The demand for public goods in India: an empirical test of Wagner's Law

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Abstract. *The public sector has become increasingly important in the modern market economies of today. According to Adolph Wagner (1959), at any given time public expenditures reflect the requirements of the prevailing economic situation in a country. Changes in these expenditures signals structural changes in the national economy. Wagner based this on the income elasticities of demand for services provided by the government, and the encroachment of the public sector on the private sector in the course of economic development. The focus of this study is on both of these considerations. An empirical study on the income elasticities of demand for public goods in India is conducted for the 1955-1983 post-independence period. The second consideration follows the income elasticity test thus completing an empirical test of Wagner's Law.*

Introduction

In the mixed economic systems of modern market economies, the role of the public sector has increased over the last one hundred years. This has been recorded in terms of both the government's role in satisfying public wants and the increased role of transfer payments in private income (Adler *et al.*, 1964). Studies done for the United States (Fabricant and Lipsey, 1952), Germany (Andic and Viverka, 1964), Japan (Emi, 1963) and most notably, the United Kingdom (Peacock and Wiseman, 1961) show evidence of this fact. It has since been generally accepted as a universal phenomenon (Hicks, 1966).

Adolph Wagner (1959) stated that at any given time, public expenditures reflected the requirements of the prevailing economic situation in a country. Increases in these expenditures indicate social progress or changes in the structure of the national economy.

This was based on two considerations: first, that the income elasticities of demand for services provided by the government are greater than unity, and second, that during the course of economic development, the public sector constantly encroaches on the private sector (Pryor, 1966).

In analyzing the first consideration, which is the focus of this study, Wagner divided government expenditure into two functions. First is the justice and power function that deals with internal and external security. The second is the cultural and welfare function, which deals with socio-cultural and economic expenditures (Reddy, 1972).

Regarding the former, Wagner stated that military forces in such economies, even without their aggressive aspects, take on a preventive role which requires increasingly large standing armies, even in peacetime. The latter function, according to Wagner, implies that larger expenditure on education and public health are needed with higher GNP. This is because education leads to productivity, which is needed for an expanding economy. Growth also leads to urbanization, creating problems of public health that must be addressed by the government. The consumption of cultural services grow faster than GNP, as needs of the population increase with increased income. Along with this, bureaucratization increases with the increasing functions of the government (Reddy, 1972).

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The second consideration, namely that of public sector encroachment on the private sector, is due to the consolidation of government powers and breakdowns on the market mechanism (Peacock and Wiseman, 1961). This leads one to believe that the existence of the public sector is a positive externality, which is reflected in the positive income elasticity of demand for public goods. The investigation of whether this is true for a developing market economy, such as India, completes the theme of this paper.

One may analytically restate Wagner's Law as follows: if the income elasticity of demand for government output is unity, then the ratio of government output to total demand remains constant. If this income elasticity is greater than unity, public expenditures will account for an increasing proportion of total income over time.

This hypothesis has been empirically verified extensively for both developing and developed countries, using both time series and cross sectional data (Andic and Viverka, 1964; Hadjimatheou, 1976; Hinrichs, 1965; Johansen, 1965). The objective of this paper is to prove that an increasing proportion of government spending to total income is not necessarily implied by a proportionately greater increase in demand caused by a given increase in per capita income for a developing country, such as India. Alternately stated, the "power function" of government expenditure may dominate the "welfare function" in such a case. This study investigates whether this is true for India. Although the advent of Neoliberalism in the 1980s has had appreciable effect on the economic policies of developing countries, the current study is not affected. The hypotheses tested here can be stated as "is the income elasticity for public goods in India, a developing country during the period between 1955 to 1983, greater than, less than or equal to one (e.g. the Wagner effect). That is did the Wagner effect hold for India during the post-independence years studied.

Section I of this study develops this hypothesis after outlining the above theory analytically. Section II describes the structural model used, the nature and sources of data and the estimation procedure along with the analytical results of the study. Section III presents the summary of results and the conclusion.

I. Theoretical development

The following framework for testing which Engel curve application of Wagner's law holds for India is adopted here. The analytics basically involve using the implied Engel curve approach (Gandhi, 1971). The earlier stated hypothesis can be explained in the following form:

$$\frac{dQg}{dY}\frac{Y}{Qg}=1 \qquad (1)$$

implies

$$\frac{dQg}{dY}=\frac{Qg}{Y}=k$$

and $\frac{dk}{dt}=0$,

where

Qg = government output

Y = national product

t = time index

Alternately,

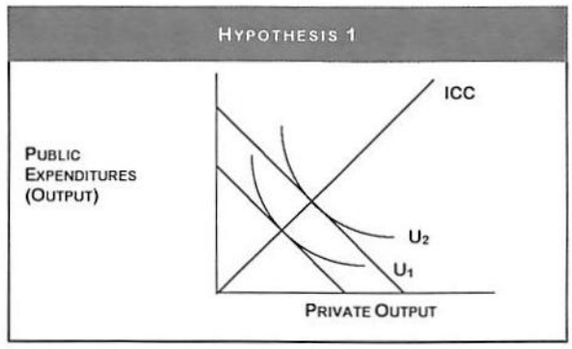
$$\frac{dQg}{dY}\frac{Y}{Qg}\neq 1 \qquad (2)$$

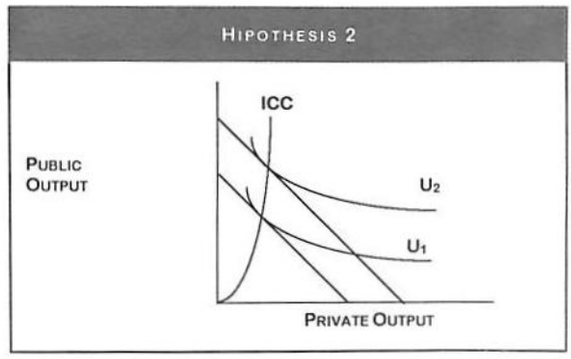
implies

$$\frac{dQg}{dY}\rangle\frac{Qg}{Y}=k \quad \text{and} \quad \frac{dk}{dt}\rangle 0$$

These are graphically shown below, where U_i are community indifference curves. These show that in (1), public expenditures are normal goods and in (2), they assume the character of "superior" goods. Empirical and theoretical literature (Ganti and Kolluri, 1979; Gupta, 1967; Hadjimatheou, 1976) supports the above, which for the purpose of this study is treated compositely as a null hypothesis, i.e.,

for India, $\frac{dQg}{dY}\frac{Y}{Qg}=1$ and $\frac{dk}{dt}\geq 0$





The following is the alternate hypothesis, in which Y is measured as Net Private Domestic Product. This works as a proxy for Personal Disposable Income. It is a common concept used for Y in market economies such as the United States, and is more appropriate for the measurement of income elasticity. Qg is measured in terms of non-defense government expenditures:

$$\frac{dQg}{dY}\frac{Y}{Qg} \neq 1 \quad \text{and} \quad \frac{dk}{dt} \geq 0$$

After testing the above hypothesis, the implications of the findings will be presented in the conclusions.

II. Estimation

The time series data for non-defense government expenditure (Qg) and Net Private Domestic Product (Y) are obtained from the Annual Reports on Currency and Finance of the Reserve Bank of India (1955-83). This period of 28 years is sufficient for the purpose of this study, since it is an empirical test of Wagner's Law. The former item is from the Statements in each report entitled "Reserve Receipts and Expenditure of the Government of India". The Y variable above is taken from the item "Net Domestic Product at factor cost accruing to the private sector", from the Statements entitled "National Income and Allied Indicators". The international sector is excluded because in India, it largely consists of government transactions, and also because it forms less than 5% of total GNP, for the period between 1955 and 1983. Since this study purports to test Wagner's law for India of the post independence era, the 28 year period between 1955 and 1983 is sufficient for the analysis. No attempt is made here to extrapolate beyond that period .

The data for unemployment (i.e., number of unemployed in each year) are obtained from the Handbook of Labor Statistics, International Labor Office, Geneva.

The most common early analyses were carried out using Ordinary Least Squares with time series (Gupta, 1967) as well as cross sectional data (Hinrichs, 1965; Thorn, 1967). However, OLS estimation could produce biased estimates, compounded by the use of cross sectional data (Hadjimatheou, 1976).

The use of Indirect Least Squares (Henning and Tussing, 1974) on time series data is a more successful and efficient procedure. Analytical relationship between private and public expenditure elasticity has

been derived (Henning and Tussing, 1974), which is used later in this paper. On that basis, an efficient estimation procedure has been developed (Ganti *et al.*, 1979) using errors-in-variables approach, or the framework of regression models containing unobservable dependent variables (Zellner, 1970). This framework led to increased efficiency in Wagner's law study results on time series data for the United States (Ganti *et al.*, 1979).

A time series approach is chosen because it matches the objective of the study, where time is an important, though implicit, variable. Besides, in general, time series estimation eliminates heteroskedasticity which is almost a certainty in estimation from cross-sectional data in this area of study.

The following is the structural model (Ganti *et al.*, 1979, Zellner 1970), that is used here. Like the 'conventional' reduced form, it involves parameter restrictions across equations.

Consider (3) - (5):

$$Y_{1t} = Y_{2t}^{*}a + Z_t^{'}l + U_{lt} \qquad (3)$$

$$Y_{2t} = Y_{2t}^{*} + U_{2t} \qquad (4)$$

$$Y_{2t}^{*} = X_t^{'}b \qquad (5)$$

Y_1, Y_2 = observed dependent variables

Y_2^{*} = unobservable regressor variable

$X = G$x1 vector of non-stochastic observables

$Z = H$x1 vector of non-stochastic observable explanatory variables

U_{1t}, U_{2t} = are disturbances for periods t
a = scalar parameter
b = Gx1 vector of parameters
l = Hx1 vector of parameters
t = index number of observations.

In this paper, equation (3) relates non-defense government expenditures to unobservable income and defense spending, as in Ganti and Kolluri (1979), who use Gross Private Product. Here, Private Net Domestic Product (NDP = $C + I$ - Capital Consumption Allowance) is used as the income variable to avoid regressing part of the I and G on themselves (thus the use of Capital Consumption Allowance and Net Private Domestic Product). The exogenously determined defense expenditure variable is the Z vector in this model. Equation (4), as in Zellner (1970), shows that the difference between expected and measured GNP is purely stochastic, and equation (5) specifies unobservable expected incomes as a linear combination of potential GNP and business cycle variables relating to unemployment, as in Ganti and Kolluri (1979).

The model can be expressed explicitly assuming a log linear functional form as:

$$\ln G1 = k + a\ln GP^* + \ln D + U_{1t} \quad (6)$$
$$\ln GP = \ln GP^* \quad (7)$$
$$\ln GP^* = b_1 \ln GP_f + b_2 \ln B + U_{2t} \quad (8)$$

$G1$ = Per Capita non-defense Government expenditures
GP^* = Expected per capita private NDP
D = Per capita defense expenditures
B = 1/1 - U

$$U = \text{unemployment ratio} = \left| \frac{\textit{Natural rate} - \textit{Actual rate}}{\textit{Natural rate of unemployent}} \right|$$

$GP_f = GP/1 - U$

The reduced form of (6) to (8) is:

$$\ln G1 = k + ab_1 \ln GP_f + ab_2 \ln B + \ln D + U_{1t} \quad (9)$$
$$\ln GP = b_1 \ln GP_f + b_2 \ln B + U_{2t} \quad (10)$$

This leads to computation of the interest elasticity of government expenditures, which is directly derived from equation (9):

$$\frac{d \ln G1}{d \ln GP_f} \quad \frac{\ln GP_f}{\ln G1}$$

From (9), this expression is seen to be a where a is equal to the interest elasticity of government expenditures.

Setting a = n, then $n^* = 1 + \dfrac{n-1}{1+kn}$ (11)

n^* = Private income elasticity of government expenditures
n = estimated net private domestic product elasticity, and

$$k = \frac{G}{Y}$$

The above is an adaptation of the reputed Henning-Tussing (1974) measure of the total income elasticity of government expenditures.

The estimation procedure is the 2SLS LIML technique on SAS because this technique is best used for consistently estimating structural parameters for overidentified equations of a simultaneous equation system.

The initial block and 2SLS estimation shows evidence of positive serial correlation, by showing computed values of 'd' to be less than the lower limits of the Durbin Watson statistic (d_L) at both the 1% and 5% levels of significance.

Thus, autocorrelation at the 1% and 5% level is confirmed. To correct for this bias, a Cochran-Orcutt procedure is instituted.

In Stage 1 of this procedure, r_1 and r_2 are estimated from the following equations:

$$\ln GP_t^* = b_0(l-r_1) + r_1 \ln GP_{t-1}^* + ab_1 \ln GP_{f,t} - ab_1 r_1 \ln GP_{f,t-1} + ab_2 \ln B_t - ab_2 r_1 \ln B_{t-1} + V_{1t} \quad (12)$$
$$\ln G1_t = g_0(l-r_2) + r_2 \ln G1_{t-1} + b_1 \ln GP_{t-1}\, b_1 r_2 \ln GP_{t-1} + b_2 \ln D_t - b_2 r_2 \ln D_{t-1} + V_{2t} \quad (13)$$

r_1 and r_2 are the coefficients of determination in (12) and (13). r_1 is found to be 0.965996 and r_2 is 0.7394. Thus, in Stage 2, equation (12) has to be rerun as shown in (14), on the first differences of the original variables (since r_1 is significantly close to unity), dropping the intercept term by using the option NOINY in SAS. Equation (13), however, has to be rerun after transforming the variables, as shown in (15).

$$\ln GP_t - \ln GP_{t-1} = ab_1 (\ln GP_{f,t} - \ln GP_{f,t-1}) + ab_2(\ln B_t - \ln B_{t-1}) \quad (14)$$
$$\ln G1_t - r_2 \ln G1_{t-1} = g_0 r_2 + b_1 (\ln GP_t - r_2 \ln GP_{t-1}) + b_2 (\ln D - r_2 \ln D_{t-1}) + (V_{2,t} - r_2 V_{2,t-1}) \quad (15)$$

A modification to (15) is introduced here, because in this pure form, there is a specification error causing the reduced form two equation system to break down into two independent OLS equations. This modification is that first difference of $\ln GP$, i.e., estimated $\ln GP_t - \ln GP_{t-1}$ from (14) replaced $\ln GP_t - r_2 \ln GP_{t-1}$ in (15) to form (16).

$$\ln G1_t - r_2 \ln G1_{t-1} = g_0(1-r_2) + b_1(1\ln GP_t - \ln GP_{t-1}) + b_2(1\ln D - r_2 1\ln D_{t-1}) + (V_{2t} - r_2 V_{2t-1}) \quad \textbf{(16)}$$

The final 2SLS equations estimated are (14) and (16) with LNGPS (in SAS) representing the dependent variables, $G1$ the dependent variables of (16) and GP and D as the independent variables. The resulting estimated model is as follows:

$$\ln GP_t - \ln GP_{t-1} = 0.824\ (1\ln GP_{f,t} - \ln GP_{f,t-1}) - 77.93\ (1\ln B_t - \ln B_{t-1}) \quad \textbf{(17)}$$

with

$R^2 = 0.9625$

$d_1 = 1.4055$

$d_2 < d_1 < d_u$ (No significant serial correlation)

$$\ln G1_t - \ln G1_{t-1} = -2.693 - 0.22\ (1\ln GP_t - \ln GP_{t-1}) + 0.97\ (1\ln D_t - \ln D_{t-1}) \quad \textbf{(18)}$$

$R^2 = 0.9461$

$d_2 = 1.2446$

$d_L < d_2 < d_u$ (No significant serial correlation)

The t-statistics are generally confirmed, if not at 1% or 5% levels, then at the 10% level. The F ratio shows that the models are significant. Thus, having corrected for autocorrelation, the high R^2 values show that the model has accurately established causality at a high significance level.

From the structural coefficient values, which have been summarized in the next section, the most important is a, which gives the value of n, the NDP elasticity of government expenditure to be -0.218679. Since $G > 0$, $Y > 0$, Total Income Elasticity is

$$1 + \frac{-0.218679 - 1}{1 + \frac{G}{Y}(-0.218679)} < 1$$

We therefore reject the null hypothesis that $\frac{dQg}{dY}\frac{Y}{Qg} = 1$ is true for India and accept the alternate that

$$\frac{dk}{dt} < 0, \text{ where } k = Qg/Y \text{ since } \frac{dQg}{dY}\frac{Y}{Qg} \neq 1$$

TABLE 1

ML RESULTS (t- RATIOS IN PARENTHESES)		
k	-2.692671 (-23.2373)	
a	-0.218679 (-0.4992)	$R^2 = 0.9461$
l	0.973165 (18.6933)	
b_1	-3.767594 (16.3215)	$R^2 = 0.9625$
b_2	356.37286 (-0.4275)	

The most significant results of this study are the values of a and l from the table above. These are the income elasticities of demand for non-defense public goods and defense expenditures respectively. It is notable that the former is significantly negative and different from unity. The latter is positive and not significantly different from 1. This can be explained through a line of reasoning, which, following Wagner's tradition, is based on historical observation.

III. Summary and conclusions

In the years following independence, the Indian private sector has increased in size and scope, while the non-defense input of the public sector has been largely toward debt servicing and the management of "sick" industrial units (Muhammed, 1972). Thus the role of the public sector in non-defense activity has been shrinking in size and scope. This is because "sick" units and debt servicing are not the revenue and, consequently, employment generating activities that produce positive externalities to the extent that such activities would cause output and, therefore, expenditure to increase. On the other hand, the defense needs of the country have increased manifold and as can be seen (from the value of b), defense expansion was increasingly at the expense of non-defense public enterprise.

The other explanation could be in terms of the particular nature of the voting process in India. Steiner (1977) argues that in the absence of a pricing mechanism, the voting mechanism acts as its proxy. In terms of the allocation of government resources, it could be argued that the political process in India has not yet developed into one through which individuals make public resource allocation decisions. General elections in India have been contested on issues which emphasized redistribution of wealth rather than public spending towards growth as the goal of government policy. However, defense has been an issue through an increasing focus on national security needs because of periodic military conflicts India has been involved in. Thus, the displacement literature on India (Nagarajan, 1979) shows evidence of the relationship of public expenditures to national disturbances in the context of increased defense spending.

The other question this study raises is whether the involvement of government in inefficient enterprises has reduced its credibility as an efficient provider of public services. This is arguably true since the bankrupt "sick" units that the government takes over could hardly be expected to generate the most de-

sired positive externality from government involvement, namely, increased employment. It appears, from the value of a, that this may well be increasingly true.

The other aspect of public involvement, Wagner's "power function", seems to hold in this case (from the high magnitude of 1). Defense expenditures have shown a proportionate trend that influences the total allocation of public expenditure, which may well reflect the public's increasing concern with national security. This may be verified by a study of the relationship between security issues and national economic aspirations, both of which are supposedly expressed through the voting process. That, however, is beyond the scope of this paper.

Finally, this study could also raise the issue of a centralized political system's ability to articulate the preferences of a pluralistic and economically developing society. Most allocation decisions in India are made at the central level and may not represent the preferences stated by people who are remote from national political decision making. These preferences, it could be argued, are more likely to be stated at the state and local level because of the proximity of the decision making process. Thus, it is possible that Wagner's Law may not hold for India. This could be a hypothesis open for verification and the aim of further research. ◆

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