sdmimd JOURNAL OF MANAGEMENT

DOI:10.18311/sdmimd/2023/33007

An Econometric Analysis of Public Expenditure and Agriculture Output: An Evidence from India#

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Abstract

In the present era, the agricultural sector played a significant role in the development of the nation by creating jobs for rural people and developing of agricultural sector needed in labour-intensive nations like India. Hence, the study examined the relationship between public expenditure on agriculture and economic growth, public expenditure on agriculture and agricultural output in the context of India. Therefore, the study used the Unit root test, Cointegration test, Var, and ECM for analysis. The results show that there is no cointegration vector between public expenditure and economic growth and found that negative relationship between public expenditure and economic growth. But, the study reveals that there is a cointegration vector between public expenditure and agricultural output. Significant Error Correction term (ECt-1) indicates that 85.2 per cent of total disequilibrium in public expenditure on agriculture and agriculture output is corrected each year in India. The coefficient of the EC2t-1 term is statistically insignificant. short-run coefficients are also insignificant, which concludes that there is no short-run causality between public Expenditure and agriculture output in any direction. One way causality exists from agriculture output to public expenditure in the long run and is supported the Wagner's hypotheses instead of Keynesian Hypotheses in India.

Keywords: : Agriculture, Cointegration, Economic Growth, Expenditure, VECM

JEL Classification: H6, Q1, C4, C5

1. Introduction

Indian Government used Five Year plans as a Strategy for the upliftment of the Agriculture sector from a traditional to a modern well-developed sector. Under the Five Year Plans, the government has increased agricultural production and rural employment by setting up community development programs and agricultural extension services throughout the country, expansion of irrigation facilities, fertilizers, and pesticides, distributing high-yielding varieties of seeds, and expansion of transportation, power, marketing, and providing institutional credit. Another side, the government set up agro-based industries and handicrafts in rural areas, and encourage the movement of people from agriculture to industries and service sectors to reduce the pressure of the population on land. Finally, to create equality and justice in rural India, the government used a land reforms strategy that included the removal of intermediaries, like the Zamindars, tenancy legislation, the ceiling of land holding, and the distribution of surplus land among landless labourers and small and marginal farmers. According to Oriakhi and Arodoye (2013), public spending promotes capital accumulation and promotes long-term economic growth. When investments are

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#This is the modified version of the paper presented in the 7th International Economics Conference on "Economic Growth and Sustainable Development: Emerging Trends" organised by SDMIMD, Mysuru on November 24-25, 2022.

made in rural areas, it enhances the economy whole by reducing labour surpluses and supplying affordable food to the urban population, in addition to creating jobs and income (Fan & Rao, 2008).

Since the Green Revolution period, when great expenditures were made in public rural goods, particularly agricultural research, infrastructure, and irrigation, India's agricultural Gross Domestic Product (GDP) and total factor productivity growth have experienced an extraordinary increase. As a result of the fast adoption of high-yielding cereal varieties, agricultural GDP growth reached new highs in the 1970s and 1980s (Singh *et al*., 2015). According to Awokuse (2009), there is a debate over whether agriculture can significantly boost the economies of developing nations. The early works and such arguments are related (Lewis, 1954; Fei & Ranis, 1961; Jorgenson, 1961; Johnston & Mellor, 1961; Schultz, 1964). Investment in agriculture, the development of infrastructure, and the establishment of institutions are basic requirements for economic growth, according to research by Schultz (1964) and Timmer (1995). These studies demonstrate how agricultural growth influences rural incomes and provides resources for structural change, acting as a driver for overall economic development (Dowrick & Gemmell, 1991; Datt & Ravallion, 1998; Thirtle *et al*., 2003). Therefore, public spending is important to agricultural growth and any reduction in it could harm agriculture performs.

2. Theoretical Background and Empirical Evidence

Several studies have used various methods to examine the relationship between agricultural and economic growth. While the Keynesian approach asserts that public expenditure is a fundamental driver of economic growth, Wagner's law emphasizes economic growth as the main determinant of public expenditure (Wagner, 1883; Keynes, 1936). There are conflicting findings from numerous research that have looked at how public spending affects economic growth. Wagner's law is supported by the findings of Salih (2012) in the Sudan and Wang *et al*., (2016) in Romania. The Keynesian principle, however, is supported by research is done in South Sudan by Okezie *et al*., (2013) and Guandong & Muturi (2016). According to several studies (Dowrick & Gemmell, 1991; Datt & Ravallion, 1998; Thirtle *et al*., 2003), agricultural growth is a driver for overall economic growth by boosting rural incomes and providing resources for structural change. Studies by Shuaib *et al*., (2015), Chandio *et al*., (2016), Guandong & Muturi (2016), and Akarue & Eyovwunu (2017) all suggest a positive relationship between government expenditures on agricultural and economic growth. Others have found a negative impact (Kormendi & Meguire, 1985; Diamond, 1989). However, neither Landau (1986) nor Scully (1989) establishes any link between government spending and economic expansion. Satter (1993) noted that while public spending does not affect economic growth in developed nations, it has a positive effect in developing nations. The purpose of these investigations is to determine if Wagner's or Keynesian theory is applicable.

In this context, the study tested the applicability of Wagner's or Keynesian theory in India for this purpose, the study attempts to analyze the relationship between public expenditure on agriculture and economic growth and also agriculture output. Also focused on the impact of public expenditure on agriculture on economic growth and agricultural output in India.

3. Materials and Methodology

The study used secondary data on government expenditure on agriculture and allied activities, agriculture output, and gross domestic product from 2009-10 to 2022-23 by RBI and Indian economic survey reports. For applicability of Wagner's or Keynesian theory in India, the study examines the relationship between government expenditure on agriculture and allied activities and economic growth by using Johansen's maximum likelihood cointegration procedure and Vector Error Correction Model (VECM) as developed by Granger (1969) and (1986), Engle & Granger (1987). Several tests are available for testing whether a series is stationary. The study used the PP (Phillips & Perron, 1988) test for stationarity, which is designed to be robust in the presence of autocorrelation and heteroscedasticity (Ramphul, 2012). The Phillips-Perron test equation:

$$X_t = \mu_t + b_1 t + \sum_{i=1}^{n} X_{t-n} + U_t \quad (1)$$

Where,

X = The series; t = Time; u_t = I(0)

n = Number of optimal Newey West bandwidth chosen by using the Bartlett Kernel Criterion.

The study used the Granger causality test via Error-Correction Modelling (ECM) to examine the relationship and applicability of Wagner's or Keynesian theory in India. ECM included the long-run relationships with the short-run dynamics of the model. The cointegrated error-correction granger causality test for GDP and government expenditure agriculture and allied activities is

$$\Delta ln(gdp)_t = a_1 + \sum_{i=1}^{n} b_i \Delta ln(gdp)_{t-i} + \sum_{i=1}^{m} d_i \Delta ln(AEXP)_{t-j} + r_i (EC_l)_{t-1} + e_1 \quad (2)$$

$$\Delta ln(gdp)_t = a_1 + \sum_{i=1}^{n} b_i \Delta ln(gdp)_{t-i} + \sum_{i=1}^{m} d_i \Delta ln(AEXP)_{t-j} + r_i (EC_l)_{t-1} + e_1 \quad (3)$$

The Cointegrated error-correction Granger causality test for government expenditure Agriculture and Allied Activities and Agriculture Output is

$$\Delta ln(AEXP)_t = a_1 + \sum_{i=1}^{n} b_i \Delta ln(AEXP)_{t-i} + \sum_{i=1}^{m} d_i \Delta ln(AO)_{t-j} + r_i (EC_l)_{t-1} + e_1 \quad (4)$$

$$\Delta ln(AO)_t = a_2 + \sum_{i=1}^{n} c_i \Delta ln(AO)_{t-i} + \sum_{i=1}^{m} g_i \Delta ln(AEXP)_{t-j} + l_i (EC_2)_{t-1} + e_1 \quad (5)$$

Where,

Δ = First Difference; AEXP = Agriculture and Allied Activities Expenditure

AO = Agriculture Output; u_t and e_t = White noise error terms
s n m = lag lengths; EC_{1t-1} and EC_{2t-1} = error correction term

Δln(AEXP) and Δln(AO) = Short-run parameters

The study also used diagnostic tests such as VEC residual heteroscedasticity test, VEC residual serial correlation LM test, and the Jarque-Bera normality test.

4. Empirical Results Analysis

4.1 Descriptive Statistics

Table 1 shows the descriptive statistics of variables. Standard deviation measures the dispersion in the series, which is very low for all variables. The skewness is nearer to zero in all four variables, which measures the asymmetry of the distribution of the series. Kurtosis also is less than 3 in all variables, indicating that the distribution of all four series under consideration is flat or platykurtic relative to the normal distribution. According to the Jarque-Bera statistic, there is no evidence to reject the null hypothesis of normal distribution.

4.2 Phillips-Perron: Unit Root Test

Phillips-Perron unit root test was performed on each variable to investigate whether each series have stationary or not, and presented its results in Table 2. Results reveal, at the level cannot reject the null hypothesis (P=0), i.e., both intercept and trend with intercept have non-stationary. But, at the first difference, the study rejected the null hypothesis (p=0) and concluded each series have stationery. All these variables are integrated into the order of one, i.e., I (1). These results indicate that the series may

Table 1. Summary of statistics

Descriptive Statistics	LNAEXP	LNAO	LNGDP
Mean	10.53383	14.51913	16.40137
Median	10.44821	14.51038	16.28611
Maximum	11.92848	14.71417	17.06589
Minimum	9.189627	14.27073	15.82106
Std. Dev.	1.011245	0.141131	0.419898
Skewness	0.180011	-0.096571	0.171228
Kurtosis	1.492418	1.819750	1.526590
Jarque-Bera	1.401411	0.834339	1.334791
Probability	0.496235	0.658909	0.513043
Sum	147.4737	203.2678	229.6192
Sum Sq. Dev.	13.29401	0.258933	2.292088
Observations	14	14	14

Eviews - 9 Results

Table 2. Phillips-Perron: unit root results

Variable	Level		First Difference		Order of Integration
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	
LNAEXP	-0.2138	-1.8110	-3.6455**	-4.2541**	I(1)
LNAO	-2.1969	-3.8106	-6.4305***	-5.6856***	I(1)
LNGDP	0.1941	-1.9792	-2.9979*	-2.9210	I(1)

a: (*)Significant at 10%; (**)Significant at 5%; (***) Significant at 1% and (no) Not Significant

b: Lag Length based on SIC

c: Probability based on MacKinnon's (1996) one-sided p-values

Table 3. Johansen cointegration results

Variable	Trace Test			Maximum Eigenvalue Test		
	Hypothesis No. of CE(s)	Test Statistic	Critical Value for 5% Confidence interval	Hypothesis No. of CE(s)	Test Statistic	Critical Value for 5% Confidence interval
LNAEXP & LNGDP	h=0	17.57742	20.26184	h=0	12.82440	15.89210
	h=1	4.753019	9.164546	h=1	4.753019	9.164546
LNAEXP & LNAO	h=0*	21.66215	20.26184	h=0*	17.17873	15.89210
	h=1	4.483424	9.164546	h=1	4.483424	9.164546

Trace test indicates 1 cointegrating equation(s) at the 0.05 level

*denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values be co-integrated. The study used one lag based on the Akaike Information Criterion (AIC).

4.3 Cointegration Test Results

Johansen Co-integration test presented in Table 3, these results can be interpreted in two ways. One is trace statistics (t_{trace}) and maximum eigenvalue (t_{max}) statistics and used one optimal lag based on the Akaike Information Criterion (AIC). Table 3, shows that for H0: h=0 and h=1, the 5 per cent critical values are greater than the calculated values in both the trace statistics test and Maximum Eigen value. Therefore, the study fails to reject the null hypothesis of no cointegration or equation of no long-run relationship between agriculture and allied activities expenditure and economic growth. The null hypothesis of h=0, there is no evidence to accept because 5 per cent critical values are lesser than the calculated values. Suggested, there is one cointegrating vector in the model, that shows the long-run relationship between the expenditure of agriculture and allied activities and agriculture output. The study found that there is no long-run relationship between total government expenditure on agriculture and allied activities and economic growth but there is a long-run relationship between total government expenditure on Agriculture and Allied Activities and agriculture output.

4.4 Short-Run and Long-Run Causality between Government Total Expenditure of Agriculture and Allied Activities and Agriculture Output

Table 4, presents the information of the granger causality test based on the error-correction model for the causal relationship between government expenditure on agriculture and allied activities expenditure and agriculture output. The coefficient of the ECt-1 term examines the causality between agriculture output and government expenditure on agriculture and allied activities. The coefficient has an expected sign negative and is statistically significant. Therefore, fails to accept the null hypothesis that agriculture output does not cause government expenditure on agriculture and allied activities. Government expenditure on agriculture and allied activities increased by an increase in agriculture output in the long run. Significant error correction term indicates that 0.85 per cent of total disequilibrium

Table 4. Causality between government total expenditure of agriculture and allied activities and agriculture output based on Error-Correction Model

Independent Variables	**Dependent Variables**	
	ln(AEXP)t	**ln(AO)t**
EC_{t-1}	-0.852779 [-2.11796]*	-0.008859 [-0.44514]
$\Delta ln(AEXP)_{t-1}$	0.469522[1.487301]	0.039871[2.55515]*
$\Delta ln(AO)_{t-1}$	-5.794038[-1.34266]	-0.415528[-1.94806]
C	0.301353[1.60858]	0.036028[3.89065]*
Diagnostic		
R^2	0.497736	0.533441
F-Stat	2.642625*	3.048939*
LM-Stat	9.340148 (0.0531)	
Heteroscedasticity	26.24313 (0.5051)	

Note: *1% significance level, [] t-Statistics, () Probability in agriculture output and government expenditure on agriculture and allied activities is corrected each year in India. The coefficient of the EC2t-1 term is statistically insignificant. Therefore, there is no evidence to reject the null hypothesis, i.e., government expenditure on agriculture and allied activities does not cause agriculture output, and short-run coefficients are insignificant, which concludes that there is no short-run causality between agriculture output and government expenditure on agriculture and allied activities in any direction. Unidirectional causality exists between agriculture output and government expenditure in agriculture and allied activities in the long run.

5. Conclusions and Policy Implications

The study found that there is no long-run relationship between total government expenditure of Agriculture and Allied Activities and economic growth supported by Landau (1986) and Scully (1989) but there is a long-run relationship between total government expenditure of agriculture and allied activities and agriculture output. The result of the Vector Error Correction Model evinces that there is one-way causality running from agriculture output to expenditure of agriculture and allied activities both in the short-run and long-run supporting "Wagner's hypothesis" in India. The conclusion that there is unidirectional causality from agriculture output to an expenditure of agriculture and allied activities are supported by Salih (2012), and Wang *et al*., (2016). The results also differ from those of Okezie *et al*., (2013) and Guandong & Muturi (2016), who found a unidirectional causality from expenditure to economic growth. Hence, in India, the agriculture sector is the major sector and agriculture output plays a significant role in the development of the nation; this sector provides more employment opportunities to rural people as compared to the other two sectors in India. Therefore, there is a need for the development of the agriculture sector by the government through budget allocation as well as effective management of existing agricultural programmes in India.

6. References

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