Government Expenditure and Economic Growth: Panel Evidence from Asian Countries

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Abstract: This paper attempted to examine the causality relationship between government expenditure and economic growth for two panels of 27 Asian countries over the 1970 to 2009 years. A Panel-VECM causality framework based on Wald's test employed to investigate short-run and long-run causality between government expenditure and economic growth and indicates bidirectional causality for Asian developing panel, while the results of long-run causality for advanced and newly industrialized countries does not support causality in any direction. These findings have the policy implication for policymakers and economists.
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1. Introduction

The relationship between government expenditure and economic growth is an important issue among the economist and policymakers for decades. Many empirical studies examined the relationship between government expenditure and economic growth for both developed and developing countries by using various econometric methods, but the results are mixed among the different studies. Some of these studies imply that government expenditure must decrease for achieving to more economic growth, and some of them indicate that government expenditure can stimulate growth. Further, some studies show that there is no relationship between government expenditure and economic growth in some countries.

The study of Gregoriou and Ghosh (2009) attempted to investigate the effect of government expenditure on economic growth for a panel of 15 developing countries over the 1972-1999 periods. The results of GMM method indicates that, for countries such as Brazil government expenditure plays a major role in long-run growth, whereas for countries like Sudan, government current expenditure have a minor role in economic growth. In other words impact of government expenditure is varying across the countries. Iyare and Lorde (2004) examined six versions of Wagner's law for nine Caribbean cointries, Empirical finding indicate the existence of long-run relationship between government expenditure and income for Grenada, Guyana and Jamaica for a specific version of Wagner's law. Results of Granger causality test indicate causality from income to government expenditure for Guyana and from government expenditure to income for Grenada and Jamaica. Results of short-run causality are mixed but causality from income to government expenditure is predominant causal relationship. Akitoby et al. (2006) studied the relationship between government spending and economic growth for 51 developing countries by employing error-correction model. The empirical results support existence of long-run relationship between government spending and GDP for 70% of countries. Wu et al. (2010) analyzed the Wagner's law hypothesis for 182 OECD and non-OECD countries by using panel data technique. Empirical results of this study indicate bi-directional causality for the full sample of countries. Also, the results of sub-sample countries support the bi-directional causality between government expenditure and economic growth. Huang (2006) investigates Wagner's law for China and Taiwan by employing Bound test approach proposed by Pesaran et al. (2001). The results of cointegration performed in this study cannot support existence of long-run relationship between government expenditure and GDP. In addition, the results of this study cannot support Wagner's law for China and Taiwan.

Wahab (2004) employed an ECM framework to analyze the nature of relationship between economic growth and government expenditure for OECD countries to investigate Wagner's law in these countries. The empirical finding reveals a limited support for Wagner's law. The study of Chang (2002) investigated five versions of Wagner's law for six emerging and industrialized countries over the 1951 to 1996 periods. The result

indicates unidirectional Granger Causality from income to government spending for South Korea, Taiwan, Japan, United Kingdom, and United States. Also, Chang et al. (2004) re-examined Wagner's law for ten emerging and industrialized countries and found same results as pervious work.

Landau (1983) tried to examine the relation between these variables for over 100 countries. The results of this paper indicate negative relationship between government consumption expenditure and the rate of growth of per capita GDP. Hsieh and Lai (1994) examined the relationship between government expenditure and economic growth for G7 countries by using Granger causality test and VAR technique. The results show that the relationship between government spending and growth can vary significantly across time as well as across the major industrialized countries. The empirical work of Dritsakis and Adamopoulos (2004) indicates bi-directional causality relationship between different category of expenditure and economic growth for Greek over the 1960 to 2001 years. Kolluri et al. (2000) showed short and long-run effects of economic growth on government expenditure for G7 countries by using annual time series data over the 1960 to 1993 years. Agell et al. (1997) examined relation between growth and the public sector for 23 OECD countries over the 1970 to 1990 years. The finding could not illustrate that relation is negative, positive or no relation exist between growth and public sector. Samudram et al. (2009) examined the relationship between different category of public expenditure and growth for Malaysia over the 1970 to 2004 years. The result indicates bi-directional causality between economic growth and spending on health and administration and for other kinds of spending causality run from economic growth to spending. The study of Loizides and Vamvoukas (2005) employed Granger causality framework to investigate the relationship between size of government and economic growth by examining a bi-variate model and two different tri-varibale models. The empirical results indicate causality from government size to economic growth in all countries in the short run and for Ireland and the UK in the long-run. In addition, causality from economic growth to government size in Greece and, when inflation included, in the UK.

As seen, there is no common consensus between the different studies. The difference between the findings could be due to different time periods or using different econometric methods. However, in this paper, we examine the causality relationship between government expenditure and economic growth for two panels of Asian countries by employing panel causality approach.

The rest of this paper is organized as follows: Section 2 discussed data and methodology. Section 3 present empirical results and finally conclusion presented in Section 4.

2. Data and Methodology

2.1 Data

The use of panel data has several benefits in contrast with time series data: controlling for individual heterogeneity and give more informative data, more variability, less colinearity among the variables, and more efficiency (Baltagi. 2005). Therefore, this paper applies panel data of government expenditure and real GDP of 27 Asian countries over the 1970 to 2009 years. Countries are categorized in two separate panels; one panel includes five Asian advanced economies: Hong Kong, Japan, Singapore, South Korea, Taiwan and five Asian newly industrialized countries: China, India, Malaysia, Philippines, and Thailand. Another's panel includes 17 Asian developing countries: Afghanistan, Bahrain, Bangladesh, Cambodia, Indonesia, Iran, Iraq, Jordan, Laos, Lebanon, Maldives, Nepal, Oman, Pakistan, Sri Lanka, Syrian Arab Republic, and Vietnam. Further, some of the countries excluded due to lack of data in the sample of 1970 to 2009 years.

The annual data of government expenditure and real GDP obtained from Penn Word Table 7.0. Government expenditure measured as the ratio of government expenditure to GDP, and real GDP measured in constant 2005 dollars, the natural logarithms of variables are denoted as LG and LGDP.

2.2 Methodology

2.2.1 Panel Unit Root Test

Several Panel unit root tests presented to investigate the stationary properties of panel data. This paper applied four tests proposed by Im et al. (IPS, 2003), Levin et al. (LLC, 2002), Breitung (2000) and Fisher-type test proposed by Maddala and Wu (1999) and Choi (2001) to test the null hypothesis of having unit root.

The test of Im, Pesaran and Shin (IPS, 2003) allow for a heterogeneous coefficient of y_{it-1} and propose an alternative testing procedure based on averaging individual unit root test statistics. IPS suggests an average of the ADF tests when u_{it} is serially correlated with different serial correlation properties across cross-sectional units.

The t-statistic of IPS can be expressed as follows:

$$t_{IPS} = \frac{\sqrt{N}(\bar{t} - \frac{1}{N}\sum_{i=1}^{N} E[t_{iT} \mid \rho_i = 0])}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} \mathrm{var}[t_{iT} \mid \rho_i = 0]}} \Rightarrow N(0,1) \quad (1)$$

Values of $E[t_{iT} \mid \rho_i = 0]$ and $\mathrm{var}[t_{iT} \mid \rho_i = 0]$ obtained from the results of Monte Carlo simulations carried out by IPS.

Following Dickey and Fuller (1979, 1981), Levin and Lin (1993), and Levin, Lin and Chu (2002), consider a panel extension of the null hypothesis that each individual time series in the panel contains a unit root against the alternative hypothesis that all individual series are stationary.(Hsiao, 2003).

The adjusted t-statistic of LLC is:

$$t_{\rho}^{*} = \frac{t_{\rho} - N\tilde{T}\hat{S}_N \hat{\sigma}_{\varepsilon}^{2} \sigma(\hat{\rho}) \mu_{m\tilde{T}}^{*}}{\sigma_{m\tilde{T}}^{*}} \quad (2)$$

Where $\mu_{m\tilde{T}}^{*}$ and $\sigma_{m\tilde{T}}^{*}$ are the mean and standard deviation adjustments provided by table 2 of LLC. Levin, Lin and Chu show that t_{ρ}^{*} is asymptotically distributed as $N(0, 1)$.

As mentioned in Baltagi (2005), LLC and IPS tests may not keep nominal size well when either N is small or N is large relative to T. Breitung (2000) found that the LLC and IPS tests suffer from a dramatic loss of power if individual-specific trends are included. Breitung suggests a test statistic that does not employ a bias adjustment whose power is substantially higher than LLC or the IPS tests using Monte Carlo experiments.

Maddala and Wu (1999) and Choi (2001) proposed a Fisher-type test of unit root, which combines the p-values from unit root tests for each cross-section i to test for unit root in panel data. The Fisher test is nonparametric and distributed as chi-square with two degrees of freedom:

$$p\lambda = -2\sum log_e \pi_i \quad (3)$$

2.2.2 Panel Cointegration Test

Several test presented to examine the existence of cointegration in panel data. This paper applied panel cointegration test of Pedroni (1999, 2004) and Kao (1999).

Pedroni presented seven statistics for testing the null hypothesis of no cointegration in panel data. Four statistics called panel cointegration statistics and based on pooling along what is commonly referred to as the within-dimension. And other three statistics developed by Pedroni called group-mean panel cointegration statistics, are based on pooling along what is commonly referred to as the between-dimension.

Kao (1999) introduced parametric residual-based panel cointegration. He expanded four DF-types and one ADF-type tests for testing the null hypothesis of no cointegration. The tests are based on the spurious least squares dummy variable (LSDV) panel regression equation with one single regressor.

2.2.3 Granger Causality Test

To investigate the causality relationship between two variables in panel data we can use the following bi-variate vector autoregressive (VAR) model and employing Wald's test:

$$y_{it} = \lambda_i + \sum_{i=1}^{k} \alpha_{ik} y_{it-k} + \sum_{i=1}^{k} \beta_{ik} x_{it-k} + \varepsilon_{it} \quad (4)$$

$$x_{it} = \theta_i + \sum_{i=1}^{k} \gamma_{ik} y_{it-k} + \sum_{i=1}^{k} \delta_{ik} x_{it-k} + \upsilon_{it} \quad (5)$$

Where $i=1, \ldots, N$; $t=1, \ldots, T$; k refers to the lag, and ε_{it} and υ_{it} denote white-noise error terms.

3. Empirical Results

3.1. Panel Unit Root Test

The results of Im et al. (IPS, 2003), Levin et al. (LLC, 2002), Breitung (2000) and Fisher-type panel unit root test of Asian advanced economies and Asian newly industrialized countries presented in table 1 and results of Asian developing countries reported in table 2.

The results of different panel unit root tests indicates that LG is stationary in levels for developing panel while for advanced and newly industrialized countries become stationary after first difference. Furthermore, LGDP for both panels of countries is non-stationary in levels and become stationary after first difference, which means that LGDP is integrated of order one I (1).

3.2. Panel Cointegration Test

Table 3 presents the results of Pedroni panel cointegration tests for both panels of countries. Five statistics of pedroni test support the existence of cointegration between government expenditure and economic growth for advanced and newly industrialized countries. Further, all statistics of Pedroni tests reject the null hypothesis of no cointegration and indicate long-run relationship between LG and LGDP for developing countires.

Table 1. Panel Unit Root Tests – Advanced and Newly Industrialized Countries

Variable	*LG*		*LGDP*	
Test	Levels	1st differences	Levels	1st differences
IPS (2003)	0.512	-9.963 ***	1.002	-10.158 ***
LLC (2002)	1.108	-9.543 ***	-2.675 **	—
Breitung (2000)	-0.486	-3.608 ***	5.017	-4.211 ***
ADF-Fisher	17.433	138.114 ***	28.769	135.299 ***
PP-Fisher	21.291	184.035 ***	33.430 **	—

Note: *** and ** denote statistical significance at the 1 and 5% levels.

Table 2. Panel Unit Root Tests –Developing Countries

Variable	*LG*		*LGDP*	
Test	Levels	1st differences	Levels	1st differences
IPS (2003)	- 5.289 ***	—	3.294	-12.871 ***
LLC (2002)	-3.935 ***	—	3.686	-13.346 ***
Breitung (2000)	-2.711 ***	—	1.819	-5.144 ***
ADF-Fisher	99.170 ***	—	32.990	237.946 ***
PP-Fisher	73.804 ***	—	21.885	346.160 ***

Note: *** denote statistical significance at the 1% levels.

Table 3. Pedroni Panel Cointegration Test

Panel Group	Advanced and Newly Industrialized	Developing
Statistics		
Panel *v*-statistic	2.513 ***	3.200 ***
Panel ρ-statistic	-0.368	-4.684 ***
Panel non-parametric (PP) *t*-statistic	-1.322 *	-5.209 ***
Panel parametric (ADF) *t*-statistic	-3.161 ***	-6.934 ***
Group ρ-statistic	0.616	-2.539 ***
Group non-parametric *t*-statistic	-0.783 *	-4.024 ***
Group parametric *t*-statistic	-2.666 ***	-6.018 ***

Note: ***, ** and * denote statistical significance at the 1, 5 and 10% levels, respectively.

Table 4. Kao Panel Cointegration Test

Panel Group	Advanced and Newly Industrialized	Developing
Statistics		
DF_ρ	-0.739	-7.272 ***
DF_t	-0.807 *	-4.890 ***
DF_ρ^*	-5.282 ***	-17.137 ***
DF_t^*	-1.824 **	-4.904 ***
ADF	-1.899 **	-4.696 ***

Note: ***, ** and * denote statistical significance at the 1, 5 and 10% levels, respectively.

The results of Kao panel cointegration test reported in table 4. All statistics of Kao test except DF_ρ support the existence of cointegration between series for advanced and newly industrialized countries. Also, several statistics of Kao test reveal cointegration relationships between government expenditure and economic growth for developing panels. As seen, the results of Kao panel cointegration test adopt results of Pedroni panel cointegration test.

3.3. Panel Causality Test

As Granger (1969, 1988) points out, if there exists a cointegration between variables, there is causality among these variables at least in one direction. Therefore, to determine the direction of causality a panel-VECM causality which is based on Wald's test applied in this paper.

A bi-variate panel-VECM to examine the causal relationship between government expenditure and economic growth can be written as follows:

$$\Delta LG_{it} = c_{1i} + \sum_{i=1}^{k} \alpha_{1ik} \Delta LG_{it-k} + \sum_{i=1}^{k} \beta_{1ik} \Delta LGDP_{it-k} + \gamma_{1i} ECT_{t-1} + \varepsilon_{it} \quad (6)$$

$$\Delta LGDP_{it} = c_{2i} + \sum_{i=1}^{k} \alpha_{2ik} \Delta LG_{it-k} + \sum_{i=1}^{k} \beta_{2ik} \Delta LGDP_{it-k} + \gamma_{2i} ECT_{t-1} + \upsilon_{it} \quad (7)$$

Where Δ is the first difference operator and ECT_{t-1} is lagged values of the error correction term. The short-run causality from economic growth to government expenditure tested by H_0: $\beta_{1ik} = 0$ for all i and k in Eq. (6). Similarly, the null hypothesis for Eq. (7), is H_0: $\alpha_{2ik} = 0$ for all i and k, which test short-run causality from government expenditure to economic growth. Further, to investigate the long-run causality, the null hypothesis of no long-run causality in each Eq. (6)-(7), is tested by examining the significance of the coefficient of the respective error correction term.

Lag-length selection using Akaike's information criterion (AIC) indicated 3 lags for advanced and newly industrialized panel and four lag for developing panel. The results of panel causality reported in table 5 and 6.

Table 5. Panel Causality Test - Advanced and Newly Industrialized Countries

Dependent variable	Source of causation (independent variables)		
	Short-run		Long-run
	ΔLG	ΔLGDP	ECT
ΔLG	—	2.631 **	- 0.008
ΔLGDP	1.956	—	0.002

Note: ** denote statistical significance at the 5% levels.

The evidence of Panel–VECM causality framework in short-run reveals the unidirectional causality from LGDP to LG for advanced and newly industrialized countries and bidirectional causality between government expenditure and economic growth for developing countries. The results of causality in long-run indicate causality running in both directions for developing countries while for advanced and newly industrialized countries; we cannot find evidence of causality relationship between government expenditure and economic growth in any directions.

Table 6. Panel Causality Test - Developing Countries

Dependent variable	Source of causation (independent variables)		
	Short-run		Long-run
	ΔLG	ΔLGDP	ECT
ΔLG	—	4.316 ***	- 0.055 ***
ΔLGDP	2.423 **	—	-0.013 ***

Note: ***, ** and denote statistical significance at the 1 and 5% levels.

4. Conclusion

There are many empirical studies about the relationship between government expenditure and economic growth, but there are no common consequences between the different studies, so work on this issue is still debatable among economist. Therefore, this paper examined the causal relationship between government expenditure and economic growth in short-run and long-run for two panels of Asian countries; one panel consists of advanced and newly industrialized countries, and another's panel includes developing countries.

The empirical result of panel cointegration test indicates cointegration between government expenditure and economic growth for both panels. The panel-VECM causality framework based on Wald's test performed after investigates cointegration relationship and reveals bidirectional causality for developing countries in short-run and long-run. Furthermore, the empirical finding of panel causality test for advanced and newly industrialized countries indicates unidirectional causality running from economic growth to government expenditure in short-run, and no causality relationship in long-run. These findings can be important for policymakers, because they can conclude some policy implication for the size of government expenditure with respect to these results.

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