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An Application of Wagner's Law in the Indian Economy: 1970-71 to 2010-11

Rahul RANJAN[1], Abhishek K. CHINTU[2]

[1]*Jawahar Lal Nehru University, New Delhi, India, E-mail: rkrahul555@gmail.com*
[2]*Faculty of Social Science, Department of Economics, JPU Chapra Bihar, India, E-mail: abhishekchintu2001@gmail.com*

Abstract *Wagner's Law is the first model of public spending in the history of public finance. Wagner's 'law' of expanding state activity, is the proposition that there is a long run propensity for government expenditure to grow relative to national income. This paper tests Wagner's Law for India, using annual time series data covering the period 1970-2010. To estimate the long-run relationship between government expenditures and output. Empirical analysis is performed by using cointegration test, error correction model (ECM) and Granger causality. The results test indicated that economic growth is cointegrated with size of government. So, economic growth is the long-run forcing variable on size of government. Also Granger causality test show that a unidirectional causal flows from economic growth to size of government. On the other hands, Wagner's law is confirmed in India during the period of this study.*

Key words:
India, Wagner's Law, Economic Growth, Public Finance and Government Expenditure

JEL Codes:
H50, O10, C32

1. Introduction

The relationship between government expenditure and economic growth has received considerable attention over the last three decades. For a long time, there was no model of the determination of public expenditures. Of course, some classical economists, Adam Smith paid attention to tendencies in the long-term trend in public expenditures, but there was no attempt to translate such observations into a general theory [Tarschys, 1975]. However, over one hundred years ago, a simple model of the determination of public expenditures was offered by Adolph Wagner [1835-1917], a leading German economist of the time. On the basis of empirical findings, Wagner formulated a law of expanding state expenditures; which pointed to the growing importance of government activity and expenditure as an inevitable feature of 'progressive' state [Bird, 1971]. He was the first scholar to recognize the existence of a positive correlation between the level of economic development and the size of the public sector. Wagner [1883] offered a model of the determination of public expenditure in which public expenditure growth was a natural consequence of economic growth. Later, his views were formulated as a law and are often referred to as "Wagner's Law". His main contribution in this field was that he tried to establish generalizations about public expenditures, not from postulates about the logic of choice, but rather by direct inference from historical evidence. According to Wagner, there are inherent tendencies for the activities of different levels of a government to increase both intensively and extensively.

The idea behind Wagner's law is that goods and services provided by the government, including redistribution via transfers and, in particular, the activities of public enterprises, would increase with a county's industrialization since as the economy grows: 1) the administrative and protective functions of the state would substitute public for private activity; 2) there will be a need for increased provision of social and cultural goods and services; 3) government intervention would be required to manage and finance natural monopolies and to ensure the smooth operation of market forces (Bird, 1971). The recognition and how to mutual influence of important variables such as government spending and economic growth always have been regarded by economists and policymakers. On the one hand Government spending can be considered as an exogenous factor and affect economic growth in the form of policy instruments (Keynes's view) and on the other hand, this kind of expenditure as an exogenous factor may be the result of growth (Wagner's law). Adolf Wagner (1883) realized the positive relationship between public spending and rates of economic growth based on diachronically tendency. The public expending is one of the main factors to increase the expense of the private costs.

2. Literature Review

2.1. Wagner's Law: Theoretical Framework

Over the past two decades a vast amount of research has been devoted to testing Wagner's hypothesis which states that as economic activity grows there is a tendency for government activities to increase (Chang, 2004). Wagner's law contains five versions which have been empirically tested by different economists over the years. Despite Wagner did not present his hypothesis in mathematical form, over the decades, different economists have used different mathematical model for testing this hypothesis. Specifically, there are six versions of this law that have been empirically tested by different economists.

Peacock and Wiseman used the following double log equation to estimate the elasticity. According to them, growth in real government expenditure (RGE) is dependent upon the growth in real GDP. We have

$$\text{Ln } RGE_t = \beta 0 + \beta 1 \text{ Ln } (RGDP_t) + €_t \qquad (1)$$

Gupta used different model to test the validity of Wagner's law by accounting the increase in population. He affirmed that growth in real per-capita government expenditure (RGE/P) is dependent upon the growth in real GDP per Capita (RGDP/P).

Table 1. Absolute and Relative Version of Wagner's Law

Number	Function Form	Version
Absolute Version of Wagner's Law		
1.	Ln RGEt = β0 + β1 Ln (RGDPt) + €t	Peacock & Wiseman (1967)
2.	Ln (RGEt/Pt) = β0 + β1 Ln (RGDPt/*Pt*) + €t	Gupta (1967)
3.	Ln RGEt = β0 + β1 Ln (RGDPt/*Pt*) + €t	Goffman (1968)
Relative Version of Wagner's Law		
4.	Ln (NGEt/NGDPt) = β0 + β1 Ln (RGDPt/*Pt*) + €t	Musgrave (1969)
5.	Ln (NGEt/NGDPt) = β0 + β1 Ln (RGDPt) + €t	Mann (1980)

The difference in the above versions basically lies in the definition of dependent variable which is the role of government as defined in terms of government expenditure. The government expenditure variables used are total expenditure, consumption expenditure, per capita total expenditure and ratio of expenditure to GDP. The growth variables used in the above models are total GDP and per capita GDP.

$$\text{Ln } (RGE_t/P_t) = \beta 0 + \beta 1 \text{ Ln } (RGDP_t/P_t) + €_t \qquad (2)$$

Goffman used another mathematical form, known as the absolute version of the law, where he emphasized that real government expenditure (RGE) is dependent upon the growth in real GDP per capita (RGDP/P). Consider

$$\text{Ln } RGE_t = \beta 0 + \beta 1 \text{ Ln } (RGDP_t/P_t) + €_t \qquad (3)$$

R. A.Musgrave and P. B.Musgrave have explained that growth in the share of nominal government expenditures in nominal GDP (NGE/NGDP) depends upon the real GDP per capita (RGDP/P). Consider

$$\text{Ln } (NGE_t/NGDP_t) = \beta 0 + \beta 1 \text{ Ln } (RGDP_t/P_t) + €_t \qquad (4)$$

Mann interpreted the law in relative sense. He used the real GDP instead of real GDP per capita as an independent variable. According to him, nominal government expenditures in nominal GDP (NGE/NGDP) depend upon real GDP as follows:

$$\text{Ln } (NGE_t/NGDP_t) = \beta 0 + \beta 1 \text{ Ln } (RGDP_t) + €_t \qquad (5)$$

We summarize the entire theoretical framework as in table 1.

2.2. Empirical Studies

Empirical tests of this law have yielded results that differ considerably from country to country. Several multi-country studies have been conducted, an example being the studies of Wagner and Weber (1977) which tests the law for 34 nations during the post World War II era. With the exception of France, Germany and Iceland, Wagner and Weber conclude that most Western democracies show trends supporting Wagner's Law.

Ranjan and Sharma examined the effect of public expenditure on economic growth during the period from 1950 to 2007 in India. They found a significant positive impact of public expenditure on economic growth. They also reported an existence of cointegration among the variables. Singh and Sahni used Granger causality test to determine the causality direction between national income and public expenditures in India. Aggregate as well as disaggregate expenditure data for the period of 1950 to 1981 was used. Data used in the study were annual and deflated by using implicit national income deflator. The study finds no causal relationship confirming the Wagnerian law or the opposite view.

Studies done by Abisadeh and Gray (1985) cover the period 1963-1979 for 53 countries and point out that Wagner's Law holds true for the developing countries but not for poor and developed countries. On the other hand, studies by Ram (1986) examines 63 countries for the period 1950-1980 and finds limited support for Wagner's Law. However, a recent studies by Chang (2002) examines three emerging countries in Asia (South Korea, Taiwan, and Thailand) as well as three industrialized countries (Japan, the United States, and the United Kingdom) over the period 1951-1996, with the exception of Thailand, again supports the validity of Wagner's Law.

Verma and Arora (2010) examined the validity of Wagner's law in India over the period from 1951 to 2008. Empirical evidences regarding short-run dynamics refuted the existence of any relationship between economic growth and the size of the government expenditure. Afzal and Abbas reinvestigated the application of the Wagner's hypothesis to Pakistan over the period from 1960 to 2007 using time series econometrics techniques. The study found that Wagner's hypothesis does not hold for aggregate public spending and income for three periods (1961–2007, 1973–1990, and 1991–2007) while it holds only for the period from 1981 to 1991. However, when fiscal deficit is included, the results supported the existence of Keynesian views about public spending and growth. Table 2 shows the empirical findings of the test of Wagner's law.

Table 2. Selected empirical findings on Wagner's law

Author's	Country	Method	Main Results
Oxley (1994)	Britain	Granger causality test	Support Wagner's law during the period 1870-1913
Islam (2001)	USA	Johansen-Juselius cointegration test	Strong Support for Wagner's law for the USA during the period 1929-1996
Aregbeyen (2006)	India	Johansen Cointegration test and Granger causality test	Support Wagner's law during the period 1970-2003
Ghorbani and Firooz Zarea (2009)	Bangladesh	Engle and Granger - ECM	Support Wagner's law during the period 1960-2000
Aziz and Abul Kalam (2009)	Pakistan	Johansen's cointegration test and Granger Causality test	Support Wagner's law during the period 1976-2007
Verma and Arora (2010)	India	Cointegration and Error Correction Model	Support Wagner's law during the period 1950-2007

Source: Author's finding

Finally, Murthy (1994) suggests a broad interpretation of the law to allow for the addition of more explanatory variables related to economic development and government expenditure, such as the degree of urbanization, budget deficits, etc into Wagner's functional forms, which would also reduce the omitted variable bias and misspecification in econometric estimations.

3. Objective of the Study

The primarily objectives of the paper is to test five models of Wagner's Law in the Indian phenomenon.

- To test the Wagner's Law in the Indian context
- To examine the short and long run relationship between government expenditure and output
- To examine the causal relationship between government expenditure and output.

3.1. Methodology and Data Source

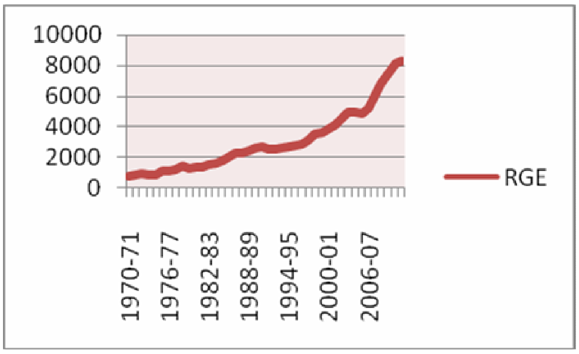
The study test the Wagner's Law in the Indian context. The data used in this study are real and nominal GDP, real and nominal government expenditures[2], and population. The annual data covers the period 1970–2010. Gross Domestic Product (GDP) is taken at factor cost at constant price for the base year 2004-05. We use five models for testing this hypothesis which is discussed above. We shall test for stationary test for that we will use the ADF or PP test. For measuring short and long run relationship between GDP and Government Expenditure, the Co-integration and Error Correction Mechanism will be applied respectively. Then, after that Granger Causality test will be applied to test causal relation between GDP and Government Expenditure.

Data Sources: The data will be collected from the secondary sources. The main sources of data are RBI annual report. The data for the study will be collected from RBI Handbook of Statistics in Indian Economy

2011-12. The real and nominal GDP, nominal government expenditure and population data is taken from the RBI handbook and real government expenditure is calculated form nominal government expenditure by using GDP implicit deflator[3]. Actually, real government expenditure is not given so we use the appropriate deflator (GDP Implicit Deflator) to convert the real government expenditure.

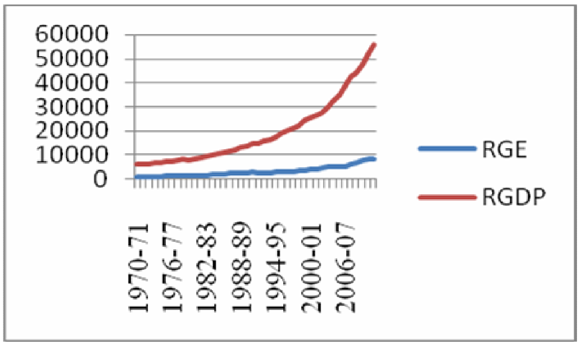
4. Trend of Public Expenditure in India

The magnitude of public expenditure is one of the applied ways to measure the size of government in the whole economy. For this purpose, it is also necessary to compare the magnitude with something else that can enable reader to get a glance idea about its size. In Figure 1, we introduce a time series data of public expenditure in a real term for the period of 1970 – 2010.



Source: RBI Handbook 2011-12

Figure 1. Trend of Public Expenditure



Source: RBI Handbook 2011-12

Figure 2. Trend of Public Expenditure and Economic Growth

Since the beginning of the period, public expenditure had experienced with an increasing trend. This trend itself cannot, however, give apparent idea about what would have caused to such increase. Taking 1991s policy changes on economic structure into account, it is a questionable matter that, though, India started to experience with the model of open economy, and privatizing policies were in governments' agendas, public expenditure had however sharply gone up, figure 2 presents magnitude of both public expenditure and GDP in real terms.

4.1. Regression Analysis

For the validity of Wagner's law, the growth elasticity of public expenditure values should exceed unity and more than zero for absolute and relative versions respectively. That means the value of coefficients (β1) for one to three models should be greater than one and the value of β1 for four or five models should be positive. For that we shall use simple OLS model for the testing of Wagner's Law.

Table 3. Regression Analysis

Model	Intercept (β0)	Long Run Elasticity (β1)	R^2
1.	-2.125 (000)*	1.026 (000)*	0.974
2.	-2.11 (000)*	1.024 (000)*	0.939
3.	-7.753 (000)*	1.578 (000)*	0.944
4.	-2.115 (000)*	0.241 (000)*	0.084
5.	-2.214 (000)*	0.026 (000)*	0.023

*Note: * means 1% level of significance*

In models 1 to 3, β1 is greater than one and model 4 to 5, β1 is positive and all are statistically significant at 1% level of significance. The regression results show that all five models do satisfy the Wagner's Law in the Indian context for the period of 1970-71 to 2010-11.

5. Stationary Test

If time series data are non stationary then the regression results based on the ordinary least squares (OLS) method will be spurious. Therefore there is a need to test whether the time series is stationary or not. In other words the determination of order of integration of each time series variable is required. The objective will be attained by unit root testing of the time series. The unit root test provides the information about the stationary of the time series variable is not stationary, then the series contains unit root and for determining the order of integration of each time series variable is to deploy the Augmented Dicky Fuller (ADF) test[5]. This test involves the estimation of the following forms of regression equations with intercept and trend. Before going to use the ADF test we will formulate the hypotheses which are the null or alternative hypothesizes and they are denoted as H0 or H1 respectively.

H0: The given data is non stationary that it has unit root and *H1: The given data is stationary that means it does not have unit root.*

Table 4. Stationary Tests (Trend and Intercept)

Variables	ADF		PP		Order of Integration
	Level	1st difference	Level	1st difference	
LNRGE	-2.745	-5.217**	-2.626	-6.225**	I (1)
LNRGDP	-1.255	-5.592**	-1.420	-7.987*	I (1)
LNRPCGE	-2.564	-5.196**	-2.37	-6.199**	I (1)
LNRPCGDP	-0.819	-5.584**	-0.979	-7.898*	I (1)
LN (NGE/NGDP)	-2.227	-5.439**	-2.534	-5.79**	I (1)

*Note: * and ** means 1% and 5% level of significance*

Table 4 shows that all variables are not stationary at the level and they are stationary at the first difference. The next step is to test whether they have long run relationship or not, they are cointegrated in the long run or not. For that we use the Cointegration test.

5.1. Co-integration Test

The two variables will be cointegrated if they have a long term, or equilibrium relationship between them. In order to examine whether there is long run equilibrium relationship between GE and GDP, the stationary of the residuals obtained from the cointegration regression of GE on GDP has to be tested by using ADF test with trend and intercept. Since our data is stationary at I(1), then the residuals from these equations must be stationary at I(0), then we can say that two variables are cointegrated or there is long run relationship between them. The equation can be expressed as:

$$\Delta U_t = \beta 0 + \beta 1t + \beta 2\, U_{t-1} + \sum_{i=1}^{k} \beta i\, U_{t-1}$$

Table 5. Cointegration: Unit Root Test for Residuals

Model	Variables	Level	Order of integration
1.	Error1	-5.419**	I (0)
2.	Error2	-5.416**	I (0)
3.	Error3	-5.418**	I (0)
4.	Error4	-5.400**	I (0)
5.	Error5	-5.420**	I (0)

Note: ** means 5% level of significance

In table 5 all error terms are stationary at the level that means there is long run relationship between the variables or they are cointegrated in the long run. The presence of cointegration implies that there exists short run dynamics, which will lead to equilibrium in long run. Therefore, it is possible to estimate an Error Correction Model to know the short-run dynamics between economic growth and growth of public expenditure in case of India.

5.2. Error Correction Model

If we find evidence of a long run relationship, we then estimate the error correction model (ECM), which incorporates variables both in their levels and first difference and captures the short run disequilibrium situations as well as the long run equilibrium adjustments between the variables. As per this study, the ECM specification is given as follows:

$$\Delta LNRGE = \beta 0 + \beta 1\, \Delta\, LNRGDP + \beta 2\, €_{t-1} + €t$$

Where Δ denotes the first difference operator, €t is a random error term and € (t-1) is the one period lagged value of the error from the cointegration regression. The above error correction model states that ΔLNRGE depends on Δ LNRGDP and also on the equilibrium error term. Where β1 and β2 are parameters to be estimated and while β1 measures the immediate impact of a change in LNRGE; β2 indicates a direct convergence to long run equilibrium. Table 6 presents the results of an error correction model (ECM).

Table 6. Error Correction Model

Model	Intercept (β0)	Short Run Income Elasticity (β1)	Error Term (β2)
1.	0.0101 (0.619)	0.9335** (0.013)	0.104 (0.546)
2.	0.0101 (0.514)	0.913** (0.010)	0.100 (0.561)
3.	0.0315** (0.049)	0.859** (0.016)	0.098 (0.570)
4.	0.0100 (0.514)	-0.0869 (0.798)	0.100 (0.561)
5.	0.0107 (0.619)	-0.066 (0.853)	0.104 (0.546)

*Note: ** means 5% level of significance*

The adjustment coefficient is positive suggesting that any deviation of public spending from the value implied by the long run equilibrium relationship with GDP in the same direction. In particular, the error correction coefficient is positive in all the models but they are not statistically significant. The short run elasticity is high in the first three models and they are statistically significant but short run elasticity in the last models is very and they are not statistically significant.

5.3. Granger Causality Test

The next step of the estimation is to test the causality among the variables. For this purpose, the causal direction framework developed by Granger (1969) has been used the systematic testing and determination of causal direction framework, simply based on the axiom that past and present may cause the future, but the future cannot cause the past. The Granger causality test will be run based on the following equations:

$$\Delta\ LNRGE_t = \beta 0 + \sum_{i=1}^{k}\beta i\ \Delta LNRGE_{t-i} + \sum_{j=1}^{k}\beta i\ \Delta LNRGDP_{t-j} + U_t$$

$$\Delta\ LNRGDP_t = \beta 0 + \sum_{i=1}^{k}\beta i\ \Delta LNRGDP_{t-i} + \sum_{j=1}^{k}\beta i\ \Delta LNRGE_{t-j} + U_t$$

Where LNRGE (t) and LNRGDP (t) are two stationary series and i and j stand for lag lengths. The unilateral causality exists when LNRGE (t) is said to be Granger caused by LNRGDP (t) which means that the coefficients on the lagged of LNRGDP (t) statistically significant. On the other hand, a bilateral causality is said to exist when both coefficients are statistically significant, and there is independence when both are statistically insignificant. Table 7 presents the Granger Causality results.

Table 7. Granger Causality Results

Model	Null Hypothesis	Lag	Obs	F Stat	Prob.	Final Result
1.	RGE does not Granger cause RGDP	2	39	1.067	0.355	Not Rejected
	RGDP does not Granger cause RGE	2	39	0.827	0.446	Not Rejected
2.	RPCGE does not Granger cause RPCGDP	2	39	1.010	0.375	Not Rejected
	RPCGDP does not Granger cause RPCGE	2	39	0.979	0.386	Not Rejected
3.	RGE does not Granger cause RPCGDP	2	39	0.848	0.437	Not Rejected
	RPCGDP does not Granger cause RGE	2	39	1.188	0.317	Not Rejected
4.	(NGE/NGDP) does not Granger cause RPCGDP	2	39	0.036	0.965	Not Rejected
	RPCGDP does not Granger cause (NGE/NGDP)	2	39	1.010	0.374	Not Rejected
5.	(NGE/NGDP) does not Granger cause RGDP	2	39	0.044	0.957	Not Rejected
	RGDP does not Granger cause (NGE/NGDP)	2	39	1.067	0.350	Not Rejected
1.	RGE does not Granger cause RGDP	3	38	0.850	0.477	Not Rejected
	RGDP does not Granger cause RGE	3	38	0.388	0.762	Not Rejected
2.	RPCGE does not Granger cause RPCGDP	3	38	0.888	0.458	Not Rejected
	RPCGDP does not Granger cause RPCGE	3	38	0.405	0.750	Not Rejected
3.	RGE does not Granger cause RPCGDP	3	38	0.365	0.779	Not Rejected
	RPCGDP does not Granger cause RGE	3	38	0.958	0.425	Not Rejected
4.	(NGE/NGDP) does not Granger cause RPCGDP	3	38	0.307	0.820	Not Rejected
	RPCGDP does not Granger cause (NGE/NGDP)	3	38	0.888	0.458	Not Rejected
5.	(NGE/NGDP) does not Granger cause RGDP	3	38	0.283	0.837	Not Rejected
	RGDP does not Granger cause (NGE/NGDP)	3	38	0.850	0.477	Not Rejected
1.	RGE does not Granger cause RGDP	4	37	2.241	0.089*	Rejected
	RGDP does not Granger cause RGE	4	37	0.296	0.878	Not Rejected
2.	RPCGE does not Granger cause RPCGDP	4	37	2.252	0.092*	Rejected
	RPCGDP does not Granger cause RPCGE	4	37	0.260	0.900	Not Rejected
3.	RGE does not Granger cause RPCGDP	4	37	0.254	0.305	Not Rejected
	RPCGDP does not Granger cause RGE	4	37	2.326	0.080*	Rejected
4.	(NGE/NGDP) does not Granger cause RPCGDP	4	37	0.198	0.938	Not Rejected
	RPCGDP does not Granger cause (NGE/NGDP)	4	37	2.340	0.098*	Rejected
5.	(NGE/NGDP) does not Granger cause RGDP	4	37	0.216	0.928	Not Rejected
	RGDP does not Granger cause (NGE/NGDP)	4	37	2.242	0.089*	Rejected

The Granger causality test is conducted for all five models using different lags to examine the lead-lag relationship among the variables incorporated in this study. The results are reported in Table 7. The reported results reveal that, there is no evidence of bilateral causality between public expenditure and economic growth but we found the evidence of unilateral causality between public expenditure and economic growth.

6. Conclusions

The present study provides empirical support to the Wagner's law in the Indian context for the period 1970-71 to 2010-11. For the validity of Wagner's law, we test the hypothesis whether the growth elasticity of public expenditure is greater than one (for absolute version) and positive (for relative version), the popular five mathematical models of Wagner's law have been estimated and all models do satisfy the Wagner's law. The overall conclusion that emerges from the empirical analysis is that there exists long run relationship between economic growth and growth of public expenditure in case of India. Empirical evidences regarding short run impact of economic growth on public expenditure is significant which confirms the impact of increasing GDP on the size of government expenditure. But there is no two way causation relationship between public expenditure and economic growth in India. However, this study can be further extended in future by considering the composition of public expenditure and economic growth in India which can help the policy makers to make a deeper understanding on the relationship between public expenditure and economic growth.

Endnotes

1. See Verma and Arora paper (2010)

2. When GDP is taken at constant price is called real GDP and it is taken at current price is called nominal GDP, same condition apply in the government expenditure.

3. *GDP Implicit deflator is a ratio of nominal GDP and real GDP*

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