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An empirical examination of the linkage between economic growth and government expenditure in India using aggregate and disaggregated expenditure

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Abstract
This paper attempts to study the association between government expenditures and economic growth for the Indian economy to test the applicability of Wagner's law, for the post-liberalization period i.e. 1991-2021, using the ARDL bounds testing procedure. The study is conducted by using aggregate expenditure as well as disaggregated data of public expenditure i.e revenue and capital expenditure. To test the validity of Wagner's law, two versions of Wagner's law are used for this analysis, both with total expenditure as well as the revenue and capital expenditure (used individually). Econometric tests of stationarity, cointegration, and causality testing are conducted in all models. Empirical results indicate the presence of a long-run relationship of economic growth with expenditure variables (total expenditure, revenue expenditure, and capital expenditure taken separately). Causality results support causality from economic growth to the expenditure variables. On the whole, there does exist a long-run and stable relation between the expenditure variables and growth over the sample period, which is unidirectional from growth to expenditure, thus validating Wagner's law in the case of both versions with total expenditure and revenue expenditure and one version with capital expenditure.

Keywords: *Wagner's law; revenue expenditure; capital expenditure; ARDL; India*

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I. INTRODUCTION

A prominent theory in the economics studies explaining the association between two important variables-public expenditure and economic growth is the Wagner's law according to which as the economy grows (as income increases) the public expenditure will increase. According to Wagner, each government both at national or subnational level tends to increase its activities and thus public expenditure due to which growth of government sector is faster than economic growth (Bhatia (2014)). The public sector expands at a rate greater than the income of the country (economic growth). According to Wagner the three reasons for the phenomena are: as industrialization takes place, accompanied by urbanization and population growth, there is a requirement for increased administrative and protective functions provided by the state. As income increases the demand for various public services increase like education, health and welfare. The increasing technological requirements would necessitate large scale investment where role of government will become important as it becomes unlikely to be done by private sector (Iyare and Lorde (2004)). Different economists have used different functional forms to study the relationship between economic growth and public expenditure. The six most prevalent versions of the Wagner's law are the Peacock-Wiseman (1961), Gupta (1967), Goffman (1968), Pryor (1969), Musgrave(1969) and Mann(1980)versions.

Total spending or expenditure of the government can be decomposed or disaggregated into two components viz. revenue and capital expenditure. Broadly capital expenditure is the expenditure incurred in creation of assets like land, building, machinery etc., benefits of which accrue over many years and is not incurred on operating expenditure. On the other hand revenue expenditure is incurred by the government to meet day to day expenses of various government departments, services, interest charges etc. and does not lead to any asset creation.

Another research question tested in the literature pertains to the association of economic growth with components of total expenditure. Some studies which have tested the relationship of economic growth with components of expenditure include Narayan et al (2012), Selvanathan et al(2021), Kucukkkale and Yamak(2012), Ali and Munir(2016), Bojanic(2013), Mlilo and Netshikulwe (2017), Kaur(2018).

There is extensive and rich literature on the linkages of total expenditure with economic growth in the case of India, using various versions of Wagner's law. The studies differ in terms of time period, variables definition, versions studied, country level or state level study etc. However, study of the association of the components of total expenditure i.e. revenue expenditure and capital expenditure and economic growth at the country level is limited. So, the main objective here is to study the linkages of revenue and capital expenditure with economic growth.

This paper revisits and extends existing work on Wagner's law at the country level by using disaggregated expenditure. The paper attempts to study the linkages of total, revenue, and capital expenditure (taken one at a time) with economic growth. To confirm the validity of Wagner's law, two versions of Wagner's law viz. the Gupta (1967) and Goffman (1968) versions are used. For doing this study the ARDL bounds testing approach is employed followed by causality analysis and the sample period is the post-liberalization phase i.e. 1991-2021. The layout of the paper is as follows. Section II provides the literature survey. Data definition and sources form section III. Methodology along with the results are given in Section IV. The last section i.e, Section V concludes the paper.

II. LITERATURE SURVEY

This section presents a summary of some of the studies which have tested the relationship of aggregate public expenditure and its components with growth of the country both in India and in overseas. Using data for Egypt from 1960-2018, Ghazy et al (2020), find presence of a long run relation between government expenditure and GDP using three versions of Wagner's law. There is bidirectional causality between government consumption expenditure and GDP. Taking data of over a century for Greece, Sideris (2007) results validate a long run relation between the variables government expenditure and national income using Wagner's law six versions and the results support causality from income to expenditure. Selvanathan et al (2021) study Sri Lankan data using ARDL framework and three different models for aggregate and sectoral level data. Results confirm both Keynesian and Wagner's hypothesis in the long run for all three models and inconclusive results in short run. Find that both capital and recurrent expenditure positively affect economic growth both in short and long run. In long run agriculture and health expenditure have a positive impact on economic growth with expenditure on welfare having negative impact. Kucukkale and Yamak (2012) test the cointegration and causality of public expenditure and economic growth using disaggregated data of public expenditure as current expenditure, transfer expenditure, investment expenditure and military expenditure. The study is for Turkey using 5 models of Wagner's law. Results show presence of only a single strong bidirectional relation between public investment expenditure and economic growth in the short run in all the versions and no long-run relation between the variables-public expenditure, aggregated or disaggregated, and economic growth. Ali and Munir (2016) study the relationship of public spending-aggregate and disaggregate with economic growth in Pakistan from 1976-2015 using Engle granger cointegration and causality tests. Using five versions of Wagner's law show expenditure made on defense, current subsidies, current expenditure and development expenditure support Wagner's law, whereas expenditure on economic, social and education services support Keynesian hypothesis. Bojanic (2013) examines the long-run relation among income and different types of government expenditure for Bolivia for a long sample of 70 years using 9 versions of Wagner's law, which includes 4 versions using disaggregated government expenditure on defense, infrastructure, health and education. In six versions bidirectional causality is established among government expenditure and income and Wagner's law explains growth in health, defense and infrastructure expenditure. Mlilo and Netshikulwe (2017) test causality between GDP and total and government expenditure on health and education using Gupta's version of Wagner's law for South Africa from 1994-2015. Their results indicate that causality is from total expenditure and expenditure on education to output supporting the Keynesian hypothesis.

Verma and Arora (2010) analysis confirms Wagner's law validity in pre and post reforms period for India. Srinivasan (2013) used cointeration approach with error correction model from 1973-2012 for India and confirmed that long run relation between economic growth and public expenditure exists with support for Wagner's law. Sharma and Singh (2019) confirm validity of Wagner's law in the post liberalization period in India in the long run. Also effect of urbanization public expenditure is larger than that of national income. On the other hand Budhedeo (2018) examines two models of Wagner's law and the results show that Wagner's law does not hold for India. There is support for Keynesian hypothesis in the long run. Kaur and Afifa(2017)study from 1970-71 to 2013-14 using six versions of Wagner's law find Peacock, Gupta, Goffman and Musgrave model valid for India. Adil et al (2017) use autoregressive distributed lag model and bounds test and conclude that there is long-run relation among GDP and public expenditure, however evidence for Wagner's law is weak. Rani and Kumar (2022) findings show weak evidence for the pre-reform period for Wagner's law in India and strong evidence in the post-reform period using ARDL bounds test with the presence of cointegration between expenditure and economic growth in both periods. Javed and Khan(2021) employing ARDL technique for 1980-

81 to 2018-19 find support for Wagner's hypothesis in India as the direction of causality is established as unidirectional from GDP to GE.

Gupta and Shastri (2020) analyze relation between plan expenditure, non-plan expenditure and economic growth from 1980-2015 for India. From granger causality tests, unidirectional causality from economic growth to non-plan expenditure and plan to non-plan expenditure is obtained. Narayan et al (2012) test the Wagner's law for India's 15 states. The paper uses expenditure, per capita expenditure, real capital and real consumption expenditure and per capita expenditure. Results point to Wagner's law driven by consumption expenditure. Kaur (2018) using 44 years data on Indian economy analyzes link of economic growth with government spending-total , capital and revenue expenditure in total as well as per capita terms by using Engle granger, Johansen cointegration test and VECM estimates six models. Johansen cointegration results show presence of cointegration in all models. Long run causality is seen from GDP to revenue expenditure, from per capita capital expenditure to per capita GDP. Bidirectional causality is there, between per capita total expenditure and per capita GDP and per capita GDP and per capita revenue expenditure.

III. DATA DEFINITION AND DATA SOURCES

The present study is on the post liberalization phase in India so the sample is annual data from 1991-92 till 2021-22. To measure total expenditure(E) the total government expenditure of the Center which is the sum of revenue and capital expenditure is taken. Revenue expenditure and capital expenditure are of the central government. Gross Domestic Product measures the economic growth in all models. The total population (P) variable is used to obtain per capita GDP and all per capita expenditure estimates. These nominal values of total expenditure, revenue, capital expenditure, and GDP are deflated at 2010 prices (WPI) to get their real values. Then, the variables are changed into natural logarithms before estimation. The source for the data on the above variables is different issues of the Handbook of Statistics, RBI, EPWRF database, World Bank database.

The two versions of Wagner's law to be estimated in this study are by:

- 1. Gupta (1967) – in this version per capita expenditure is a function of per capita GDP.
- 2.Goffman(1968)-here expenditure is a function of per capita GDP

In double log functional form, the above two versions are estimated respectively as follows
Model 1 : Gupta(1967) version: (E/P) =a + b (G/P) +e
Model 2 :-Goffman(1968) version: E= a + b (G/P) + e
where E- natural log (real expenditure)
G-natural log (real gross domestic product (GDP)),
(E/P)-natural log (per capita real expenditure)
(G/P)-natural log (per capita real GDP)
e is the error term
b is the real income elasticity coefficient (or elasticity of real expenditure w.r.t real GDP (as defined) in each model). For Wagner's law to be valid, b>0 in the Gupta version which is the ratio version and b>1 in Goffman version which is the non-ratio version, and causality must be from the income variable to the expenditure variable (Iyare and Lorde (2004))

Three categories in which expenditure has been used in this paper are total expenditure, capital expenditure and revenue expenditure. Using these three expenditure variables in the Gupta and Goffman versions, the following six models are estimated respectively in this paper- using total expenditure(Models 1,2), capital expenditure(Models1c,2c), and revenue expenditure(Models1r,2r) as the relevant expenditure variable.
Model 1: (E/P) =a + b (G/P) +e
Model 2: E= a + b (G/P) + e
Model 1c: (CE/P) =a + b (G/P) +e
Model 2c: CE= a + b (G/P) + e
Model 1r: (RE/P) =a + b (G/P) +e
Model 2r: RE= a + b (G/P) + e
where CE- natural log (real capital expenditure) , RE- natural log (real revenue expenditure), (RE/P)-natural log (per capita real revenue expenditure) , (CE/P)- natural log (per capita real capital expenditure

IV. METHODOLOGY AND RESULTS

In this section, the methodology and the corresponding results are discussed. The estimation process is divided into three parts-testing for stationarity, cointegration using ARDL framework and granger causality tests.

A. Stationarity tests and results

Econometric methodology starts with testing for stationarity of the variables in levels using ADF test. If the variables are found to be non-stationary then the same test is conducted on the first differences of the variables. This will indicate about the order of integration of the variables.

Results displayed in Table 1 show that the null hypothesis of unit root (i.e. series is non-stationary) is not rejected for all variables of the study. Conducting the tests now on the first differences of these variables, it is seen that they are now stationary. This means all variables i.e. E, G/P, E/P, RE, RE/P, CE, CE/P are integrated of order one (I(1)) since they become stationary on the first difference. Thus, no variable is I (2), so can proceed with the ARDL procedure.

Table1. Results of Augmented Dicky Fuller test for stationarity

Variable	In levels		In first difference		Result of the order of integration
	ADF-Test statistic	p-value	ADF-Test-statistic	p-value	
E	0.669	0.989	-5.026	0.0004*	I(1)
(E/P)	0.823	0.993	-4.902	0.0005*	I(1)
(G/P)	0.467	0.982	-4.140	0.0032*	I(1)
CE	1.687	0.999	-4.538	0.0014*	I(1)
CE/P	1.610	0.999	-4.455	0.0017*	I(1)
RE	0.312	0.975	-4.671	0.0008*	I(1)
RE/P	0.468	0.982	-4.567	0.0011*	I(1)

*Statistically significant at 5%level of significance

B. <u>ARDL Methodology and results</u>

ARDL methodology involves the following parts: -bounds test approach, estimating long run coefficients, and the error correction term. The advantages with the ARDL approach are that the variables can be I(0) or I(1). It can be used with small sample sizes and both long and short-run models can be estimated simultaneously.

Generalized ARDL (p,q) model is written as

$$E_t = \beta_0 + \sum_{i=1}^{p} \beta_i E_{t-i} + \sum_{i=0}^{q} \gamma_i G_{t-i} + \varepsilon_t$$

Where β_0 is the intercept and ε_t is the random error,

The above model is written as ARDL bounds test model

$\Delta E_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta E_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta G_{t-i} + \varphi_1 E_{t-1} + \varphi_2 G_{t-1} + \varepsilon_t$

Where β, ϒ are short-run dynamic coefficients and φ_1 and φ_2 are long-run multipliers. E_t is the error term. The equation is estimated using OLS to check for the presence of long-run relation and then conduct an F test for joint significance of the coefficient of lagged levels of variables i.e E and G.

The null hypothesis is $\varphi_1 = \varphi_2 = 0$ which means no cointegration against the alternate hypothesis of $\varphi_1 \neq \varphi_2 \neq 0$ which implies cointegration,

This null of no cointegration is tested against the alternative by F test and critical values given by Pesaran et al (2001) are used. Two sets of critical values are given one assuming variables to be I (0) is lower bound and the second variables to be I(1) is upper bound. The decision rule is as follows. As given in Pesaran et al(2001), if the calculated F value > upper bound then H0 is rejected which means the presence of cointegration between the variables is established. If calculated F value < lower bound then H0 is not rejected which means the absence of cointegration and if F value >=lower bound and <= upper bound then the results of the test are inconclusive.

Once cointegration is confirmed between the variables then the long run model is obtained. Next since cointegration is established, then the short-run model can be written as

$$\Delta E_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta E_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta G_{t-i} + \theta\, ECT_{t-1} + \varepsilon_t$$

β_i, Υ_i are short run dynamic coefficients and θ is the speed of adjustment. How much of the error from previous period is corrected in present period is indicated by the coefficient of the error correction term(ECT). If the ECT is negative and significant then it means that for any given disturbance the system will be back to equilibrium.

Table 2. Results of ARDL bounds testing

Model	F-stat				Result
Total expenditure		Critical values	I(0)	I(1)	
Model 1, ARDL(2,2)	7.097*				Presence of cointegration
Model 2, ARDL(2,1)	6.482*				Presence of cointegration
Capital expenditure					
Model 1c, ARDL(2,2)	4.203**	10%	3.02	3.51	Presence of cointegration
Model 2c, ARDL(2,2)	5.090*	5%	3.62	4.16	Presence of cointegration
Revenue expenditure		1%	4.94	5.58	
Model 1r, ARDL(1,1)	6.166*				Presence of cointegration
Model 2r, ARDL(1,1)	7.134*				Presence of cointegration

Note: ARDL model lag structure is selected using Akaike Information criteria (AIC). No of regressors, k=1 in all models. *,**,***-level of statistical significance at 1%,5%,10%

The lag structure of the ARDL(p,q) model is determined as given by AIC. The table shows ARDL bounds test results for checking for cointegration for all the models. The results in Table 2, show that the null hypothesis of no cointegration is rejected by all six models. This is because the calculated F is above the upper critical value bound I(1) for all models. Thus, there is evidence of cointegration in all cases considered between the growth and expenditure variable(as defined in the models).

After cointegration is confirmed, the next step is the estimation of the long-run coefficients by estimating the long-run model (Table 3). Results of Table 3 show that a 1% increase in per capita growth variable will on average cause a 0.90% increase in total expenditure per capita, 1.05%increase in case in revenue expenditure per capita and 52.9% increase in capital expenditure per capita.

Table 3. Results of the Long Run Model

Model	Dependent Variable	Independent Variable	Coefficient	SE	t-stat	p-value
Total expenditure						
Model 1	E/P	G/P C	0.899 -1.210	0.0307 0.184	29.183 -6.566	0.000 0.000
Model 2	E	G/P C	1.181 1.776	0.055 0.330	21.326 5.380	0.000 0.000
Capital expenditure						
Model 1c	CE/P	G/P C	0.529 -0.705	0.106 0.653	4.978 -1.080	0.000 0.291
Model 2c	CE	G/P C	0.788 2.388	0.089 0.551	8.762 4.331	0.000 0.000
Revenue expenditure						
Model 1r	RE/P	G/P C	1.055 -2.260	0.067 0.399	15.657 -5.651	0.000 0.000
Model 2r	RE	G/P C	1.335 0.806	0.087 0.520	15.203 1.550	0.000 0.133

The coefficient of models 2,2r,2c respectively means that if per capita GDP increases by 1% then it causes on average an increase in total expenditure by 1.18%, revenue expenditure by 1.33% and capital expenditure by 0.79% respectively. Thus, in all cases, the expenditure grows with GDP. There thus exists long-run association and signs of elasticity are in accordance to the two versions of Wagner law in all models except in model 2c.

Table 4. Results of the short-run model

Model	Dependent Variable	Variable	Coefficient	SE	t-stat	p-value
Total expenditure						
Model 1	D(E/P)	D(E/P(-1))	0.622	0.151	4.099	0.000
		D(GP)	-0.041	0.243	-0.172	0.869
		D(GP(-1))	-0.563	0.336	-1.673	0.107
		Cointeq(-1)	-0.727	0.151	-4.811	0.000
Model 2	D(E)	D(E(-1))	0.404	0.136	2.959	0.006
		D(GP)	-0.101	0.242	-0.418	0.679
		Cointeq(-1)	-0.428	0.093	-4.589	0.000
Capital expenditure						
Model 1c	D(CE/P)	D/(C/P(-1))	0.370	0.193	1.918	0.067
		D(GP)	0.981	0.900	1.089	0.287
		D(GP(-1))	-2.367	1.001	-2.364	0.0269

		Cointeq(-1)	-0.767	0.207	-3.702	0.001
Model 2c	D(CE)	D(CE(-1)	0.422	0.189	2.226	0.036
		D(GP)	1.154	0.861	1.340	0.193
		D(GP(-1))	-2.534	0.989	-2.560	0.017
		Cointeq(-1)	-0.859	0.210	-4.074	0.000
Revenue expenditure						
Model 1r	D(RE/P)	D(GP)	-0.171	0.260	-0.656	0.517
		Cointeq(-1)	-0.359	0.080	-4.463	0.000
Model 2r	D(RE)	D(GP)	-0.116	0.276	-0.420	0.677
		Cointeq(-1)	-0.277	0.057	-4.801	0.000

Last get the short run dynamic estimates by estimating an error correction term. The error correction term (Cointeg(-1)) coefficient is negative and significant(at 5%level of significance) in all models estimated and falls between -1 &0. The speed of adjustment i.e how much of short-term adjustment toward long run equilibrium takes place is 73%,43%,77%,86%36%,27% in models 1,2,1c,2c,1r,2r respectively..

C. Causality tests

Table 5. Results of Granger causality tests

Model	Null hypothesis	Obs	F-stat	p-value	Causality result
Total expenditure					
Model 1	G/P does not granger cause E/P E/P does not granger cause G/P	29	10.069 0.255	0.000 0.776	Unidirectional G/P→E/P
Model 2	G/P does not granger cause E E does not granger cause G/P	29	6.113 0.673	0.007 0.519	Unidirectional G/P→E
Capital expenditure					
Model 1c	G/P does not granger cause CE/P CE/P does not granger cause G/P	29	6.253 0.652	0.006 0.529	Unidirectional G/P→CE/P
Model 2c	G/P does not granger cause CE CE does not granger cause G/P	29	7.583 0.647	0.002 0.532	Unidirectional G/P→CE
Revenue expenditure					
Model 1r	G/P does not granger cause RE/P RE/P does not granger cause G/P	30	8.804 0.002	0.006 0.957	Unidirectional G/P→RE/P
Model 2r	G/P does not granger cause RE RE does not granger cause G/P	30	6.687 0.311	0.015 0.581	Unidirectional G/P→RE

Pairwise Granger causality tests are next conducted in all models. From the results displayed in Table 5 it is seen that in all models 1,2,1c,2c,1r,2r , the value of the F statistic & p value confirms unidirectional causality from the economic growth variable to the expenditure variable(at 5%level of significance) thus supporting the applicability of the Wagner hypothesis.

D. Diagnostic tests and test for stability

Diagnostic tests for serial correlation (Breuch-Godfrey serial correlation LM test), heteroskedasticity (ARCH Test), and RESET test are carried out for all models. Diagnostic test results are given in the table 6. From Table 6, using p-values we find we find that all six models clear the serial correlation, and heteroskedasticity tests and RESET test i.e models do not suffer from the problem of autocorrelation(except model 2c), heteroskedasticity and models are correctly specified.

Table 6. Results of the diagnostic tests

Model	Breuch-Godfrey serial correlation LM test F	Heteroskedasticity ARCH Test	RESET test F
Total expenditure			
Model 1	1.352(0.280)	3.200(0.202)	1.573(0.222)
Model 2	2.345(0.119)	2.502(0.286)	1.298(0.266)
Capital expenditure			

Model 1c	3.344(0.054)	0.127(0.881)	3.571(0.072)
Model 2c	3.765(0.040)*	0.035(0.982)	4.150(0.054)
Revenue expenditure			
Model 1r	1.668(0.209)	0.193(0.659)	1.275(0.269)
Model 2r	0.903(0.418)	0.605(0.436)	2.990(0.096)

p value in parenthesis, * statistically significant at 5%

Based on the above test results it is noted that Wagner's law is validated using models 1,2(using total expenditure), model 1c (using capital expenditure), and model 1r,2r (using revenue expenditure) over the sample period studied. With model 2c (using capital expenditure) the value of the elasticity coefficient is not satisfied.

V. CONCLUSIONS

This study aims to study the association among public expenditure and economic growth to assess if Wagner's law holds, at aggregate and disaggregated levels of expenditure i.e by using aggregate public expenditure as well as its components i.e revenue and capital expenditure. Two versions of Wagner's law are used for this analysis viz Gupta (1967) version and Goffman (1968) version. The study phase is the post-liberalization phase i.e. from 1991-2021 for the Indian economy using annual data and the econometric methodology of the ARDL test is employed followed by causality tests.

Based on results from the ARDL cointegration approach presence of a long-term association between variables i.e. expenditure-total, capital, and revenue (taken singly), and economic growth is established in all 6 models. Granger causality is established from growth to expenditure and not the reverse in all the models studied. In sum the results support the validity of the Wagner's law for both total expenditure and revenue expenditure using both versions and capital expenditure with one version over the sample period.

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