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WAGNER'S LAW AND THE CAUSAL NEXUS BETWEEN GOVERNMENT EXPENDITURES AND TAX RECEIPTS: AN EMPIRICAL STUDY OF GHANA.

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November 2006

Preface

Wagner's law has been empirically tested for several developed and developing countries. In most of these studies, the law is tested without relating it to how public spending is financed. This paper for the first time empirically tests the law, and relates it to the causal relationship between government spending and tax revenues.

The study provides empirical evidence to the view that whereas Wagner's law relates economic growth to the source of the expanding role of government its flip side is what Keynes proposed in his *General Theory* in 1936, where the role of government serves as an engine of economic development and a countercyclical fiscal policy tool.

The study also tests the relationship between government spending and tax revenues by relating the findings to views proposed by Friedman, Buchanan-Wagner, and Barro. Classical and recent econometric techniques are used to investigate the empirical relationships.

The study is organized as follows: Section 1 is an introduction to the study. The literature review of Wagner's law, its related empirical tests, and the causal linkages between taxes and government spending are discussed in Section 2. In Section 3, the model is developed, by giving special treatment to error-correction model for a quadrivariate model, and stationarity properties of the data. Granger causality tests, data and sources of data are also discussed. The empirical results and associated diagnostic tests are reported and discussed in Section 4. The paper is concluded with policy recommendation in Section 5.

Exhaustive references are provided in the bibliography to assist future researchers to either continue with the current research or initiate a new study. The study is supported with thirteen figures and six tables.

We do hope you find this publication useful.

Mrs. Jean Mensa
Administrator
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Abstract

Wagner's law is tested by using the traditional versions and our own versions which account for prices. Results show that Wagner's law exists in Ghana. However, there is no empirical support to the view that increases in government expenditures lead to economic growth. We also fail to lend empirical support to Friedman and Buchanan-Wagner's claim that changes in taxes cause changes in government expenditures. There is no empirical evidence to support the view that budgetary processes of the country were unduly influenced along antagonistic party lines over the period of study. Rather, we find that Barro's view on fiscal policy exists in the country. This suggests that neither tax cuts proposed by Friedman, nor tax hikes advocated by Buchanan-Wagner, is an ideal policy that can be implemented to reduce the growing fiscal deficits and national debt. The optimal policy for reducing both fiscal deficits and national debt is to cut government expenditures. We also find that changes in interest rates influence economic growth, which means that monetary policy is also important in stabilizing the Ghanaian economy.

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1. Introduction

It has been long observed that as economies develop and grow, their expenditures on public services and regulations also increase and even at a higher rate than their economic growth. Adolph Wagner who pioneered the empirical test of this observation found that the elasticity of government expenditures with respect to income was greater than unity. Among the reasons for this observation is the fact that as economies grow, the role of government and its expenditures increase even faster because population in urban areas increases which in turn places more demand on social amenities such as road networks, electricity, portable water, refuse collection and extensive sewer systems. Additionally, expenditures on education, security services and protection of people and property, health services, and many more public goods become urgently needed to meet the social and political needs of the growing population, especially in the urban areas. Wagner's law therefore sees economic development and growth as a factor that causes more than proportional share in growth of government expenditures.

On the other hand, during the Great Depression, John Maynard Keynes observed that relying on the views of classical economists that market forces are invisible hands that must be left unfettered by nations and their governments to efficiently drive economic growth, hindered the economic recovery process from the mass unemployment of both people and resources which brought in their wake untold misery and poverty to the world from 1929 to 1945. In his 1936 *General Theory*, he advised nations and their governments to stop relying on the self correcting mechanism of market

forces to pull them out of the state of massive unemployment during the Great Depression, and rather lead their economies to economic recovery and growth by actively engaging in public economic activities. His recommendation on how to bring nations from the Great Depression led to the birth of fiscal and monetary policy or the field of macroeconomics. He called on governments to spend more money in building road networks, bridges, social infrastructures, hospitals, etc. which were destroyed by the Second World War (WW2). In response to his recommendation the Marshall Plan was launched by President Franklin Roosevelt of the US in the New Deal, and the expanding role of government in spending and other public activities and regulations pulled the world from the Great Depression shortly after the WW2.[1]

Thus, whereas, Wagner's law suggests that economic growth causes growth in government expenditures, Keynes' views which are dubbed as Keynesian economics suggest that growth in government expenditures causes economic growth and development. It is in the light of these two views that the current study wants to find out what the historical time series data informs us about the Ghanaian economy over the period 1965 to 2004, a sample of at most 39 years. Does the economy of Ghana exhibit Wagner's law or Keynesian economics? Although this question has been answered in studies

[1] Milton Friedman disputes the notion that Keynesian economics advocacy of fiscal policy led to the economic recovery of nations from the mass unemployment of both people and resources that saddled the world during the Great Depression. He attributes the economic recovery to WW2 and the resilience of the economy which is euphemistically known as the invisible hands or market forces. See John Hawkins' (undated) interview of Milton Friedman in the *Right Wing News, pp. 5 and 6.*

for several developed countries and some developing countries, we are not aware of any study which employs Ghana's data to answer it, so in this study we shall attempt to do just that.

We shall also study the causal relationship between government expenditures and tax receipts. As nations and economies experience economic growth their government expenditures and activities also increase even faster and thereby cause their national debts to grow exponentially. To bring national debts under control, nations must reduce their deficits, and there are varying views among economists as to the best means to achieve this objective. Some economists believe that the best way of reducing the national debt is to reduce the tax revenues of governments. Milton Friedman believes that governments are often unrestrained when it comes to spending. He argues that the only way of controlling government spending is by reducing tax receipts. He finds any attempt of governments to raise taxes to reduce the fiscal deficit and the national debt to be the principal source of feeding higher spending.[2] This means that in a situation where a country observes that its taxes are causing increase in government spending, the only way it can avert or solve its growing national debt problem is by reducing its deficits and that can be achieved only by cutting its taxes or reducing its tax receipts.

James Buchanan and Richard Wagner (1977, 1978) also attribute high

[2] Friedman claims and I quote: "I am in favor of cutting taxes under any circumstances and for any excuse, for any reason, whenever it's possible. The reason I am is because I believe the big problem is not taxes, the big problem is spending ..." See John Hawkins, *ibid*, p.2

deficits to high government spending. However, in their view, to reduce deficits and by extension the growing debts of nations, governments must be convinced to spend less and the most effective way of achieving this goal is by imposing higher taxes on the public to finance government spending. In their view, deficit finance occurs when the government employs indirect taxes in the form of printing money which creates inflation and higher interest rates due to the crowding out effect but because the public suffer from money illusion they allow the government to expand by increasing fiscal spending. It is only when they are subject to direct tax hikes that the public realize the ills of a growing government and demand that their government reduce spending. Buchanan-Wagner therefore view national debt as a net wealth created by accumulated deficit which results from politicians taking advantage of money illusion suffered by the public or voters. Deficit spending therefore makes government activities cheaper so it leads to high government spending, whereas a tax hike causes people to demand that their governments reduce their spending and behave responsibly.

Therefore both Friedman and Buchanan-Wagner consider changes in taxes as causing changes in government spending, except that in the case of Friedman, higher taxes cause higher spending, whereas in the case of Buchanan-Wagner, higher taxes cause people to force their governments to reduce their spending.

Robert Barro (1974) on the other hand argues that increases in government

spending cause budget deficits which feed into the national debt. As a result, governments are forced to increase taxes or borrow to finance their debts. In what is now commonly known as the Barro-Ricardian Equivalence, an increase in government spending which causes budget deficits and accumulates into a national debt problem is ultimately paid off by higher taxes either now or in the future even though in the short term governments can resort to borrowing. Thus in the view of Barro, national debt is not a net wealth to households. This means that increase in government spending causes an increase in taxes, so as a policy, when a country is faced with a debt problem, it should cut its spending.[3]

There are others who think that taxes and government spending are interrelated because they are determined in tandem. If that is the case then the causal relationship should be bi-directional. Others also think that the budgetary processes of the government are determined through political processes which are determined along the lines of party interests which are often in constant conflict with each other. As a result, government spending which is one of the outcomes of such budgetary processes is determined in a conflicting environment and so it is not related to taxes. This view implies that there is no causal relationship between government spending and taxes.

[3] There are many who think that Barro-Ricardian Equivalence may not hold as there is no empirical evidence to support the notion that an increase in government expenditures is matched by an increase in private savings. This is because taxes and deficits are not equivalent to government outlays. Note that Ricardo the pioneer of the equivalence idea changed his mind in his subsequent writings

In this study, we also hope to find out empirically whether increases government expenditures cause increases in tax receipts as proposed Barro or whether increases in tax receipts cause increases in governme spending as proposed by Friedman and Buchanan-Wagner; and in the case the latter, we shall also attempt to find out whether Friedman's view Buchanan-Wagner's view holds for the country. We note that if Friedmar view is true for the country, then government expenditures and tax receip will be directly related so the policy direction is to cut taxes. If on the oth hand we find out that Buchanan-Wagner's view holds for the nation, the taxes will be inversely related to government expenditures, in which case ta hikes will be required to reduce the deficits and the national debt. If Barro view holds we shall recommend that the government reduces its spending t either reduce the fiscal deficits and national debt problem or as a conditio for the public to benefit from a tax cut. A bi-directional causal relationshi will imply that either a tax change or change in government spending or bot will be required to control the deficits and the growing national deb problem. But if indeed N. Manage and M.L. Marlow's (1986, p.619) interpretation of a bi-directional causation between taxes and spending indicates that higher taxes lead to higher spending, then we will be inclined to recommend a tax cut as suggested by Friedman to reduce the deficit and national debt.[4] An independent relationship between government spending and taxes will mean that taxes are unrelated to government spending because

[4] Others believe that bi-direction causation means that governments synchronize fiscal accounts by weighing the benefit of its activities against its cost. See R.A. Musgrave (1966) and A.H. Metzler and S.F. Richard (1981).

the national budgetary processes are either determined along antagonistic party lines or the constitution separates institutions that allocate government outlays from those that collect tax receipts.

The paper is organized along the following format. The literature on Wagner's law and the causal relationship(s) between taxes and government spending is presented in Section 2. The model employed in the study and data are presented in Section 3. In Section 4, the empirical results on Wagner's law are reported and discussed. It is followed by the presentation and discussion of the empirical results on the causal relationships between government spending and tax receipts. The paper is summarized and the policy recommendations gleaned from the empirical results are presented to conclude the paper in Section 5.

2. Literature Review

2.1. Wagner's Law

Adolph Wagner pioneered a principle which he described as a 'law of increasing extension of state activity' in the late 1870s. In 1958, his works were translated into English from German, and because it occurred at a time when the Cowles Foundation was promoting econometrics as a branch of the economics discipline, it stimulated a plethora of empirical studies. The traditional version of the law was formulated by A.T. Peacock and J. Wiseman (1961). They expressed government expenditures as a function of

economic growth or development which was captured by gross domestic product (GDP) or gross domestic national product (GNP). F.L. Pryor (1968) tested the law by substituting government consumption for government expenditures. However, other earlier studies modified the traditional version by either deflating government expenditures with population or GDP, and GDP by population. See S. Gupta (1967), R.A. Musgrave (1969), N.A. Michas (1975), and A.J. Mann (1980). These studies employed the classical econometric method to estimate the relationship between the two variables. Most of the studies conducted for developed countries have employed time series data, but because of the paucity of such data in developing countries cross-sectional data are used. Often studies of developing countries have also been carried out in a generalized way by pooling cross-sectional data o several of such countries together to expand the sample period. See Gupta (1967), M. Beck (1979), S. Abizadeh and J. Gray (1985), and R. Ram (1987)

The law has also been tested in recent times using the new econometri methods of cointegration and causality tests developed by C.W.J. Grange (1969), and R.F. Engle and Granger (1987), S. Johansen (1988) an Johansen and K. Juselius (1990). See V.N.R. Murthy (1993), C Hondroyiannis and E. Papapetrou (1995), L. Oxley (1994) and S. Demirba (1999). N. Dritsakis and A. Adamopoulos (2004) tested a modified versio of Musgrave's specification of the law by replacing the per capita GDP wit per capita real GDP. But their specification did not yield the result predicte by Wagner's law. As an extension of the existing empirical literature c Wagner's law, we have modified Goffman's version, Peacock-Wiseman

version, Gupta-Michas version and Musgrave's version by accounting for prices. We have therefore expressed Wagner's law as a relationship between real economic growth and real government expenditures. This is because Wagner's law was developed during a period when inflation was not a problem in the economies of the world. However, inflation is now a problem, especially after the late 1960s. We have therefore interpreted the law to mean that when a country experiences real economic growth (per capita), its real government expenditures (per capita) increases even faster with the elasticity of the latter exceeding unity.

We have estimated ten versions of Wagner's law for Ghana: six versions from other authors and four versions from our own modification of the earlier versions. These are as follows:

Peacock-Wiseman's version: $\ln G = \alpha_1 + \alpha_2 \ln Y + u_1$ (1.1)

Goffman's version: $\ln G = \alpha_3 + \alpha_4 \ln(Y/Pop) + u_2$ (1.2)

Musgrave's version: $\ln(G/Y) = \alpha_5 + \alpha_6 \ln(Y/Pop) + u_3$ (1.3)

Gupta-Michas's version: $\ln(G/Pop) = \alpha_7 + \alpha_8 \ln(Y/Pop) + u_4$ (1.4)

Mann's version: $\ln(G/Y) = \alpha_9 + \alpha_{10} \ln Y + u_5$ (1.5)

Dritsakis-Adamopoulos' version: $\ln(G/Y) = \alpha_{11} + \alpha_{12} \ln(Y/(PopxCPI)) + u_6$ (1.6)

Ghartey's versions are modified from the existing models as follows:

$\ln(G/(CPI)) = \alpha_{13} + \alpha_{14} \ln(Y/(CPI)) + u_7$ (1.7)

$\ln(G/CPI) = \alpha_{15} + \alpha_{16} \ln(Y/(PopxCPI)) + u_8$ (1.8)

$\ln(G/(CPIxPop)) = \alpha_{17} + \alpha_{18} \ln(Y/(PopxCPI)) + u_9$ (1.9)

$\ln(G/(YxPop)) = \alpha_{19} + \alpha_{20} \ln(Y/(PopxCPI)) + u_{10}$ (1.10)

where, G = government expenditures, Y = incomes, Pop = population, CPI = consumer price index. The a *priori* expectation is that the coefficients of real per capita income on the right hand side of the equations which measure the elasticity of real per capita income with respect to the left hand side variables should be greater than unity. The error terms are also assumed to be either white noise or serially uncorrelated.

In using the recent econometric methods, Wagner's law is tested by establishing that there is a long-run equilibrium relationship (i.e. cointegration) between economic growth and government expenditures as a first approximation. The sufficient condition for testing the law is to establish that economic growth or development causes government expenditures, and this is done by using Granger causality techniques. However, because Keynes proposed fiscal expansion as a means for promoting economic growth, reverse causation will be interpreted as evidence which support Keynesian economics view. [5]

2.2. Taxes versus Spending Nexus

Ghana has been running a continuous deficit ever since the fiscal data became available in 1965. The budget deficit as a ratio of GDP rose from 5.9 percent in 1965 to 9.4 percent in 1976. It then declined steadily thereafter, recording a surplus of 0.38 percent in 1987, 0.3 percent in 1991 and 1.5 percent in 1994. However, it turned into a deficit in 1995 and continued thereon to reach its peak of 14.57 percent in 2001. Note that the gradient of

[5] See M.I. Ansari, D.V. Gordon and C. Akuamoah (1997).

deficit graph rose sharply after 1997 as shown in Figure 1: it increased further from 8 percent in 2003 to 9.5 percent in 2004 our terminal year. See also Table 1.

Ghana's growing deficits have translated into a huge national debt. Nations that experience growth in size of their government often encounter deficits because politicians tend to have a proclivity to spend more than their realized tax receipts over time. However, in 1996 when the World Bank and the International Monetary Fund launched the highly indebted poor countries (HIPC) initiative, a framework was created which enabled all creditors to provide debt relief to the world's poorest and most heavily indebted countries. This benefited Ghana when it became a member of HIPC. As a result, limitations which debts impose on economic growth of the country have been reduced, and this has been assisting it to pursue its poverty reduction strategy.[6] In July 9, 2004, Ghana reached the completion point of the HIPC initiative so its nominal debt service was reduced by $3500 million.

Additionally, the G8 proposal for debt relief which is now known as the Multilateral Debt Relief Initiative (MDRI) began to cancel the poorest countries of the world's debts in July 1, 2006, and Ghana became a beneficiary.[7] There was an additional $17 billion debt relief committed by the

[6] The HIPC initiative was modified in 1999 to allow more countries to benefit from deeper and broader debt relief. Ghana became a member after 2000 when the first New Patriotic Party (NPP) administration assumed office.

[7] The MDRI planned to cancel $37 billion debts of some poorest countries in the world's which include Ghana.

International Development Agency (IDA) under the enhanced H initiative, and Ghana stands to receive 100 percent of its debts cance This is not to mention a $547m grant made by the US to the Millenn Challenge Account to boost production of high value commercial and b food crops, and foster greater private investment in agriculture to impr the well being of the rural communities.

Thus, although the country has been running persistent deficits as shown Figure 2, the recent positive developments in the world must not misconstrued to mean that we continue on the course of incurring mo deficits. This is because the continuous increase in deficits permits t current generation to shift some of their tax burden to their children a generations unborn. It also compels the government to issue treasu securities which also leads to high interest rates which crowd out privat investments. It also causes a rise in external debt which will make it difficul for the country to access international markets to borrow. Finally, it reduce the standard of living of the nationals as the associated crowding out effec results in high interest rates which chokes off private investments and reduces expenditures and output.

As a result of the growing deficit we want to examine whether taxes cause government spending or whether there is a reverse causation. Some empirical studies have found evidence in support of increase in government spending causing taxes. See the contributions of Anderson, Wallace and Warner (1986), and G.M. von Furstenberg, R.J. Green and J. Jeong (1986).

Other studies by A.F. Darrat (1998), P.R. Blackley (1986), J.W. Ahiakpor and S. Amirkhalkhali (1989) and R. Ram (1986) have shown that increase in taxes cause increase in government spending. On the other hand, D. Joulfain and R. Mookerjie (1990), S.M. Miller and F.S. Russek (1990), and O. Owoye (1995) show a feedback causal relationship in their studies, whereas Manage and Marlow's (1986) results are ambiguous: increase in taxes causes increase in government spending, but their results vary with lag lengths. Additionally, they obtained a reverse causation when they accounted for inflation in their data.

Note that although most of these studies have been done for developed countries, and some studies have employed data from middle income countries, we are not aware of any study done for a member of HIPC on the subject.

Additionally, some studies have employed bivariate models while others have employed multivariate models. Darrat (1998) argues that because of the contradictory nature of the findings of some studies which employed a bivariate model, it is important that multivariate models be used in such studies because omission of some relevant variables could be the source of such biased results. In our view, if indeed omitted variables are sources of bias, then one cannot limit the number of variables to be included in such studies to three or four as was done by him. Note that the objection of omitted variables was pointed out by H. Lutkepohl (1982, p.367) as a possible source of bias in bivariate models, but the problem cannot be resolved by including

more than two variables in such studies.

In our judgment, a rigorous study can conclusively determine the causa relationship between any two variables, say taxes and spending. Note that ir Lutkepohl (1989), he employed a bivariate model in testing his causa relationship. This means that the use of two variables in such a study is no the problem. It is only in a situation where the results yield a feedbacl relationship between two variables that in our judgment one may have t introduce a third variable to try and resolve the causal direction if that i possible. See E.E. Ghartey (1993). A limitation in this type of study is tha even though one relies on economic theory to include the variables in th study, it is always possible to miss a relevant variable which may b influential in the outcome of such studies because of other reasons Additionally, the period covered is not marked by deflation, where one ca argue that interest rates are otiose and so exchange rates or other variables b used as a substitute transmission mechanism. Note that an increase i government spending can cause interest rates to rise and bring about decrease in income through the crowding out effect. Interest rates a therefore used as an important third variable to resolve a possible feedbac effect between government spending and income.

We have therefore employed four variables in our study to rule out th criticism raised in Darrat (1998), although we disagree with its merit. W have also tested for cointegration of the variables to identify the number possible endogenous variables which exist in our quadrivariate model. T

lend rigor to our results, we have employed different causality test approaches, tested for the stability of our leading results, and forecast historical values of our leading variables of interest and use them to track movements of their actual data.

3. The Model

3.1. The Error-Correction Model

Four variables (W, X, Y and Z) are cointergrated if there is a long-run equilibrium relationship among them. We write their relationship as

$$W_t = AX_tY_tZ_t \qquad (1a)$$

By log-linearizing, we obtain

$$\ln W_t = \ln A + \ln X_t + \ln Y_t + \ln Z_t \qquad (1b)$$

We use smaller case letters for log forms of the variables, and re-write equation (1b) as

$$w_t = a + x_t + y_t + z_t \qquad (2a)$$

in the long-run the above equilibrium relationship becomes

$$w_t = x_t + y_t + z_t, \text{ and } a \to 0, \text{ as} t \to \infty \ . \qquad (2b)$$

A disequilibrium relationship of equation (2a) in an estimation form can be written as

$$w_t = b + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 y_t + \alpha_3 y_{t-1} + \alpha_4 z_t + \alpha_5 z_{t-1} + \beta w_{t-1} + \varepsilon_t \qquad (3)$$

where $0 < \beta < 1$ for stability. Equation 3 is autoregressive distributed lag order (ARDL) (1,1,1,1), where the number in parentheses are lag lengths of the dependent variables followed by the three independent variables.

In the steady-state $y_t = y_{t-1}$, $z_t = z_{t-1}$ and $w_t = w_{t-1}$, etc.

By substituting the steady condition into equation (3), we obtain

$$w_t = b + (\alpha_0 + \alpha_1)xt + (\alpha_2 + \alpha_3)y_t + (\alpha_4 + \alpha_5)z_t + \beta w_t + \varepsilon_t \qquad (4)$$

But in the long-run equation (2a) equals equation (4) if the coefficients are equal. This means that

$$(\alpha_0 + \alpha_1) = (\alpha_2 + \alpha_3) = (\alpha_4 + \alpha_5) = (1 - \beta) = \lambda, \text{ and } E(\varepsilon_t) = 0 \text{ or } \varepsilon_t \text{ is iid.}$$

Therefore

$$\alpha_1 = \lambda - \alpha_0,\ \alpha_3 = \lambda - \alpha_2,\ \alpha_5 = \lambda\ \alpha_4; \text{ and } \beta = 1 - \lambda$$

By substituting the above into equation (3) we obtain

$$w_t = b + \alpha_0 x_t + (\lambda\ \alpha_0)x_{t-1} + \alpha_2 y_t + (\lambda - \alpha_2)y_{t-1} + \alpha_4 z_t + (\lambda - \alpha_4)z_{t-1} + (1 - \lambda)w_{t-1} + \varepsilon_t$$

which is then arranged as follows:

$$w_t - w_{t-1} = b + \alpha_0(x_t - x_{t-1}) + \alpha_2(y_t - y_{t-1}) + \alpha_4(z_t - z_{t-1})\ \lambda(w_{t-1} - x_{t-1} - y_{t-1} - z_{t-1}) + \varepsilon_t$$

or

$$\Delta w_t = b + \alpha_0 \Delta x_t + \alpha_2 \Delta y_t + \alpha_4 \Delta z_t - \lambda(w_{t-1} - x_{t-1} - y_{t-1} - z_{t-1}) + \varepsilon_t \qquad (5)$$

Equation (5) is the error-correction model (ECM), and can be expressed as ARDL(1,0,0,0), where the number in parentheses are the lag lengths of the error correction term, followed by the lag lengths of the three first differenced form independent variables. The expression in the parentheses in equation 5 is the long-run equilibrium relationship and it is obtained by invoking the steady state condition to yield

$$w_{t-1} - x_{t-1} - y_{t-1} - z_{t-1} = 0 \text{ or } w_t = x_t + y_t + z_t$$

The error-correction term in equation (5) is λ, and it measures the speed by which deviations from a long-run equilibrium are corrected. It ranges from -1 to 0. In an econometric estimation, if λ is significant and has the correct sign,

it means all four variables are cointegrated. According to Granger (1991) and Engle and Granger (1987) the causal relationship can be inferred from the significance of the error-correction term if the associated sign is correct. We have therefore used the ECM to infer long-run equilibrium relationship between and among our variables of interest and their Granger causal relationship. We have also employed the Johansen cointegration technique to test for the long-run equilibrium relationship, and the traditional Granger definition of causality to test the causal relationship among the variables.

3.2. The Stationarity Test

The unit root tests of the variables of interest are found by using the augmented Dickey-Fuller (ADF) test, Philip-Perron (PP) test and ADF-GLS test which was developed by G. Elliott, T.J. Rothenberg and J.H. Stock (1996). The augmentation in the ADF test is chosen from a maximum lag length of four by using a 't-sig' technique employed by J.Y. Campbell and P. Perron (1991) which S. Ng and Perron (1995) found to be superior to other information based techniques. In this technique, a maximum lag length is arbitrarily set based on the sample size, and it is chosen for the ADF test if its t-ratio is significant, otherwise it is reduced by a unit and retested. The process is continued successively until the last lag length is found to be significant. If no significant lag length is found, the Dickey-Fuller test is done by setting the augmentation lag length to zero. The ADF test is specified as follows:

$$\Delta y_t = \alpha + \beta t + \rho y_{t-1} + \sum_{i=1}^{i=k} \beta i \Delta y_{t-i} + \xi \qquad (6)$$

The PP which is a first order autoregressive process is specified as

$$\Delta y_t = \alpha + \beta' t + \rho' y_{t-1} + \xi'_t \qquad (7)$$

The ADF test corrects for higher order serial correlation by addin lagged differenced terms as explanatory variables. The PP test employ Newey and West dynamic estimates with truncation lags to correct the t statistic of the coefficient of the lagged endogenous variables in the firs order autoregressive process for serial correlation in the error term. Th correction is non parametric, and robust to heteroscedasticity an autocorrelation of unknown forms. The final ADF-GLS test is an efficien unit roots test for variables that are affected by autoregressive problem.

3.3. Granger Causality Test

Granger (1969) defines causality in terms of errors associated with forecasting a variable. If y is predicted by using all available information (U) and the associated forecast error is $\sigma^2(y/U)$, and it is again predicted using all available information except x and the forecast error is $\sigma^2(y/U\text{-}x)$, and $\sigma^2(y/U) > \sigma^2(y/U\text{-}x)$, then x causes ($\Rightarrow$) y. In an operational form, Granger causality is defined by using past information instead of all available information. Thus, if y is predicted by using all of its past information and the associated forecast error is $\sigma^2(y/\bar{y})$ and it is again predicted using both its own past information and past information of x and the associated forecast error is $\sigma^2(y/\bar{y},\bar{x})$, then $x \Rightarrow y$ if $\sigma^2(y/\bar{y},\bar{x}) < \sigma^2(y/\bar{y})$. In a trivariate model we will expect the forecast error associated with past information of the three variables to yield a smaller forecast error than the forecast error from its own past. To

determine the lag lengths of the past information, we have in the past used Akaike's Finite Prediction Error (FPE) or information criterion, or Schwarz Bayesian criterion (SBC) or Hannan-Quinn criterion (HQC) or the log-likelihood ratio of Simms. In this study, we have used the 't-sig' method and the SBC.

The quadrivariate model for Granger casuality test is specified as

$$\Delta y_t = \alpha + \sum_{i=1}^{i=k} \beta 1i \Delta y_t - i + \sum_{i=1}^{i=l} \beta 2i \Delta g_t - i + \sum_{i=1}^{i=m} \beta 3i \Delta x_t - i + \sum_{i=1}^{i=n} \beta 4i \Delta r_t - i + \xi \quad (8)$$

$$\Delta g_t = \alpha + \sum_{i=1}^{i=k} \beta 1i \Delta g_t - i + \sum_{i=1}^{i=k} \beta 2i \Delta y_t - i + \sum_{i=1}^{i=m} \beta 3i \Delta x_t - i + \sum_{i=1}^{i=n} \beta 4i \Delta r_t - i + \xi' \quad (9)$$

where k,l, and m are the lag lengths chosen from the 't' sig method or other information criterion. ξ_t and ξ_t' are error terms and assumed to be white noise. For a causality test between Δy_t and Δg_t in a bivariate model, we shall set $\sum_{i=1}^{i=n} \beta 4i = \sum_{i=1}^{i=n} \beta 3i = 0$, and test for the significance of the coefficients of Δg_{t-i} in equation (8), and that of Δy_{t-i} in equation (9). If the coefficients of both Δy_{t-i} and Δg_{t-i} are significant as judged by the Wald test or F-test, then there is a feedback or bi-directional causal relationship between them or Δy_t Δg_t. If on the other hand, the coefficients of Δg_{t-i} are significant either independently as judged by their respective t-ratios or jointly as judged by Wald test or F-test, whereas the coefficient of Δy_{t-i} are not significant either independently as judged by their respective t-ratios or jointly as judged by Wald test or F-test, then we conclude that $\Delta g_t \Rightarrow \Delta y_t$. A similar exercise is then repeated for trivariate and quadrivariate models to resolve a bi-directional causation results. There is no causal relationship between any two variables if their

coefficients are found to be insignificant in such exercise. For instance, if t coefficients of Δg_{t-i} and Δy_{t-i} are not significant in a similar exercise, then conclude that Δg_t and Δy_t are either independent or not causally related.

3.4. Data

Data used are collected from various issues of the International Monetar Fund's *International Financial Statistical Yearbooks*. The notations of th variables are as follows: Y is gross domestic product or GDP, G government expenditures, X is taxes, BD is budget deficits, CPI is consume price index using 1995 as the base year, Pop is population, and I is interes rates taken from Treasury Bills Rates. The sample period is 1965 to 200 which gives us 39 years. In different estimation the sample size may vary du to either the number of lags used or the estimation techniques.

4. Discussion of Empirical Results

The results in Table 2 show that with the exception of Musgrave, Mann and Dritsakis and Adamopoulos versions, all the remaining traditional versions yield income elasticity of government activities (or the elasticity of government expenditures with respect to income) coefficients of more than unity, which support Wagner's law in Ghana. Considering that all the results are plagued with serial correlation problems which affected the functional forms of the variables in some cases, we have employed a first order autoregressive process to correct them by using the Cochrane-Orcutt's (CORC) method. We have also employed the dynamic ordinary least squares

(DOLS) estimator which uses the Newey and West method to adjust standard errors of ordinary least squares (OLS) estimates by using Parzen's weight with truncation lags of 24 to correct for heteroscedasticity and serial correlation problems. There are therefore no R^2 and DW reports on the DOLS, because they are the same as the R2 and DW obtained in the OLS results.

The results in Table 2 show that the elasticity of income is greater than unity and is significant at 0.01 levels which support Wagner's law. Our versions reported in Table 3 also yield results which support Wagner's law as our income elasticity coefficients are also greater than unity with the exception of our modification from the Gupta-Michas model which yields 0.956 to 0.983. All of our results are significant at 0.01 levels, and robust: the diagnostic tests show that there are no serial correlation and heteroscedasticity problems, and the functional forms are also correct.

The stationarity tests at 0.01 significant levels using unit roots tests show that all three different tests indicate that all variables except government expenditures from the ADF-GLS tests are stationary in their first difference forms. The level form of government expenditures in the ADF-GLS form is stationary at 0.01 significant levels. See Table 4.

The Johansen's cointegration results without trends and intercepts reported in Table 5 for the quadrivariate model show that there are at most two cointegrated equations which are significant at 0.05 levels as judged by the trace (λTrace) and the maximal eigenvectors (λMax) of the stochastic

matrices.[8] This means that there are possibly two endgoneous varial among the four variables. When we reduce the variables to determine wh of the variables are endogenous, we find that government expenditures and tax receipts (x) are the two possible endogenous variables among th When each of these variables (g and x) is paired with the rest of the variab we find that there is at most one cointegrated equation between their pairs.

We also tested Granger causality between the variables using the fi difference form of the variables. The optimum lag length for these tests unity and is chosen by using the t-sig method, which is also supported most cases by the Scwarz Bayesian criterion and in a few cases by Akaik Finite Prediction criterion, and Hannan-Quinn criterion. The results of t Granger's causality test are reported in Table 6. We find that changes interest rates cause changes in economic growth; changes in econom growth cause changes in government expenditures; changes in bo economic growth and government expenditures independently cau changes in taxes; and finally, changes in taxes cause changes in interest rate The results therefore support Wagner's law as was reported in Tables 2, 3 ar 5.

We note that even though the results are robust, as judged by the diagnosti tests, and the stability of coefficients test, both Philip-Perron's tests and AD tests show that all the variables are stationary at the first different form, bu

[8] Results in Table 5 are consistent with the Johansen's cointegration results with intercept but no trends, although we have not reported the latter to conserve space.

the ADF-GLS efficient tests show similar results with exception of government expenditures which are stationary at the level form. For this reason, we have employed the autoregressive distributed lag (ARDL) estimator developed by M. Pesaran and Y. Shin (1995) which allows us to estimate error-correction model without the pre-condition of having all the variables integrated at the same order. The results of the ARDL error-correction model allow us to test cointegration, short-run dynamics and the causal relationship between the variables. The results reported in Table 6 are far more robust and confirm that Wagner's law holds in Ghana over the long-run, and in the short term as changes in economic growth cause changes in government expenditures. Additionally, changes in government expenditures cause changes in taxes, among others. The estimated error-correction terms show that the speed of adjustment to correct for long-run deviation from equilibrium ranges from -0.34 to -0.11. The speed of Wagner's law -0.26, and the speed of changes in government expenditures causing taxes is -0.34. The long-run elasticity of public expenditures with respect to changes in income is -1.09. We tested their stability by using both cumulative sum of squares (CUSUMSQ) of recursive residuals and cumulative sum (CUSUM) of recursive residuals. Both the more efficient CUSUMSQ and the less efficient CUSUM of recursive residuals, our variables of interest are shown Figures 3a-6b. The forecast of taxes using government expenditures, and government expenditures using income, are reported in Figures 7 and 8, respectively. It is clear from the figures that both downturns and upturns of actual values of taxes are captured by the forecast, and actual values of government expenditures matches their predicted values.

5. Conclusion

The empirical evidence provided in the study by using the ea specifications of Wagner's law by Peacock-Wiseman, Goffman, and Gu Michas, and our own modified versions which account for changes in pr because of inflation tendencies in economies of the world in recent tir support the law's application in Ghana. Thus, economic growth results more than proportionate share in growth of government expenditures. statistical results are further supported by recent advances in econome as there is cointegration relationship between economic growth government expenditures, and both vector auto-regressions and er correction approaches support that economic growth causes change government expenditures.

We do not find government spending to stimulate economic growth in country. This means that Keynesian-type fiscal expansion cannot lea economic growth. It may crowd out private businesses. Economic gro should be the source of expanding the activities of the government.

The same comprehensive empirical results also show that change government expenditures cause changes in government tax receipts.

There is also a bi-directional causation/feedback causation existing betw interest rates and income; changes in interest rates cause change government spending; and changes in taxes cause changes in interest ra However, these latter results are not very robust, as some of the causal t

do not confirm them.

We conclude that Barro's view which suggests that government expenditures cause government tax receipts has been strongly supported by the Ghanaian data. Both views of Friedman and Buchanan-Wagner on changes in tax receipts causing changes in government expenditures do not hold in the country. Thus, although, the Barro-Ricardian Equivalence contention that taxes and deficits are equivalent means of financing government expenditure has not been empirically tested in the study, we have provided ample evidence to support the fact that the best way for the country to deal with its growing debt is to cut government expenditures. Apart from the crowding out effect of the growing deficits and debt, we caution the government not to depend on the recent positive trends in external grants and funding to continue the trend of sharply rising fiscal deficits. In our view the country will be better served not by relying on government's activities to lead economic growth, but by relying on economic growth to bring about expansion in government activities. After all, whereas the government can only facilitate economic growth; it cannot be an engine of economic growth in the country.

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Figure 1a: Budget Deficit as a share of GDP

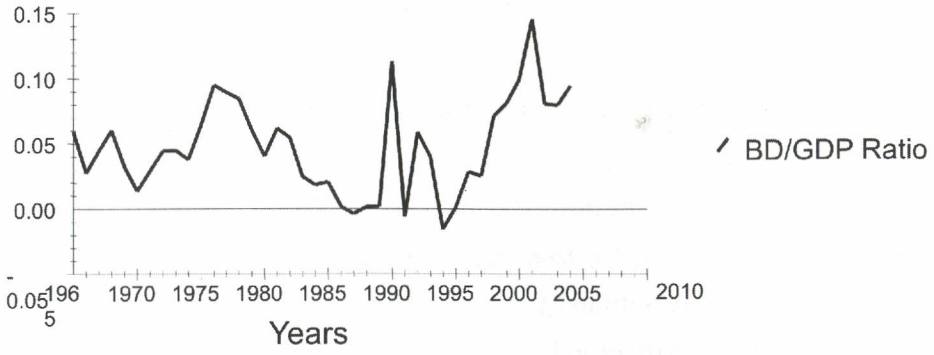

Figure 1b: Budget Deficit in millions of cedis

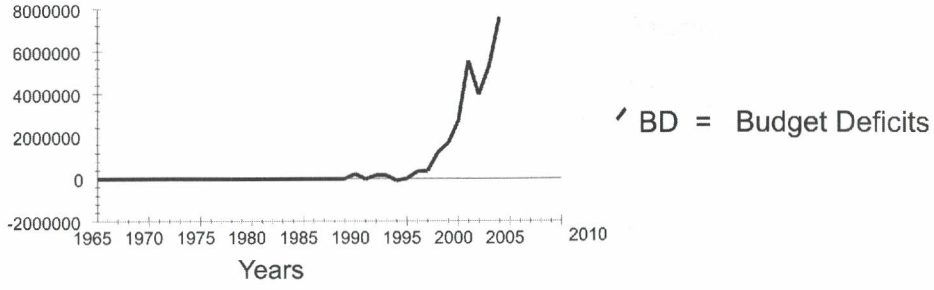

Figure 2: Government Expenditures (GEX) and Tax Receipts (GTX) as a Ratio of GDP

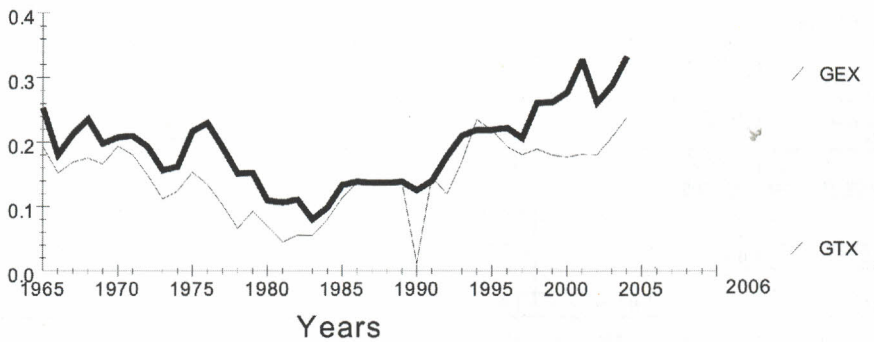

Table 1: Levels and Growth Rates of Government Expenditures and Tax Receipts as a Ratio of GDP for Some Years

	Levels		Growth Rates	
Years	GEX/GDP (%)	GTX/GDP (%)	GEX/GDP (%)	GTX/GDP (%)
1965	25.314	19.372	-	-
1970	20.713	19.358	4.742	16.557
1975	21.696	15.313	34.070	23.268
1980	10.893	6.886	-28.435	-25.252
1985	13.340	11.279	35.211	40.443
1990	12.526	1.179	-9.650	-91.352
1995	21.911	21.812	-0.000	-7.075
2000	27.713	17.718	5.833	-1.689
2004	33.286	23.783	15.580	14.488

Table 2: Estimates of the Elasticity Coefficients of the Six Versions of Wagner's Law

Version	Elasticity	$\overline{R}^2$	DW	F(k,n-k-1)	$\chi^2_{SC}(1)$	$\chi^2_{FF}(1)$	$X^2_H(1)$
Goffman's Version (1.2)							
OLS	1.132	0.990	0.258	3408.5*	24.861*	24.681*	0.962
	[58.383]*						
DOLS	1.132						
	[59.333]*						
CORC	1.121	0.997	1.722	6273.0*			
	[14.439]*						
Peacock-Wiseman's Version (1.1)							
OLS	1.024	0.992	0.252	5064.1*	28.809*	30.558*	0.005
	[71.163]*						
DOLS	1.024						
	[34.255]*						
CORC	1.052	0.998	1.758	9894.2*			
	[20.933]*						
Musgrave's Version (1.3)							
OLS	0.042	0.111	0.260	5.129*	24.505*	25.010*	0.614
	[2.265]**						
DOLS	0.042						
	[1.153]						
CORC	0.056	0.777	1.746	56.753*			
	[0.890]						
Gupta-Michas' Version (1.4)							
OLS	1.042	0.990	0.260	3211.1*	24.505*	25.010*	0.917
	[56.666]*						
DOLS	1.042						
	[28.842]*						
CORC	1.056	0.997	1.746	5904.0*			
	[16.761]*						
Mann's Version (1.5)							
OLS	0.023	0.043	0.252	2.769**	28.809*	30.558*	0.094
	[1.664]						
DOLS	0.023						
	[0.801]						
CORC	0.052	0.764	1.758	62.489*			
	[1.036]						
Dritsakis-Adamopoulos' Version (1.6)							
OLS	0.457	0.169	0.282	7.697*	24.870*	14.688*	0.693
	[2.774]*						
DOLS	0.457						
	[1.932]**						
CORC	0.158	0.778	1.858	57.170*			
	[0.612]						

Notes: Figures in parentheses are degrees of freedom, and the figures in square brackets are t-ratios. *, ** and *** denote significance at 0.01, 0.05 and 0.10 levels, respectively.

Table 3: Estimates of the Elasticity Coefficients of Ghartey's Versions of Wagner's Law

Version	Elasticity	$\overline{R}_2$	DW	F(k,n-k-1)	$\chi^2_{SC}(1)$	$\chi^2_{FF}(1)$	$\chi^2_{H}(1)$
Modification of Dritsakis and Adamopoulos Version (1.10)							
OLS	6.471	0.439	0.087	26.846*	30.725*	9.866**	0.139
	[5.181]*						
DOLS	6.471						
	[4.138]*						
CORC	1.389	0.991	1.824	1867.2*			
	[3.114]*						
Modification of Goffman's Version (1.8)							
OLS	1.042	0.278	0.097	13.728*	30.547*	14.438*	1.553
	[3.705]*						
DOLS	1.042						
	[2.534]*						
CORC	1.148	0.931	1.934	217.916			
	[4.485]*						
CORCAR(2)	1.005	0.926	1.906	137.857			
	[3.882]*						
Modification of Gupta-Michas' Version (1.9)							
OLS	0.956	0.991	0.264	3564.1*	24.036*	25.186*	0.938
	[59.700]*						
DOLS	0.956						
	[30.331]*						
CORC	0.983	0.997	1.781	6545.2*			
	[18.541]*						
Modification of Peacock-Wiseman's Version (1.7)							
OLS	1.917	0.894	0.991	320.963*	9.100**	0.959	0.073
	[17.915]*						
DOLS	1.917						
	[13.664]*						
CORC	1.409	0.930	1.943	245.928*			
	[8.193]*						

Notes: If ε is an error term which follows an AR(2) behavior then the error term is expressed as $\varepsilon_t = \rho^2\varepsilon_{t-2} + \rho\varepsilon_{t-1} + u_t$, where u is a white noise innovation. See also Table 2. CORCAR(2) is a Cochrane-Orcutt estimation where the error term is expressed as a second-order autoregressive process.

Table 4: Stationarity Tests using Unit Roots

	ADF(k)		PP		ADF-GLS	
Level form of Variables						
Gross Domestic Products, y	-0.852	[-2.95]	0.048	[-3.6]	0.874	[-2.6]
Government Expenditures, g	-0.092	[-2.95]	1.688	[-3.6]	-2.85*	[-2.6]
Government Tax Receipts, x	-0.117	[-2.95]	1.158	[-3.6]	0.38	[-2.6]
Interest Rates, i	-1.884	[-2.95]	-1.827	[-3.6]	-1.84	[-3.6]
First Difference-form of Variables						
Δy	-3.292*	[-2.95]	-9.78*	[-3.6]	-9.36*	[-2.6]
Δg	-3.113*	[-2.95]	-5.63*	[-3.6]		
Δx	-5.114*	[-2.95]	-4.34*	[-3.6]	-2.89*	[-2.6]
Δi	-5.153*	[-2.95]	-8.26*	[-3.6]	-8.23*	[-3.6]

Notes: Small case letters denote the log form of variables. The figures in the square brackets are t-ratios at 0.01 significant levels. The t-ratios for the Philip-Perron test for both level form and first differenced form at 0.01 significant levels is -3.6, ADF test is -2.9, and ADF-GLS developed by Elliott-Rothenberg-Stock is -2.6 for all except interest rates which is -3.6 for both level form and first difference form. K is the augmentation lags, and is unity.

Table 5: Johansen's Cointegration Test Results

Multivariate relations					
	H_0	H_1	λ_{MAX}	H_1	λ_{TRACE}
y, g, x and i	r = 0	r = 1	77.390*	r = 1	120.896*
	r = 1	r = 2	35.991*	r = 2	43.505*
	r = 2	r = 3	6.990	r = 3	7.514
	r = 3	r = 4	0.524	r = 4	0.524
y, g and x	r = 0	r =1	73.109*	r = 1	103.091*
	r = 1	r = 2	29.505*	r = 2	29.982*
	r = 2	r = 3	0.477	r = 3	0.477
y, g and i	r = 0	r = 1	75.693*	r = 1	83.895*
	r = 1	r =1	7.539	r = 2	8.203
	r = 2	r = 2	0.663	r = 3	0.663
g, x and i	r = 0	r = 1	73.109*	r = 1	103.091*
	r = 1	r = 2	29.505*	r = 2	29.982*
	r = 2	r = 3	0.477	r = 3	0.477
Bivariate relations					
y and g	r = 0	r = 1	72.471*	r = 1	73.010*
	r = 1	r = 2	0.538	r = 2	0.538
y and x	r = 0	r = 1	67.476*	r = 1	70.445*
	r = 1	r = 2	2.969	r = 2	2.969
y and i	r = 0	r = 1	62.507*	r = 1	63.217*
	r = 1	r = 2	0.709	r = 2	0.709
g and x	r = 0	r = 1	53.890*	r = 1	77.570*
	r = 1	r = 2	23.681*	r = 2	23.681*
g and i	r = 0	r = 1	58.549*	r = 1	58.550*
	r = 1	r = 2	0.001	r = 2	0.001
x and i	r = 0	r = 1	12.418*	r = 1	12.808*
	R= 2	r = 2	0.390	r = 2	0.390

Notes: * denotes significance at 0.05 levels.

Table 6: Autoregressive Distributed Lag Estimates of Long-run and Error Correction Model for Validating Causal Relationships; 1965-2004.

H_0: No Causal Relationship	ARDL Order (p,q,s)	Long-run Estimates	Coef. Of EC Term	Causal Direction
Incomes do not cause Gov't Expenditures	(1,0) n = 39	1.087 [40.504]*	-0.262 [5.079]*	$\Delta y_t \Rightarrow \Delta g_t$
Gov't Expenditures do not cause Income	(1,1) n = 39	1.011 [4.817]*	0.039 [0.438]	$\Delta g_t \Rightarrow \Delta y_t$
Gov't Expenditures do not cause Taxes	(2,0,3) n = 36	0.991 [68.529]*	-0.336 [4.357]*	$\Delta g_t \Rightarrow \Delta x_t$
Taxes do not cause Gov't Expenditures	(1,1,1) n = 39	1.052 [15.085]*	-0.134 [1.288]	$\Delta x_t \Rightarrow \Delta g_t$
Incomes do not cause Taxes	(2,0,3) n = 36	1.078 [30.199]*	-0.223 [4.037]*	$\Delta y_t \Rightarrow \Delta x_t$
Taxes do not cause Incomes	(1,1,1) n = 39	0.977 [21.083]*	0.112 [3.845]*	$\Delta x_t \Rightarrow \Delta y_t$
Incomes do not cause Interest Rates	(1,1) n = 39	0.115 [2.520]	-0.280 [2.171]***	$\Delta y_t \Rightarrow \Delta r_t$
Interest Rates do not cause Incomes	(1,0,0) n = 39	8.125 [4.021*]	-0.027 [1.847]***	$\Delta r_t \Rightarrow \Delta y_t$
Taxes do not cause Interest Rates	(1,1) n = 39	6.737 [4.747]*	-0.087 [2.111]***	$\Delta x_t \Rightarrow \Delta r_t$
Interest Rates do not cause Taxes	(2,0,3) n = 36	14.917 [0.407]	0.005 [0.723]	$\Delta r_t \Rightarrow \Delta x_t$
Gov't Expenditures do not cause Interest Rates	(1,0) n = 39	14.866 [1.244]	-0.013 [0.874]	$\Delta g_t \Rightarrow \Delta r_t$
Interest Rates do not cause Gov't Expenditures	(1,0) n = 39	0.114 [2.031]***	-0.223 [1.706]***	$\Delta r_t \Rightarrow \Delta g_t$

Notes: In the null hypotheses that states that incomes do not cause government expenditures, incomes are the manipulated or exogenous variables, and government expenditures are the controlled or endogenous variables. $\Rightarrow$ denotes 'cause', so $\Delta g_t \Rightarrow \Delta x_t$ means changes in government expenditures cause changes in taxes. Figures in parentheses are the order of the ARDL, and those in the square brackets are the absolute values of the t-ratios. *, **, and *** denote significant levels at 0.01, 0.05 and 0.10, respectively, EC denotes error correction, and n is the sample size. The EC model specified as ARDL (p, q, s) are two variables ECM where the lag lengths of the EC terms, dependent variable and the independent variable p, q and s, respectively. In the case of an ARDL (p, q, s) of three variables, p is the lag length of the dependent variable and q and s are the lag length of first and second independent variables.

Figure 3a: Income causing government expenditure

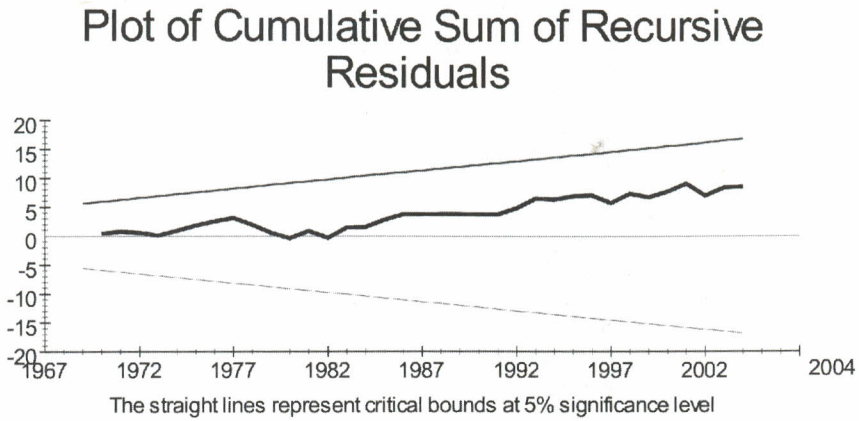

Figure 3b: Income causing government expenditures

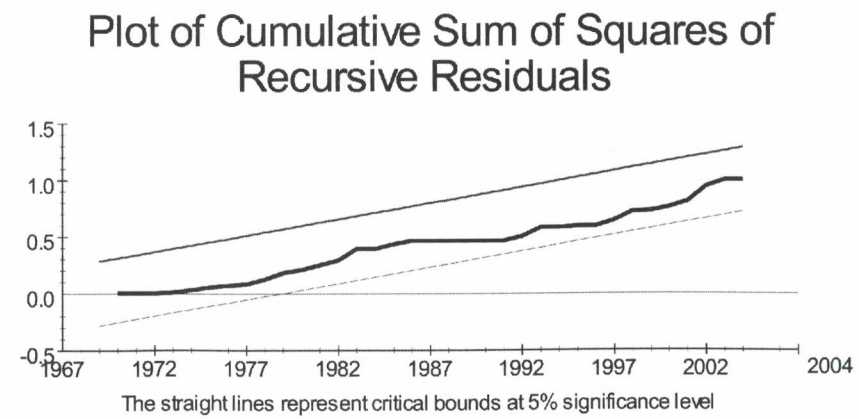

Figure 4a: Government expenditures causing income

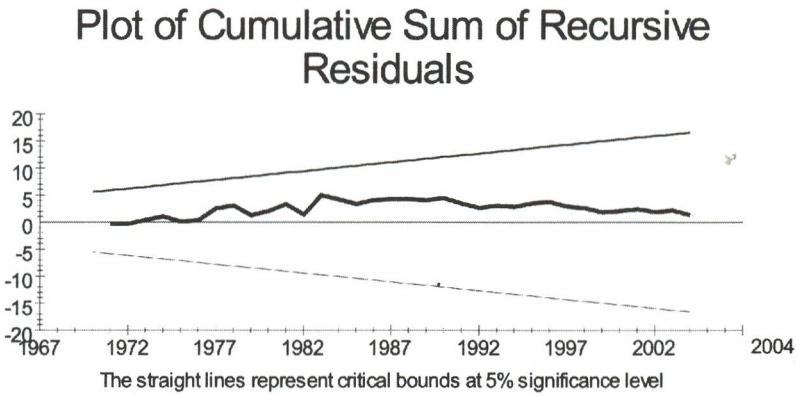

Figure 4b: Government expenditures causing income

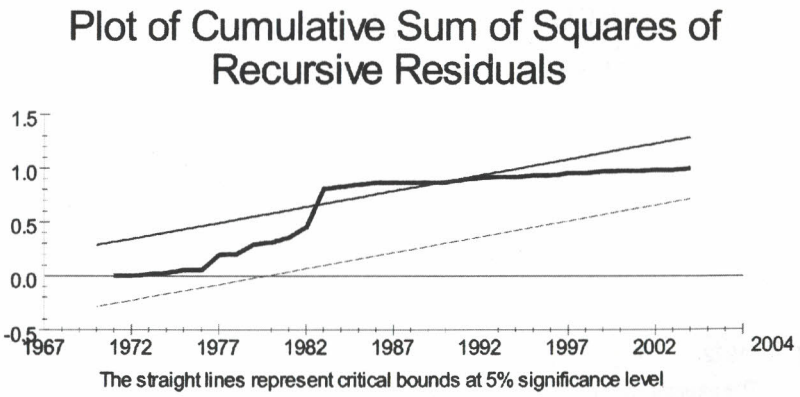

Figure 5a: Government expenditures causing taxes

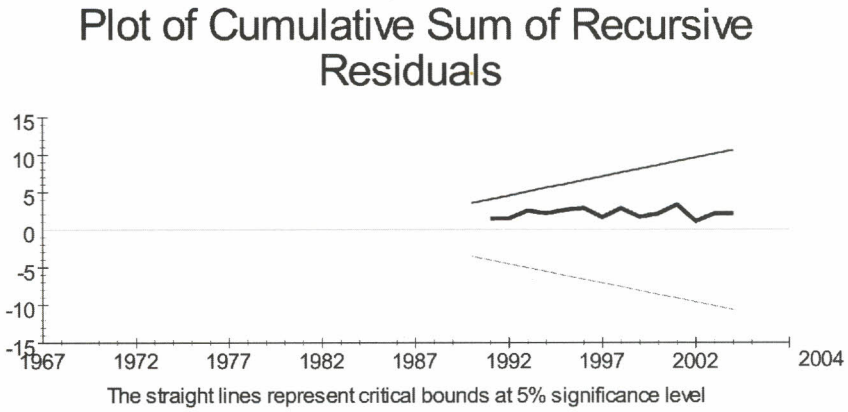

Figure 5b: Government expenditures causing taxes

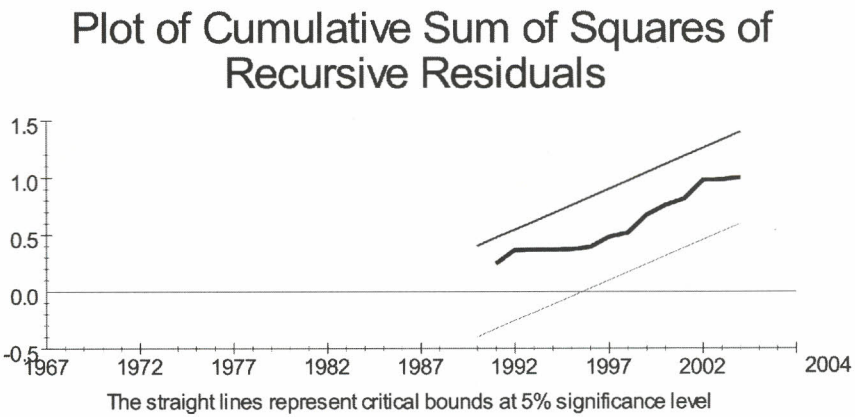

Figure 6a: Taxes causing government expenditures

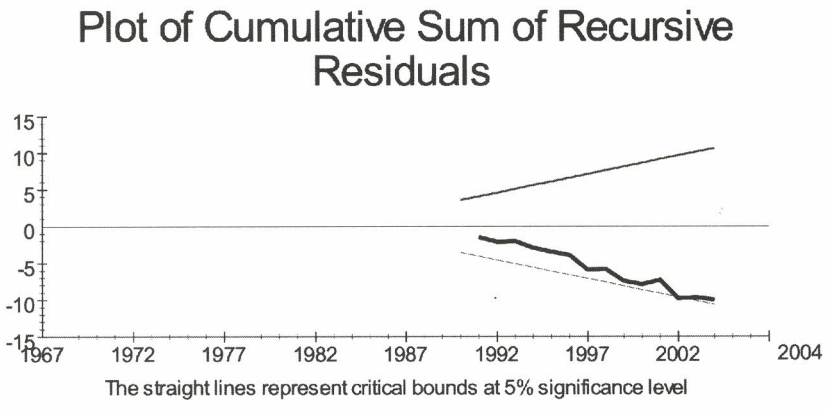

Figure 6b: Taxes causing Government expenditures

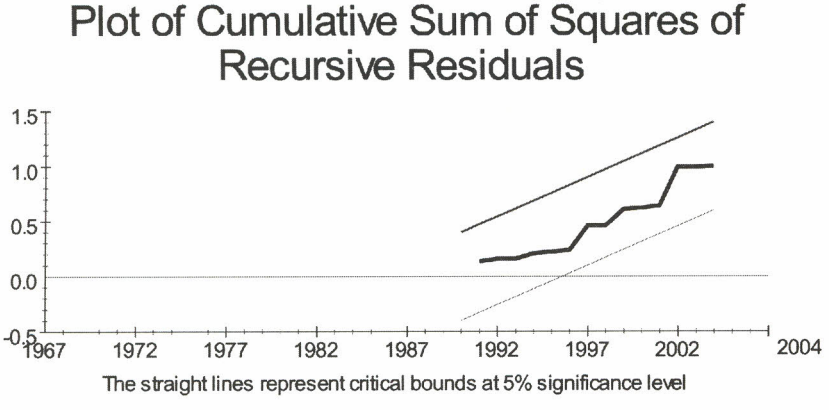

Figure 7: Plot of actual and predicted values of taxes from estimation using lagged government expenditures

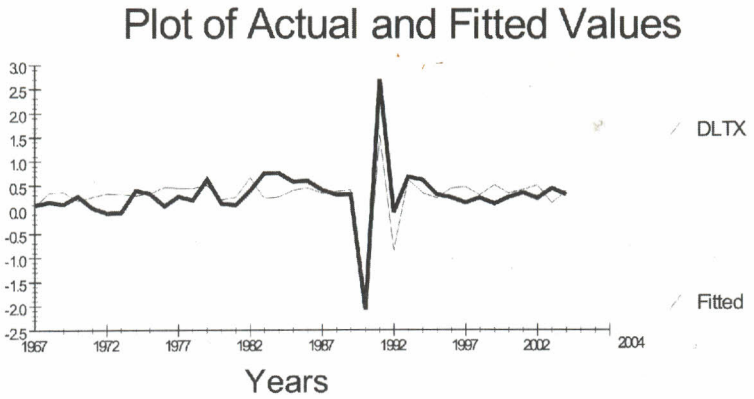

Figure 8: Plot of actual and predicted values of log form government expenditures from estimation using lagged income