

Testing the Validity of Wagner's Law in Bolivia:  
A Cointegration and Causality Analysis with Disaggregated Data

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<sup>1</sup> The author wishes to thank Wen Rong Liu for his detailed criticism and comments. The author alone is responsible for any errors that remain.

## Testing the Validity of Wagner's Law in Bolivia

### Abstract

Nine versions of Wagner's law are examined employing annual time-series data on Bolivia for the period 1940-2010. The analysis is an advance over previous work in several ways. First, the hypothesis of a long-run relationship between different types of government expenditures and income is tested via cointegration analysis. Second, Error Correction Models are utilized to determine the direction of causality between the variables of interest. Lastly, the study comprises a period of seventy years, the longest of its kind for Bolivia. Consistent with Wagner's proposition, bidirectional Granger causality is found between income and government expenditures in six of the nine versions of the law. The findings also suggest that government expenditures do not exert a positive influence on growth, hence the need to rethink how public funds are spent on a variety of public services.

JEL: C10, H50, O10, O54

*Keywords:* Wagner law, cointegration, Error Correction models

## 1. Introduction

Over the past decades a vast amount of research has been devoted to examining Wagner's hypothesis which states that as economic activity grows, there is a tendency for government activities to increase. Following Mann's (1980) and Chang, *et al.* (2004) studies, nine different versions of Wagner's law are tested using disaggregated annual time-series data for Bolivia over the period 1940 – 2010.

Wagner law states that *with* economic development the size of government activities increase. The alternative, Keynesian view, is that government expenditures boost economic growth, particularly in times of economic stagnation. In this work I specifically test for the validity of Wagner law with a variety of specifications, but I also explore the role that government expenditures – disaggregated into four key components – have played in Bolivia's economic growth since 1940. From the perspective of the policymaker, a key consideration is whether economic growth is the result of government activities, as the Keynesian school advocates, or whether economic growth causes the size of the state to increase, as Wagner predicted more than one hundred years ago. The findings presented in this work provide strong evidence in favor of Wagner's proposition and largely discredits the Keynesian claim that government expenditures are conducive to economic growth.

The significance of Wagner's law rests on understanding the seemingly inevitable growth and importance of government intervention as an economy becomes more advanced. While this assertion is widely accepted in developed countries, developing nations seem less certain, and the preponderance of evidence against Wagner's law in

many studies that concentrate on these nations may reflect ambivalence towards government intervention.

Testing the validity of the law in Bolivia should produce intriguing results as this country has had a unique relation with its many governments for most of its history as an independent nation. For the period analyzed here, 1940 to 2010, Bolivia has experienced with a number of military dictatorships with various ideological leanings. It has endured at least two episodes of severe hyperinflation – in the mid 1950s and during the 1980s – which were the result of misguided government interventions. After the economic collapse of the 1980s, the country experienced a painful but necessary period of structural adjustments that lasted until the turn of the new century, when a backlash to these reforms began taking root. A backtracking to these structural reforms began in 2001 and has lasted until the present, with the current, self-proclaimed populist government bent on reversing all of the so-called ‘neoliberal reforms’ and establishing a control-and-command economy, with government at the heart and center of all economic activity. With this background in mind, determining whether the hypothesis of Wagner law holds for a country like Bolivia should indeed be a compelling exercise. Determining whether government expenditures have contributed to economic growth, as the Keynesian school of thought advocates, should also posit interesting questions.

This paper adds to the preceding research on the subject in at least three respects. First, the hypothesis of a long-run relationship between government expenditures and income is tested using bivariate cointegrated systems and employing the methodology of cointegration analysis suggested by Johansen (1988), Johansen and Juselius (1990),

and Johansen (1994). Second, the issue of causality is determined using Error Correction models for cointegrated variables; standard Granger regressions would be used if a long-run equilibrium relationship was found not to exist. Finally, this is the first study that concentrates solely on Bolivia, utilizing the largest dataset available for the country. The results show that cointegration holds for the nine versions of the law. However, the causality findings lend support to Wagner's law in only six of the versions tested. The long-term effect of government expenditures on economic growth is found to be negative in all cases, calling into question the efficiency with which these public funds are spent on a variety of public services.

The paper is organized as follows: Section two presents the Wagner hypothesis and a sample of studies that have tested its existence in various contexts. The data and the empirical model are presented in Section three. Section four presents the results and Section five concludes.

## **2. Wagner's Hypothesis and previous tests**

More than one hundred years ago, Adolph Wagner (1883) formulated the 'Law of the Increasing Extension of State Activity'. He asserted that there is a long run propensity for the scope of government to increase with higher levels of economic development. Wagner's hypothesis deals with the growing relative importance of government activity and has come to be known as Wagner's Law.

According to Wagner, there are three reasons to expect an expanding scope of public activity: first, as nations develop there is an increased complexity of legal relations and

communications – along with greater urbanization and population density – and it forces government to produce the regulatory framework that will accompany the greater intricacy of relations among economic agents. Second, as income increases, societies demand more education, entertainment, a more equitable distribution of income, and generally more public services. Finally, the technological needs of an industrialized society require larger amounts of capital infrastructure than are forthcoming from the private sector, hence the need for government to step in to fill in the gap.

Wagner's law has been tested empirically for various countries using both time series and cross-sectional data. Results differ considerably and there is no discernible pattern that emerges from these studies. Abizadeh and Gray (1985) analyze the period 1963-1979 and find support for Wagner law in wealthier countries but not in poorer ones. Diamond (1977), Ram (1986), Afxentiou and Serletis (1996), Chang, *et al.* (2004), and Akitoby, *et al.* (2006) analyze different countries and time periods and find limited support for the law. Wu, *et al.* (2010), on the other hand, utilizing a dataset of 182 countries for the period 1950-2004, find strong support for Wagner's law.

Country-specific studies are also abundant. Afxentiou and Serletis (1991), and Ahsan *et al.* (1996) have analyzed Wagner's Law for Canada, with findings generally in support of the law. Mann (1980), Nagarajan and Spears (1990), Murthy (1993), Ashworth (1994), Hayo (1994) and Lin (1995) have found mixed results for Mexico. Vatter and Walker (1986), and Yousefi and Abizadeh (1992) have examined the law for the United States with results generally in favor of the law. Tobin (2005), focusing on

China, finds support for the law. More recently, Afzal and Abbas (2010) in Pakistan and Zhen, *et al.* (2010) in China have found little supporting evidence for the law.

The more recent set of papers analyzes Wagner's law using disaggregated public expenditure data. A sample of country-specific works includes Chlestos and Kollias (1997) on Greece; Asseery, *et al.* (1999) on Iraq; Biswal, *et al.* (1999) on Canada; and Magazzino (2010) on Italy. For sets of countries, Dakurah, *et al.* (2001) find no causal link between military spending and economic growth in 62 countries. In a slightly different approach, Gupta and Verhoeven (2001), concentrating on expenditures on health and education, find inefficient spending on a set of 37 African countries; and Abu-Bader and Abu-Qarn (2003), find a negative, bidirectional causality between military expenditures and economic growth in Egypt, Israel and Syria.

### **3. Data and the Empirical Model**

The empirical analysis uses annual data on real GDP, real total government expenditures disaggregated into four key components – infrastructure, health, education, and defense expenditures – and population for the 1940-2010 period.<sup>2</sup> The base year for all variables is 2000. All data have been obtained from the Statistical Bulletins and the Annual Reports of the Central Bank of Bolivia ([www.bcb.gob.bo](http://www.bcb.gob.bo)). Finally, all the data series have been transformed to the logarithmic form to achieve stationarity in variance.

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<sup>2</sup> Values for 2010 are preliminary.

Despite the abundance of research on the subject, the general manner in which Wagner established a relation between ‘economic progress’ and the ‘growth of state activity’, makes it difficult to test the law. In this work, in addition to the basic specifications tested in Mann (1980) and Chang, *et al.* (2004), four more versions of the law are analyzed utilizing disaggregated data. The nine empirical versions are the following:

$$(1a) \text{ } lrg_e = f(lry)$$

$$(1f) \text{ } lrg_{infra} = f(lry)$$

$$(1b) \text{ } lrg_e = f(lry/pop)$$

$$(1g) \text{ } lrg_{health} = f(lry)$$

$$(1c) \text{ } lrg_e/pop = f(lry/pop)$$

$$(1h) \text{ } lrg_{edu} = f(lry)$$

$$(1d) \text{ } lrg_e/lry = f(lry/pop)$$

$$(1i) \text{ } lrg_{def} = f(lry)$$

$$(1e) \text{ } lrg_e/lry = f(lry)$$

where  $lrg_e$  = real total government expenditure,  $lry$  = real GDP,<sup>3</sup>  $lry/pop$  = real GDP per capita,  $lrg_e/pop$  = real total government expenditure per capita,  $lrg_e/lry$  = the share of real total government expenditures on real GDP,  $lrg_{infra}$  = real government expenditures on infrastructure,  $lrg_{health}$  = real government expenditures on health,  $lrg_{edu}$  = real government expenditures on education, and  $lrg_{def}$  = real government expenditures on defense.

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<sup>3</sup> In this work, the terms ‘real GDP’ and ‘real Income’ will be used interchangeably.

#### 4. Results

A preliminary appreciation of the results is presented in Figure 1, which illustrates the nine versions of the Wagner Law tested in this work.

(Insert Figure 1 about here)

Generally, there seems to exist a high degree of correlation of the variables in most versions of the law. However, the visual correlation between variables lessens in versions four and five, when the share of total government expenditures on income is paired with real GDP per capita and real GDP. A point worth mentioning is that in 1982 government expenditures reached a historical low – as is evident from the graphical representations in Figure 1 – largely due to disarray in all government activities caused by the hyperinflation the country experienced during the first part of that decade.

To complement the visual correlations of Figure 1, Table 1 reports pairwise correlations for all variables utilized in this study.

(Insert Table 1 about here)

Pairwise correlations confirm that there is a high degree of correlation between various indicators of government intervention and indicators of economic activity. The objective of this study is to probe deeper into these correlations to determine the validity of Wagner's law and to analyze the alternative hypothesis of whether government spending has had a positive impact on the country's economic growth.

Having established that there is high correlation between various indicators of government expenditure and income, cointegration tests are used to determine

whether there exists a long-run equilibrium relationship between government expenditures (real total government expenditures, real total government expenditures per capita, share of real total government expenditures on real GDP, real expenditures on infrastructure, health, education, and defense) and income (real GDP and real GDP per capita).<sup>4</sup> In all cointegration tests, an exogenous, inflation dummy variable is included to account for the hyperinflation years of 1982 and 1983. Following the Johansen and Juselius method (1990), a VAR model is estimated and the Johansen Cointegration Test results are presented in Table 2.

(Insert Table 2 about here)

Cointegration results for the nine versions of the Wagner law demonstrate that there is indeed a long-run equilibrium relationship between government expenditures and income. The Trace statistics for each of the nine versions of the law produce results suggesting the existence of one cointegrating equation at both the 5 percent and 1 percent levels of significance.<sup>5</sup>

Since cointegration has been confirmed for the nine versions of Wagner's Law, error-correction models can be estimated as a basis for determining causality between the variables of interest. Table 3 reports these test results.

(Insert Table 3 about here)

As can be observed, bidirectional Granger causality holds for six of the nine versions of the law. However, the effect of income on the various indicators of government

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<sup>4</sup> Unit root tests using the Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) tests show that all variables, with the exception of *lrge/lry* and *lrgedu*, are integrated of order one, or  $I(1)$ . The appendix of this work reports these test results.

<sup>5</sup> For the nine versions of the law, the Maximum Eigenvalue test corroborates the results found with the Trace test.

expenditures seems stronger – as evidenced by the generally bigger coefficients of *lry* and *lry/pop* – which is consistent with Wagner’s proposition. In versions four, five and eight, the direction of causality runs from government expenditures (*lrge/lry* and *lrgedu*) to income (*lry/pop* and *lry*), which does not support Wagner’s proposition.<sup>6</sup> As to the specifications with disaggregated government expenditures, the results show that the growth of infrastructure, health, and defense expenditures are explained in terms of Wagner’s law.

The findings also suggest that government expenditures have not had a positive influence on economic growth, contravening the Keynesian school which advocates public spending to boost economic activity. In all cases, the causality sign on the coefficient of the various types of government expenditure is negative, suggesting that government spending inhibits rather than promotes economic growth. This finding calls into question the desire of the current government to grow the size of the public sector at all costs. As the results of this study attest, public spending is not necessarily conducive to higher growth.

## 5. Conclusions

In this study, nine different versions of Wagner’s law have been empirically examined by employing annual time-series data on Bolivia for the period 1940-2010. The analysis is an advance over previous work in several ways. First, the hypothesis of a long-run relationship between government expenditures and income is tested using bivariate cointegrated systems and employing the methodology of cointegration

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<sup>6</sup> These findings, however, should be taken in with care, as the variables *lrge/lry* and *lrgedu* were found to be stationary in levels, rendering the cointegration and causality results potentially spurious.

analysis. Second, the question of causality is settled using Error Correction Models, as the variables in all specifications were found to be cointegrated. Finally, this study comprises a period of seventy years, the longest of its kind for Bolivia. Overall, bidirectional Granger causality is found between income and government expenditures in six of the nine versions of the law. However, the effect of income on the various indicators of government expenditures seems stronger, lending credence to Wagner's proposition. As to the disaggregated components of government expenditures, the growth in infrastructure, health, and defense expenditures were found to be explained in terms of Wagner's law.

The policy implications of the findings reported here are particularly relevant today, as the administration of Evo Morales is forcefully advancing an agenda where government intervention touches almost every facet of the Bolivian economy. While the results reported in this study may offer a partial justification for such an agenda – bidirectional causality was found to exist between government expenditures and income – current policy makers would be advised to remember that not long ago imprudent government interventions caused the worst case of hyperinflation a country ever experienced in times of peace. It would also be judicious to realize that Wagner's proposition implies that *with* economic growth comes a bigger role for government, not the other way around. Policies whose sole aim is to increase the role of government may in fact cause the opposite – indeed, the results of this study indicate a negative influence of government expenditures on growth – hence the need for caution and responsibility in determining where and how much government intervention is needed to complement other growth-generating policies.

## REFERENCES

Abizadeh, Sohrab and John Gray (1985). Wagner's Law: A Pooled Time-Series Cross-Section Comparison, *National Tax Journal*, 88, pp. 209-18.

Abu-Bader Suleiman and Aamer Abu-Qarn (2003). Government Expenditures, Military Spending and Economic Growth: Causality Evidence from Egypt, Israel, and Syria, *Journal of Policy Modeling*, 25(6-7), pp. 567-583.

Afxentiou, Panayiotis C., and Apostolos Serletis (1991). A Time-Series Analysis of the Relationship between Government Expenditure and GDP in Canada, *Public Finance Quarterly*, 19, pp. 316-33.

Afxentiou, Panayiotis C., and Apostolos Serletis (1996). Government Expenditures in the European Union: Do They Converge or Follow Wagner's Law, *International Economic Journal*, 10, pp. 33-47.

Afzal, Mohamad and Qaisar Abbas (2010). Wagner's Law in Pakistan: Another Look, *Journal of Economics and International Finance*, 2:1, pp. 012-019.

Akitoby, Bernardin, Benedict Clements, Sanjeev Gupta and Gabriela Inchauste (2006). Public Spending, Voracity and Wagner's Law in Developing Countries, *European Journal of Political Economy*, 22, pp. 908-924.

Ahsan, Syed, Andy Kwan, and Balbir Sahni (1996). Cointegration and Wagner's Hypothesis: Time Series Evidence for Canada, *Applied Economics*, 28, pp. 1055-58.

Asseery, Ahmed, David Law, and Nicholas Perdikis (1999). Wagner's Law and Public Expenditure in Iraq: A Test using Disaggregated Data, *Applied Economic Letters*, 6, pp. 39-44.

Ashworth, John (1994). Spurious in Mexico: A Comment on Wagner's Law, *Public Finance*, 49:2, pp. 282-86.

Biswal, Bagala, Urvashi Dhawan, and Hooi-Yean Lee (1999). Testing Wagner versus Keynes using Disaggregated Public Expenditure Data for Canada, *Applied Economics*, 31, pp. 1283-91.

Chang, Tsangyao, Wenrong Liu and Steve B. Caudill (2004). A re-examination of Wagner's law for ten countries based on cointegration and error-correction modeling techniques, *Applied Financial Economics*, 14, pp. 577-589.

Chletsos, Michael and Christos Kollias (1997). Testing Wagner's Law Using Disaggregated Public Expenditure Data in the Case of Greece: 1958-93, *Applied Economics*, 29:3, pp. 371-77.

Dakurah, Angson H., Stephen Davies, and Rajan Sampath (2001). Defense Spending and Economic Growth in Developing Countries: A Causality Analysis, *Journal of Policy Modeling*, 23:6, pp. 651-658.

Diamond, Jack (1977). Wagner's "Law" and the Developing Countries, *The Developing Economies*, 15:1, pp. 37-59.

Gupta, Sanjeev and Marijn Verhoeven (2001). The Efficiency of Government Expenditure: Experiences from Africa, *Journal of Policy Modeling*, 23:4, pp. 433-467

Hayo, Bernd (1994). No Further Evidence of Wagner's Law for Mexico, *Public Finance*, 49:2, pp. 287-94.

Johansen, Soren (1988). Statistical Analysis of Cointegration Vectors, *Journal of economic Dynamics and Control*, 12, pp. 231-54.

Johansen, Soren (1994). Testing Weak Exogeneity and the Order of Cointegration in UK Money Demand Data, *Journal of Policy Modelling*, 14, pp. 313-34.

Johansen, Soren and Katarina Juselius (1990). Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, 52, pp. 169-210.

Lin, Chi-ang (1995). More Evidence on Wagner's Law for Mexico, *Public Finance*, 50:2, pp. 262-77.

Magazzino, Cosimo (2010). Wagner's Law and Italian Disaggregated Public Spending: Some Empirical Evidences, MPRA Paper No. 26662.

Mann, Arthur, J. (1980). Wagner's Law: An Econometric Test for Mexico, *National Tax Journal*, 33, pp. 189-201.

Murthy, Vasudeva (1993). Further Evidence of Wagner's Law for Mexico: An Application of Cointegration Analysis, *Public Finance*, 48:1, pp. 92-6.

Nagarajan, Palanisamy and Annie Spears (1990). An Econometric Test of Wagner's Law for Mexico: A Reexamination, *Public Finance*, 1, 165-8.

Ram, Rati (1986). Causality between Income and Government Expenditure: A Broad International Perspective, *Public Finance*, 3, pp. 393-13.

Tobin, D. (2005). Economic Liberalization, the Changing Role of the State and Wagner's Law: China's Development since 1978, *World Development*, 33, pp. 729-43.

Vatter, Harold, G., and John, F. Walker (1986). Real Public Sector Employment Growth, Wagner's Law, and Economic Growth in the United States, *Public Finance*, 1, pp. 117-37.

Wagner, Adolph (1883). *Grundlegung der Politischen Ökonomie*, 3<sup>rd</sup> Edition, Leipzig: C. F. Winter.

Wu, Shih-Ying, Jenn-Hong Tang, and Eric Lin (2010). The Impact of Government Expenditure on Economic Growth: How Sensitive to the Level of Development? *Journal of Policy Modeling*, 32:6, pp. 804-817.

Yousefi, Mahmood, and Sohrab Abizadeh (1992). Growth of State Government Expenditures: Empirical Evidence from the United States, *Public Finance*, 47:2, pp. 322-39.

Zheng, Yan, Jiabai Li, Xiao-Li Wang, Changqing Li (2010). An Empirical Analysis of the Validity of Wagner's Law in China: A Case Study Based on Gibbs Sampler, *International Journal of Business Management*, 5:6, pp. 161-168.

Appendix: Unit Root Tests

	ADF				PP	
	Level	AIC (n)	First Difference	AIC (n)	Level	First Difference
Real Income	0.0025	0.1913	-4.8797**	0.2070	-0.3080	8.1358**
Real Government Expenditures	-2.1860	3.4189	-7.0859**	3.3798	-2.2046	-7.5178**
Real Government Expenditures per Capita	-2.7169	3.3800	-7.0931**	3.3774	-2.6804	-7.4779**
Real Income per Capita	-0.4177	0.1822	-4.8925**	0.2008	-0.7488	-8.0984**
Real Share of Government Exp. on GDP	-4.0106**	3.3076	-6.9993**	3.4116	-3.5056*	-7.3124**
Real Expenditures on Infrastructure	-2.1643	3.4858	-7.0367**	3.4109	-2.0550	-8.0705**
Real Expenditures on Health	-3.0243*	3.6762	-8.1974**	3.4581	-2.9704*	-8.0469**
Real Expenditures on Education	-3.5402**	3.6276	-7.1420**	3.7147	-3.4847*	-8.0043**
Real Expenditures on Defense	-2.8544	3.5042	-7.0124**	3.4965	-2.7364	-8.2034**

Note: \*\* and \* denote significance at the 1% and 5% level, respectively

Table 1  
Pairwise Correlations

	Real Income	Real government expenditures	Real government expenditures per capita	Real income per capita	Real share of gov. expenditures on GDP	Real expenditures on infrastructure	Real expenditures on health	Real expenditures on education	Real expenditures on defense
Real Income	1								
Real government expenditures	0.7007	1							
Real government expenditures per capita	0.6103	0.9908	1						
Real income per capita	0.9862	0.6356	0.5505	1					
Real share of gov. expenditures on GDP	0.1891	0.8331	0.8905	0.1103	1				
Real expenditures on infrastructure	0.7476	0.9884	0.9744	0.6960	0.7808	1			
Real expenditures on health	0.6101	0.9363	0.9444	0.5662	0.8157	0.9359	1		
Real expenditures on education	0.3686	0.7219	0.7456	0.3299	0.7078	0.7093	0.8709	1	
Real expenditures on defense	0.6393	0.9728	0.9810	0.5956	0.8433	0.9759	0.9358	0.7147	1

Table 2: Cointegration Test Results

	Trace Statistic	Critical Value (5%)	Critical Value (1%)
1) Government Expenditures, Income (VAR lag=2)			
$H_0: r = 0$	161.69**	18.17	23.46
$H_0: r \leq 1$	2.48	3.74	6.40
2) Government Expenditures, Income per Capita (VAR lag=2)			
$H_0: r = 0$	161.42**	18.17	23.46
$H_0: r \leq 1$	2.37	3.74	6.40
3) Government Expenditures per Capita, Income per Capita (VAR lag=2)			
$H_0: r = 0$	161.66**	18.17	23.46
$H_0: r \leq 1$	2.36	3.74	6.40
4) Share of Government Expenditures on Income, Income per Capita (VAR lag=2)			
$H_0: r = 0$	161.66**	18.17	23.46
$H_0: r \leq 1$	2.36	3.74	6.40
5) Share of Government Expenditures on Income, Income (VAR lag=2)			
$H_0: r = 0$	161.69**	18.17	23.46
$H_0: r \leq 1$	2.48	3.74	6.40
6) Expenditures on Infrastructure, Income (VAR lag=2)			
$H_0: r = 0$	134.19**	18.17	23.46
$H_0: r \leq 1$	2.43	3.74	6.40
7) Expenditures on Health, Income (VAR lag=2)			
$H_0: r = 0$	73.53**	18.17	23.46
$H_0: r \leq 1$	2.15	3.74	6.40
8) Expenditures on Education, Income (VAR lag=2)			
$H_0: r = 0$	35.23**	18.17	23.46
$H_0: r \leq 1$	2.27	3.74	6.40
9) Expenditures on Defense, Income (VAR lag=2)			
$H_0: r = 0$	121.34**	18.17	23.46
$H_0: r \leq 1$	2.24	3.74	6.40

## Notes:

- \* and \*\* denote significance at the 5% and 1% level, respectively
- $r$  denotes the number of cointegrating vectors
- the Schwartz criteria (SC) is used to select the number of lags required in the cointegrating test.
- All specifications follow a quadratic, deterministic trend
- All specifications include an exogenous, inflation dummy to account for the 1982-83 hyperinflation period

Table 3: Granger Causality Test Results with Error Correction Models

(1) Government Expenditures ( <i>lrge</i> ) and Income ( <i>lry</i> )			
<i>lrge</i>	[1]	<i>lry</i>	[1]
Bidirectional causality			
-1.33 <i>lry</i> (-4.70)	[1]	-0.75 <i>lrge</i> (-6.13)	[1]
(2) Government Expenditures ( <i>lrge</i> ) and Income per Capita ( <i>lry/pop</i> )			
<i>lrge</i>	[1]	<i>lry/pop</i>	[1]
Bidirectional causality			
-1.83 <i>lry/pop</i> (-3.82)	[1]	-0.55 <i>lrge</i> (-5.15)	[1]
(3) Government Expenditure per Capita ( <i>lrge/pop</i> ) and Income per Capita ( <i>lry/pop</i> )			
<i>lrge/pop</i>	[1]	<i>lry/pop</i>	[1]
Bidirectional causality			
-1.37 <i>lry/pop</i> (-3.29)	[1]	-0.73 <i>lrge/pop</i> (-5.09)	[1]
(4) Share of Government Expenditures on Income ( <i>lrge/lry</i> ) and Income per Capita ( <i>lry/pop</i> )			
<i>lrge/lry</i>	[1]	<i>lry/pop</i>	[1]
<i>lrge/lry</i> Granger causes <i>lry/pop</i>			
-0.37 <i>lry/pop</i> (-0.90)	[1]	-2.68 <i>lrge/lry</i> (-4.25)	[1]
(5) Share of Government Expenditures on Income ( <i>lrge/lry</i> ) and Income ( <i>lry</i> )			
<i>lrge/lry</i>	[1]	<i>lry</i>	[1]
<i>lrge/lry</i> Granger causes <i>lry</i>			
-0.33 <i>lry</i> (-1.17)	[1]	-3.03 <i>lrge/lry</i> (-4.40)	[1]
(6) Expenditures on Infrastructure ( <i>lrginfra</i> ) and Income ( <i>lry</i> )			
<i>lrginfra</i>	[1]	<i>lry</i>	[1]
Bidirectional causality			
-1.49 <i>lry</i> (-5.32)	[1]	-0.67 <i>lrginfra</i> (-6.58)	[1]
(7) Expenditures on Health ( <i>lrghealth</i> ) and Income ( <i>lry</i> )			
<i>lrghealth</i>	[1]	<i>lry</i>	[1]
Bidirectional causality			
-0.94 <i>lry</i> (-4.09)	[1]	-1.06 <i>lrghealth</i> (-6.34)	[1]
(8) Expenditures on Education ( <i>lrgedu</i> ) and Income ( <i>lry</i> )			
<i>lrgedu</i>	[1]	<i>lry</i>	[1]
<i>lrgedu</i> Granger causes <i>lry</i>			
-0.51 <i>lry</i> (-1.81)	[1]	-1.96 <i>lrgedu</i> (-4.87)	[1]

(9) Expenditures on Defense (*lrgdef*) and Income (*lry*)

Lrgdef [1] Lry [1]

Bidirectional causality

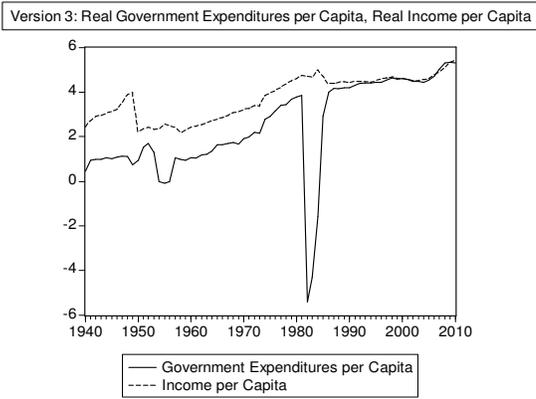
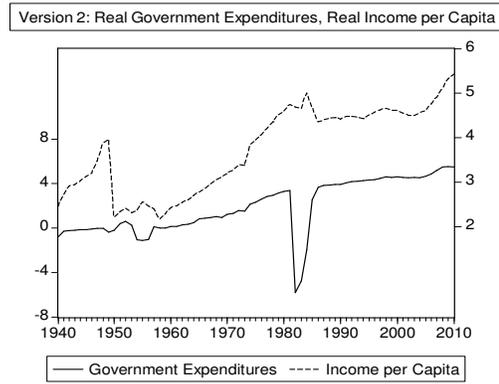
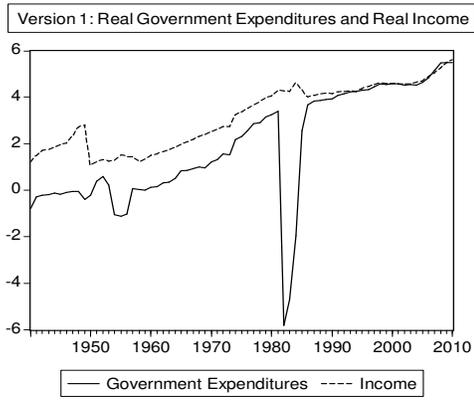
-1.08 lry (-4.06) [1] -0.92 lrgdef (-5.83) [1]

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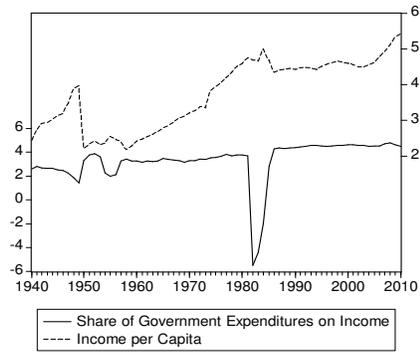
Note:

1. Numbers in brackets indicate the lag length selected by using the FPE criterion
2. Number in parenthesis are t-statistics

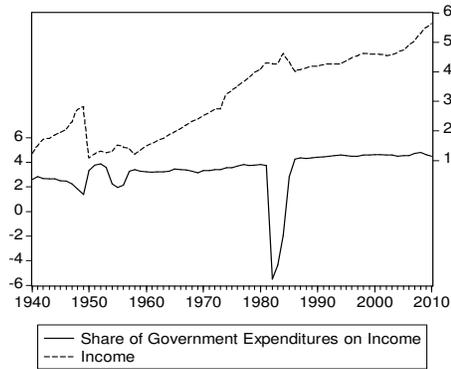
Figure 1: Nine Versions of Wagner Law



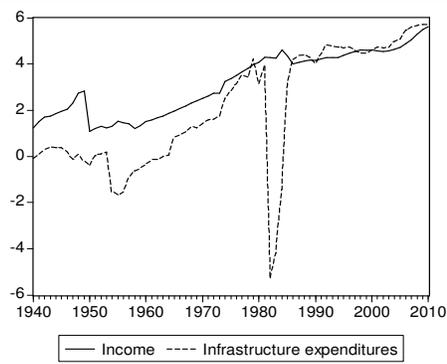
Version 4: Share of Government Expenditures on Income, Real Income per Capita



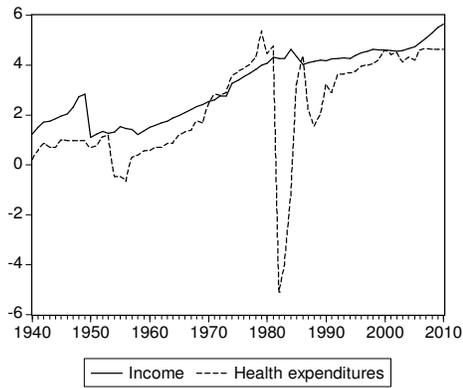
Version 5: Share of Government Expenditures on Income, Real Income



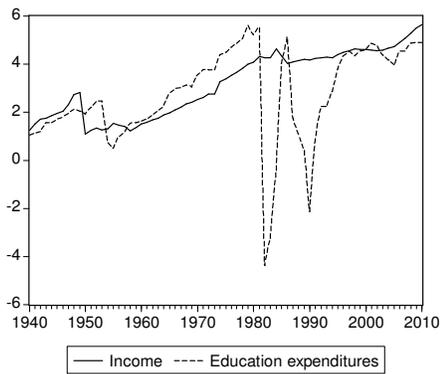
Version 6: Real Government Expenditures on Infrastructure and Real Income



Version 7: Real Government Expenditures on Health and Real Income



Version 8: Real Government Expenditures on Education and Real Income



Version 9: Real Government Expenditures on Defense and Real Income

