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Public Health Expenditure and Manufacturing Sector Output in South Africa

Sibanda Kin[1], Gonese Dorcas[2], Mukarumbwa Peter[3] and Tsegaye Asrat[4]

[1-4]University of Fort Hare, South Africa. Email: [1]sibandak@ufh.ac.za, [1]keith08.kin@gmail.com, [2]dorcasgonese@gmail.com, [3]peerta@gmail.com, [4]atsegaye@ufh.ac.za

ABSTRACT

The study analysed public health expenditure impact on manufacturing sector output in South Africa. The study employs the basic panel data methods which include (pooled, random, fixed and the LSDV). Panel data was used over the period 2000-2015 with twelve manufacturing sub-sectors. The fixed, effect, LSDV and FGLS estimator show that government expenditure on health rises and falls together with manufacturing sector output in South Africa. The empirical results obtained from this study have shown that public health expenditure has a positive relationship with 10 out of 13 manufacturing sector output. However, the radio and science equipment sector output are not sensitive to government expenditure on health. The important policy implication of these results is that the South African government must continue allocating more resources towards public health expenditure. However, there is need for the government to improve the health sector, through enhancing management and leadership. Most importantly transparency must be ensured in the use of budget allocated to heath. This will assist in circumventing current challenges being encountered in the public health sector, consequently improving manufacturing sector output in specific as well as the entire economy at large.

Keywords: Public health expenditure, manufacturing sector output, panel data methods, economic growth.

1. INTRODUCTION

The World Health Organisation (WHO) (2005) highlighted that one of the vital components for economic development is health; higher productivity emanates from a healthy population, leading to higher income per head. In that regard, the pivotal role of human capital towards economic growth cannot be over

stressed since it catalyses economic development (Lucas, 1988; Mankiw *et. al.,* 1992). Furthermore, it has been indicated that a healthy labour force has higher motivation because they expect to reap benefits in the long term, as such they are prepared to acquire new skills and knowledge (Bloom and Canning, 2000; Kurt, 2015). In fact a direct relationship has been shown to exist between health spending and economic growth because of its input on accumulation of human and physical capital (Jack and Lewis, 2009; Odior, 2011). Investments in health as well as infrastructure at the macro-level is envisaged to enhance health standards, leading to improved human capital of the country and ultimately productivity increases (Aboubacar and Xu, 2017). Conversely, there is negative influence on productivity if labour force is in poor health state. This help to clarify developmental differences exhibited in various parts of the globe (Cole and Neumayer, 2006). It is estimated that a whopping 50% of discrepancy in economic development between low income and industrialised countries is attributed to poor-health as well as low life expectancy (WHO, 2005).

In South Africa the legacy of apartheid which exposed the majority of citizens to poor health conditions makes investment in public health a priority. Furthermore, besides the detrimental effects of apartheid legacy, accessing better health care and health outcomes are regarded as an engine to economic growth and prioritized goal since independence in 1994 (Burger, Bredenkamp, Grobler and van der Berg, 2012). This priority is also enshrined in the country's constitution which endeavour to promote health care services access to all citizens (Republic of South Africa, 1996).

The country invests enormous amounts of public funds in heath. According to the National Treasury (2015), South Africa's allocation to health has constituted biggest public expenditure and has indicated significant real growth since 2002/03. For example, provincial health data indicate that expenditure in public health rose from R864 in 2002/03 to an estimated R2855 in 2012/13 exhibiting a 12.7% annual average growth in nominal terms. Furthermore, about 9% of South Africa's gross domestic product (GDP) is spent on health (Bidzha, Greyling and Mahabir, 2017; Department of Health 2015). This figure is way above average of similar countries categorised as middle income countries. Again, expenditure in public health in South Africa compared with other upper-middle income countries is relatively high. For instance, in 2014 public health spending as a percentage of GDP was about 4.3% in comparison to other upper-middle income countries average of 3.8% (World Bank, 2014). Regardless of these huge investments, health outcome indicators of South Africa are relatively lower compared with countries at the same income level (Bidzha *et. al.,* 2017; National Planning Commission 2012; Hofman and Tollman, 2010).

The South African health system poor performance in comparison with countries of the same income level, despite its huge public health expenditure is attributed to "fault lines" (Rispel, 2016). According to Rispel (2016) these "fault lines" are dysfunctional district level system, critical shortage of health workers as well as poor management and leadership and within the health sector. Similar sentiments were also echoed earlier by Hofman and Tollman (2010) that huge public expenditure in South Africa fail to attain health outcomes in comparisons with countries at the similar income level due to numerous challenges[1].

South Africa's manufacturing sector plays a vital aspect in the country's economic growth as well as employment. The sector is a key driver of GDP growth and has important backward and forward linkages with other sectors particularly the service sectors. Despite this recognition, the manufacturing sector has

[1] According to Hofman and Tollman (2010) some of these challenges include poor health personal management, available data rarely linking to limited evidence base so as to inform programming and system development, inequality which cause uneven access to health services along racial lines

been on a declining trend pertaining its contribution both to employment and economic growth (Bhorat and Rooney, 2017; IDC, 2013). According to Industrial Development Corporation (IDC, 2013) the sector used to have a dominant part within the economy in 1994 representing close to 21% of GDP. However, the manufacturing sector has declined by 20% since 2001 to date (Bhorat and Rooney, 2017). Additionally, between 2008 and 2014, South Africa's manufacturing sector has shed 331 000 jobs, by far the largest of any sector (Statistics South Africa, 2016). The sector has been exhibiting a poor growth rate averaging a meagre 2.8%/annum between 1994 and 2012 in comparison to other sectors (IDC, 2013). Again, in 2009 the sector recorded a negative growth rate, contracting by 20% mainly due to the global financial crisis (IDC, 2013). This lack of dynamism within the labour-intensive manufacturing sector is a cause for concern, as to date, no country has transitioned from middle to high-income level lacking the presence of a vigorous manufacturing sector (Bhorat and Rooney, 2017).

According to Bidzha *et. al.,* (2017) there is lack of clarity in the existing empirical research on the relationship between public health spending and South Africa's "health outcomes". Moreover, the relationship between public health spending and manufacturing sector output in the country is scarce. Hence, from the forgoing this paper endeavours to close this existing gap by unearthing such a relationship. This emanates from the understanding that public health investments plays a vital role in improve the health status of the country's population and economic productivity at large. This study seeks to empirically investigate the influence of public health expenditure on South Africa's manufacturing sector output. After, the introductory part a brief overview of health expenditure and manufacturing sector output in South Africa is offered in Section 2. Then Section 3 outlines the theoretical framework, whereas a summary of some important preceding empirical studies are presented in Section 4. The research methodology, data and empirical estimation techniques are discussed in Section 5. Lastly, conclusion and policy recommendations emanating from the study are presented in Section 6.

2. HEALTH EXPENDITURE AND MANUFACTURING SECTOR OUTPUT IN SOUTH AFRICA-OVERVIEW

South Africa's health care sector is dual in nature comprising the public and private sector with limited funding from non-governmental organisations (NGOs). Finances for the public health care spending are derived from tax revenues, while medical aid schemes (medical insurance) constitute a large proportion of the private health care system. Medical schemes account for about 83.5% contribution of private health expenditure, while the other 13% is out of pocket payment (Department of Health, 2015). Majority of the country's population (84%) depend upon public health care provision while the remaining small proportion (16%) use private health care (Mayosi and Benatar, 2014; Health System Trust, 2014). Furthermore, about 25% of people who do not have medical aid, pay out of pocket to access private-sector care (Mayosi and Benatar, 2014). However, there are wide disparities between private health expenditure and public sector. For example the annual per capita private sector's health expenditure in 2009 was about $1,400 while that of the public sector was estimated at $140 (Coovadia *et. al.,* 2009).

The mandate of formulating health policies within the country lies with the National Department of Health and these policies are implemented at provincial level. Thus, in South Africa, the provincial government is the main provider of public health care. In that way, the bulk of the country's health care system is the responsibility of provinces through their expenditures (Bidzha *et. al.,* 2017). The South

African health system is mainly funded through the instruments of unconditional as well as the conditional intergovernmental fiscal transfers emanating from the national governments to all the nine provinces. Unconditional grants are the main funders of public health services, of which the provincial equitable share (PES) is the largest (Bidzha *et. al.,* 2017).

South Africa spend about 9% of its GDP on health (Bidzha, Greyling and Mahabir, 2017; Department of Health 2015). Regardless of that, the health care benefits in the country are skewed. They do not match the health care services needs of its population. For instance, the country's richest 20% of population receive 36% of total health benefits, even though their health needs are less than 10%, conversely the poorest 20% of the country's population obtain only 12.5% of the health benefits even though they have more than 25% of health needs share (Department of Health, 2015). As such, there are major inequalities that the country faces in terms of its health distribution and ultimately health outcomes. Additionally, the country is also confronted with the "quadruple burden of disease in the form of communicable diseases such as HIV and AIDS and tuberculosis, maternal and child mortality, non-communicable diseases" as well as injury and trauma (Department of Health, 2015).Thus, from the forgoing it has been argued that government must come up with targeted health expenditures for the disadvantaged in-order to ensure equitable distribution of expected health outcomes (Ataguba, Day and McIntyre, 2015).

Moreover, the high rate of HIV prevalence has caused life expectancy to decline marginally in South Africa. The life expectancy in South Africa decreased from 61.4 years in 1995 (Ssozi and Amlani, 2015) to 59.7 years in 2016 (Stats SA, 2016). Consequently, this has reversed progress made with the universal health care system in South Africa. In that view, there is a sharp contrast in comparison to other countries such as Ghana, Mauritius and Rwanda were universal health care system has improved health outcomes (Ssozi and Amlani, 2015).

Contrary to the above findings, there is a view that provincial health expenditures in South Africa have yielded positive health outcomes since 2009. For example, Mayosi *et. al.,* (2012) highlighted that since "the 2009 Lancet Health in South Africa Series, important changes have occurred in the country, resulting in an increase in life expectancy to 60 years". This view is also supported by the National Treasury (2014) which pointed out that life expectancy rose "from 51.6 years in 2005 to 59.6 years in 2013, whereas under-5 mortality rate has decreased from 85.4 to 56.6 per 1 000 live births" over the same period. This scenario, illustrates the ambivalence in empirical literature about the impact of public health spending on "health outcomes" in South Africa.

There has been a substantial transformation in the South African economy since independence in 1994. The economy achieved an average annual growth rate of 3.3% in real terms from 1994 to 2012 (IDC, 2013). It was a major development in comparison with the average growth rate of 1.4% per annum attained from 1980 to 1993 (IDC, 2013). Nonetheless, the country's gross domestic product (GDP) declined by 0.3% in the last quarter of 2016, having increased by 0.4% in the third quarter of 2016 (Stats SA, 2016). The mining and quarrying industry was the highest negative contributors to GDP growth in the last quarter, having declined by 11.5% and recorded a −0,9 percentage point to GDP growth (Stats SA, 2016). Next in line was the manufacturing sector, which declined by 3.1% and recorded a −0,4 of a percentage point. (Stats SA, 2016). Conversely, finance, real estate and business services as well as the trade, catering and accommodation industry rose by 1.6% and 2.1% respectively, and each posted a 0.3 percentage point to

GDP growth (Stats SA, 2016). In the same way, transport, storage and communication industry rose by 2.6% and marked a 0.2 percentage point to GDP growth (Stats SA, 2016).

According to Industrial Development Corporation (IDC, 2017) the economy of South Africa expanded by a mere 0.3% in 2016, this was attributed mainly to depressed output within the electricity, mining and agriculture sectors. Nonetheless, various other sectors noted modest rates of growth. It is stated that besides the recession experienced in 2009, when GDP declined by 1.5%, the year 2016 experienced one of the poorest performance in economic growth since the advert of democracy in 1994 (IDC, 2017). Furthermore, the economic prospects of the country remain mostly gloomy in the shorter term. The GDP growth forecast of South Africa's is projected at 1% for year 2017, while the rate of expansion is expected to increase in succeeding years (IDC, 2017).

With reference to specific sectors, the agricultural GDP contracted by 7.8% in comparison with previous years merely due to drought, similarly there was a 4.7% drop in the mining GDP in 2016 due to weak global demand and domestic operational challenges (IDC, 2017). In the same vein, the manufacturing sector recorded a GDP growth of just 0.7% in 2016 due to difficult economic conditions and low domestic demand (IDC, 2017). According to the same source output in the manufacturing sector contracted by 0.8% over the year to the first quarter of 2016. Despite conditions showing some slight improvements as the sector recorded a 32 month peak in April 2016, manufacturing output trend is still on a downward trend as explained earlier in the above section.

Against this background of generally reduced economic growth in South Africa coupled with limited resources, it has been highlighted that efforts to improve health delivery in the country require enhanced health care management and governance as well as recognition of being able to do more with less (Mayosi and Benatar, 2014).

3. THEORETICAL FRAMEWORK

The theoretical framework employed in this study considers the traditional neoclassical growth models as a starting point. Neo-classical growth models explain a steady-state growth in terms of the savings rate and technological progress. Solow (1956) indicated that given technology, the level of savings-capital accumulation has an effect on growth in the transition period. Moreover, in the Solow's (1956) model technological change has the effect of augmenting the labour force and resulting in higher steady state-growth. Nonetheless, the Solow model has been criticized for assuming exogenous technology and neglecting human capital which is a very vital input.

In view of that, various models have been developed to include the effect of human capital on economic development (Romer 1986; Lucas 1988; Romer, 1990; Barro 1991). The endogenous growth models explain ways through which public health spending impact economic growth and ultimately economic development. The models emphasise the pivotal role of human capital on economic growth. These endogenous growth models do not make the assumption of human capital being a constant. Rather, they also incorporate both the short-run and the long-run ability of the human capital to influence growth (Piabuo and Tieguhong, 2017). However, experience, skills and knowledge acquired by the labour is also included in the endogenous growth models as such capital expands beyond physical capital only (Kurt, 2015). Thus, health and education enable the components of the human capital, knowledge, skills, abilities and experience to be ever emerging (Kurt, 2015).

In tandem with economic theory, good health can influence increased output of a country's economic sectors and ultimately economic growth in various ways. For example, increased health spending is envisaged to enhance the health status of the labour force and as a result productivity increases. High productivity from healthier workers enable them to earn high wage (Strauss and Thomas, 1998). "Higher wages in turn contribute to higher consumption and savings, which by virtue of improving the wellbeing and happiness of people contribute to economic growth" (Narayan, Narayan and Mishra, 2010).

Furthermore, workers are incentivised to attain schooling through improvements in health, because investments in education can be repaid over a longer working life (Kalemli-Ozcan, Ryder, and Weil, 2000). It follows that healthier workers have reduced absence from work. Reduced absenteeism increases production. As such, investment in health assist in economic growth of a country positively, through improving human capital quality and accumulation of knowledge in the country.

According to (Narayan *et. al.,* 2010) human capital is noted as a vital factor that improves productivity in a number of ways. Firstly, the human capital theory posits that education is a foundation in skills investment, which enhances productivity (Schultz, 1961; Schultz, 1971). The endogenous growth models, as noted above, assumes a direct relationship between human capital and creativity. Additionally accumulation of knowledge either through experience or intentional effort improves labour and capital productivity (Lucas, 1988; Azariades and Drazen, 1990). Secondly, human capital increases allocative efficiency, skilled workers are more efficient and respond to new opportunities in a better way (Nelson and Phelps, 1966; Schultz, 1971). Thirdly human capital has spill over effects which do not benefit not only the individual but the entire society at large (Self and Grabowski, 2004). According to Li and Liu (2005) theoretically, technological diffusion is generated by investment which contributes to economic growth. Therefore, the theoretical model employed in this paper indicate a vital link between public health spending, economic growth and human capital development.

4. HEALTH EXPENDITURE AND MANUFACTURING OUTPUT: THE NATURE OF THE RELATIONSHIP IN PREVIOUS EMPIRICAL WORK

Empirical studies that focus specifically on health expenditure and sectorial output are scanty in Sub-Saharan Africa (SSA) generally and particularly in South Africa. Rather, to the best of our knowledge such kind of a study that analyse the nexus between public health expenditure and manufacturing sector output does not exist in South Africa. Most studies have tend to focus on the influence of public health spending on the aggregate economy. Majority of these studies reveal significant as well as a positive relationship between public health spending and economic growth as explained below.

Sorkin (1977) study can be accredited amongst the pioneer studies to investigate how "economic growth" is impacted by health. According to Sorkin (1977), reduction in birth rates affect economic growth positively. Strauss and Thomas (1998) concluded the existence of mutual effect between health and income. They also resolved that health status affect economic growth particularly the labour market of developing economies. Arora (2001) examined the impact of health on economic growth of ten developed countries for a period of between 100 to 125 years. The study found out that economic growth increased with about 30-40 per cent due to changes in health.

Similarly, Reeves *et. al.,* (2013) employed the cross-national fixed effects models from 25 European Union (EU) nations for the period 1995 to 2010, the study concluded that public health spending can lead

to short-term effects that enable economic recovery. Also, Elmi and Sadeghi (2012) investigated the causality and co-integration relationships between health care spending and economic growth in developing nations from 1990-2009.They employed panel cointegration and causality in Vector Error Correction Modelling (VECM) framework. Their findings indicated a short-run causality from GDP to health care spending and there was a bilateral causality and long-run relationship between health spending and economic growth. Hence, the health-led growth hypothesis was confirmed by their study in developing countries. Novignon *et. al.,* (2012) employed the fixed and random effects panel data regression models, to determine the effect of health care expenditure on population health status covering 44 countries in SSA using data spanning from 1995 to 2010. They found out that population health status was significantly influenced by health care expenditure, through reducing death and infant mortality rates as well as improving life expectancy at birth.

Using data from 1965-90 for both low income countries and industrialised countries, Bhargava *et. al.,* (2001) concluded that economic performance in developing countries increase with the improvements in public health. Narayan *et. al.,* (2010) analysed the relationship between economic growth as well as health for 5 Asian countries from 1974–2007. Their results indicated that in the long-run the interaction of health, education as well as research and development contributed positively to economic growth.

Again, more recently Aboubacar and Xu (2017) investigated the relationship between health spending and economic growth in SSA from 1995-2014, using the General Method of Moments (GMM) technique. Their results showed existence of a statistically significant as well as positive relationship between health spending and impact on the economic growth in SSA. Piabuo and Tieguhong (2017) conducted a comparative analysis on the influence of health spending on economic growth amongst countries in the economic community for central African states (CEMAC) sub-region and five other African countries that attained the Abuja declaration. Their findings revealed that health expenditure positively and significantly affect economic growth in the two samples.

There also exist country specific studies in literature examining the link between public health spending and economic growth. Some selected studies at country level analysing this relationship are discussed in this section. Their findings tend to offer almost similar results as those of cross country studies discussed above.

Odior (2011) investigated the effects of public health spending on the long run economic performance of the Nigerian economy. The results of the integrated sequential dynamic computable general equilibrium (CGE) revealed that there was a significant association between increasing public health expenditure and economic growth in the country. In the same way, Bakare and Olubokun, (2011) employed the ordinary least square multiple regression analytical method, using time series data spanning from 1970-2008 in Nigeria. Their results revealed a positive and significant association between health care spending as well as economic growth in Nigeria. Hence, their findings recommended an increase in budgetary allocation to the health sector by Nigerian policy makers. On the contrary, Eneji *et. al.,* (2013) using public healthcare spending data covering the period from 1999-2012, investigated the link between healthcare spending, the health status and Nigeria's national productivity. They found out a weak causal relationship in the Nigeria context. From the forgoing it can be deduced, that merely increasing budgetary allocation is not enough but rather linking expenditure to specific revenue decisions as well as ensuring transparency in their use.

Additionally, Boussalem *et. al.,* (2014) examined the causality and co-integration association between public health expenditure and economic growth in Algeria by means of time series annual data from1974-2014. Their findings revealed a long-run causality from public health spending to economic growth whereas, they did not find any short-run causality from public health expenditure to economic growth. Mandiefe and Chupezi, (2015) measured the influence of public health investments to Cameroon's economic growth using annual from 1988 to 2013. Their findings from the VECM suggested that public health investments influence Cameroon's economic growth only in the long run.

A close analysis of literature, reveals that most empirical studies focus on one broad segment. That is the association among public health spending and economic growth. The empirical literature that focuses specifically on health expenditure and labour productivity at sectorial level is relatively thin. Nonetheless, such kind of studies are important based on the conceptualisation that a healthy labour force tend to be more productive.

While, most empirical studies concur that there is a significant and positive association between health expenditure as well as economic growth, there remains ambiguity between health expenditures and health outcomes in empirical studies. For instance, Moreno-Serra and Smith (2011) claimed that increase in public health expenditure might not have significant enhancement in health outcomes. This might be due to several reasons such as additional funds being spent mainly on low productivity inputs. These findings are supported by an earlier study of Musgrove's (1996) that there was no systematic association between health spending and health outcomes. The results were based on a cross-sectional data from 69 randomly chosen countries from the Organisation for Economic Co-operation and Development (OECD), other developed as well as developing countries in 1991. The ordinary least squares regression was employed for analysis. Conversely, recent studies have revealed increased evidence of high public health spending leading to improved health outcomes (Aghion *et. al.*, 2010; Brown *et. al.*, 2014).

In South Africa, majority of empirical studies have scrutinised the association between increased public health expenditure and inequities in access to health, rather than sectorial output (see Ataguba et. al., 2011; Burger *et. al.,* 2012; Ataguba *et. al.,* 2015; van den Heever, 2016; Cooper *et. al.,* 2016). The review of literature has shown that studies focusing on the association between health expenditure and economic growth dominant literature. Nonetheless, studies that specifically focus on health expenditure and sectorial output are scanty in SSA in general and specifically in South Africa. This paper extends the ongoing research about public health spending in South Africa by examining the association between public health expenditure and manufacturing sector output. Furthermore, the study also contributes to the health economics literature and provides South Africa with important policy implications.

5. RESEARCH METHODOLOGY, DATA AND EMPIRICAL ESTIMATION TECHNIQUES

Based on the availability of data, a sample of thirteen manufacturing sub-sectors was considered over the period 2000-2015.Thus the data include 16 time dimensions and 13 individual sectors. Therefore it was pooled into a panel data set and estimated using the panel data regression analysis. The panel data estimation system allows control of unobserved and omitted variables such as business practices and environmental factors. More so, the estimation technique controls for heterogeneity bias within the regression model as well as within the selected individual sectors.

The paper follows the panel data modelling and it applies the three basic methods of panel data which include pooled, fixed and random estimators. To control for biased R-squared, the paper employs the least squares dummy variable estimator (LSDV). Usually, panel data models are associated with heteroscedasticity, serial and cross sectional correlation. Therefore if these are present within the model, the paper employs robust estimators such as the panel corrected standard error (PCSE) if T<N and the feasible generalised least of squares (FGLS) if T>N.

The panel data analysis for this paper employs manufacturing sector output as the dependent variable. The government expenditure on health is the main explanatory variable. Other regressors include sector specific variables (intermediate input prices (IIP), real gross fixed investment (RI), unit labour cost (Ulc), real gross fixed capital formation (Rf), employment (Emp), remuneration (Rem), sectoral import (Imp)) and macro-economic variables (such as inflation (Inf), exchange rate (Ei), oil prices (Op) and interest rate (Ir)).

The main aim of this paper is to investigate the influence of government expenditure on health on the manufacturing sectoral output using panel data analysis. The panel estimations were conducted given the advantages that they allow the control for variables that cannot be observed or measured such as business practices across sectors. Panel data models also control for sectoral heterogeneity.

The paper investigates the government expenditure on health on sectoral output in South Africa following Arun and Kumar (2015) who used panel data analysis to investigate the causality between health spending and "economic growth" at country level in BRICS countries and their models expressed in equations 4.1 below as:

$$\ln GDP_{it} = \alpha_i + \beta_1 \ln PCHE_{it} + \varepsilon_{it} \quad (4.1)$$

where,

$\ln GDP_{it}$ is the output in a country at time t, $\ln PCHE_{it}$ is the log of per capital public health expenditure, α_i is the vector of exogenous variables and β_1 is the vector of coefficients

The model of this study shall use panel data analysis to investigate expenditure on health and output at sectoral level. Therefore, the above mentioned model (equation 4.1) is modified into panel data analysis. Again the paper included other independent variables such as macroeconomic and sector specific variables.

The econometric model for this paper is estimated in Stat a as:

$$MY_{it} = \beta_0 + \beta_1 Exh_t + \beta_2 SV_{it} + \beta_3 ZE_t + \mu_{it},\ i = 1, \ldots, N,\ t = 1, \ldots, T \quad (4.2)$$

where MY is the manufacturing sectoral output, Exh is the expenditure on health, SV is the sector specific variables, ZE is the macroeconomic variables. β_0 is the constant and μ_{it} is the error, disturbance or stochastic term which signifies all those variables that affect sectoral output but are not explicitly taken into account. β_1, β_2, and β_3 are coefficients of the explanatory variables to be estimated which can be the same in each time period. The t is the subscript that denotes the time period that is 16 years. The i is the i^{th} cross sectional unit which signifies numerous economic sectors denoted by subscript i which include, (food and beverages, textile and clothing, wood and paper, petroleum products chemicals, other metallic mineral products, metal products, electrical machinery, radio and television instruments, professional and scientific equipment, transport equipment, furniture and other manufacturing, other manufacturing and communication equipment) thus $i = 13$.

5.1. Empirical Results Interpretation and Analysis

The paper employs the basic panel data methods which include (pooled, random, fixed and the LSDV). The Breusch Pagan Lagrange Multiplier (BP/LM) test for random test has the chi- statistic of 293.411 and the *p*-value is 0.000, which is less than 5%. This entails that there is variation between entities, thus the random effect will be appropriate. However the random effect is efficient and consistent when the errors are not correlated with the predictor variables. Therefore, to detect that the paper employs the Hausman test. The estimation results on the Hausman test suggest 0.0000, a *p*-value of less than 0.05. Thus the *p*-value is small enough to reject the null hypothesis. Therefore the study rejects the null hypothesis and accepts the alternative one. This implies that the fixed effect estimator is the appropriate method to use for the paper. Apart from that, the Woodridge test for serial correlation, Wald test for unequal variances and the cross sectional dependence Pesaran test statistics indicate that their *p*-values are 0.0016, 0.000 and 0.001 respectively. This entails that heteroscedasticity, serial and cross sectional correlation are present within the variables. And so, to control that, the paper utilises the (FGLS) or (PCSE) estimator. This paper uses the FGLS estimator to control for violation of panel linear regression since they are consistent and efficient when the time dimensions (T = 16) is greater than the cross sectional units (N = 13).

In testing for stationarity tests, the paper also adopts both the common and individual unit root tests (see appendix 1). The best unit root test will be based on the majority. If the test results show that the variables have a trend at levels and are stationary at first difference, then it will be considered as the benchmark stationarity test which follows the panel cointergration. Moreover, panel data is used over the period 2000-2015 with twelve manufacturing sectors. The data was obtained from Quantec, and the Reserve bank of South Africa. The paper used both the common (LLC and Breitung) and the individual (Im Pesaran) unit root test to identify the majority methods. Therefore the results indicate that the Breitung unit root test is the benchmark test (see Appendix) since it fulfils the precondition of the panel cointegration. The panel integration precondition suggests that, all the variables are stationary at first difference.

Regression Results

Table 5.1 shows the regression results from the pooled, random, fixed effects, LSDV and FGLS estimators. The pooled and fixed effects were used to detect the appropriate method which is the fixed effect model.

Table 1
Regression results

Variable	*Pooled*	*Random*	*Fixed*	*LSDV*	*FGLS*
LnExh	0.486223**	0.42567**	0.50016**	0.50016**	0.25630***
	0.041507	0.04852	0.42915	0.42915	0.11281
LnIip	-0.09368	0.00855	-0.11987	-0.11987	-0.15267
	0.08529	0.09974	0.08809	0.08809	0.23170
LnRi	-0.02248	-0.03856***	-0.01815	-0.01815	0.05732
	0.01578	0.01840	0.01629	0.01629	0.03965
LnRf	0.03943	0.10937**	0.02294	0.02294	0.15432**
	0.02428	0.02665	0.25407	0.25407	0.04403

Variable	*Pooled*	*Random*	*Fixed*	*LSDV*	*FGLS*
LnEmp	0.52841**	0.70216**	0.48094**	0.48094**	0.72560**
	0.04772	0.44576	0.05139	0.05139	0.33323
LnRem	0.09697**	0.21397**	0.06909***	0.06909***	0.55724**
	0.35341	0.07693	0.03705	0.03705	0.03332
LnUlc	-0.32218**	-0.35595**	-0.31419**	-0.31419**	-0.13219
	0.04020	0.04756	0.04141	0.04141	0.11656
LnIpt	0.05661***	0.09578**	0.04905	0.04905	0.10560**
	0.03115	0.34239	0.32350	0.32350	0.01946
LnEi	0.10663	0.06705*	0.11508	0.11508	0.09790
	0.06929	0.82095	0.07132	0.07132	0.21921
LnInf	-0.03493**	-0.03571**	-0.34786**	-0.34786**	-0.03660
	0.01183	0.01410	0.01216	0.01216	0.03896
LnOp	-0.10013**	-0.12154**	-0.95181**	-0.95181**	-0.14111***
	0.02138	0.02514	0.22036	0.22036	0.06687
LnIr	0.21908**	0.18901**	0.22581**	0.22581**	0.16546***
	0.02480	0.02906	0.25582	0.25582	0.07625***
Constant	-0.75604**	-4.34005**	0.16254	-0.53907	-8.2925**
	0.91588	0.86978	0.96519	0.88542	1.50881
R-squared	-	0.8321	0.8556	0.9984	-
Probability	0.000	0.0000	0.0000	0.0010	0.000
F-statics	-	-	90.35	4870.30	-
Wald Chi 2	1183.22	1132.60	-	-	10988.86
Corr (u_i,xb)	-	0	0.8301	-	-
Case (groups)	208 (13)	208(13)	208(13)	208(13)	208(13)

$p < 0.01^{**}$, $p < 0.05^{***}$, $p < 0.1^{*}$

The BP/LM and Hausman tests indicate that the fixed effect estimator is the appropriate method to use in this paper. Again, the results of this paper are based on the fixed effect, LSDV and the FGLS estimator as presented in Table 1. The fixed, effect, LSDV and FGLS estimator show that government expenditure on health rise and fall together with manufacturing sector output in South Africa. For a unit increase in expenditure in health, manufacturing sectoral output is expected to increase by 2.5% to 5%.The fixed effect, LSDV and FGLS estimator show that intermediate input prices, real fixed investment and exchange rate are not significant to explain changes in movement in the manufacturing sectoral output. However, all other variables both the sector specific and macroeconomic variables are statistically significant to explain manufacturing sectoral output.

The fixed effect and LSDV estimators indicate that the unit labour cost and inflation rate are negative and significant to explain changes in the manufacturing sectoral output. However, the FGLS estimator as it caters for heteroscedasticity and serial correlation shows that the Ulc and inflation are negative but weakly significant to explain movements in the sectoral output. This may have been caused by the fixed effects which allows heterogeneity across sectors since they differ in terms of their business practices. In other words the regression as per FGLS indicates that some sectors are sensitive to Ulc and inflation whilst other are not.

The total employment and real gross fixed capital formation are positively related to the manufacturing sectoral output. This also confirms Babatunde (2014) who found a positive relationship between real gross fixed capital formation and employment and GDP in Nigeria.

Remuneration, sector imports, and interest rates are positively related to the manufacturing output at sectoral level as presented in Table 1. Thus a unit increase in remuneration, sector imports and interest rates will increase sectoral output by 5%, 10% and 16% respectively. Regarding remuneration, a positive relationship entails that an increase workers incentives boosts employee morale, hence the employees become loyal and productive. This in turn will induce output within the manufacturing sector. More so, a positive impact of sector imports indicates that, various manufacturing sectors gain competitiveness though importing cheaper and quality inputs for their production since South Africa is an open economy, thereby increasing output. Again, a positive impact of interest rate implies that South Africa as an open economy allows savers to invest in other countries. Therefore, the South African economy can avoid the implication of the interest rate in their investments. In doing so, the interest rate will be determined by interaction of supply and demand of investable fund a global level. More so, the interest rate in South Africa seem to be very low. Thus an average interest rate of 6.6% since 2000 up to 2015 might have been harmless to the manufacturing savers and investors. Regarding the oil prices, a negative and significant impact entails that one unit increase in oil price will increase the production costs for manufacturing sectors resulting in a 14% decrease in output.

Table 2
Sectoral analysis

Sector name and number	*LSDV*
LnSY	*LnExh*
Communication equipment (TV and Radio) (1)	-
	(-)
Electrical machinery and apparatus (2)	0.577101**
	(0.081054)
Food, beverages and tobacco (3)	1.492706**
	(0.180962)
Furniture and other manufacturing (4)	0.706844**
	(0.123641)
Metal, metal products machinery and equipment (5)	1.393025**
	(0.199296)
Nonmetallic mineral products (6)	0.344336**
	(0.123401)
Other manufacturing (7)	0.664117**
	(0.104082)
Petroleum products, chemicals, rubber and plastic (8)	1.878525**
	(0.186243)
Radio, Television instruments, watches and clocks (9)	0.044545
	(0.043329)
Professional and science equipment (10)	-0.611888**
	(0.040928)

Sector name and number	*LSDV*
Textile, clothing and leather (11)	0.230337*
	(0.134535)
Transport equipment (12)	1.426327**
	(0.146031)
Wood, paper, publishing and printing (13)	0.972218**
	(0.156738)

R-squared = 0.9982
Number of observations = 208
$p < 0.01^{**}$, $p < 0.05^{***}$, $p < 0.1^{*}$

The LSDV estimator shows that an increase in government on expenditure on health have a significant and positive influence on the manufacturing output at sectoral level. Nonetheless, the impact of expenditure on health on the manufacturing output varies across the manufacturing sector since the economic sector have different behaviour towards day to day operation, business practise and production processes. The empirical results in Table 5.2 specifies that the government expenditure on health is positively related to 10 out of 13 manufacturing sector output employed in the paper. However, the radio and science equipment sector output are not sensitive to government expenditure on health. Apart from that, the expenditure health has a great effect on the food and beverage, metal, petroleum, transport and the wood sector output. An interesting issue is that as the expenditure on health increases, the professional science and equipment output goes down. This implies that. The food, beverages and tobacco, transport equipment, metal products machinery and equipment is greatly sensitive to expenditure on health. Thus, an increase in government expenditure on health will increase the above mentioned sector output by 14.9%, 14.2% and 13.9% respectively. This is consistent with Arun and Kumar (2015), Babatunde (2014) and Erdil and Yetkiner (2009).

One other interesting issue on this paper is that not all manufacturing outputs are positively affected by expenditure on health. Thus the radio, television instruments, watches and clocks sector is not sensitive to expenditure on health. Again, the professional and science equipment has a negative relationship with government expenditure on health in the sense that an increase government expenditure on health is associated with a decrease in the output for professional and science equipment by 6.1%.

6. CONCLUSION AND POLICY RECOMMENDATIONS

The findings of the study show that an increase in government expenditure on health boost output in the manufacturing sector with the exception of the radio and science equipment sectors. Given this the paper recommends the government to be more delicate to the issue of uncertainty to lives and properties and safeguard the adequate provisions of health and medical facilities, stimulate the welfare of health and medical workers. This would reduce pressure and accident related death and condense the danger of attacks on lives and properties, thereby, improving the longevity of workers' lives for increased productivity in the manufacturing sector in South Africa. Again, the policymakers and the government should implement policies that improve health facilities in the country so as to reduce absenteeism at work, boost employee morale, future prospect and thoughts, fitness thereby inducing output in the manufacturing output in South Africa. Hence, the findings of this study reinforces widespread consensus that investment in public health contribute to economic growth in the long term by creating healthier better educated and ultimately more

productive labour force. As such with specific focus on manufacturing sector continued investment in health will lead to increased output. This is very vital given the pivotal role that South Africa's manufacturing sector plays in economic growth and employment creation. Furthermore, the sector has important backward and forward linkages with other sectors of the economy.

Given the fact that currently the government spend an estimated 9% of GDP on health with not so impressive outcomes in comparison with other countries of similar income level, the following key policy implication are drawn from the study. There is need for the government of South Africa to improve the health sector, through enhancing management and leadership. This might help in circumventing the challenges encountered in the health sector. Most importantly transparency must be ensured in the use of budget allocated to the health sector. Consequently, this can enable checks and balances to be established leading to efficiency and equity for better outcomes improving manufacturing sector output in specific and the entire economy at large.

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Appendices

Appendix 1
The panel unit root test results

Method	*LLC*		*Breitung*		*Im Pesaran*	
Variable	*1(0)*	*(1)*	*1(0)*	*1(1)*	*1(0)*	*1(1)*
SY	-6.2640**	-1.9592***	1.8981	-4.4804**	-2.0421***	-2.2984***
Exh	-9.5711**	10.9613	-8.2855**	3.7820**	-4.4597**	1.6787
Iip	1.9518	0.6075	1.8353	-6.6882**	5.3638	-2.8915**
Ri	-3.6039**	-5.7678**	-2.2576***	-6.5793**	-1.0976	-4.1013**
Rf	-5.5948**	-3.6105**	-2.4210**	-2.2659**	-2.4823**	02.0334***
Emp	-2.7920**	-4.5132**	0.0709	-4.2502**	-1.5401*	-3.2392**
Rem	-0.3333	-2.6969**	1.4678	-5.3498**	3.6466	-1.9735***
Ulc	7.2752	-1.9872***	3.9536	2.5424**	8.6733	1.0545
Ipt	-3.8115**	-6.7791**	0.3436	-8.2514**	0.6919	-4.6778**
Ei	-7.5941**	-9.1127**	-5.1691**	-5.9612**	-5.6360**-	-6.7469**
Inf	-10.1559**	-12.0790**	-9.3428**	-8.9418**	-6.9752**	-8.5116**
Op	-2.5801**	13.5124	-2.4581**	-7.5669**	-0.4442***	-1.1247
Ir	-4.2017**	-10.6686**	-6.1296**	-9.2005**	-1.4627*	-7.8156**

$p < 0.1^{*}, p < 0.05^{***}, p < 0.01^{**}$
Source: Author's own compilation from Quantec, SARB data (2016) Stata (13) results.