ISSN: 2321-6247
EPRA International Journal of Economic Growth and Environmental Issues (EGEI)
SJIF Impact Factor:5.708|Volume:5|June–May 2017-18

THE TODA–YAMAMOTO APPROACH TO GRANGER NON CAUSALITY TEST: THE EXPERIENCE FROM INDIA (1975 to 2014)

Dr. Paranan Konwar[1]

[1]Assistant Professor, Department of Economics, Sonari College, P.O.: Sonari, District: Charaideo, Pin:785690, Assam, India

ABSTRACT

The objective of this paper is to investigate the nature and direction of causal relationship between government expenditure and economic growth in India in contexts of Wagner's law. The hypothesis adopted is to test that the government expenditure is endogenous, an outcome of economic growth. The time series data used in the present study covers the period from 1975-76 to 2013-14. From the Toda and Yamamoto non-causality test, no evidence of causality is detected between GDP and GER No-causality between public expenditure and GDP is referred to as 'neutrality hypothesis'. It implies that public expenditure is not correlated with GDP, which means that neither contraction nor expansionary policies in relation to public expenditure have any effect on economic growth. It nullifies the applicability of both Wagner's law and the Keynsian law in India.

KEYWORDS: *economic growth; government expenditure; Wagner's law; causality; India*

1 INTRODUCTION

The nexus between government expenditure and economic growth has been an enduring issue in the literatures of public economics both at theoretical and empirical levels. The focus is mainly on two approaches that call for two opposite directions of causality: first (Keynesian law) running from public expenditure to economic growth and second (Wagner's law) running from economic growth to public expenditure.

In the nineteenth century, public expenditure under the influence of the classicals, played a limited role in economic activity. There was neither any sound classification of government expenditure nor any standard laid on which all such expenditures should be based. However, in the latter part of the nineteenth century, Adolph Wagner (1835-1917), a German political economist put forward his law of increasing public expenditures in 1893. Wagner's hypothesis is a classical approach which views public expenditure as an endogenous factor to economic growth or national income. As per capita income increases, the share of public sector expenditure rises to meet the increased protective, administarative and educational functions of the state. (Cheong, 2001:38). His "aim is to establish generalizations about government expenditures, not from postulates about the logic of choice, but rather by direct inference from historical evidence (Peacock & Wiseman, 1961:16). Thus, his suggestion is not prescriptive, but rather explanatory in character (Peacock & Wiseman, 1961:16). It does not contain any *priori* property. He put his model forward with regard to *posterior* results, i.e. he made his suggestion depending on empirical results observed in a number of industrializing countries. (Bagdigen and Centinuas, 2003:58).

2 OBJECTIVES AND HYPOTHESIS

The objective of this paper is to investigate the nature and direction of causal relationship between government expenditure and economic growth in India with reference to Wagner's law. The hypothesis of the study is to test that the government expenditure is endogenous, an outcome of economic growth.

3 METHODOLOGY AND DATA SOURCES

Data used in the present study are collected from the *Handbook of Statistics on Indi- an Economy* by the Reserve Bank of India (RBI, 2015). All data are annual figures covering the 1975-76 to 2013-14 period and variables are measured (at constant price) with base year 2004-05 prices. The choice of the starting period was constrainedby the availability of time series data on GDP, Government Expenditure and Capital formation.

The study defines government expenditure (GE) as sum of government final *consumption* expenditure (CE) and government sector gross *capital formation* expenditure (I), that is GE = CE + I and economic growth as real gross domestic product at factor cost. Here, GDP means annual growth rate of GDP at factor cost (at constant price) base year: 2004-05 (per cent). GER is ratio of GE to GDP, i.e. share of govt. expenditure (on goods and services) in annual GDP.

Toda and Yamamoto (1995) have developed a simple procedure that involves testing for Granger non-causality in level VARs irrespective of whether a series is I(0), I(1) or I(2), non-cointegrated or cointegrated (Karimi, 2009). The approach proposed by Toda and Yamamoto (1995) is to employ a modified Wald test for restriction on the parameters of the VAR (k) where k is the lag length of the VAR system. The basic idea of this approach is to artificially augment the correct VAR order, k; by the maximal order of integration, say dmax: Once this is done, a (k +Dmax)th order of VAR is estimated and the coefficients of the last lagged dmax vector are ignored (see Caporale and Pittis, 1999; Rambaldi and Doran, 1996; Rambaldi, 1997; Zapata and Rambaldi, 1997). The application of the Toda and Yamamoto (1995) procedure ensures that the usual test statistic for Granger causality has the standard asymptotic distribution where valid inference can be made.

To undertake Toda and Yamamoto (1995) version of the Granger non-causality test, we represent the GDP – GER model in the following VAR system:

$$LY_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} LY_{t-i} + \sum_{j=k+1}^{d\,max} \alpha_{2j} LY_{t-j} + \sum_{i=1}^{k} \delta_{1i} LX_{t-i} + \sum_{j=k+1}^{d\,max} \delta_{2j} LX_{t-j} + u_{1t}$$

$$LX_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} LX_{t-i} + \sum_{j=p+1}^{d\,max} \beta_{2j} LX_{t-j} + \sum_{i=1}^{p} \beta_{1i} LY_{t-i} + \sum_{j=p+1}^{p+m} \beta_{2j} LY_{t-j} + u_{2t}$$

The model given by above two equations is estimated using the Seemingly Unrelated Regression (SUR) technique. A Wald test is then carried out to test the hypothesis. The computed Wald-statistic has an asymptotic chi-square distribution with k degrees of freedom.

4 EMPIRICAL ANALYSIS AND RESULTS

Descriptive Statistics and Correlation Matrix

Table 1 displays the descriptive statistics of the data series. The table shows no unusual features in any series. The standard deviation that measures the dispersion is low for the three series. The skewness that measures asymmetry of the distribution of the series around its mean indicates that the series are skewed negatively. The kurtosis which measures the peakedness or flatnesss of the series distribution is less than 3 in two series implying that the distributions of the three series are flat or platykurtic relative to the normal distribution. Furthermore, the Jarque-Bera statistic that tests whether the series is normally distributed rejected the null hypothesis of normal distribution at any conventional significance level in case of two series and accepts the normality in case of one series. The correlation is strong in between LGER and LIR.

Table 1. Summary statistics on the variables and the correlation matrix

Part A: Descriptive statistics									
Variables	**Mean**	**Med.**	**Max.**	**Min.**	**Std.**	**Skew.**	**Kur.**	**JB**	**Pr.**
LGDP	1.730	1.808	2.322	0.182	0.468	-1.532	5.854	28.500	0.000
LGER	0.628	0.767	1.703	-0.706	0.744	-0.465	1.982	3.086	0.214
Part B: Correlation matrix									
	LGDP		LGER						
LGDP	1.000		0.269						
LGER	0.269		1.000						

Notes:
Med.: Median; Max.: Maximum ; Min.: Minimum; Std.: Standard Deviation; Skew.: Skewness; Kur.: Kurtosis; JB: Jarque-Bera; Pr.: Probability
Values reported here are the natural logs of the variables. We use natural log forms in our estimation.

Source: Estimated by the author on the basis of secondary data compiled from RBI

Unit Root Tests

Before testing for co-integration, we tested for unit roots to find the stationarity properties of each series of the data. Augmented Dickey Fuller (ADF) and Phillips Perron (PP) were used on each of the three time series data. The lag length for ADF tests was selected to ensure that the residuals were white noise.To determine the stationarity property of the variable, the unit root test was used for their levels. The table 2 shows that the null hypothesis of a unit root cannot be rejected for the given variable accepts LGDP. Thus we can conclude that the variables are not stationary at their levels. Then the unit test was applied to the first differences. However, the null hypothesis that the series have unit roots in first differences is rejected, meaning that the three series are stationary at their first differences , that is, they are integrated of the order one i.e I(1)].

Table 2. Unit Root Tests

	Augmented Dickey Fuller (ADF)		**Phillips Perron (PP)**	
	Level			
Variable	**Constant Without Trend**	**Constant With Trend**	**Constant Without Trend**	**Constant With Trend**
LGDP	-6.294*** (0)	-7.273*** (0)	-6.291*** [1]	-7.707*** [6]
LGER	-2.524 (8)	-1.256 (0)	-1.361 [7]	-1.233 [4]
	First Difference			
LGDP	-4.638*** (3)	-3.505* (9)	-22.270*** [16]	-24.046*** [17]
LGER	-5.571*** (0)	-2.681 (9)	-5.551*** [4]	-5.836*** [9]

Notes: ***, ** and *denotes significant at 1%, 5% and 10% significance level, respectively. The figure in parenthesis (...) represents optimum lag length selected based on Akaike Information Criterion. The figure in bracket [...] represents the Bandwidth used in the KPSS test selected based on Newey-West Bandwidth criterion.

Source: Estimated by the author on the basis of secondary data compiled from RBI

Selection of the Optimum Lag Length

Before undertaking cointegration tests, we first need to determine the number of lags that will be used in the underlying vector autoregression (VAR) model. The relevant order of lags used in the VAR model was determined using the Akaike information criterion (AIC), Schwarz information criterion (SC), Hannan-Quinn information criterion (HQ). Table 3 presents the lag specification results and the number of lags determined is one.

Table 3. Lag selection based on VAR lag length criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-55.558	NA	0.077	3.111	3.198	3.142
1	34.565	165.631*	0.001*	-1.544*	-1.283*	-1.452*
2	34.869	0.525	0.001	-1.344	-0.909	-1.191

Notes:
* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Estimated by the author on the basis of secondary data compiled from RBI

The Toda–Yamamoto Approach to Granger Non-causality Test:

Now we proceed to non-causality tests using the Toda and Yamamoto procedure. As the maximum order of integration of the series under investigation is one, the Toda and Yamamoto test involves the addition of one extra lag of each of the variables to control for potential cointegration.

Table 4. VAR Model Estimates between GDP and GER

Endogenous variables	Dependent variables	
	LGDP	LGER
LGDP(-1)	-0.007166	0.034898
	(0.15968)	(0.02707)
	[-0.04488]	[1.28907]
LGER(-1)	0.551035	1.044992
	(1.05402)	(0.17870)
	[0.52279]	[5.84786]
Exogenous variables		
C	1.634101	0.022355
	(0.39890)	(0.06763)
	[4.09655]	[0.33056]
LGDP(-2)	0.013006	-0.002542
	(0.15473)	(0.02623)
	[0.08406]	[-0.09690]
LGER(-2)	-0.409969	-0.074837
	(1.03649)	(0.17572)
	[-0.39554]	[-0.42588]
R-squared	0.065511	0.991302
Adj. R-squared	-0.051300	0.990215
F-statistic	0.560829	911.8028
Log likelihood	-16.52282	49.14027
Akaike AIC	1.163396	-2.385961
Schwarz SC	1.381087	-2.168269

Source: Estimated by the author on the basis of secondary data compiled from RBI

Findings of the Toda and Yamamoto tests are presented in Table 5. As can be learned from the significance of the p-values of the modified Wald (MWALD) statistic, there is no evidence of causality between GDP and GER.

Table 5. Toda and Yamamoto Non-causality Test Result

Null Hypothesis	p-value	Sum of lagged coefficient	Causality
GDP doesnot granger cause GER	0.1974	1.661710	NO
GER doesnot granger cause GDP	0.6011	0.273314	NO

Source: Estimated by the author on the basis of secondary data compiled from RBI

5 CONCLUSIONS AND RECOMMENDATION

Wagner's Law is the first model of public expenditure in the history of public economics. Various studies across the world are trying to investigate the association between the government expenditure and economic growth and found mixed results. The objective of this paper is to investigate the nature and direction of causal relationship between government expenditure and economic growth in India in the contexts of Wagner's law. From the Toda and Yamamoto non-causality test, no evidence of causality is detected between GDP and GER No-causality between public expenditure and GDP is referred to as 'neutrality hypothesis'. It implies that public expenditure is not correlated with GDP, which means that neither contraction nor expansionary policies in relation to public expenditure have any effect on economic growth.

REFERENCES

1. *Ahmad, M. (2014).Government expenditure and economic growth: An econometric test for India. International Journal of Social Science and Humanities Research, 2 (3), 79-88.*
2. *Atkinson, A. B., & Stiglitz, J. E. (1980). Lectures on public economics. New York: McGraw-Hill.*
3. *Bird, R. M. (1970). The growth of government spending in Canada. Toronto: Canadian Tax Foundation.*
4. *Demirbas, S. (1999, May). Cointegration analysis-causality testing and Wagner's law: The case of Turkey, 1950-1990 (Paper presented at the annual meeting of the European Public Choice Society held in Lisbon (April 7-10, 1999). Retrieved from www.le.ac.uk/economics/ research/repec/lec/leecon/ econ99-3.pdf*
5. *Dickey, D.A., & Fuller, W.A. (1979). Distribution of the estimators for autoregressive time-series with a unit root. Journal of the American Statistical Association, 74, 427-431.*
6. *Dickey, D.A., & Fuller, W.A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49, 1057-1072.*
7. *Dickey, D.A., & Pantula, S.G. (1987). Determining the order of differencing in autoregressive processes. Journal of Business and Economics Statistics, 5, 455-461.*
8. *Granger, C.W.J. (1969). Investigating causal relations by econometric models and cross spectral methods, Econometrica, 37, 424-438.*
9. *Granger, C.W.J. (1986). Developments in the study of cointegrated economic variables. Oxford Bulletin of Economics and Statistics, 48, 213-228.*
10. *Granger, C.W.J. (1988). Some recent developments in a concept of causality. Journal of Econometrics, 39, 199-211.*
11. *Henrekson, M. (1990, January). Wagner's law: A spurious relationship? (Memorandum No. 131). Trade Union Institute for Economic Research, Stockholm, Sweden.*
12. *Henrekson, M. (1993). Wagner's law: A spurious relationship? Public Finance, 48 (2), 406-415.*
13. *Islam, A. M. (2001). Wagner's law revisited: Cointegration and exogeneity tests for the USA. Applied Economics Letters, 8, 509-515.*
14. *Mann, A. J. (1980). Wagner's law: An econometric test for Mexico: 1925-1976. National Tax Journal, 33, 189-201.*
15. *Phillips, P.C.B., & Perron, P. (1988). Testing for a unit root in time series regression. Biometrika, 75, 335 -346.*
16. *Ram, R. (1987).Wagner's hypothesis in time-series and cross-section perspectives: Evidence from 'real' data for 115 countries. Review of Economics and Statistics, 62, 194-204*
17. *RBI (2015). Handbook of Statistics on Indian Economy. Reserve Bank of India 2014-15. Mumbai: Department of Statistics and Information Management, Reserve Bank of India (http:// dbie.rbi.org.in).*
18. *Toda, H.Y., &Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated process. Journal of Econometrics, 66, 225–250.*

ISSN : 2321 - 6247