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Exploring the Impact of Provincial Expenditure on Expanded Public Works Programme on Economic Growth and Labour Dynamics in the Free State Province:
ARIMA and VAR Modelling Approach

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Oyeyinka Omoshoro-Jones[1]

Abstract

Large body of evaluation studies have been devoted to assess the poverty-reducing and employment generating effects of public works programmes (PWP), including the indirect effect of these programmes to spur accumulation of infrastructure via implementation of labour intensive infrastructure projects, build human capital by acquiring skills and work-experience through (education or trainings), as well as, reduce vulnerability of the poor to aggregate idiosyncratic shocks. Hitherto, the veracity of these voluminous evaluation studies have been challenged in the absence of substantive empirical evidence. We close this research gap, by employing array of novel multivariate econometric models (i.e. VAR, seasonal ARIMA-OLS, Granger causality) to examine the influence of an archetype PWP on economic growth and labour market performance. Using a dataset spanning over 2005:Q1 to 2014:Q4. We obtain a strong statistically significant results in the ARIMA model suggesting that a high public spending on EPWP at provincial level (taken as a large government size) induce: (i) a negative impact on domestic economic growth, (ii) a weak positive correlation with labour force participation rates, (iii) negative effect on unemployment rate, and (iv) a reducing effect on unemployment. Further, empirical results from the Johansen cointegration test and VAR model provides no evidence for long-run and short-run relationship between the selected variables. This inference is reinforced by the result of the Granger causality and Wald test, confirming the absence of no causal link, and feedback dynamics between the variables. Our analyses of a one–time positive shock to public expenditure on EPWP using the impulse response function shows that, on impact, a positive fiscal shocks to EPWP has a weak stimulating effect on labour force participation rate, but an insignificant positive effect on economic growth and unemployment rate in the province in the short-and medium-term, but the positive economic growth turns negative in the short run. For policy purpose, it is imperative for policy makers to proactively re-design the current EPWP initiatives to become an effective pro-growth and anti-poverty tool to ease the structural binding constraints in the local economy and labour market. If effectively implemented, EPWP can used as an effective risk coping policy tool to reduce the prevailing high poverty incidence, chronic unemployment rate and widening income inequality in the Free State.

JEL Classification: H53, J08, P35, P36

Keywords: Public works programme, EPWP, infrastructure investment, government size, economic growth, labour market, risk coping, crowding out, VAR, ARMA-OLS, impulse response function, variance decomposition

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1. INTRODUCTION

Generally, high unemployment (in some cases, underemployment), acute poverty incidence and inequality are prominent features of socioeconomic problems facing many (if not all) developing countries. Intuitively, the extent of unemployment, poverty incidence and inequality can be attributed to the rapidity of population growth, structural constraints in the labour market (e.g. skill mismatch), shift in sectoral composition largely driven by high capital intensity accompanied by effective demand for highly skilled labour inputs, technological advancement, weak institutional policy and transient idiosyncratic (or covariate) shocks resulting from macroeconomic crisis, natural disaster and climate changes, and so on (cf. Libberandt et al. 2011; Triegaardt, 2009; Woodlard et al. 2009; Satchi et al. 2006-see Hull; Subbarrao, 2001, 2003; Ames et al. 2001).

In this context, public works programmes (hereafter, PWP) has gain popularity as critical counter-cyclical policy to provide social protection and risk-coping benefits during a transient (co-variate) shocks associated with systemic (domestic and/or external) crisis – e.g. economic recession, financial contagion and natural disaster – to reduce the vulnerability and exposure to increased risks (cf. Subbarao, 2014). Indeed, the in-built social protection and risk coping functions characterising PWPs, specifically, their employment and poverty reducing ability have led to prolific implementation amongst the national governments of Latin America, Asia and Southern Africa countries, where domestic economic growth is severely low to raise output productivity, labour absorption rate, as well as, prevent dramatic fall in household consumption level which are symptomatic of high unemployment rate, acute poverty incidence and inequality[2]. Additionally, PWP can be effective in because PWPs are self-targeting – set wage rates below the prevailing market wage rate to attracts only the poor; if well designed, labour-intensive PWP have a lasting impact on the quantity and quality of jobs by releasing binding constraints on growth (Radwan, 2005).

Conversely, by design, it is a common notion that positive externalities of PWPs can translate into a tangible indirect effects entails skill enhancement through training / education (human capital development) and creation of productive assets, where the former facilitates employability of participants in the mainstream labour market and/or self-employment, in effect, lowering the susceptibility of the working poor to risks, shrink the both skill and income inequality gap. Albeit, there is a limited anecdotal evidence from quality evaluation studies that the indirect effects of PWP to induce public capital accumulation to support employment intensive growth, enhance skill development to provide opportunity of future employment opportunity in labour market and/or encourage entrepreneurship spirit leading to self-employment, allows the poor to graduate from poverty (see McCord and Farrington, 2009; McCord and Meth, 2007).

Moreover, copious evidence from cross and country-specific studies on investigating the impact of public employment programmes confirmed the effectiveness of these programmes to reduce poverty incidence and employment rate by the way of providing steady stream of income and large labour-intensive infrastructure based projects[3]. While, there is a general consensus in the

[2] In the literature, often inequality can be explained as Income and skill inequality.

[3] For comprehensive cross-country studies, see Lipton (1996); Keddeman (1998); World Bank, 1994, 2001) McCord (2008), Subbarao (2007, 2014), Holmes et al. (2013). On regional evidence, see McCord and Slatter (2009) for Sub-Saharan Africa and Martin et al. (2001) for OECD countries. For country-specific evidence, see Ahmed et al. (2014) for Bangladesh; Harvey (2007) for Argentina; Datts and Ravallion (1992),

literature that public employment programmes acts as a powerful risk-coping mechanism by protecting the poor against malnutrition and sale of assets during crisis periods, the cost effectiveness of these programmes compared to other social protection policies such as cash transfers remain contentious. Simply put, given that the employment and income benefits accrued from PWPs is contingent on the duration of implemented projects, which are typically lasted for short periods of about three to four months as widely cited in the existing literature, as such, the use of an alternative strategy with lower administrative cost, for example, cash transfers can provides similar income-relief offered by the expensive large-scale public works programmes.

Also, in many studies, there is limited anecdotal evidence that large scaled PWP prevent sale of assets by participants during stressful periods; mitigate rural-urban migration in search for job opportunities; and improves household savings and/or investment decisions[4]; to accumulate financial assets[5] to provide basic needs, for example, buying clothes and send their children to school to acquire education, thereby, creating a highly skilled future labour force. Clearly, in spite of their prolific implementation in response to idiosyncratic (or co-variate) shocks due to either global or domestic disequilibrium in the real economy and/or dysfunctional labour market, it is evident that, PWP reduces vulnerability of the poor to aggregate systemic shocks (Devereaux, 2000; Del Nino, et al. 2009; Subbarao, 1997) nevertheless, the general consensus is that public employment programmes does not provide an escape route out of acute poverty and persistently high unemployment.[6]

Based on the strong evidence on the poverty-reduction and employment generating effects of large-scaled infrastructure-based public works programmes documented in World Bank (2001), as well as, the concrete theoretical and empirical findings supporting positive correlation between high public infrastructure investment (i.e. public capital accumulation) and economic growth and adverse impact of the latter on poverty rate and inequality[7] (income per capita) led South Africa government to formally adopt an archetype of PWP, namely the expanded public works programme (EPWP) in 2004. Specifically, in addition to the national government's attempt to reduce income inequality via imposition of progressive tax system that re-distribute income (from the rich) to the poor in the form of cash transfers and preceding pro-poor policies such as GEAR (1994), RDP (1996), JIPSA (2006) and ASGISA (2006)[8] – to tackle high poverty incidence and unemployment rate, facilitate human capital development, and stimulate economic growth.

Dev (1995), Mehrotra and Hirway (2007), Pellisiery (2008), Mehrotra (2005) for India; Jones (2004), World Bank (2005) for Afghanistan; Ofem (2008) for Nigeria; Gedamu, (2006), Subbarao and Smith (2003) for Ethiopia; Oxfam (2006) for Niger; Mattien et al. (2006) for Somalia; Adato et al.(1999), Hemson (2007); Hough et.al (2013); Lieuw-Kie-Song (2009); McCord (2002,2004,2007); McCord and Farrington (2008); McCutheon and Parkins (2009); Meth (2011); ESAU (2004) for South Africa; Zimmerman (2014) for Ethiopia and Ruwanda.

[4] For example, see Devereaux (2000); McCord and van Seventer (2004), and Mashiri et al. (2009).

[5] See Sultan and Slater (2005) and Ndoto and Macun (2005) amongst others.

[6] See McCord and Farrington (*ibid)*; Phillips (2004).

[7] Pereira and Andraz (2012) provides an up-to-date empirical evidence since the seminal work of Ashaeur (1986) which was the first to report the positive relationship between public infrastructure investment (public capital stock) and economic growth in the US. For earlier surveys, see Gramlich (1994), Kessides (1996), and Romp and de Haan (2005).

[8]While, the Growth, Employment and Redistribution (GEAR), Reconstruction and Development Programme (RDP) and Accelerated and Shared Growth Initiative for South Africa (ASGISA) had multiple policy goals to boost employment-intensive economic growth and ameliorate poverty and inequality rate whilst removing rent (wage) distortions in the labour market, in contrast, the Joint Initiative On Priority Skills

It is well documented that, these anti-poverty and pro-poor policies yield mixed results[9], albeit, their impact on South Africa's poverty, unemployment and inequality rates is negligible (see, e.g,, Leibbrandt et al. 2010, 2011; Woolard, 2009; Triegaardt (2009); Tregenna et al. (2008); Hoogveen and Ozler (2005); Bhorat et al. (2006); van der Berg et al. (2005,2007); Seekings (2006) amongst others). To date, most of the studies assessing the evolution of poverty and inequality in South Africa asserts that, in spite of successive pro-poor government policies, specifically aimed at reducing unemployment, poverty and widening inequality gap in the country; aggregate inequality is mainly driven by skill level, access to educational level, the expanding capital-intensity of the labour market. To close the existing skill gap, improve labour force participation rate, encourage capital and human asset accumulation necessary for economic growth, it is logical and intuitively appealing to use public employment programmes as a crucial policy tool in the country[10].

One of the crucial objectives of the national government in the post-Apartheid era, is to utilize the expanded public works pogramme (hereafter EPWP) is to redress some of the adverse effect of the draconian Apartheid regime, which prevents the majority of the population (i.e. African Blacks) to gain access into the labour market by the way of racial segregation and quality education / training which resulted into a microcosm of highly skilled workers, largely in favour of the minority groups (Whites). In essence, the goal of EPWP is to draw the poor into productive work that are largely labour-intensive in order to provide transient employment opportunities for the unemployed economically inactive (reference), nonetheless, the deleterious effects of the Apartheid era's racial segregation policy still manifest as a sizeable skill gap and highly segmented labour market (i.e. low- and high labour productive sectors) at the expense of the majority of the population in the country.

Globally, the success of employment creation and poverty reducing benefits of PWP observed in some Asian (e.g. India, Bangladesh, Philippines), Latin America (Argentina), Sub-Saharan African (Ethiopia, Kenya, Botswana, Tunisia, Mauritius) and few developed countries are well documented[11], yet, the contribution of EPWP to reduce high unemployment and poverty rate

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Acquisition (JIPSA) explicitly focused on human capital accumulation through skills development, trainings and quality education targeted at the previously disadvantaged majority in South Africa in order to close the existing skill gap.

[9] Recent country-specific report by World Bank (2014) have shown that progressive tax system adopted in South Africa has had a slight effect on extreme poverty incidence and inequality by lifting about 3.6 million above the poverty line (measured as $2.50 or R750 per day) as poverty fell from 34.4 percent to 16.5 percent – after the adoption of the redistributive fiscal policy mainly through cash transfers to poor households, this also, lead to a slight decline in in inequality to 0.59 (using the Gini coefficient) in 2014 compared to 0.77 (in 1994), while income inequality appeared to be significantly large. Noticeably, further results suggest shrinking fiscal space to utilise the current tax policy to finance the growing demand for grants, echoing van der Berg et al. (2005) conjecture that the use of social grants as anti-poverty tool is becoming ineffective due to fiscal constraints.

[10] For example, see Del Nino et al. (2009) for India; Ahmed et al. (2014) and Subbarao (2001) for Bangladesh; Zimmerman (2014) for Ethiopia and Rwanda; McCutcheon et al. (2009); for Botswana and Kenya; Subbarao (2014) for India, Argentina and Ethiopia, Subbarao (1997) and Lipton (1998).

[11] See Subbarao, 1997, 2014; McCord, 2008; Rifkin, 1996; Lipton, 1998; McCord and Slatter, 2009; Teklu and Asefa (1999) ; Gedamu (2006); Giligan and Hoddinot (2006); Jones (2004); Ofem and Ajayi (2008); Montani et al. (2002); Mattien et al. (2006) McCord and McCutheon, Del Nino et al. (2000); Zimmerman (2014). The implementation and size of public work programmes differs across countries based to their level of exposure to aggregate idiosyncratic shocks (e.g. global economic recession), type of natural disaster (e.g.

remains insignificant despite increasing government expenditure on implemented programmes at the national, provincial and district levels. Some of the prominent factors responsible for impervious impact of EPWP in SA is the structural nature of unemployment rate, labour market segmentation driven by skill and education, low labour intensiveness of implemented infrastructure projects due to high usage of capital (i.e. machineries) contravening the promulgated rules in the outlined frameworks, and so on (see, e.g. Omoshoro-Jones, 2014; NDPW, 2005, 2006, 2009; Haddad et al. 2001).

Hitherto, in the existing literature, large body of studies have been devoted to appraise the effectiveness and/or assess the impact of adopted PWP initiatives on skill development, poverty, inequality and economic growth. Most of these studies typically employ qualitative evaluation techniques, albeit, empirical studies assessing the impact of EPWP on the dynamics of labour market and economic activities – at both international and regional level, remain scarce.[12] These valuation studies suffered from two shortcomings. First, the dearth of verifiable data on PWPs to substantiate the poverty-reducing and employment generation benefits accrued to the poor (Devereux and Solomon, 2006; McCord and Slater, 2009). Second, inadequate performance indicators to reflect the true performance of PWPs in terms of actual number of jobs created and duration of employment opportunities (see Meth, 2011; Chakwizira, 2010). Third, ineffective documentation and reporting –of data pertaining to beneficiaries for monitoring purposes, a problem often associated with large upscale PWPs (see, e.g. Mehrotra and Hirway, 2009 for Inidia; McCutheon and Parkins, 2009 for South Africa). As a result of these shortcomings, the efficacy of employment opportunities created in many public employment programmes is openly debateable (see, e.g. Betcherman et al. 2004; Martin et al. 2001), thus, these studies failed to capture the poverty-reducing and employment generation effects of these programmes, as well as, possible interrelationship between government spending on PWPs, labour market performance and the real economy. After an extensive cross-country comparative study on more than 200 PWPs, McCord (2008, 2009) concludes that in the policy circle, employment creation is considered synonymous with poverty reduction, irrespective of the quality of employment or its distribution.

Unlike the large volume of studies in the existing literature, which commonly focus on the effect of high public spending on economic growth, job creation and total factor productivity; to the best of our knowledge, at regional and/or international level, no empirical work has attempt to examine the relationship between high public government spending ion EPWP projects on labour market dynamics and real economy. In this paper, we extend the literature on PWP along the empirical front. Specifically, we contribute to extant literature in three folds. First, differing from evaluation studies at international and national level, the scope of our research is explicitly focused on the distributive impact of aggregate government spending on public employment programmes at the provincial level. In this way, our analysis intend to shed more light on the transmission channels by which budgetary allocation to EPWP acts as catalyst to stimulate

drought) and duration of crisis (e.g. agricultural off seasons), nevertheless, the central objectives of PWP are generally similar, i.e. acts as social safety net, provides risk-coping mechanism and risk mitigating functions. Also, implemented PWPs can be in form of workfare, food-for-work, input-for-work structure.

[12] In evaluation studies, it is a common conjecture in many evaluation studies that reduces poverty incidence without validating this hypothesis with empirical evidence on impact or attribution (see Holmes et al., ibid). So far, to the best of our knowledge, only the works of McCord and Wilkinson (2009); McCord and van Seventer (2004) Meth (2011); McCutheon and Parkins (2009); NDPW (2012) and Omoshoro-Jones (2014) have explicitly applied some form of quantitative techniques to evaluate the performance of an archetype of public employment programme, i.e. EPWP. Nevertheless, the scope of these studies differs.

economic growth, and, at the same time, enhance labour market absorption rate by influencing labour market indicators such as (un)employment rate and labour force participation rate. In this way, the results of our empirical analysis provides an in-depth understanding useful to policy makers to determine whether there is a need to raise provincial government spending per GDP ratio, at provincial level to improve the domestic labour market dynamics and foster an all-inclusive output and economic growth.

Secondly, we extend the few existing empirical works on EPWP along the methodological approach employed, at local and intentional level. Specifically, in this paper, we employed a estimated a higher order seasonal ARIMA model, VAR, Johansen-Julieus cointegration and Granger Causality tests to : (i) examine the dynamic feedback between high public spending on EPWP, provincial economic growth, labour force participation rate, employment and unemployment rate (as selected variables), (ii) identify long-run and short-run association between the selected variables, and also, determine the existence of causal link among the selected variables, and (iii) determine the response of economic growth and labour market performance indicators (labour force participation rate, employment and unemployment rate) to EPWP's innovations. Thirdly, we resolve the data paucity and model specification problems (loss of degree of freedom) common in econometric modelling, by applying linear interpolation method to transformed annual data to quarterly data covering the period of 2005:Q1 to 2014:Q4. Finally, we study the response of the selected variables to innovations using impulse response function and variance decomposition to gain insight into the dynamic feedback on individual variables modelled as endogenous system.

Furthermore, given the third implementation phase of ongoing EPWP intiatives as public employment programme in South Africa since 2004, in this study, we examine the relationship between high public government spending on EPWP, domestic economic growth and the labour market dynamics at provincial level by explicitly focusing on the Free State.

Specifically, this paper seek to answer the following questions: Why is output growth and the labour market irresponsive to high public spending on expanded public works programmes in the Free State? Is there any long-run and/or short-run relationship between high public spending on EPWP initiatives, economic growth, and labour market indicators? If any, what is the direction of causality between high public spending on EPWP initiatives, economic growth, and labour market indicators? Finally, what are the probable cause or binding constraints undermining the employment generating and poverty reducing effect of an upscaled EPWP schemes in the Free State province?

The implication of our empirical findings is crucial, at provincial level, for policy makers to embark on proactively design effective pro-growth and anti-poverty policies to binding constraints in the local economy and labour market in terms of enhancing private sector employment and productivity needed to revive the apparent waning private sector participation, which in turn, is compressing economic growth.

To the best of our knowledge, this is the first study to employ sophisticated econometric techniques in the growing literature studying the direct and indirect impact of PWPs on economic growth and labour market performance.

The remainder of this paper is organised as follows. Section 2 discusses the theoretical underpinnings explaining poverty reducing and employment generating effects of high public spending (interchangeably use as government size) on infrastructure. This section shed light on the infrastructure-economic growth nexus, and, provides succinct appraisal of relevant literature. The econometric techniques employed, data analysis, and specification of models are presented following methodology section. Section 4 discusses empirical results and diagnostic tests assessing the robustness of the constructed model. Section 5 provides concluding remarks, while the final section provides policy-relevant recommendations based on empirical findings.

1.1. Stylized Features on South Africa Economic Condition and Labour Performance.

Presently, South Africa is experiencing a high rate of unemployment (hovering around 25 percent or 34 percent per narrow or broader definition) and poverty incidence (gini coefficient of 0.69) whilst inequality (income and skill) widens similar to other developing countries, where typically unemployment and poverty rate is prevalent because population growth outpace economic growth leading to a low absorption rate of new entrants into the labour market as labour supply exceeds demand.

For instance, the latest labour market survey data (Stats SA, 2015:Q4) reveals that, out of the total population of about 59.4 million people, only 66.7 percent (36.3 million) are economically active (i.e 25 – 64 years old), whereas from the economically active group, about 29.4 percent (16 million) are gainfully employed. This apparent constraints is reflected in the lower rate of labour force participation rate (58.5 percent) and absorption ratio of about 44.2 percent. *See Table 1 in the appendix for an up-to-date data on labour market dynamics in SA*.

At the same time, the labour market performance in South Africa is worsened by the simultaneous emergence of an increasing youth unemployment rate and long-term unemployment rate (long unemployment spell) amongst the large economic active population[13] amidst declining economic growth from 1.4 percent (at the end of 2015) to 0.6 (in the first quarter of 2016) and inflation pressure[14].

The proximate cause of high youth unemployment could be linked to lack of adequate skills and/or lack of work experience required to acess the mainstream labour market since large proportion of the youths are less skilled and inexperienced. Labour data shows that almost 86 percent of youths do not possess tertiary education, while two-thirds have never worked. In effect, the bulk of productive labour required to drive output and economic growth are dormant as obsolete skills, this in turn, exacerbates the fiscal burden on the national government to provide more social safety nets amidst the tight financial conditions in the economy, in addition to the widening trade and fiscal deficits (4.2 percent and 4 percent – of GDP respectively)[15] and high debt-GDP ratio at 45.9 percent (World Bank, 2014).

[13] Published labour statistics data published (Stats SA, 2014), long-term unemployment spell among the economic active group rose sharply from 2,6 million in 2008 to 3,4 million in 2014, within this group, those who were looking for work for more than five years increased from about 1,0 million to 1,5 million between 2008 and 2014

[14] The post-apartheid economic growth averaged 5 percent between 2004 and 2007, with an all-time high of 7.6 percent growth in real GDP during the post-apartheid era, and lowest average growth of 2 percent between 2007 and 2008. At the time of writing this paper, inflation rate is 7 percent in South Africa.

[15] National Treasury (2016), data extracted from the published National Budget Review (NBR) document.

On economic and labour market performance in the Free State province, a furtive glance at Table 10 and Fig. 2 (in the appendix) elucidates that among the provinces in South Africa, the Free State has the highest unemployment rate (at 29.8%) per the narrow definition, with absorption rate of 40 percent, and labour force participation rate of 62.7 percent. While the largest employer in the province is the public sector; employment creation and labour productivity of the private sector is very low. Although weak participation of the private sector in the domestic economy might seem to hamper aggregate employment and output growth, still, the unimpressive performance of the labour market tend to signify a considerable underlining constraints related to the magnitude of government investment and size in the local economy in conjunction with implemented macroeconomic policies.

Interestingly, Fig. 2 depicts a counter-intuitive inverse relationship between economic growth rate and high public spending on EPWP schemes, in contrast , to the anticipated positive relationship, that high publics spending on infrastructure-linked EPWP would spur economic growth, as effective demand is generated, while aggregate output and income per capita improves. In the same vein, surprisingly, while labour participation rate tend to increase, as more unemployed poor find transitory jobs in the public sector, for example via EPWP schemes, the overall, positive response of the labour force participation rate to an expanded EPWP projects is severely weak, to the extent that, the high public spending on EPWP and declining economic growth is insufficient to improve the absorption rate of labour.

Another important inference from Fig. 2, relevant for observation, is the irresponsiveness of both unemployment and employment rates to the increasing fiscal allocation to upscale EPWP projects in the province.

2. REVIEW OF LITERATURE

To substantiate the research scope of this paper, and present a coherent theoretical and empirical underpinnings for the empirical exercise undertaken, in relation to assess the implication of large public works programme financed by the government on an archetype economy, first, relevant economic theoretical and empirical evidence on two strands of literature, to a larger extent. formed the basis of the widespread of PWP initiatives is discussed in a synoptic survey of country-specific – and cross country– studies on PWP works at the international level, as well as, the scant literature on EPWP in South Africa.

2.1. Exploring Infrastructure-Economic Growth-Poverty-Inequality Nexus: Theory and Empirical Evidence

The first strand of literature relevant for the empirical work in this paper, is the he voluminous literature on studies examining infrastructure-economic growth-poverty-inequality nexus, and theoretical underpinnings supporting the empirical results of these studies.

The direct positive correlation between infrastructure investment and economic growth, and reducing effect of capital accumulation (or stock) and poverty and inequality as an indirect result of high public infrastructure investment forms the core foundation of public works programmes (PWP). The seminar work of Aschaeur (1986), was the first series of empirical works to show that high public infrastructure investment that led to an increased capital accumulation is a catalyst for economic growth, whereas, underinvestment in infrastructure limits economic growth[16]. Subsequent studies assessing the infrastructure-economic growth nexus confirmed this finding, albeit, reporting lower output elasticity than Aschaeur (1998) irrespective of econometric techniques employed.

Theoretically, infrastructure affects growth through both direct and indirect channels. While, an increase in capital stock resulting from intensified infrastructure investment directly lead to economic growth as lower cost of production leads to an increased output productivity and firm's expansion. In response to high output production, demand for factor inputs is generated causing demand for labour to rise, thus creating employment opportunities, thereby easing demand constraints in the mainstream labour market and improving absorption ratio. Also, the rent (wages) paid to workers for supplying their labour as factor input of production raises household income, especially for the previously unemployed worker / poor, which in turn, improves consumption and aggregate expenditure on local / imported goods and services inducing further upward pressure on effective demand, sectoral productivity and economic growth through multiplier effect on the economy.

Equally, the indirect effect of infrastructure-economic growth nexus manifest through advancement in technology and innovations to improve quality and quantity of physical and economic infrastructures (e.g. number of schools, hospitals, dams, electricity grids constructed etc), greater access to market (reducing trade costs, for example for farmers in rural areas) and road networks – summing up as an increased in total factor productivity.

To identify and disentangle the infrastructure-economic growth nexus, recent studies has established notable transmission channels through which infrastructure can influence economic growth: (i) enhance productivity / output growth, for example, by facilitating human capital development by producing related public assets, (ii) as a direct input in production process and/or factor of production, (iii) stimulate aggregate effective demand via high public spending on construction, preventive maintenance and upgrade of created public assets – thereby providing employment opportunities that provides income (as wages) to workers, (iv) as complementary input into production process, in effect, lowering by providing economies of scales (or raising) production costs, (v) acts as a countercyclical policy tool to mitigate adverse global economic shocks to sustain achieved economic growth, and/or an effective policy tool to enhance industrialization and development, (vi) reduces transaction and trade costs – construction of extensive transport (air, road and sea) networks aids bilateral international trade across regions/ countries[17].

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[16] See Gramlich (1994), Kessides (1996), Romp and de Haan (2005), Pereira and Andraz (2012) and Omoshoro-Jones (2013) for empirical survey of earlier works.

[17] For more theoretical explanation on infrastructure-economic growth nexus, see Fedderke and Garlick (2008), Estache and Garsous (2012), and Sahoo et al. (2010). Apart from economic growth, Agénor and Moreno-Dodson (2006) hypothesized additional channels through which infrastructure affects poverty, inequality (income per capita) and employment. Empirically, Gannon and Liu(1997), Smith et al. (2001) and Estache (2003) finds that infrastructure helps poorer individuals and underdeveloped areas to get connected to core economic activities, thus allowing them to access additional productive opportunities, thus, infrastructure development in poorer regions reduces production and transaction costs. Conversely, infrastructure access can raise the value of the assets of the poor. Jacoby, (2000) explored the link asset value of poor farm areas (as proxied by the net present value of the profits generated by their crops) to the distance to agricultural markets, he finds that an improvements in communication and road services

Further empirical studies have employed varying econometric models to construct indices (as instrument variables) to capture the impact of different types of physical and economic infrastructure on economic growth, income per capita and welfare gain - all substantiate the theoretical notion that high infrastructure promotes economic growth, employment and reduces both poverty and inequality. Some of these studies established dynamic feedback effect (in response to innovations), long-run and short-run relationships, and direction of causality between infrastructures, economic growth, national income per capita using sophisticated econometric techniques.

On the empirical front, among others, Hulten (1997), Sanchez and Robles (1998); Canning and Pedroni (1999,2004), Cheng et al. (1997), Chong and Calderon (2001); Pereira (2000), Pereira et al. (2005); Sahoo et al. (2010); Babatunde et al. (2012); Snieska et al. (2009); Fedderke and Bogetic (2006); Perkins et al. (2005); Mamuneas (2000); Roller and Waverman (2001)– all employed sophisticated econometric models in cross-country and country-specific studies to provide concrete evidence that high infrastructure investment (on transport, telecommunication, electricity, freights service, road networks etc) positive influence long-term economic growth performance and public sector employment, and adverse impact on private sector employment and labour productivity. In many instances, most of these studies found evidence of bi-directional causality between infrastructure and economic growth, and unidirectional causality between private sector employment and economic growth (Kumo, 2012).

On the other hand, Calderon and Sérven (2004) and Jong-A-Pin et al. (2008) provides evidence supporting the poverty reduction effect (operating through income per capita) of an increased infrastructure spending, while Lopez (2003) and Estache (2003), among others, reported the positive effect of infrastructure investment on inequality. While, Rodrik (1997) and Edwards et al. (2006) found a positive relationship between infrastructure investment and export performance – international trade, while Palei (2015) reported a positive correlation between infrastructure and global competitiveness.

Even though, empirical studies at local / district level is scanty due to data paucity, nonetheless, few studies have delved into this space, for example, Rives and Heaney (1995) applied factor analysis technique to construct indices to capture economic development at local level, namely, median household income, labour force employed, valuation per capita and employment, they found that high infrastructure investment at local level positively affect economic development, promote human capital accumulation, agglomeration (development of clustered productive firms), however, financing high infrastructure investment through higher taxes negatively affect economic development needed for growth.

In the same vein, using macroeconomic models to assess the distributive impact of infrastructure on domestic economy, household income and aggregate productivity, Ngadu et al. (2010)

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raised capital gains of poor farmers. In addition, Estache and Fay (1995) find that enhanced access to roads and sanitation has been a key determinant of income convergence for the poorest regions in Argentina and Brazil. Brenneman and Kerf (2002) surveyed the literature, and reported that, Infrastructure development exerts a disproportionate impact on the human capital of the poor, and hence on their job opportunities and income prospects. This refers not only to education, but most importantly to health via education, a better transportation system and a safer road network help raise school attendance.

studied the impact of infrastructure investment on sectoral productivity in South Africa utilising a social accounting matrix (hereafter, SAM)-based structural path analysis (SPA) model, their result suggests that an increase in investment in the construction sector tend to enhance aggregate productivity and high household income level.

Also, Omoshoro-Jones et al. (2013) used a disaggregated SAM for Free State province (in South Africa), their analysis shows that high public investment in the manufacturing has the largest multiplier effects to reduce income equality among households, stimulate economic growth and productivity of sectors in the province. Focusing on Philippines, Corong et al. (2012), investigates the role of public infrastructure investment on economic growth and poverty reduction in a micro-simulated computable general equilibrium (CGE) model, they found a positive supply side effects of higher public investment expenditure stimulates growth and productivity operating via higher capital accumulation.

Furthermore, some empirical analysis have shown that, even though, an increased infrastructure investment can positively affect long term economic growth, an over-investment in infrastructure could dampen this positive relationship, to the extent that, high infrastructure spending exerts a negligible – , negative – , and/or zero – economic growth by crowding out private sector productivity (see Fedderke and Bogetic, 2006; Jong-A-Pin and de Haan,2008; Kumo, 2012) and private sector employment (see Amusa, 2016; Pereira, 2000).

All in all, theory and empirics suggests that an intensive public investment on infrastructure has positive influence on growth, poverty and inequality. Meanwhile, the evidence of bilateral causality between infrastructure and economic growth asserts in the long run higher public infrastructure investment not only positively impacts growth, but also reduces poverty and inequality in the short and long run. Albeit, the contemporaneous effect of high infrastructure on growth could be negative in the short run or impose an ambiguous effect (e.g. see, Kumo, 2012; Fedderke and Bogetic, 2006). But, high infrastructure investment (public capital accumulation) to reduce poverty incidence and income inequality, it should improve accessibility of poor / low-income household to quality infrastructure (see, e.g. Estache et al. 2000), equally, such investment needs to generate employment intensive growth, rather than productive-intensive growth, in order to alleviate extreme poverty and inequality as argued in the literature, for example, Ames et al. (2001), Khan (2001), Islam (2004) and Hull (2009)

Therefore, by implication, for infrastructure-based PWPs are expected to foster output and productivity growth through creation of useful public assets, as well as, generate employment opportunities and income transfers to the poor (especially those in the rural areas) through the implementation of labour intensive projects.

2.2. Exploring Crowing out Effect: Government size – Labour market performance – Private sector Nexus: Theory and Empirical Evidence

The second strand of literature survey to gain insight on the impact of high government spending on labour market performance and output growth, is those empirical studies assessing the source of crowding out effect on private sector employment, productivity and labour market performance emanating from large share of government size (i.e. public sector) in the economy.

In public infrastructure literature, public investment on infrastructure is contingent on the size of government revenue allocated for infrastructure expenditure. In this way, the extent of government participation, also referred to as the public sector (e.g. consumption and spending) relative to the private sector is a crucial determining factor in terms of labour market performance. Simply put, government infrastructure spending on infrastructure is synonymous to government size. In this sense, an increased government spending, for example, on creating social safety nets, public employment programmes, and/or infrastructure projects to boost growth, represent government size, which can determine the performance of the labour market in terms of employment creation and reduction in poverty and inequality.

In the literature, large body of empirical research that studies the macroeconomic effect of an increase in government size – in this case, an increase in public expenditure[18] to create employment opportunities– on real economy (economic growth) and labour market performance finds strong evidence supporting a crowding out effect (either a full or partial) on private sector employment, and fall in economic growth.

Theoretically, the crowding out effect between public sector (in this case, denoting high government spending on public employment programmes and/or government size) on private sector performance and the labour market can occur through the following channels: First, an increased public jobs tends to exert adverse effect on private sector employment. For instance, if the rent (wage rate) in the public sector is higher than rents in the private-sector, the favourable rents paid for labour input attract workers into the public sectors, in effect, large public sector crowds out private employment. Second, the degree of substitutability between private and public production can cause crowding out, if labour force participation rate improves as a direct result of an increased employment opportunity in the public sector. Adding to these transmission channels, Behar and Mok (2015) indicates that the use of higher taxes[19], higher interest rate and competition from state-owned enterprises with access to public funding can stimulate derived labour demand, which in turn, affects the product market.

Conversely, job security, high wage rate (reinforced by unionization), and the likelihood of finding jobs in the public sectors, can also, limit labour supply to the private sector because able-bodied workers continue to search for public sector jobs. Finally, crowding out effect could result from the importance of human capital accumulation associated with educational attainment, where by, large proportion of economically active groups seek for minimum educational qualification to gain employment in the public sector, rather acquiring the skills needed for productive employment in the private sector.

Indeed, in support of large government size, especially in developing countries, in a cross-country study, Rodrik (1998) found a positive correlation between country's vulnerability to shocks via international trade and government size, thus arguing that exposure to external shocks originating from international trade, fluctuation in exchange rate, level of economic and social development (e.g. access to health, education and public infrastructures), degree of urbanization, and so on, are some of the factors driving large government size, especially in developing countries. Arguably, the finding of Rodrik (1998) affirmed that large government size (i.e. spending) plays a risk-reducing role that mitigate country's exposure to aggregate

[18] In this paper, public expenditure is interchangeably used as public spending.

[19] For instance, imposition of higher taxes to generate revenue to finance large infrastructure projects needed to support growth or improve social safety nets

idiosyncratic shocks that has adverse effect on domestic economic growth and labour market performance as labour absorption rate declines.

Nevertheless, there is an overwhelming empirical results confirming the adverse effect of public sector (or government size) on private sectors productivity and employment. For instance, testing the theoretical conjectures, Algan et al. (2002), Behar and Mok (2015)[20] and Stepanyan et al. (2015), all examined the role of rents in the public sector and degree of substitutability of public employment for the impact of public employment on unemployment and private employment, and found crowing out effect of private sector employment induced by large public sector. Specifically, in their study, Boeri et al. (2000) include public employment along with labour market institutions, to investigate the impact of public sector jobs on private sector employment. Using a panel data from 1982-1995 from 19 OECD countries, their results reveals a positive correlation between large public size and unemployment rate, in particular, one job created in the public sector crowds out 0.3 private jobs. In the same vein, Algan et al. (2002) focused on 17 OECD countries with a panel data that covered the period 1960-2000, they found that an increased public employment crowds out private employment, such that one job created in the public sector destroys about 1.5 private jobs, while number of unemployed increased by 0.3 – evidence suggests that for every 100 public jobs created, crowds out private sector to add 33 unemployed workers overall, an indicative of full crowding out.

Similarly, Stepanyan et al. (2015) focused on 24 upper and middle income countries (which includes South Africa), using a dataset from 2005-2011. Using a pooled cross sectional panel technique, they found that, in many countries, large government size co-exists with persistently high unemployment rate, and these countries are prone to employment volatility, with highest variation observed in South Africa and Jordan. On crowing out effects, these authors found a larger crowding effect of public sector jobs on private sector employment as reported in Boeri et al. (2000), but smaller than Algan et al. (2002) and Behar et al. (2015), specifically, their inference indicates that creation of 100 of public jobs destroys 70 private jobs, on average.

Along the same line, Fieldmann (2009a,b) found a significant link between large government size and unemployment, while Fieldman (2007) reported same evidence for industrialised countries. By implication, large share of aggregate consumption (purchase of goods)[21] as a result of government size, and high spending to stimulate growth increases unemployment. In addition, Edin and Holmund (1997) used annual data for 22 OECD countries with a dataset from 1968-90, finds that public sector employment decreases unemployment in the short-run, with no significant long-run effect on the labour market.

On the deleterious effect government size (or high consumption spending) and unemployment; Aysu et al. (2011), investigate the relationship between government size and unemployment rate, focusing on 17 OECDs countries using data spanning 1990-2007 in a panel cointegration analysis, they reported an inverse relationship, but a positive effect on GDP. These author concludes that, the adverse impact of government size on unemployment rate is due to lower private sector

[20] Behar and Mok (2015) used fixed effect panel regression and GMM, and pay special attention to MCD countries- Middle East and Central Asia

[21] The results from the study of Finn (1998) on US economy reveals that public and private sectors respond positively a positive shock to goods purchased by government – public consumption, while same shock to government employment reduce jobs in the private sector

productivity and savings resulting from substitution effects of higher taxes and crowding out of private sector investment and production.

Similar to the findings of cross-country empirical studies, several country specific studies has reported the adverse influence of high government spending (in this case, government size) on labour market performance. For example, Amusa (2016), investigated the relationship between public spending and labour productivity using panel Cobb–Douglas production function[22], and found a strong evidence substantiating the negative effect of an increased government spending on labour productivity, meanwhile, an increase in private sector performance positively affect aggregate labour productivity. In a different empirical work. Murwirapachena et al. (2013) applied VECM to annual time series for South Africa spanning over 1980 to 2010. Their assessment on the influence of a large government size and spending, in terms of high government consumption (of purchased goods) and expenditure on labour market performance reveals that, while government consumption and tax has a positive effect on unemployment, government investment expenditure increases unemployment rate.

Finally, relevant to the empirical exercise in this paper, is the works of Holmund et al. (1993) and Calmfors et al. (1995) investigate the effect of temporary public employment programmes on the labour market performance, results shows that, apart from the former crowding jobs in public sectors, ensuing access to temporary public jobs exert a significant upward pressure on wages, this in turn, destroy jobs in the private sector.

Evidently, public employment plays a significant role in the medium term to long-term performance of the labour market (Stepanyan et al. 2015), yet, a large public sector (or government size) accompanied by high spending, not only crowds out private sector productivity required to create ample employment opportunities and ease constraints in the labour market, but also, lead to higher unemployment rate. In sum, it is best to reduce to reduce government size to tackle unemployment.

Putting it all together, empirical evidence suggests that public sector employment: (i) does not reduce unemployment, (ii) increase fiscal burden via high wage rate and demand for public jobs, (iii) inhibits long-term economic growth in private sector employment. By implication, a job creation in the public sector is detrimental to long term fiscal sustainability with limited benefits. An alternative means to reduce unemployment rate, poverty and inequality – fiscal allocations can be devoted to shore up social safety net for the poor (see Behar et al. 2015).

2.3. International Evidence: Mixed Impact of Public Works Programmes on High Poverty Incidence and Unemployment rate

Across the globe, PWPs enjoys widespread support from national government and international donors due to the flexibility of setting up and replicate these programmes, ease of decentralizing implementation functions in urban and rural areas, as well as, their employment intensive nature, which is, fundamentally based on implementation of infrastructure projects, which are predominantly labour intensive such as construction, road upgrade, irrigation, storm drainage,

[22]This model, explicitly includes the impact of private capital and productive public expenditure in socio-economic infrastructure (such as roads, electricity, and water and sanitation) on municipal labour productivity.

flora and fauna conservation, and so on, provides anecdotal evidence for an indirect benefit of PWPs in the form of creating public assets (e.g. see, McCord, 2008; Thwala, 2008).

Based on theories and vast empirical evidence: creation of assets via PWPs is anticipated to induce a positive effect on economic growth, and total factor productivity as a result of high capital accumulation (see Ashauer, 1986; Holtz-Eakin , 1988; Canning, 1999; Munnell, 1990, 1994; Aaron, 1990; Jorgenson, 1991; Tatom, 1991; World Bank, 1994; Pereira, 2000; Agénor et al. 2006) [23]. As already cited in the literature review, the empirical studies of Estache et al. (2007), Calderon et al. (2004), Estache, (2003) World Bank (2003) Chong et al. (2001), Estache et al. (2002) and Calderon and Chong – all established the positive impact of increased capital accumulation on income distribution and welfare gain, in effect, ameliorates poverty incidence and close inequality gap.

As earlier discussed, the general consensus in the literature studying the influence of large infrastructure-linked PWPs asserts that, to a larger extent, acting as a crucial social safety net in low - and middle - income countries, these programmes tends to reduce unemployment and poverty incidence by drawing poor households into productive work, provides means of income (wages) and mitigate rural-urban migration[24]. Nevertheless, there is limited (and anecdotal) evidence of indirect poverty-reducing benefits accrued to the poor in terms of sustainable income gain and skills/ training acquired from creation of productive asset[25] due to short duration of PWP schemes in conjunction with lack of and/or inadequate community participation in selection of useful public assets (see, e.g. McCord and Farrington, 2009; Subbarao, 2003; Mashiri and Mahapa, 2002; Haddad et al. 2001; Devereux, 2000; Lipton, 1996).

Albeit, despite the policy appeal of using PWP initiatives as a short-term policy measure in response to co-variate or transient shocks in the economy, the impact of these initiatives as employment-generating and poverty-reducing policy remains mixed. For instance, while ample evidence from extant literature affirmed that an effective PWP schemes can significantly reduce high poverty and unemployment rates[26]. On the contrary, in a cross-country study, Teklu and Asefa (1999) assessed the effectiveness of PWP initiatives in SSA (i.e. Botswana and Kenya), Asia and Latin America, and finds that public works programmes only reduces poverty intensity (poverty gap) rather than poverty incidence.

Conversely, some studies argued that consumption-smoothing is the primary benefit of short-term employment in response to acute or chronic crisis (cf. Holmes, et al. 2013:21; McCord and Farrington, 2008). Meanwhile, ample evidence from evaluation studies on PWPs indicates that the

[23] For evidence on For OECDs (Snieka et al. 2009; Jong-A-Pin et al. 2008), for Asian (Sahoo, 2010; Corong et al. 2012; Seneviratne et al. 2013); for Latin America (Pereira et al. 2005; Esfahani, 2002), for developing countries (Estache and Garsous, 2012; Kumo, 2012; Babatunde et al. 2012; Fedderke et al. 2006, 2008; Perkins, 2005; Rives, 1995). Albeit, Pereira and Andraz (2013), Omoshoro-Jones (2013), Romp and de Haan (2007), Gramlich (1994), and Munnell (1992) provide an excellent survey of literature on the impact of public infrastructure investment on economic growth, poverty incidence and inequality.

[24] See Omoshoro-Jones (2014), Holmes et al. (2013), Subbarao (1997, 2003, 2014), McCord and Slater (2009) for a quality and comprehensive cross-country surveys on variant types of implemented PWPs, and ample evidence on employment generating and poverty-reducing capability of these pro-poor programmes

[25] For example, road construction, building of schools, health care facilities etc.

[26] For example, see Del Nino et al. (2009) for India; Ahmed et al. (2014) and Subbarao (2001) for Bangladesh; Zimmerman (2014) for Ethiopia and Rwanda; McCutcheon et al. (2009); for Botswana and Kenya; Subbarao (2014) for India, Argentina and Ethiopia, Subbarao (1997) and Lipton (1998).

contributions of these programmes to reduce unemployment and poverty rate are inefficient and short-lived, whereas, the indirect effects of PWP through asset creation and skill enhancement of the poor remains weak.

However, of recent, there is a renewed debate on the cost effectiveness of PWPs, compared to other alternative social safety nets (e.g. cash transfers) solely due the relatively high financing costs, dead weight loss (setting generous wages) that causes price distortion in the labour market, and the inability these programmes to significantly lower poverty and unemployment rates in the long-run by facilitating self-employment, increase employability of participants in the domestic labour market, encourage household savings / investment in assets and improve the skills of beneficiaries through adequate training/education (McCord and Meth, 2011; Esau, 2004).

Drawing from international surveys, some of widely discussed large-scaled PWPs are: (i) the ongoing Maharashtra Employment Guarantee Scheme in India (MEGS), (ii) Argentina's Jefe's programme, (iii) Ethiopian Productive Safety Net Programmes (PSNP), and (iv) the New Deal programme during the Great Depression in the USA. Meanwhile, short-term PWPs are commonly implemented in developing countries such as the Padat Karya (PK) programme in Indonesia, the Expanded Public Works programmes (EPWP) in South Africa, Kenya Rural Access Roads Programmes (KRARP) in Kenya, Malawi Social Action Fund (MASAF) in Malawi and Tanzania Social Action Fund (TASAF) in Tanzania; Ethiopia's Productive Safety Net Program (PSNP) and Rwanda's Vision 2020 Umurenge Program (VUP)[27].

2.4. Regional Evidence: Impact of EPWP on High Poverty Incidence and Unemployment rate.

In brief, evaluation studies have been undertaken in developing countries to identify externalities created public works pprogrammes initiated as safety net. For instance, Gedamu (2006) survey on 200 households beneficiaries of food-for-work (FFW) programme in Ethiopia, and found an increase in consumption and nutrition levels of participants. In a separate study for Ethiopia, using difference-in-difference (DID) and propensity score matching (PSM) method on data from longitudinal household survey on FFW participants, Gilligan and Hoddinot (2006) reported that after 18 months of exiting PWP programme, there is an evidence of considerable increase in consumption and food security, and household savings.

Meanwhile, Jones (2004) examined the impact of CFW programme initiated by Oxfam in Afghanistan, in response to transient (drought) and cyclical crisis (in the agriculture sector), he finds evidence of decline in seasonal migration, sale of assets, soil erosion and water scarcity, asset provision and temporary income relief. In related evaluation study by Oxfam (2006) to assessed the impact of an Oxfam PWP designed as cash-for-work (CFW) in Niger rural areas, from the survey of 16 focus group discussions and semi-structure interview of participants randomly selected (out of 48 projects), results from this study provide evidence supporting general improvement in livelihoods of participants to about 54 percent, low seasonal migration, increased horizontal distribution, reduced disinvestment of asset and improved quality of food intake, and limited household savings (only 13 percent could afford to save).[28]

[27] See McCord (2008) for an extensive survey of PWPs.
[28] At least, 30% of household still use debt to improve consumption.

Elsewhere, Ofem and Ajayi (2008) analysed the effects of Youth Employment Scheme, an employment creation initiative in Nigeria. Using ordered probit regression model based on multi-stage sampling to analyse the survey response of 200 youths from 10 communities, they found positive but limited impact on the short-term job creation and wage transfer. Similarly, the result of separate survey studies assessing the impact of CFW/FFW programmes in Somalia by Montani and Ogden (2002) and Mattien and Ogden (2006), indicate a positive impact on beneficiaries derived from asset creation, income relief to prevent selling of assets and reliance on grants, improved productivity in agricultural sector due to earnings received in form of cash or agricultural products (e.g. seeds, fertilizers, tools etc), and improvement in consumption[29]. The combined effect of these programmes in Somalia act as catalyst to indirectly stimulate domestic economic growth and trade.

On the contrary, the success of PWP in other developing countries, especially, those with high growth rate, is not evident in South Africa following the implementation of the country's flagship public works programme, referred to as EPWP. Most notable inference from region-specific studies have shown that consumption smoothening associated with income transferred to poor as wages, is the main benefit accrued from the programme, whilst evidence of asset created, poverty reducing benefits, human capital accumulation due to adequate education/training are missing (see Mashiri et al.2002; McCord 2003; McCord and Farrington, 2008)[30].

To the best of our knowledge, only the works of McCord and Wilkinson (2009) assessed the effectiveness of self-targeting aim of expanded public works programme - EPWP (an archetype of PWP in South Africa) to reduce poverty and unemployment rate by exclusively attracting only the poor into productive labour-intensive work.

While McCord and van Seventer (2004) applied a dynamic SAM-based CGE model to examine the economic-wide impact of shifting from capital-intensive to labour-intensive work approach by the way of high government expenditure on two well-known labour-intensive EPWP initiatives. They found limited evidence to justify an increase in fiscal allocation to encourage labour-intensive instead of capital intensive – work approach in EPWP projects, in particular, compared to the latter, labour-intensive work approach has a relatively small effect on government revenue which is mainly driven by commodity and import taxes, but stimulates sectoral productivity, nonetheless, further results suggests that labour work approach exert an insignificant impact, only raised national employment by 1 percent, translating into 80,000 persons year equivalents out of about 8 million workers currently employed in South Africa at the time of this study. This raise the question of the real economic value of adopting labour intensive work approach to resolve the structural unemployment problem in the country. In addition, these authors found sizeable income (welfare gain) effects on households operating through multilier effects in the

[29] The survey of Mattien, et al. (2006) covered 400 beneficiaries using a semi-structure focus group discussion and interview.

[30]Amongst others, for district-specific evaluation studies on infrastructure-related PWPs in South Africa, see McCord et al. (2004, 2009), ESAU(2004), for Zimbabele and Gundo Lashu EPWPs implemented in Kwazulu-Natal and Limpopo; Khanyile (2008); Mfusi and Govender (2014); Mkhize (2012) for KwaZulu-Natal, Moyo(2013) for North West (Modimolla Integrated EPWP); Mothapo (2012) for Mpumlanga (Bushbuckridge municipality); Hough and Prozesky (2013) for Western Cape (Working for Water EPWP); Ghassi-Razzavi (2013) for Gauteng. Up till now, evaluation study is not available for Free State province. See Omoshoro-Jones (2014) for further discussion on district-specific evaluation studies in South Africa.

economy. Strikingly, the influence of labour-intensive work approach on economic growth is negligible.

Also, while Meth (2011) attempt to quantitatively assess the credibility of the performance of EPWP during the first phase (2004-2009) as reported by the national government (see NDPW, 2009) explicitly noting the: unreliable performance data reported by the national government, inadequate performance indicators, and the insignificant impact on the prevailing massive structural employment and poverty incidence[31]. Equally, McCutheon and Parkins (2009) investigates effectiveness of EPWP in both the first and second phase (2009-2013) taking into account both the budgetary and labour-intensiveness of implemented projects, evidence affirmed a dramatic decline in labour-intensity ratio of infrastructure-linked EPWP projects, indicating usage of capital intensive (business as usual) work approach, severely low employment of labour inputs, high operating costs, and low income transfers to the targeted unemployed poor.

In different analytical studies, NDPW (2012) and Omoshoro-Jones (2014) examined the labour intensiveness and effectiveness of EPWP as a risk coping policy tool that provides income transfers to participants. The scope of these analytical studies differs, since the former focused on cross-provincial analysis of all infrastructure-based EPWP projects from 2004-2011, and the latter focused on the completed two phases of EPWP (i.e. from 2004-2014) in a cross-provincial comparative analysis, as well as, provides an in-depth inter-district analysis for implemented programmes in the Free State. These authors found strong evidence of low labour intensity in the wide-range of implemented EPWPs associated with short duration of projects and inadequate trainings to enhance employability of beneficiaries in mainstream labour market as important binding constraints undermining the poverty reducing and employment generating effects of implemented public programmes.

Other studies, for example, McCord and Wilikinson (2009), Mtapuri (2014) and Heradien (2013) – all investigates the of EPWP's conceptual underpinnings, theoretical framework and objectives in comparison to other large scaled successful PWP initiatives elsewhere, subsequent findings reveals poor exit strategies to integrate beneficiaries into the labour market, shoddy project planning, extensive use of machines in lieu to labour-intensive work approach as legislated, little / no skill enhancement education and/or training provided –together, these debilitating factors erodes the relevance of EPWP schemes as a risk-coping safety net, as well as, the anticipated positive externalities of job creation and poverty reduction.

Further, Hough and Prozesky (2013) examine the extent of social protection (financial stability) and employment creation in EPWP schemes on labour market, he finds evidence supporting perverse behaviour among participants related to: (i) high dependency on jobs created due to generous, and uninterrupted stream of income, (ii) increased substitution effect, which undermines the self-targeting strategy to attract only the unemployed poor, as large proportion of casual workers elsewhere gain employment in implemented projects, thereby excluding the targeted unemployed poor, (iii) unwillingness to search for alternative jobs after projects have ended, but wait for the commencement of next project, and (iv) extended participation of beneficiaries beyond the stipulated two(2) years. All in all, despite the wage transfer benefits of EPWP initiatives, due to generous wages, these initiative are characterised with significant dead

[31] Also, see Meth (2007); McCord and Meth (2007).

weight losses, which induces fiscal burden, exclusion of the targeted unemployed poor, creates labour market distortion linked to varying rents (wages), and so on.

Indeed, Subbarao (1997) reported similar findings of higher wage rate for PWPs in Philippines, Kenya, Botswana and Tanzania, providing concrete support for Datt et.al (1994) findings, asserting that payment of high wage rate above the prevailing market wage (evident in India's Maharashtra Employment Guarantee Scheme) leads to an increased demand for public works employment, which in turn, cause job rationing – eroding the 'guarantee' element of the programme to create jobs for the unemployed poor.

Even though, international literature on public works programs (Subbarao et al. 1997;Subbarao 1997; Deolalikar 1995; von Braun, Teklu, and Webb 1992) concur that the multiple objectives of EPWP as a multiple-pronged policy tool is unique and precedent elsewhere in the world, yet, these multiple objectives negatively contribute to: ineffectiveness of the programme to simultaneously reduce poverty and unemployment and high operating costs linked to substantial budgetary pressures (see, e.g., Haddad et al. 2001; McCord, 2007; McCutheon et al. 2009). Simply put, the short duration of initiatives, low labour intensity of infrastructure-related projects, unequal wage setting triggers job substitution and exclusion of the poor, inadequate trainings/education, non-inclusive participation in selection of projects and beneficiaries by communities to enhance skills and incoherent institutional oversight are some of the constraints affecting the effectiveness of EPWP schemes in South Africa.

Over all, based on the theoretical notion and evidence that large-scaled public works programmes are significant policy strategies to employment generating and poverty-reducing effect, which in turn, support economic growth, output productivity and enhance labour market performance as more working age poor gain access into the mainstream labour market leading to a substantial improvement in labour market performance. It is worth mentioning that, in the case, where labour-intensity of infrastructure-linked PWP is high, it is expected that, substantial income is transferred to the poor as wages. Thus, in addition to human capital accumulation through prescribed trainings/ work experience gained by participants of PWP initiatives, over a long period of time, the creation of productive assets leads to accumulation of infrastructure capital, which exerts a positive, but an indirect effect on economic growth and factor productivity, this in turn, improves the labour market absorption rate, there by easing unemployment rate.

However, overwhelming evidence from extant literature on public employment works reveals that, in the absence of high economic growth (and employment intensive growth), high public spending on PWPs, in the short-run can reduce poverty incidence and unemployment rate, whereas, in the long-run, an insignificant impact is probable. On the other hand, low labour intensity of infrastructure-linked PWP could have an insignificant on economic growth and labour market performance (i.e. unemployment rate and poverty incidence).

Finally, as elucidated in the theoretical overview section, skills acquisition constitutes an increase in the stock of human capital, so such acquisition may in fact positively impact on economic growth. Yet, the available empirical evidence in South Africa does not provide significant support for this hypothesis, specifically, McCord (2003) finds that the performance of public sector infrastructure projects with respect to skills transfer (and employment generation) has not met the expectations of policy-makers, due to the short period of employment and the low-skilled nature of the available work. This suggests a limited or negligible scope for infrastructure to positively impact on economic growth through this channel.

3. METHODOLOGY

3.1. Data Treatment and Sources.

To ensure a robust model estimation, the nominal GDP-R and EPWPex variables are adjusted for inflation by headline consumer price index (CPI) to obtain real variables. Following this, both the CPI and real GDP-R seasonalised by employing the X-12 ARIMA programme in Eviews 8.

Before determine the presence of unit roots in the selected variables, to overcome the problem of data paucity, misspecification and spurious regression attributable to small sample size, and loss of degrees of freedom (d.f), the linear interpolation technique is used to generate quarterly data (from the initially available annual data) for all the selected variables, in so doing, extending the entire dataset to cover the period of 2005Q1-2013Q4[32]. Notably, all the selected time series variables were log-transformed. Additionally, Table 11, in the appendix provides the sources of used data, these include: Global Insight (Rex database), Statistics South Africa (StatsSA), National Treasury, and reported financial data by Free State Department of Public Works during annual budgetary allocation *Vote Speech* by Free State Department of Public Works, and published in the National Department of Public Work (NDPW) database. Specifically, the reported provincial financial data on EPWP initiatives were verified with the recorded figures in the NDPW database.

3.1.1. Motivation for Selected Variables and Description.

To explore the dynamic effects of the increasing government expenditure (*EPWPex*) on the labour performance of Free State province, in this paper, the unemployment rate (UNRATE), employment rate (EMP) and the total labour force (LABF) are selected dependent variables to capture the labour market performance, whereas, the real domestic economic is captured by using the regional economic growth (GDP-R).

The motivation behind the selected variables is that, foremost, theory and empirics asserts that, an increase in government expenditure on EPWP schemes is an indicative of high public spending that would not only expand the implemented schemes, but also generate employment and reduce poverty, as participants earn income, which stimulates household consumption expenditure on basic goods and effective demand, which in turn, raise aggregate production. The increase in local production due to rising demand for goods by poor households, results into a rise in demand for labour, thus generating employment opportunities facilitating accumulation of human and physical capital necessary to support economic and output growth. Noticeably, government expenditure on EPWP also represents a form of social spending to provide safety nets and risk coping mechanism for the poor with the inability to access to cash transfers, in this way, evidence suggests that access to streams of income (wages) by poor households, has a

[32] The small sample size, based on annual data is because, EPWP was formerly adopted in 2004, currently in its third implementation phase (each phase lasted for 5 years), at the national-, provincial-, and local district-level, the available expenditure data on EPWP is limited to only 10 years, i.e. 2004 – 2014. Apart from the small sample periods, the initial – annual format of all the time series presents a small sample size problem. By implication, without transforming all the selected variables to quarterly data, our estimated multivariate model will suffer from loss of degrees of freedom, misspecification and spurious inferences.

long-term effect on poverty incidence through savings, investments, and increased demand for intermediate inputs as production increases short run through.

Although, high government spending on public employment programmes can impose a sizeable positive effect on poverty alleviation (e.g. see, Sen, 1996; Agrawal, 2008), yet, in it is evident that, to a larger extent, temporary employment programmes induces distortionary effects on both the labour market and real economy, by directly hindering labour market performance and productivity, at the same time, indirectly compress economic growth, by exerting an upward pressure on wages (rents) in the private sector, leading to crowding out of labour productivity and destruction of jobs in the private sector, which is the engine of growth in terms of job creation and productivity (see, e.g. Holmund et al.1993; Calmfors et al.1995).

In other words, government's intervention in the economy to boost growth and improve labour performance by the way of higher public spending on employment creation programmes to increased public sector employment, an indicative of large government size; such policy strategy has an unintentional consequence of crowding out private sector employment, dampens aggregate productivity, create substantial fiscal burden, and, generally has an insignificant influence on unemployment rate[33]. In essence, there is a considerable evidence have established the crowding out effect of private sector employment by jobs created in the public sector in the developed and developing countries; thus affirming that an increased public sector employment, not only create substantial fiscal burden, but also, has an insignificant influence on unemployment rate. Put differently, public employment programmes do not reduce unemployment rate, albeit, these programmes are effective policy tool to reduce high unemployment and poverty incidence, if higher economic growth rate is achieved, and translates into employment-intensive growth.

In the context of our exploratory empirical exercise, on *priori,* the distributive effect of high public spending to amplify the positive impact of EPWP to reach large proportion of the poor could have a positive or negative (mixed) effect on economic growth variable (RGDP) and labour market performance (i.e. EMP and LABF variables) used in our analysis.

For example, for international evidence, in a country-specific study, Pereira et al. (2005) applied VAR to annual dataset from 1965-2001 for Portugal, and found empirical evidence supporting the positive impact of public sector investments on long-term economic performance, while, a cut in public investment in (transportation) infrastructure will exert a negative long-term effect on output growth and fiscal consolidation. Equally, in a cross-country, Aysu et al. (2011), used dataset for 17 OECD countries over the periods of 1990-2007 to investigate the relationship between government size and unemployment rate by applying a panel cointegration analysis, analogus to plethora evidence in the literature, he reported an inverse relationship between government spending and unemployment, but a positive impact on GDP. The author concludes that the adverse effect of government size on unemployment rate can be attributed to lower private sector productivity and savings resulting from a forceful substitution effects related to imposition of higher taxes and crowding out of private sector investment and production.

Similar evidence has been found for South Africa, for instance, Murwirapachena et al. (2013) assessed the impact of increased in government consumption (purchase of goods) proxied as public spending on labour market performance, he utilize vector autroregression error correction

[33] For example, see Cachuc (2002), Aysu (2011), Behar et al.(2015) and Stephayan et al. (2015).

(VECM) model and annual data for South Africa covering the period from 1980-2010. They found that, while government consumption and tax has positive effect on unemployment, government investment expenditure increases unemployment rate. Likewise, Kumo (2012) examine the feedback relationship and direction of causality between high infrastructure investment and economic growth utilising vector autoregression (VAR) and autoregressive distributed lag (ARDL) on a dataset covering 1960-2009 for South Africa.

Interestingly, while causality results from confirmed a bidirectional causality between government expenditure and economic growth, a forceful unidirectional causality between public sector employment and economic growth running from the latter to the former, in contrast, there is no causal link running from economic growth to private sector employment, indicating that economic growth may not directly translates into more employment in the private sector.

Secondly, since employment is the basic route to escape poverty, the EMP variable remains a key indicator to gauge the labour market performance in response to high government expenditure on EPWP. According to Khan (2001), in the context of ameliorating the exposure of the poor to transient shocks, the employment-poverty reduction nexus could operates via the following channel: (a) access to labour-intensive work that provides wages, (ii) rise in wage rate associated with an increase in labour demanded as production expands in response to effective demand by household, (c) skill enhancement trainings provided lowers income inequality, as well as, improves the employability of the poor and self-employment, thereby lowering poverty incidence (d) an increase in economic growth facilitated by technology advancement that is largely employment intensive and cause shift of labour input into highly productive sectors.

Conversely, the UNEMP variable is another key variable to labour market performance in terms of absorption rate since the inaccessibility of the poor to the labour market is often associated with low skill level, lack of work experience and lack of employment opportunities, these factors effectively exclude the poor from accruing the benefit of economic growth (Islam, 2004). In other instances, where economic growth is insufficient to support the growing population of new entrants into the labour market, unemployment rate (UNEMP) tends to rise.

Finally, it general consensus in the literature studying economic growth-poverty-inequality nexus agreed that economic growth (GDP) is the most single important factor influencing poverty, evident by the inverse relationship between per capital income and poverty indicators (see Ames et al.2001; Dollar and Kray 2001, Deaton and Dreze, 2001; Datt and Ravallion, 2002). In the literature, higher economic growth reduces poverty by inducing higher employment and higher real wages (Ravallion and Datt, 1996).

It is worth noting that, because the focal lens of our empirical analysis is explicitly regional-specific, in our case, the Free State province, the investigate the impact of high spending on public works programme (i.e. EPWP) on domestic output growth at provincial level, the regional GDP (hereafter GDP-R) variable is utilised computed by Statistics South Africa (StatsSA) is used. Although, the estimated gross value added for the province (GVA-R) could have been used in lieu of GDP, nonetheless, there is a strong endogeneity relationship these variables. To build a parsimonious model, following previous empirical studies in the public infrastructure literature, we opt for the provincial GDP (referred to as GDP-R), which represents the total sum of gross value added by all resident producers in the local economy plus any product taxes minus subsidies not included in the value of the products. Therefore, on priori *ground*, we anticipate the following relationship between the increasing public spending on EPWP, economic growth and labour market performance, as succinctly highlighted in Table 1.

Table 1: Expected Coefficient Signs of Estimated Variables on Priori grounds

Variables	Expected Coefficient Signs	Rationale
GDPR	-ve or +ve	High labour intensity emanating from implemented infrastructure linked EPWP projects can directly foster a positive correlation between infrastructure investment and GDP via creation of productive asset that enhance public capital accumulation. Other possible channels for positive impact on GDP are income gain and effective demand generated via multiplier effect in the local economy. On the contrary, low labour intensity of infrastructure projects, the low nature of skills acquired, and excessive public investment on infrastructure projects could lead to a negative or insignificant impact of high infrastructure spending on EPWP initiatives on GDP, crowding out of private sector employment (i.e. job destruction) sector, in effect, dampening the labour productivity needed for GDP growth.
LABF	+ve	The transient job opportunity created by EPWP is expected to increase labour participation rate in the short-run, as the unemployed poor are drawn into productive and renumerative work due to short duration of projects.
UNEMP	-ve	Crowding out effect of public sector jobs on private sector employment, high job substitutability associated with generous rents in the public sector, high job rationing owed to excessive demand for EPWP jobs – altogether could yield a negligible (adverse) impact of high public spending on EPWP on unemployment rate.
EMP	+ve and -ve	As a result of transitory rise in labour force participation rate created by access to temporary productive work in the public sector, labour market constraints is expected to ease somewhat, leading to a slight improvement in employment rate, nonetheless, in the short run, with no lasting impact on the labour market and/or the real economy.

3.1.2. Descriptive Statistics of Data

A bird's eye view of the statistical properties of all the five selected variables shows that GDP-R, EMP and UNEMP series are non-normal distribution, but the EPWPex and LABF are normally distributed because the Jacque-Bera (JB) ratio is significant, in addition, according to Kurtosis, all variables exhibits leptokurtic features.

Table 2: Descriptive Statistics of Variables

Variables	EPWPEX	REALGDP	LABF	EMP	UNEMP
Mean	46893736	25529989	1035207.	742778.5	292429.0
Median	15602625	26759638	1031451.	746494.5	288833.5
Maximum	1.94E+08	36369299	1060708.	766061.0	340632.0
Minimum	7857000.	12435550	1028602.	700078.0	265505.0
Std. Dev.	60540169	5900063.	8224.699	18966.31	21794.02
Skewness	1.478981	-0.542988	1.788235	-0.908187	0.548108
Kurtosis	3.478631	2.621743	5.232773	2.761715	2.238504
Jarque-Bera	13.46794	1.983634	26.66461	5.033986	2.672350
Probability	0.001190	0.370902	0.000002	0.080702	0.262849
Sum	1.69E+09	9.19E+08	37267465	26740026	10527446
Sum Sq. Dev.	1.28E+17	1.22E+15	2.37E+09	1.26E+10	1.66E+10
Observations	36	36	36	36	36

3.2. Models Specification

Because, our empirical objective of this paper is to examine the impact of an intensified government efforts to expand initiatives as a critical safety net with employment creation and poverty-reducing effects, which improves labour market performance, and economic growth, a phenomenon associated with fall in income and skill inequality operating directly through the steady flow of income transfer (wages) and indirectly via quality on-the-job work experience / skills enhancement trainings (human capital accumulation) provided. For the purpose of our analysis, we estimate a multivariate variable model, the hypothesized model to study the capture the influence of an increased spending on temporary public employment programme (in this case, EPWP) on growth rate, labour force participation rate, unemployment and employment levels can be mathematically represented as:

$$\log EPWP_{ex} = f(\log GDPR, \log LABF, \log UNEMP, \log EMP) \qquad (1.1)$$

From Eq. (1.1), government spending on EPWP is linear function of domestic economic growth and labour market indicators treated as endogenous variables. Because the linear model estimated in Eq.(1.1) in insufficient to capture possible dynamic feedback (long-run and short-run), as well as, causality relationships that might exists among the exogenous and endogenous variables modelled in Eq.(1.1). To assess the stationarity properties of the time series, Eq. 1.1 is re-specified as an auxiliary multivariate regression computed as:

$$\ln EPWP_{ex} = b_0 + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + e_t \qquad (1.2)$$

where b_0 denotes the constant, while $b_{1,}\ b_{2,}\ b_3$ and $b_{n,t}$ represents the coefficients of the endogenous variables, $x_1, x_2, x_3,$ and x_4 represents the natural logarithms of GDP, LABF, UNEMP and EMP, while e_t represent idiosyncratic shocks – residuals in the system. To avoid drawing erroneous inferences based on spurious statistical relationship(s) and properties of the time series associated with the presence of unit root. To do this, visual inspection of the correlograms of all the variables indicate the presence of unit root problem in all the selected variables suggesting the need for differencing to obtain stationary series. Yet, a formal stationarity test is required, as such, the Dickey Fuller-GLS and Phillip-Perron (PP) unit root tests were employed to establish the stationarity of selected variables with Schwarz Info Criterion (SIC) to select maximum number of lags.

For the purpose of the outlined empirical objective, first, to capture possible interrelationship between high public spending on EPWP schemes, the real economy and domestic labour market in Free State, an autoregressive moving average (ARIMA) fitted ordinary least square (OLS) model was computed. Second, in the literature, a vector autoregression (VAR) and/or vector error correction (VECM) models could be employed to examine possible feedback dynamics between selected variables, as well as long-run and short-run relationships between the selected variables. Albeit, the presence of (at least one) long-run relationship among these variables, indicating possible cointegration is the main determinant to specify a VECM model.

In the contemporary, the Johansen-Julieus (JJ) cointegration test is generally preferred to identify the number of cointegrating matrix in a VAR system, rather than Engle and Granger's two step method because the former allows all variables in a system to be modelled as independent variables while maintain the same cointegration result. In an instance, where there is no long-run relationship between variables, then, a VAR model can be estimated. Therefore, we estimated VAR model due to the evidence of long-run relationship among the selected variables as according to the Johansen-Julieus' cointegration test.

However, in our constructed unrestricted VAR model, the impulse response function (IRF) and Variance decomposition were used to analyse the response of economic growth and labour market indicators to innovations (positive shocks) from an increased government spending on EPWP schemes. Thirdly, to identify influence of the selected endogenous variables on the EPWP variable (i.e. short run dynamics) Wald coefficient test carried out on the variables estimated in the VAR system. Adding to this, we applied Granger Causality test to determine whether the direction of causality between the variables. It is worth noting that, in practice, the Granger causality results can be used to corroborate the short-run interrelationship (or the nonexistence thereof) observed from the Wald Test, in this case, Granger causality test becomes a powerful analytical tool.

3.2.1. Model 1: Constructing the Autogressive Moving Average Model (ARIMA)

Given that the variables in Eq 1.1 are stationary after *differencing*, confirmed by the results DF-GLS and PP tests, to compute a parsimonious model, an ARIMA(p,d,q)-OLS fitted model is constructed, where, p denotes the order of the autoregressive series, d represents the integration order of variables, and q indicates the order of the moving average (MA) series. This can be written mathematically written as:

$$(1-B)^d Y_t = h + \left(\frac{q(B)}{f(\mathrm{B})}\right) e_t \quad \text{for } [Y_t : 1 \le t \le n] \qquad (1.3)$$

where, t denotes time, h represent the mean term, while B denotes the backshift operator that is, $BX_t = X_{t-1}$. Whereas, $q(B)$ denotes the AR process indicated as a polynomial in the back shift operator $q(B) = 1 - f_1 B - \ldots - f_p B^p$, and the MA operator is represented by $q(B) = 1 - q_1 B - \ldots - q_q B^q$ in the backshift operator, while e_t is the independent (random) error term with intensity s^2.

Following the rigorous Box-Jenkins Methodology[34] to obtain a parsimonious ARIMA-OLS model, an ARIMA (2,2,1) model is constructed. Additionally, we account for quarterly seasonality by

[34] Box-Jenkins methodology entails: (i) model specification - selection of most appropriate lags for AR and MA, as well as, determining if selected variables require first-differencing to induce stationarity. Here the autocorrelation function (ACF) and partial autocorrelation function (PACF) are used in addition to information criteria to identify the best model; (ii) estimate OLS fitted ARIMA model, and (iii) carry out battery of special diagnostic tests (e.g. ARMA root structure test, IRF, Correlogram – Ljung Box or Q statistic test, Frequency spectrum, as well as, general tests such as JB normality test, serial correlation and heteroscedasticity tests on the error term. If specified model fails the diagnostic tests, then, model requires re-estimation, usually by adding more variables.

including seasonal AR and MA term in the model. See Table 12 for results on seasonal ARIMA-OLS Model

3.2.2. <u>Model 2:</u> Specification of the unrestricted VAR model

As earlier discussed, to determine the long-run association in the selected variables, foremost, we test for cointegration using the Johansen-Julieus cointegration test. Particularly. This procedure of testing for possible long-run association among variables, relies on the relationship between the rank of matrix and its characteristic roots and then estimates long-run relationship between non-stationary variables using maximum-likelihood procedure. Based on the rank of the coefficient matrix P of the equation, the test equation of the approach is of the form,

$$\mathrm{D}X_t = \mathrm{G}_1\mathrm{D}X_{t-1} + \mathrm{D}X_{t-2} + \ldots + \mathrm{G}_{k-1}\mathrm{D}X_{t-h} + \mathrm{P}\,\mathrm{D}X_{t-k} + f + e_t \qquad (1.4)$$

Where X_t is a $k+1$ vector of series integrated order one, $I(1)$ variables of $\mathrm{G}_1,\ldots,\mathrm{G}_{k-1}$, while P denotes $k \times k$ matrices of unknown parameters and contains information about the cointegration relationships. Thus, the null hypothesis for r cointegrating vector is that P has a reduced rank, $r < k$. By implication the reduced rank is suggests that $\mathrm{D}X_t$ is stationary and X_t is non-stationary. In this case, the absence of cointegrating vectors results into a rank of P equals to zero, indicating no long-run relationships (i.e. stationary combination) between the variables, on the other hand, if P is between r and k, it implies that, there exists r cointegrating vectors and the X variables are cointegrated. Meanwhile, a full rank of P suggests that all elements of X are stationary.

The Maximum Eigenvalue statistic tests the null hypothesis of r cointegrating relations against the alternative $r+1$ cointegrating relations for $r = 0,1,2\ldots n-1$. This test statistics are computed as:

$$LR_{\max}\left(\frac{r}{n+1}\right) = -T * \log(1 - \hat{j}) \qquad (1.5)$$

Where j is the Maximum Eingenvalue, and T is represents the sample size. In contrast, the Trace statistics investigate the null hypothesis of r cointegrating relations, where, n denotes the number of variables in the system for $r = 0,1,2\ldots n-1$. Trace statistic test is estimated as:

$$LR_{tr}\left(\frac{r}{n}\right) = -T * \sum_{i=r+1}^{n} \log(1 - \hat{j}_i) \qquad (1.6)$$

In equations 1.4 and 1.5, $\hat{j}_i$ is the estimated values of the characteristic roots generated from the P matrix, r represents the number of cointegrating vectors, and T equals the number of observations. It is worth mentioning that, in some cases, the Maximum Eingenvalue and Trace tests could provide varying results (Alexander, 2001), in this case, the result of trace should be preferred (e.g., see Asari, et al.2011).

Based on the evidence of no long-run relationship (see the next section), we proceed to estimate an unrestricted VAR model. Adopting the VAR modelling technique developed by Sim (1980), using Eq. 1.1., in this paper, we follow Pesearan et al. (2001), by constructing a multivariate vector autoregressive (VAR) of order p, denoted by $VAR(p)$ explicitly to investigate the influence of high public spending on an archetype temporary public employment programme (in this case EPWP) initiated at local level, on economic activities and labour market performance as:

$$(1-L)\begin{bmatrix} \mathrm{D}EPWP_{ex} \\ \mathrm{D}GDP \\ \mathrm{D}LABF \\ \mathrm{D}UENMP \\ \mathrm{D}EMP \end{bmatrix} = \begin{bmatrix} a_1 & d_1 \\ a_2 & d_2 \\ a_3 & d_3 \\ a_4 & d_3 \end{bmatrix} \begin{pmatrix} 1 \\ e_{t-1} \end{pmatrix} + \sum_{t=1}^{n} (1-L) \begin{bmatrix} b_{11i} & b_{12i} & b_{13i} & b_{14} \\ b_{21i} & b_{22i} & b_{23i} & b_{24} \\ b_{31i} & b_{32i} & b_{33i} & b_{34} \\ b_{41i} & b_{42i} & b_{43i} & b_{44} \end{bmatrix} \begin{bmatrix} \mathrm{D}EPWP_{ex,t-i} \\ \mathrm{D}GDP_{t-i} \\ \mathrm{D}LABF_{t-i} \\ \mathrm{D}UENMP_{t-i} \\ \mathrm{D}EMP_{t-i} \end{bmatrix} + \begin{bmatrix} e_{1it} \\ e_{2it} \\ e_{3it} \\ e_{4it} \end{bmatrix} \quad (1.7)$$

Where, L is the lag operator and $(1-L)$ is the difference operator such that $(1-L)\,y_t = y_t - y_{t-1}$ represents the first difference of each of the variables in the VAR system, and e_t is the stationary residuals from the integration equations generated in the system in the form of:

$$y_t = b_0 + b_1 Z_t + b_2 Z_t + b_3 Z_t + b_4 Z_t + e_t \quad (1.8)$$

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Post-Estimation Diagnostic Tests

The stationarity test results depicted in Table 3 confirmed that the selected variables are not stationary in levels, $I(0)$ but at second difference, implying an $I(2)$ series, with the exception of $EPWP_{ex}$ variable that can be modelled as $I(1) or\ I(2)$ series.

Table 3: Stationarity (Unit root) Test

	DF-GLS Test Statistics			PP		
Variables	**Level**	**1st Diff**	**2nd Diff**	**Level**	**1st Diff**	**2nd Diff**
$\ln EPWP_{ex}$	-0.684	-2.612**,*	-6.636***,**,*	0.245	-2.614	-6.614***,**,*
$\ln GDPR$	-2.251**,*	-2.049**,*	-6.210***,**,*	-1.989	-2.173	-6.172***,**,*
$\ln LABF$	-1.749*	-0.443	-6.052***,**,*	-3.947***,**,*	-1.199	-6.165***,**,*
$\ln UNEMP$	-2.292**,*	-0.589	-5.806***,**,*	-0.3445	-0.656	-5.743***,**,*
$\ln EMP$	-1.140	-1.215	-5.659***,**,*	1.042	-1.230	-5.569***,**,*

Test Critical Values for DF-GLS at 1% level =-2.635, 5% level =-1.951 and 10% =-1.611, while the Adj.t-Stats for PP test at 1% level =-3.646, 5% =-2.954, and 10% = -2.616.
***,** &* denote *p-value* at 1%, 5% and 10%

4.1.1. The Seasonal ARIMA MODEL

The parsimonious ARIMA-OLS model constructed include seasonal AR and MA terms, to account for seasonality in the quarterly data. The ARIMA (2,2,1) model with seasonal autoregressive and moving average terms is constructed such that, the AR(1) (AR(2) and SAR(4) is estimated as:

$$\left(1-\rho_1 L-\rho_2 L^2\right)\left(1-\theta L^4\right)u_t=\varepsilon_t \qquad (1.9)$$

where, the estimated error structure of the higher order AR polynomial and seasonal term modelled in Eq. 1.9 is computed as:

$$u_t=\rho_1 u_{t-1}+\rho_2 u_{t-2}+\theta_{t-4}+\varepsilon_t \qquad (1.10)$$

Meanwhile, the estimate MA (1) and SMA (4) is fitted into the OLS model as:

$$\left(\beta_1\varphi_t\right)+u_t \qquad (1.11)$$

From, Eq. 1.11, the he lag operator for MA is estimated as:

$$u_t=(1+\varphi_1 L)(1+\omega L^4)\varepsilon_t \qquad (1.12)$$

such that, the error process of the MA term is equivalent to:

$$u_t=\varepsilon_t+\varphi_1\varepsilon_{t-1}+\omega\varphi_{t-4} \qquad (1.13)$$

Before analysing the results of the constructed ARIMA-OLS fitted model, it is imperative to assess the stability of the model, stationarity, and subject the error terms to battery of tests. The results of relevant diagnostic test is tabulated in TABLE . Notably, the estimated model is free from serial correlation, heteroscedacity, while the residuals are normally distributed. Looking at the reported adjusted R^2 and R^2 - a crucial statistics to assess the fitness of a well-specified model shows that the estimated model is robust, devoid of spurious regression and useful to make tangible inference.

However, for parsimonious ARMA model, the (co-variance) stationarity (or stability) and invertability of the AR and MA roots are more important to determine a well specified model. The estimated model passed all the stationarity, stability and invertability tests as graphically illustrated in Fig. 3 to Fig. 6 (in the appendix) That is, first, the estimated ARMA root structure test shows that the roots of the AR and MA including the seasonal terms are inside the unit circle indicating that the model is stationary and invertible. It can be noted that, If specified model is not invertible and the roots of AR and MA terms are outside the unit circle, it implies that, the estimated residuals of the model cannot be considered as estimates of the true random shocks, and confirm the presence of a unit root problem.

Second, the stability of the estimated ARIMA model is further reinforced by the sum of coefficients of $\rho_1, \rho_2, \theta, \beta_1, \varphi$ that is less than unity, indicating that the estimated model is not explosive and do not suffer from imaginary MA roots with modulus greater than unity. Another condition for stationarity of ARIMA model is the convergence of impulse responses to zero.

Third, as reflect in Fig. 5, the estimated ARMA model is stationary, the impulse responses will asymptote to zero (converge to zero), while the accumulated responses will asymptote to its long-run value[35]. Fourthly, it is imperative to confirm rigorously examine the stability of ARMA models by considering the correlogram (i.e. the pattern of both the autocorrelation and partial autocorrelation functions) since the correlogram compares the autocorrelation pattern of the structural residuals and that of the estimated model for a specified number of periods (note that, the structural residuals are the residuals after removing the effect of the fitted exogenous regressors but *not* the ARMA terms).

Therefore, for a properly specified model, the residual and theoretical (estimated) autocorrelations and partial autocorrelations should be "close". As expected, the residual and estimated autocorrelations and partial autocorrelations functions of the estimated seasonal ARIMA-OLS fitted model is exhibits a tight relationship as illustrated in Fig. 4 (in the appendix). Finally, the frequency spectrum of the estimated ARIMA model frequency, λ is symmetric around zero as shown in Fig. 5[36].

[35] The ARMA impulse response view traces the response of the ARMA part of the estimated equation to shocks in the innovation Therefore, An impulse response function traces the response to a one-time shock in the innovation. The accumulated response is the accumulated sum of the impulse responses. It can be interpreted as the response to step impulse where the same shock occurs in every period from the first.

[36] Here, λ is measured in radians, and thus takes values $-\pi$ from to π , such that frequency spectrum of the ARMA is symmetric around 0, i.e. in the range [π, 0]

Table 4: Diagnostic Tests Result for the Computed Seasonal ARIMA-OLS Model

Name of Test	**Ho = Null hypothesis**		**Conclusion**
Misspecification/ Stability test:			
ARMA Structure Roots Tests	ARIMA is invertible and (covariance stationary)		ARMA model is invertible and stationary
	ARMA is explosive, AR and MA roots lies outside the unit circle		AR and MA roots are inside the unit circle. No imaginary AR or MA roots.
Residual Tests	**Ho = Null hypothesis**	**Test Statistic**	***p-value***
Ljung-Box Q	No 16th order autocorrelation in residual	$LB_Q(16)=12.449$	0.132
Ljung-Box Q^2	No 16th order autocorrelation in residual	$LB_Q(16)=10.087$	0.08
Breusch-Godfrey	No 2nd order autocorrelation in residual	$nR^2(2)=6.586$	0.159
Gelsjer test	No 2nd order autocorrelation in residual	$nR^2(2)=4.309$	0.365
ARCH-LM	No 2nd order autoregressive conditional heteroscedacity	$nR^2(2)=0.414$	0.519
JB normality Test	Residual are normally distributed	0.373	0.829

Having follow the outlined procedure, and ensure that the estimated seasonally ARIMA-OLS model is stable, invertible, and free of serial correlation, heteroscedacity, and so on. The estimation of the parsimonious seasonal ARIMA–OLS fitted is presented in Eqs. 1.14 and 1.15 denoting the OLS and ARIMA parts of the estimated model respectively, such that:

$$\left.\begin{array}{l}\Delta EPWP_{ex} = \underset{[0.02]}{\underset{(0.25)}{0.023}} - \underset{[0.22]}{\underset{(0.02)}{0.55}} * \Delta(lrgdp-(2)) + \underset{[244.79]}{\underset{(0.00)}{1314.74}} * \Delta(llabf-(2)) - \underset{[174.63]}{\underset{(0.00)}{888.37}} * \Delta(lemp-(2)) \\ \qquad - \underset{[63.48]}{\underset{(0.00)}{308.10}} * \Delta(lunemp-(2)) + u_t \end{array}\right\} \quad (1.14)$$

$$\left(1+0.35L\right)\left(1-0.29L^4\right)u_t = \left(1+0.63L\right)\left(1-0.877L^4\right)\Big\} \text{ ARIMA model} \qquad (1.15)$$

where, DW=2.09 AdjR^2 = 0.68 R^2=0.77, SE=0.09
S.E = [ ] in parenthesis, p-values = ( ) in parenthesis, **p<0.05 (highly significant)

See the appendix for a detailed tabulated results of the ARIMA-OLS fitted model

From Eqs. 1.14 and 1.15, all empirical results are strongly statistically significant at 0.05 level, and they suggests that, high public spending on expanded public works programme at provincial level (taken as a large government size), induce: (i) a negative impact on domestic economic growth. This result is consistent with the findings of Fedderke and Bogetic (2006) and Kumo (2012) for South Africa, Jong-A-Pin and de Haan (2008) for OECD countries, (ii) a positive correlation with labour force participation rates, as such, high public spending tends to absorb unemployment poor into the labour market to engage in productive work. Sen (1996); Islam (2004), Agrawal (2008) Khan (2001), World Bank (2001), Zimmermann (2014) reported similar findings for public employment programmes, (iii) negatively affects unemployment rate. This finding is consistent with the results of several country-specific or cross country studies undertaken by Stepanyan et al. (2015), Amusa (2016), and Murwirapachena et al. (2013) for South Africa; Behar and Mok (2015); Aysu et al. (2011), Fieldmann (2007,2009), Algan et al. (2002), Cachuc (2002) and Boeri et al.(2000) for OECD countries; Pereira (2000) for U.S, Pereira et al. (2005) for Portugal; Holmund et al. (1997) and Calmfors et al (1995) for temporary public employment programmes in OECD countries.

The rationale for the negative correlation between high spending on public employment programmes are attributable to crowding out of private sector labour productivity, and destruction of jobs in the private sectors due to increased jobs in the public sector, higher rents paid to workers in public jobs associated with increase job substitution and misallocation of labout inputs, and so on. Other factors could be low nature of skills acquired by beneficiaries of public works programme that hamper the employability of beneficiaries in the mainstream labour market (McCoord and Farrington, 2008), intense job rationing linked to excessive demand for EPWP jobs (McCutheon and Parkins, 2009), and son on, and (iv) a reducing effect on unemployment. This is in line with the findings of Zimmerman (2015); Ahmed et al. (2014) for Bangladesh; Corong et al. (2012) for Philippines, McCord et al. (2004), Rodrik (1998) and so on. (See Table 1 for additional motivation for these mixed results).

4.1.2. The VAR MODEL

Preceding the Johansen cointegration test, it is expected that the lag length used to compute the unrestricted VAR model is small enough to allow for estimation, at the same time, high enough to ensure that errors are approximately of white noise. Therefore to determine the robustness of the estimated VAR model to capture short-run dynamics, in this paper, the maximum lags length chosen is three (3) to allow adequate adjustment in the model as well as well-behaved residuals. The lag length criteria results tabulated in Table 5 shows a strong convergence among all the five different information criteria viz: sequential modified LR test Statistic (LR), final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ), with an irrefutable conclusion that the optimal lag length the VAR model is one (1).

Table 5: Lag Order Selection Criteria

Sample: 2005Q1 2013Q4
No. of observations: 32

Lag	LogL	LR	FPE	AIC	SC	HQ
1	407.9427	NA	2.71e-16*	-24.49642*	-23.76355*	-24.25349*
2	410.5513	3.912880	6.51e-16	-23.65946	-22.19372	-23.17361
3	416.7826	7.789160	1.34e-15	-23.04891	-20.85031	-22.32014

** indicates lag order selected by the criterion*
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Based on the optimal lag length result, an unrestricted VAR (1,1) is estimated. It worth noting that, to prevent endogeneity effect, the EMP variable is excluded from the VAR model, since the influence of public work progarmmes on labour market performance can be sufficiently captured with the UNEMP variable.

- ***Testing for Long-run Relationship: Johansen Cointegration Test***

Therefore, to test for cointegration relationship between the remaining four variables, the Johansen-Julieus test is applied. Results of the cointegration test reported in Table 6, both the Trace and Maximum-Eingevalue (at 0.05 percent significant value) suggests no long-run relationship between the public expenditure on EPWP, economic growth and labour market performance proxied as labour participation and unemployment rates.

Table 6: Bivariate Johansen and Julieus Cointegration Test

Trace Test			Maximum Eingenvalue Tests		
Null hyp	Trace Statistic	Critical Value 95%	Null hyp	Max-Eigen Statistics	Critical Value 95%
$r=0$	31.974 [0.614]	47.856[§]	$r=0$	14.819 [0.762]	27.584[§]
$r \leq 1$	17.156 [0.629]	29.797[§]	$r \leq 1$	11.280 [0.619]	21.131[§]
$r \leq 2$	5.876 [0.710]	15.494[§]	$r \leq 2$	5.448 [0.685]	14.265[§]
$r \leq 3$	0.428 [0.513]	3.841[§]	$r \leq 3$	0.428 [0.513]	3.841[§]

Note, Eigenvalue for both the unrestricted cointegration rank test for Trace and Maximum Eigenvalue are: 0.362, 0.289, 0.152, 0.013 for $r=0,\ r \leq 1,\ r \leq 2\ and\ r \leq 3$

[§]*Fail to reject null hypothesis, numbers in [ ] denotes p-values.*

To analyse the short-run dynamics of the selected variables, we proceed to compute an unrestricted model as elucidated in Eq.1.7. Note that, out the generated system of equations in the VAR model, we only focused on the equation, where public spending on EPWP is modelled as exogenous variable, while the lags of GDPR, LABF, UNEMP appeared as endogenous variables, as written in Eq. 1.16:

$$\Delta \ln EPWP_{ex} = 0.64 * \Delta \ln epwp_{ex}(-1) - 0.09 * \Delta \ln rgdp(-1) - 7.58 * \Delta \ln labf(-1) + 1.80 * \Delta \ln unemp(-1) + \varepsilon_t \quad (1.16)$$

To ascertain the validity of the inference in Eq. 1.16, the residuals of the VAR model was subjected to battery of diagnostic tests, as presented in TABLE . It is evident that the residuals are well behaved, implying that the estimated VAR model is robust and well specified.

From equation 1.16, it is evident that, in the short-run, an increased public expenditure on EPWP initiatives has an adversely on lagged variables of economic growth and labour productivity in the province, possibly operating through crowding out effect of – and destruction of private sector employment evidence by low participation of private sector in the economy, weaken private investment in large infrastructure projects, low labour intensity of implemented infrastructure-linked EPWP projects, high job substutability and job rationing linked to generous wage, and so on. This findings is consistent with corroborates the result of the seasonal ARIMA regression, and consistent with reported findings of Behar and Mok (2015), Stepayan et al.(2015), Aysu et al.(2011), Algan et al. (2002), Cachuc (2002), Boeri et al.(2000), Holmund et al. (1997) and Calmfors et al. (1995). See detailed output of Eq. 1.16 is reported in TABLE, .

Additionally, we assess whether the endogenous variables in Eq. 1.16 are significant to explain changes in the public spending on EPWP, to do this, we estimate the VAR models as a system of coefficients. See Table 13 in appendix for detailed estimation. The *p-value* of the coefficient for EPWPex, GDP, LABF, and UNEMP exceeds 5% significance level, indicating that the lags of economic growth rate, and labour market indicators cannot explain any changes in the EPWPex variable, this finding also, point towards the evidence of nonexistence of short-run association between the selected variables. On the other hand, this particular inference is crucial, and it implies that the increased budget allocation on public employment programmes in the Free State is not triggered by output growth, economic activities and labour market conditions. In other words, there are other external factors, such as, institutional influence associated with political goals, pre-set socio-economic mandates, and so on.

- ***Evidence of Short-Run Dynamics: Wald Test and Granger Causality Test.***

Despite the empirical finding of no long-run relationship between the selected variables computed in Eq.1.2, the likelihood of short-run feedback dynamics to exist between these variables. In this paper, we simultaneously investigate the evidence of a possible short-run dynamics, and causality using the Wald coefficient test and Granger Causality respectively.

Firstly, based on the hypothesis that the coefficients of the estimated output of lagged variables Eq. 1.16, is equal to zero, that is, $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$, as the null-hypothesis. The obtained Wald statistics (*F-statistics*) for the joint hypothesis reported in Table 14 (in the appendix) are statically insignificant, as *p-value* exceeds the 5% significance level, as a result, we fail to reject the null hypothesis, concluding that there is no short-run relationship between the selected variables in the VAR model.

Table 7: WALD Test: Coefficient Test for (F-Test) Joint Significance Hypothesis

System: SYS03_ROBUSTVAR_FMODEL

Test Statistic	Value	df	Probability
Chi-square	0.539057	3	0.9102

Null Hypothesis: C(2)=C(3)=C(4)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	-0.095726	0.309713
C(3)	-7.582661	17.45621
C(4)	1.808499	2.665644

Restrictions are linear in coefficients.

By implication, the provincial GDP, LABF, UNEMP cannot jointly influence government's spending on EPWP schemes. This finding corroborates previous result that the economic growth, labour force participation rate and unemployment variables are insufficient to explain possible changes (increase or decrease) in public spending on EPWP.

As cited in the literature reviewed in section 2, large body of studies on public infrastructure investment (or government spending), as well as, the size of government typically attempt to identify the direction of causality between infrastructure, economic growth, public sector and private (un)employment, and in some cases, income per capita (to account for inequality). Intuitively, the presence of cointegration – i.e. long-run relationship between two or more variables does not mean there is causal relation, if any, between these variables.

Economic theories and empirics ascertain that the likelihood of unidirectional causality running from one variable to the other is conceivable. In this paper, both the short run feedback and direction of causality is examined using Granger Causality[37] test on the variables estimated in the VAR model; obtained results are presented in Table 8, as pair-wise analyses. Note, significant *p-values* denote rejection of the null hypothesis. The result of the performed Granger Causality test provides a compelling support for the inferences of both the Wald test and coefficient test. By implication, the analytical conjecture on the Coefficient and Wald tests is valid given the evidence of no conceivable (the long-run and short-run) linkage between government expenditure, economic activities and labour market performance in the local economy, in the Free State province.

Table 8: Granger Causality Test: Identifying the Direction of Causality

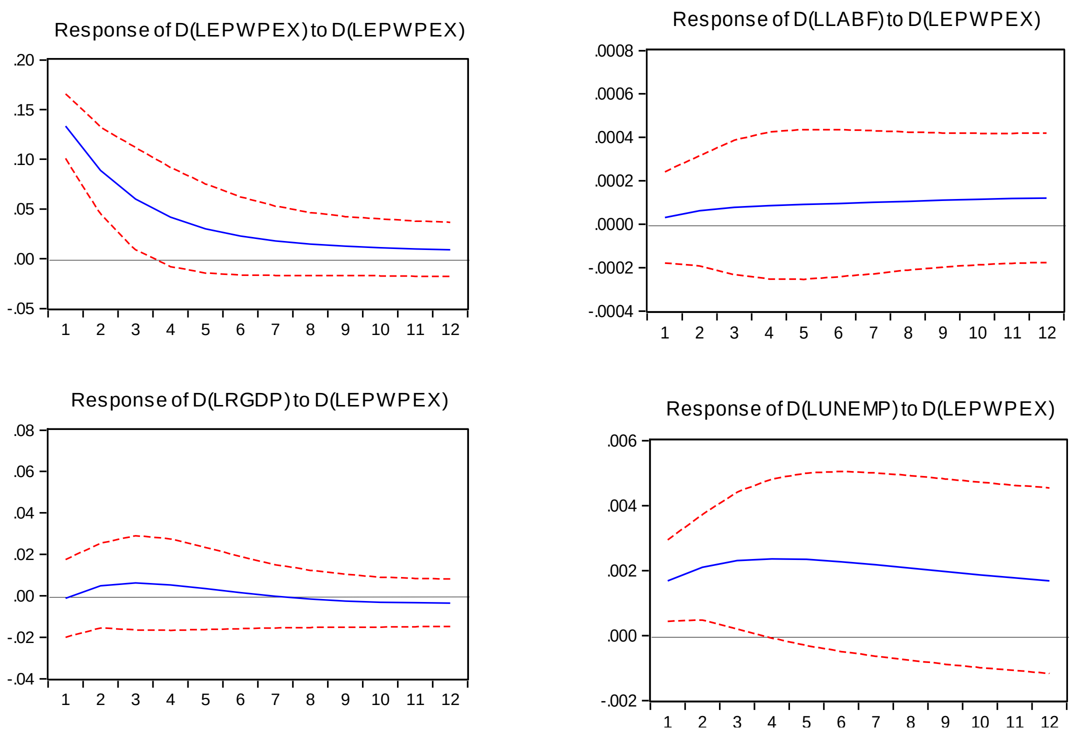
Null Hypothesis	χ^2	*p*-value	Decision
RGDP does not granger cause EPWPex	0.096	0.757	Accept null hypothesis
LABF does not granger cause EPWPex	0.189	0.664	Accept null hypothesis
UNEMP does not granger cause EPWPex	0.460	0.497	Accept null hypothesis
EPWPex does not granger cause RGDP	0.931	0.334	Accept null hypothesis
LABF does not granger cause RGDP	2.669	0.102	Accept null hypothesis
UNEMP does not granger cause RGDP	2.396	0.121	Accept null hypothesis
EPWPex does not granger cause LABF	0.060	0.806	Accept null hypothesis
RGDP does not granger cause LABF	0.583	0.445	Accept null hypothesis
UNEMP does not granger cause LABF	0.186	0.666	Accept null hypothesis
EPWPex does not granger cause UNEMP	0.966	0.325	Accept null hypothesis
RGDP does not granger cause UNEMP	0.046	0.829	Accept null hypothesis
LABF does not granger cause UNEMP	1.939	0.163	Accept null hypothesis

[37] In the Granger causality test, the chi-square statistics and probability to measure causality between the variables. Chi-Square statistics and probability values constructed under the null hypothesis of non-causality show that there is a causal relationship between two or more variables.

- ***Identifying Innovation to Variables – Impulse Response Function and Variance Decomposition***

The graph below (see Fig. 7 in the appendix for a detailed graphical illustration) shows the generalized impulse responses to one standard deviation shock to public spending on EPWP for a horizon of 12 quarters. Each graphical representation display point estimates of the impulse response. Clearly, it is evident that a one-time innovation to EPWP exert varying size of impact on domestic economic growth, labour force participation and unemployment rate in the Free State province.

Fig.1: Impulse Response Function of Estimated VAR model



By interpretation, the impulse response function (IRF) shows varying degree of economic growth and labour market variables to innovation affecting public spending on EPWP. Specifically, while both labour participation react positively to a one-time positive fiscal shock on EPWP initiatives, in contrast, the impact of similar shock on the provincial-GDP is negligible in the short run, i.e. only lasted 3 quarters, and turns negative after the 7th quarter. Additionally, the unemployment rate appear to be irresponsive to a one-time positive fiscal shock on EPWP on impact, nonetheless, in the short-run, the reducing effect of a positive shock to EPWP expenditure merely produce a slight decline in unemployment rate in the 6th quarter. Notably, this inference, confirmed earlier findings of negative effect of high public spending on economic growth and negligible impact on labour market performance discussed in the literature review. In particular, for South Africa, the negligible impact of temporary public employment programmes on economic growth, unemployment rate and poverty incidence have been widely documented in few evaluation studies assessing the expanded public works porgrammes.

Moreover, it is evident that benefits derived from marginal public spending on EPWP itself diminishes over time, and subsequently become negligible in the medium-term as illustrated in Figs. 1 and 6 , where the contemporaneous effect of high spending EPWP on itself dies out after

6 quarters. This finding can be explained by co-operant factors as a result of an over-excessive infrastructure accumulation and wage variability that impose an upward pressure on the fiscus and high financing costs to sustain implemented projects, and income transferred to the poor unemployed.

Then again, as expected, the expansion of EPWP initiatives to reach the unemployed poor, usually leads to an increase in labour participation rate, although this positive impact seem to be long-lasting, still, the aggregate impact is marginal. In other words, the aim of drawing the poor unemployed into productive work has the propensity to increase the labour market absorption rate, however, excessive demand for EPWP works that leads to job rationing and substitution, lack of skill enhancing education or training to facilitate human capital accumulation tends to culminate into a significant negative effect which effectively undermine the potential of EPWP to ease binding constraints in the domestic economy and the labour market. But, insofar, a recurrent budget allocation is being used to fund EPWP projects, intensify the implementation of large infrastructure projects in the rural areas, whilst an effective monitoring and exit strategy is implemented, thus, a favorable fiscal shock to EPWP could promote labour participation rate, considerably reduce the high unemployment rate and poverty incidence in Free State.

On the other hand, the response of the provincial GDPR to a one-time fiscal shock to EPWP is not surprising. This intriguing observation provides support for the findings of Omoshoro-Jones (2014) that apart from short-duration of implemented projects that is insufficient to acquire tangible skill enhancing training / work experience to gain employment in the highly skilled mainstream labour market; the pervasive low labour-intensity that characterized most of (if not all) the infrastructure-linked EPWP schemes in Free State, does not support employment-intensive growth, human capital accumulation and creation of productive public assets require to (indirectly) stimulate an employment intensive growth.

Equally, other contributing factors to negative impact of high spending on EPWP on economic growth in Free State can be attributed to crowding out of private sector investment and weak participation in the domestic economy. The crowding out of private sector by the public sector (through large government size) effectively emasculate the main driver (i.e. source) of job creation and output productivity. In addition to the IRF's result, the variance decomposition which represents the linear combinations of the EPWP variable to its own current innovations and lagged innovations of the GDP, LABF and UNEMP in the VAR system.

The tabulated results in Table 9 shows that response of EPWP variables to a contemporaneous shocks is largely explained (about 97 percent) by its own lagged variables. Whereas, innovations to lagged variables of the dependent variables, namely, GDP, LABF and UNEMP appears to carry a diminutive information about the volatility of EPWP, the endogenous variable, to shocks. For instance, on impact (i.e. first quarter), 100% of EPWPex is explained by its own innovation with a steady decline to 98% in the 12th quarter. Whereas, other endogenous variables (GDP-R, LABF and UNEMP) cannot explain the variation in EPWPex in the first quarter, evidence by the 0% variance.

Even though, the explanatory power of the three endogenous variables to explain the variation in EPWPex improved in the 2nd quarter, still their explanatory power is severely low, that is, in the 12th quarter only 0.48% of GDP-R, 0.72% of LABF and 2.12% respectively, can explain the variation of EPWPex. Again, this inference reinforced the previous results of no long-run or short-run relationship, and causal link (feedback effect) between high public spending on EPWP schemes, economic growth and labour market performance in the Free State. *See Table 15, in the appendix for detailed regression output of the variance decomposition.*

Table 9: Variance Decomposition Result for VAR Model

Variance Decomposition of D(LEPWPEX):					
Period	S.E.	D(LEPWPEX)	D(LRGDP)	D(LLABF)	D(LUNEMP)
1	0.133261	100.0000	0.000000	0.000000	0.000000
2	0.160326	99.80680	0.022537	0.072554	0.09prev8104
3	0.171567	99.45305	0.033158	0.210112	0.303675
4	0.176991	99.02203	0.031766	0.369138	0.577063
5	0.179956	98.57615	0.036311	0.512388	0.875150
6	0.181779	98.15424	0.061155	0.619776	1.164833
7	0.183019	97.77586	0.109956	0.687543	1.426638
8	0.183930	97.44742	0.177891	0.722194	1.652498
9	0.184635	97.16737	0.256489	0.734331	1.841807
10	0.185202	96.93017	0.337438	0.734452	1.997938
11	0.185670	96.72878	0.414487	0.730879	2.125849
12	0.186063	96.55625	0.483885	0.729175	2.230693

5. CONCLUDING REMARKS AND POLICY SUGGESTION

If effectively implemented, as elucidated in the National Development Plan (NDP,2012), the expanded public works programmes could become an effective tool to reduce the prevailing high poverty incidence, chronic unemployment rates and income inequality in the Free State province. Albeit, the extensive quantitative study of Omoshoro-Jones (2014) found evidence supporting pervasive low labour intensity in infrastructure-linked EPWP projects, inadequate skill enhancing education / trainings to improve the employability of beneficiaries and facilitate self-employment required to revive domestic growth, labour productivity and create employment-intensive growth. Clearly, the importance of expanding the current EPWP schemes to rural areas, where poverty and (youth) unemployment rate is prevalent cannot be over-emphasized as a potential policy tool sufficient enough to provide tangible risk-coping and safety net to the unemployed poor without access to social grants.

Anecdotal evidence on public works programmes assert that large PWPs with single objectives (to mention a few, India, Bangladesh, Pakistan, Argentina, Kenya Uganda and Botswana) in contrast to EPWP implemented in South Africa, can influence creation of productive assets such as road networks, schools, hospitals, etc, improved in household savings, reduce overpopulation in one location by stemming rural-urban migration, and accumulation of financial assets (Zimmermann, 2015; Subbarao, 2014; Ahmed et al.2014; Del Nino, 2009; Thwala, 2008; McCord et al.2008; Ofem et al.2008; Mehrotra, 2005; Mehrotra et al. 2007; Gilligan et al.2006; Devereaux,2000 amongst others). Undoubtedly, the positive impact of properly designed and implemented typically contribute immensely to accumulation of infrastructure assets, human development (in terms of skills upgrade and labour productivity) and economic development, these in turn, indirectly support vibrant economic growth and ease binding constraints in the labour market.

In this paper, our contribution to the existing literature on PWP is significant. First, this paper deviated from the norm of research scope on public works programmes at the national and international level due to ample data availability, instead, our scope of study explicitly focused on a regional (in this case, Free State province) analysis. Secondly, we close the extant research gap in the literature on PWP, by employing array of novel multivariate econometric models (e.g. VAR, seasonal ARIMA-OLS, Granger causality) to assess the influence of an archetype PWP on economic growth and labour market performance. Hitherto, large numbers of available studies investigating the distributive impact and/or influence of PWP are qualitative in nature using cross-sectional surveys or focus-group interviews. The credibility of such studies have been challenged by Betcherman et al. (2004) and Martin et al. (2001) cited in Holmes et al. (2013:6) owed to lack of substantive empirical evidence. Indeed, along the same line, McCord and Slater (2009) and Devereux and Solomon (2006) confirmed the paucity of robust impact evaluation material on PWPs.

As such, to the best of our knowledge, this is the first empirical work to applied sophisticated econometric techniques to examine the dynamic effect of PWP on labour market performance and output growth in a domestic economy.

Specifically, this paper seek to answer the following questions: Why is output growth and the labour market irresponsive to high public spending on expanded public works programmes in the Free State? Is there any long-run and/or short-run relationship between high public spending on EPWP initiatives, economic growth, and labour market indicators? If any, what is the direction of causality between high public spending on EPWP initiatives, economic growth, and labour market indicators? Finally, what are the probable cause or binding constraints undermining the employment generating and poverty reducing effect of an upscaled EPWP schemes in the Free State province?

To answer the posed research questions, we employ array of econometric techniques, particularly, we estimated a higher order seasonal ARIMA model, VAR, Johansen-Julieus cointegration and Granger Causality tests to : (i) examine the dynamic feedback between high public spending on EPWP, provincial economic growth, labour force participation rate, employment and unemployment rate (as selected variables), (ii) identify long-run and short-run association between the selected variables, and also, determine the existence of causal link among the selected variables, and (iii) determine the response of economic growth and labour market performance indicators (labour force participation rate, employment and unemployment rate) to EPWP's innovations.

Against this backdrop, first, in the constructed seasonal ARIMA model, all empirical results are strongly statistically significant suggesting that a high public spending on expanded public works programme at provincial level (taken as a large government size), induce: (i) a negative impact on domestic economic growth, (ii) a positive correlation with labour force participation rates, as such, high public spending tends to absorb unemployment poor into the labour market to engage in productive work, (iii) negatively affects unemployment rate, and (iv) a reducing effect on unemployment. All our results are consistent with findings in the literature.

Possible rationale for the negative correlation between high spending on public employment programmes could be attributed to a forceful crowding out of private sector, labour productivity, and destruction of jobs in the private sectors due to   high public spending on EPWP to create employment opportunities; an increased in temporary jobs in the public sector accompanied by a higher rents paid to workers, which in turn triggers an strong job substitution and misallocation of labout inputs, and so on. Other factors could be low nature of skills acquired by beneficiaries of public works programme that hamper the employability of beneficiaries in the mainstream labour market (McCoord and Farrington, 2008), intense job rationing associated with excessive demand for EPWP jobs (McCutheon and Parkins, 2009),

Secondly, using the Johansen-Julieus cointegration test and VAR, we found no evidence supporting possible long-run and long-run relationship between the expansion of EPWP schemes through high fiscal spending, the domestic economy and labour market. This inference is reinforced by the result of the Granger causality and Wald test, indicating the absence of no causal link, and short-run feedback dynamics between the selected variables. Conversely, our analyses of a one–time positive shock to public expenditure on transient public employment programme (i.e. EPWP) using the impulse response function shows that, on impact, a positive fiscal shocks to EPWP has a stimulating effect on labour force participation rate, but an insignificant positive effect on economic growth and unemployment rate in the province over the short-and medium-term. Strikingly, the economic growth becomes negative in the short run (i.e. 6^{th} quarter) in response to innovation to the high public spending on EPWP. All in all, our empirical findings are consistent with theoretical underpinnings and results from empirical studies document in the literature.

Putting it altogether, the implication of our empirical findings is crucial, at provincial level, for policy makers to embark on proactively design effective pro-growth and anti-poverty policies to binding constraints in the local economy and labour market in terms of enhancing private sector employment and productivity needed to revive the apparent waning private sector participation, which in turn, is compressing economic growth. Along the same line, the results of the IRF analysis is useful for policy implantation, since it shed light on how the provincial government (through the Department of Public Works and Economic Development) can re-align the objectives of EPWP to optimize that creates a vibrant economic activities and ameliorate the prevailing high unemployment rate, poverty incidence and inequality.

To provoke robust discussion in the policy circle, provide tangible direction for policy implementation, and make an attempt to alleviate the predominantly high unemployment rate, acute poverty incidence and low labour market absorption rate in Free State through EPWP. Hence, based on the veracity of empirical evidence in this paper, we put forward arrays of recommendations for the consideration of the provincial government and policy makers, in this context, it is imperative to:

- Re-design the current EPWP framework to include an extensive training to ensure adequate skill development. First, an adequate on-the-job and accredited trainings integrated into the framework of EPWP will obviate the apparent skill mismatch problem in the labour market due to the changing structure of the labour market that is becoming more capital intensive with high demand for skilled workers relative to the over-supply of unskilled / obsolete labour inputs. Second, sufficient trainings will also, equip EPWP beneficiaries with necessary skills required to gain suitable employment in the existing labour market.

- Re-aligned strategy provincial policies to facilitate a vibrant private sector participation via public private partnerships (PPP) to remove the domestic labor market constraints from the demand side, which in effect, boost employment creation opportunity and productivity in both the private and public sector.

- Provide access to micro-finance to boost entrepreneurial spirit, encourage self-employment and establishment of SMMEs in the urban and rural areas, which are critical indirect objectives of EPWP initiatives.

- Consolidate EPWP projects since proliferation of small projects (especially infrastructure) diminish the positive externalities of economies of scale

- Enforce the adopted stipulation in the DoRA to mainly use labour-intensive work technique in all EPWP projects as opposed to the "business as usual" and/or conventional capital-intensive (machines) method commonly used by contractors in EPWP projects. Adherence to the labour-intensive work method will raise labour intensity, improve absorption rate, increase employment opportunities for the poor, stimulate income distribution, enhance skill upgrade and reduce operational costs.

- Focus on expanding EPWP schemes to deep rural area where poverty and unemployment is acutely high. This strategy will not only foster rural development, but also, prevent surge in rural-urban migration associated with the poor searching for work opportunity, reduce job-search cost and create balanced rural-urban growth

- Facilitate the creation of tangible assets (e.g. road, schools) through an inclusive participation of the community in the selection of EPWP construction / infrastructure projects.

- Incorporate a new EPWP initiative that focus on re-vitalising the waning agricultural sector improve the labour absorption rate in the economy. Notably, a productive agricultural sector can significantly reduce unemployment rate since the pervasive labour demand constraint are removed to a large extent as large chunk of the unskilled and obsolete labours (made up the largest proportion of the unemployment rate) could be utilised as inputs in the production process. Also, a growing agricultural sector has the potential to improve sectoral productivity, which in turn, leads to creation of agro-processing and agri-business sectors.

- Focus on routine infrastructure (road) upgrade and maintenance via EPWP schemes, rather than construction of new infrastructure assets which are usually accompanied by high financial costs. By intensifying routine upgrade and maintenance, apart from extending the life cycle of existing assets; copious amount of unskilled able-bodied workers could be put into productive work with the benefit of earning income.

- Consider extending the length of EPWP projects beyond 6 months, since beneficiaries income is linked to the duration of implemented projects. Long-term EPWP projects would generate a continuous stream of income (wage transfers) to participants, this in turn, encourage savings (stokvels) and investment. In effect, lowering poverty incidence and reduce unemployment rate.

- Link the current EPWP initiatives and its operational framework to other poverty and employment creating policy in FS, for example, the flagship policy document referred to as the Free State Government Developmental Strategy (FSGDS).

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TECHNICAL APPENDIX

A1. TABLES

Table 10: South Africa's Labour Market Data

	Unemployment rate (narrow definition)	Expanded Unemployment rate	Labour force Participation rate	Labour market absorption ratio
South Africa	24.5	33.8	58.5	44.2
Province				
Western Cape	19.4	22	68.4	55.1
Northern Cape	25.8	38.9	54.5	40.4
Eastern Cape	27.4	40.3	47.2	24.2
Free State	29.8	36.3	62.7	40
KwaZulu-Natal	20.5	36.8	47.2	37.5
Mpumalanga	25.7	39.4	57.8	42.9
Limpopo	19.8	38.6	45.6	36.5
Gauteng	27.6	30.2	72.9	52.8
North West	23.9	38.9	72.9	52.8

Stats SA (2016), QLFS, 2015:Q4

Table 11: Data sources and Transformation

Variables	Source	Transformation
EPWP[1]	National Treasury – FS Department of Public Works, Vote 9	Linear interpolation[2]
Real regional-GDP (R-GDP)	IHS Global Insight	$\text{rgdp}=\left(\frac{\text{GDP-R}}{\text{infl}}\right)$
Real regional-GVA (R-GVA)	IHS Global Insight	$\text{rgdp}=\left(\frac{\text{GVA-R}}{\text{infl}}\right)$
Labour Force (LABF)	IHS Global Insight	
Inflation	Statistics South Africa	
CPI	Statistics South Africa	y-o-y growth of cpi
Unemployment rate	IHS Global Insight	
Inflation Rate		$\text{infl}=\frac{(\text{cpi-cpi}(-1))}{\text{cpi}(-1)}*100$

Table 12: Regression Output, Estimated Seasonal ARIMA-OLS Fitted Model

Dependent Variable: D(LEPWPEX)
Method: Least Squares
Sample (adjusted): 2006Q4 2013Q4
Included observations: 29 after adjustments
Convergence achieved after 37 iterations
MA Backcast: 2005Q3 2006Q3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LRGDP,2)	-0.551414	0.223012	-2.472573	0.0225
D(LLABF,2)	1314.736	244.7916	5.370838	0.0000
D(LEMP,2)	-884.3797	174.6359	-5.064133	0.0001
D(LUNEMP,2)	-308.1022	63.48784	-4.852933	0.0001
C	0.023734	0.020120	1.179672	0.2520
AR(1)	0.354244	0.241028	1.469723	0.1572
SAR(4)	-0.291041	0.166636	-1.746566	0.0961
MA(1)	0.638889	0.176217	3.625580	0.0017
SMA(4)	-0.877789	0.041309	-21.24915	0.0000

R-squared	0.778421	Mean dependent var	0.097931
Adjusted R-squared	0.689789	S.D. dependent var	0.165740
S.E. of regression	0.092311	Akaike info criterion	-1.678175
Sum squared resid	0.170427	Schwarz criterion	-1.253842
Log likelihood	33.33353	Hannan-Quinn criter.	-1.545279
F-statistic	8.782655	Durbin-Watson stat	2.095754
Prob(F-statistic)	0.000042		

Inverted AR Roots	.52-.52i	.52+.52i	.35	-.52+.52i
	-.52+.52i			
Inverted MA Roots	.97	.00-.97i		

Table 13: Robustness Check: Diagnostic tests on residuals from Estimated VAR model

Name of Test	**Ho**	**Test Statistic**	**P value**	**Inference**
Normality Tests Jacque-Bera (joint test)	Residuals are multivariate normal	379.93	0.000	Accept null
Skewness	Residuals are multivariate normal	82.510	0.000	Accept null
Kurtosis	Residuals are multivariate normal	297.427	0.000	Accept null
Residual Test: Portmanteau Test for autocorrelations	No 2nd order serial correlation in residuals	7.548	0.951	Accept null
Heteroscedasticity test (White Test) – joint test	No heteroskedacity	nR^2 (No cross terms) =108.68	0.018	Accept null
Serial correlation LM	No 2nd order serial correlation in residuals	4.500	0.997	Accept null

Table 14: Short-run Feedback: Coefficient Test for (F-test) Joint Significance Hypothesis

System: SYS03_ROBUSTVAR_FMODEL

Estimation Method: Least Squares

Sample: 2005Q3 2013Q4

Included observations: 34

Total system (balanced) observations 136

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.644796	0.156560	4.118534	0.0001
C(2)	-0.095726	0.309713	-0.309080	0.7578
C(3)	-7.582661	17.45621	-0.434382	0.6648
C(4)	1.808499	2.665644	0.678447	0.4988
C(5)	0.061940	0.064188	0.964983	0.3365
C(6)	0.731182	0.126978	5.758319	0.0000
C(7)	11.69390	7.156831	1.633949	0.1049
C(8)	-1.691643	1.092881	-1.547874	0.1243
C(9)	0.000176	0.000717	0.245739	0.8063
C(10)	-0.001083	0.001419	-0.763651	0.4466
C(11)	0.900320	0.079963	11.25925	0.0000
C(12)	0.005266	0.012211	0.431272	0.6670
C(13)	0.004440	0.004518	0.982700	0.3277
C(14)	0.001925	0.008937	0.215391	0.8298
C(15)	0.701522	0.503721	1.392679	0.1663
C(16)	0.882960	0.076921	11.47886	0.0000
Determinant residual covariance		8.86E-17		

Table 15: Regression Output for Estimated VAR Model

Vector Autoregression Estimates
Sample (adjusted): 2005Q3 2013Q4
Included observations: 34 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(LEPWPEX)	D(LRGDP)	D(LLABF)	D(LUNEMP)
D(LEPWPEX(-1))	0.644796	0.061940	0.000176	0.004440
	(0.15656)	(0.06419)	(0.00072)	(0.00452)
	[4.11853]	[0.96498]	[0.24574]	[0.98270]
D(LRGDP(-1))	-0.095726	0.731182	-0.001083	0.001925
	(0.30971)	(0.12698)	(0.00142)	(0.00894)
	[-0.30908]	[5.75832]	[-0.76365]	[0.21539]
D(LLABF(-1))	-7.582661	11.69390	0.900320	0.701522
	(17.4562)	(7.15683)	(0.07996)	(0.50372)
	[-0.43438]	[1.63395]	[11.2592]	[1.39268]
D(LUNEMP(-1))	1.808499	-1.691643	0.005266	0.882960
	(2.66564)	(1.09288)	(0.01221)	(0.07692)
	[0.67845]	[-1.54787]	[0.43127]	[11.4789]

Table 16: Variance Decomposition Result

Variance Decomposition of D(LEPWPEX):					
Period	S.E.	D(LEPWPEX)	D(LRGDP)	D(LLABF)	D(LUNEMP)
1	0.133261	100.0000	0.000000	0.000000	0.000000
2	0.160326	99.80680	0.022537	0.072554	0.098104
3	0.171567	99.45305	0.033158	0.210112	0.303675
4	0.176991	99.02203	0.031766	0.369138	0.577063
5	0.179956	98.57615	0.036311	0.512388	0.875150
6	0.181779	98.15424	0.061155	0.619776	1.164833
7	0.183019	97.77586	0.109956	0.687543	1.426638
8	0.183930	97.44742	0.177891	0.722194	1.652498
9	0.184635	97.16737	0.256489	0.734331	1.841807
10	0.185202	96.93017	0.337438	0.734452	1.997938
11	0.185670	96.72878	0.414487	0.730879	2.125849
12	0.186063	96.55625	0.483885	0.729175	2.230693
Variance Decomposition of D(LRGDP):					
Period	S.E.	D(LEPWPEX)	D(LRGDP)	D(LLABF)	D(LUNEMP)
1	0.054636	0.053231	99.94677	0.000000	0.000000
2	0.067147	0.555406	97.93221	1.023025	0.489357
3	0.072908	1.197527	94.64690	2.792165	1.363404
4	0.075901	1.588448	91.28769	4.748778	2.375083
5	0.077604	1.716414	88.42775	6.510897	3.344943
6	0.078672	1.705435	86.22644	7.894214	4.173910
7	0.079412	1.674771	84.62934	8.867042	4.828847
8	0.079965	1.690845	83.50544	9.485408	5.318310
9	0.080398	1.770848	82.72079	9.837996	5.670370
10	0.080744	1.903116	82.16741	10.01189	5.917582
11	0.081022	2.065718	81.76799	10.07713	6.089163
12	0.081244	2.237665	81.47073	10.08340	6.208203
Variance Decomposition of D(LLABF):					
Period	S.E.	D(LEPWPEX)	D(LRGDP)	D(LLABF)	D(LUNEMP)
1	0.000610	0.254625	3.741824	96.00355	0.000000
2	0.000819	0.704635	2.579995	96.68349	0.031882
3	0.000953	1.169324	1.954583	96.73949	0.136606
4	0.001048	1.626842	1.616981	96.42025	0.335924
5	0.001118	2.086249	1.422353	95.85525	0.636144
6	0.001173	2.561446	1.295939	95.11232	1.030298
7	0.001216	3.062938	1.205035	94.22997	1.502058
8	0.001252	3.595797	1.138986	93.23517	2.030045
9	0.001283	4.159780	1.096463	92.15209	2.591673
10	0.001310	4.750311	1.078398	91.00526	3.166029
11	0.001335	5.359825	1.084794	89.81975	3.735631
12	0.001357	5.979176	1.113854	88.61981	4.287156
Variance Decomposition of D(LUNEMP):					
Period	S.E.	D(LEPWPEX)	D(LRGDP)	D(LLABF)	D(LUNEMP)
1	0.003845	19.19387	28.56917	0.097172	52.13979
2	0.005430	24.55626	27.92893	0.984956	46.52985
3	0.006616	28.62911	26.81821	2.260711	42.29196
4	0.007570	31.61338	25.56178	3.706826	39.11802
5	0.008362	33.75663	24.31969	5.192568	36.73111
6	0.009030	35.27501	23.16461	6.640778	34.91960
7	0.009601	36.33865	22.12399	8.007690	33.52967
8	0.010095	37.07572	21.20251	9.270813	32.45096
9	0.010527	37.58064	20.39391	10.42129	31.60415
10	0.010907	37.92195	19.68736	11.45888	30.93181
11	0.011245	38.14889	19.07067	12.38851	30.39193
12	0.011547	38.29652	18.53195	13.21800	29.95352
Cholesky Ordering: D(LEPWPEX) D(LRGDP) D(LLABF) D(LUNEMP)					

A2. FIGURES

Fig. 2: Economic Growth and Labour Market Performance in FS

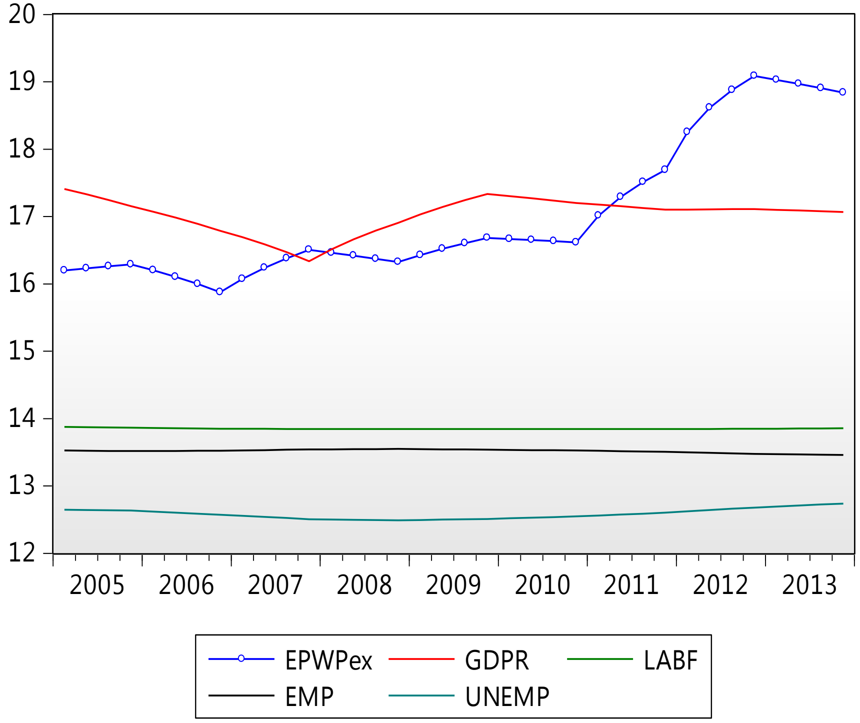


Fig. 3: ARMA Structure for Stationarity and Invertibility

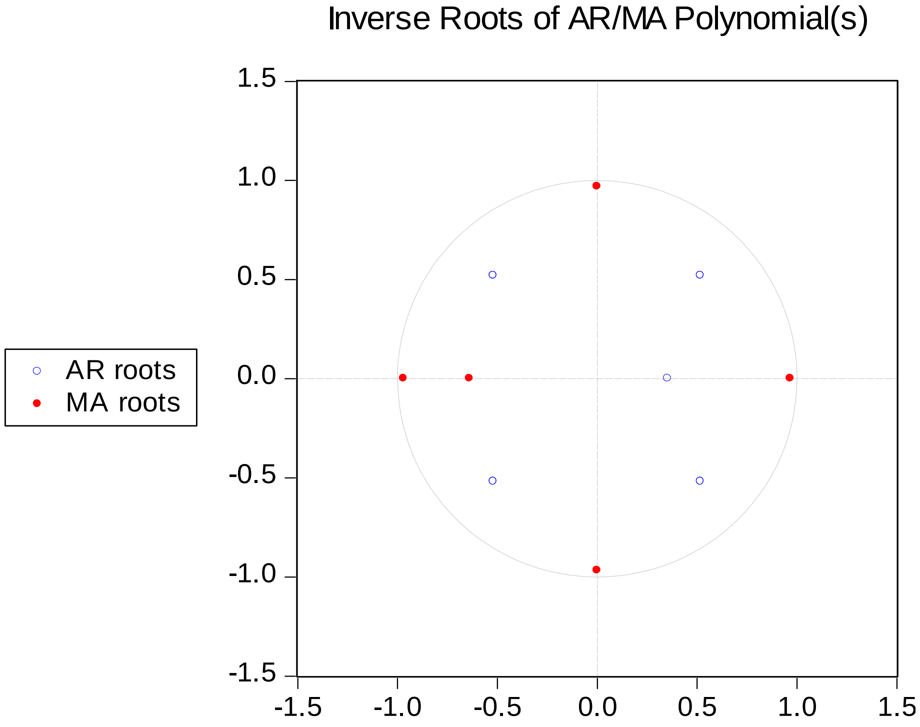


Fig. 4. Correlogram (Q-Statistic) Test for ARIMA model Stationarity

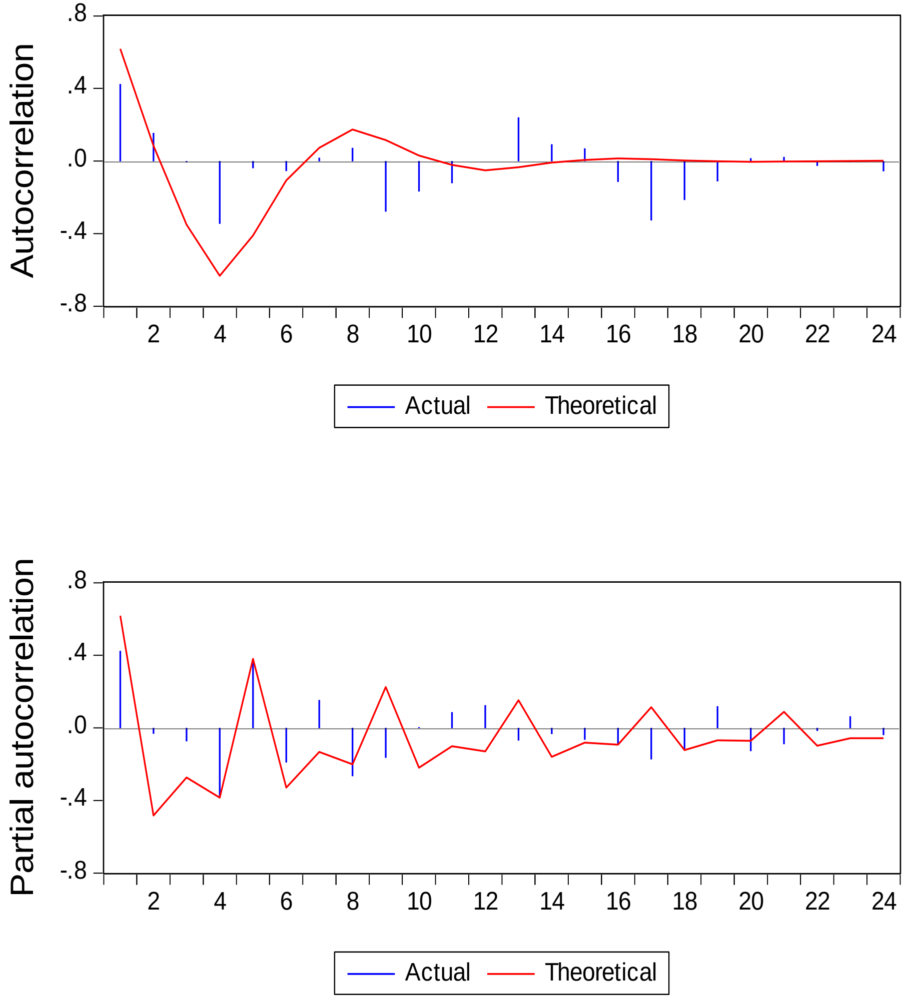


Fig. 5: Impulse Response for ARIMA model Stationarity

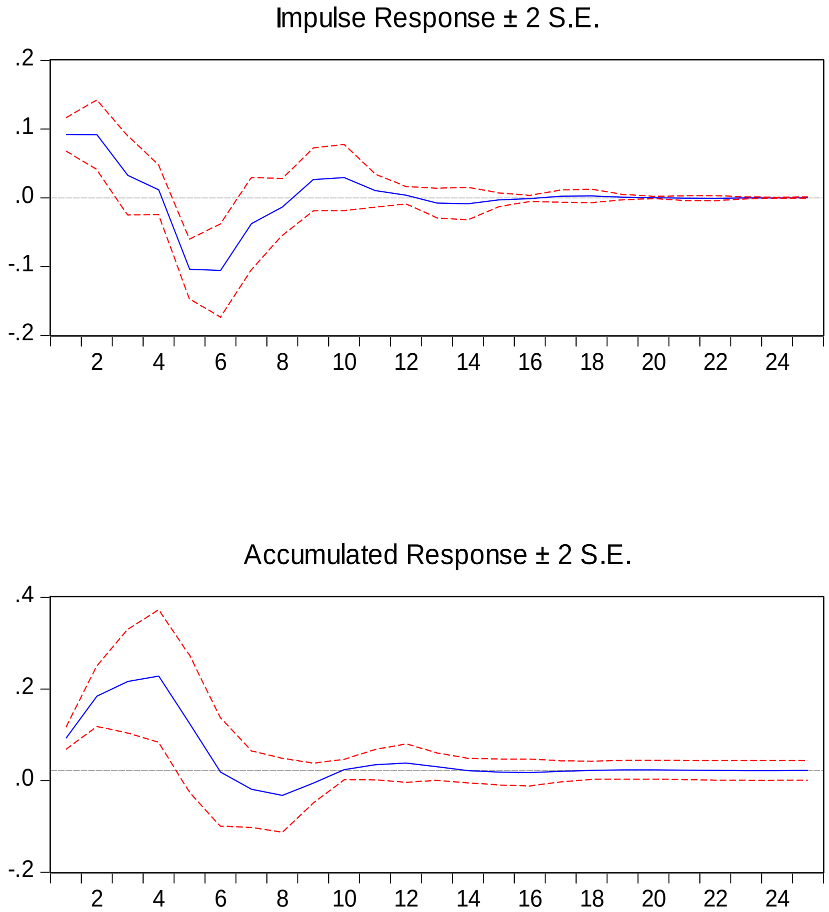


Fig. 6: ARMA Frequency Spectrum for Stationarity and Invertibility

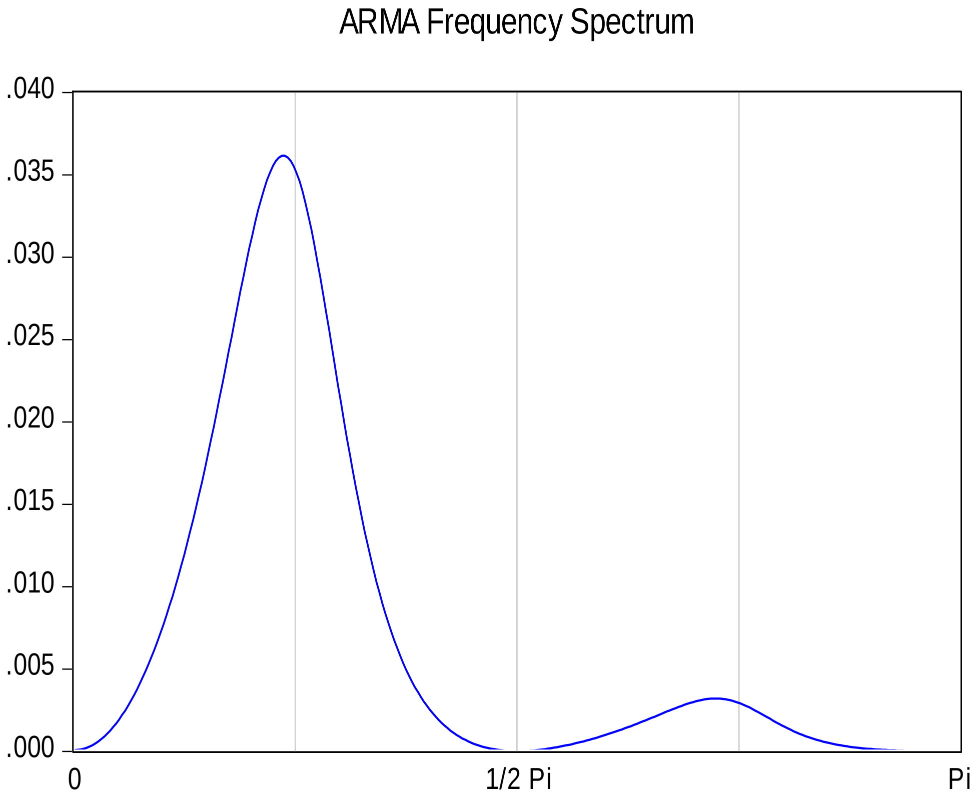
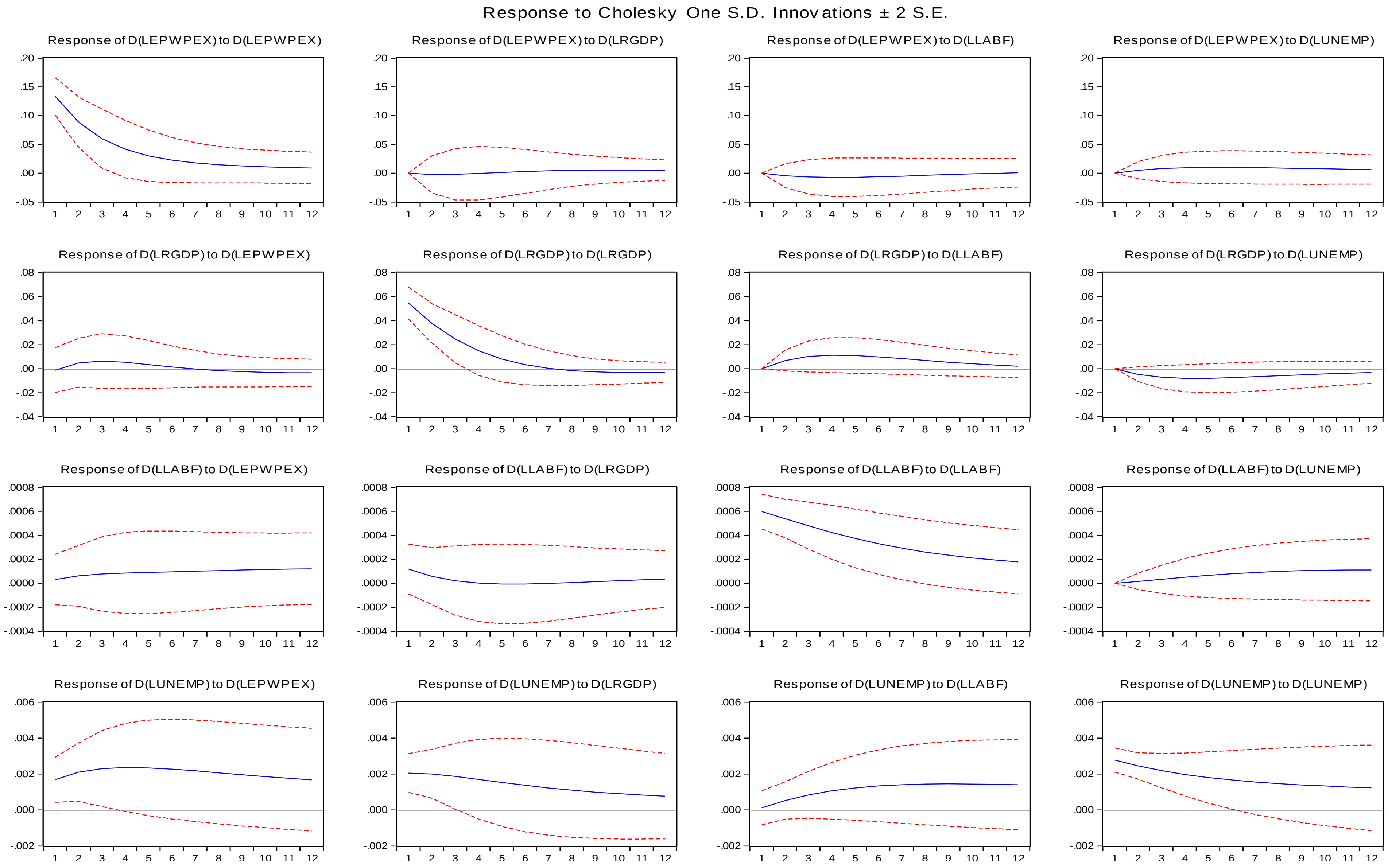


Fig 7: Impulse Response Function for Estimated VAR Model.



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