Investigating the Provincial Government Expenditure–Economic Growth Nexus in a Multivariate Model: Empirical Evidence from Free State Province*

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Abstract

This paper examines the relationship between government expenditure and economic growth in the Free State province based on two opposing theories (i.e., Wagner's Law and Keynasian theory). Five commonly-used functional forms of Wagner's law are estimated in both bivariate and trivariate models over the period 2001:Q1 to 2014:Q4. Population variable is included as a third endogenous variable in our model to avoid the 'omitted variable' problem and erroneous conclusion on causative link in the specified model. The long-run relations and causal links among variables are tested using the novel Autoregressive Distributed Lag (ARDL)–bound testing approach and Toda-Yamamoto causality test. Our results shows a bi-directional causal link between total provincial government expenditure (PGE) and economic growth (real GDP) in the short run, while the real GDP Granger-causes PGE in the long-run. We also find a unidirectional causal flow from population growth to both GDP and PGE in the short-run, suggesting that demographic factor plays a key role in explaining rise in total PGE. Other evidence reveals a long-run income elasticity ranging from 0.99 to 1.2%, implying that a 1% increase in real GDP in the Free State will cause PGE to rise by 0.99 – 1.2%. In view of 'voracity effect', we find that total PGE can rise by 0.49 – 2.12% in the short-run, in response to a positive shock suggesting that external shocks influences total PGE. Policy implication of our findings provides strong support for the adopted ongoing fiscal consolidation stance by the province to enhance effective allocation of limited fiscal resources, curb wasteful expenditure and reduce government size. Albeit, the bi-directional causal link between real GDP and PGE require policy makers to prudently balance both current and future public expenditures not to crowd-out output and labour productivity.

JEL Classification: C10, C51, E62, H50, O10

Keywords: Economic growth, Government expenditure, ARDL, Toda-Yamamoto causality test, Wagner's Law, Keynesian theory, Free State.

1. INTRODUCTION

The interest to clearly understand the relationship between economic growth and government expenditure (or government size) is a phenomenon that has gained substantial attention in the academia and policy circle in both the developing and developed countries with mixed conclusion. Thus, in the vast economics and public finance literature, two opposing theories fundamentally supporting the government expenditure-economic growth nexus namely Wagner's law and Keynesian hypothesis, while the latter is widely accepted in public finance, the former is popular in the field of economics, and mostly used in the policy circle for formulating macroeconomic policies.

While, the empirical works of Adolph Wagner (1883,1893) culminated into the influential Wagner's law Wagner law of "increasing expansion of public and state activities", which hypothesise the propensity of public expenditure to rise faster than income due to growth enhancing factors

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such as economic development, technological advancement, progressive society, and so on. On the other hand, a widespread policy stance, particularly found in developing countries, is to use [rapidly increasing] government expenditure as policy tool to stimulate economic growth and in the short-run based on Keynesian theory. According to Keynes (1936), government expenditure is an effective counter-cyclical policy tool during economic recession. By implication, government expenditure becomes a key policy instrument with an innate stabilizing function operating through multiplier effect.

Most importantly for policy design, in order to adopt an effective policy it is imperative to: empirically establish the nature and direction of causal link in the government expenditure-economic growth nexus; validate the true relationship between national income and government expenditures given the complex and dynamics underpinning the relationship between these variables, rather than relying on *priori* judgment to arbitrarily adopt the so-called growth-enhancing fiscal policies by raising government expenditure.

Up till now, large number of studies assessing the economic growth–government expenditure nexus in relation to Wagner's law in the extant literature are devoted to mostly developed and developing countries in the Asian and Latin America region, while very few empirical research focused on Africa countries, particularly South Africa which is generally viewed the most industrialised, and an emerging country in Sub-Saharan Africa (SSA) region. Conversely, the conclusion of earlier studies in this strand of literature are susceptible to wrong conclusions due to misspecification bias, inappropriate econometrics techniques and the influence of 'omitted' variable problems. Despite these weaknesses, few researchers have made some attempt to validate the relevance of Wagner's law in a handful of cross-sectional and country-specific studies with mixed evidence, same as the findings reported in the international literature.

This present study differs from prior empirical works since none of earlier studies have considered looking into the relevance of Wagner's law or Keynesian theory, in the context of, the relationship between economic growth and government expenditure, from a provincial perspective. Closest studies to our work in the international literature are the studies of Abizadeh and Yousefi (1988) on 10 states of the United States and Narayan et al. (2008) on Chinese provinces. Unlike existing studies on South Africa, a novel feature of this current study is the use of provincial level data. Narayan et al. (2008:298-299) cited four advantages of using provincial data.

This study contributes to the literature in three folds. First, it fills the current research gap by examining the long-run relationship and causal links between economic growth and government expenditure using provincial data for a South African province, i.e. Free State province. Second, unlike existing studies, we utilized both a bi-variate and multivariate model. In the trivariate model, population is used a third endogenous variable to avoid the problem of 'omitted variable', misspecification bias, and erroneous detection of spurious causal link which is seemingly ignored in the few extant studies for South Africa. Third, to obtain a robust result, we estimated the five commonly-used functional forms of Wagner's law. Possible long-run relationships and causal flow between selected variables were investigated using ARDL cointegration and Toda-Yamamoto causality tests respectively.

The remainder of this paper is structured as follows: Section 2 discusses the trends in government expenditure and economic growth for the Free State province. Section 3 provides the theoretical framework for analysing the dynamic relationships between aggregate government expenditure and economic growth, and also summarizes studies related to Wagner's Law. Sections 4 and 5 detail the econometric techniques and empirical results respectively. Policy implications of the findings is discussed in Section 6. Section 7 concludes.

2. STYLISED FACTS: TRENDS IN GOVERNMENT EXPENDITURE AND ECONOMIC GROWTH FOR FREE STATE PROVINCE

A general trend commonly observed in most countries pertains to the rapid increase in government expenditure relative to economic activity due to political factors driving the former, rather market forces (Dilrukshini, 2009). This phenomenon is evident in the pattern of co-movement between government spending and economic growth in the Free State province.

A furtive glance at Figure 1, it is evident that government expenditure and economic growth tends to co-move in the same direction with a possibility of long-run relationship, which is an empirical issue to be examined. Beginning with trends in economic growth and national expenditure in South Africa as a whole, while the former has been relatively weak since post 2007/08 global recession from 5.4% in 2007 to 0.1% in 2016, while a growth of 1.1% has been projected for 2017 (IMF, 2016), nonetheless, government expenditure is increasing a rapid pace. For instance, in the current policy on public spending, according to 2016 National Budget, is to enforce a strict fiscal discipline by implanting fiscal consolidation while shifting a greater proportion of the budget towards economic infrastructure investment (i.e. water, public transport and public broad band connections), tertiary education (post graduate) and training, improved health services and social protection (mainly social grants). The main objective of the adopted fiscal consolidation is enforced by adopting cost containment measures to (i) reduce public debt (as percentage of GDP) to 46.2% in 2017/18, and (ii) shrink budget deficit to a sustainable level of about 2.4% by 2018/19 from 3.9% in 2015/16 financial year via cost by imposing an expenditure ceiling of R25 billion on the growing public sector wage bill (i.e. personnel sending) over the next three financial years. In addition, a tax revenue of R18.1 billion is anticipated to be raised in 2016/17, with an additional R15 billion in the following two consecutive years.

Equally, on the basis of the increase in provincial expenditure by 5.4% from 29.5 billion (2015/16) to 30.8 billion in 2016/17, the Free State government in the 2016/17 Provincial budget trimmed the public spending over the next three financial years (MTEF) to R30.8 billion, R32.8 billion and R34.5 billion in 2016/17, 2017/18, and 2018/19 through several fiscal consolidation strategies, which is expected to ceiled public expenses on non-core programmes to R35.8 million in 2016/17.

The fiscal consolidation measures implemented are: periodic head count of public servants to curtailed moon-lightning and ghost workers, in effect, curbing the growing wage bill. Also, limit recruitment into the public sector, streamlined the functioning of provincial government departments by identifying duplicated functions and integrate multiple public sector services. Following the implementation of the intergovernmental fiscal framework to improve the disbursement of national revenue (equitable shares) in 2000 to provinces to meet a variety government financial obligations (e.g. facilitate service delivery, support infrastructural and economic development), total government expenditure has grown from of R7.4 billion in 2000/01 to R14.2 billion in 2005/06. By the end of 2015/16, government expenditure had tripled to about R29.5 in 2015/16 financial year.

A further analysis of the government expenditures per provincial departments shows that a large proportion of the total expenditure is dominated by three components which are: education, health and social welfare. Specifically, using the available data, 16-year period analysis reveals that, on average, the largest share of total government expenditure is on education is about 39.5%, followed by health (26.4%) and social welfare (10.6%). In contrast, lower percentage share of the total government expenditure is allocated to infrastructure expenditure (6.8%) and human settlement (4.7%). Similarly, on average, the lowest share of government expenditure is allocated to agriculture (2%); sports, arts and recreation (1.6%); economic development (1.6%); governance (0.8%), protection and legal services (0.6%). It is worth noting that, while provincial government expenditure on education and health appeared to be normalised around 40% and 29% respectively since 2005, nonetheless, fiscal expenditure on social welfare has decline dramatically from almost 28% in 2005/06 to 3.4% in 2015/16. On the other hand, there is a notable shift is observed in government expenditure on security and road transport with a steady rise from about 1.6% in 2008/09 to a peak of 8.3% in 2014/15. This remarkable increase could be attributed to the 2010 World Cup event held in the province. By and large, a long-run estimate, depicts a lower share of government expenditure below 6%. This low public investment on infrastructure could partly explain the prevailing weak economic activity, growing unemployment rates and acute poverty level in the province (Ascaheur, 1986).

Since 2000, expected provincial government expenditure rise faster than economic growth over the period considered, this is consistent with Wagner's theory of expanding government size (see Figure 2)[2]. After the adoption of the intergovernmental fiscal framework in 2000 by the national government,, real total provincial government expenditure rapidly grew from 10.7% in 2000 to about 13% in 2004[3]. During this period, the upsurge government expenditure lift domestic economic growth from -2.4% in 2000 to 3.9% in 2004. Surprisingly, while economic activity improved in 2005 as GDP growth peaked at 4.2%, albeit, a steadily decline (to 9%) in public expenditure is observable. Notably, government expenditure has been on a downward decline since 2009, partly due to the emergent tight economic condition in the global economy due to 2007/8 recession and the adopted fiscal consolidation strategy at the national level.

3. LITERATURE REVIEW: THEORETCIAL AND EMPIRICAL EVIDENCE

According to Wagner's law, there is a long-run relationship between government expenditure and income[4], nonetheless, as the economy develops, large proportion of income of devoted to government expenditure due to increase in per capita income, which in turn, intensifies aggregate demand, for example, public goods and services (education and health), safety and security, good governance, technological investment, and so on. In the long-run, as real income increases, the share of government expenditure tends to rise faster relative to income, in effect, leading to large government size. Wagner's postulation of rapidly increasing in growth of government expenditure is caused by economic growth (national income) is widely accepted in public finance (Henrekson, 1990), hence, the treatment of the former as a behavioural endogenous variable (Singh et al. 1983). Empirically,

[2] In reference to Wagner (1883), factors that can explain rapid expenditure-led growth are: demographic factor (expanding population), aggregate demand for public goods and services, which is closely linked to increasing urbanization. For the Free State province, the observed growth in public expenditure could be ascribe to the shift in the provincial government's policy to meet the National government's pro-poor goals to: increase social security coverage, accelerate infrastructure (transport) development, facilitate regional industrialization by creating Special Economic Zones, support small enterprise establishments, investment in green energy, and undertake extensive preventive and rehabilitation of existing physical and economic infrastructure (2016 FS Province Budget Speech)

[3] The South Africa's Equitable Share (ES) formula is a mechanism for transfer of funds from the National government to provincial (9 provinces) and local governments (consists of 278 municipalities) to support basic services including water and sanitation. The disbursement of equitable shares (i.e. national revenue) to provinces are calculated based on seven (7) weighted components, namely: education (numbers of enrolment, school age); health (population with/out medical aid support); social development (proportion of the population accessing social grants and ruralness); level of economic activity; backlog in public implemented programmes (health, education, rural development etc); basic services (population growth), and institutional funds. (National Treasury, IGFR)

[4] In this paper, government expenditure is interchangeably referred to public spending (or government spending), while economic growth is referred to as national income (or income) based on the context of focal discussion.

evidence supporting Wagner's law indicates a unidirectional causality running from economic growth (national income) to government expenditure (public size). If Wagner's law holds, from a policy perspective, government expenditure is not a reliable policy tool to stimulate economic growth.

In *Grundlegung der politischen okonomie* (1893), Wagner presented three rationale for an expanding government size or an increasing share of government expenditure in national income, over a time period. First, economic development (industrialization) leads to substitution of private sector activity with the public sector to produce quality goods and services, as well as, prevent monopolistic behaviour of private sector to promote market efficiency. Hence, the societal need for regulations, administrative (e.g. governance) and protective functions amplifies the government's role (or size) in a growing economy, as the society prosper. Other factors include: urbanization, population growth, need for legislations – legal rules to ensure proper governance, and communication. Second, growing income per capita leads to greater demand for income elastic public goods and services, such as: improved health services, education, social grants, cultural and recreational activities. On this assumption, income elasticity relative to government expenditure is expected to be greater than unity. Third, technological advancement requires government to undertake large projects considered too risky or not profitable by private sector. Additionally, large government size, which is synonymous to high public expenditure is predominant in most countries given the ubiquitous perception that government play a critical role in harmonizing conflicts between private and social interests, resist exploitation by foreign interests and increase socially desirable investment.

Empirically, although both Ram (1992:497) and (Henrekson, 1993:406) argued that Wagner's law is explicitly a long-run phenomenon, without considering any possible co-movement between economic development and government size in the short-run (cited in Ashan et al. 1996:1055). But, in the literature, it is widely accepted that the existence of a long-run relationship suggests the possibility of a prevailing inter-temporal relationship accentuated by a prima facie causative process between national income and government expenditures in the short-run (Holmes and Hutton, 1990; Ansari et al. 1997; Islam, 2001; Iyare and Lorde, 2004; Narayan et al. 2008). Thus, the precise knowledge on the direction of causality is important to adopt an effective policy stance. For example, a causative process validating Wagner law relegates government expenditure to a passive role, whereas, an evidence of a causal flow consistent with Keynesian theory ascertain the significant role of government expenditure as a key policy variable to stimulate economic activities and development (Sing and Sahni, 1983:198; Loizoides et al. 2001:133).

On the contrary, according to Keynes (1936), government expenditure is an effective counter-cyclical policy tool during economic recession. By implication, government expenditure becomes a key policy instrument with an innate stabilizing function operating through multiplier effect. For instance, high government [consumption] expenditure is considered to be useful during an economic recession (upswing) when government embarks on an expansionary (restrictive) monetary policy stance, this in turn, can lead to simultaneous positive impact on aggregate production, demand for labour supply and job creation. Over time, effective demand rises, as per capita income of individual households increased owed to high labour productivity linked to significant employment growth.

In the past decade, the Keynesian theory on the important role of government in the domestic economy has been widely adopted in developing countries to support the rationale for a large government size (i.e., public sector) due to market failures, and private sector's inability to supply the large public goods (infrastructures) as a result of monopolistic and capitalist behavior. Another reason why Keynes theory gained widespread popularity in most developing countries is attributed to the simplicity and practical application of the theory to formulate macroeconomic policies as well as display political commitments. For example, national government tends to increase its expenditure to: stimulate economic growth in the short-run during recessionary periods, which in turn, can lead to economic development (see, e.g., Lin, 1994; Ashan et al. 1996; Yasin, 2011; Abdullahi et al. 2007; Alexiou, 2009; Asghar et al. 2011; Alshahrani et al. 2014; Garba et al. 2013; Gemmell et al. 2015; Sabir, 2015 and Lahirushan et al. 2015) and mitigate the severe effects of idiosyncratic shocks on the economy, e.g. war and natural disaster (Rodrik, 1998). Additionally, an intensive government spending on large projects, which can create temporary jobs indirectly, is indicative of staunch commitment by the national government from the voters' perspective.

3.1 Theoretical Framework

Though, Wagner's law have enjoy an overwhelming empirical support in earlier studies (see, e.g. Peacock and Wiseman, 1961; Gupta, 1967; Goffman, 1968; Musgrave, 1969; Mann, 1980; Ram, 1986) documented in Birds (1970) and Henrekson (1993), yet the exact interpretation of Wagner's conjecture remain elusive, because no definite mathematical representation was proffered by Wagner (see, e.g. Klingman, 1980; Rao, 1989). For instance, Henrekson (1993) interpreted the be interpreted Wagner's law as an increased share for the public sector in the total economy relative to per real income growth, in contrast, Musgrave's (1969) viewed the law an increase in the share of government in national income or the absolute level of government. As a result, the extant literature is dominated with five function forms of the law as interpreted in Eqs.1.1 to 1.5:

$$GE = f(Y) \qquad \text{(1.1): Peacock-Wiseman (1961)}$$

$$GE = f\left(\frac{\mathrm{Y}}{\mathrm{P}}\right) \qquad \text{(1.2): Goffman (1968)}$$

$$\left(\frac{GE}{Y}\right) = f\left(\frac{\mathrm{Y}}{\mathrm{P}}\right) \qquad \text{(1.3): Musgrave (1969)}$$

$$\left(\frac{GE}{P}\right) = f\left(\frac{Y}{P}\right) \qquad \text{(1.4): Gupta (1967)}$$

$$\left(\frac{GE}{Y}\right) = f(Y) \qquad \text{(1.5): Mann (1980) – modified version of Eq.1.1.}$$

where, GE denotes government expenditure; Y represents real gross domestic product (GDP) and P indicates population growth; $\left(\frac{GE}{P}\right)$ is the real total expenditure per capita; $\left(\frac{Y}{P}\right)$ real income per capita, and $\left(\frac{GE}{Y}\right)$ represents real total expenditure as a share of real income.

According to the first proposition by Peacock and Wiseman (1961), government expenditure growth to be greater than economic growth (GDP), whereas, Goffman (1968) viewed the law as a higher rate of government expenditure relative to the growth in per capita GDP, as an archetype economy move towards 'developmental or industrialisation phase'. Musgrave (1969) asserts that the share of government expenditure in GDP increases as income per capita grows during a 'developmental or industrialisation phase', whereas, Gupta (1967) interpreted taking into account population growth (urbanisation) linked to increased demand for income elastic public goods, and posits that per capita government expenditure is a function of GDP per capita. Meanwhile, Mann

(1980) maintains that the share of government expenditure in GDP is a linear function of economic growth (GDP).

In some studies, an augmented version of the Peacock and Wiseman's (hereafter, P-W) proposed by Pryor (1969) suggesting that the share of government consumption expenditure is expected to be higher than economic growth in developing countries have been considered in cross-sectional studies (see, e.g., Barth and Brady, 1987; Diamond, 1989; Landau, 1983,1986; Komendi et al. 1985; Barro, 1991; Afxentiou et al. 1996; Kolluri et al. 2001) and country specific-studies (e.g. Ghali, 1997 for Saudi Arabia; Nikolaos et al. 2004 for Greece; Tulshidharan, 2006 for India; Ho, 2007 for Japan; Ocran, 2011 for South Africa; Amin, 2011 for Bangladesh; Maku et al. 2014 for Nigeria), with mixed empirical evidence supporting either Wagner's law or Keynesian hypothesis or both.

Essentially, establishing a long run relationship is insufficient to affirmed Wagner's law (see, e.g., Ansari et al. 1997; Islam, 2001; Iyare and Lorde, 2004), but the direction of causality is necessary to determine a robust relationship. On the whole, if unambiguous support for Wagner's law is to be inferred, a unidirectional causality running from national income to government expenditures should be observed (Narayan et al. 2008:300).

3.2. Empirical Evidence

There is an extensive literature studying the relationship between government expenditure and income in a cross-sectional or country-specific framework using a simple to sophisticated econometric techniques to shed light on the long-run and/or short-run dynamic between these variables. Nonetheless, the conclusion from these studies remain inconclusive. Some studies, for example, Landau (1983,86), Grier and Tullock (1986), Barth and Brady (1987), Diamond (i989), Barro (1990,1991), Ho (2007), Asghar et al. (2011), and Ogundipe et al. (2013) all have reported a negative relationship between government expenditure (and its components) and income for both developed and developing countries. Conversely, a prima facie positive relationship between economic growth and government spending have also been reported by Ram (1986), Aschaeur (1986), Lin (1994), Yasin (2000), Abdullahi et al. (2007), Alexiou (2009), Alshahrani et al. (2014) and Garba (2013). Meanwhile, Komendi and Meguire (1985) and Maku (2014) found no evidence.

In the extant vast literature, great number of empirical studies investigating the relationship between government expenditure and economic growth mostly focus on developed countries and their developing counterparts in the Asian and Latin American region, whereas, there is a dearth of research on sub-Saharan Africa (SSA) countries. Nonetheless, a survey of the literature focusing on SSA region provide mixed evidence on the validity of Wagner's law from the few existing cross-sectional and country-specific studies, which is similar to ambiguous evidence reported for both developed and developing countries in other parts of the world. An extensive survey of the existing literature on studies examining the GDP–GE nexus is presented in Table BII to BIV in the Appendix.

Focusing on SSA studies, beginning with cross-sectional studies. In a panel regression of 23 SSA countries, Yasin (2011) investigate the impact of government expenditure on economic growth covering the period 1987 to 1997. The results of the fixed and random effects analysis shows that trade-openness and private investment expenditures exerts positive and significant influence on economic growth, but population growth rate influence on economic growth is statistically insignificant. In addition, Oteng-Abaiye (2011) considered five ECOWAS (Gambia, Ghana, Guinea, Nigeria and Serria Leone) countries using a panel cointegration test, and finds of cointegration between government expenditure and per capita income.

On the other hand, country-specific studies by: Tsauri and Odhiambo (2013) for Zimbabwe

(1980-2011); Thabane and Lebina (2016) for Lesotho (annual data:1980-2012); Danladi et al. (2015) for Nigeria (annual data:1980-2013); Ogbuagu and Ekpenyong (2015) for Nigeria (annual data:1970-2014) – all reported evidence supporting Wagner's law employing the more superior autoregressive distributed lag (ARDL) bound testing approach developed by Pesaran et al. (2001) and combinations of Granger causality and Toda-Yamamoto non-Granger causality tests to affirmed a unidirectional causal flow from income to government expenditures. On the contrary, Salwindi and Seshamani (2016) used Juselieus and Johansen (1992) cointegration test to confirmed the law for Zambia over the period studied (annual data: 1980-2013), while Babatunde (2011) modelled the commonly cited five functional forms of Wagner's law using annual data over 1970 to 2006 for Nigeria, by employing the novel ARDL and the superior Toda-Yamamoto causality test of (Toda and Yamamoto, 1995). Subsequent results indicates no evidence of cointegration among used variables, while the causality results provides no support for Wagner's law but a weak evidence for Keynesian theory in most of the specified models.

Focusing on studies related to South Africa, Ansari et al. (1997) examined the causal link between income and government expenditure focusing on South Africa, Kenya and Ghana employing the causality tests of Granger (1969), and Holmes and Hutton (1990). Using the traditional Engle and Granger (1987) cointegration test to affirm a long-run relationship between used variables, the causality test results support Wagner's law for Ghana (1963-1988 period) only, while no causal link between real income per capita and per capita expenditure is found for South Africa (1957-1990 period) and Kenya (1964-1989 period) over the studied periods. Recently, Alimi (2014) re-assessed the causal relationship between government spending and national income in panel of three African countries (Nigeria, Ghana and South Africa) over the period 1970 to 2012 in a cross-sectional and time-series analysis using Johansen Fisher panel and Johansen-Juselius cointegration tests. The cointegration test result ascertained a long-run relationship among focal variables for Ghana, while evidence of no cointegration is observed in both Kenyan and South Africa. Also, causality tests indicates a bi-directional causal flow from national income to government expenditure from South Africa and Kenya, but a unidirectional flow consistent with Keynesian theory was reported for Ghana.

On country-specific studies, Seeber and Dockel (1978) assessed the behavior of functional expenditures over the period 1948-1975. Obtained results revealed that past expenditures and income are the main determinants of total government expenditures, and because the estimated income elasticities exceeds unity, they concluded that Wagner's law is partially confirmed for South Africa. Also, Abedian and Standish (1984) examined the sources of growth in national government expenditure taking into account various functional government expenditures over the period 1920 to 1982. They concluded that Wagner's law is applicable to South Africa. Nonetheless, the results of both Seeber et al. (1978) and Abedian et al. (1984) validating Wagner's law is not robust because of their failure to established the causative linkages between variables used (Rao, 1989) resulting in misspecification bias.

Conversely, simply establishing a long-run relationship between used variables is insufficient or income elasticity are insufficient to validates Wagner's law due to possible prima facie dynamic relationship between economic growth and total government expenditures (or other expenditure components) (Holmes et al. 1990). In addition, the employed econometric technique used, that is, ordinary least squares (OLS) is inadequate to aptly unmask the complex relationship between variables studied. In this strand of study, recent empirical study of Ocran (2011) finds that government consumption expenditure has a significant positive effect on real GDP for South Africa.

Since 2000, subsequent studies have employed more sophisticated econometric models to unravel the relationship between government expenditure and economic growth in South Africa, specifically testing the relevance of Wagner's law for the country. For instance, Chang et al. (2004) used annual data spanning 1951 to 1996 for seven developed and three developing countries in conjunction with Johansen cointegration test and Granger casualty test to identify both long-run relationship and temporal causal flow between economic growth and government expenditure, they reported evidence of no causal link between used variables, thus invalidating Wagner's law for South Africa. Indeed, mixed results on Wagner's law remain unsettled in recent studies utilizing more robust econometric techniques.

In view of Gupta (1967) interpretation of Wagner's law, Ziramba (2008) used historical data over 1960 to 2006, as well as, ARDL and Toda-Yamamoto causality to examine long-run relationship and direction of causality between real per capita government expenditure and real per capita income. Obtained results provide evidence of long-run relationship, however, a bi-directional causal flow between used variables was observed, suggestive of a feedback dynamic effect. The tentatively concluded that Wagner's law finds no support in South Africa. Meanwhile, in a times series analysis with data covering 1960-2007 for South Africa, by applying the Johansen (1988) cointegration test, an error correction model (ECM) and Granger causality test to identify both long-run and short-run relationships, including the nature of causal flow in a multivariate specification, Alm and Embaye (2010) found a long-run relationship between per capita income and government expenditure - tax share and wage rate and government expenditure, as well as, a unidirectional causality running from income per capita to per capita expenditure, firmly support Wagner's law, opposing earlier findings reported by Ziramba (2008) that employed a bi-variate model in line with Peacock-Wiseman's (1961) assumption of the law. Alms et al. (2010) also considered the influence of external shocks on government expenditures, results shows that external shocks positively affects per capita government expenditure, implying that external shocks are one of the influential factors responsible for the rapid increase in expenditure growth.

Given the ambiguous conclusions on the validity of Wagner's law, applying ARDL and Engle-Granger causality test to annual data spanning 1950-2007, Menyah and Wolde-Rufael (2012), in simple Peacock-Wiseman ((hereafter, P-W (1960)) functional form of Wagner's law re-assess the relationship between government expenditure and economic growth. At the same time, an alternative P-W models was estimated from Keynesian theory's view point, where national income is treated as exogenous variables. They find evidence of cointegration between real GDP and government expenditure, as well as, the latter Granger cause government expenditure in both the long-run and short-run, without any feedback effect, i.e. a unidirectional causal flow, which strongly support Wagner's law for South Africa. In addition, the long-run income elasticity estimated by Menyah et al.(2012) shows an income elasticity ranging from 1.12 to 1.57, implying that a 1% increase in income leads to a 1.12 to 1.57% increase in government expenditure, in line with Wagner's postulation of rapidly expanding government size resulting associated with income growth.

Recently, Gadinabokao and Daw (2013) applied Juselieus and Johansen cointegration test, ECM and Engle-Granger causality test to annual data over 1980-2011 for South Africa. In a multivariate model, where gross fixed capital is included as a third explanatory variable, subsequent results indicates a positive and significant long-run association between income and government spending, while causality test affirmed that gross capital formation Granger causes economic growth, in contrast, there is a little evidence to conclude that income Granger cause government expenditure.

Meanwhile, Odihambo (2015) applied ARDL to test for cointegration, ECM and Engle-Granger causality test to an annual time-series data over 1970-2013, in a trivariate model using unemployment rate as a third endogenous variable. The obtained results confirm a long-run relationship between per capita income and government expenditure. Nonetheless, the causality test results suggests a unidirectional causality running from income to government expenditure in the long-run, and a bi-directional between income and government expenditure in the short-run. This finding concretely substantiate earlier conclusion of Ziramba (2008).

On the whole, the findings from burgeoning studies testing the validity of Wagner's law can be grouped into four (4) distinct groups, which entails those that provides evidence supporting: (i) a unidirectional causal flow running from income to aggregate expenditure (or its component) in line with Wagner's law; (ii) Keynesian views, where income Granger cause government expenditures (or its components), (iii) both Wagner's and Keynesian hypothesis, suggesting a bi-directional causal flow between income and government expenditures, an indicative of a feedback effect which explains the complex relationship between these variables, and (iv) no inference of causal link between income and government expenditures, pin pointing the existence of a neutral relationship [or effect] in the government expenditures–income nexus. See Tables BII to BIV in the Appendix for a systematic review of studies that found support, no support and mixed results for the Wagner's law.

4. EMPIRICAL FRAMEWORK, DATA AND ESTIMATION TECHNIQUE

4.1. Empirical Frame work

To deduce a robust evidence supporting the two opposing hypothesis discussed earlier, we attempt to capture both the long-run and short-run dynamic relationship between aggregate government expenditure and economic growth or the FS province, five (5) variants of Wagner's functional forms were estimated. We relied on the Peacock Wiseman (1967) view of the law depicted in Eq.1.1, we followed the standard procedure cited in the literature[5] by re-estimating this equation in a multivariate model with the inclusion of population variable as a third endogenous variable to obviate the problem of "omitted" variable and misspecification bias. The multivariate model is estimated as a functional form of Peacock-Wiseman model written in a reduced form as:

$$GE_t = f(Y_t, \mathrm{P}_t) \tag{1.6}$$

In the context of Wagner's view, from, Eq.1.11, aggregate government expenditure for the FS province is assumed to be influenced by economic growth and increase in population. To investigate the simultaneously investigate both Wagner's law and Keynesian theory, we specified two functional forms of the P-W model version, by interchangeably using aggregate expenditure, GE_t as an exogenous (endogenous) variable as postulated by Wagner's law (Keynesian theory), while the former (latter) assumed economic growth, Y_t be exogenous (endogenous) in the estimated trivariate model based on Peacock-Wiseman (1967) interpretation of the law. Using log-linear function form, the computed trivariate model based on the P-W are represented as:

Model 1a: P-W (1961) model in line with Wagner's law:

$$ln(GE_t) = \alpha_0 + \alpha_2 ln(Y)_t + \alpha_3 ln(P_t) + \varepsilon_t \tag{1.7}$$

[5] See Murthy (1994) for detail discussion. In a panel regression, Ashan et al. (1992) includes budget deficit and money stock, while Loizides et al. (2004) add inflation in their estimated multivariate models. In addition, this procedure has become a norm to include more endogenous variables when testing for Wagner's law in country-specific studies, popular variables used are: population (Kalam, 2009 for Bangladesh; Permana et al. 2012 for Indonesia), budget deficit to GDP ratio (Halicioglu, 2003 for Turkey), money supply (Cheng, et al. 1997 for South Korea), as well as, capital stock and labour (Govindaraju, 2011 for Malaysia), to mention a few.

Model 1b: P-W (1961) model consistent with Keynesian theory:

$$ln(Y_t) = \alpha_0 + \alpha_2 ln(GE_t) + \alpha_3 ln(P_t) + \varepsilon_t \quad (1.8)$$

Other alternative functional forms of Wagner's law follows Eq. 1.2 to 1.5, estimated as:

Model 2: Goffman (1968)

$$ln(GE_t) = \alpha_0 + \alpha_2 ln\left(\frac{Y_t}{P_t}\right) + \varepsilon_t \quad (1.9)$$

Model 3: Musgrave (1969)

$$ln\left(\frac{GE_t}{Y_t}\right) = \alpha_0 + \alpha_2 ln\left(\frac{Y_t}{P_t}\right) + \varepsilon_t \quad (1.10)$$

Model 4: Gupta (1967)

$$ln\left(\frac{GE_t}{P_t}\right) = \alpha_0 + \alpha_2 ln\left(\frac{Y_t}{P_t}\right) + \varepsilon_t \quad (1.11)$$

Model 5: Mann (1980) – modified version of Peacock-Wiseman model.

$$ln\left(\frac{GE_t}{Y_t}\right) = \alpha_0 + \alpha_2 ln(Y_t) + \varepsilon_t \quad (1.12)$$

From Eqs. 1.7 to 1.12, ln denotes natural logarithm, and ε_t are serially uncorrelated error terms with $N(0,\sigma)$ properties, and t is the time index. By interpretation, although Wagner's law posits a long-run relations between total government expenditure (government expenditure per capita and share of government expenditure in economic growth) and real GDP (real per capita GDP), Wagner law only holds if the following conditions are satisfied:(i) real income elasticity coefficients is greater than unity (i.e. $\alpha_2 > 1$) for non-ratio versions (Eqs.1.7 and 1.9), greater than zero (i.e. $\alpha_2 > 0$) for ratio versions (Eqs. 1.10 to 1.12); (ii) a causal flow from real economic growth (income) to aggregate government expenditure, (iii) variables should be stationary and (iv) error terms must be uncorrelated and homoscedastic. Herenkson (1993) proposed the last two conditions due to critique of spurious regression (Granger and Newbold, 1974) resulting from the well-known unit-root problem because of their failure to establish the stationarity properties of the data used in earlier studies prior 1990 testing the validity of Wagner's law, (e.g. see, Landau, 1983,1986; Barro, 1986). Arguably, inferences from these earlier studies could be considered erroneous.

Additionally, the negligence of these studies to establish the causative relations (for example, unidirectional, bi-directional or neutral) between national income and aggregate expenditure (or different expenditure components) utilised rendered the inferred conclusions on the competing theories inaccurate purely based on plausible unidentified feedback macro relations between used variables (Rao, 1989; Hutton and Holmes, 1993)[6]. Among the few studies for South Africa investigating Wagner's law have used Gupta Model (see Ziramba, 2008), Peacock-Wiseman model (Menyah and Wolde-Rufael, 2012); Odhiambo (2015) used an augmented version of Goffman (1968) in a trivariate model by including unemployment rate as the third endogenous variable. Other multivariate studies on South Africa have used other variables in the context of Peacock-Wisemnan's functional form, for instance, Gadinabokao and Daw (2013) includes gross capital formation, but Chipaumire (2013) added money stock and real investment.

4.2. Data.

The intergovernmental fiscal framework (IGFR) in South Africa for disbursement of national revenue to other sub-national government spheres (i.e. province and municipalities) was fully established in 2000/2001 financial cycle, thus, the limited historical data on provincial government expenditures is insufficient to achieve our empirical aim. To circumvent the issue of data paucity and spurious regression associated with loss of degrees of freedom, we employed interpolation technique to convert available annual data on: regional GDP (1999–2015), provincial government expenditure (2000 – 2015) and population (2000-2015) into quarterly data spanning the periods of 2001:Q4 to 2014:Q4.

The regional GDP is measured at constant (2010=100) prices. Nominal variables of regional GDP and provincial total government expenditure are deflated by the consumer price index (2012=100) to obtain real variables. The series of real GDP is seasonally adjusted using ARIMA-12 model. The time series data on the regional GDP, consumer price index (CPI) and population were retrieved from Statistics South Africa (Stats SA) at http://www.statssa.gov.za/. Data on the provincial government expenditures is extracted by Budget Management Directorate in the Free State Provincial Treasury (FSPT, available at http://www.dot.fs.gov.za/) from the In-Year-Monitoring (IYM) financial database.

The motivation behind the use of population as the third endogenous variable in our trivariate model are in two folds. First, in addition to minimizing misspecification bias and influence of 'omitted variables', this procedure is suitable to uncover a robust causative process in the aggregate government expenditure-real GDP nexus operating through a third channel. In this way, a bi-directional causality can be considered as a 'strong causal relationship' which confirms the dynamic and complex links in the studied nexus, while a unidirectional causal flow is referred to as 'a causal relationship'. Second, the original view of Wagner's law premised on countries going through industrialization (or economic development phase) consisting of a 'rich progressive society' due to urbanization. Simply put, demographic factors such as population is an influential determinant of government expenditure (Kormedi and Meguire, 1985; Alm and Embaye, 2011), but yet to receive adequate empirical attention (Durevall and Henrekson 2010). Intuitively, as the economy grows, an increase in per capita income usually leads to a population shift from the province towards urban areas, which in turn, increase aggregate demand for infrastructure related public goods (e.g. water supply, sewerage, electricity, road network, hospitals, schools, and so on). Lastly, a large proportion of working age population generally accelerate economic growth, while a population with significant proportion of young and elderly dependents not only influence growth negatively but increases social

[6] Rao (1989) made the earliest attempt to empirically investigate the influential findings of Landau (1986) and Barro (1986); he concludes that the evidence from these studies are imprecise since the direction and the nature of causal flow between used variables are not determined.

spending (Garba et al. 2013). Likewise, the combine effect of a rapid population growth and urbanisation can result a permanent and significant increase government expenditure on health and education (David and Velenchik, 1992).

4.3. Application of Econometric Techniques.

To empirically investigative the long-run relationship and temporal links among the variable of interest, we specified all five Wagner's functional forms using the novel econometric technique of new autoregressive distributed lag (ARDL or bound test) model developed by Pesaran et al. (2001).

The rationale for employing the ARDL model to establish the long-run relationship among variables compared to other co-integration tests are as follows. First, compared to other conventional multivariate co-integration tests, the ARDL procedure yields a far more superior inference when using a finite sample or small sample data sizes (Narayan, 2005) as is the case in this study unlike the Engle-Granger (1987) approach, which suffers from considerable small sample bias (Mah, 2000). Second, the ARDL avoids the econometric burden of pre-testing for unit-roots and establishing order of integration of variables as $I(0)$ and $I(1)$ associated with standard co-integration analysis. ARDL is applicable irrespective of whether the underlying explanatory variables are integrated of order zero ($I(0)$) or one ($I(1)$) (Pesaran et al., 2001). Second, endogeneity problems and inability to test hypotheses on the estimated coefficients in the long run associated with the Engle–Granger (1987) method are avoided. With the bound testing procedure is possible when the explanatory variables are endogenous and sufficiently to simultaneously correct for residual serial correlation. Third, ARDL have better statistical properties because it does not push the short-run dynamics into the residual term as in the Engle-Granger (1987) technique (Pattichis, 1999). Fourth, both the long-run and short-run parameters can be simultaneously estimated by the model. Nonetheless, it has been pointed out that this procedure is inappropriate when endogenous variable are $I(2)$ series. In this case, the model will fail. Finally, our predilection to use the ARDL is further motivated by the argument of Rao (1986:276) asserting that, in the presence of contemporaneous variables, the inclusion of more lagged variables in a system, can cause the number of bi-directional relationships to drop quickly, in effect, reduce the ambiguous results supporting bi-directional causality.

For this study, the ARDL model estimated for the five Wagner's function forms in Eqs 1.7 to 1.12 are as follows:

Model 1a: $$\Delta GE_t = \alpha_0 + \sum_{i=1}^{l} \alpha_1 \Delta G_{t-1} + \sum_{i=0}^{l} \alpha_{2i} \Delta Y_{t-i} + \sum_{i=0}^{l} \alpha_{3i} \Delta P_{t-i} + \delta_1 ECT_{t-1} + \varepsilon_{1t} \tag{1.13}$$

Model 1b: $$\Delta Y_t = \alpha_0 + \sum_{i=1}^{l} \alpha_1 \Delta Y_{t-1} + \sum_{i=0}^{l} \alpha_{2i} \Delta GE_{t-i} + \sum_{i=0}^{l} \alpha_{3i} \Delta P_{t-i} + \delta_2 ECT_{t-1} + \varepsilon_{2t} \tag{1.14}$$

Model 2: $$\Delta GE_t = \alpha_0 + \sum_{i=1}^{l} \alpha_1 \Delta GE_{t-1} + \sum_{i=0}^{l} \alpha_{2i} \Delta \left(\frac{Y}{P}\right)_{t-i} + \delta_3 ECT_{t-1} + \varepsilon_{3t} \tag{1.15}$$

Model 3: $$\Delta \left(\frac{GE}{Y}\right)_t = \alpha_0 + \sum_{i=1}^{l} \alpha_1 \Delta \left(\frac{GE}{Y}\right)_{t-1} + \sum_{i=0}^{l} \alpha_{2i} \Delta \left(\frac{Y}{P}\right)_{t-i} + \delta_4 ECT_{t-1} + \varepsilon_{4t} \tag{1.16}$$

Model 4: $$\Delta \left(\frac{GE}{P}\right)_t = \alpha_0 + \sum_{i=1}^{l} \alpha_1 \Delta \left(\frac{GE}{P}\right)_{t-1} + \sum_{i=0}^{l} \alpha_{2i} \Delta \left(\frac{Y}{P}\right)_{t-i} + \delta_5 ECT_{t-1} + \varepsilon_{5t} \tag{1.17}$$

Model 5: $$\Delta\left(\frac{GE}{Y}\right)_t = \alpha_0 + \sum_{i=1}^{l}\alpha_1\Delta\left(\frac{GE}{Y}\right)_{t-1} + \sum_{i=0}^{l}\alpha_{2i}\Delta Y_{t-i} + \delta_6 ECT_{t-1} + \varepsilon_{6t} \quad (1.18)$$

From Eqs. 1.13 to 1.18, the subscript, l is the lag length, ΔGE_t and ΔY_t, ΔP_t are the first differences of logarithms of G_t, Y_t and P_t respectively. ECT_{t-1} is the lagged error-correction term obtained from the long-run equations 1.7 to 1.12, and the $\delta_1, \delta_2 \ldots \delta_6$ are corresponding adjustment coefficients in the short-run. The significance of the *F*-statistic on explanatory variables will determine the direction of short-run causality, while the long-run causal effect will be shown by the *t*-statistic on the coefficient of ECT_{t-1}, if only there is co-integration between government expenditure and real GDP. In the case of no long-run cointegrating relationship between these variables, equations (1.13 to 1.18) will be estimated without the error-correction term and only the direction of the short-run causality will be determined.

Note that, in contrast to the traditional Granger causality method, the ARDL as an unrestricted error correction based causality test allows for the inclusion of the lagged error-correction term (ECT) mainly to reintroduce any long-run information lost through differencing into the system in a statistically acceptable procedure (Menyah et al., 2012:203). In the spirit of Granger and Newbold, (1974) long-run equilibrium can be established in Eqs. 1.13 to 1.18, only if a cointegration system exists, while the short-run behaviour of the variables can then be modelled using an error-correction procedure, which allows for both short-run dynamic behaviour and an error correction term to maintain the long-run equilibrium (Hendry, 1986).

Therefore, to determine the existence of co-integration in the system, Pesaran et al. (2001) compute two sets of critical values are provided given significance level: one which is appropriate when all variables are $I(0)$ and the other is for all variables that are $I(1)$, thus covering all the possible classifications of the series into $I(0)$, $I(1)$ or mutually cointegrated. Notably, the asymptotic distribution of the *F*-statistic is nonstandard under the null hypothesis of no cointegration relationship between the examined variables, without recourse to whether the underlying explanatory variables are purely $I(0)$ or $I(1)$. The null hypothesis of the cointegration $\left[H_0 : \theta_1 = \theta_2 = \theta_3 = 0\right]$ is tested against the alternativehypothesis of $\left[H_0 : \theta_1 \neq \theta_2 \neq \theta_3 \neq 0\right]$. In this case, if the computed *F*-statistic exceeds the upper critical bounds value, a conclusive inference of cointegration can be made without the knowing the order of integration of the variables, in this case, the null hypothesis is rejected. If the *F*-statistic is below the lower critical bounds value, it implies no cointegration. Lastly, if the *F*-statistic falls into the bounds, then the test becomes inconclusive, in this case, the order of integration for the underlying explanatory variables must be known before any conclusion can be drawn.

From Eqs. 1.13 to 1.18 testing Wagner's law, the significance of the first differenced variables provides evidence on the direction of the short-run causation while the *t-statistics* on the one period lagged ECT term denotes long-run causation. In addition, a negative and statistically significant ECT term is an indicative of causal flow from all right hand variables to the corresponding left-hand side variables (Tasserven, 2011:313). Inference satisfying these provide further evidence and confirmation of the long-run and dynamic short-run relationships between the variables. In all other cases, where evidence of no cointegrated prevails, the inter-temporal causality will be examined by estimating Equations Eqs. 1.13 to 1.18 without the ECT term. Noticeably, for our application, the asymptotic non-standard *F-statistic* under the null hypothesis is derived from bootstrapped critical values computed for small samples by Narayan et al (2005) based on the critical values for large samples provided by Pesaran et al. (2001). See Narayan (2005) for more details.

In what follows, we proceed to test the direction of causality between selected variables using a more robust causality test developed by Toda and Yamamoto (1995). The Toda-Yamamoto non-Granger causality test utilise a modified Wald statistic (MWALD) for the restrictions on the parameters of an 'augmented' vector autoregressive, VAR (k) model, where k is the lag length in the system. The MWALD statistic has an asymptotic chi-square distribution when a VAR $(k+d_{\max})$ is estimated. This procedure have been found to be superior to ordinary Granger causality tests because it ignores any possible non-stationarity or cointegration between the series outlined in Section 3, when testing for causality (Wolde-Rufael, 2005:896). Causality inference from Toda-Yamamoto non-Granger causality test is valid regardless of whether a series is $I(0)$, $I(1)$ or $I(2)$, non-cointegrated or cointegrated of any arbitrary order. Typically, Granger causality test is susceptible to erroneous inference as noted by Ansari et al. (1997), and suffers from nuisance parameter dependency asymptotically in some cases producing unreliable results (Babatunde, 2011).

In this approach Toda and Yamamoto (1995) proposed an 'augmented' vector autoregressive (VAR) model in the levels of the variables (rather than the first differences, as the case with Granger causality tests) thereby minimising the risks associated with the possibility of wrongly identifying the order of integration of the series. In this approach, a standard VAR is artificially augment to determine the maximal order of integration $d_{\max}$ (where, $d_{\max}$ is the maximal order of integration suspected to exist in the system), which is expected to be present in the model. Thereafter, VAR (k) is estimated in levels with a total of $(k+d_{\max})$ lags. Once this is done, the coefficients of the last lagged $d_{\max}$ vector are ignored (e.g., see Zapata and Rambaldi, 1997). According to Toda and Yamamoto (1995), for $d=1$, the lag selection procedure is always valid, at least asymptotically, $k \geq 1 = d$ If d = 2, then the procedure is valid unless k = 1. Toda and Yamamoto have proven that the modified Wald-statistic is valid regardless whether a series is $I(0)$, $I(1)$ or $I(2)$ non-cointegrated or cointegrated of an arbitrary order. The Wald-statistic is asymptotically distributed as a chi-square (χ^2), with degrees of freedom equal to the number of 'zero restrictions', irrespective of the integrated order $\{I(0) \text{ or } I(1)\}$, noncointegrated or cointegrated of an arbitrary order. All in all, the use of the Toda and Yamamoto (1995) approach allows the usual test statistic for Granger causality retains the standard asymptotic distribution to obtain a robust inference. To undertake Toda and Yamamoto (1995) version of the Granger non-causality test, we represent the government expenditure-real GDP models in the following VAR system:

Model 1a:

$$\ln GE_t = \alpha_0 + \sum_{i=1}^{k+d_{\max}} \alpha_{1i} \ln GE_{t-i} + \sum_{i=1}^{k+d_{\max}} \alpha_2 lnY_{t-1} + \sum_{i=1}^{k+d_{\max}} \alpha_3 lnP + \sum_{i=1}^{k+d_{\max}} \lambda_{1i} \ln GE_{t-i} + \sum_{j=1}^{k+d_{\max}} \lambda_{2j} lnY_{t-j} + \sum_{m=1}^{k+d_{\max}} \lambda_{3m} lnP_{t-m} + \varepsilon_{1t} \tag{1.19}$$

Model 1b:

$$\ln GE_t = \alpha_0 + \sum_{i=1}^{k+d_{\max}} \alpha_{1i} \ln GE_{t-i} + \sum_{i=1}^{k+d_{\max}} \alpha_2 lnY_{t-1} + \sum_{i=1}^{k+d_{\max}} \alpha_3 lnP + \sum_{i=1}^{k+d_{\max}} \lambda_{1i} \ln GE_{t-i} + \sum_{j=1}^{k+d_{\max}} \lambda_{2j} lnY_{t-j} + \sum_{m=1}^{k+d_{\max}} \lambda_{3m} lnP_{t-m} + \varepsilon_{1t} \tag{1.20}$$

Model 2:

$$lnY_t = \beta_0 + \sum_{i=1}^{k+d_{\max}} \beta_{1i} lnY_{t-i} + \sum_{i=1}^{k+d_{\max}} \beta_2 \ln GE_{t-1} + \sum_{i=1}^{k+d_{\max}} \alpha_3 lnP + \sum_{i=1}^{k+d_{\max}} \varphi_{1i} lnY_{t-i} + \sum_{j=1}^{k+d_{\max}} \varphi_{2j} \ln GE_{t-j} + \sum_{m=1}^{k+d_{\max}} \varphi_{3m} lnP_{t-m} + \varepsilon_{2t} \tag{1.21}$$

Model 3:

$$ln\left(\frac{GE}{Y}\right)_t = \alpha_0 + \sum_{i=1}^{k+d_{\max}} \alpha_{1i} ln\left(\frac{GE}{Y}\right)_{t-i} + \sum_{i=1}^{k+d_{\max}} \alpha_2 ln\left(\frac{Y}{P}\right)_{t-1} + \sum_{i=1}^{k+d_{\max}} \lambda_{1i} ln\left(\frac{GE}{Y}\right)_{t-i} + \sum_{j=1}^{k+d_{\max}} \lambda_{2j} ln\left(\frac{Y}{P}\right)_{t-j} + \varepsilon_{4t} \tag{1.22}$$

Model 4:

$$ln\left(\frac{G}{P}\right)_t = \alpha_0 + \sum_{i=1}^{k+d_{\max}} \alpha_{1i} ln\left(\frac{G}{P}\right)_{t-i} + \sum_{i=1}^{k+d_{\max}} \alpha_2 ln\left(\frac{Y}{P}\right)_{t-1} + \sum_{i=1}^{k+d_{\max}} \lambda_{1i} ln\left(\frac{G}{P}\right)_{t-i} + \sum_{j=1}^{k+d_{\max}} \lambda_{2j} ln\left(\frac{Y}{P}\right)_{t-j} + \varepsilon_{5t} \tag{1.23}$$

Model 5:

$$ln\left(\frac{G}{Y}\right)_t = \alpha_0 + \sum_{i=1}^{k+d_{\max}} \alpha_{1i} ln\left(\frac{G}{Y}\right)_{t-i} + \sum_{i=1}^{k+d_{\max}} \alpha_2 lnY_{t-1} + \sum_{i=1}^{k+d_{\max}} \lambda_{1i} ln\left(\frac{G}{Y}\right)_{t-i} + \sum_{j=1}^{k+d_{\max}} \lambda_{2j} lnY_{t-j} + \varepsilon_{6t} \tag{1.24}$$

From Eqs. 1.19 to 1.24, k is the optimal lag length, and $d_{\max}$ is the maximum order of integration in the system. While $\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}, \varepsilon_{5t}$, and ε_{6t} are error terms that are assumed to be white noise. In our application, the optimal lag length (l) is determined using Akaike Information Criterion (AIC), Schwarz Criteria (SC), the modified LR test (LR), the Final prediction error (FPE) and the Hannan-Quin information criterion (HQ). In all cases, optimal lag length of two $[l = 2]$ is selected. With optimal lag lengths determined, the existing causative process can be easily identified, for example, in Eq. 1.19, Granger causality from: (i) Y_t to GE_t implies that: $\lambda_2 \neq 0 \forall i$, (ii) P_t to GE_t indicating that: $\lambda_3 \neq 0 \forall i$; and (iii) both Y_t and P_t to GE_t (joint effect) implies that: $\lambda_2 = \lambda_3 \neq 0 \forall i$, and considering Eq. 1.20, GE_t Granger cause Y_t only if $\varphi_2 \neq 0 \forall i$, while causality runs from P_t to Y_t only if $\varphi_3 \neq 0 \forall i$, meanwhile both GE_t and P_t will jointly influence Y_t only if $\varphi_2 = \varphi_3 \neq 0 \forall i$.It is worth noting that, following Toda-Yamamoto procedure, the 'augmented' VAR(k) models are computed using seemingly unrelated regression SUR (see Rambaldi and Doran 1996; Wold-Rufael 2008:276) even if there is no cointegration, as long as the order of integration of the process does not exceed the true lag length of the model (Toda and Yamamoto, 1995:225). Notably, an irrefutable support for Wagner's law requires unidirectional causality from real GDP to government expenditure, which implies the rejection of null hypothesis, H_1 of Granger causality running from exogenous variables (on the left hand side) to explanatory variables on the right hand side) of Eqs. 1.19 to 1.24, but accept the alternative hypothesis, H_o suggest causal flow in the opposite direction (from endogenous variables to the exogenous variable).

5. EMPIRICAL RESULTS AND DISCUSSION

5.1. Stationarity Test Results

Although our preferred ARDL chosen to validate co-integration between the selected variables provides reliable inference on long-run equilibrium and precludes pre-testing stationarity properties of time series, yet it is standard in the literature for recent studies on Wagner's law to identify the integration order of variables and test for unit roots (e.g. see, Herenkson, 1993; Oxley, 1994). To obviate spurious regression associated with non-stationary series, we use the more efficient univariate DF-GLS test for autoregressive unit root proposed by Elliot et al. (1996) and Phillip-Perron (1988) to test the stationarity properties of the interested variables.

The preferred unit root tests are superior to the traditional ADF test. The DF-GLS is an augmented version of traditional Dickey-Fuller (1979) t-test since it applies generalized least squares (GLS) to detrend time series before running the ADF test regression. Compared to ADF tests, the DF-GLS test has the best overall performance in terms of sample size and power. It has substantially improved power when an unknown mean or trend is present (Elliot et al. 1996), while ADF test suffers from low power. Whereas, the PP test is an extension of the Dickey–Fuller test, which corrects for autocorrelation and is more robust in the case of weakly autocorrelated and heteroscedastic regression residuals. Also, it is more powerful than the ADF test for aggregate data. The stationarity test results for all the selected variables are reported in Table 1 in the Appendix. All variables are stationary in $I(1)$, i.e. integrated order of one at 5% significance level.

We also applied the Breusch-Godfrey LM test and ARCH LM tests to assess the homoscedastic and uncorrelated properties of the residuals, while the Jacque-Bera (JB) test is used to test the normality of the residuals. Our results shows that the residuals are uncorrelated, homoscedastic and normally distributed at 5% significance level, reported in Tables 2 and 3 in the Appendix. Next, the parameter constancy (i.e. stability) of the estimated parsimonious models is investigated employing the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) of recursive residuals prescribed by Brown et al. (1975). The CUSUM plots are illustrated in Figure 3 in the Appendix, indicating that the test statistic was within the 5% significant level suggesting the absence of any significant structural instability.

5.2. Co-integration Test Results

Having establish the stationarity properties of the time series, the next question is ask whether there is some possible long-run and short-run relationship between real government expenditure, real GDP and population for the FS province from the estimated models. To specify a parsimonious ARDL models, we employ Hendry (1986) general-to-specific procedure. All estimated ARDL models in this fashion are subjected to diagnostic tests to assess the uni-variate properties of the residuals of the models to ensure that these error terms are homoscedastic and uncorrelated prior testing for cointegration as pre-requisite conditions to be satisfied discussed in Section 4.

In what follows, we proceed to identify the long-run relationship and inter-temporal causal links between the aggregate government expenditures (including other measuring units such as, per capita expenditures and share of government expenditure in income), real GDP (including other measures such as, per capita income) and population in the trivariate models 1a and 1b, presented in Eqs1.13 to 1.18. The results are presented in Table 2. In all cases, the F-statistics on the joint significance of the lagged levels of variables exceeds the 5% upper bound critical value, except in model 1b where F-statistics exceeds 1%, but, the result is inconclusive in model 5. Generally speaking, the results of the ARDL suggests the existence of a long-run relationship in the estimated models.

Since the results in Table 2 supports the existence of cointegration, the evidence of a long-run equilibrium is inferred by the inclusion of the ECT term in parsimonious ARDL models as estimated in Eqs. 1.13 to 1.18. Results presented in Table 3 shows the expected statistically significant negative ECT only in the constructed trivariate P-W model. This result is consistent with Wagner's law, which is strongly confirmed the significant t- statistics test developed by Pesaran et al. (2001). By implication of this finding are two folds. First, in response to any external shock(s) introduced into the system or the provincial economy, there is slow revision to long-run equilibrium (steady state) of about 43%. Second, the long-run causality flows from both real GDP (and population) to aggregate government expenditures.

Likewise, note that even though a long-run relationship is observed in the bi-variate model 2 compared to the evidence of no cointegration in models 3, 4 and 5. The long-run causal flow from aggregate government expenditure to real GDP per capita is rejected based on the coefficient of the ECT term, which is positive and statistically significant. Similar finding is reported by Gadinabokao et al. (2013) for South Africa. On technicality, this inference implies that, in the presence of external shocks, the divergence between aggregate government expenditure and per capita income growth will persists, but subsequent increase in aggregate expenditure will induce a positive influence on real GDP per capita growth. Also, evidence of no long-run causality is inferred in model 2.

5.3. Causality Test Results

To use the Toda-Yamamoto non-Granger Causality (Wald) test to identify the underlying causative flow in the short-run in our parsimonious ARDL model. Being cautious not to over fit the 'augmented' VAR (k) models in Eqs. 1.19 to 1.24, the optimal lag length (l) was determined using Akaike Information Criterion (AIC), Schwarz Criteria (SC), the modified LR test (LR), the Final prediction error (FPE) and the Hannan-Quin information criterion (HQ). Subsequent results suggest optimal lag length is two $[l = 2]$.

The results of the Toda-Yamamoto non-Granger Causality Wald test are reported in Table 4. The causality results reported in Table 4 suggests that the null hypothesis of no Granger causality can be in rejected in both directions in model 1a, implying a bi-directional causality running between real government expenditure and real GDP in the short-run. In addition, an inference of uni-directionality running from population to both real government expenditure and real GDP in the short-run is evident in model 1a. In other models 2 to 5, we find no evidence of supporting short-run causal flow in other models.

To this end, our empirical findings on long-run and short-run relationships between the government expenditure and real GDP for the Free State province is consistent with those reported in the studies of: Ziramba (2008), Alimi (2014) and Odhiambo (2015) for South Africa, but at odds with the findings of Menyah et al. (2012) for South Africa. In part, the evidence of no causality found in models 2 to 5 aligns with the findings of Ansari et al. (1997) for South Africa.

5.4. Long-run Income elasticities and Voracity effect results.

To augment our empirical analysis, we estimated both short and long-run elasticities of real government expenditure to real GDP for the FS province. This practical exercise is congruent with central idea of Wagner's law that income selasticity relative to government expenditures should be greater than unity since the latter rises faster than income growth. Using the specified parsimonious ARDL models, to obtain both long-run and short-run income elasticity estimates, we normalised the coefficients aggregate government expenditure relative to all lagged endogenous variables. Obtained results reveals that a real GDP elasticity ranging from 0.99 to 1.2, implying that a 1% increase in real GDP leads to a 0.99 to 1.2% increase in real government expenditure. This empirical evidence therefore shows that provincial government expenditure rises faster than the increase in (regional) income, which is consistent of Wagner's law in the case of South Africa province.

In the extant Africa literature, our results are consistent with Menyah et al. (2012) reported a long-run income elasticity ranging from 1.12 to 1.57 for South Africa in the Peacock-Wiseman (1961) model, as well as, Menyah et al. (2013) based on the obtained income elasticity ranging from 1.73 to 1.79 for Ethiopia in the long-run using annual data spanning 1950 -2007. Our findings align with those reported in international literature. For example, Akitoby et al. (2006) found a long-run income elasticity ranging from 1.28 to 2.7 in a panel dataset for 51 developing countries, while Kumar (2009) used five functional forms of Wagner's law same as this study, and found a long-run income elasticity between 0.75 and 1.16 in a panel of five Asian countries.

While, Lamartina et al. (2010) observed a long-run income elasticity exceeding unity for 23 OECD countries in a panel dataset covering 1970 to 2006, Tasseven (2011) reported an income elasticity of 0.54 for Turkey from non-ratio versions of Wagner's functional form.For New Zealand, Kumar (2012) found income elasticity ranging from 0.56 to 0.84 in per capita income relative to the share of government expenditure in income over the period studied (1960-2007), whereas, a recent study by Atasoy (2016) for China over the period 1982 to 2011, reveals a long-run income elasticity between 1.32 to 1.38 for China. For similar findings on income elasticity, see, for example, Ashan et al. (1996) for Canada, Islam (2001) for United States, Kolluri et al. (2000) for G7 countries and Arpaia et al. (2008) for OECD countries.

To conclude, we considered the widely accepted notion of voracity effect and cyclical ratcheting in studies focusing on the influence of external shocks on government expenditure in public finance. Voracity effect is refers to the impact of an (external) positive shock to income generating a more than proportional increase in public spending, even when this shock is transitory, whereas, cyclical ratcheting refers to the tendency for the government spending-to-GDP ratio to rise during recessions and to be only partially reduced during expansions (Akitoby, 2006:990).

Finally, following Akitoby (2006), we attempt to find out whether 'voracity effect' is relevant to aggregate expenditure growth at provincial level. Specifically, obtained results suggests a short run elasticity of total government expenditure ranging between 0.49 to 2.12% in response to a given shock to real GDP in FS province. This positive and statistically significant elasticity coefficient, which is greater than unity implying that, in response to a given shock to real GDP, aggregate government expenditure will increase more in percentage terms. This inference is consistent with Akitoby (2006), and, corroborate the reported findings by Alm et al. (2010) for South Africa, where empirical results asserts that external shocks has a significantly positive effect on per capita government expenditure, therefore, external shocks play an important role in explaining the dynamic of growth in government expenditure at the national level.

6. POLICY IMPLICATION OF EMPIRICAL FINDINGS AND RECOMMENDATION

All the empirical evidence in this study substantiate the preliminary analysis on the trend of growth in government expenditure, economic growth and government revenue of the Free State province, which reveals a rapidly growing expenditure relative to government revenue and economic activity level. Our empirical results has important policy implication for the provincial government as follows. First, given the shrinking fiscal space, gradual reduction of the PES, severely low aggregate revenue compared to the increasing expenditure on education, health and social welfare etc., the provincial government should be cautious about its present and future spending as extra public spending is unlikely to cause higher income in the long run in the current tight financial condition.

Second, it is important for the provincial government to understand the complexity of utilising its expenditure to stimulate growth since there an evidence of a dynamic feedback between government expenditure and real GDP is established favouring both Wagner's law and Keynesian theory. As a result, on one hand, the provincial government need to balance its aggregate expenditure on public goods, services and political mandates to avoid crowding out economic and labour productivity growth through high public spending in spite of the prevailing socioeconomic conditions, such as high unemployment rate (about 31% on strict definition) and acute poverty. On the other hand, in view of the concrete evidence supporting Wagner's law, growth in per capita income (economic growth) has become determinant of aggregate government expenditure, even so, the provincial government has to achieve higher growth to cope with the growing demand for social and infrastructure expenditure

Third, the evidence of long-run and short-run flow from real income to aggregate government expenditure, which is consistent with Wagner's law shed light on the irrefutable argument opposing the prevalent priori decision in the policy circle to boost economic growth by increasing aggregate government expenditure. This policy stance is very precarious for the provincial government, thus, it is imperative for the provincial government to reduce its role in creating employment opportunities, instead the government should provide a conducive economic-, social- and political - environment for vibrant private sector participation in the local economy, which in turn, facilitate entrepreneurial and private job opportunities. Along this line, having being the largest employer in the province (StatsSA, Quarterly Labour Market Review, 2016:Q1-Q4) in the past, it is important for the provincial government to continue its proactive efforts, through strict fiscal consolidation stance, to reduce its public size by minimizing public sector employment which have resulted into a considerable large wage bill, which is presently unsustainable.

Fourth, the provincial government can spur the prevalent weak economic growth directly by harmonising its efforts to intensify infrastructure investment, and indirectly via a well-structured accumulation of human capital targeting the youths. This strategy would improve the labour absorption rate, raise aggregate productivity, reduce unemployment and poverty rate. Nevertheless, since Devarajan et al. (1996:338) argued that an excessive use of productive public expenditure can become unproductive, hence, high public expenditure on non-productive public goods and services will have no effect on economic growth. For instance, it would be beneficial for the provincial government to carefully evaluate its expenditure on the state-sponsored education bursary aimed at building a knowledge endowed state and human capital necessary to sustain economic growth. As such, the provincial government to determine the sizeable educational spending on bursary is productive, and also be able to track its return on investment (ROI) by taking into account the number of state-sponsored graduates that re-invest their accrued human capital gains into the domestic economy, to improve growth, as well as, enhance total labour productivity.

7. CONCLUDING REMARKS

In this study, we contribute to the scarce literature on Wagner's law on South Africa using novel econometric techniques. Most importantly, we dealt with the weaknesses of earlier studies, as well as, close the current research gap by using provincial data to empirically test the applicability of Wagner's Law at a sub-national government level, in this case the Free State province using a quarterly data for period 2001:Q1 to 2014:Q4. The long-run relationship and direction of causality in the short-run among variables is confirmed employing advanced econometric models, namely the ARDL– bound test model proposed by Pesaran et al. (2001) and Toda-Yamamoto causality test by Toda and Yamamoto (1995). The general-to-specific procedure to estimate parsimonious ARDL models in order to obtain robust empirical results that is consistent with postulated theories.

Our empirical results are summarized as follows. First, we find evidence for a bi-directional causal link between total provincial government expenditure and economic growth in the short run, while economic growth Granger-causes government expenditure in the long-run. This result is consistent with the findings of Ziramba (2012), Odhiambo (2016) and Alimi (2013) for South Africa, but at odds with the findings of Menyah et al. (2012), where Wagner's law is confirmed for South Africa. Surprisingly, we find evidence of no causal relations in the estimated models 2, 3, 4 and 5 testing Wagner's Law which also aligns with the findings of Ansari et al. (1996) for South Africa. Second, as predicted by Wagner's Law, income elasticity estimate results shows a long-run income elasticity ranging from 0.99 to 1.2%, which implies that in the Free State province, a 1% increase in real economic growth will cause total government expenditure to rise by 0.99 – 1.2%. This finding is aligns with the reported income elasticity of 1.12 to 1.57 by Menyah et al. (2012) for South Africa. Third, we infer a unidirectional causal flow (long-run forcing) from population growth to both economic growth and total provincial government expenditure in the short-run, an indicative of the influence of demographic factor on the provincial fiscus and development. Fourth, in view of the stylized conjecture of 'voracity effect' in public finance, result shows that total government expenditure can rise by 0.49 – 2.12% in the short-run, in response to a positive shock, indicative of idiosyncratic shocks playing a key role in explaining the evolving pattern in government expenditure. This is in line with the findings of Akitoby (2006), and Alm et al. (2010) for South Africa.

Based on our empirical findings, on policy front; it is expedient the provincial government to: continue with the adopted fiscal consolidation strategies in the province to enhance effective allocation of limited fiscal resources, curb wasteful public spending and reduce government size, which in turn, would effectively curtail the bulging wage bill by restricting public sector employment and streamlining duplicative functions across provincial departments. Additionally, the provincial government need to continue reducing its public size (i.e. role play) in the economic structure to allow private sector productivity needed to sustain economic growth. Furthermore, the evidence of a bi-directional causal link between economic growth and government expenditure necessitate the need for policy makers to cautiously balance both current and future public expenditures not to crowd-out output and labour productivity. Finally, the provincial government need to shift its focus on identifying productive expenditure across provincial departments, and adopt a policy shift towards capital infrastructure to ease the prevailing structural bottlenecks, thereby inducing an indirect positive influence on economic activities level in the province.

APPENDIX: LIST OF FIGURES & TABLES

Figure 1. Real gross domestic product (GDP) and total provincial expenditure (real) for FS, 2000-2014

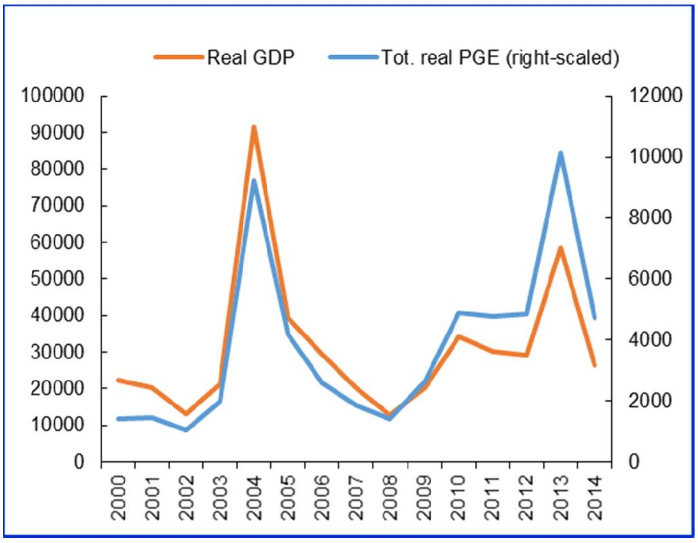
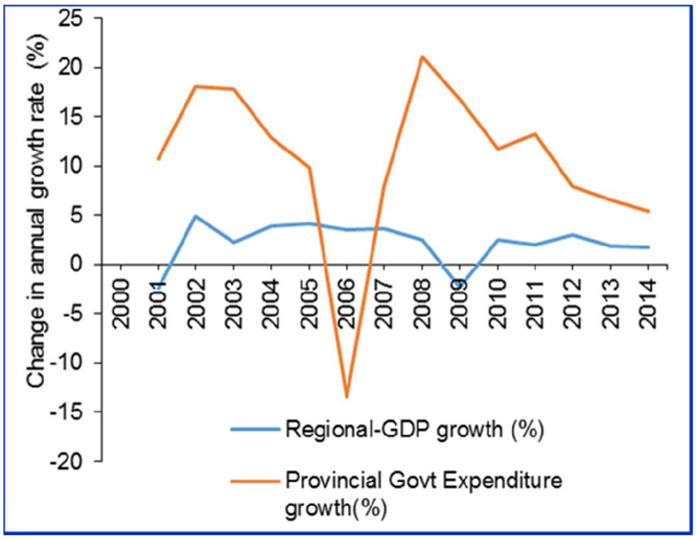
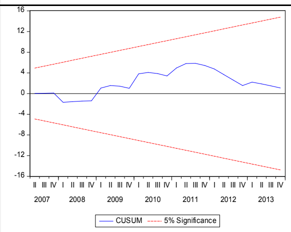
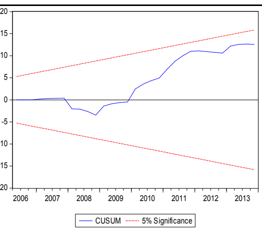
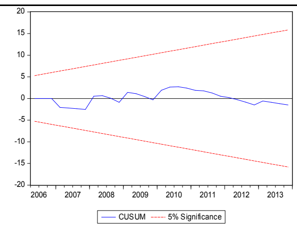
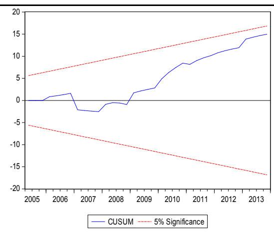
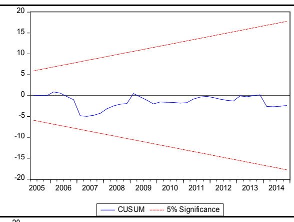
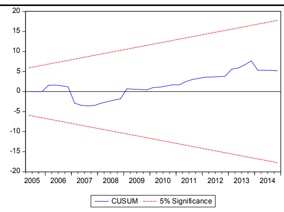
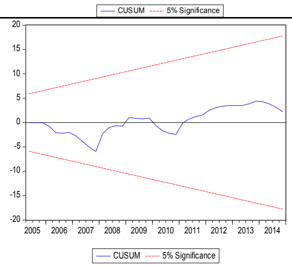
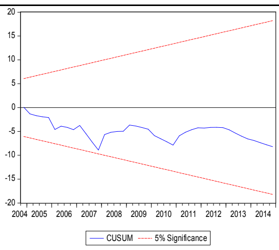
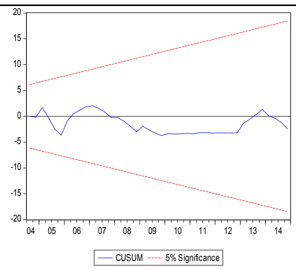
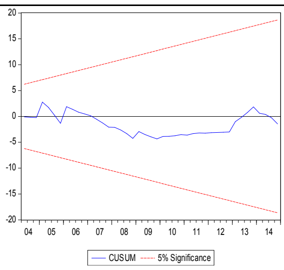
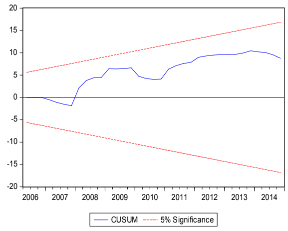
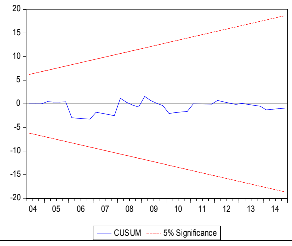


Figure 1: Growth in total real PGE and real GDP for FS, 2000-2014



Data source: FSPT IYM database; StatsSA; Author's own illustration

Figures 2: CUSUM Parameter Constancy (Stability) Test for Parsimonious ARDL models

ESTIMATED MODELS	LONG-RUN MODELS	SHORT RUN MODELS
1a. Peacock-Wiseman (1961) (Wagner's Law)		
1b.Peacock-Wiseman (1961) (Keynesian theory)		
2. Goffman (1968) – WL		
3. Musgrave (1969) - WL		
4. Gupta (1967) – WL		
5. Mann (1980) - WL		

Source: Author's illustration.

Table 1: Stationarity (unit-root) Test results

	DF-GLS		PP	
Variables	Levels	First Difference	Levels	First Difference
$\ln Y$	-3.456	-2.763***	-2.104	-2.987*
$\ln GE$	-2.438	-2.635***	-1.738	-2.829*
lnP	0.636	-3.473***	4.171	-3.241**
$\ln(Y/P)$	-3.603	-2.608**	-2.279	-3.354**
$\ln(GE/P)$	-3.032	-2.521**	-2.044	-3.164**
$\ln(GE/Y)$	0.089	-2072**	-0.083	-8.536***

Note: Test Critical Values for DF-GLS at 1% level =-2.607, 5% level =-1.946 and 10% =-1.612, while the Adj.t-Stats for PP test at 1% level =-3.552, 5% =-2.914 and 10% = -2.595.

****,** &* denote p-value at 1%, 5% and 10% in parenthesis.*

Table 2: Parsimonious ARDL –Bound Test results for Cointegration.

Estimated Models	Dependent Variable	Function	F-Test Statistics	*p-value*
1a	$\ln(GE_t)$	$F_{GE}\left(GE\middle|Y,P\right)$	6.5805**	0.001
1b	$\ln(Y_t)$	$F_Y\left(Y\middle|GE,P\right)$	5.0107*	0.005
2	$\ln(GE_t)$	$F_{GE}\left(Y/P\right)$	10.391**	0.000
3	$\ln\left(GE/Y\right)$	$F_{GE/Y}\left(Y/P\right)$	5.326**	0.009
4	$\ln\left(GE/P\right)$	$F_{GE/P}\left(Y/P\right)$	13.596**	0.000
5	$\ln\left(G/Y\right)$	$F_{GE/Y}(Y)$	3.4185	0.043

Asymptotic critical values – Case III (Models 1, 3 and 5)	1%		5%		10%	
	I(0)	1(1)	I(0)	1(1)	I(0)	1(1)
	5.920	7.179	4.083	5.207	3.330	4.347
Asymptotic Critical Values – Case V (Models 2 and 4)	**1%**		**5%**		**10%**	
	I(0)	1(1)	I(0)	1(1)	I(0)	1(1)
	9.895	10.965	6.8985	7.860	5.780	6.540

****,** &* denote p-value at 1%, 5% and 10% .*

Note: Narayan (2005), p.1988, Case III (unrestricted intercept, no trend) and Case V: Unrestricted Intercept and unrestricted Trend). Models 1, 3 and 5 modelled without trend, while models 2, and 4 are estimated with trend components. Cointegration relationship is inconclusive. For models 1a &1b, N=43 and $k=2$ *, while in models 2 to 5, N=48 and* $k=1$

Table 3: Parsimonious ARDL – Bound Test Procedure results for Long-run and short-run Relationships.

		Short-run Causality (Wald or Pairwise F-test)				**Long-run Causality**
		***F*-Statistics** (probability)				$\delta_{i=6} ECT_{t-1}$
Estimated Models	Dependent Variable	$\Delta \ln GE_t$	$\Delta \ln Y_t$	$\Delta \ln P_t$	$\Delta \ln\left(Y/P\right)$	ECT coefficient [t-statistic]
1a	$\Delta \ln GE_t$	-	46.552 (0.000)***		-	-0.43 [-2.13]**
1b	$\Delta \ln Y_t$	9.692 (0.000)***	N/a		-	-0.04 [-0.23]
	$\Delta \ln P_t$	4.459 (0.041)**	0.081 (0.776)		-	-
2	$\Delta \ln GE_t$	-	-		49.755 (0.000)***	0.43 [3.64]**
3	$\Delta \ln\left(GE/Y\right)$	-	-		21.723 (0.000) ***	0.002 [0.10]
4	$\Delta \ln\left(GE/P\right)$	-	-		4.750 (0.034)**	0.79 [5.23]**
5	$\Delta \ln\left(GE/Y\right)$	-	11.976 (0.000)***		-	-0.004 [-0.21]

Error Correction Models	**1a**	**1b**	**2**	**3**	**4**	**5**
R^2	0.78	0.64	0.79	0.52	0.71	0.52
DW	1.52	1.84	2.21	1.93	2.11	2.18
SER	0.08	0.10	0.08	0.06	0.10	0.03
B-G SC (2 lags)	4.31(0.11)	0.78(0.67)	1.78(0.40)	0.31(0.85)	0.82(0.66)	1.27(0.52)
ARCH (2 lags)	0.02(0.98)	0.01(0.85)	1.13(0.56)	0.35(0.89)	0.11(0.94)	1.69(0.42)
JB Stat (df)	17.7(0.79)	60.6(0.48)	4.49(0.10)	9.31(0.11)	76.1(0.36)	65.2(0.17)

****,** &* denote p-value at 1%, 5% and 10% respectively, p-value are in ( ) parenthesis while t – statistics for rejecting the null hypothesis of no cointegration are in [ ]. Notes: Critical values for the F-statistics were obtained from Narayan (2005, p. 1988), Table III. While, the t-test, critical values are from Pesaran et al. (2001, p. 303).*

Table 4: Toda-Yamamoto non-Granger causality test results

Trivariate non-linear model: Model 1a and 1b				
Null hypothesis: H_0	**Function**	**Test Statistic** $\left(\chi^2\right)$	***p*-value**	**Inference**
Y does not Granger-cause GE	$F_{GE}\left(GE \mid Y,P\right)$	15.954	0.014***	Reject H_0
P does not Granger-cause GE	$F_{GE}\left(GE \mid Y,P\right)$	18.103	0.006**	Reject H_0
GE does not Granger-cause Y	$F_{Y}\left(Y \mid GE,P\right)$	12.740	0.047**	Reject H_0
P does not Granger-cause Y	$F_{Y}\left(Y \mid GE,P\right)$	19.000	0.004**	Reject H_0
Bi-variate non-linear models 2 to 5				
Null hypothesis: H_0	**Function**	**Test Statistic** $\left(\chi^2\right)$	***p*-value**	**Inference**
GE does not Granger-cause Y/P	$F_{GE}\left(Y/P\right)$	0.014	0.993	Accept H_0
Y/P does not Granger-cause GE	$F_{GE}\left(Y/P\right)$	5.074	0.079***	Reject H_0
GE/Y does not Granger-cause Y/P	$F_{GE/Y}\left(Y/P\right)$	2.482	0.289	Accept H_0
Y/P does not Granger-cause GE/Y	$F_{GE/Y}\left(Y/P\right)$	0.917	0.631	Accept H_0
GE/P does not Granger-cause Y/P	$F_{GE/P}\left(Y/P\right)$	0.177	0.914	Accept H_0
Y/P does not Granger-cause GE/P	$F_{GE/P}\left(Y/P\right)$	0.056	0.972	Accept H_0
GE/Y does not Granger-cause Y	$F_{GE/Y}(Y)$	0.545	0.761	Accept H_0
Y does not Granger-cause GE/Y	$F_{GE/Y}(Y)$	1.183	0.553	Accept H_0

Note: ***,** &* denote p-value at 1%, 5% and 10% significance level.

Table B.I: A Brief Summary of Existing studies on Wagner's Law and Keynes Hypothesis

Cross sectional studies: Found Support Wagner hypothesis			
Author	Econometric Technique Used	Evidence for	Sample period
Ram (1986)	Cross-section (Pooled time series)	96 countries*	115 countries: 1960 - 1980
Hsieh and Lai (1994)	VAR and Granger causality	Germany, Italy and US	G7 countries: 1885 - 1987
Kolluri (2000)	2 step E-G and ECM	G7 countries	G7 countries: 1960-1993
Chang (2002)	JJ and ECM	Thailand	3 developed and 3 developing Asian countries : 1950-1996
Iyare and Lorde (2004)	2 step E-G and Granger causality tests	Guyana	9 Caribbean countries:
Akitoby et al. (2006)	ECM	70% of countries studied	51 developing countries: 1970-2002
Ansari et al. (1997)	Holmes-Hutton and Granger causality test	Ghana	Ghana (1963-1988), Kenya (1964-1989) and South Africa (1957-1990
Grenade and Wright (2014)	Panel Dynamic OLS, Granger causality and Baek and Brock(1992) nonlinear causality test	Barbados, St Vincent and Grenadines	4 Caribbean countries: 1980-2011
Narayan et al. (2008)	Panel co-integration (Pedroni) test and ECM	Small panels of China's western and Eastern provinces	Chinese provinces Eastern and Western provinces
Kumar (2009)	Gregory Hansen (1996) structural break co-integration test	4 out 5 Asian countries	6 Asian countries:1960-2007
Lamartina et al. (2010)	ARDL and Wald F-statistic test	OECD countries	23 OECDs: 1970-200
Kariagianni et al. (2011)	E-G and JJ cointegration tests	France and Italy*	EU-15
Magazzino et al. (2012a)	Panel cointegration test and Granger causality	Austria, Germany, Netherlands, Portugal and Spain	Euro area: 1990-2010
Magazzino et al. (2012b)	2-step E-G and JJ cointegration tests, Granger causality and ECM	14 EU countries out of EU-27	EU-27:1970-2009
Khan and Bashar (2015)	2 step E-G and JJ cointegration tests and Granger causality	Australia	Australia and New Zealand: 1980-2012
Ashan et al. (1992)	Granger causality (add money stock)	UK and Japan in both univariate and trivariate model	G6 (excluding U.S): 1960-1980
Loizides et al. (2004)	JJ, Granger causality and ECM	Greece and UK (when inflation is included in a trivariate model)	Greece, UK and Ireland: 1950-1995
Paleologlu et al. (2015)	Semi-parametric estimates in a partial linear model.	Developing countries in linear and nonlinear models	5 developing; 5 developed and 5 relatively poor EU countries:1960-2007

Country Specific studies: Supporting Wagner's hypothesis			
Author	Econometric Technique Used	Evidence for	Sample period
Ghali (1997)	VAR and Granger causality test	Saudi Arabia (weak evidence)	1960 - 1996
Islam (2001)	JJ and E-G cointegration tests	US	1929 -1996
Srinivasan (2013)	JJ cointegration test; VECM and Granger causality	India	1973 - 2012
Seeber and Dockel (1978)	OLS	South Africa	1948 -1975

Note: VAR = vector autoregressive model; E-G = Engle-Granger (1987); JJ = Johansen Juselieus cointegration test. ECM = Error correction model; VECM = vector autoregressive model; OLS = Ordinary least square; ARDL = Autoregressive distributed lag-bound testing and TY= Toda Yamamoto causality test; FGLS = Feasible Generalized Least Squares; CB= Cobb Douglas Production function.

Table B.II: A Brief Summary of Existing studies on Wagner's Law and Keynes Hypothesis

Country Specific studies: Supporting Wagner's hypothesis			
Author	Econometric Technique Used	Evidence for	Sample period
Abedian et al. (1984)	OLS	South Africa	1920 - 1982
Ziramba (2008)	ARDL and TY	South Africa	1960 - 2006
Alm et al. (2010)	JJ cointegration test, ECM and Granger causality	South Africa	1960 - 2007
Kojo and Wolde-Rafael (2012)	ARDL, E-G and ECM	South Africa	1950 - 2007
Odhiambo (2015)	ARDL and Granger causality	South Africa	1970 - 2013
Tsauri and Odhiambo (2013)	ARDL and Granger causality	Zimbabwe	1980 - 2011
Salwindi et al. (2016)	JJ and Granger causality	Zambia	1980 - 2013
Thabane and Lebina (2016)	ARDL, 2-step E-G and ECM	Lesotho	1980 - 2012
Danladi et al. (2015)	ARDL, JJ and Granger causality	Nigeria	1980 - 2013
Ogbuagbu et al. (2015)	ARDL and TY	Nigeria	1970 - 2014
Ibok et al. (2016)	JJ and Granger causality	Nigeria (Agriculture sector)	1961 - 2012
Oyinlola et al. (2013)	Gregory-Hansen structural break cointegration test and ECM	Nigeria	1961 - 2009
Dada et al.(2013)	JJ and VECM	Nigeria	1961 - 2011
Lawal et al. (2015)	JJ and Granger causality	Nigeria (heath, transport &communication sectors)	1977 - 2012
Cormelus et al. (2016)	OLS (multivariate regression)	Nigeria	1980 - 2012
Ahmad and Longanathan (2016)	Bootstrap non-Granger causality with fixed rolling window	Nigeria (for sub period of 1985 – 1995)	1960 - 2014
Salih (2012)	JJ, 2-step E-G coint.test , Granger causality and ECM	Sudan	1970 - 2010
Kamasa et al. (2015)	JJ and Granger -Sim causality	Ghana	1980 - 2010
Menyah at al. (2015)	ARDL and TY	Ethiopia	1950 - 2007
Kalam (2009)	2-step EG cointegration test, JJ and Granger causality	Bangladesh	1976 - 2007
Al-Zeoud (2013)	2-step EG cointegration test, JJ, VECM and Granger causality	Jordan	1990 - 2011
Tasseven (2011)	VECM, TY and JJ	Turkey (trivariate model)	1960 - 2006
Govindaraju et al. (2011)	ARDL and Granger causality	Malaysia (trivariate model)	1970 - 2006
Permana et al. (2012)	ARDL and GARCH	Indonesia	1990 - 2011
Pahlvani et al. (2011)	ARDL, TY and Granger causality	Iran	1960 - 2008
Sideris (2007)	JJ and Granger causality	Greece	1833 - 1938
Magazzino (2010)	OLS, FGLS, ARIMAX, GARCH, Finite mixture model, CB	Italy (weak evidence)	1960 - 2008
Kumar et al. (2009)	Fully modified OLS (FMOLS), ARDL, 2-step E-G and JJ	New Zealand	1960 - 2007
Pahlvani et al. (2011)	ARDL, TY and Granger causality	Iran	1960 - 2008
Sideris (2007)	JJ and Granger causality	Greece	1833 - 1938
Magazzino (2010)	OLS, FGLS, ARIMAX, GARCH, Finite mixture model, CB	Italy (weak evidence)	1960 - 2008
Kumar et al. (2009)	Fully modified OLS (FMOLS), ARDL, 2-step E-G and JJ	New Zealand	1960 - 2007
Szarowská (2009)	JJ and Generalised methods of moments (GMM)	Czech Republic	1995- 2008
Cotsomitis (1996)	E-G	China	1952 - 1998
Atasoy (2016)	ARDL, TY and Granger causality	China	1982 - 2011

Note: VAR = vector autoregressive model; E-G = Engle-Granger (1987); JJ = Johansen Juselieus cointegration test. ECM = Error correction model; VECM = vector autoregressive model; OLS = Ordinary least square; ARDL = Autoregressive distributed lag-bound testing and TY= Toda Yamamoto causality test; FGLS = Feasible Generalized Least Squares; CB= Cobb Douglas Production function.

Table B.III: A Brief Summary of Existing studies on Wagner's Law and Keynes Hypothesis

Cross sectional studies: Supporting Keynes hypothesis			
Author	Econometric Technique	Evidence for	Sample period
Landau (1986)			104 Countries: Summer-Heston data
Hsieh and Lai (1994)	VAR and Granger causality	Canada, Japan and UK	G7 countries: 1885-1987
Iyare and Lorde (2004)	2-step E-G and Granger causality	At least 7 Caribbean countries	9 Caribbean countries: Varied periods
Dogan et al.(2006)	JJ and Granger causality	Philippines	5 East Asian countries: 1960 - 2002
Zammanian et al. (2012)	TY	Bangladesh, China, Pakistan Philippines and Syrian Arab Rep	12 Asian countries: 1960-2009
Khan et al. (2015)	JJ, E-G causality test and ECM	New Zealand (on education and health public spending)	Australia and New Zealand: 1980-2012
Paleologou et al. (2015)	Semi-parametric estimates in a partial linear model.	Developed countries (nonlinear model)	5 developing; 5 developed and 5 relatively poor EU countries:1960-2007
Country Specific studies: Supporting for Keynesian hypothesis			
Author	Econometric Technique	Evidence for	Sample period
Holmes and Hutton (1990)	Holmes –Hutton multiple rank *F*-causality test	India	1950 - 1981
Tulsidharan et al. (2006)	2 step E-G cointegration test, ECM and Granger Causality	India	1960 - 2002
Babatunde et al.(2011)	ARDL and TY	Nigeria (weak evidence)	1970 - 2006
Omoke et al. (2009)	JJ and Granger causality	Nigeria	1970 - 2009
Ighodaro et al. (2010)	JJ and Granger causality	Nigeria	1961 - 2007
Sevitenyi (2012)	JJ, TY and Granger causality	Nigeria	1960 - 2009
Lawal et al. (2015)	JJ and Granger causality	Nigeria (agricultural sector)	1977 - 2012
Amin (2011)	JJ, TY and Granger causality	Bangladesh	1976 -2009
Yilgör et al. (2012)	VAR and Granger causality	Turkey	1980 - 2010
Künü et al, (2015a)	2-step E-G cointegration test, JJ and Granger causality	Turkey	1990 - 2012
Künü et al, (2015b)	ARDL and ECM	Turkey	1970 - 2012
Govindaraju et al. (2011)	ARDL and Granger causality	Malaysia (multivariate model)	1970 - 2006
Gürgül et al. (2012)	2-step E-G cointegration test, TY and VAR	Poland	2001:Q1 - 2008:Q3
Country Specific studies: Supporting for both Wagner and Keynes hypothesis (bi-directional hypothesis)			
Author	Econometric Technique	Evidence for	Sample period
Ashan et al. (1992)	Granger causality	US and Canada	G7 (excluding U.S): 1960 - 1980
Afxentiou et al. (1996)	2-step E-G and Granger causality		EU countries: 1961 - 1991
Grenade and Wright (2014)	Panel Dynamic OLS, Granger causality test and Baek et al. (1992) nonlinear causality test	Grenada and St. Lucia	4 Caribbean countries: 1980-2011
Huang (2006)		China and Taiwan	
Narayan et al. (2008)	Panel cointegration (Pedroni) test, ECM and VAR	Full panel of Asian countries	Chinese Eastern and Western provinces: varied periods
Safdri et al.(2012)	Panel cointegration test (Pedroni and Kao tests) and Panel-VECM	17 Asian developing countries	27 Asian countries: 1970 - 2009
Mahmoodi et al. (2014)	Panel cointegration and Granger causality	Hong Kong, Japan, South Korea, Taiwan, China, Malaysia, Philippines, and Thailand	20 Asian countries: 1970 - 2010
Lahirushan et al. (2014)	Panel cointegration (Pedroni and Kao) test and Panel-VECM	Singapore, Malaysia, Thailand, South Korea, Japan, China, Sri Lanka, India and Bhutan	9 Asian countries: 1970 - 2013
Magazzino et al. (2012a)	Panel Cointegration test and Granger Causality	Cyprus, France, Greece, Ireland and Slovenia	Euro area: 1990 - 2010

Note: VAR = vector autoregressive model; E-G = Engle-Granger (1987); JJ = Johansen Juselieus cointegration test ECM = Error correction model; VECM = vector autoregressive model; OLS = Ordinary least square; ARDL = Autoregressive distributed lag-bound testing and TY= Toda Yamamoto causality test; FGLS = Feasible Generalized Least Squares; CB= Cobb Douglas Production function.

Table B.IV: A Brief Summary of Existing studies on Wagner's Law and Keynes Hypothesis

Country-specific: Found Support for both Wagner and Keynes hypothesis (bi-directional hypothesis)

Author	Econometric Technique	Evidence for	Sample period
Singh et al. (1984)	Granger causality test	India	1950 - 1981
Ziramba (2008)	ARDL and TY	South Africa	1960 - 2006
Odhiambo (2015)	ARDL, ECM and Granger causality	South Africa (trivariate model)	1970 - 2013
Alimi et al. (2013)	JJ and ECM	Nigeria	1970 - 2012
Ahmad et al. (2016)	Bootstrap non-Granger causality with fixed rolling window	Nigeria, period 2011-2014	1961 - 2014
Mekdad et al. (2014)	JJ and Granger causality	Algeria (education expenditure)	1974 - 2012
Rana (2014)	JJ, VECM and Granger causality	Bangladesh	1973 - 2012
Halicioglu (2003)	JJ, and Granger causality	Turkey (both bi-variate and trivariate models)	1960 - 2000
Tasseven (2011)	VECM, TY and JJ	Turkey	1960 - 2006
Abu-Eideh (2015)	2-step E-G cointegration test and Granger causality	Palestine	1994 - 2013
Bojanic (2013)	2-step E-G cointegration test, JJ and Granger causality	Bolivia (infrastructure, health and defence expenditures)	1940 - 2012
Nikolaos et al. (2004)	2-step E-G cointegration test and ECM	Greece	1960 - 2001
Ritcher and Dinitrios (2012)	2-step E-G cointegration test, JJ and Granger causality	UK	1885 - 2010
Cheng et al. (1997)	2-step E-G cointegration test, JJ, Hsiao's Granger causality and VAR	South Korea (multivariate model)	1954 - 1994

Cross-sectional Studies: Found no support for both Wagner and Keynes hypothesis (Neutrality hypothesis)

Author	Econometric Technique	Evidence for	Sample period
Komendi and Meguire (1985)			47 countries:
Ansari et al. (1997)	Granger and Holmes-Hutton Causality tests	South Africa and Kenya	3 African countries: varied periods
Chang et al. (2004)	JJ	South Africa, Australia, New Zealand and Thailand	10 countries: 1951 -1996
Huang (2006)	ARDL and TY	China and Taiwan	2 Asian countries: 1979 - 2002
Oten-Abaiye (2011)	Panel cointegration test	Gambia, Ghana, Guinea, Nigeria and Serra Leone	5 ECOWAS countries: Varied data:
Dogan et al. (2006)	JJ and Granger causality	Malaysia, Singapore and Thailand.	5 East Asian Countries: 1960 – 2002
Magazzino et al. (2012a)	Panel Cointegration test and Granger Causality	Belgium, Estonia, Finland, Italy, Luxemburg, Malta and Slovakia	23 OECD countries: 1970 -2006

Country-specific : Found no support for both Wagner and Keynes hypothesis (Neutrality hypothesis)

Author	Econometric Technique	Evidence for	Sample period
Sinha et al. (2007)	ARDL and TY	Thailand	1950 -2003
Dilrukshini (2009)	JJ and Granger causality	Sri Lanka	1952 -2002
Kesavarajah (2012)	JJ, ECM and Granger causality	Sri Lanka	1960 - 2010
Muhammad et al. (2015)	JJ and Granger causality	Pakistan	1972 - 2013

Note: VAR = vector autoregressive model; E-G = Engle-Granger (1987); JJ = Johansen Juselieus cointegration test; ECM = Error correction model; VECM = vector autoregressive model; OLS = Ordinary least square; ARDL = Autoregressive distributed lag-bound testing and TY= Toda Yamamoto causality test; FGLS = Feasible Generalized Least Squares; CB= Cobb Douglas Production function.

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