International Journal of Economics, Commerce and Management
United Kingdom Vol. II, Issue 4, 2014
http://ijecm.co.uk/ ISSN 2348 0386

NATIONAL INCOME AND GOVERNMENT SPENDING: CO-INTEGRATION AND CAUSALITY RESULTS FOR SELECTED LATIN AMERICAN COUNTRIES

Grullón, Santiago
Senior Director of Research and Analysis, NYC & Company, New York City, United States
santiago.grullon@gmail.com

Abstract

This study investigates Wagner's Law of a long-run tendency for government expenditure to expand at a faster rate than the pace of growth of national output in Chile, Colombia, Honduras, Panama, and Paraguay during the period 1980-2012. Results from the bounds test approach co-integration provide evidence of a long-run relationship between gross domestic product and government expenditure in these countries. Estimates of the long-run coefficient show above-unity elasticities for all five countries. Moreover, Granger Pairwise causality tests show causal linkages running from gross domestic product to government spending. Combined, all these results confirm the validity of Wagner's Law for this sample of Latin American countries. The policy implications of these findings suggest the governments of these countries should be cautious about their future spending as any further increase could lead to a significant deterioration of their public finances.

Keywords: Wagner's Law, national income, public spending, bounds test, Granger Pairwise causality

INTRODUCTION

Adolph Wagner (1883) argued that the process of economic development produces a long-run tendency for government expenditure to expand at a faster rate than the pace of growth of national output. Wagner's law of '*expanding state expenditure*' is based on the following three elements. First, public spending will rise to meet an expansion in the administrative and protective functions of the state; second, economic development will lead to increased spending in 'cultural and welfare' services such as education and health care; and third, expenditures on highways, railroads, and other infrastructure-type projects will increase due to the absence of private sector incentives to undertake these large scale investments. Wagner's hypothesis of a long-run causal relation between national income and public expenditure has been empirically tested and found to be valid for a number of countries. Narayan et al. (2008) examined it for Fiji for the period 1970-2002. Using the Johansen test for co-integration, they found one co-

integration relationship between national output and government expenditure. Using five different long-run estimators, they obtained robust results on the impact of national income on government expenditure. They also found that in the long run national income Granger caused government expenditure. Samudram et al. (2009) investigated Wagner's law in Malaysia for the period 1970-2004. The empirical results using the bounds test approach to co-integration showed evidence of a long-run relationship between total expenditures and Gross National Product. The results also showed long-run causality from GNP to government expenditures.

Iniguez-Montiel (2010) tested the relationship between government expenditures and national income in Mexico during 1950-1999 and found a co-integrated relationship between the variables. The causality results proved uni-directional causality running from GDP to government spending. Rehman et al. (2010) examined the nature and the direction of causality between national income and public expenditure in Pakistan during the period of 1971-2006. The findings showed uni-directional causality from GDP to government expenditure. Akpan (2011) employed the bounds test approach to co-integration and Granger causality test and found strong support for Wagner's hypothesis in Nigeria over the period 1970-2008. Alm and Embaye (2011) investigated the growth of per capita government spending and per capita income in the Republic of South Africa for the period 1960-2007 using multivariate co-integration techniques and Granger causality tests. They found a long-run relation between these two variables. Their Granger causality test results showed uni-directional causality from per capita income to per capita government spending. Grullón (2012) assessed Wagner's law in the Dominican Republic under alternative growth regimes during the periods 1960-1984 and 1985-2005. Using the bounds test approach to co-integration and a method developed by Bårdsen (1989) to derive long-run coefficients, the results show the existence of a co-integrated relationship between GDP and government consumption expenditure during the first period, with a long-run coefficient above unity. The findings for the second period also confirm the presence of co-integration between GDP and government consumption spending. However, the long-run coefficient was below unity. In addition, Granger Pairwise causality tests showed causal linkages from GDP to government consumption expenditure during both periods.

Kumar et al. (2012) used the bounds test approach to co-integration and found evidence of a long-run relation between the share of government spending in national output and per capita income in New Zealand during the period 1960-2007. They also applied five estimation techniques to measure the impact of per capita income on the share of government spending in output and found consistent results with income elasticities ranging from 0.56 to 0.84. Results from the Granger causality tests provided evidence in favor of per capita income Granger-causing the share of government spending in income. Bojanic (2013) examined nine different versions of Wagner's law in Bolivia for the period 1940-2010 using bi-variate co-integrated systems and found all the variables in all specifications were co-integrated. The findings from

Granger causality tests proved a bi-directional linkage between income and government expenditure in six of the nine versions of the law assessed. Srinivasan (2013) applied the Johansen approach to co-integration and causality tests to examine the long-run nexus between public expenditure and economic growth in India over the period 1973- 2012. The co-integration results confirmed the existence of long-run equilibrium relationship between the two variables. Results from an error correction model showed one-way causality from economic growth to public expenditure in the short-run and in the long-run.

Table 1 shows the growth rates of gross domestic product (*Y*) - net of government expenditure – and of government spending (*G*) for Chile, Colombia, Honduras, Panama, and Paraguay. The respective growth rates of gross domestic product (*Y*) ranged from a low of 2.5 percent in Paraguay to a high of nearly 6 percent in Panama. Meanwhile, the individual growth rates of government spending ranged from a low of 4.7 percent in Honduras to a high of 8.0 percent in Panama and exceeded the rate of expansion of GDP in all five countries.

Table 1: Gross Domestic Product (*Y*) and Public Expenditure (*G*)

Country	**Period**	**Growth of *Y* (%)**	**Growth of *G* (%)**	***G* – *Y* (% pt.)**
Chile	1990-2012	5.2	5.9	0.7
Colombia	1982-2012	3.1	6.0	2.9
Honduras	1990-2012	3.8	4.7	0.9
Panama	1980-2012	5.8	8.0	2.2
Paraguay	1980-2012	2.5	5.5	3.0

The excess growth rate of government spending over that of the overall economy in these countries makes this an ideal case to empirically test the validity of Wagner's hypothesis on the relationship between national income and government spending. The approach is as follows. First, we use the bounds testing approach to the analysis of level relationship of Pesaran et al. (2001) to investigate the existence of a co-integration relationship between national income and public expenditure. Second, we estimate the long-run coefficient of the responsiveness of government spending to output expansion using a method developed by Bårdsen (1989) for error correction models. Thirdly, we use Granger Pairwise causality tests to determine the direction of causality among the variables of interest.

.

RESEARCH METHODOLOGY

Following Iniguez-Montiel (2010), the validity of Wagner's law on the relationship between the growth of gross domestic product and government spending is tested using the 'Peacock-Wiseman Traditional Version' of Wagner's law:

$$G = f(Y) \qquad (1)$$

where: *G* represents real government spending and *Y* is real gross domestic product (net of government spending). The empirical analysis uses annual statistics. Data on the gross domestic product and government spending are from the IMF's World Economic Outlook database, October 2013. The GDP data are available in constant local currency. The government spending data are available in current prices and were adjusted by the GDP implicit price deflator.

The methodological framework for conducting the empirical analysis uses the bounds testing approach to the analysis of level relationships of Pesaran et al. (2001). The bounds testing methodology developed by these researchers uses an autoregressive distributed lag (ARDL) model to estimate an unrestricted error correction model (UECM). This method can be reliably used to estimate and test hypotheses on the long-run coefficients irrespective of whether the underlying regressors are purely *I*(0), purely *I*((1), or mutually co-integrated. Therefore, unlike other applications of co-integration analysis, which require that the order of integration of the underlying regressors be ascertained prior to testing the existence of a long-run relationship between the dependent variable and the independent variables, this method does not necessitate a precise identification of the order of integration of the underlying data. It thus eliminates the uncertainty associated with pre-testing the order of integration; this can be particularly troublesome in studies that have a small sample size as is the case in the present study. Thus, Wagner's hypothesis of the relationship between gross domestic product and government spending can be represented by the following ARDL/UECM equation:

$$\Delta \log G = \chi_0 + \chi_1 \log Y_{t-i} + \chi_2 \log G_{t-i} + \sum_{i=0}^{k4} \chi_4 \Delta \log Y_{t-i} + \sum_{i=1}^{k4} \chi_5 \Delta \log G_{t-i} + e \qquad (2)$$

where G and *Y* stand for government spending and gross domestic product (net of government spending), respectively, and *e* is the error term. Equation (2) was modified by including exogenously a dummy variable (Dummy) for Colombia and Panama to capture the effects of variations in the respective growth rates of GDP. In performing the ARDL/UECM estimation, the maximum number of lags of the levels variables is set equal to one, and on the first-differenced variables the process starts off from a maximum of four lags, then the optimum number is chosen based on the Akaike's Information Criterion (AIC), the Ramsey RESET test, and the adjusted R^2. Thus, the formulation with the lowest AIC, the Ramsey RESET test results for the

best-fit specification, and the highest adjusted R^2 is selected. The test for the existence of co-integration between the terms in levels is conducted by means of a Wald *F*-test as follows:

H_o: $\chi_1 = \chi_2 = 0$ (no co-integration exists)

H_A: $\chi_1 \neq \chi_2 \neq 0$ (co-integration exists)

Pesaran et al. (2001) provide two sets of critical value bounds covering the two polar cases of the included lagged level explanatory variables (Table 2 below). If the computed Wald *F*-statistic falls below the lower bound (indicating that $\chi_1 = \chi_2 = 0$), then this would lead us to conclude that there is no co-integration between overall output growth and government spending. If, on the other hand, the computed *F*-statistic exceeds the upper bound of the critical value (signifying that $\chi_1 \neq \chi_2 \neq 0$), then the alternative hypothesis of co-integration between gross domestic product and government spending will be accepted.

Table 2. Critical value bounds for the Wald *F*-statistic

Level of Significance	Lower Bound Value *I*(0)	Upper Bound Value *I*(1)
1%	6.84	7.84
5%	4.94	5.73
10%	4.04	4.78

Source: Pesaran et al. (2001), Table C1.iii: Case III: Unrestricted intercept and no trend.

After establishing a co-integration relation between the variables, following Bårdsen (1989), the long-run elasticity of government spending to variations in gross domestic product (μ) is $-(\chi_1/\chi_2)$. Wagner's law requires that $\mu > 1$. Engle and Granger (1987:259) point out that a two-variable co-integrated system must have a causal ordering in at least one direction. Thus, the study will then proceed to apply Pairwise Granger causality tests to establish whether there is a causal association between the variables. To implement the Granger causality test, the following model based on Granger (1969:431) will be estimated:

$$G_t = \sum_{j=1}^{m} a_j G_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \varepsilon_t,$$

$$Y_t = \sum_{j=1}^{m} c_j G_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t \qquad (3)$$

where G and *Y* are as previously defined and are assumed to be two stationary time series with zero means, and ε_t and η_t are taken to be two uncorrelated white-noise series. Granger's

definition of causality expressed by Equation (3) implies that Y_t is causing G_t provided some b_j is not zero. Likewise, G_t is said to be causing Y_t provided some c_j is not zero. If either of these cases exists, then there is one-way causality between G_t and Y_t. However, if both of these events occur, there is a two-way causal relationship between G_t and Y_t.

EMPIRICAL RESULTS

The econometric results summarized in Table 3 show the existence of a long-run equilibrium relationship between gross domestic product and government spending in all five countries studied. Chile has the smallest elasticity of the five countries, but is nonetheless above-unity. The Wald *F*-statistic exceeds the upper bound value at 5 percent and 10 percent levels of significance (see Table 2 above). Colombia has the second highest elasticity of the five countries studied. The Wald *F*-statistic exceeds the upper bound value at 5 percent and 10 percent levels of significance. Honduras shows the second lowest elasticity, but is above-unity. Furthermore, Honduras has the highest Wald *F*-statistic and it exceeds the upper bound value at all three levels of significance. The results for Panama show an above-unity elasticity. Panama has the second highest Wald *F*-statistic and it clearly exceeds the upper bound value at all three levels of significance. Paraguay shows the highest elasticity of the five countries studied, and a Wald *F*-statistic that exceeds the upper bound value at all three levels of significance.

Table 3: Gross Domestic Product and Government Spending – Summary Results

Country	**Period**	**Elasticity (μ)**	**Wald *F*-Test**
Chile	1990-2012	1.12	7.43
Colombia	1982-2012	1.96	6.24
Honduras	1990-2012	1.30	11.91
Panama	1980-2012	1.48	8.84
Paraguay	1980-2012	2.25	8.53

Moreover, the findings presented in Table 4 show the existence of a causal link running from gross domestic product to government spending. They therefore provide further evidence supporting Wagner's law in the sample of countries analyzed.

Table 4. Pairwise Granger causality tests

Null Hypothesis:	*F*-Statistics	Probability	Conclusion
Chile:			
log*Y* does not Granger Cause log*G*	6.91	0.017	Reject
log*G* does not Granger Cause log*Y*	0.06	0.809	Accept
Colombia:			
log*Y* does not Granger Cause log*G*	8.00	0.009	Reject
log*G* does not Granger Cause log*Y*	0.14	0.715	Accept
Honduras:			
log*Y* does not Granger Cause log*G*	3.68	0.070	Reject
log*G* does not Granger Cause log*Y*	0.04	0.840	Accept
Panama:			
log*Y* does not Granger Cause log*G*	6.49	0.016	Reject
log*G* does not Granger Cause log*Y*	2.72	0.110	Accept
Paraguay:			
log*Y* does not Granger Cause log*G*	12.14	0.002	Reject
log*G* does not Granger Cause log*Y*	0.02	0.886	Accept

CONCLUSION

The aim of this study has been to investigate Wagner's law in Chile, Colombia, Honduras, Panama, and Paraguay during the period 1980-2012. Results from the bounds test confirm the presence of a co-integration relationship between gross domestic product and government spending in all five countries. The respective estimates of the long-run coefficient vary from a low of 1.12 in Chile to a high of 2.25 in Paraguay. In addition, Granger Pairwise causality tests show causal linkages running from gross domestic product to government expenditure in all five countries. Combined, these results are consistent with Wagner's law for this sample of countries.

Over the course of the period under analysis, the growth rate of the overall economy in the five countries studied varied from a low of 2.5 percent in Paraguay to a high of 5.8 percent in Panama. Meanwhile, the respective growth rates of government spending oscillated from a low of 4.7 percent in Honduras to a high of 8.0 percent in Panama. Moreover, all five countries showed an excess growth rate of government spending over that of the overall economy.

The policy implication of this study suggests the governments of these countries, particularly Colombia and Paraguay that had the highest excess growth rate of government spending over that of gross domestic product, should be cautious about their future spending as any further increase could lead to a significant deterioration of their public finances. This, in turn, would imply that these governments might have to service their public debts by cutting their spending on education, health, and infrastructure. While this policy could, in the short-run, have

a positive impact on economic growth, over the long-run it would have an adverse effect on economic competitiveness.

The results of this study suggest some important further research. Since in all five countries government spending grew at rates higher than GDP, it would be interesting to examine the long-run and causal relationships between the budget deficit and the trade deficit in these nations. It would also be of interest to examine whether the slower rates of economic growth in Colombia and Paraguay were the result of government spending "crowding-out" the private sector.

REFERENCES

Alm, J. and A. Embaye (2011). Explaining the Growth of Government Spending in South Africa. Tulane Economics Working Paper Series, Working Paper 1105 (April).

Akpan, F. (2011). Co-integration, Causality and Wagner's Hypothesis:Time Series Evidence for Nigeria, 1970-2008. Journal of Economic Research, Vol. 16, 59- 84.

Aladejare, S. A. (2013). Government Spending and Economic Growth: Evidence from Nigeria. MPRA Paper No. 43916, January 2013.

Bårdsen, G. (1989). Estimation of Long Run Coefficients in Error Correction Models.Oxford Bulletin of Economics and Statistics, 51, 346-351.

Bojanic, A. N. (2013). Testing the Validity of Wagner's Law in Bolivia: A Co-integration and Causality Analysis with Disaggregated Data. Revista de Análisis Económico**,** Vol. 28, Nº 1, pp. 25-45 (Abril).

Chang, T. (2002). An Econometric Test of Wagner's Law for Six Countries Based on Co-integration and Error Correction Modelling Techniques. Applied Economics, 34, 1157-1169.

_____, Liu, W. and Caudill, S. B. (2004). A Re-examination of Wagner's Law for Ten Countries Based on Co-integration and Error Correction Modelling Techniques. Applied Financial Economics, 14, 577–589.

Engle, R. F. and Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, Estimation, and Testing. Econometrica, 55, 251-276.

Granger, C. W. J. (1969). Investigating Causal Relations by Econometric Models and Cross-Spectral Methods. Econometrica, 37, 424-438.

_____ (2004). Time Series Analysis, Co-integration, and Applications. American Economic Review, 94, 421-425.

Grullón, S. (2012). National Income and Government Spending: Co-integration and Causality Results for the Dominican Republic. Developing Countries Studies, Volume 2, No. 3, March.

Harris, R. I. D. (1995). Using Co-integration Analysis in Econometric Modelling. London: Prentice Hall/Harvester Wheatsheaf,.

Iniguez-Montiel, A. J, (2010). Government Expenditure and National Income in Mexico: Keynes versus Wagner. Applied Economics Letters, 17, 887-893.

Iyare, S. O. and T. Lorde, (2004). Co-integration, Causality and Wagner's Law: Tests for Selected Caribbean Countries. Applied Economics Letters, 11, 815-825.

Kolluri, B., and Wahab, M. (2007). Asymmetries in the Conditional Relation of Government Expenditure and Economic Growth. Applied Economics, 39, 2303–2322.

Kumar, S., Webber, D. J. and Fargher, S. (2012). Wagner's Law Revisited: Co-integration and Causality Tests for New Zealand. Applied Economics, 44 (5), pp. 607-616,

Narayana, P. K., Prasadb, A., and Singhet, B. (2008). A Test of the Wagner's Hypothesis for the Fiji Islands. Applied Economics, 40, 2793–2801.

Pesaran, M. H., and Y. Shin (1997). An Autoregressive Distributed Lag Modelling Approach to Co-integration Analysis. Journal of Applied Econometrics, Vol. 12, No. 1, January-February.

Pesaran, H. H., Shin, Y., and Smith, R. J. (2001). Bound Testing Approaches to the Analysis of Level Relationships. Journal of Applied Econometrics, 16, 289-326.

Rehman, J., Iqbal, A. and Siddiqi, M. W. (2010). Co-integration-Causality Analysis between Public Expenditures and Economic Growth in Pakistan. European Journal of Social Sciences, 13, 556-565.

Samundram, M., Nair, M. and Vaithilingam, S. (2009). Keynes and Wagner on Government Expenditures and Economic Development: The Case of a Developing Economy. Empirical Economics, 36, 697-712.

Srinivasan, P. (2013). Causality between Public Expenditure and Economic Growth: The Indian Case. International Journal of Economics and Management, Volume 7, No. 2, 335 – 347.

Thornton, J. (1999). Co-integration, Causality and Wagner's Law in 19th Century Europe. Applied Economics Letters, 6, 413-416.

Wagner, A., (1883). Three Extracts on Public Finance. In Richard A. Musgrave and Alan T. Peacok [eds.] (1958) Classics in The Theory of Public Finance. London: Macmillan