

## Investigating Wagner's Law-Cointegration and Causality Tests for Kenya

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**Abstract:** Wagner's law is widely held as the first model of public expenditure in the history of public finance. It is an antithesis of the Keynesian postulation that Government expenditure causes economic growth hence taking the former as a policy instrument. This study contributes to the existing literature by assessing the empirical evidence of Wagner's law in Kenya for the period of 1960-2009. It applies cointegration analysis in the investigation of long-run relationship between public expenditure and GDP. The existing literature reveals that Cointegration is a necessary condition to establishing a long-run relationship between public expenditure growth and income. However, in support of the Wagner's law, the required sufficient condition is the existence of a unidirectional causality from GDP to public expenditure. The study employed the Engle and Granger two-steps cointegration test, Granger causality test and time series aggregated data to carry out the test. The findings reveal that two versions of the law meet the necessary and sufficient condition hence, the Wagner's law holds in Kenya for the entire period under study.

**Key words:** Aggregated data, economic growth, public expenditure, stationarity, Wagner's hypothesis

### INTRODUCTION

Kolluri *et al.* (2000) points out that, the source of growth of public expenditure and its impact on economic activity have been issues of significant interest in the economic literature as far back as the mid-1800s. They further observed that, a considerable amount of attention has been directed towards assessing the effects of the general flow of government services on the productivity of the private sector of an economy and, more specifically, the impact of public-sector investment on private decision making.

Over the past three decades however, a vast amount of research has been devoted to testing the Wagner's law, which postulates that as the economic activity grows there is a tendency for government activities to increase. The Wagner's law has been tested empirically for various countries using both time series and cross-sectional data sets and, the empirical tests of this law have yielded results that differ considerably from country to country, Chang (2002).

In the history of economic analysis, the relationship between government expenditures and economic growth is one of the most debated issues. This is an issue that originates with the classical economics, whose representatives considered the growth of government expenditure as being detrimental to economic growth and they argued that state activities should be kept to a minimum, Katrakilidis and Tsaliki (2009).

In 1883, Adolph Wagner, a leading Germany economist of the time was the first person to offer a model of the determination of public expenditure. Based on his empirical findings, he formulated a law of expanding state expenditure which pointed to the growing importance of government expenditure activity as an inevitable feature of progressive state (Bird, 1971). Several Models exist to explain government expenditure growth but Wagner's law remains the most cited.

Wagner's law was established from the Wagner's theoretical model, which explained that public expenditure growth is a natural consequence of economic growth. (Musgrave, 1969; Bird, 1971; Kryzaniak, 1972; Mann, 1980; Ansari, 1997; Chletsos and Kollias, 1997) are some of the Economists whose investigation on the validity of Wagner's law was motivated by the publication of Wagner's theoretical writing into an English translation and the results differ considerably from country to country and period to period. In addition, the law has been captured in various mathematical formulations which are known as the six versions of Wagner's law stated in both absolute and relative terms.

One aspect that might be attributed to the variation in results obtained in testing this law is a wrong approach in analyzing the time series data variables. (Henrekson, 1992) points out that a test of Wagner's law should focus on the time series behavior of public expenditure in a country for the longest period possible rather than on a cross-section of countries with different income levels.

The relationship between government expenditure and national output is important for policy related issues. During recessionary periods, the attempts by fiscal policy authorities to manage aggregate demand through expenditure may not yield the desired results if the Wagner's law holds. In addition, the establishment of the relationship will provide a clear theoretical framework against which to formulate and judge fiscal policies, specifically with the ensuing raft of fiscal policy measures like Constituency Development Fund (CDF), women and youth development funds respectively. The intent of this study therefore, is to examine whether there is long-run relationship between public expenditure and GDP in the context of Kenya and along the lines suggested by Wagner's law. It applies recent advances in time series analysis including: cointegration and causality testing approaches to test five versions of the Wagner's law.

**Wagner's hypothesis:** Adolph Wagner, a 19th century German economist, was the first person to empirically test the hypothesis that government sector grows at a faster rate than income. Wagner stipulated that an increase in the size of government expenditure is a natural consequence of economic growth. The law states that the share of the government expenditure in GDP will increase with heightened economic development. This is due to social, administrative and welfare issues, which increase with need and complexity as the economy grows.

Wagner further posts that the process of economic growth and development, takes place accompanied by urbanization and industrialization. As a result, external dis-economies like congestion, pollution and environmental degradation arise. Since such externalities cannot be resolved through the market forces mechanism, the problem of market failure sets in. This calls in for the intervention of the public sector to address the issue through legislation and creation of regulatory institutions suggesting that the direction of causation is from GDP growth to the share of government expenditure. Consequently, public expenditure increases at a faster rate than that of the national output. In other words, as per-capita income rises in industrializing nations, the public sector will grow relatively, (Bird, 1971).

Another strand of literature holds that technological change and growing scale of firms tend to create monopolies whose pricing and output levels attract state intervention through enactment of regulation laws and the establishment of regulatory authorities like the commission of monopolies. The rationale behind this economic law is found in the public choice model, (Meltzer and Richard, 1981). The model holds that the government spends to satisfy the median voter which generates relationship between growth and spending.

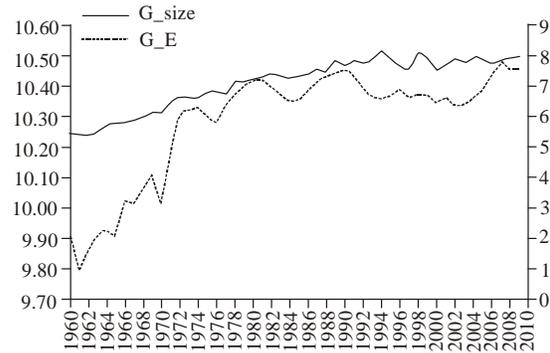


Fig. 1: Trend of government expenditure and the size of the Government (1960-2009) G\_size = government size; G\_E = government expenditure

**Review of Government expenditure and economic growth in Kenya:** The size of the public sector has been increasing since independence. This is attributed to the need for infrastructure, education and other social amenities. It can also be explained by the fact that, as the economy grows, the range of activities undertaken by the private sector widens. As a result, the government comes up with institutions and legal frameworks for regulation purposes so as to safeguard the welfare of the consumers in the economy. The process of regulation is usually aimed at ensuring that the free market system works efficiently and to protect unhealthy competition in the market.

Figure 1 shows that government expenditure and the size of the government have been growing over time probably due to population growth which comes with an increase in demand for public goods like security, roads, free education and health facilities among other social amenities provided for by the government.

The size of government declines drastically from 1992 to around 2003 probably due to increased privatization of state-owned enterprises in the wake of structural adjustment programs. The trend then changes drastically around year 2004 and this can be attributed to a government's initiative to generate economic development through free education, rural electrification and economic stimulus programs.

## LITERATURE REVIEW

The relationship between public expenditure and national income has been an area of great interest to economists since the inception of the discipline of public finance, (Peacock and Wiseman, 1961; Gupta, 1967). Singh and Sahni (1984) postulated that the relationship between public expenditure and national income has been

treated in different ways in two major areas of economic analysis. In the Wagnerian approach, the growth in government expenditure is said to be as a result of growth in national expenditure suggesting a unidirectional causality from national income to government expenditure. On the other hand, macro-economic models have tendency to take the view that, national income growth is partly as a result of growth in government expenditure. This approach is known as the Keynesian view and, it implies that government expenditure is an exogenous variable and thus it can be used as a policy instrument.

Public finance studies that take Wagner (1883) approach imply that, government expenditure has no role to play in the growth of national income in an economy since it is a behavioral variable. There are a number of studies carried out with regard to public expenditure with the most conspicuous case for Africa being South Africa. Other studies done include: (Abedian and Standish, 1984; Seeber and Dockel, 1978; Ansari, 1997; Chang *et al.*, 2004; Akitoby, 2006).

There seems to be weak support for the Wagner's law in developing countries although stronger support is evident in the industrialized countries, Akitoby (2006). The empirical results in developed countries show mixed results, with some studies establishing a cointegrating relationship in some countries and missing in others, Chiang (2002). Seeber and Dockel (1978) analyzed the behavior of functional expenditures in South Africa over the period 1948-1975 and they concluded that Wagner's law appeared to hold in the case of South Africa. Webber *et al.* (2010) tested for Wagner's law in New Zealand for the period 1960-2007 and they revealed that, economic growth granger-causes the share of government expenditure in the long-run therefore demonstrating a support for the Wagner's law.

Ansari (1997) tested the law using data for three African countries: Ghana, Kenya and South Africa. The motive was to investigate the long-run relationship between real income per capita and per capita real government expenditure using Engle and Granger (1987) cointegration test. Causality between the two variables, on the other hand, was analyzed using the Granger (1969) causality tests as well as the Holmes and Hutton (1988) tests. For the case of South Africa, the Holmes-Hutton tests showed no significant evidence of causality for the two variables and they concluded that, there was no causal relationship between income and government spending for South Africa neither for Kenya. However, economic literature is rich with warnings against using panel data from countries whose per-capita income is not of equal magnitude.

Chang *et al.* (2004) employed a time series data for seven industrialized countries and three developing

countries including that of South Africa. The time series properties of the data were analyzed using the Augmented Dickey-Fuller (ADF) and KPSS unit root tests. They further used the Johansen co-integration procedure to test the long-run relationship between GDP and government expenditure. Their Granger causality test results found no causal relationship between income and government spending for South Africa, using data for the time period 1951-1996 and hence concluded that Wagner's law doesn't hold in South Africa.

Akitoby (2006) in a different study set to investigate the short- and long-term relationship between government spending and output in a group of 51 developing countries which included South Africa. They used an error-correction framework to examine fiscal and output co-movements and also estimated the elasticity of government spending with respect to output for each country. Their results showed consistency with cyclical ratcheting and voracity reflected in a tendency for government spending to increase over time. They also found that output and government spending were co-integrated for at least one of the spending aggregates in 70% of the countries. Their results depicted a long-term relationship between government spending and output. They concluded that their results were consistent with the Wagner's law on the basis of a long-term relationship. However, one short-coming from their research work is that, they did not conduct causality tests to establish the direction of causality between the variables under study. Contrary to their approach, Henrekson (1992) points out that a test of Wagner's law should focus on the time series behavior of public expenditure in a country for the longest period possible, rather than on a cross-section of countries of different income levels. This observation therefore inspires the empirical assessment of the Wagner's law in Kenya.

Demirbas (1999) investigated the validity of Wagner's law in the Turkish economy for the period 1950-1990. Using Engle and Granger cointegration test and the Granger causality test, he found no support for the Wagner's law. (Musgrave, 1969; Gandhi, 1971) while working separately reached the conclusion that, cross-section analysis that includes both developed and underdeveloped countries as well as more backward countries support Wagner's hypothesis, while samples formed only from less developed countries do not support this. Singh and Sahni (1984), in an attempt to study the causality link between public expenditure and national income for India during the period 1950-1981, found that the effect of growth in public expenditure on that of national income is relatively low when compared to its effect on the growth of expenditure income. The conclusion they reached at is that, public expenditure and national income are linked by a causal mechanism with a

feedback effect; but the empirical evidence suggested that such a causality nature of relationship is neither of a Wagnerian nor a Keynesian type.

Demirbas (1999) observed that some researchers have ignored the time series characteristics of some variables, this therefore resulting in an implicit and false assumption that the variables are stationary. Moreover, this is against economic convention that most macro-economic variables of a time series nature have unit roots and only become stationary at difference. In this study, thence, we test for unit roots in all the time series using the Augmented Dickey-Fuller (ADF) test. We also establish the order of integration after detecting a case of difference stationarity. Finally, we proceed to test for cointegration in order to establish whether all the variables are integrated of the same order. This helps to check against the common statistical vice of running a spurious regression and this approach also helps in eradicating some earlier existing methodological shortcomings.

Tang (2001), using time series data for Malaysia during the period 1960-1998, applied Johansen's multivariate cointegration tests and he found no cointegration between national income and government expenditure. A short-run causality was however observed running from national income to government expenditure (in growth rates). His results support the Wagner's law over the period 1960-1998. Dogan and Tang (2006) using a time series data for Philippines, Indonesia, Malaysia, Singapore and Thailand found a unidirectional causality running from government expenditures to national income for the Philippines, while no empirical support of Wagner's law or Keynesian hypothesis for Indonesia, Malaysia, Singapore and Thailand was found to exist. In a different study, Furuoka (2008) found a long-run relationship between economic development and government expenditure in Malaysia and the Wagner's law was also supported by the data in the short-run.

After employing a recursive approach on causality tests, Tang (2008) found no stable causality pattern between government expenditure and economic growth although the Wagner's law held for the entire duration under review and the Keynesian view is only for prior to 1980. Tan (2003), using disaggregated government expenditure data for Malaysia, from the first quarter of 1991 to the third quarter of 2003 found cointegration between real GDP and real government expenditure in Malaysia. The error-correction based causality tests showed uni-directional causality from real GDP to government expenditure in the short-run thereby demonstrating support for the Wagner's law.

Ziramba (2008) used time series data for the period 1960-2006 to test the validity of Wager's law in South Africa. The long-run relationship between real government expenditure and real income was tested using

autoregressive distributive lag approach to cointegration suggested by Pesaran *et al.* (2001). The Granger non-causality test procedure developed by Toda and Yamamoto (1995) was employed in investigating the directional causality between the two variables. The results revealed no long-run relationship between the two but in the short-run, there existed a bi-directional causality ruling out the validity of Wagner's law.

Islam (2001) using annual data for 1929-1996 re-examined Wagner's hypothesis for USA and found that relative government expenditure and real GDP per capita are cointegrated by using Johansen-Juselius cointegration approach. Moreover, the Wagner's law was strongly supported by the results of Engle and Granger (1987) error correction approach used by the same researcher.

Magazzino (2010) investigated the empirical evidence of Wagner's law in Italy using data spanning 1960-2008, i.e., total expenditure and real GDP, which resulted in favor of Wagnerian hypothesis. By using real annual data covering 1964-1998 to test six mathematical formulations of Wagner's law in Saudi Arabia, Albatel (2002) obtained results that support the validity of Wagner's hypothesis. Ghorbani and Zarea (2009) on the other hand while using time series data for Iran for the period 1960-2000 found that, along this period, government expenditure growth is a result of economic growth which is in consonance with Wagner's law.

Afzal and Abbas (2010) using traditional and time series econometrics technique re-investigated the application of Wagner's hypothesis in Pakistan for the period covering 1960-2007. They reached a conclusion that the law doesn't hold for the periods (1961-2007, 1973-1990, 1991-2007), but the law is valid for 1981-1991. In addition, Omoke (2009) studied the direction of causality between government expenditure and National income in Nigeria using annual data for the period covering 1970-2005. There was no cointegration established and it was also inferred that the direction of causality was running from government expenditure to economic growth implying that Keynesian hypothesis holds but not the Wagner's postulation.

This study consequently, intends to test the following five versions of Wagner's law as suggested by economists since there is not any particularly existing and formulated criterion of choosing the appropriate version:

Functional form	Version
• $LN\_E = a + bLN\_Y$	Peacock and Wiseman (1967)
• $LN\_C = a + bLN\_Y$	Pryor (1969)
• $LN\_ [E/P] = a + bLN\_ (Y/P)$	Gupta (1967)
• $LN\_E = a + bLN\_ (Y/P)$	Goffman (1968)
• $LN\_ [E/Y] = a + bLN\_ Y$	Mann (1980)

where  $E$  is real total government expenditure;  $Y$  is real annual  $GDP$ ;  $E/N$  is the real total government expenditure per capita;  $G/Y$  is ratio of government expenditure to real  $GDP$  and  $C$  is final government consumption.

## METHODOLOGY

**Data source:** This study uses annual data from 1960 to 2009 which translates into 49 annual observations. Data on government expenditure was obtained from government national accounts published in the annual statistical abstracts by the Ministry of Finance and Planning, while population,  $GDP$ ,  $GDP$  per capita and government final consumption data were obtained from world bank (2010) website (publication of Africa Economic indicators). The data series have been transformed in to real variables using the  $GDP$  deflator obtained from the World Bank economic indicators data series.

**Preliminary data analysis:** Literature is rich with evidence revealing that much of the controversy arising in testing for the Wagner's law is as a result of methodological faults. For instance, some researchers assume that the time series variables are stationary at level which is normally not the case especially when macro-economic time series variables are involved. Henrekson (1992) observed that, a bulk of the support of Wagner's law derives from regressions in level and, banking on Granger and Newbold (1974), cautions that regression equations specified in levels of time series often lead to erroneous inferences if the variables are non-stationary. He concludes that most of the results reported by researchers may be spurious.

On the other hand, Demirbas (1999) outlines that earlier studies of the growth in public expenditure have not considered the time series properties of the variables involved. Most macro-economic time series tend to have a stochastic trend, a property known as difference stationarity. If pairs of time series variables are integrated of the same order, i.e., they are stationary at the same level of differencing, it's important to test for cointegration to capture the short- and long-run causal relationship between the two variables. This study will therefore fill this gap by applying the Augmented Dickey-Fuller (ADF) test to check for unit roots, the Engle-Granger two-step procedure for cointegration and finally the Granger causality test.

**Descriptive statistics and test for normality:** The descriptive statistics reveal that during the period under study, national income had the highest value while government expenditure (LN\_E) had the highest standard deviation indicating that it was the most erratic among the variables under investigation. It is crucial to investigate

the distribution of the set of time series variables which formally implies testing for normality. In testing for normality, the Jarque-Bera test for the time series data variables is employed.

The hypothesis to be tested is:

$$H_0: JB = 0 \quad (\text{normally distributed})$$

$$H_1: JB \neq 0 \quad (\text{not normally distributed})$$

**Time series properties of the series:** Under this, we seek to establish whether the time series data are stationary and if not, establish whether they are integrated of the same order. If the series is integrated of the same order, then, it is important to test for co-integration to avoid performing a spurious regression, i.e. statistical regressions among integrated series are only meaningful if they involve co-integrated variables, Banarjee *et al.* (1993).

**Co-integration analysis:** Co-integration was defined by Granger (1981), as the statistical implication of long-run relationship between economic variables. The basic idea behind co-integration is that, if in the long-run two or more series move closely together, even though the series are trended, the difference between them is constant, Hall and Henry (1989). The absence of cointegration suggests that, the variables under observation have no long-run relationship and, in principle they can wander arbitrary far away from each other, Dickey and Fuller (1981). As suggested by Engle and Granger (1987), before applying the cointegration tests, Augmented Dickey-Fuller (ADF) unit root tests are applied to each series and their first differences are used to determine the stationarity of each individual series, Ismet *et al.* (1998). The ADF test is derived respectively, from the following regression, Engle and Granger (1987):

$$\Delta y_t = \alpha y_{t-1} + \sum_{i=1}^m \beta_i \Delta y_{t-i} + \theta + \gamma_t + \varepsilon_t \text{ for levels}$$

$$\Delta \Delta y_t = \alpha y_{t-1} + \sum_{i=1}^m \beta_i \Delta \Delta y_{t-i} + \theta + \gamma_t + \varepsilon_t \text{ for first}$$

difference

where  $\Delta y$  are the first differences of the series,  $m$  is the number of lags and  $t$  is time and  $y$  is the variable whose stationarity is being investigated. The practical rule for establishing the number of lags involves a trade-off between the degrees of freedom and autocorrelation. The number of lags should be small to save the degrees of freedom but large enough not to allow for the existence of autocorrelation, Charemza and Deadman (1992).

Table 1: The conclusion - all the variables are normally distributed

	LN_C	LN_E	LN_GP	LN_Y
Mean	22.03417	7.150597	4.223023	27.03125
Median	22.12658	7.420268	4.323701	27.13320
Maximum	22.9557	8.173641	4.889465	27.96236
Minimum	20.92733	5.425574	3.270643	25.74053
Std. Dev.	0.625458	0.842438	0.413587	0.650654
Skewness	-0.304071	-0.768928	-0.885730	-0.511434
Kurtosis	1.847685	2.247633	2.805901	2.069788
Jarque-Bera	3.536808	6.106363	6.616137	3.982399
Probability	0.170605*	0.047208**	0.036587**	0.13653*

\*\* : insignificant at 10%; \* : insignificant at 5%

Table 2: ADF unit root test in levels (ADF regression with an intercept)

VARIABLE	ADF(0)	Cv5%	ADF(1)	Cv5%	ADF(2)	Cv5%
LN_C	0.784118	-2.9215	0.317434	-2.9228	0.453197	-2.9241
LN_E	-1.84339	-2.9215	-2.177422	-2.9228	-3.1158	-3.5745**
LN_G/P	-2.146965	-2.9215	-2.356249	-2.9228	-2.854237	-2.9241
LN_G/Y	-1.835705	-2.9215	-2.729562	-2.9241	-2.6331577	-2.9256
LN_Y	-2.146965	-2.9215	-2.356249	-2.922	-2.854235	-2.9241
LN_Y/P	-1.704811	-2.9215	-2.645286	-2.9228	-2.259535	-2.9241

\* : cv at 5% level of significance; \*\* : cv at 10%, [CV = critical values]

Table 3: ADF UNIT Root test in Levels (ADF regression with intercept & linear trend)

VARIABLE	ADF(0)	Cv5%	ADF(1)	Cv5%	ADF(2)	Cv5%
LN_C	-2.34635	-3.5025	-2.731341	-3.5045	-3.199900	-3.5066
LN_E	-1.570571	-3.5025	-1.475824	-3.5045	-0.986142	-3.5066
LN_G/P	-1.78080	-3.5025	-1.687712	-3.5045	-1.230054	-3.5066
LN_G/Y	-1.483636	-3.5025	-2.364450	-3.5045	-2.052293	-3.5066
LN_Y	-1.143263	-3.5025	-1.939125	-3.5025	-1.675791	-3.5060
LN_Y/P	-1.455094	-3.5045	-2.239534	-3.5045	-1.931887	-3.5066

\* : cv at 5% level of significance; \*\* : cv at 10%, [CV = critical values]

Table 4: ADF UNIT Root test in first difference (ADF regression with intercept & linear trend)

VARIABLE	ADF(0)	Cv5%	ADF(1)	Cv5%	ADF(2)	Cv5%
$\Delta$ LN_C	-6.124176	-3.5045	-5.46040	-3.5066	-3.242923	-4.1678**
$\Delta$ LN_E	-8.06604	-3.5045	-8.530610	-3.5066	-6.934084	-3.5088
$\Delta$ LN_G/P	-8.081541	-3.5045	-8.557531	-3.5066	-6.965665	-3.5088
$\Delta$ LN_G/Y	-7.46443	-3.5045	-5.271980	-3.5066	-3.887791	-3.5088
$\Delta$ LN_Y	-7.613672	-3.5045	-5.388539	-3.5066	-4.006220	-3.5088
$\Delta$ LN_Y/P	-6.21850	-3.5045	-4.833140	-3.5066	-3.857940	-3.5088

\*\* : cv at 1% C

**Unit Root Tests:** In testing for stationarity, the following hypothesis is examined:

$H_0: \alpha = 0$  (non stationary)

$H_1: \alpha \neq 0$  (stationary)

If the null hypothesis is rejected, then it means that the time series data is stationary. The decision criterion involves comparing the computed Tau ( $t$ ) values with the MacKinnon critical values for rejection of a hypothesis of unit root. If the computed tau ( $t$ ) statistic is less negative relative to the critical values, we do not reject the null hypothesis of non-stationarity in time series variables.

In the two cases, (Table 1 and 2), the computed Tau Statistics are less negative than the MacKinnon critical Tau Values; we do not reject the null hypothesis that the time series data variables are non-stationary. In all the above cases, the computed Tau Statistics are less negative than the MacKinnon critical values; hence we do not

reject the null hypothesis that the time series data variables are non-stationary. The time series therefore exhibits difference stationarity.

## RESULT AND DISCUSSION

**Empirical results and cointegration test:** The Engle and Granger (1987) two-way procedure is used to determine the possible existence of a long-run relationship between the variables under study. The test is residual based and is necessary in order to avoid running a spurious regression. The first step is to estimate the hypothesized long-run relationship using the (Ordinary Least Squares) OLS method (cointegrating regression). In the second step, we generated the residual series using the Eviews econometric application software and subjected the residuals to an ADF test (Table 3 and 4). Here, we expected the error term to be an I(0) process for the variables to be co-integrated.

Table 5: Regression results and cointegration tests

Version of law	Dependent variables	constant	p-value	slope coefficient	p-value	R <sup>2</sup>	ADF (*)	CV
LN_E	LN_Y	-26.99669	0.000	1.263252	0.000	0.95	-2.88044 (0)	-2.7215**
LN_C	LN_Y	39.08755	0.000	-0.630876	0.000	0.43	-1.40245 (0)	-1.9474*
LN_(E/P)	L_(Y/P)	-16.73464	0.000	2.037064	0.000	0.849	-3.75460 (0)	-2.9215*
LN_E	LN_Y/P	-35.425	0.000	4.138338	0.000	0.845	-2.2752 (0)	-2.9215*
LN_(E/Y)	LN_(Y)	3.357204	0.000	0.256406	0.000	0.795	-1.36825 (0)	-2.9215*

\*: critical MacKinnon values; \*\*: 5% significance level; \*: 10% level of significance  
 Number of lags in parentheses was chosen using the Akaike Information Criteria (AIC)

.Applying the ADF test on the residuals involves running the following regression:

$$\Delta I_t = \phi I_{t-1} + \sum_{i=1}^m \phi \Delta I_{t-i} + v_t$$

The hypothesis tested is:

- H<sub>0</sub>:  $\phi = 0$  (non stationary)
- H<sub>1</sub>:  $\phi \neq 0$  (stationary)

The Mackinnon critical values are then compared with the tau statistic computed by the economic application software, Eviews.

In Table 5, we observe that only three models exhibit the computed tau statistic as being more negative than the reported critical values. This implies that there is a cointegrating relationship in Gupta and Peacock-Wiseman versions of Wagner’s law. We therefore conclude that, there is a long-run equilibrium relationship between public expenditure and GDP in Kenya over the period under review.

The necessary condition for Wagner’s law to hold is that, government expenditure and the national income should be cointegrated. In this case, three of the versions of Wagner’s law, reveal no long-run relationship between income and government expenditure. These three versions include: Pryor (1969), Mann (1980) and Goffman (1968). The sufficient condition for the law to hold is that, there should be unidirectional causality from national income to government expenditure.

**Cointegrating relationships:**

- **Peacock and Wiseman model:** The Fig. 2 shows that the error terms are mean reverting, which emphasizes that the two variables under study have a long-run relationship.
- **Gupta model:** In the Fig. 3, a long-run relationship between national income and government expenditure is repeated because the error terms are once more reverting to their mean.

Based on the above analysis, the models specified by Mann, Pryor and Goffman did not suffice the necessary

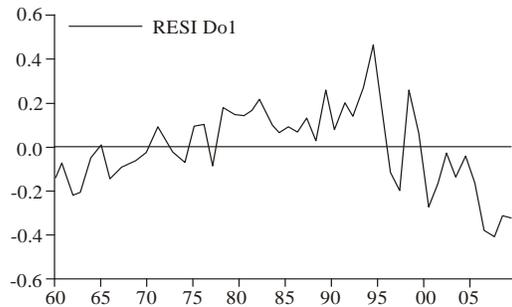


Fig. 2: Peacock and Wiseman model

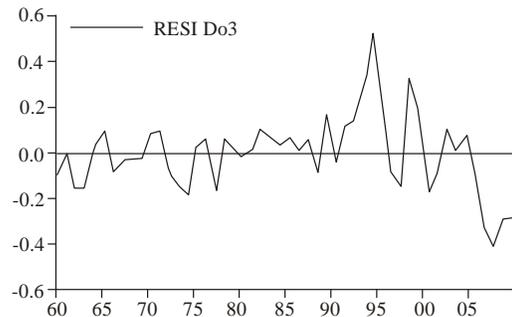


Fig. 3: Gupta model

condition required to validate the Wagner’s law since the pair of variables under analysis are not cointegrated. In the next step, and for the law to hold, unidirectional causality must persist from income to the government expenditure. Demirbas (1999) argued that causality studies based on Wagner’s reasoning should be hypothesized to run from GNP and/or GNP/P) to the dependent variable which may take any of the four different forms: E, C, E/P and E/GNP.

**Granger causality test between government expenditure and national income:** The Granger directional causality testing method was developed by Granger 1969 and it’s based on the axiom that: the past and the present may cause the future but the future cannot cause the past. The causal relationship between variables such as, x and y is examined through running bivariate regressions of the following form:

Table 6: Granger causality test results (F-test) - Bivariate case

Null hypothesis	F- statistic	p-value*	conclusion
LN_Y Does not Granger cause LN_E	5.40337	0.02457	Reject the null hypothesis
LN_E Does not granger cause LN	0.04136	0.83974	Do not reject the null hypothesis
LN_Y/P Does not Granger cause LN_E/P	8.03344	0.00680	Reject the null hypothesis
LN_E/P Does not Granger cause LNY/P	0.25301	0.91557	Do not reject the null hypothesis

\*: p-value of the F statistic at 5% level of significance (1 lag)

Table 7: Result of short-run dynamic

Null hypothesis	F statistic	p-value**	conclusion
$\Delta LN_Y$ Does not Granger cause $\Delta LN_E$	0.29355	0.59062	Do not reject the null hypothesis
$\Delta LN_E$ Does not granger cause $\Delta LN_Y$	0.3028	0.58485	Do not reject the null hypothesis
$\Delta LN_Y/P$ Does not Granger cause $\Delta LN_E/P$	0.1738	0.67736	Do not reject the null hypothesis
$\Delta LN_E/P$ Does not Granger cause $\Delta LN_Y/P$	0.20490	0.65297	Do not reject the null hypothesis

\*\*: p-value of the F statistic at 5% level of significance (1 lag)

$$y_t = \alpha_1 + \sum_{i=1}^m \beta_i x_{t-i} + \sum \delta_1 y_{t-1} + \varepsilon_t$$

$$x_t = \alpha_2 + \sum_{i=1}^m \beta_j y_{t-i} + \sum \delta_1 x_{t-1} + v_t$$

where  $\varepsilon_t$  and  $v_t$  are two uncorrelated white-noise series.

The justification as to whether and how  $X$  causes  $Y$  can be explained by using the past values of  $Y$  as determinants of  $Y$  and then see whether adding the lagged values of  $X$  can improve the explanation. If it does, then  $Y$  is said to be Granger caused by  $X$  i.e.,  $X$  helps in predicting  $Y$ . We test the null hypothesis of  $B_i = 0$  to determine if  $X$  granger causes  $Y$ ; and  $B_j = 0$  to determine if  $Y$  granger causes  $X$ .

It's equally of immense importance to determine an appropriate lag length,  $m$ . (Demirbas, 1999; Bird, 1971) observed that in literature: 1, 2, 3 and 4 are the most common number of lags that are used. For causality to hold, all the time series under consideration are assumed to be stationary. However, if the variables exhibit difference stationarity, the cointegrating hypothesis is not rejected, hence we apply the Granger causality using the variables at levels. Alternatively, the F-test may be used to determine the causal nexus between variables under investigation. This study consequently applied this test to two of the models that meet the necessary condition for the Wagner's law to hold. In this case, Gupta, Peacock and Wiseman models are used.

From the Table 6, we see unidirectional causalities from GDP to Government expenditure. This implies that there is a long-run unidirectional causality in the two versions of hypothesis; hence the sufficient condition for the law to hold is met satisfactorily. As can be seen from the Table 6 and in the long-run, the Wagner's causality order holds for Kenya during the entire period under study.

**Short-run dynamics:** On a different perspective, it is very interesting to observe the inferences of a short-run

relationship between the two variables after checking for causalities using the variables at first difference. In Table 7, We arrive at the conclusion that no causality exists in the short-run.

### CONCLUSION

This study tested for the existence of Wagner's law in Kenya using aggregate data for the period 1960-2009. It looks at the time series properties of the data, i.e. testing for the existence of unit roots. As it was found, both public expenditure and GDP variables were non-stationary in levels but stationary at first differences: that is, they are integrated of order one (I(1)). Since the study entails the use of single equation model(s), a cointegration test has been applied (the first stage of Engle and Granger's two-stage residual based approach) to six versions of Wagner's Law. Based on the test results, there is no cointegrating relationship between the variables in three out of six versions of the law.

These findings show support of Wagner's Law as found by many early researchers that, when the variables under observation are not cointegrated, the results may be spurious. In this test based on Kenya, a long-run positive relationship is found to exist between public expenditure and GDP variables for Peacock and Gupta versions of Wagner's Law. However, a further analysis reveals that the causal link is unidirectional in the long-run for only two of the versions. As such therefore, there is evidence to support Wagner's law in two versions of the Wagner's model but not the Keynesian hypothesis.

Based on empirical findings, the study suggests that the growth of public expenditure in Kenya is directly dependent on and is determined by the level of economic growth as the Wagner's law articulates. Public expenditure is of course, the outcome of many decisions in the light of changing economic circumstances. However, it is shaped by the various decisions about how public expenditure should be distributed among competing groups: whether geographically concentrated or aggregated in organized interests, Kelley (1976). Thus, other factors, such as political processes, interest group

behavior and the nature of economic development may be considered as possible explanatory variables for the increase in the size of public expenditure.

The findings from this study have exhibited a strong case for Wagner's law using aggregate data.

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