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TESTING WAGNER'S LAW FOR PAKISTAN: 1972-2004

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Abstract. This paper is an attempt to test the existence of Wagner's Law in Pakistan. In this connection the Johansen and Juselius (1990) Cointegration approach has been used to test the long-run relationship between government expenditures and its determinants for Pakistan. Short-run dynamics are estimated by using the Error Correction Mechanism (ECM), various diagnostics and the stability tests are used to examine the existence of the relationship between variables. We find a long-run relationship between government expenditures and the determinants like per capita income, openness of Pakistan's economy, and the financial development. The existence of this relationship has far reaching implication for policy makers in designing the expenditures policy of the government in Pakistan as well as for other developing countries like Pakistan.

I. INTRODUCTION

The relative size of public sector has shown promising growth in both developing and developed countries of the world. After the World War II every country had tried to achieve rapid economic growth and a sharp increase in public expenditures as well as in GDP had been recorded over the past few decades. The positive relationship between public expenditure and GDP has attracted a lot of attention from researchers. Furthermore, the recent advances in time series techniques have also encouraged the researchers to re-examine the long-run relationship between variables.

The Economic literature remained deprived from model of determination of public expenditure for a long period; although a few classical economists address

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the tendencies found in the long-term behaviour of public expenditure but did not present these tendencies in the form of specific theory (Tarschys, 1975). However, a century before, Adolph Wagner presented a simple model formulated for the determination of public expenditure. He also used this model for empirical purposes and formulated a law based on his empirical findings which presented a relationship between government activities and its expenditure for 'progressive nation' (Bird, 1971). As a result, Wagner became the first economist who showed a positive correlation between the level of country's development and size of its public sector.

Wagner's Law has received considerable attention from economists and practitioners of public finance for well over 100 years. Since then, and particularly in recent decades, a variety of empirical studies have sought to test the validity of Wagner's law. These studies have utilized a variety of models and tests to compare the growth of government expenditure against various indicators of economic development.

Wagner's Law gained popularity in academic circles after the publication of English translation of Wagner's work in 1958. Afterwards, it has been analyzed and tested by many researchers for developing and developed countries, for example, Musgrave (1969), Bird (1971), Mann (1980), Sahni and Singh (1984), Abizadeh and Gray (1985), Ram (1986, 1987), Khan (1990), Henrekson (1992), Murthy (1993), Oxley (1994), Ansari *et al.* (1997) and Chletsos and Kollias (1997).[1] Following the existing economic literature some researchers used ordinary least squares (OLS) for regression analysis, while some tried to apply causality test, and some also carried out cointegration analysis. A considerable variation is found among these researchers results for various countries from period to period (Safa, 1999). This study is an attempt to examine the Wagner's Law for Pakistan by employing annual time series data over the period 1972-2004.

The study is divided into five sections. Section I is the introduction of the study and literature review. Section II presents model specification. In section III methodology and data are discussed, whereas section IV presents empirical results, and section V concludes the study.

II. MODEL SPECIFICATION

In econometrics a variety of models have been employed and several proxies have been utilized for the Wagnerian variables (Bird, 1971; Gandhi, 1971; Michas, 1975; Abizadeh, 1988). Wagnerian argument suggests that government expenditures as a percentage of GDP is function of real per capita GDP (Michas, 1975). Quantitatively, it has been postulated that

$$\frac{GE}{GDP} = f\left(\frac{RGDP}{POP}\right) \qquad (i)$$

[1]For detail, see Chang (2002).

Where *GE* represents nominal government expenditure, *POP* denotes total population, and *GDP* and *RGDP* are nominal and real national output, respectively. However, some other studies in testing Wagner's law utilized the following formulation (Goffman and Mahar, 1971; Musgrave, 1969).

$$GE = f(GDP) \qquad (ii)$$

GE and *GDP* are either real or nominal. As per the relationship the elasticity value of *GE* with respect to *GDP* is being expected to exceed unity to validate Wagner's law, postulating a faster rate of increase of government expenditure than national output. Another formulation is, for example, by Gupta (1967).

$$\frac{GE}{POP} = f\left(\frac{GDP}{POP}\right) \qquad (iii)$$

GE and *GDP* are in constant prices. Two more formulations have been suggested and empirically tested by Mann (1980):

$$GE = f\left(\frac{GDP}{POP}\right) \qquad (iv)$$

$$\frac{GE}{POP} = f(GDP) \qquad (v)$$

Wagner's Law is valid if the elasticity values in relation (*iv*) exceeds unity and exceeds zero in relation (*v*) respectively.

Our model is the modified version of the Abizadeh and Gray (1985) as:

$$LGE_t = \beta_0 + \beta_1 LPY_t + \beta_2 LOP_t + \beta_3 LFD_t + \varepsilon_t \qquad (vi)$$

Where *L* is used as the variables are used in log form.

GE = Government expenditure ratio: total government expenditures in year *t* divided by *GDP* in year *t*, both in current value terms

PY = Real per capita *GDP* in Pak Rupees.

OP = Openness: (Exports + Imports) divided by *GDP*, both in current value terms.

FD = Financial Development: M_2 divided by *GDP*

To measure the growth of government spending over time we adopted the dependent variable the Government expenditure ratio: total government expenditures in year *t* divided by *GDP* in year *t*, both in current value terms. It is a reasonable and accepted measure of Wagner's Law of expanding state expenditures. It allows comparison of the growth of government expenditure relative to the growth of the economy.

Real per capita *GDP* is included as an independent variable measuring both the level and trend of economic development in the country. It is also widely used in other tests of Wagner's Law. A positive relationship is hypothesized.

The Openness of the economy, measured by the ratio of Exports plus Imports to *GDP*, reflects the development and diversification of the economy. It has also been used successfully in other studies. A positive relationship is hypothesized.

Financial development in the economy is defined by the ratio of M_2 to *GDP*, as development progresses; there will be less reliance on cash balances for transaction purposes. Thus, a negative relationship is hypothesized.

In this study the annual data from 1972 to 2004 on variables including: Gross Domestic Product (*GDP*), Government Expenditures, Exports and Imports, M_2, population and prices are used. Data have been taken from International Financial Statistics (IFS) various issues.

III. METHODOLOGY AND DATA

UNIT ROOT TESTS

Before testing for cointegration, we first need to determine whether the individual series are integrated of order one, *i.e.* $I(1)$. Since it is a necessary, but not sufficient condition for a set of variables to be cointegrated. We will use Augmented Dicky-Fuller test (ADF) for a unit root (Dicky and Fuller, 1979). This is a test for stochastic non-stationarity. It is also possible that the non-stationarity in individual series results from a deterministic process such as time trend. Therefore, we estimate the following regression using ordinary least squares (OLS).

$$\Delta x_t = C + \delta_1 t + \delta_2 \times_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta x_{t-1} + \varepsilon_t$$

Where x_t is individual time series, t is linear time trend and Δ is first difference operator, *i.e.* $\Delta x_t = x_t - x_{t-1}$, ε_t is a serially uncorrelated random term, and C is a constant, the terms Δx_{t-1}, $i = 1, 2, \ldots, n$ are included to ensure that ε_t is white noise.

First we test the hypothesis:

H_0: $\delta_2 = 0$

H_1: $\delta_2 < 0$ series contains a unit root

Second the Hypothesis that H_0: $(\delta_1\ \delta_2) = (0, 0)$, *i.e.* non-stationarity does not in addition result from a linear time trend. If we cannot reject the second Hypothesis we re-estimate the equation without time trend and again test the first hypothesis.

Cointegration techniques are used to find the long-run relationship between variables if they are integrated of order one, *i.e.* $I(1)$. Johansen approach will be used to examine the existence of cointegration between government expenditures and its determinants. The validity of the estimated model is tested using the standard diagnostic tests — the Jarque and Bera (1980) test for normality, the Brush and Godfrey (1981) Lagrange Multiplier (LM) test for serial correlation. The White (1980) heteroskedasticity test and Cusum and Cusum of Squares test (Brown, Durbin and Evans, 1975) of stability are also applied.

IV. EMPIRICAL RESULTS

At the first step, the individual series are tested for their order of integration by Augmented Dicky-Fuller (ADF) test. This test confirmed the order of integration of the individual series. The ADF test is performed on level as well as on first difference of the series. The results are presented in Table 1.

TABLE 1

Augmented Dickey-Fuller Test Results for Unit Roots

Variables Level	ADF stats	Variables First Difference	ADF stats	Result
LGE	–1.6283	Δ *LGE*	–5.7376*	$I(1)$
LFI	–2.0675	Δ *LFI*	–4.2573*	$I(1)$
LOP	–3.4239	Δ *LOP*	–5.4620*	$I(1)$
LPY	–1.5003	Δ *LPY*	–4.8512*	$I(1)$

NOTE: * denotes significance at 5 percent, $I(1)$ indicates unit root in levels and stationary after first differencing.

THE LONG-RUN GOVERNMENT EXPENDITURES FUNCTION: A COINTEGRATION ANALYSIS

We have investigated the number of cointegrating vectors by applying the likelihood ratio test that is based on the maximal eigen values and trace statistics of the stochastic matrix of the Johansen (1988) procedure. The results from the Johansen cointegrated test (both the Eigen values and the trace test) are presented in Table 2. All the variables included for the test have the same order of integration.

The likelihood ratio (LR) test indicates one cointegrating equation at 5 percent level of significance in each case. The null hypothesis of zero cointegrating vector is rejected against the alternative of one cointegrating vector. Consequently we can conclude that there is one cointegrating relationships among the variables, specified in the model.

TABLE 2

Johansen Test for Cointegration

Maximum Eigen Value Test

Null Hypothesis	Alternative Hypothesis	Test Statistic
$r = 0$	$r = 1$	30.23894*
$r = 1$	$r = 2$	19.86597
$r = 2$	$r = 3$	9.408874
$r = 3$	$r = 4$	0.307602

Trace Test

Null Hypothesis	Alternative Hypothesis	Test statistic
$r = 0$	$r \geq 1$	59.82138*
$r = 1$	$r \geq 2$	29.58247
$r = 2$	$r \geq 3$	9.716508
$r = 3$	$r \geq 4$	0.307615

NOTE: 1. * indicates significant at the 5 percent level.

2. Variables included in the cointegrating vector: *LGE*, *LFI*, *LOP* and *LPY*.

The long-run private investment function presented here is obtained by normalizing the estimated cointegrated vector on the government expenditures (LGE). So the results of estimated long-run government expenditure function are reported in the Table 3.

TABLE 3

Normalized Coefficients of Johansen Test on *LGE*

Variables	Coefficients	Standard Error	T-value
LPY	2.393672*	0.23444	10.2102
LOP	–0.331420*	0.12744	–2.600596
LFI	0.433083*	0.03845	11.2635
Constant	11.45022	–	–

NOTE: * represents significance at 5% critical values.

The estimated coefficients of *LPY*, *LOP* and *LFI* have expected signs and are significant. The estimated equation indicates that the government expenditures are mainly determined by the per capita income, openness of the economy and financial developments having elasticities of 2.39, –0.33 and 0.43 respectively.

THE SHORT-RUN DYNAMIC MODEL OF GOVERNMENT EXPENDITURES: THE ERROR CORRECTION APPROACH

After establishing the Cointegration relationship an error correction model (ECM) is established to determine the short-run dynamics of the regression model. The following error correction model (ECM) is established to determine the short-run dynamics of the regression model.

$$\Delta LGE = \beta_0 + \beta_1 \Delta LGE(-1) + \beta_2 \Delta LPY + \beta_3 \Delta LPY(-1) + \beta_4 \Delta LOP + \beta_5 \Delta LOP(-1) + \beta_6 \Delta LFI + \beta_7 \Delta LFI(-1) + \beta_8 EC(-1)$$

After estimating this model, we gradually eliminate the insignificant variables. The results suggested that out of these regressors only five are establishing short-term relationship with the government expenditures significantly. All others insignificant variables are dropped from the ECM. The following ECM is found to be the most appropriate and fits the data best.

$$\Delta LGE = \beta_0 + \beta_2 \Delta LPY + \beta_4 \Delta LOP + \beta_5 \Delta LOP(-1) + \beta_6 \Delta LFI + \beta_8 EC(-1)$$

The results of final estimated parsimonious dynamic error correction model are given in Table 4.

TABLE 4

Error Correction Model Estimates Dependent Variable Δ *LGE*

Variables	Coefficients	Standard Error	T-value
Δ *LPY*	1.114827	0.548161	2.033759
Δ *LOP*	–0.293870	0.119796	–2.453084
Δ *LOP*(–1)	0.235198	0.099251	2.369728
Δ *LFI*	0.434153	0.161852	2.682407
EC(–1)	–0.878597	0.166452	–5.278395
Constant	0.031127	0.024095	1.291808
R-square = 0.720460 F (6, 30) = 12.37109			

The error correction coefficient carries negative expected sign which is highly significant, indicating that in Pakistan government expenditure ratio, real per capita GDP, openness and financial development are cointegrated. Furthermore, the estimated coefficient of error correction indicates that approximately 88 percent of the disequilibrium is corrected immediately, *i.e.* in the next year.

Diagnostic Test

The validity of the estimated model is tested using the standard diagnostic tests. The residual passed the diagnostic test of no autocorrelation and no heteroskedasticity. The parameter stability of any estimated function has been the more crucial test, this stability in the model is confirmed by the CUSUM and CUSUM SQUARES.

Graphical presentation of CUSUM and CUSUM SQUARES are provided in Figures 1 and 2.

FIGURE 1

CUSUM

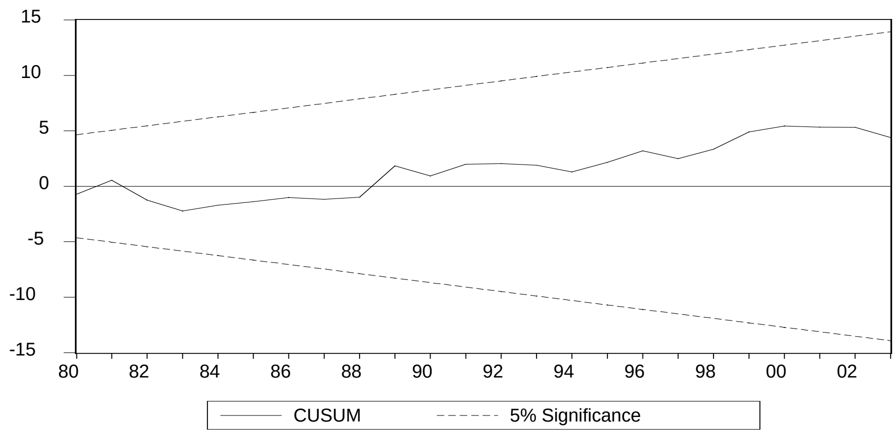
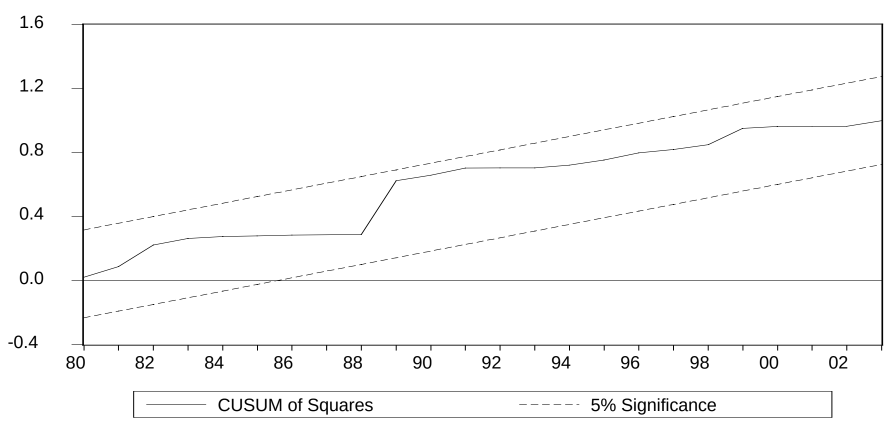


FIGURE 2

CUSUM SQ



It can be seen, the plots of these two tests do not cross the critical value line, indicating a stable long-run relationship between government expenditure ratio, real per capita GDP, openness and financial development. Thus, it can be concluded that the results are appropriate for policy implications.

There is no movement outside the critical lines in both tests that shows the coefficients are stable and no instability in the model.

V. CONCLUSIONS

Finally we can conclude that per capita income, openness of the economy and financial developments are the major determinants of the government expenditures in Pakistan. Moreover, we have found a long-run relationship between government expenditures and above stated determinants, and the existence of this relationship has far reaching implications for policy makers in designing the governmental expenditure policies in Pakistan as well as for other developing countries.

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