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Tax Revenue Shocks and Economic Growth in Nigeria, 1961-2011

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ABSTRACT

This study examined the impact of tax revenue shocks on economic growth in Nigeria during the period from 1961 to 2011. Times series data on variables (government expenditure, tax revenue, GDP and consumer price index) were used. The data were sourced from the CBN Statistical Bulletin 2012 edition and World Development Indicators (WDIs) version 2012. The unit root property of each of the variables was investigated using ADF and PP unit root tests. The study also employed Johansen co integration technique to test for the co integration relationship among the variables in the VAR model. The results indicate that tax revenue shocks have positive effect on government expenditure and real output. The findings also suggest that tax revenue turns out to contribute increasingly to innovations in government spending and real output from the first year up to the end of the period. The study concluded that any policy that induces tax revenue will equally induce government expenditure and real output, hence, tax revenue shocks have positive effect on long-run economic growth in Nigeria.

Keywords: *Tax revenue shocks, economic growth, government expenditure, VAR model, Nigeria*

1. INTRODUCTION

It should be noted that the role of taxes in the use of fiscal policy as instrument of economic management cannot be overemphasized both in term of revenue generation as well as income or wealth distribution among the citizens of a country. One of the arguments against the market economy is that income inequality and wealth-poverty gap continues to rise as such system progresses, hence, market system is said to be inefficient in the allocation of resources. Government intervention is therefore becomes necessary to reallocate resources for the overall benefit of the entire population. Government, through its fiscal policy influences the economic activities of a state. The major purpose of taxation is to raise revenue for the government to meet its financial obligation. Aside from this, taxes are imposed in order to reduce wealth-poverty gap in an economy. The widening gap in income inequality has been traced to the inefficiency of the market system. The inefficiency of the market system to equitably distribute income for the benefit of all and sundry has been responsible for high rate of poverty in most of the developing countries. This calls for government intervention to correct this anomaly using fiscal policy instruments of which taxation is an integral part.

Tax policy is a deliberate attempt designed to take from those who have excess and give to those who have not for the betterment of the overall citizens of a country. In the absence of a well organized and locally controlled money market, most developing countries have had to rely primarily on fiscal measures to mobilize domestic resources. The principal instrument of such public resource mobilization is government tax policy, typically direct and indirect taxes. Direct taxes are those levied on private individuals and corporations and mainly on properties. On the other hand, indirect taxes are those levied on goods and services produced in an economy (excise duty), goods imported into the country (import duty) and goods sold to other countries (export duty), these refer to duties levied on foreign trade and excise duties levied on the direct domestic consumption of different commodities like petrol, cigarettes, liquors, consumer durables etc.

Traditionally, taxation may have four major purposes in the less developed countries: First is to check the production and consumption of goods believed to be harmful to human's health capable of reducing someone's marginal physical product which decreases earnings significantly.

Second is tax concession, a physical incentive which has been thought of as a means of stimulating private enterprises. Such concessions and incentive have typically been offered to foreign private investment.
Third is to encourage local investors to participate in the economic activities of their countries. Most third world countries were made to be directly involved in the economic activities of their countries through ownership and control of public corporations and state trading agencies.

Fourth purpose of taxation is the mobilization of resources to finance public expenditures. Whatever the prevailing political or economic ideology of any less developed country, its economics and social progress largely depends on government ability to generate sufficient revenue to finance expanding programmes of essential, non-profit yielding public services such as health, education, communication, transport and other components.

It should be made known that the whole essence of governance is to advance the welfare of an increasing

number of people. The 1999 Constitution of the Federal Republic of Nigeria in many of its provisions affirms this position. The general belief is that productive government spending will affect the economy positively and thereby leads to improved welfare for the entire populace. Tax revenue therefore becomes a very important determinant of government spending. Any shock to tax revenue is believed to affect government spending and thereby affect the national output. On this strength this paper was set to examine the impact of tax revenue shocks on economic growth in Nigeria.

The rest of this paper is organized as follows: The next section provides the theoretical and empirical literature review. Section 3 describes the data and methodology used in the analysis. Section 4 handles the presentation of empirical results while section 5 draws the conclusion.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The relationship between economic growth and government spending has a long history, beginning from Wagner (1890). This seminal work gave rise to the popular Wagner Law, which states that there is a long run tendency for state activities to grow relative to the growth of national income. Since Wagner's epochal work, several studies have been undertaken on his conclusions. Most of these studies, according to Essien (1997) rest on i. appropriate measure of public sector growth; ii. Correct interpretation of the Law; iii. finding an index of government size to facilitate comparison among countries; and iv. testing the law by adopting a cause-effect relation to estimate the income elasticity of government expenditure.

Essien (1997) in his own study on the "test of Wagner's Law on the Nigeria economy i.e. the extent to which the size of Government would grow, relative to increase in National output". Hinrichs (1966) examined for industrial countries, the thesis of a rising government share of expenditure during development. It should be recognized that Wagner (1890) did not offer clearly reasons for "the growing share of state activity" Bahl and Linn (1998). However, subsequent studies attempted a filling of this gap. For instance, Peacock-Wiseman displacement thesis concluded that government expenditures undergo a shift in response to major crisis of distribution. This thesis is an explanation of the upward shift in government's share has been tested statistically with some success for a number of industrial countries (Gupta 1967). For a small sample of developing countries, the same result was found, Goffman and Mahar (1971) but Bahlm, Kinn and Park (1986) estimated a downward displacement for Korean growing government expenditures between 1961 and 1964. From Adebayo (2000) the following government activities, which have pronounced implications for poverty reduction and development, may be linked to increase in government expenditure. First is "Expenditure on Poverty Reducing

Activities". Specifically the activities are those in the Education, Health and Social services sectors. The rule of thumb is; the higher the expenditure on these activities, the lower the incidence of absolute poverty. The second is the meeting of the basic needs of the poorest 40% - 50% of the population. This is often referred to as The Basic Needs Approach to development. Indicators of the basic needs are usually (i.) Food; calorie-supply per head or calories supply as a percentage of requirements of proteins. (ii.) Education; Literacy rates, primary school enrolment (as a percentage of the population aged 5-14). (iii.) Health: Life expectancy at birth infant mortality (per thousand at birth). (iv.)Water Supply: Percentage of the population with access to potable water. (v.) Housing: percentage of the population with access to quality housing.

The concept of Targeting as an interventionist policy in welfare enhancement and particularly in poverty reduction, has received considerable attention overtime. Good examples in this regard include Ravallion (1991), Kanbur et al (1994), Van de Walle (1998), and Coady et al (2004). Targeting can assume different dimensions and may be of several types. Van de Walle (1998) specified two categories of Targeting. These are Broad and Narrow. In Broad Targeting, no attempt is made to reach the poor as individuals rather, efforts are made of targeting types of spending that are relatively more important to the poor. Examples of Broad Targeting expenditure include basic social services, primary education, rural development, health care delivery, safe water provision and basic physical infrastructure. According to Van de Walle (1998), "spending on basic social services is found to benefit the poor. Money spent on primary education for example, is likely to reach more poor children than money spent on secondary or tertiary education… Better health and basic education, access to safe water and basic physical infrastructure raise poor people's well being and may also raise their productivity and income". Van de Walle (1998; 236) defined Narrow Targeting as "a deliberate attempt to concentrate benefits on poor people – whatever the type of spending". Narrow Targeting is said to have become popular in recent times, because it enhances the chance of reducing budget deficits and public spending, while still protecting the poor.

Narrow Targeting can be of two types; Indicator Targeting also called Categorical Targeting. Basley and Kanbur (1993) explained Categorical Targeting as one that identifies a characteristic of the poor (an indicator) that is highly correlated with low income. Examples of such indicators include region of residence (geographical targeting, land holding class, gender, nutritional sisters, disability, household and size. A second variant of Narrow targeting is called self Targeting. Van de Walle (1998) submitted that in Self Targeting "Instead of relying on an administrator to choose participants, these schemes aim to have beneficiaries select themselves,

through creating incentives that will induce the poor and only the poor to participate".

Government spending can also be channeled into employment generation, in order to reduce poverty level. There is a growing interest in studying the linkage between poverty reduction and employment characteristics, Rahman and Islam (2003) is a good example. The study examined whether self-employment, casual wage employment and employment as 'employees' have different implications for chances of being in poverty. Rahman (2004) hypothesizes the linkages between self-employment, wage employment and poverty processes. Using a flow chart, he concluded that sector and status of employment act as critical links between employment, earning and poverty. Baye (1998) in his study of the relationship between nature of employment and earning capacity among civil servants in Cameroun at a time of the country's currency devaluation and slash in salary, discovered exacerbated poverty.

It should be noted that government requires enormous amount of money in the discharge of its constitutional responsibilities. Although there are many sources of such revenue, tax is an important aspect. Tax has been defined differently by different writers. For the purpose of this study, tax may be seen as an amount of money paid by one person to government, towards defraying expenses incurred by the latter in the common interest of all, without reference to special benefits conferred. Naiyeju (1996) gave a simpler definition which is equally useful for our purpose. According to him, a "tax is simply a compulsory payment levied on the citizens by the government for the purpose of achieving its goals." From these definitions, two major issues become very relevant. The first is government responsibilities and the second is a citizen's duties and/or obligations. It is need not to say that government exists in order to perform certain functions and play certain roles, in the common interest of all. These functions and roles especially those advancing the general welfare, require a large amount of money, which is generated through many sources. One of such is tax. Studies over time have indicated that many governments have found it more convenient to generate income, more readily from tax than from other sources.

The relative importance of tax has sometimes pushed some governments into over-stressing tax to the point, where its use becomes counter-productive. Nigeria's current democratic experiment places greater responsibility on government to look for ways of improving its revenue generation. This is because political office-holders and their parties, having made election promises and having found themselves in power, may now come to grip with the reality of the moment; need for large amount of money to prosecute party programmes in the context of an almost empty government treasury. The earlier this position is realized, the better, given the traditional nature of high expectations of the Nigerian electorates.

The problem of lack of fund to prosecute welfare programmes by political parties can be solved, using a fair and effective Tax Administration and Assessment system. According to Omorogiuwa (1988), 'Assessment' can be defined as "the process of determining the taxable income of a person and applying the statutory rates to compute the tax bill". From this definition alone, two basic and yet fundamental elements of tax assessment emerge; determination of taxable income and computation of tax liability, through the application of statutory rates. These elements engender a big dilemma more for civilian administrations than the military. The dilemma sometimes referred to as 'The Politics of Tax Assessment' stem from the cautions that civilian regimes often attempt to take in order to avoid 'stepping on toes' of the influential and the general electorate that constitute the tax-paying public. If the tax rates are raised in order to generate more revenue for improved public services, there may be public outcry with attendant risks for the party in power, whereas, if the tax rates are low, with revenue from tax efforts also being low, there may not be enough revenue for government. The latter may result in inadequate provision of social amenities and inefficiency of units of government charged with the provision of public services. A situation of non-performance of government like this also portends great danger for a party in power and in the long run, sustainable democracy. Aside, this goes a long way to impede economic growth since government's ability to provide social infrastructure which act as catalyst to economic growth is already hampered. The output which may not respond directly to changes in tax revenue but to government spending is affected while government spending responds directly to changes in tax revenue. Changes in tax revenue can bring about changes in government expenditure which in turn bring about changes in output. Based on the survey of literature on this subject matter and to the best of the author's knowledge, there is no study ever, focusing on the impact of tax revenue shocks on economic growth in Nigeria between 1961 and 2011, hence this study.

3. DATA AND ECONOMETRIC METHODOLOGY

The main objective of this study is to examine the dynamic effects of tax revenue on government expenditure and real output in Nigeria. To achieve this, the study employed a multivariate unrestricted VAR model. In this kind of model, all variables enter the system as endogenous. Each variable is explained by its own lag and lags of other variables in the system. The data on variables such as government expenditure, tax revenue, gross domestic product and consumer prices were sourced from the Central Bank of Nigeria Statistical Bulletin 2012 edition and World Development Indicators (WDIs) version 2012. The three variables of interest were expressed in real terms using consumer price index and

also in their natural logarithm. The study considers the VAR model of the form

$$R_t = \omega_0 + \sum_{i=1}^{k} \phi_i R_{t-i} + u_t \ldots\ldots\ldots\ldots (1)$$

Where R_t is a px1 vector of endogenous variables, u_t is a px1 vector of error terms, ω_0 is a px1 vector of constant term coefficients and ϕ_i is a pxp matrices of coefficients in the ith lag of R.

It should be noted that, the vector of endogenous variables in the unrestricted VAR model represented by R_t is given by

R_t = (RTAXREV, RGEXP, RGDP).

Transforming the VAR system into its moving average representation, we have

$$R_t = \delta_0 + \sum_{i=0}^{q} \Psi_i u_{t-i} \ldots\ldots\ldots\ldots\ldots (2)$$

Where Ψ_i is the identity matrix and δ_0 is the mean of the moving average process.

4.   EMPIRICAL RESULTS

4.1 Unit Root Test

The study proceed by properly identify the order of integration of each of the variable in the VAR system. This is done by conducting the unit root test on each of the variables included in the VAR model. The study used the Augmented Dickey-Fuller (ADF) and Phillip-Perron unit root tests. The results obtained from the ADF and PP unit root test are presented in Table1. It is evidently cleared from the table that all variables are I(1) since both the ADF and PP statistic could not reject the hypothesis of unit root at the level of each of the variables at the 5 percent level of significant. However, the hypothesis of unit root could be conveniently rejected using the first difference of each of the variables. This indicates that all the variables are non-stationary in their level form while their first differences are stationary.

Table 1: Result of the unit root test

Variables	ADF Test Statistic At Level	Mackinnon Critical Value (5%)	ADF Test Statistic At 1st Difference	Mackinnon Critical Value (5%)	Order of Integration
Log(RTAXREV)	-1.81	-3.5	-6.16	-3.5	I(1)
Log(RGEXP)	-2.21	-3.5	-7.98	-3.5	I(1)
Log(RGDP)	-0.90	-3.5	-6.09	-3.5	I(1)
Variables	PP Test Statistic At Level	Mackinnon Critical Value (5%)	PP Test Statistic At 1st Difference	Mackinnon Critical Value (5%)	Order of Integration
Log(RTAXREV)	-2.08	-3.5	-6.16	-3.5	I(1)
Log(RGEXP)	-2.21	-3.5	-7.98	-3.5	I(1)
Log(RGDP)	-0.92	-3.5	-6.08	-3.5	I(1)

4.2 Co integration

Given a vector of I(1) variables, the variables are said to be co integrated if and only if there exists linear combination of the variables, which are stationary. This study employed co integration test proposed by Johansen and Juselius (1990). This presents two maximum likelihood ratio test statistics namely the maximal eigenvalue and the trace statistic. The two statistics were

used to test the hypothesis of no co integration. The results in Table 2a and Table 2b showed that variables are not co integrated as both the Trace statistic and the Maximal eigenvalue statistic could not reject the hypothesis of no co integration at the 5% significant level.

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Table 2a: Co integration test result (Trace test)

Sample (adjusted): 1963 2011				
Included observations: 43 after adjustments				
Trend assumption: Linear deterministic trend				
Series: LOG(RTAXREV) LOG(RGEXP) LOG(RGDP)				
Lags interval (in first differences): 1 to 1				
Unrestricted Co integration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.185044	15.56150	29.79707	0.7427
At most 1	0.109372	6.762801	15.49471	0.6054
At most 2	0.040599	1.782183	3.841466	0.1819
Trace test indicates no co integration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 2b: Co integration test result (Max-Eigenvalue test)

Unrestricted Co integration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.185044	8.798696	21.13162	0.8483
At most 1	0.109372	4.980618	14.26460	0.7443
At most 2	0.040599	1.782183	3.841466	0.1819
Max-eigenvalue test indicates no co integration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

4.3 The Impulse Response Functions (IRFs)

The impulse response functions help us to map out the response of each endogenous variable in the VAR to its own shock and shock to other variables. In this study, the impulse response functions trace out the response of current and future values of government expenditure and real output to a one standard deviation innovations in tax revenue.

We present the result of the impulse response functions in Table 3. It is evidenced from the table that both government expenditure and real output respond positively to shocks in tax revenue. Innovations to tax revenue are found to have significant and persistent positive effect on government spending until after the fifth year when the impact marginally decreases until the 10th year. However, innovations to tax revenue are found to have significant and persistent positive effect on real output from the initial year up to the 10th year. The largest response of government expenditure is observed in the 5th and 6th years from the initial shock to tax revenue. As regards the response of real output, it increases continuously from the initial year up to the 10th year. On the whole, the findings indicate that tax revenue serves as important variable determined government expenditure and real output in Nigeria.

Table 3: Result of the Impulse Response Functions (IMFs)

RESPONSE OF GOVERNMENT EXPENDITURE TO TAX REVENUE			
PERIOD	LOG(RTAXREV)	LOG(RGEXP)	LOG(RGDP)
1.	0.058 (0.040)	0.266 (0.028)	0.000 (0.000)
2.	0.068 (0.040)	0.222 (0.035)	0.001 (0.011)
3.	0.074 (0.044)	0.189 (0.045)	0.002 (0.020)
4.	0.077 (0.050)	0.164 (0.051)	0.003 (0.026)
5.	0.079 (0.054)	0.144 (0.054)	0.003 (0.030)
6.	0.079 (0.056)	0.129 (0.055)	0.004 (0.035)

7.	0.077 (0.058)	0.117 (0.054)	0.004 (0.035)
8.	0.075 (0.059)	0.107 (0.053)	0.004 (0.036)
9.	0.073 (0.059)	0.099 (0.051)	0.004 (0.037)
10	0.070 (0.059)	0.092 (0.050)	0.004 (0.038)
RESPONSE OF REAL OUTPUT TO TAX REVENUE			
PERIOD	**LOG(RTAXREV)**	**LOG(RGEXP)**	**LOG(RGDP)**
1.	0.040 (0.044)	-0.013 (0.048)	0.294 (0.031)
2.	0.052 (0.045)	0.063 (0.048)	0.258 (0.030)
3.	0.066 (0.054)	0.117 (0.058)	0.227 (0.032)
4.	0.079 (0.063)	0.155 (0.066)	0.200 (0.036)
5.	0.092 (0.071)	0.182 (0.072)	0.176 (0.041)
6.	0.103 (0.078)	0.200 (0.078)	0.155 (0.045)
7.	0.112 (0.085)	0.212 (0.082)	0.137 (0.050)
8.	0.121 (0.091)	0.218 (0.086)	0.122 (0.054)
9.	0.127 (0.097)	0.222 (0.089)	0.108 (0.058)
10.	0.132 (0.101)	0.222 (0.092)	0.096 (0.061)

4.4 The Variance Decomposition (VD)

The result of variance decomposition is presented in Table 4. It is evidenced from the Table that innovations in tax revenue have positive effect on government expenditure and real output. Based on the result presented, about 4.6 percent of the variance in government spending in the first period is due to innovations in tax revenue. This increases to 6.3 percent in the second period, 8.0 percent in the third period, 9.7 percent in the fourth period, 11.3 percent in the fifth period, 12.7 percent in the sixth period, 13.9 percent in the seventh period, 15.1 percent in the eighth period, 16.1 percent in the ninth period and finally to 16.9 percent in the tenth period. Tax revenue shocks increasingly explained the shocks to government spending right from the first period to the end of the period. Similarly, it is evidently cleared from the Table that innovations in tax revenue contributes about 1.8 percent of the variation in real output in the first period, 2.7 percent in the second period, 3.8 percent in the third period, 5.0 percent in the fourth period, 6.2 percent in the fifth period, 7.6 percent in the sixth period, 8.9 percent in the seventh period, 10.2 percent in the eight period, 11.4 percent in ninth period and 12.5 percent in the tenth period. This shows that innovations in tax revenue increasingly explained the variance in government expenditure and real output shocks.

Table 4: Result of the Variance Decomposition (VD)

VARIANCE DECOMPOSITION OF REAL GOVERNMENT SPENDING				
PERIOD	**S.E**	**LOG(RTAXREV)**	**LOG(RGEXP)**	**LOG(RGDP)**
1.	0.272	4.568	95.432	0.000
2.	0.358	6.292	93.707	0.001
3.	0.411	8.029	91.967	0.004
4.	0.449	9.697	90.296	0.007
5.	0.478	11.250	88.739	0.011
6.	0.502	12.663	87.320	0.016
7.	0.521	13.932	86.047	0.021
8.	0.537	15.059	84.915	0.026
9.	0.551	16.055	83.915	0.030
10	0.563	16.931	83.034	0.035
VARIANCE DECOMPOSITION OF REAL OUTPUT				
1.	0.297	1.820	0.178	98.002
2.	0.402	2.689	2.531	94.779
3.	0.480	3.753	7.673	88.573
4.	0.548	4.957	13.877	81.166
5.	0.611	6.242	20.042	73.716
6.	0.669	7.600	25.625	66.815
7.	0.724	8.872	30.438	60.690
8.	0.775	10.151	34.477	55.372
9.	0.823	11.380	37.817	50.804
10.	0.868	12.545	40.559	46.896

The VAR stability condition was put to test using the roots of the characteristic polynomial. The result showed that all roots lie inside the unit circle, there is no root lies outside the unit circle. This implies that the VAR satisfies the stability condition. The serial correlation LM test was conducted on the residuals and the result showed that there is absence of serial correlation, LM statistic 3.7822(0.32). Also, the residuals were said to follow a normal distribution as evidenced by the result of the residual normality test with JB statistic 2.567(0.321).

5. CONCLUSION

This study examined the impact of tax revenue shocks on economic growth in Nigeria during the period from 1961 to 2011 using Times series data on variables namely government expenditure, tax revenue, GDP and consumer prices. The study employed secondary data obtained from the CBN Statistical Bulletin 2012 edition and World Development Indicators (WDIs) version 2012. The unit root property of each of the variables was investigated using ADF and PP unit root tests. The study also employed Johansen co integration technique to test for the co integration relationship among the variables in the VAR model. The results indicate that tax revenue shocks have positive effect on government expenditure and real output. The findings also suggest that tax revenue turns out to contribute increasingly to innovations in government spending and real output from the first year up to the end of the period. Based on the econometric analysis and associated findings of this study, we concluded that any policy that affects tax revenue will equally affect government expenditure and real output, hence, tax revenue shocks have positive effect on long-run economic growth in Nigeria.

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APPENDIX 1: Graphical display of trend in the data series

LOG(RTAXREV)

LOG(RGEXP)

LOG(RGDP)
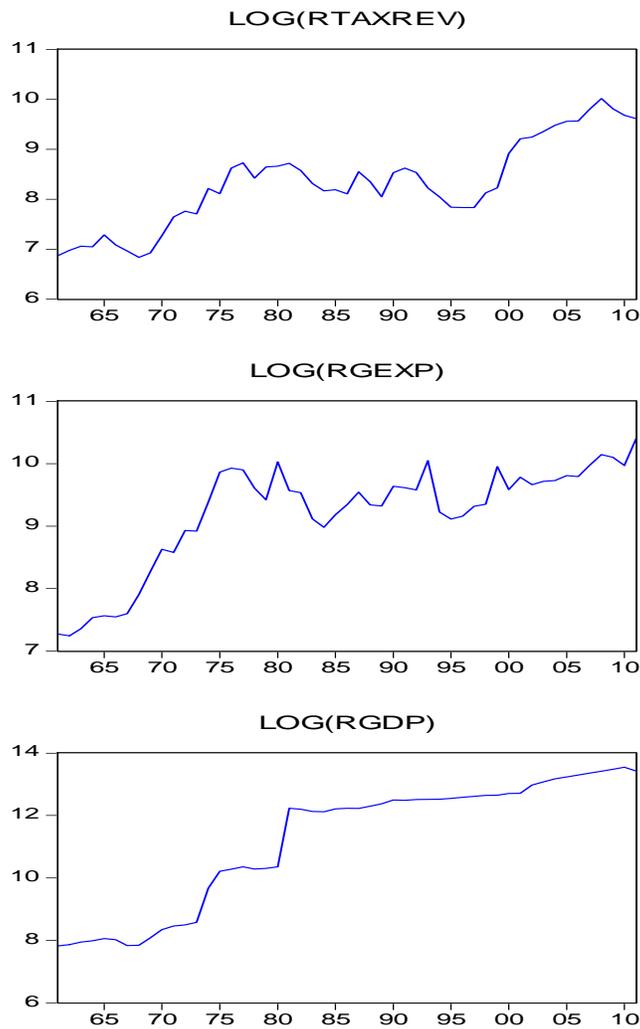
APPENDIX 2: Var Estimate Using 2 Lags

Vector Auto regression Estimates			
Date: 12/03/13 Time: 18:56			
Sample (adjusted): 1963 2011			
Included observations: 43 after adjustments			
Standard errors in ( ) & t-statistics in [ ]			
	LOG(RTAXREV)	LOG(RGEXP)	LOG(RGDP)
LOG(RTAXREV(-1))	0.917011	0.269233	-0.067228
	(0.17267)	(0.19698)	(0.21993)
	[5.31080]	[1.36679]	[-0.30568]
LOG(RTAXREV(-2))	-0.054033	-0.224529	0.134920
	(0.16697)	(0.19048)	(0.21267)
	[-0.32361]	[-1.17875]	[0.63440]
LOG(RGEXP(-1))	0.293919	0.645920	0.494831
	(0.14513)	(0.16556)	(0.18485)

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	[2.02523]	[3.90133]	[2.67689]
LOG(RGEXP(-2))	-0.189391	0.204732	-0.275221
	(0.15267)	(0.17417)	(0.19446)
	[-1.24053]	[1.17549]	[-1.41532]
LOG(RGDP(-1))	-0.026968	0.066052	0.896293
	(0.12853)	(0.14663)	(0.16372)
	[-0.20981]	[0.45046]	[5.47466]
LOG(RGDP(-2))	0.037177	-0.063692	-0.015662
	(0.11794)	(0.13455)	(0.15022)
	[0.31521]	[-0.47337]	[-0.10426]
C	0.117706	1.041186	-1.153334
	(0.51100)	(0.58295)	(0.65086)
	[0.23035]	[1.78607]	[-1.77200]
R-squared	0.936401	0.901556	0.980648
Adj. R-squared	0.925801	0.885149	0.977423
Sum sq. resids	2.129219	2.771058	3.454355
S.E. equation	0.243197	0.277442	0.309765
F-statistic	88.34090	54.94842	304.0487
Log likelihood	3.602713	-2.061982	-6.800726
Akaike AIC	0.158013	0.421488	0.641894
Schwarz SC	0.444720	0.708195	0.928601
Mean dependent	8.411080	9.290582	11.18272
S.D. dependent	0.892812	0.818660	2.061570
Determinant resid covariance (dof adj.)	0.000398		
Determinant resid covariance	0.000234		
Log likelihood	-3.284536		
Akaike information criterion	1.129513		
Schwarz criterion	1.989634		

APPENDIX 3: Result of Optimal Lag Selection

VAR Lag Order Selection Criteria						
Endogenous variables: LOG(RTAXREV) LOG(RGEXP) LOG(RGDP)						
Exogenous variables: C						
Date: 12/03/13 Time: 18:58						
Sample: 1961 2011						
Included observations: 37						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-117.9508	NA	0.138663	6.537882	6.668497	6.583930
1	-5.406636	200.7545*	0.000516*	0.940899*	1.463359*	1.125091*
2	-2.163787	5.258674	0.000712	1.252097	2.166401	1.574432
3	8.373297	15.37845	0.000673	1.169011	2.475161	1.629490
4	19.35040	14.24057	0.000638	1.062140	2.760135	1.660763
* 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				

APPENDIX 4: Var Estimate Using the Optimal Lag Selected By the System

	LOG(RTAXREV)	LOG(RGEXP)	LOG(RGDP)
Vector Auto regression Estimates			
Date: 12/03/13 Time: 19:00			
Sample (adjusted): 1962 2011			
Included observations: 46 after adjustments			
Standard errors in ( ) & t-statistics in [ ]			
LOG(RTAXREV(-1))	0.834449	0.084161	0.004377
	(0.08612)	(0.10063)	(0.10983)
	[9.68951]	[0.83638]	[0.03985]
LOG(RGEXP(-1))	0.143756	0.835470	0.277184
	(0.08255)	(0.09645)	(0.10527)
	[1.74152]	[8.66211]	[2.63309]
LOG(RGDP(-1))	0.001556	0.004286	0.877575
	(0.03331)	(0.03892)	(0.04248)
	[0.04672]	[0.11012]	[20.6604]
C	0.107457	0.838469	-1.103976
	(0.44035)	(0.51452)	(0.56156)
	[0.24403]	[1.62961]	[-1.96589]
R-squared	0.936032	0.903720	0.980794
Adj. R-squared	0.931463	0.896843	0.979423
Sum sq. resids	2.275785	3.107062	3.701204
S.E. equation	0.232777	0.271988	0.296857
F-statistic	204.8594	131.4088	714.9570
Log likelihood	3.874102	-3.287007	-7.311558
Akaike AIC	0.005474	0.316826	0.491807
Schwarz SC	0.164486	0.475839	0.650819
Mean dependent	8.369050	9.245024	11.16473
S.D. dependent	0.889156	0.846838	2.069437
Determinant resid covariance (dof adj.)	0.000330		
Determinant resid covariance	0.000251		
Log likelihood	-5.184858		
Akaike information criterion	0.747168		
Schwarz criterion	1.224205		

APPENDIX 5: Var Stability Test

A. TABLE

Roots of Characteristic Polynomial	
Endogenous variables: LOG(RTAXREV) LOG(RGEXP) LOG(RGDP)	
Exogenous variables: C	
Lag specification: 1	
Date: 12/03/13 Time: 19:02	
Root	Modulus
0.955207	0.955207
0.870071	0.870071
0.722216	0.722216
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

B. Graphical Display of the VAR stability condition.

Inverse Roots of AR Characteristic Polynomial
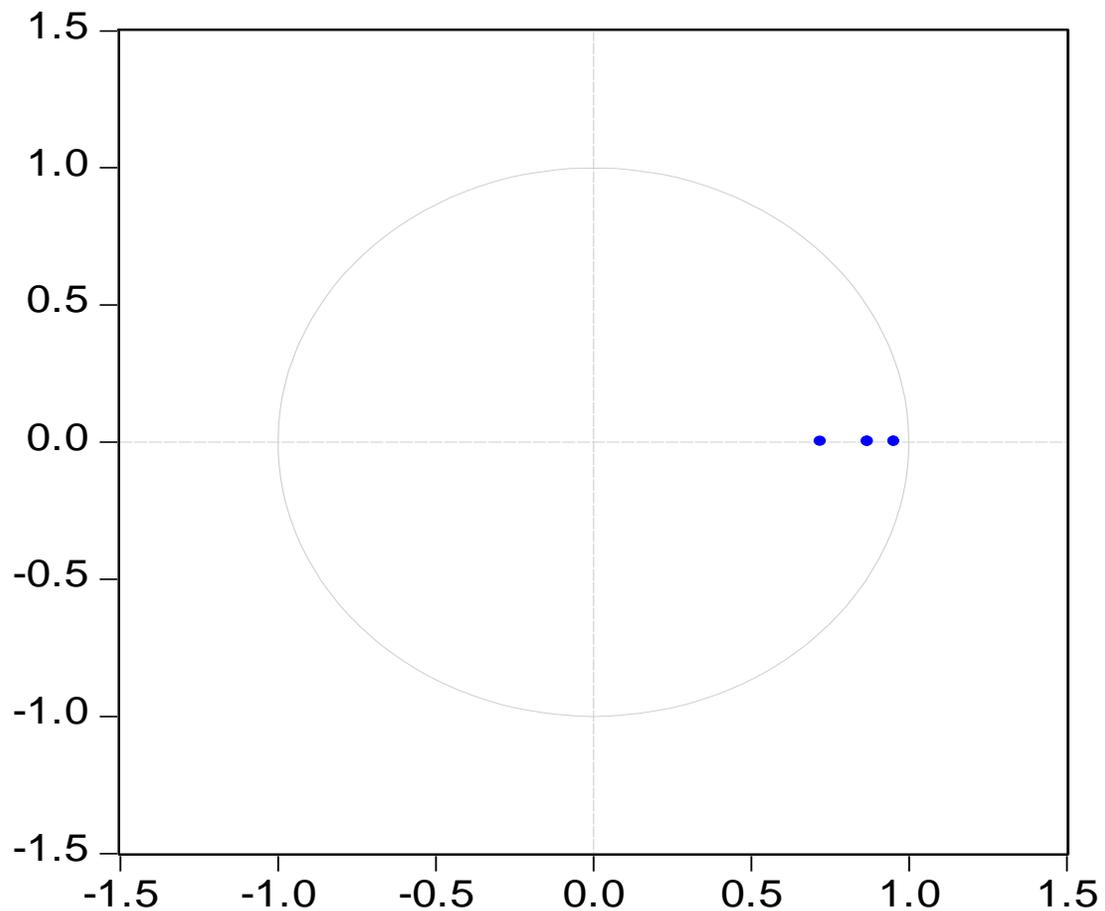
APPENDIX 6: Graphical presentation of the Impulse Response Functions (IRFs)

Response to Cholesky One S.D. Innovations ± 2 S.E.