CAUSALITY TESTING AND WAGNER'S LAW: THE CASE OF SRI LANKA

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ABSTRACT

This paper presents an empirical investigation into the validity of Wagner's Law for Sri Lanka over the period 1959-2010. The research methodology employed includes testing for unit root, with the Augmented Dickey-Fuller (ADF) test, the use of a Vector Autoregression (VAR) model for the implementation of the Granger causality test, and cointegration tests according to Johansen-Juselious. The cointegration tests indicate that there is a long run relationship between public expenditure (TE) and Gross Domestic Product (GDP), and the ratio of total government (public) expenditure to gross domestic product (TE/GDP) and GDP (First and Six version of Wagner's Law). Both eigenvalue and trace tests indicate that there is one cointegrating vector. Although the results reported herein do not reveal uniformity among the six versions of Wagner's Law, the results show an apparent prevalence of the direction of causality from growth of GDP to public expenditure. For the first three versions of Wagner's Law and the fifth version appear that Granger- causality runs one-way from GDP to TE, GDP to Total Consumption Expenditure (TCE), per capita gross domestic product (GDP/POP) to TE, and (GDP/POP) to per capita government expenditure (TE/POP), respectively. According to empirical findings of this study, it is possible to say that the growth of public expenditure in Sri Lanka is depended on and determined by economic growth as Wagner's Law.

INTRODUCTION

The relationship between public expenditure (government expenditure) and economic growth has attracted considerable interest among economists and policy makers since recently. Public expenditure is a key instrument of state intervention to achieve several policy goals. But there is a debate about whether the government should intervene in the market in order to correct the activities done by market forces. The classical economists disagree with the government intervention and believe that market forces swiftly bring the economy to long-run equilibrium through adjustment in the labor market. Keynesian economists identified the use of fiscal policies to boost economic activity in the time period of recessions. They prescribe expansionary fiscal policies to avoid long recessions. They identified the government expenditure as an exogenous policy instrument.

Classical and Neoclassical judgments of fiscal policies are ineffective on the basis of crowding-out phenomenon. This concept explains that when public expenditure rises,

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public goods are substitute for private goods. Then, it leads to lower the private expenditure on education, health, transportation, and other goods and services. Whenever, the government borrows heavily for spending, it makes pressures on the credit market, and, as a result, interest rate goes up. Increased interest rate reduces the private investment. However the government intervention in the economy is beneficial because it leads to correction of the resource allocations. Sometimes, it may delay or slow down the growth of economic activities. For example, competition between the less efficient public sector and the private sector in the credit market often leads to an increase in interest rate. As a result of this situation, investment as well as economic growth goes down. At the same time tax imposed by the government can affect the market prices and resource allocation process. Although government actions may also slow down the economic activities, there are arguments for the importance of government intervention in the market to correct the activities done by market forces.

Thus, the growth of public expenditure as a proportion of Gross National Product (GNP) or Gross Domestic Product (GDP) has claimed considerable attention from economists, who have mainly focused their attention on the analysis of the reasons for the growth of public expenditure. Therefore, the specific objective of this research is to see if there is a causal relationship between government expenditure and economic growth.

Due to different definitional problems, limitations, etc. the study was limited to data from the period between 1959 and 2010. The data are also examined in per capita terms and some data used in the analysis are in the form of ratios. The data are taken from the World Development Indicators (WDI) 2010 CD-ROM and Central Bank Annual reports in Sri Lanka. In the study, all variables are in natural logarithms of the variables and thus, first difference of the variable gives the growth rate. Using the econometric methodology, it is expected to study the Granger causality and long-run relationships of the variables.

THEORETICAL BACKGROUND

For a long time, there has been no general theory of determination of public expenditure. However, over one hundred years ago, a simple model of determination of public expenditure was developed by Adolph Wagner. This model can be identified as the oldest and the most cited model that explains public expenditure growth. After the publication of Wagner's works in 1958, Wagner's Law has become very popular in academic circles. And it has been tested by many researchers. For example, on the basis of his findings, Bird (1971) formulated a law of expanding state expenditure; it highlighted the importance of growing government activity and expenditure as a main feature of progressive states. Wagner's Law basically examines the long-run trends in public expenditure and economic growth, where economic growth leads to greater public sector expansion. According to Wagner (1883), when the economic activity grows, there is a tendency for the government activities to increase in the long-run. The model explains that in the process of economic development, public expenditure tends to increase at a faster rate than that of national output. Three reasons are given to justify this hypothesis as follows:

i. Social activities of the state

Wagner assumed that private sector monopolies would not pay attention to the social needs of society as a whole and therefore, those needs should be fulfilled by the public corporations.

ii. Administrative and protective actions

Further he explained that if private sector companies became larger and larger, the economy would become unstable. The individual companies create some problems and those would adversely affect the society as a whole.

iii. Welfare functions

Finally, government would need to expand the provision of some economic and social welfare activities to the society as a whole.

There are at least six broad versions of Wagner's Law, which define the relationship between economic growth and public expenditure. There is no formal rule to decide which one is the best and the easiest to use in testing the model. Therefore, any researcher should consider six versions of the law to postulate the causality direction. The six versions of the Wagner's Law are summarized in logarithm form in Table 01.

Table 01: Six Versions of Wagner's Law

Functional Form	Version
LTE = a + bLGDP	Peacock-Wiseman (1968)
LTCE = a + bLGDP	Pryor (1969)
LTE = a + bLGDP/POP	Goffman (1968)
L(TE/GDP) = a + bLGDP/POP	Musgrave (1969)
L(TE/POP) = a + bLGDP/POP	Gupta (1967)
L(TE/GDP) = a + bLGDP	Mann (1980)

Source: Based on the Wagner's Law

Where TE is the total government expenditure, GDP is the gross domestic product, TCE is the total government consumption expenditure, POP is the population of the country, GDP/POP is the per capita gross domestic product, TE/GDP is the ratio of total government expenditure to gross domestic product, TE/POP is the per capita government expenditure. In the above table, the first version of the Wagner's Law explains that the total public expenditure is a function of GDP. The second version indicates that the total consumption expenditure is a function of GDP of the country. Next explains that the change in total public expenditure is a result of the change in per capita GDP. The forth version of Wagner's Law describes the change in per capita income leads to change in the ratio of public expenditure to national income. The fifth model explains the relationship between per capita GDP and per capita total expenditure. The last point explains that the ratio of total public expenditure to GDP is a function of national income.

LITERATURE SURVEY

This section briefly reviews some selected papers that have studied the impact of government expenditure on economic growth and relationship between government expenditure and economic growth. There have been quite a number of empirical studies analyzing the effect of public expenditure on economic growth so far. However, the results are different from one to another based on the adopted techniques and data. In most of the studies, the effect of public expenditure on economic growth rate is also inconclusive. As mentioned above, public finance studies have hypothesized the growth in public expenditure as a result of growth in national income. Macroeconomic view revealed the other way that has treated the public expenditure as an exogenous variable. In a recent study by Agell et al (1997), it is revealed that there is no relationship between the rate of economic growth and size of the public sector in terms of public expenditure. Most of the empirical studies have analyzed the effect of public expenditure on economic growth by using cross-section or panel data. Ram (1986) revealed that the government expenditure promoted economic growth.

Aschauer (1989), Barro (1991), and Easterly and Rebelo (1993) found that the government expenditures on "core infrastructure", such as streets, highways, airports, and other public capital expenditures have the most explanatory power for private sector productivity. Devarajan et al (1993) have observed that the level of current expenditure has a significant positive effect on economic growth and the level of capital expenditure does not have any significant effect on the economic growth and it is negative. The evidence on the effect of sectoral composition of expenditure also is inconclusive. Barro (1990) indicates that growth effects of education and defense expenditure are higher. Diamond (1989) shows that there is a relationship between social sector expenditure and economic growth. Further, it is revealed that there is no evidence to conclude that the infrastructure expenditure is a significant factor in growth process.

Landau (1986) studied the impact of government expenditure on economic growth. In this study, government expenditure has been divided in to five sections: consumption, education, defense, transfers, and capital expenditure. The Study was conducted based on cross-section data for less developed 96 countries from 1960 to 1980. The results revealed that the above five sections have reported either significant negative, or insignificant positive effect on economic growth. Grier and Tullock (1989) examined the correlation between the growth of government expenditure in GDP and economic growth for 24 OCED countries and 89 other countries for the period of 1951-1980 and 1961-1980 respectively. They found that the growth of government expenditure in GDP and economic growth has a positive effect in Asian countries, but a negative one in OECD, African, and American countries. Chen et al. (2003) analyzed the proportion of public sector expenditure to GDP and economic growth rate for 09 countries from 1972 to 1992. They found that the economic growth rate decreased with increased proportion of the public expenditure to GDP. Demirbas (1999) investigated the existence of a long-run relationship between public expenditure and GNP for the period of 1950 to 1990 using the data for Turkey. He used time series aggregate data and the study revealed that there was no evidence to support the long-run relationship between public expenditure and economic growth. Krzyzaniak (1974) conducted a study for Turkey for the period of 1950 to 1969. He used regression analysis to identify the significance of public expenditure on GNP and found a statistically significant relationship between the income elasticity of public expenditure and GNP which supports Wagner's Law.

Ziramba (2008) examined the validity of Wagner's Law by using the causal relationship between real government expenditure and real income for South Africa for the period 1960-2006. This study revealed a long-run relationship between real government expenditure and real income. Results of the causality test showed that there was bidirectional causality. On the basis of the results, the researcher concluded that Wagner's Law does not support in South Africa.

Although a large numbers of studies are available in public finance literature, only a few have applied modern econometric techniques. Thus, the contribution of this study to the literature on the growth of public expenditure in terms of Wagner's Law will be in terms of a new approach. It applies recent econometrics techniques that investigate time series properties of the variables, and examine the causal relationship between economic growth and public expenditure.

METHODOLOGY AND RESULTS

The data employed for the study consist of GDP, total public expenditure, total public consumption expenditure, all in real terms from 1959 to 2010. The data are also examined in per capita terms and some data used in the analysis are in the form of ratios. In

the study, TE/GDP is the ratio of total government expenditure to GDP, as required by the various formulations of Wagner's Law. This paper studied pair wise Granger causality tests, and used the bi-variate Granger causality test. The bi-variate regression equations are given as follows:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_j y_{t-j} + \beta_1 x_{t-1} + \ldots + \beta_j x_{-j} + \varepsilon_t \quad (1)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_j x_{t-j} + \beta_1 y_{t-1} + \ldots + \beta_j y_{-j} + \mu_t \quad (2)$$

The bi-variate regression equations (1) and (2) test causality by implementing the propositions that,

i. the future cannot cause the present or the past;
ii. an event *x* can only cause *y* if it occurs before *y*; and
iii. the prediction of *y* can be made more accurate given the occurrence of *x*.

The Granger (1969) approach to the question of whether χ causes y is to see how much of the current γ can be explained by its past value. Further adding lagged values of χ can improve the explanation of γ. γ is said to be Granger-caused by χ if χ helps in the prediction of γ. The two-way causation is frequently the case; χ Granger cause γ and γ Granger cause χ. F-statistic is used to test the joint significance of each of the other lagged endogenous variables in the equations. The null hypothesis for the F-statistics is given as follows.

$$\beta_1 = \beta_2 = \ldots = \beta_j = 0 \quad (3)$$

Cointegration and causality tests will be performed in order to recognize whether there are long run relationships among time series. In these tests, the pattern of effect of one variable on another will be tested. Before starting the cointegration and causality tests, it is essential to investigate stationarity (or non-stationary) of each time series. If a time series is non-stationary, the regression analysis done in a conventional way will produce spurious results. In this context, the first step is to examine the time series properties of the variables.

A number of alternative tests are available for testing the stationarity of time series data. The Augmented Dickey-Fuller (ADF) test has been used to test stationarity of these variables. These tests are carried out at both levels and first difference of each time series. First, the unit root test results are reported in Table 02 for the levels and their first differences.

Table 02: Results of the Unit Root Test in Level and First Difference

	Level			First Difference		
Variable	Constant	Constant, Linear Trend	Conclusion	Constant	Constant, Linear Trend	Conclusion
LGDP	2.475923	-3.446796	U. R	-4.069197**	-4.293645**	Not U.R.
LTCE	2.447143	-1.764483	U. R	-6.066178**	-6.814512**	Not U.R.
LTE	0.703712	-2.382686	U. R	-8.200747**	-8.238046**	Not U.R.
L(GDP/POP)	2.562523	-4.083560**	U. R in Constant	-4.634343**	-5.025295**	Not U.R.

L(TE/POP)	0.942063	-2.662244	U. R	-8.210976**	-8.346791**	Not U.R.
L(TE/GDP)	-1.472335	-1.851297	U. R	-11.51026**	-11.53359**	Not U.R.

Source: Author constructed
Notes: Augmented Dickey-Fuller (ADF) Test examines the null hypothesis of a unit root against stationary.
All critical values are at 5% significant level (MacKinnon (1996) one-sided p-values).
Significant at the 5 % confidence level is represented by **.

The results show that the ADF test statistics for the per capita gross domestic product (GDP/POP) variable exceed the critical value in absolute term in the level and all other variables are non-stationary in their levels. However, when the first differences of each variable were taken, the ADF statistics are greater than the respective critical values in absolute terms, indicating that the level variables are I (1) and all other variables are stationary.

The paper found that while GDP/POP variable is integrated of order zero I (0), the other variables are integrated of order one I (1). Next, the study conducted generalized Johansen cointegration tests to see whether the TE, GDP, TCE, and the TE/GDP have a long run relationship. The tests indicate that there is a long run relationship between TE and GDP, and TE/GDP and GDP (First and Six versions of Wagner's Law). Both eigenvalue and trace tests indicate that there is one cointegrating vector.

Table 03: Results of the Johansen Co-integration Test between GDP and TE

The null hypothesis for both the tests is $r = 0$			
Trace tests		Maximum Eigenvalue tests	
Test statistics	Critical values	Test statistics	Critical value
26.74400**	25.87211	22.45853**	19.38704
The null hypothesis for both the tests is $r \leq 1$			
Trace tests		Maximum Eigenvalue tests	
Test statistics	Critical values	Test statistics	Critical value
4.285475	12.51798	4.285475	12.51798

Source: Author constructed
Note: Critical values are at the 5% significance level. MacKinnon-Haug-Michelis (1999) p-values.
** Significant at the 5% level.

Table 04: Results of the Johansen Co-integration Test between GDP and TCE

The null hypothesis for both the tests is $r = 0$			
Trace tests		Maximum Eigenvalue tests	
Test statistics	Critical values	Test statistics	Critical value
21.30994	25.87211	16.77117	19.38704
The null hypothesis for both the tests is $r \leq 1$			
Trace tests		Maximum Eigenvalue tests	
Test statistics	Critical values	Test statistics	Critical value
4.538769	12.51798	4.538769	12.51798

Source: Author constructed

Note: Critical values are at the 5% significance level. MacKinnon-Haug-Michelis (1999) p-values.

** Significant at the 5% level.

Table 05: Results of the Johansen Co-integration Test between (TE/GDP) and GDP

The null hypothesis for both the tests is $r = 0$			
Trace tests		Maximum Eigenvalue tests	
Test statistics	Critical values	Test statistics	Critical value
26.74400**	25.87211	22.45853**	19.38704
The null hypothesis for both the tests is $r \leq 1$			
Trace tests		Maximum Eigenvalue tests	
Test statistics	Critical values	Test statistics	Critical value
4.285475	12.51798	4.285475	12.51798

Source: Author constructed

Note: Critical values are at the 5% significance level. MacKinnon-Haug-Michelis (1999) p-values.

** Significant at the 5% level.

The existence of a long-run relationship between the Government Expenditure and GDP advocates that there must be Granger causality in at least one direction. In order to examine whether one variable is causally related to another, Granger (1969) introduced a concept of causality which is commonly known as, "Granger causality". This concept is based on the idea that the future cannot affect the present or the past. In a bivariate concept, if current and lagged values of 'X' improve the prediction of the future value of 'Y', then it is said that X Granger causes Y. In the present research, the causality test is carried out for the six versions of Wagner's Law. The standard F-test is used in order to determine the causal relationship between the variables. Interchanging the causal and the dependent variables in the regression equation allows a test for bi-directional causality. In the tests, causality is hypothesized to run from GDP or GDP/POP to the dependent variables, which are taking four different forms, TE, TCE, TE/GDP and TE/POP. In other words, the hypothesis that GDP causes public expenditure, requires that public expenditure does not cause GDP. The number of lags was selected using the Akaike Information Criterion (AIC). The null hypothesis is tested by using F- statistics. The results are presented in Table 6 in bivariate system of causality.

Table 06: Results of the Granger Causality Tests on the Six Versions of Wagner's Law

Null Hypothesis	F-Statistic Lag 1
DLOG(GDP) does not Granger Cause DLOG(TE)	15.5767*
DLOG(TE) does not Granger Cause DLOG(GDP)	2.81892
DLOG(GDP) does not Granger Cause DLOG(TCE)	4.36892**
DLOG(TCE) does not Granger Cause DLOG(GDP)	0.40412
DLOG(GDP_POP) does not Granger Cause DLOG(TE)	10.7951*
DLOG(TE) does not Granger Cause DLOG(GDP_POP)	3.22284
DLOG(GDP_POP) does not Granger Cause DLOG(TE_GDP)	0.04233
DLOG(TE_GDP) does not Granger Cause DLOG(GDP_POP)	1.78848
DLOG(GDP_POP) does not Granger Cause DLOG(TE_POP)	11.3715*
DLOG(TE_POP) does not Granger Cause DLOG(GDP_POP)	1.78848
DLOG(GDP) does not Granger Cause DLOG(TE_GDP)	0.00699
DLOG(TE_GDP) does not Granger Cause DLOG(GDP)	2.81892

Source: Author constructed

(*) (**) Rejection of the null hypothesis at 1%, and 5%, respectively and therefore, there is Granger causality.

The results in Table 06 show that there is evidence to support unidirectional causality from income to expenditure. In the short-run, the study found that the GDP/POP (per capita income) Granger causes government spending (TE) and the per capita government expenditure (TE/POP). The Gross Domestic Product (GDP) Granger causes government spending (TE) and the total government consumption expenditure (TCE). Hence, these results are consistent with Wagner's Law. According to empirical findings of this study, it is possible to say that the growth of public expenditure in Sri Lanka is depended on and determined by economic growth as Wagner's Law.

CONCLUSIONS

In this research, Wagner's Law was tested using the aggregate data for Sri Lanka for the period of 1959 to 2010. First this paper looked at the time series properties of the data, i.e. conducted the unit root test. The test indicated that both the public expenditure and GDP variables are non-stationary in levels except (GDP/POP), but stationary in first differences. Though the variables are in the different order of integration, this study does not use the per capita gross domestic product (GDP/POP) for testing cointegration relationships. The study found that while the GDP/POP variable is integrated of order zero I (0), the other variables are integrated of order one I (1). The study conducted generalized Johansen cointegration tests to see whether the total government expenditure (TGE), the gross domestic product (GDP), the total government consumption expenditure (TCE), and the ratio of total government expenditure to gross domestic product (TE/GDP) have a long run relationship. Both eigenvalue and trace tests indicate that there is one cointegrating vector. Next this paper carried out Granger causality test for the short-run relationship between the

variables. Granger causality test found that the growth of GDP contributed to the growth of public expenditure.

Although the results reported herein do not reveal uniformity among the six versions of Wagner's Law, the results show an apparent prevalence of the direction of causality from growth of GDP to public expenditure. For the first three versions of Wagner's Law and the fifth version appear that the Granger- causality runs one-way from DLGDP to DLTE, DLGDP to DLTCE, DL(GDP/POP) to DLTE, and DL(GDP/POP) to DL(TE/POP), respectively. Thus, results show that the growth of GDP contributes to the growth of public expenditure in Sri Lanka. The policy implications are simple. Policies that encourage gross domestic product are likely to contribute to public expenditure. Thus, if the past behavior is any guide, further increases in the economic growth are likely to be translated into higher public expenditure in Sri Lanka.

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