Does the Wagner's Law hold for Thailand? A Time Series Study

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Abstract:

Wagner's Law suggests that as the GDP of a country increases, so does its government expenditure. We test for the Law for Thailand using recent advances in econometric techniques. Both total and per capita GDP and government expenditure are used. Ng-Perron unit root tests show that all variables are integrated of order 1. Toda-Yamamoto tests of Granger causality show that there is no causality flowing from either direction between GDP and government expenditure. Autoregressive Distributed Lag (ARDL) tests of cointegration show very weak evidence of a long-run relationship between GDP and government expenditure. Thus, we do not find much evidence that the Wagner's Law holds for Thailand.

I. INTRODUCTION

Thailand has achieved a remarkable rate of growth during the last 40 years. From a backward nation of the 1950s, it has gone through a striking transformation. The reliance on the agricultural sector has declined rapidly. Agriculture now accounts for less than 10 per cent of GDP. Thailand now has the largest manufacturing sector among the Association of South East Asian Nations (ASEAN) members. Thailand appeared to have fully recovered from the Asian Financial Crisis. Recently, Thailand has been hit by political uncertainty and was being governed by a caretaker government until the military coup that took on September, 2006. Higher interest rates and the increase in oil prices have also adversely affected the growth prospects in 2006 (Asian Development Bank, 2006). Nevertheless, the economy grew at more than 5 per cent during the first half of 2006. What role does the government expenditure has in the remarkable growth of Thailand? This paper seeks to investigate the relationship between government expenditure and economic growth in Thailand. The role of the state is coming under scrutiny especially for the developing countries.

Wagner was one of the first economists to have recognized the positive correlation between GDP and government expenditure. According to Henrekson (1993), Wagner had three reasons to believe that the government's role would increase over time. First, private activities would be substituted by public activities as countries go through the process of industrialization and modernization. In particular, government expenditure on law and order and contractual enforcement would increase. Second, 'cultural and welfare' expenditures are income elastic and therefore, would increase with the increase in real income. Wagner believed that cultural and educational needs were better served by the public sector rather than the private sector. Third, Wagner believed that "natural monopolies" are best managed by the public sector. He cited the case of railroads as a natural monopoly and pointed out that the private sector would be unable to raise huge finances and run such natural monopolies efficiently.

Most studies of Wagner's Law have been more concerned with the general trends that he predicted rather than Wagner's original propositions. As more data have become available for developing countries, the Law has been tested more for the developing countries. Recent advances in time series econometric methodology have been increasingly applied to the study of the Law. Earlier studies have used cross-section data because reliable time series data were not available for a reasonable length of time. However, studies which use cross section data are less useful. Bird (1971) makes the following observations about the cross section studies: "there is nothing in any conceivable formulation of Wagner's "law" which tells us country A must have a higher expenditure ratio than country B simply because the level of average per capita income is higher in A than B at a particular point in time." (p. 10).

There is now a huge literature on the Wagner's Law. Kolluri, Panik and Wahab (2000) study the Wagner's Law using time series data for G7 countries for 1960-1993. They find that the Law holds for some components of the government expenditure for these countries. Lin (2002) studies the long run properties of the government size for the US. He finds big long term persistence in government size at all levels of the US government. For developing countries, the recent studies use time series data. There are a number of studies on India. These include Mohsin, Naidu and Kamaiah (1995) who use cross section data on different states in India and Sinha (1998). While Mohsin, Naidu and Kamaiah find a weak relationship between government expenditure and GDP, Sinha finds some support for the causality flowing from the GDP growth to the growth of government expenditure. Ram (1986, 1987) studies the relationship between government expenditure and GDP for a number of developing countries using both cross section and time series data. His general result is that government expenditure affects GDP positively mainly through the externality effect. However, his sample of countries does not include Thailand. To our knowledge, the only study that tests for Wagner's Law for Thailand is Chang, Liu and Caudill (2004). They use time series data for 7 industrialized countries and 3 developing countries including Thailand using data for 1951-1996. ADF and KPSS unit root tests, Johansen cointegration tests and Granger causality tests are used. They find no causal relationship in either direction between GDP and government expenditure for Thailand. Our study differs from their study in three different ways. First, we use data for a much longer period. Second, we use more recently developed unit root test and cointegration test. Third, we use Toda-Yamamoto tests of Granger causality.

Different interpretations of the Wagner's Law have been tested for many different countries. Afxentiou and Serletis (1992) summarize these different interpretations.

(a) GC=f(Y) Pryor (1968)

(b) G=f(Y/N) Goffman (1968)

(c) G/N=f(Y/N) Gupta (1967) and Michas (1975)

(d) G/Y=f(Y) Mann (1980)

G, GC, Y and N stand for total government expenditure, (total) government consumption expenditure, gross domestic product and population respectively. Following most authors, we use the natural logarithms of the variables. Thus, the variables in this study are as follows:

ln(Y/N) = natural log of per capita GDP

ln(G) = natural log of government expenditure

ln(G/N) = natural log of per capita government expenditure

ln(G/Y) = natural log of share of government expenditure in GDP.

We use Penn World Table (Heston, Summers and Aten, 2006) data for 1950-2003. Since the Penn World Table do not contain data on government consumption expenditure, we will limit our testing using all but (a) version. Penn World Table data which were developed by the International Comparison Project in cooperation with the World Bank are reportedly more reliable than data from other sources. The data are being constantly updated. We use the most recent version of the Penn World Table (version 6.2).

There are several characteristic features of government finance in Thailand. Patmasiriwat (1995) summarizes these features well. First, in common with many other countries, government revenue moves procyclically with economic activities. Second, government spending on education and health have continued to increase. In 2004, these two categories constituted 42.35 per cent of total government expenditure (Government of Thailand, 2006). The number of public schools and health clinics has increased dramatically since the beginning of the Third Plan in 1972. Third, a series of tax reforms have been implemented. These include a broadening of the tax base, a reduction in industrial protection, the adoption of uniform tariff rates and the introduction of the VAT in 1992. Fourth, government expenditure as a percentage of GDP has been falling in recent years. Figure 1 shows the government expenditure as a percentage of GDP for 1950-2003 for Thailand. Government investment expenditure as a percentage of GDP or in comparison with private investment has fallen. During the early 1980s, the Thailand economy was faced with both economic recession and high budget deficits. The government had to reduce its capital-investment spending because recurrent and consumption expenditure could not easily cut. Thus, during 1970-1990, government consumption expenditure as a percentage of GDP increased while government investment expenditure as a percentage of GDP fell. In recent years, private investment has complemented government investment in such areas as highway construction and telephone and telecommunications networks.

[Figure 1, about here]

II. ECONOMETRIC METHODS AND RESULTS

We perform the Ng-Perron (2001) unit root tests. The Ng-Perron tests have several advantages. First, the tests are more suitable than the traditional tests for small samples. Second, unlike the traditional tests, Ng-Perron tests do not over-reject the null hypothesis of a unit root. A description of the relatively new tests is as follows. The starting point for the tests is the Dickey-Fuller test (ADF) (Dickey and Fuller, 1979, 1981). $\Delta y_t = \alpha y_{t-1} + x_t^{/}\delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \ldots\ldots\ldots \beta_p \Delta y_{t-p} + v_t$ (1)

The null hypothesis of unit root involves testing $\alpha = 0$ against the alternative hypothesis $\alpha < 1$ using the conventional *t*-test. Since the statistic does not follow the conventional Student's t-distribution, Dickey and Fuller (1979) and Mackinnon (1996) simulate the critical values. For ADF tests, one can include a constant and/or a linear time trend. Elliot, Rothemberg and Stock (ERS hereinafter) (1996) modify the ADF tests for two cases – one with a constant and the other with a constant and a trend, as follows. First, a quasi-difference of y_t is defined. The quasi-difference of y_t depends on the value of a representing the specific point against which the null hypothesis below is tested:

$d(y_t|a) = y_t$ if $t = 1$ and $d(y_t|a) = y_t - ay_t$ if $t > 1$

Second, quasi-differenced data $d(y_t|a)$ is regressed on quasi-differenced $d(x_t|a)$ as follows:

$$d(y_t|a) = d(x_t|a)^{/}\,\delta(a) + \eta_t \qquad (2)$$

where x_t contains a constant or a constant and a trend. Let $\hat{\delta}(a)$ be the OLS estimate of $\delta(a)$

For a, ERS recommend using $a = \overline{a}$ where $\overline{a} = 1 - 7/T$ if $x_t = \{1\}$ and $\overline{a} = 1 - 13.5/T$ if $x_t = \{1, t\}$

GLS detrended data, $y^d{}_t$ are defined as follows. $y^d{}_t \equiv y_t - x_t^{/}\,\hat{\delta}(\overline{a})$

In ERS, GLS detrended $y^d{}_t$ is substituted for y_t.

$$\Delta y^d{}_t = \alpha\, \Delta y^d{}_{t-1} + \beta_1 \Delta y^d{}_{t-2}\ \Delta y_{t-1} + \ldots\ldots\ldots + \beta_p \Delta y^d{}_{t-p} + v_t \qquad (3)$$

Just like the ADF test, the unit root test involves the test on the coefficient α.

The ERS Point Optimal test is as follows. Let the residuals from equation (2) be $\hat{\eta}_t(a) = d(y_t|a) = d(x_t|a)^{/}\,\hat{\delta}(\overline{a})$ and let the sum of squared residuals, $\mathrm{SSR}(a) = \hat{\eta}_t{}^2(a)$. The null hypothesis for the point optimal test is $\alpha = 1$ and the alternative hypothesis is $\alpha = \overline{a}$. The test statistic is $P_T = (\mathrm{SSR}(\overline{a}) - \mathrm{SSR}(1))/f_0$ where f_0 is an estimator of the residual spectrum at frequency zero.

The four tests of Ng-Perron involve modifications of the following four unit root tests: Phillips-Perron Z_α and Z_t, Bhargava R_1 and ERS Optimal Point tests. The tests are based on GLS detrended data, $\Delta y^d{}_t$. First, let us define $\kappa = \sum_{t-2}^{T} (y^d{}_{t-1})^2 / T^2$

The four statistics are given below.

$$MZ^d{}_\alpha = (T^{-1} y^d{}_T)^2 - f_0) / 2\kappa \qquad (4)$$

$$MZ^d{}_t = MZ_\alpha \text{ x } MSB \qquad (5)$$

$$MSB^d = (\kappa / f_0)^{1/2} \qquad (6)$$

$MP^d_T = (\bar{c}^2 \kappa - \bar{c}T^{1})(y^dT)^2)/f_0$ if $x_t = \{1\}$ and $MP^d_T = (\bar{c}^2 \kappa + (1 - \bar{c})T^{1}(y^dT)^2)/f_0$ if $x_t = \{1, t\}$ where $\bar{c} = -7$ if $x_t = \{1\}$ and $\bar{c} = -13.5$ if $x_t = \{1, t\}$ (7)

The results of the unit root tests on the levels of the variables are in Table 1. The results of the unit root tests on the first differences of the variables are in Table 2. No matter which test statistic is used, the results unambiguously show that all variables are I(1).

[Tables 1-2, about here]

Next, we perform the Toda and Yamamoto (1995) tests of Granger causality. We follow Rambaldi and Doran (1996), the Toda-Yamamoto test of Granger causality can be described as follows. If d_{max} is the maximum order of integration in the system (in our case, it is one), a VAR($k + d_{max}$) has to be estimated to use the Wald test for linear restrictions on the parameters of a VAR(k) which has an asymptotic χ^2 distribution. To determine k, we use the Schwarz Bayesian Criterion (SBC). In our case, SBC is found to be 1 in all cases. Nevertheless, we report the results for both k = 1 and k = 2. Let ln(Y/N) and ln(G) be denoted by y and z respectively. For a VAR(2), we estimate the following system of equations:

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + A_2 \begin{bmatrix} y_{t-2} \\ z_{t-2} \\ \; \end{bmatrix} + A_3 \begin{bmatrix} y_{t-3} \\ z_{t-3} \\ w_{t-3} \end{bmatrix} + \begin{bmatrix} e_y \\ e_z \\ e_w \end{bmatrix} \qquad (8)$$

The above system of equations is estimated by seemingly unrelated regression (SUR) method. If we want to test that ln(G) does not Granger-cause ln(Y/N), the null hypothesis will be H_0: $a^{(1)}{}_{12} = a^{(2)}{}_{12} = 0$ where $a^{(i)}{}_{12}$ are the coefficients of z_{t-i}, i=1, 2 in the first equation of the system. The other null hypotheses are similarly defined.

The Toda-Yamamoto tests results for k=1 and k=2 are in Tables 3 and 4 respectively. Both tables show that there is no causality from either direction for any pair of variables.

[Tables 3-4, about here]

Next, we apply the recently developed Autoregressive Distributed Lag (ARDL) approach to cointegration (Pesaran, Shin and Smith, 2001). ARDL does not require prior unit root testing of variables to see whether they are I(0) or I(1). However, we have already done the unit root tests of the variables and have established that they are all I(1). There are two stages in the ARDL cointegration test process. The first stage is to test for the existence of the long run relationship among the variables. We need to compute the F-statistic for testing the significance of the lagged levels of the variables in the error correction form of the underlying ARDL model. Pesaran, Shin and Smith (2001) have tabulated the critical values for different number of regressors because the asymptotic distribution of the F-statistic is non-standard. Two sets of critical values are given. One is for all I(1) variables. The other is for all I(0) variables. So, there is a band of values. If the test statistic falls outside this band, one can conclude whether there is long run relationship or not. However, if the test statistic within the band, the results are inconclusive. In our case, we need to consider only the table for I(1) variables. If the test statistic exceeds the critical value, there is evidence of a long run relationship.

We do extensive testing of the ARDL model. All results are not reported in the paper. They are available on request from the authors.

We now turn to the discussion of the error correction version of the ARDL model in our case. One of them is as follows:

$$D(\ln Y)_t = a_0 + a_1 T + \sum_{i=1}^{n} bi\, D(\ln Y)_{t-1} + \sum_{i=1}^{n} di\, D(\ln G/Y)_{t-1} + \delta_1 (\ln Y)_{t-1} + \delta_2 \ln(G/Y)_{t-1} \quad (9)$$

In (9), D stands for the first difference and T stands for the time trend. The ARDL test requires that (9) be estimated by OLS by excluding the last two terms. The test for long run relationship involves a test of variable addition test. The null hypothesis is H_0: $\delta_1 = \delta_2 = 0$ against the alternative hypothesis $H_1 : \delta_1 \neq 0, \delta_2 \neq 0$. The other relevant equations are as follows:

$$D(\ln Y/N)_t = a_0 + a_1 T + \sum_{i=1}^{n} bi\, D(\ln Y/N)_{t-1} + \sum_{i=1}^{n} di\, D(\ln G)_{t-1} + \delta_1 (\ln Y/N)_{t-1} + \delta_2 \ln(G)_{t-1} \quad (10)$$

$$D(\ln Y/N)_t = a_0 + a_1 T + \sum_{i=1}^{n} bi\, D(\ln Y/N)_{t-1} + \sum_{i=1}^{n} di\, D(\ln G/N)_{t-1} + \delta_1 (\ln Y/N)_{t-1} + \delta_2 \ln(G/N)_{t-1} \quad (11)$$

The null hypotheses and the alternative hypotheses are similarly formulated. In selecting the lags, we use the Schwarz Bayesian Criterion. In all cases, SBC selects a lag of one. However, we also pay attention to residual serial correlation while choosing the lag. In our case, there is no problem of residual serial correlation when a lag of one is used. Even though we do not report the results, we also use a lag of two and three but the results do not change. Also, in some cases, there is a problem with residual serial correlation when a lag of two or three is used. The test statistics for equations (9) to (11) are 3.0608, 6.5742 and 7.3229 respectively. The critical values at 95% level and 90% level are 7.423 and 6.335 respectively. Thus, there is no evidence of a long run relationship for any of the equations at the 95% level. However, at the 90% level, there is evidence of long run for equations (10) and (11). These tests are when the GDP variable [ln(Y/N)] is the dependent variable. Even though the results are not reported, we have also tested by switching the dependent variable, i.e. using the government expenditure as a dependent variable. We do not find any evidence of long run relationship in that case, using either 95% or 90% level of significance in these cases. Thus, the results do not find much support for Wagner's Law for Thailand.

III. CONCLUSIONS

We study the relationship between GDP and government expenditure for Thailand using data for 1950-2003. Ng-Perron tests show that all variables are I(1). Toda-Yamamoto Granger causality tests show no causality between GDP and government expenditure in any direction. ARDL approach to cointegration shows no evidence of cointegration at the 95% level of significance. However, we find evidence of cointegration in some cases when we use 90% level of significance. Our overall conclusion is that there is very little evidence in favor of the Wagner's Law for Thailand.

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Figure 1. Government Expenditure as a Percentage of GDP in Thailand, 1950-2003

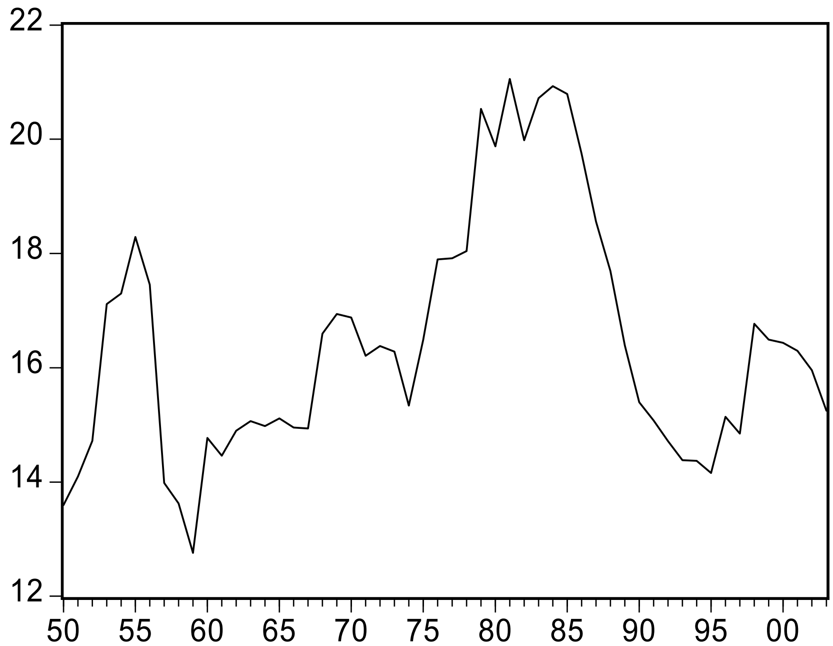

Table 1. Ng-Perron Unit Root Tests on Levels of the Variables

Variable	MZ^d_α	MZ^d_t	MSB^d	MP^d_T
ln(G)	-2.3978	-0.9343	0.3897	31.5405
	(-17.3000)	(-2.9100)	(0.1680)	(5.4800)
ln(Y)	-5.2394	-1.5749	0.3006	17.2239
	(-17.3000)	(-2.9100)	(0.1680)	(5.4800)
ln(Y/N)	-4.3063	-1.4662	0.3405	21.1497
	(-17.3000)	(-2.9100)	(0.1680)	(5.4800)
ln(G/Y)	-4.1402	-1.4373	0.3472	5.9195
	(-8.1000)	(-1.9800)	(0.2330)	(3.1700)
ln(G/N)	-3.3598	-1.2585	0.3746	26.3858
	(-17.3000)	(-2.9100)	(0.1680)	(5.4800)

Notes: ln(G), ln(Y), ln(Y/N), ln(G/Y) and ln(G/N) stand for the natural logarithms of government expenditure, real GDP, per capita real GDP, government expenditure as a percentage of real GDP and per capita government expenditure, respectively. While the other variables have a trend, ln(G/Y) does not. The critical values are in parentheses.

Table 2. Ng-Perron Unit Root Tests on First Differences of the Variables

Variable	MZ^d_α	MZ^d_t	MSB^d	MP^d_T
Δln(G)	-12.3036	-2.4798	0.2016	1.9930
	(-8.1000)	(-1.9800)	(0.2330)	(3.1700)
Δln(Y)	-14.6857	-2.6806	0.1825	1.7798
	(-8.1000)	(-1.9800)	(0.2330)	(3.1700)
Δln(Y/N)	-13.8557	-2.5863	0.1867	1.9440
	(-8.1000)	(-1.9800)	(0.2330)	(3.1700)
Δln(G/Y)	-14.7923	-2.6794	0.1811	1.8091
	(-8.1000)	(-1.9800)	(0.2330)	(3.1700)
Δln(G/N)	-11.8840	-2.4368	0.2051	2.0647
	(-8.1000)	(-1.9800)	(0.2330)	(3.1700)

Notes: Δln(G), Δln(Y), Δln(Y/N), Δln(G/Y) and Δln(G/N) stand for the first differences of natural logarithms of government expenditure, real GDP, per capita real GDP, government expenditure as a percentage of real GDP and per capita government expenditure, respectively. None of the variables has a trend. The critical values are in parentheses.

Table 3. Toda and Yamamoto Granger Causality Tests with Lag of One

Cause	Effect	Test Stat.	Probability
ln(G)	ln(Y/N)	0.4878	0.4849
ln(Y/N)	ln(G)	0.9601	0.3272
ln(G/Y)	ln(Y)	0.4403	0.5070
ln(Y)	ln(G/Y)	0.0004	0.9846
ln(G/N)	ln(Y/N)	0.3971	0.5286
ln(Y/N)	ln(G/N)	1.6752	0.1956

Table 4. Toda-Yamamoto Granger Causality Tests with Lag of Two

Cause	Effect	Test Stat.	Probability
ln(G)	ln(Y/N)	1.8819	0.3903
ln(Y/N)	ln(G)	3.1033	0.2119
ln(G/Y)	ln(Y)	1.6322	0.4421
ln(Y)	ln(G/Y)	1.0067	0.6045
ln(G/N)	ln(Y/N)	1.6592	0.4362
ln(Y/N)	ln(G/N)	4.3238	0.1151