, G., 2012. Increasing tax revenue in sub-Saharan Africa: *The Oxford Council on Good Governance economic analysis.*

Olufemi, M.S. (2015). Optimal tax rate and economic growth. Evidence from Nigeria and South Africa. *Euro Economica Issue*, 1(34).

Samuel F., (2006). Taxation in developing countries; case study of Cameroon. *World Institute for development economic research*. Research Paper No. 2006/02.

Sumera, M. Khuda, B. & Sarfraz, H. 2012. Estimating Impact of Trade Liberalization on Tax Revenue in Pakistan. *Journal of Agriculture & Social Sciences.* 8: 148–150.

Tanzi, V. (1989) The Impact of Macroeconomic Policies on the Level of Taxation and the Fiscal Balance in Developing Countries. IMF Staff Papers, 36, 633-656. http://dx.doi.org/10.2307/3867050

Terence, A., Janet G.S., &Asegedech, W., 2004. Trade Liberalization, Exchange Rate Changes, and Tax Revenue in Sub-Saharan Africa. *IMF Working Paper* WP/04/178

Ugwunta, O. D. & Ugwuanyi, U. B. (2015). Effect of distortionary and non-distortionary taxes on economic growth: Evidence from Sub-Saharan African countries. *Journal of Accounting and Taxation*, 7(6), 106 – 112. DOI: 10.5897/JAT2015.0175

Wonnacott, P. and Lutz, M. (1989) Is There a Case for Free Trade Areas? In: Schott, J., Ed., Free Trade Areas and U.S. Trade Policy, Institute of International Economics, Washington DC, 59-84. [12]

Yaya K., (2010). Estimating the growth-maximizing tax rate for Coted'Ivoire: Evidence and implications. Journal of Economics and International Finance. 9 (2), pp. 164-174

Yoon, G. (2009). Are Real Exchange Rates more likely to be Stationary during the fixed Nominal Exchange Rate Regime? *Applied Economic Letters*, 16, 17-22.

Appendix

1.0 Descriptive Statistics

2.0 Panel Unit Root Test

Group unit root test: Summary
Series: IFR, INTEREST_RATE, LNEXRATE, TAXRATIO_OF_GDP, TRADEOP, UNEMPLOY
Date: 10/25/16 Time: 22:19
Sample: 1 220
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-37.3826	0.0000	6	1302
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-35.9977	0.0000	6	1302
ADF - Fisher Chi-square	618.765	0.0000	6	1302
PP - Fisher Chi-square	499.952	0.0000	6	1308

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

4.0 Optimal Lag Length Criteria

5.0 Co-Integration Test

6.0 Vector Error Correction Model Test

Vector Error Correction Estimates
Date: 10/25/16 Time: 21:25
Sample (adjusted): 5 220
Included observations: 216 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
D(TXRGDP(-1))	1.000000
D(LNEXRATE(-1))	4.380683
	(4.13332)
	[1.05985]
D(IFR(-1))	-13.12148
	(1.20212)
	[-10.9153]
D(IR(-1))	-6.618217
	(0.63841)
	[-10.3667]
D(TRADEOP(-1))	-24.40235
	(13.3307)
	[-1.83053]
D(UNEMPLOY(-1))	-2.255491
	(1.13292)
	[-1.99086]
C	-0.326335

Error Correction:	D(TXRGDP,2)	D(LNEXRATE,2)	D(IFR,2)	D(IR,2)	D(TRADEOP,2)	D(UNEMPLOY,2)
CointEq1	-0.011971	-0.002443	0.084651	0.180442	0.002601	0.004334
	(0.01430)	(0.00275)	(0.01149)	(0.02270)	(0.00088)	(0.00993)
	[-0.83702]	[-0.88989]	[7.36451]	[7.94925]	[2.94891]	[0.43624]
D(TXRGDP(-1),2)	-0.604290	0.000711	-0.052884	-0.037092	0.002530	-0.071688
	(0.07115)	(0.01366)	(0.05719)	(0.11293)	(0.00439)	(0.04943)
	[-8.49304]	[0.05205]	[-0.92477]	[-0.32845]	[0.57639]	[-1.45043]
D(TXRGDP(-2),2)	-0.312942	-0.000177	-0.054441	-0.151481	0.000641	-0.088664
	(0.06945)	(0.01333)	(0.05581)	(0.11022)	(0.00428)	(0.04824)
	[-4.50632]	[-0.01325]	[-0.97539]	[-1.37431]	[0.14966]	[-1.83796]
D(LNEXRATE(-1),2)	-0.272216	-0.624365	-0.467384	-0.470058	-0.041991	0.141059
	(0.37834)	(0.07263)	(0.30408)	(0.60050)	(0.02334)	(0.26282)
	[-0.71950]	[-8.59671]	[-1.53703]	[-0.78278]	[-1.79931]	[0.53672]
D(LNEXRATE(-2),2)	-0.555287	-0.314069	-0.069513	-0.047097	-0.043847	0.218033
	(0.37727)	(0.07242)	(0.30322)	(0.59881)	(0.02327)	(0.26207)
	[-1.47184]	[-4.33657]	[-0.22925]	[-0.07865]	[-1.88415]	[0.83195]

D(IFR(-1),2)	-0.136602	-0.030256	-0.081140	1.583943	0.022700	0.010252
	(0.14419)	(0.02768)	(0.11589)	(0.22886)	(0.00889)	(0.10016)
	[-0.94738]	[-1.09309]	[-0.70016]	[6.92115]	[2.55230]	[0.10236]
D(IFR(-2),2)	-0.120303	-0.004475	-0.216668	0.713984	0.006868	0.002310
	(0.09022)	(0.01732)	(0.07251)	(0.14320)	(0.00557)	(0.06267)
	[-1.33344]	[-0.25840]	[-2.98804]	[4.98603]	[1.23407]	[0.03685]
D(IR(-1),2)	-0.048093	-0.015773	0.389557	-0.150636	0.012797	0.007647
	(0.07407)	(0.01422)	(0.05953)	(0.11756)	(0.00457)	(0.05145)
	[-0.64930]	[-1.10933]	[6.54378]	[-1.28133]	[2.80094]	[0.14863]
D(IR(-2),2)	-0.045748	-0.005411	0.153637	-0.094559	0.004442	-0.016618
	(0.04393)	(0.00843)	(0.03531)	(0.06972)	(0.00271)	(0.03052)
	[-1.04140]	[-0.64168]	[4.35144]	[-1.35618]	[1.63932]	[-0.54458]
D(TRADEOP(-1),2)	5.61E-06	0.139111	1.857855	0.848831	-0.808614	0.797354
	(1.08738)	(0.20874)	(0.87395)	(1.72588)	(0.06707)	(0.75535)
	[5.2e-06]	[0.66644]	[2.12581]	[0.49182]	[-12.0557]	[1.05561]
D(TRADEOP(-2),2)	-1.049630	-0.006821	2.224460	0.402533	-0.536784	0.904705
	(1.07722)	(0.20679)	(0.86579)	(1.70976)	(0.06645)	(0.74829)
	[-0.97439]	[-0.03298]	[2.56929]	[0.23543]	[-8.07843]	[1.20902]
D(UNEMPLOY(-1),2)	0.005982	-0.008406	0.084108	0.180887	0.000511	-0.716704
	(0.09806)	(0.01882)	(0.07881)	(0.15564)	(0.00605)	(0.06812)
	[0.06100]	[-0.44656]	[1.06717]	[1.16220]	[0.08442]	[-10.5215]
D(UNEMPLOY(-2),2)	-0.222765	-0.006943	0.053321	0.089728	-0.002754	-0.334333
	(0.09680)	(0.01858)	(0.07780)	(0.15364)	(0.00597)	(0.06724)
	[-2.30127]	[-0.37362]	[0.68535]	[0.58401]	[-0.46129]	[-4.97203]
C	0.006848	0.000409	-0.085869	0.043792	-0.000310	-0.000897
	(0.41086)	(0.07887)	(0.33022)	(0.65211)	(0.02534)	(0.28540)
	[0.01667]	[0.00518]	[-0.26004]	[0.06715]	[-0.01223]	[-0.00314]
R-squared	0.355543	0.339122	0.640327	0.683922	0.505048	0.402401
Adj. R-squared	0.314068	0.296590	0.617180	0.663580	0.473194	0.363941
Sum sq. resids	7364.694	271.3932	4757.367	18553.04	28.02141	3553.761
S.E. equation	6.038119	1.159108	4.852970	9.583669	0.372451	4.194387
F-statistic	8.572462	7.973371	27.66317	33.62171	15.85539	10.46301
Log likelihood	-687.6416	-331.1461	-640.4452	-787.4266	-85.92130	-608.9429
Akaike AIC	6.496681	3.195797	6.059678	7.420617	0.925197	5.767990
Schwarz SC	6.715449	3.414565	6.278446	7.639385	1.143965	5.986758
Mean dependent	-0.001876	-9.47E-05	-0.077862	0.028378	-0.000349	-0.001389
S.D. dependent	7.290562	1.382036	7.843505	16.52308	0.513150	5.259202

Determinant resid covariance (dof adj.)	151391.3
Determinant resid covariance	101271.4
Log likelihood	-3083.705
Akaike information criterion	29.38615
Schwarz criterion	30.79252

7.0 Granger Causality Test

Pairwise Granger Causality Tests
Date: 11/24/16 Time: 19:55
Sample: 2005 2014
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
IR does not Granger Cause IFR	176	0.01822	0.9819
IFR does not Granger Cause IR		0.99739	0.3710
LNEXRATE does not Granger Cause IFR	176	0.14533	0.8648
IFR does not Granger Cause LNEXRATE		2.98818	0.0530
TRADEOP does not Granger Cause IFR	176	0.87715	0.4178
IFR does not Granger Cause TRADEOP		3.88692	0.0223
TXRGDP does not Granger Cause IFR	176	0.37076	0.6908
IFR does not Granger Cause TXRGDP		0.14773	0.8628
UNEMPLOY does not Granger Cause IFR	176	0.29104	0.7479
IFR does not Granger Cause UNEMPLOY		0.07350	0.9292
LNEXRATE does not Granger Cause IR	176	4.65923	0.0107
IR does not Granger Cause LNEXRATE		0.83393	0.4361
TRADEOP does not Granger Cause IR	176	1.77543	0.1725
IR does not Granger Cause TRADEOP		0.45533	0.6350
TXRGDP does not Granger Cause IR	176	1.53950	0.2174
IR does not Granger Cause TXRGDP		0.09981	0.9051
UNEMPLOY does not Granger Cause IR	176	1.45041	0.2373
IR does not Granger Cause UNEMPLOY		0.08888	0.9150
TRADEOP does not Granger Cause LNEXRATE	176	0.60316	0.5482
LNEXRATE does not Granger Cause TRADEOP		3.02143	0.0513
TXRGDP does not Granger Cause LNEXRATE	176	0.17299	0.8413
LNEXRATE does not Granger Cause TXRGDP		1.08925	0.3388
UNEMPLOY does not Granger Cause LNEXRATE	176	0.22119	0.8018
LNEXRATE does not Granger Cause UNEMPLOY		0.54667	0.5799
TXRGDP does not Granger Cause TRADEOP	176	1.98567	0.1404
TRADEOP does not Granger Cause TXRGDP		0.85794	0.4259
UNEMPLOY does not Granger Cause TRADEOP	176	0.08821	0.9156
TRADEOP does not Granger Cause UNEMPLOY		0.53292	0.5879
UNEMPLOY does not Granger Cause TXRGDP	176	1.36420	0.2584
TXRGDP does not Granger Cause UNEMPLOY		0.85686	0.4263

8.0 Bresuch Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.045819	Prob. F(2,211)	0.9552
Obs*R-squared	0.095072	Prob. Chi-Square(2)	0.9536

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/25/16 Time: 21:13
Sample: 2 220
Included observations: 219
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.32E-05	0.335785	-9.88E-05	0.9999
D(IR)	-0.001260	0.035725	-0.035257	0.9719
D(TRADEOP)	-0.007889	1.095761	-0.007200	0.9943
D(IFR)	-0.001757	0.070691	-0.024854	0.9802
D(LNEXRATE)	0.000872	0.379936	0.002295	0.9982
D(UNEMPLOY)	0.001401	0.097897	0.014308	0.9886
RESID(-1)	0.017106	0.069450	0.246310	0.8057
RESID(-2)	-0.012634	0.069451	-0.181912	0.8558

R-squared	0.000434	Mean dependent var	9.63E-17
Adjusted R-squared	-0.032727	S.D. dependent var	4.889144
S.E. of regression	4.968503	Akaike info criterion	6.079960
Sum squared resid	5208.751	Schwarz criterion	6.203762
Log likelihood	-657.7556	Hannan-Quinn criter.	6.129960
F-statistic	0.013091	Durbin-Watson stat	1.998469
Prob(F-statistic)	0.999998		

9.0Breusch Pagan Godfrey Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.439191	Prob. F(5,213)	0.8208
Obs*R-squared	2.234772	Prob. Chi-Square(5)	0.8158
Scaled explained SS	25.23084	Prob. Chi-Square(5)	0.0001

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/25/16 Time: 21:17
Sample: 2 220
Included observations: 219

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23.79259	7.925891	3.001882	0.0030
D(IR)	0.206711	0.835422	0.247434	0.8048
D(TRADEOP)	21.19665	25.85706	0.819763	0.4133
D(IFR)	1.053515	1.662610	0.633652	0.5270
D(LNEXRATE)	-4.143326	8.967762	-0.462025	0.6445
D(UNEMPLOY)	-0.625927	2.301763	-0.271934	0.7859

R-squared	0.010204	Mean dependent var	23.79458
Adjusted R-squared	-0.013030	S.D. dependent var	116.5201
S.E. of regression	117.2767	Akaike info criterion	12.39396
Sum squared resid	2929567.	Schwarz criterion	12.48682
Log likelihood	-1351.139	Hannan-Quinn criter.	12.43146
F-statistic	0.439191	Durbin-Watson stat	1.992915
Prob(F-statistic)	0.820830		

10. Impulse Response Test