The impact of manufacturing and its sub-sectors on GDP and employment in South Africa: A time-series analysis

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DECLARATION

I, Richard Thabang Mc Camel declare that the research work presented in this dissertation is my own, except where otherwise declared as a fact and acknowledged. It is submitted for the degree of Masters in Economics at the North West University, Vaal Triangle. This dissertation has not, either in whole or to some extent, been submitted for a degree or diploma to any other university.

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Richard Thabang Mc Camel

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ABSTRACT

The manufacturing sector plays an integral part in driving industrialisation of a country and inducing economic progression by precipitating structural change, technological innovation, sustainable GDP growth and productive employment. The reason for that rests in the features of the manufacturing sector (e.g. high magnitude of capital; (2) technology, increasing returns as well as the multiplier effects; (3) employment potential; and (4) forward and backward linkages) that collectively corroborate the sector necessary for economic progression. As such, the manufacturing sector impels economic growth and employment in various countries. In South Africa, a resilient manufacturing base is established and, over the years, the country has managed to induce substantial competence in the automotive, metal, chemical, food and beverages, and clothing sectors of manufacturing.

However, production in the South African manufacturing sector and its sub-sectors has been experiencing a downswing over the last two decades and this is due to impediments or challenges to effective manufacturing production arising from both the domestic and global constraints. This involves the inadequate electricity supply, high administrative costs, skills inadequacies, antiquated technologies, effects of the 2008/09 global financial crisis and global competition. As a result of the aforementioned constraints, production in the South African manufacturing sector has been lacklustre, despite the efforts undertaken to induce effective South African manufacturing production. The Economic Development Department of South Africa have annunciated that the manufacturing sector has long been a vehicle for economic growth and is one of the labour-absorbing economic sectors in South Africa. Thus, suggesting that the modern-day poor performance of the South African manufacturing sector has mirrored the country's sluggish GDP growth rates and high unemployment levels. This imposes negative implications to the South African economy.

In view of the above discussion, the primary objective of the study is to appraise the existing South African manufacturing base and analyse the impact of production in the manufacturing sector and its predominant sub-sectors on GDP and employment in South Africa. Considering this, the empirical objectives of the study were: (1) to establish the effect of production in the manufacturing sector and its predominant sub-sectors on the South African economy; (2) to analyse the relationship between GDP, employment, production in the manufacturing sector and its predominant sub-sectors in South Africa; and (3) to formulate policy recommendations for improved sectoral development regarding manufacturing production and job creation. In achieving these empirical objectives, secondary data were derived from the South African Reserve Bank (SARB) and Statistics South Africa (Stats SA). The secondary data used covered a period 1998 Q1 to 2017 Q1 (i.e. 77 quarterly observations) and the choice of using data that covers the aforementioned period was motivated by the availability of data. As such, to analyse the data, an econometric models used included the autoregressive distributed lag (ARDL) and error correction model (ECM).

The results of the study indicated that production in the manufacturing sector and its predominant sub-sectors under study has a long-run impact on GDP and employment in the South African economy. However, production in the total manufacturing sector and four (automotive, chemical, food and beverage and metal) of the five predominant sectors of manufacturing under study increases South Africa's GDP in the long run. In other words, production in the clothing sector decreases South Africa's GDP in the long run. At the same time, production in the total manufacturing sector and four (i.e. automotive, food and beverage, clothing and metal) of the five predominant sectors of manufacturing under study has a positive long-run impact on employment in the South African economy.

That is to say, production in the chemical sector of manufacturing decreases employment in the long run. In the short run, production in the manufacturing sector increases both GDP and employment, however, only production in the automotive and metal sectors of manufacturing increase GDP in the short run. While production in the metal and food and beverages sectors of manufacturing increases employment in the short run. Therefore, based on the discussed empirical findings, the study provides recommendations for improved sectoral development regarding manufacturing production and job creation. The study also concludes that the South African government should spend its limited fiscal resources to support and boost overall effective manufacturing production, as this can induce both GDP growth and employment in the short- and long run.

Keywords: manufacturing sector, automotive sector, chemical sector, clothing sector, metal sector, food and beverages sector, gross domestic product (GDP), employment, autoregressive distributed lag (ARDL), error correction model (ECM), South Africa

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12I:	Section 12I Tax Allowance Incentive
ADEP:	Aquaculture Development Enhancement Programmes
ADF:	Augmented Dickey-Fuller
AIC:	Akaike Information Criterion
AIS:	Automotive Investment Scheme
ANC:	African National Congress
APCF:	Agro Processing Competitiveness Fund
ARDL:	Autoregressive Distributed Lag
ASGI-SA:	Accelerated and Shared Growth Initiative for South Africa
BER:	Bureau for Economic Research
BLUE:	Best Linear Unbiased Estimators
CAIA:	Chartered Alternative Investment Analyst
CRDW:	Cointegration Regression Durbin-Watson
CTCIP:	Clothing & Textile Competitiveness Improvement Programme
CUSUM:	Cumulative Sum of Recursive Residuals
CUSUMSQ:	Cumulative Sum of Squared Residuals
DESA:	United Nations Department of Economic and Social Affairs
DTI:	Department of Trade and Industry
ECM:	Error Correction Model
ECT:	Error Correction Term
EIA:	Energy Information Administration
ESKOM:	Electricity Supply Commission
E-views:	Econometric Views

FPE: Final Prediction Error

FPM Seta: Fibre Process and Manufacturing Seta

GDP: Gross Domestic Product

H_0: Null hypothesis

H_1: Alternative hypothesis

HQ: Hannan-Quinn

HSRC: Human Science Research Council

IDC: Industrial Development Corporation

ILO: International Labour Organisation

IPAP: Industrial Policy Action Plan

ISCOR: South African Iron and Steel Corporation

JB: Jarque Bera

KPSS: Kwiatkowski, Phillips, Schmidt and Shin

LM: LaGrange Multiplier

LR: Likelihood Ratio

MCEP: Manufacturing Competitiveness Enhancement Programme

METR: Marginal effective tax rates

MIP: Manufacturing Investment Programme

MTSF: Medium-Term Strategic Framework

NDP: National Development Plan

NGP: New Growth Path

NIPF: National Industrial Policy Framework

NIPF: National Industrial Policy Framework

NPC: National Planning Commission

NPC:	National Planning Commission
NWU:	North West University
OECD:	Organisation for Economic Co-operation and Development
OLS:	Ordinary Least Squares
P-AIS:	People-Carrier Automotive Incentive Schemes
PI:	Production Incentive
PP:	Phillips-Perron
P-value:	Probability value
QES:	Quarterly Employment Survey
R & D:	Research and Developments
SA:	South Africa
SARB:	South African Reserve Bank
SIC:	Schwarz Information Criterion
SME:	Small-to-Medium enterprise
SPII:	Support Programme for Industrial Innovation
Stats SA:	Statistics South Africa
UK:	United Kingdom
UNCTAD:	United Nations Conference on Trade and Development
UNIDO:	United Nations Industrial Development Organization
US:	United States

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

In the modern world with its integrated economies, through globalisation, the lack of employment opportunities has become a global problem (Akram, *et al*., 2011:292). This lack of employment remains a major problem in the economies of both developed and developing countries (Burns, 2016:5). However, the issue is more serious in developing countries, with high levels of unemployment, resulting in negative repercussions such as low economic growth and high poverty levels (Ikejiaku, 2009:16). South Africa is certainly no exception, as gross domestic product (GDP) in South Africa has generally lagged behind other emerging economies, shrinking to -1.2 percent in the first quarter of 2016 from the growth of 0.4 percent in the preceding quarter of 2015 (Stats SA, 2016). In addition, according to South African Reserve Bank (SARB) (2016), South Africa's GDP growth is stuck in low gear with real GDP growth of 0.4 percent in 2015/16 and expected to increase to 1 percent for 2016/17. The low GDP growth data has made the South African economy insufficient in alleviating unemployment and increases the risk of the economy being trapped into a recession (Yueh, 2014:2; Stats SA, 2016).

Consequently, South Africa's unemployment rate was at 26.6 percent in the second quarter of 2016, from 26.7 percent in the first quarter of 2016. When including South Africans who ceased their search for employment, the unemployment rate increases to 39.2 percent (Stats SA, 2016). The uninspiring South African economic performance of 2015/16 may have long-term repercussions of economic structural transformation (Hittler, 2009:4). According to Marcus (2013:7), post-1994, South Africa has made a steady progress in creating jobs. However, slow GDP growth, low job creation capacity and unemployment are persistent issues for the South African economy, as the country's 2016 GDP growth, employment prospects and industrial development efforts are lacklustre (O'Flaherty, 2015). Therefore, the underlying status quo is that of a fragile state and this elicits every means of growth to be explored.

Over the previous decades, GDP growth and employment in South Africa was driven by growth in manufacturing (Tregenna, 2008:193). This was because manufacturing plays an important role of being a locus for capital accumulation (Szirmai, 2009). Furthermore, according to Zalk (2014:3), South Africa experienced the highest rate of GDP growth in its history during the period between the end of World War II and the mid-1970s when manufacturing growth was

2.6 percent higher than GDP growth. This stimulated growth in employment in the formal manufacturing sector. However, in the recent decade, South Africa's manufacturing sector has been underperforming (Fedderke, 2014:13). Szirmai and Verspagen (2011:12) state that manufacturing has become a more difficult route to growth than before, in developing economies.

For that reason in the first quarter of 2016, South Africa's manufacturing sector output fell by a substantial 1.8 percent, after rising by 1.9 percent in last quarter of 2015 and the sector's overall performance for 2015 averaged growth of -0.3 percent (Stanlib, 2016:2). Not to mention, during the same period GDP decelerated to 0.6 percent from 0.7 percent in the third quarter of 2015. Consequently, job losses came at a cost to the South African economy, as South Africa's unemployment rose by 1.4 percent in the second quarter of 2014, sprouting from 24.1 percent in the first quarter of 2014 to 25.5 percent in the third quarter of 2014 (Stats SA, 2014). The reason for this was that the manufacturing sector employed 11.8 percent of the total labour force in South Africa at the time, making the sector the highest employment contributor when compared to other labour-intensive sectors, such as mining and agriculture in 2014.

Previous studies have been conducted (Kaldor, 1967; Trevena, 2007; Chakravarty and Mitra, 2009) on the impact of manufacturing on GDP and employment. Kaldor (1967) presents a model of growth rate differences between advanced capitalist countries; Kaldor's model carries the following propositions: (1) a faster growth rate in the manufacturing sector, results in faster rate of growth of GDP, this is not because of the definition that manufacturing output is a sizeable constituent of total output; however, for foundational economic rationales regarding internally and externally induced manufacturing productivity growth; (2) faster rate of growth of manufacturing output, results in a faster growth rate of labour productivity in manufacturing due to static and dynamic increasing returns, better yet economies of scale; lastly, (3) a faster growth rate of manufacturing output, results in a faster rate of transmutation of labour from other economic sectors where there are either decreasing returns, or where there is no relationship between growth in output and employment. The aforementioned propositions indicate that growth rates in manufacturing output are reflected relatively in the GDP and employment of a particular economy.

In addition, Chakravarty and Mitra (2009) discovered that manufacturing is amongst the determinants of overall economic growth, but construction and services play a vital role in determining economic growth and growth in manufacturing. Tregenna (2007) investigated the role of manufacturing in the context of South Africa and discovered that manufacturing has been exceptionally important, more especially due to its powerful backward linkages to the service sector and other economic sectors of the economy. Similarly, Wells and Thirlwall (2003) confirm that growth in manufacturing plays a major role in increasing growth in GDP when they tested Kaldor's growth model across the countries in Africa. Furthermore, Adugna (2014) investigated impacts of the Ethiopian manufacturing sector on economic growth using the Kaldorian approach. Adugna discovered that the Ethiopian manufacturing sector plays a paramount role in the structural transformation of a country and the future economic growth in the country relies on the performances of the manufacturing sector of that country. This underpins that manufacturing is invested with the potential to generate GDP growth.

Wah (1997) concludes that enhanced output in the manufacturing sector contributed to overall employment creation in the study that investigated the employment effects of output and technological progress in the context of the Malaysian manufacturing sector. In addition, Jones and Olken (2008) discovered that there is more labour in manufacturing during high growth periods and less labour in manufacturing during low growth periods. Lastly, Aydıner-Avşar & Onaran (2010) reveal that there is a positive long-run relationship between the total output in the manufacturing sector and employment in Turkey. This underpins that manufacturing is invested with the potential to generate employment.

In view of the above discussion, the study investigates the impact of the manufacturing sector and its sub-sectors on GDP and employment in the context of the South African economy. As such, it should be noted that the study will only capture the sub-sectors of manufacturing that are predominant in the South African economy, namely automotive, chemical, food and beverages, clothing and metal sectors of manufacturing (Brand South Africa, 2017).

1.2 PROBLEM STATEMENT

The poor performance of the manufacturing sector, accompanied by low GDP growth and unemployment, have been some of the most pressing issues in South Africa over the last two decades (Mahadea & Simson, 2010:391). In the face of GDP diminishing by 0.3 percent, coupled with a high unemployment rate of 26.5 percent in the fourth quarter of 2016, to keep pace with the number of people entering the labour market the South African economy need to generate nine million jobs over the next 10 years (Samson, *et al.,* 2010). According to the Economic Development Department of South Africa (2010:24), the manufacturing sector has long been a vehicle for economic growth and is one of the labour-absorbing economic sectors in South Africa. As such, manufacturing can play a crucial role in generating sustainable economic growth and employment. However, the South African manufacturing sector has been experiencing a downswing and this downswing can potentially result in a catastrophic impact on the manufacturing sector's contributions to GDP and employment.

Considering the latter, Rodseth (2016) points out that the manufacturing sector is one of the top three multiplier economic sectors with regards to generating employment, adding value and export earnings. Not to mention, the fact that the number of employed people in the manufacturing sector was 1.6 million in 2016 and the sector accounted for 13 percent of the GDP during the same year (Stats SA, 2016). As such, the main purpose of the study will be to analyse the impact of the manufacturing and its aforementioned predominant sub-sectors on GDP and employment in the South African economy. In doing so, the study will shed light on the nature and scope of the manufacturing sector in South Africa, as well as the importance of the manufacturing sector in the South African economy.

In view of the above discussion, the central formulated research questions are given as follows:

- Does production in the manufacturing sector has an impact on GDP and employment in the South African economy?
- Which sector of manufacturing induces manufacturing-driven economic growth and employment in the South African economy?

1.3 OBJECTIVES OF THE STUDY

The following objectives have been formulated for the study:

1.3.1 Primary objective

The primary objective of the study is to appraise the existing South African manufacturing base and analyse the impact of production in the manufacturing sector and its predominant sub-sectors on GDP and employment in South Africa.

1.3.2 Theoretical objectives

In order for this study to achieve its primary objective, different theoretical objectives are pursued:

- Review the theoretical aspects of the importance of the manufacturing sector aggregate supply on GDP and employment.

- Review and evaluate the importance of the growth in the manufacturing sub-sectors in an economy.
- Review theories on GDP and employment as well as the theoretical relationship between the concepts.
- Analyse vital issues pertaining to industrial performance in South Africa regarding policy development.

1.3.3 Empirical objectives

For the purpose of obtaining a viable and comprehensible result for the study, the different empirical study objectives have been pursued:

- To establish the effect of production in the manufacturing sector and its predominant sub-sectors on the South African economy
- To analyse the relationship between GDP, employment, production in the manufacturing sector and its predominant sub-sectors in South Africa
- To formulate policy recommendations for improved sectoral development regarding manufacturing production and job creation.

1.4 RESEARCH METHODOLOGY

1.4.1 Data collection method

An analysis of the impact of production in the manufacturing and its predominant sub-sectors under study on GDP and employment in South Africa requires the availability of data of a specified time frame. This study is based on quarterly time series data over the period of 1998 to 2017. Therefore, data were collected on GDP at market prices (constant), total non-agricultural employment (proxy for employment) and manufacturing sector and its sub-sectors' production volumes. A total of 77 quarterly observations were utilised, which is more than sufficient to establish the impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP and employment in South Africa. The data were collected from the South African Reserve Bank (SARB) and Statistic South Africa (Stats SA). Lastly, the collected data are reliable as they are directly from the databases of national institutions that are globally recognised.

1.4.2 Data analysis

With regard to the empirical part of the study, the researcher will use Econometric views (E-views), Version 9.0 and models that will make it possible to determine the long- and short-run impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP and employment in South Africa. Moreover, the descriptive analysis will be done between the variables selected in order to provide scores and features of the data used in the study. To ensure that variables are stationary, the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit roots tests together with the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) stationary test were estimated. Multiple break-point tests were conducted to diagnose breaks in the data of the variables of the study. This was followed by an estimation of the lag-length selection criteria, in order to determine the optimal number of lags to use. Consequently, depending on the ADF, PP and KPSS results, autoregressive distributed lag (ARDL) models may be estimated to determine the scale of the long and short-run impacts. Furthermore, if the results of the ARDL bound test approach to co-integration indicate an existence of the long-run impact running from production in the manufacturing sector and its predominant sub-sectors under study to either GDP or employment, a corresponding error correction model (ECM) will be estimated to determine the variable's speed of adjustment to restore equilibrium in the models and short-run impacts. Lastly, to ensure the reader about the robustness and validity of study results generated using the ARDL model, the model residual and stability diagnostic tests were performed on every estimated ARDL model.

1.5 ETHICAL CONSIDERATIONS

In conducting the study, secondary data used were derived from the databases available to the public. The ethical clearance from these databases (South African Reserve Bank and Statistics South Africa) was not required. However, the study was subject to ethical considerations proposed by the North West University (NWU).

1.6 IMPORTANCE OF THE STUDY

In South Africa, the manufacturing sector has been underperforming over the last two decades, however, recently the repercussions associated with this underperformance reflected through low GDP growth rates and jobs shedding. This phenomenon has serious development challenges for the South African economy as a whole. Thus, it is very important for the study to explore the impact of production in the manufacturing sector and its predominant sub-sectors on GDP and employment in South Africa. This study underpins the manufacturing sector and its various sub-sectors and provides more knowledge on how the manufacturing sector contributes towards growing the economy and generating jobs in South Africa. Moreover, the findings of this study will assist economic stakeholders, authorities and policymakers in formulating solutions to assist in saving the manufacturing sector and consequentially generate manufacturing-driven economic growth and employment in South Africa. In addition, this study can be used in future research to emphasise the fact that the manufacturing sector plays a significant role in the South-African economy. Not to mention, this study may also be used to establish whether production in the manufacturing sector and its sub-sectors play a major role in employment creation. Lastly, the study will formulate policy guidelines for improved sectoral development regarding the manufacturing sector in South Africa.

1.7 CHAPTER CLASSIFICATIONS

Chapter 1: Introduction and background

This chapter provides a brief overview of what the study entails, highlighting the study objectives, problem statement, contribution and scope of the study.

Chapter 2: Literature review: Economic growth and employment through industrialisation

This chapter conceptualises the key concepts used in the study and evaluates the theoretical aspects of manufacturing activity, GDP and employment in the economy. In this chapter, the impact of manufacturing and its sub-sectors on GDP and employment is theorised. Empirical studies conducted on manufacturing and its relation to GDP and employment are reviewed in order to prove if the theorised impact of manufacturing and its sub-sectors on GDP and employment is in line with reality.

Chapter 3: A review of manufacturing performance and support measures in South Africa

This chapter deals with analysing the production performance of the manufacturing sector and its predominant sub-sectors under study in the South African economy. The chapter also includes reviewing policies and incentive schemes available for manufacturing activity in South Africa.

Chapter 4: Research methodology and econometric modelling

This chapter provide an explanation of the sample period, data collection and econometric estimation techniques employed in the study to achieve the empirical objectives of the study.

Chapter 5: Empirical analysis, interpretation and discussion of results:

The chapter provides the results and discusses the findings of the empirical analysis in regard to the South African economy and previous empirical findings. To clarify, an ARDL model and ECM will be employed to analyse the impact of manufacturing and its predominant sub-sectors under study on GDP and employment. As such, results of this chapter will approbate the study to state explicitly whether or not the policy makers in South Africa must continue supporting the manufacturing sector. Equally important, the results of this chapter also help in distinguishing this study from many others conducted on the impact of manufacturing on GDP and employment.

Chapter 6: Conclusion and recommendations

Lastly, Chapter 6 provides a summary of the study, concludes the findings, recommends solutions and also suggests future research.

CHAPTER 2: LITERATURE REVIEW: ECONOMIC GROWTH AND EMPLOYMENT THROUGH INDUSTRIALISATION

2.1 INTRODUCTION

According to Matambalya (2015:15), industrialisation refers to the development of industries and is acknowledged widely to be a pathway to sustainable economic growth and development. Taking this into account, the use of the expression industrialisation instead of manufacturing in stipulating what Chapter 2 entails, namely to highlight the idea that developing manufacturing industries is amongst the essential initiatives towards economic growth and development (Zalk, 2014). As such, industrialisation for this study refers to the changes in the manufacturing sector's share of GDP and employment; this is not a coincidence since manufacturing came about as a result of industrialisation (Malan, 2015:9). In light of this, imbalances in industrialisation have been a central concern for economic theory (Sampath, 2014:439). Consequently, economists have been engaging in discourses concerning the nature of industrial development and policy in developing countries, in search for viable industrial based solutions for economic predicaments inhibiting inclusive economic growth and development (Page & Tarp, 2016). The reason for this is that the industrial sector is still considered pivotal to the growth and development of the modern-day economy (an industry-based as opposed to the ancient agriculture-based economy), notwithstanding the growing importance of the knowledge economy (Ganyile, 2012:1).

Furthermore, an industry-based economy provides various platforms that facilitate the application of capital, advanced technology and division of labour, three essential components for sustainable economic growth and development (United Nations, 2007:295). As such, industrialisation has been a key driver of modernisation in both developing and developed countries over the years (Rodrik, 2013:17). Su and Yao (2016:3) assert that industrialisation has been considered the most crucial driver of economic growth and this is ascribed to the manufacturing sector. Correspondingly, Kemp (1989) points out that industrialisation through the manufacturing sector increases income per capita and creates a more balanced structure of the economy, thus enabling an environment conducive for growth. The manufacturing sector is embedded with strong employment multipliers, thus suggesting that the manufacturing sector can generate employment (Tsebe & Biniza, 2015:2).

Given these circumstances, Chapter 2 explores the conventional role and impact of the performance in the manufacturing sector on economic growth and employment from a theoretical and empirical perspective, in order to have a comprehensive approach in assessing both the theoretical and empirical objective of the study.

In doing so, Chapter 2 follows an assumption that, in order to have a comprehensive approach towards analysing the effectiveness of manufacturing efforts in general and particularly within the area of study, it is indispensable to review the theoretical and empirical literature around what, why and how manufacturing facilitates economic growth and development, while providing an enabling environment for job creation. As such, Chapter 2 will provide clarity regarding key concepts used in the study, by means of examining the difference between economic growth and economic development, employment and unemployment as well as providing an extensive definition of both manufacturing and industry. This will be followed by a theoretical review of growth and employment theories, as well as a section that theoretically links manufacturing to both economic growth and employment, in order to devise a solid theoretical foundation for the study. Thereafter, the study will review empirical findings by other studies on the impact of manufacturing and its sub-sectors on GDP and employment.

2.2 CONCEPT CLARIFICATION

2.2.1 Economic growth and economic development

The use of economic growth and economic development synonymously has been a common misconception made in economic discourses (Zinn, 2008:9). Nonetheless, in some instances the usage is admissible. Even so, it should be acknowledged that the existence of two separate terms implies a certain degree of variation. Hence, it is important to elucidate the difference between economic development and economic growth, in order to have an apprehensive and explicit approach in formulating policies driving various economies. For that reason, economic development refers to a process that necessitates compositional changes in the country's outputs and inputs, with an ultimate goal of substantially improving the existing human conditions (Kindleberger & Herrick, 1977:179).

According to Porter (2000), economic development seeks to accomplish sustained improvement in a nations' standard of living over the long term. Thus, it is inclusive of economic growth and cultural and social reforms that pertain to the overall development process (Robinson, 1972:54). In contrast, economic growth refers to an increment in the national income per capita, in conjunction with more output and inputs as well as increased output per unit of input, *inter alia* economic efficiency (Haller, 2012:66). According to Colombatto (2006:243), economic growth refers to growth when dealing with proportional changes in GDP or GDP per capita. This being said, economic growth measures the market values of domestic goods (i.e. goods produced within the borders of a particular economy) in a specified period (Callen, 2012). Succinctly:

$$GDP = C + I + G + (X - Z) \tag{2.1}$$

Where:

C- Consumption

I- Investments

G- Government expenditure

(X-Z) – Net exports

In a limited sense, economic growth is keen on increasing the overall national product, either aggregate or per capita, disregarding the changes in social and cultural value system, such as reforms in the structure of the economy (Robinson, 1972:54). As such, it can be deduced that economic growth is more concerned with increasing aggregate productivity since it is associated with only increasing the national income (Howarth, 2012:33). Whilst, economic development put forward a holistic approach towards economic progression, encompassing the overall economy, with its culture and political requirements to facilitate an enabling environment for institutional reform, in order to accommodate poverty alleviation, equality and job creation (Meyer, 2013:2). To put it another way, economic development improves the quality of life and generates employment, while providing a regional economy with the capacity to generate inclusive wealth (Kane & Sand, 1988).

In spite of the dissimilarities in the concept of economic growth and economic development, the two concepts are interlinked in terms of the notion that every economy that incurs growth is likely to develop and vice versa (Haller, 2012:66). At the same time, it is important to realise that based on the evolution of macroeconomics, economic development is a variable of a higher order, since economic growth deals with only the economy's quantitative activities, whereas economic development deals with both the quantitative and the qualitative activities of the economy (Haller, 2012:69).

2.2.2 Manufacturing and industry

Manufacturing and industry are concepts that are conventionally used interchangeably and it is for this reason, this section of the study provides clarity between the two concepts. As such, industry can be conceptualised as economic approaches concerned with transforming raw materials together with manufacturing goods, such as transforming material inputs into material outputs (Berg, 1976:111). According to Berg (1976:99), industry is regarded as a key driver of modernisation, as it entails sectors (i.e. manufacturing, community services and construction) that stimulate the use of both technology and capital in production processes. On the other hand, manufacturing refers to the process of transforming the raw material into finished consumable goods by adding value (Mbelede, 2012:6).

Similarly, the United Nations Department of Economic and Social Affairs (DESA) explains manufacturing as the chemical processes concerned with transforming raw materials into final goods. With this in mind, the processes involved in transforming the raw materials or components into new products necessitate the use of industrial machines at a high scale (Popa, 2015:39). In this regard, a slight difference between the concept of manufacturing and industry can be deduced, in the sense that industry is a broad concept used to address processes included in manufacturing. Despite this, various studies use and consider the concept manufacturing inclusive of all the processes within the industry (Millin, 2003:45).

In this case, Chigozie and Ada (2013:37) discovered a large amount of the literature suggests the manufacturing sector is the key sector of the industry that presents greater opportunities for poverty reduction, sustainable growth and employment in developing countries. Not to mention, the manufacturing sector also plays a central role in ensuring that productivity growth in other economic sectors is sustained, through guided technological developments and innovation (United Nations Industrial Development Organization, 2015:2). Correspondingly, Suleman (1998:105) conceptualised manufacturing as a sector with the potential for income and job creation to foster economic development. In light of this, it can be acknowledged that manufacturing plays a pivotal role as compared to other economic sectors within the industry, such mining and construction sectors. It is also important to realise that manufacturing is also an official economic sector in the South African economy (Brand South Africa, 2017).

2.2.3 Employment and unemployment

This section points out the dichotomy between employment and unemployment, as there is a trade-off between the two concepts (Landmann, 2004:3). As such, conceptualising the two concepts is an apprehensive approach in understanding this trade-off. In doing so, it should be noted that conceptualising employment is a challenge, as the concept is considered in its simplest explanation (Brada, *et al*., 2008:4). Considering this, employment refers to a state of being in possession of a waged job. It is often a constructive relationship between two parties that enter into mutual contract, where one offers the job (employer) and one get compensated as result of agreeing to do the job (employee) (Faulkner, 2013). Lauterbach (1977:283) points out that the employment concept involves activities that are compensated financially and are considered to have a positive direct or indirect effect on labour productivity within economic sectors generating employment. In view of this, the International Labour Organisation (ILO) (2013:111) annunciates that growth in labour productivity within economic sectors creates economic growth.

Contrarily, unemployment in a limited sense is a precise antonym of employment and can be referred as a state where a person is willing but unable to participate in a financially compensated activity (OECD, 2009:5). As such, Kuper and Kuper (1996) define unemployment in terms of the state of not being employed, available and looking for work. Correspondingly, Dwivedi (2005) defines unemployment as a state in which those who are able and willing to work at the prevalent wage rate are unable to find jobs. Nonetheless, Dwivedi (2005) further elaborates that his definition of unemployment is equivocal from a policy perspective, as it did not specify the persons who should and should not be included in the category of job seekers. In that case, unemployment is the gap between full employment and the number of employed persons (Dwivedi, 2005). As such, Mosikari (2013:430) points out that unemployment is a supreme macroeconomic socio-economic problem, restricting economic growth and development.

In essence, it can be deduced that employment increases labour productivity and thus increases the GDP within a particular economy while providing a societal balance (i.e. reducing income inequality and poverty). On the other hand, in a particular economy, unemployment implies an unfavourable state of being unable to provide jobs to the people; as a consequence the economy becomes vulnerable to production problems and ultimately low economic growth.

2.3 THEORETICAL BACKGROUND

2.3.1 Introduction: Growth theory from a viewpoint of prominent school of thoughts

Growth in the context of economics entails several elements that jointly lead to economic advancement; this involves savings that are used to finance investment in the country, technology practices in manufacturing and investment in human capital (Mellet, 2012:16). As such, growth is considered an economic goal, thus it has and still is momentous for all economic agents to have a clear understanding of growth and factors that lead to growth within economies. For that reason, growth theories provide a plausible approach towards understanding economic growth and its determinants (Dewan & Hussein, 2001:2). According to Wolff and Resnick (2012:1), growth theories can be conceptualised as the sub-theories of the general economic theory that aim to explain the rate at which a particular country's economy will grow over time.

Growth theories aim to provide viable systematic ideas that serve as guidelines for different economies that are in a process of achieving sustainable growth, that is, incessant upward growth trends (Perman & Stern, 2004:3). In doing so, the growth theories explain a set of phenomena; this includes inputs, prices and time paths of output (Nelson & Winter, 1974:887). Adding to that, more often than not growth theories will employ economic models that serve as structures bolstering what a particular theory annunciates (Ouliaris, 2011:1). As such, Kindleberger (1965:40) points out that an economic model can be defined as a statement of relationships among economic variables since it denotes casual relations between critical variables in the real world. Thus, economic models generally are used to provide a clear and apprehensive approach towards understanding how different economies function over time.

Furthermore, various school of thoughts theorising economic growth have been introduced to economic theory (e.g. classical, neo-classical, new growth theorists, Keynesian etc.) (Lucas, 1988:6). These schools of thoughts were intent on explaining the operational mechanisms of the economy and establishing viable modalities that can be used to induce economic growth (Hudea, 2012:92). This study considers plausible and reviews three prominent schools of thoughts that theorise economic growth. First, the classical school of thought, which associates growth in the population with labour productivity, namely the quantity of goods and services produced in an hour of labour (Lucas, 1988:5). Secondly, the neo-classical school of thought, that supports the notion that technological advancements lead to productivity growth and thus economic growth (Mallet, 2012:19). Lastly, the modern school of thought, that stipulates that although technology advances lead to productivity growth, the standard of living will most likely lag behind if there are no incentives put in place to promote creativity, innovation and knowledge accumulation, namely human capital (Romer, 1989). Therefore, the three prominent growth school of thoughts will be reviewed and discussed, in order to set up a strong and lucid theoretical foundation for the study.

2.3.1.1 Classical growth theory

Understanding the process of economic growth was a central feature of classical economists (e.g. Adam Smith, David Ricardo) and this central feature became a common characteristic of the classical school of thought (Engel, 2010:2). According to Thirlwall (2006:122), classical economists were all development economists that wrote about the factors determining the progression of nations when industrialisation was introduced. Nevertheless, prior to the classical school of thought was the physiocratic school of thought that believed the wealth of a nation was derived only from the surplus of agricultural production (Charbit, 2002:860). The physiocrats (physiocratic custodians) believed that other forms of economic activity such as manufacturing depend on the surplus of the agricultural production. In spite of the contributions of the physiocratic school of thought to growth theory, the classical school of thought was acknowledged as the central forerunners of modern growth theory.

As such, Thirlwall (2006:122) points out that Adam Smith often is acknowledged as the main custodian of the classical school of thought and regarded as the father of modern economics. Adam Smith published his major work titled *An Inquiry into the Nature and Causes of the Wealth of Nations* in early 1776 and his most important contribution to economic theory was the introduction of concept increasing returns to scale, that is based mainly on the division of labour (or specialisation) (Smith, 1904:20). According to Mallet (2012:16), increasing returns to scale takes place when inputs are doubled, resulting in output in the economy that is more than double. Correspondingly, Thirlwall (2006:123) defines increasing returns as a situation where labour productivity and per capita income increases, as output (GDP) and employment expands. In light of this, Smith (1904:25) highlights that the division of labour results increases returns (e.g. labour productivity), since it involves the separation of employment into parts, in such a way that each activity involved in a production process is carried out by separate persons.

As a consequence, all activities involved in production will be given individual attention (specialisation), thus leading to efficiency, effective use of time, increased scope to modify production methods (e.g. introducing machines) and ultimately increase the labour productivity (Engel, 2010:4). Furthermore, Smith (1904:35) compares the agricultural sector to the manufacturing sector and points out that the nature of the agricultural sector permits limited sub-divisions of labour and it restricts absolute separation of one business from another. While the nature of manufacturing permits ample sub-division of labour and allows separations of one business from another (Smith, 1904:36). Hence, Smith recognised that increasing returns built on the division of labour is more of an intrinsic feature of the manufacturing sector than the agricultural sector (Thirlwall, 2006:124). The reason for this being that the manufacturing sector provides more scope for dividing labour (Yang, 2003:138). As such, the manufacturing sector presents a greater scope for division of labour, which in turn result in increasing returns, expanding both GDP and employment within an economy.

Corresponding to the latter, Smith also asserts that the division of labour is a central determinant of the overall economic growth and, therefore, depends on the size of the market, *inter alia* both local and global markets (Mohr & Fourie, 2008:35). This implies that the extent in which labour can be divided and the economy can grow is limited to the market size, thus market expansion will lead to the greater division of labour and result in economic growth (Arora, *et al*., 2009:788). According to Mohr and Fourie (2008:36), Smith annunciates that markets can only be expanded if there are no impediments to free trade, both locally and globally. As such, the manufacturing sector does not only provide more scope for driving labour but can potentially replace imports and expand exports, thus providing access to both local and global markets (Loto, 2012:38).

Moreover, Smith proposed a supply-side model of growth that can be expressed as follows (Smith, 1904:65):

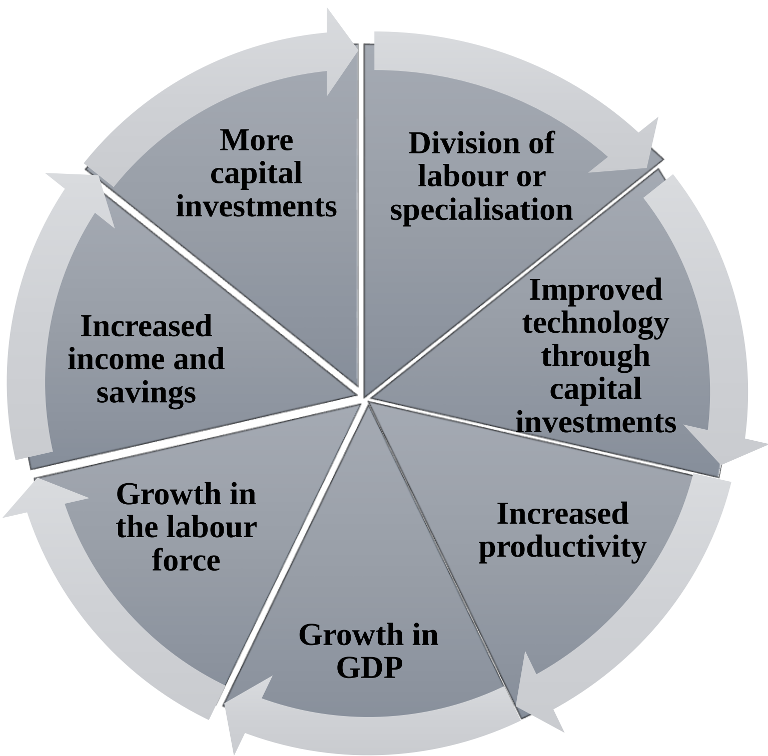
$$Y = f(L, K, T) \qquad (2.2)$$

The model above represents a production function, where Y denotes the output resulted, L denotes the labour employed, while K denotes capital and T denotes the land used to produce. Smith (1904:69) further states that there is a link between labour, capital and land as production inputs. As a consequence, growth in output (G_Y) was due to increased population (G_L), investments and capital accumulation (G_K), land growth (G_T), increased and inclusive productivity ($G_{\|}f$). This can be briefly expressed as follows:

$$G_Y = f\,(G_L,\, G_K, G_T,\, G_{\|}f) \tag{2.3}$$

Additionally, Smith (1904:420) points out that enough nutriment to accommodate the increasing number of people entering the labour force is a requirement for population growth, while increased savings is a requirement for investment. As such, Smith asserted that increased savings are solely due to profits earned in both the manufacturing and agricultural sectors as well as the scope of the division of labour (Thirlwall, 2006:123). To summarise, Figure 2.1 depicts a flow representing the process of economic growth from Smith's perspective.

Figure 2.1: Process of economic growth



Source: Compiled by the author; Smith (1904)

Equally important, Hunt (1989:11) states that Smith regarded the manufacturing sector as a more important source of increased savings and output than the agricultural sector, this is due to the greater scope of the division of labour in the manufacturing sector. Furthermore, Mallet (2012:16) scribes that Smith points out that land growth was due to new lands obtained through colonisation and increased the fertility of old lands through developments in technology. Notwithstanding this, technological developments, therefore, could result in inclusive growth (Samans, *et al*., 2015:1). In addition, Smith also considered machinery upgrades coupled with global trade as drivers of GDP growth since they extend the scope of the division of labour in the manufacturing production (Smith, 1904:38). In retrospect, Smith's foundational notion was that the division of labour drives economic growth.

Post Adam Smith's contributions to economic growth theory, was David Ricardo who published his work titled *Principles of Political Economy and Taxation*, where he asserted that capitalist economies wind up in a state of stationarity, with no GDP growth (Ricardo, 1815). Ricardo was another classical economist that was in support of the notion that GDP growth is financed out of profits resulting from productive activity (Hunt, 1989:15). Like Smith's model of growth, Ricardo's model of growth argued that growth is a function of capital accumulation and capital accumulation depends on savings derived from profits (Ricardo, 1815). According to Thirlwall (2006:127), Ricardo points out that profits are found between subsistence wages and the rent payments remitted to landlords, which rises as food prices rise, due to diminishing marginal returns to land.

Consequently, Ricardo presents a production function that acknowledged the existence of three production inputs, namely labour (N), capital (K) and land (L) (Ricardo, 1815). Succinctly:

$$Y = f\,(K, N, L) \qquad (2.4)$$

Nevertheless, unlike Smith's production function, Ricardo's production function is subjected to diminishing marginal productivity, resulting from the variable quality and fixed supply of land (Hubacek, *et al*., 2002:5). The reason is that Ricardo's growth model comprises production inputs that are fixed and those that are varied, where land is considered a fixed input, while both capital and labour are considered variable inputs in production. As such, Ricardo annunciated that to achieve GDP growth, more land is required to be cultivated; however, land cannot be created. For this reason, Kindleberger and Herrick (1977:41) point out that Ricardo emphasised the limits to GDP growth are imposed by the ultimate scarcity of land. Nonetheless, if more N, K and L are employed in production, the marginal productivity of N, K and L will decline. In a limited sense, Ricardo altered Smith's growth model by adding a diminishing marginal return to land (Ricardo, 1815). Even so, Smith's growth model will always be the uppermost model of the classical growth theory (Mallet, 2012:17).

- **Classical Keynesian theory: Harrod-Domar's growth model**

According to Thirlwall (2006:130), Roy Forbes Harrod's original model is an extension of Keynes' static equilibrium analysis, as Harrod (1939) made his purpose known that it is to give a dynamic dimension to Keynesian economics. As such, Harrod's purpose was reflected in his article titled *An Essay in Dynamic Theory* that was published in 1939 (Harrod, 1939). In addition, it was later discovered that Evsey Domar shared the same purpose as Harrod when he published an article titled *Expansion and Employment* in 1947 (Domar, 1947). Consequently, the two economists independently developed what has come to be known as the Harrod-Domar's growth model, as their independent work reached an indistinguishable central conclusion (Hunt, 1989:28). Furthermore, Hunt (1989) highlights that Harrod-Domar's growth model resuscitates two classical arguments; first the model is based on economic growth, not economic development and, secondly, the model supports the notion that economic growth is financed out of savings.

Harrod and Domar's theory is based on the work by Keynes that highlights that in an industrial society, the economy can achieve equilibrium without full employment (Grabowski, *et al.*, 2000:1). As such, this points out that Keynes focused was on the stability of the economy rather than growth. Nonetheless, Keynes' model of income determination points out that plans to save and invest are conditional for the equilibrium of income and output, but this model regarded the short run and disregarded the long run (Dutt & Skott, 2005:3). According to Andersen and Balula (2008:2), growth theories are expected to indicate how potential growth can be expanded in the long run. For this reason, Harrod and Domar integrated their work with Keynes' work and that resulted in the Keynesian theory of economic growth.

Moreover, Harrod's model independently proposed a question that if an economy incurs an accelerator process (i.e. a process where changes in investment are prompted by changes in income), at what rate must income grow to result in a situation where planned savings (S) are equal to planned investment (I)? (Harrod, 1939). The answer to this question is a situation required to comply with the condition of dynamic equilibrium for long-run economic growth (Andersen & Balula, 2008:3). As such, Harrod's focus was on determining the saving rate required to result in a situation where $S=I$ (i.e. Keynesian's general theory) and, thus, resulting in economic growth (Harrod, 1939). In doing so, Thirlwall (2011:141) pointed out that Harrod differentiated between two types of growth rates, that is, the actual growth rate (g) that can be conceptualised by an equation below:

$g = s/c$ (2.5)

Where g denotes the actual growth rate, while s denotes the ratio of saving to income (S/Y) and the ratio of additional investment to the flow of output ($\Delta K/\Delta Y = I/\Delta Y$) is denoted by c (Harrod, 1939). As a result, the actual growth can be further expressed below, when the expressions of both the s and c are incorporated in Equation 2.5:

$g = (S/Y)/(I/\Delta Y) = \Delta Y/Y$ (2.6)

Assuming S = I, then $\Delta Y/Y$ evaluates GDP growth

Nonetheless, Harrod indicated that the actual growth rate may be inadequate in explaining the steady steady-state relationship between savings and investment at full employment, thus the significance of the following growth rate (warranted growth rates) (Millin, 2003:14). The warranted growth rate (g_w) was conceptualised by Harrod (1939) as the growth rate that brings about enough investment to equal the planned savings and keep capital extensively employed, thus preventing under- or over usage of capital in order to enable manufacturers to carry on future investment at a rate equal to the preceding rate (Thirlwall, 2006:131). Therefore, the warrant growth rate is determined by the plans to save, succinctly (Harrod, 1939):

$S = sY$ (2.7)

Where s denotes the propensity to save. Millin (2003:14) points out that Harrod asserted that while S = sY provides the potential endowment of investment, the demand for investments is provided by the acceleration principle. The acceleration principle can be expressed as follows (Harrod, 1939):

$c_r = \Delta K/\Delta Y = I/\Delta Y$, therefore $I = c_r \Delta Y$ (2.8)

Then, equate planned saving to planned investments

$sY = c_r \Delta Y$ (2.9)

Thus, the growth rate required for the equilibrium that moves through time is

$g_w = s/c_r = \Delta Y/Y$ (2.10)

Where c_r denotes the accelerator coefficient, weighed as the additional investment required to result in a unit flow of GDP at a stated rate of interest and it depends on the state of technology (Thirlwall, 2006:131). In addition, Harrod asserted that an economy that is growing at g_w rate will be able to maintain its dynamic equilibrium (Harrod, 1939). For that reason, at the g_w consumption, spending will be equal to the production of consumable goods. In cases, where there is a deviation from the equilibrium condition (g=g_w), for instance (g<g_w), this will constitute a surplus in capital goods and thus inhibit investment, ultimately resulting in the actual growth rate (g) being positioned below the equilibrium growth rate and vice versa (Harrod, 1939).

Similarly, Domar encountered the same findings when he worked autonomously, however using a different approach (Domar, 1947). In light of this, Mallet (2012:18) highlights that Domar's work enunciated that investments can be seen as a double-edged sword, as it gives rise to both demand and supply, where demand is raised by the multiplier and supply is raised by its effect on amplifying capacity. Corresponding to Harrod (1939), Domar (1947) focused on determining the investment growth rate required or enough investments to result in a situation where supply grow with demand at full employment. In doing so, Domar proposed that the key investment growth rate could be determined as follows (Thirlwall, 2011:142):

$$\Delta I/s = \Delta Y_d \qquad (2.11)$$

Where the change in investment level rises to demand as denoted by Equation 2.11. While investment autonomously rises supply as denoted by Equation 2.12:

$$I\sigma = \Delta Y_s \qquad (2.12)$$

In Equation 2.12, σ denotes investment output flow per unit (or $\Delta Y/I$). Furthermore, demand will grow with supply ($\Delta Y_d = \Delta Y_s$) provided:

$$I\sigma = \Delta I/s \qquad (2.13)$$

Or

$$s\sigma = \Delta I/I \qquad (2.14)$$

Therefore, to result in $\Delta Y_d = \Delta Y_s$, the rate of investment growth must be equivalent to the product of the saving ratio as well as the $\Delta Y/I$ (Domar, 1947). For this reason, Thirlwall

(2006:133) indicates that growth in output at the rate $s\sigma$, also implies fixed savings-investment ratio. Thus, if the outflow of investments per unit (σ) is equivalent to additional investment required to result a unit flow of GDP at a stated rate of interest (I/c_r) at full employment, then Harrod (1939) and Domar (1947) findings about equilibrium growth are similar, regardless of their different approaches. Consequently, Harrod and Domar's integrated work resulted in the Harrod-Domar growth model. In a limited sense, Harrod-Domar's growth model enunciates that investment are financed through savings and this results in an expanded production capacity, leading to additional income in the succeeding period (Kindleberger & Herrick, 1977:41). Even so, Harrod-Domar's growth model fail to ensure if labour will be fully employed (Kolawole, 2013:183).

2.3.1.3 Neoclassical growth theory

According to Hudea (2015:311), classical theory has imperceptibly resulted in a pronounced theory, the neoclassicism, which in spite of having taken over the fundamental features of the classics, was also susceptible to the effects of the Keynesian theory and of the innovations encountered in the economic field. As such, in the neoclassical school of thought, growth theory emphases capital accumulation and relates it to other growth features, such as savings and technology (Mallet, 2012:19). Despite relating capital accumulation to technology, the growth theory assumes that there is an absence of technological innovation, meaning that an economy reaches a steady-state equilibrium, as in the long-run level of capital and output (Michael, 2011). With this in mind, Dornbusch *et al*. (2014:61) points out that in an economy, the steady-state equilibrium refers to a situation where per capita GDP and per capita capital are combined and the economy remains at rest − where per capita economic variables remain unchanged. Succinctly:

$$\Delta Y=0 \quad (2.15)$$

And

$$\Delta K=0 \quad (2.16)$$

Where per capita GDP is denoted by ΔY and per capita capital is denoted by ΔK. Furthermore, the neoclassical growth theory is based on three foundational propositions (Thirlwall, 2011:146). First, the neoclassical growth theory asserts that in the long run, steady-state output growth is autonomously a result of the rate of growth in the labour force. This implies that in the long run, steady-state output growth does not depend on the ratio of saving and investment to GDP, but dependent on the growth rate of the labour force, provided that the labour force grows efficiently, namely the growth rate of the labour force plus the growth rate of labour productivity (Bernanke & Gürkaynak, 2001:14). This is because of the neoclassical preconception of diminishing returns to capital, that result in a situation where a high capital-output ratio or low capital productivity counteract a high saving-investment ratio (Nell & Thirlwall, 2017:2).

Secondly, the neoclassical growth theory asserts that the level of per capita income (or output per capita) is directly related to the ratio of saving and investment to GDP and inversely related to population growth (or labour force growth) (Shuaib & Ndidi, 2015:26). Unlike, output growth, the level of per capita income depends on the ratio of savings and investment to GDP (Lasky, 2004:1). Lastly, in cases where the capital-labour ratio is related inversely to the productivity of capital across countries, while saving etiquette is directly related to technology across countries it is expected for countries consisting of insufficient or less per capita capital to grow more rapidly than those that consist of sufficient or more per capita capital (Nell & Thirlwall, 2017:3). This will result in living standards and per capita incomes across the world to converge. Therefore, the Solow-Swan model of growth indicates how these foundational propositions are arrived at.

Robert Solow and Trevor Swan developed the Solow-Swan model independently in 1956, thus it is known as the Solow-Swan model (Thirlwall, 2011:147). These two economists respectfully shared the same purpose of investigating the long-run growth, taking into account demographic factors, that is, population growth, productivity growth and growth in labour force structure (Salvadori, 2003:1). Therefore, in the Solow-Swan model, the long-run growth rate is linked to demographic factors (Solow, 1956; Swan 1956). According to Salvadori (2003:1), the Solow-Swan model was a significant contribution to macroeconomic policy since policies that give rise to long-run growth were those that would induce growth in population or the productivity of the labour force. As such, the Solow-Swan model aims to illustrate that, in the long run an economy achieves growth that is sustainable (Solow, 1956; Swan 1956).

Moreover, the Solow-Swan model is known to be an extension of the Harrod-Domar model; however, the two models are based on different assumptions and consider different factors as drivers of sustainable growth (Villanueva, 2012:1). Pietak (2014:53) points out that the Solow-Swan model proposes the assumption of substitution of factors of production, consequently this will remove the constant ratio of capital/production assumption that was assumed by the Harrod-Domar model. This implies that to produce output, any quantity of capital can be employed efficiently with an applicable quantity of labour.

In addition, the Solow-Swan model also addresses problems that the Harrod-Domar model failed to address, such as economy's lack of stability and failure to ensure full employment of labour (Pietak, 2014:53). In doing so, the model has three foundational assumptions and technological innovations are ignored for a moment (Thirlwall, 2011:147). First, the model assumes that population, in particular labour force, employment and labour-saving technical progress, increases at a constant exogenous rate. Secondly, the model assumes that there is no independent investment function, since saving finance investments ($S=I=sY$) and, lastly, the model assumes that there is an aggregate production function and can be expressed as follows:

$$Y = f\,(K, L) \tag{2.17}$$

Where output (Y) is a function of capital (K) and labour (L). This aggregate production function linking outputs to inputs does not have to decrease or increasing returns to scale but constant returns to scale (i.e. a percentage increase in both K and L, will result in the same percentage increase in Y) coupled with diminishing returns to both capital and labour (Popa, 2014:26). Furthermore, Guru (2016) points out that the neoclassical theory conceptualises the growth process using the aggregate production function in its intensive form, namely the labour-intensive form of the neoclassical production function. As such, to arrive at this labour-intensive form of the neoclassical production function both sides of Equation 2.17 will have to be divided by L, since the constant returns to scale preconception imply the same (Thirlwall, 2011:133). Succinctly:

$$\frac{Y}{L} = f\,(\frac{K}{L}) \tag{2.18}$$

Where, $y = \frac{Y}{L}$ denotes per capita output (output per worker) and $k = \frac{K}{L}$ denotes capital-labour ratio (Chand, 2016). Thus, the labour-intensive form of the neoclassical production function can be express as follows:

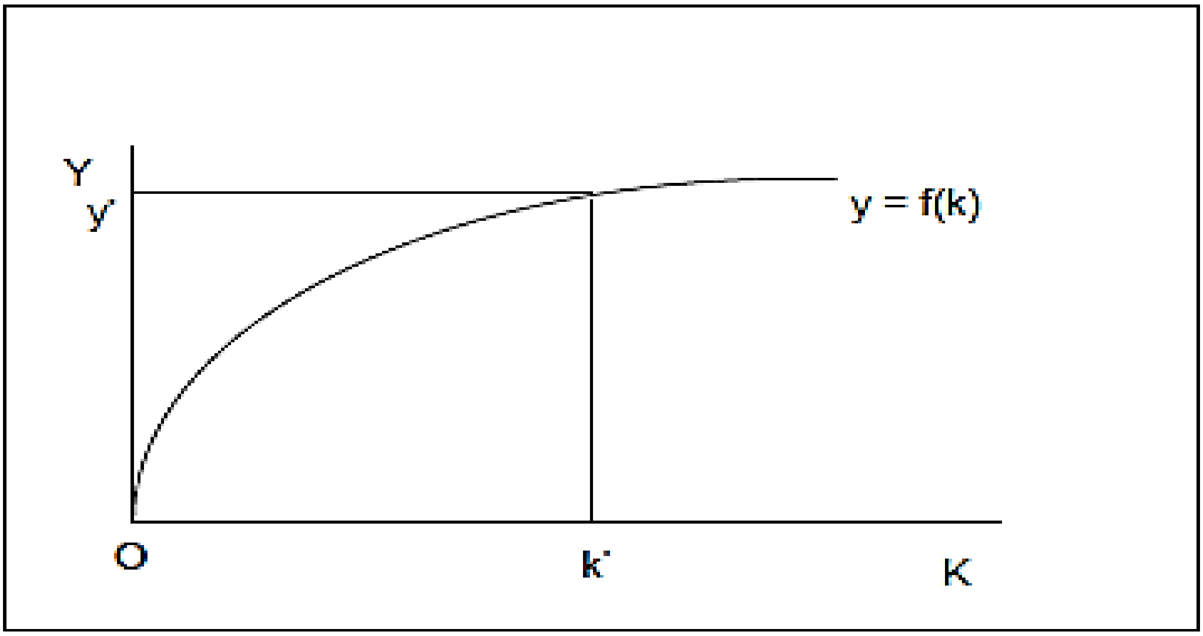
$$y = f\,(k) \tag{2.19}$$

Or

$q = b\,(k)^{\alpha}$ (when derived using Cobb-Douglas production function) (2.20)

It should be noted that Equation 2.19 and Equation 2.20 imply the same thing. Since in Equation 2.19, (q) denotes output per capita and (k) denotes capital-labour ratio (Thirlwall, 2006:137). Moreover, as stated above that the neoclassical growth theory proposes a preconception of diminishing returns to capital. Figure 2.2 is a depiction of a labour-intensive form of the neoclassical production function (i.e. Equation 2.19) with diminishing returns to capital.

Figure 2.2: Per capita production function



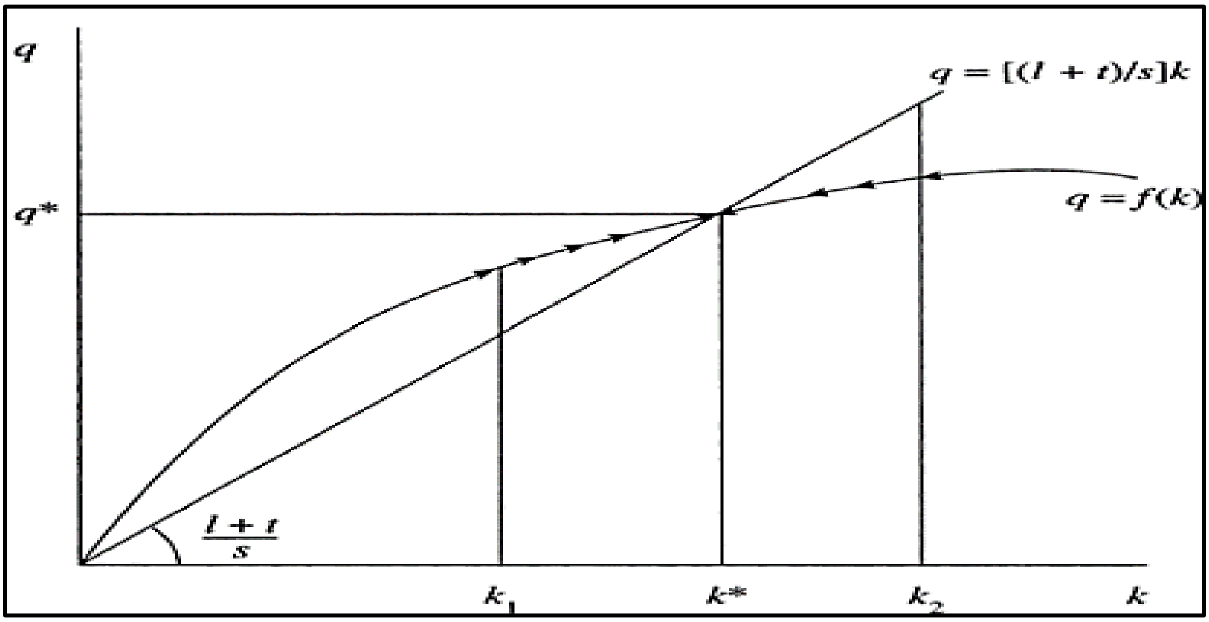
Source: Dornbusch *et al*. (2014:62)

Based on Figure 2.2, it can be deduced from the shape of the y = *f* (k) that the time path of both capital and labour is not exponential but rather asymptotic. Consequently, output increases as capital increases, however, output increases less when capital is at its high levels and increases more when capital is at its low levels, namely diminishing marginal product of capital (Dornbusch, *et al*., 2014:62). In practical terms, this implies that the inception of new machines in production will increase both capital and output; however, each additional machine leads to less output than the preceding machine (Mallet, 2012:20). In addition, the study highlights that the neoclassical growth theory proposed that output growth depends on the efficient growth of the labour force. Thirlwall (2011:147) points out that imposing a ray from the origin of y = *f* (k) will cause capital and labour to grow at the same rate, thus both capital-output ratio and the capital-labour ratio will be constant. As such, Equation 2.21 expresses y = f (k), when the slope of the ray is imposed (Mallet, 2012:27):

$$y = [^{(L+t)}/_{s}]\ k \qquad (2.21)$$

Where $[^{(L+t)}/_{s}]$ denotes the slope of the ray, where (s) is saving ratio and (L+t) is labour force in efficient units. Figure 2.3 is a depiction of Equation 2.21.

Figure 2.3: Equilibrium output per capita and capital labour-ratio



Source: Thirlwall (2002:23)

Figure 2.3 depicts the ray emerging from the origin with the slope $[^{(L+t)}/_{s}]$. The ray clearly reveals the level of output per capita required to keep capital per capita constant and the level of capital-labour ratio required to keep output per capita constant given the labour force growth rate (Thirlwall, 2006:137). Therefore, the ray determines the capital-output ratio at any point on the labour-intensive neoclassical production function, thus any change in the capital-labour ratio will lead to a change in the ray and eventually cause a change to the capital-output ratio (Mallet, 2012:19).

Additionally, Solow (1956:70) points out that the ray determines the capital-output ratio at any point on the labour-intensive neoclassical production function. As such, Figure 2.3 depicts a point where the labour-intensive neoclassical production function and the ray intersect represents the equilibrium point of output per capita and capital-labour ratio i.e. $q^{*}=k^{*}$

(Thirlwall, 2011:148). In view of this, any shift from k* to k_1 or k_2 will result growth of K to exceed growth of L (K>L) or growth of K to be less than growth of L (K<L) respectively (Solow, 1956:70). In practical terms, this implies that in production, when K>L then a more capital-intensive method of production is employed and when K<L then a more labour-intensive method of production is employed (Thirlwall, 2002:23). This suggests that an increase in production of the manufacturing sector is stimulated by a production method employed; it can either be by means of capital-intensive or labour-intensive method of production.

Furthermore, as mentioned before, the neoclassical growth theory also proposed that in the absence of technological innovations, an economy reaches a steady state. In light of this, Dornbusch *et al*. (2014:63) points out that per capita income (y*) and per capita capital (k*) are the steady state values where the required investment for supplying capital for newly employed labourers and to replace depreciated machines is equal to saving generated by the economy. This implies that all savings are invested, meaning that saving (*S*) is equal to investment (*I*) and per capita saving (*sY*) i.e. *S*=*I*=*sY* (Thirlwall, 2006:136). Given this circumstance, the neoclassical growth model assumes that (*S*) finance (*I*) required to replace deteriorating capital, thus when S>I per capita capital increases with output, but when S<I per capita output and capital decreases (Dornbusch, *et al*., 2014:63). This substantiates the neoclassical assumption that saving is used to finance investment. As such, an economy is in a steady state once (y*) and (k*) are constant, provided saving is equivalent to the investment required (Sorensen *et al*., 2010:162).

Moreover, Mallet (2012:20) highlights that not only saving is conditional for the investment required to accommodate a given level of (*k*), but also the rate of population growth as well as the rate at which machines depreciate − the depreciation rate. For this reason, it must be assumed that the rate of population growth is constant (*n*) and the economy requires investment (*nk*) to yield capital for the newly employed (Solow, 1956). In the same way, since the depreciating rate is also conditional for the investment required, it must be also assumed that the rate of depreciation is constant (*d*). As such, the requirement for new machinery and equipment can be expressed as (*dk*), while the required investment to accommodate the constant level of per capita capital is expressed as (*n*+*d*)k (Syverson, 2011:329).

Furthermore, the relationship between growth and saving is analysed, however, ignoring the effect of government and trade (Solow, 1999). In doing so, it must be assumed that saving is a constant fraction (s) of income (i.e. output), thus, per capita saving is denoted by (*sy*) and since income is equivalent to production, Equation 2.22 can be deduced (Mallet, 2012:20):

$$sy = sf(k) \quad (2.22)$$

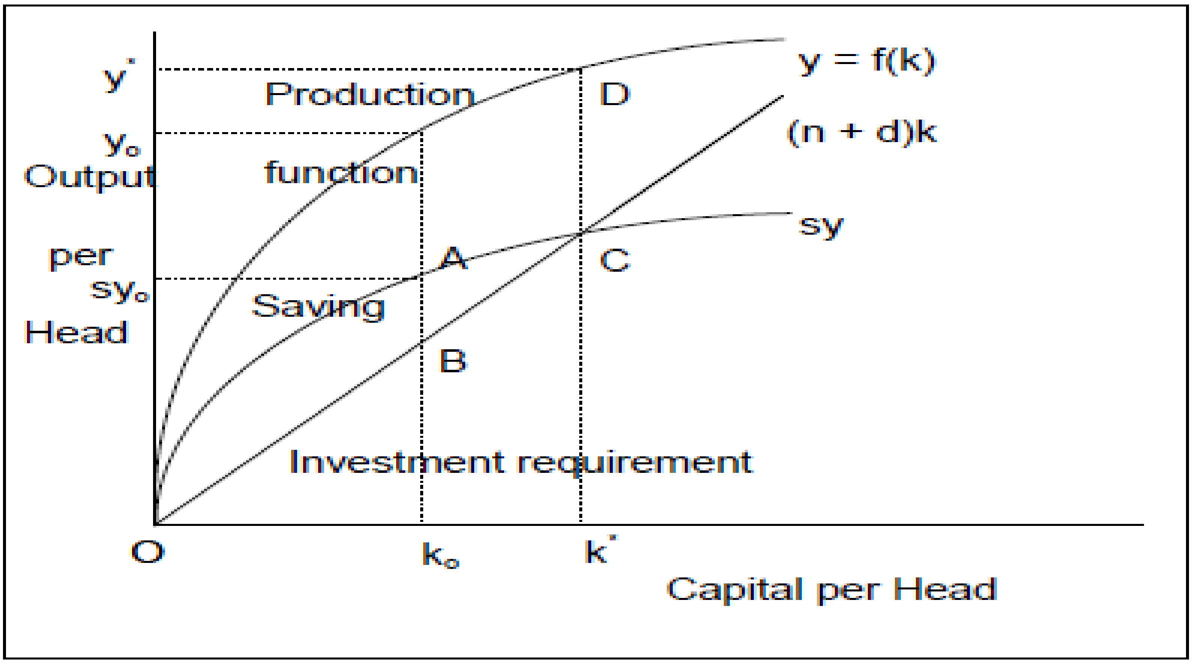
Additionally, it should be noted that the net change in per capita capital (Δk) is the surplus savings over required investment (Dornbusch, *et al*., 2014:63). Succinctly:

$$\Delta k = sy - (n+d)k \quad (2.23)$$

Hence, an economy is considered to be experiencing a steady state growth rate of output if (Δk) is zero and this occurs at the values of (y*) and (k*) (Mallet, 2012:21). This economic scenario is depicted in Figure 2.4 and can be symbolically expressed as follows:

$$sy^* = sf(k^*) = (n+d)k^* \quad (2.24)$$

Figure 2.4: Steady-state growth rate of output

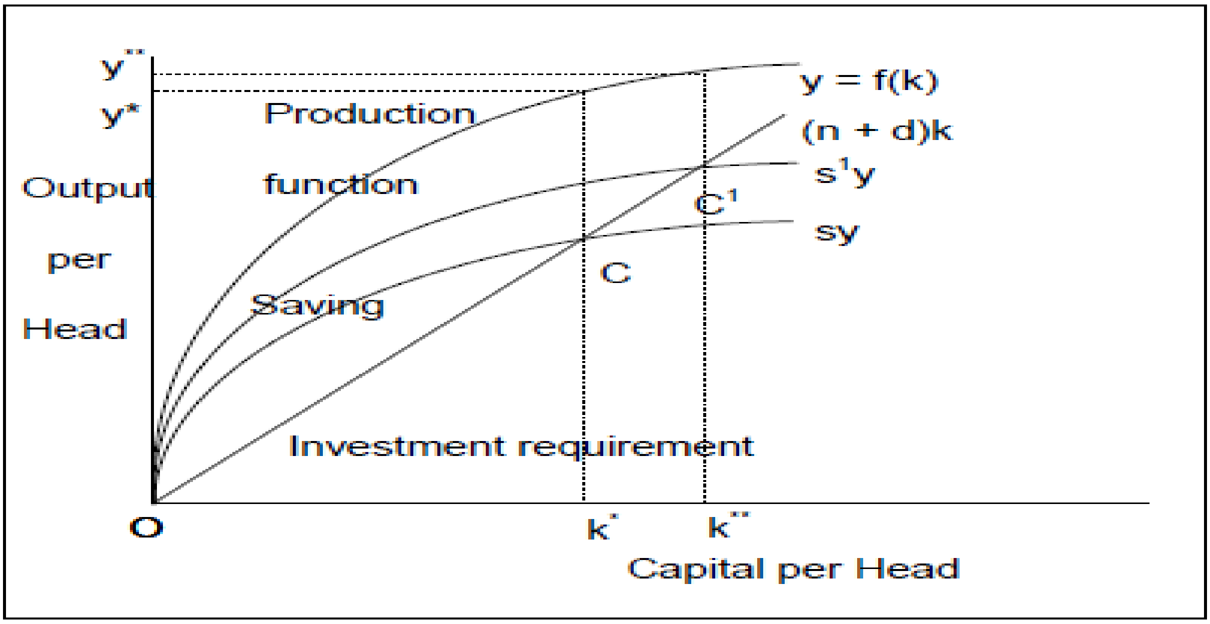


Source: Dornbusch *et al*. (1998:51)

Based on Figure 2.4, the asymptotic lines labelled sy and y =*f*(k) represent per capita saving and per capita output respectively. As such, (sy) is a constant fraction of output and it depicts the level of saving in each (*k*) and y =*f*(k) depicts *y* that is increasing at a diminishing rate while *k* increases (Chand, 2016). In addition, the straight-line labelled (*n*+*d*)k represents the investment required to ensure consistency of (*k*) at different levels, by means of adding machines to accommodate the newly employed labour and also replace those machines that have depreciated (Dornbusch, *et al*., 2014:64). In light of this, at point C (*sy* and *n*+*d*)k intersect one another, this means that point C represents stability as savings and investment balance and per capita, capital is equal to *k**, while per capita output is equal to y* (i.e. point D). For that reason, point C denotes the steady-state equilibrium, since sy* is equal to *(n+d)k**.

In this regard, Hammond and Rodríguez-Clare (1993:5) point out that the neoclassical growth theory asserts that in the long run, the saving rate does not affect the growth rate of output, however, in the short run the saving rate has an effect on the growth rate of output, namely ability to shift the steady-state equilibrium. The reason is that in the long run, only the level of per capita capital and output will increase as saving increases, but the growth rate of output will be unaffected (Ickes, 1996:4). Nonetheless, in the short run, the saving rate has an effect on the growth rate of output, as there are cases where people are willing to save more of their income. For that reason, there will be more savings to keep per capita capital constant than required, thus leading to an increase in per capita capital (Grossman, *et al*., 2017) Figure 2.5 depicts the effect of an increased saving rate on growth in the short run.

Figure 2.5: The effect of an increased saving rate

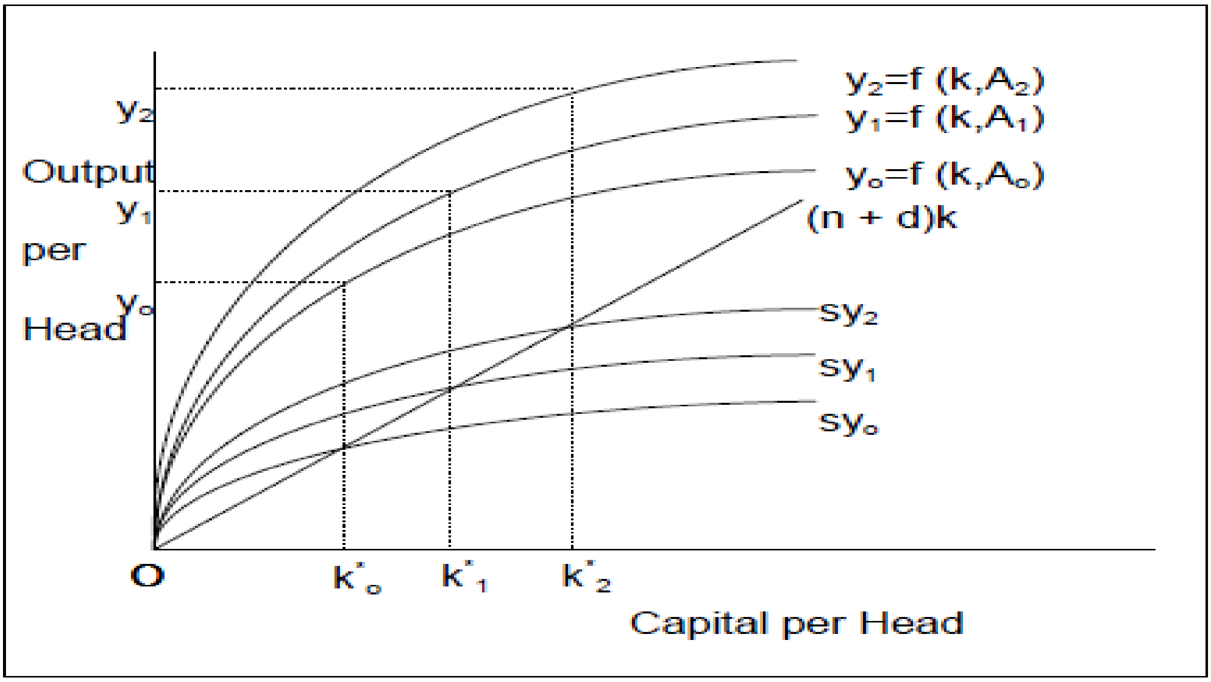


Source: Dornbusch *et al*. (1998:52)

Based on Figure 2.5, it can be deduced that an increase in savings caused a shift from the initial steady-state equilibrium at point C to the new steady-state equilibrium at point C^1. Consequently, per capita capital will increase until it arrives at point C^1, where the steady-state equilibrium is re-established and consists of increased values of both per capita capital (k**) and output (y**). Therefore, at this point C^1, saving has increased and now is sufficient to accommodate the higher capital (K) stock (Mallet, 2012:22).

Among other things, neoclassical growth theory contributed greatly when it acknowledged the effect of technological innovations. Brugger and Gehrke (2014:3) point out that the concept of exogenous technological innovations was incorporated to the Solow-Swan neoclassical growth model, but prominent neoclassical theorists did not pursue it. Nonetheless, the embodiment of exogenous technological innovations will cause (y) to increase from y_0 to y_1 and ultimately y_2 over time as depicted by Figure 2.6 (Dornbusch, *et al*. 1998:52). The reason is that, exogenous technological innovation influence the steady-state rate of growth of per capita output (Boianovsky, *et al*., 2009).

Figure 2.6: The effect of exogenous technological progress



Sources: Dornbusch *et al*. (1998:52)

From Figure 2.6, it can be deduced that exogenous technological innovations caused the neoclassical production function to rise (Fourie, *et al*., 2009:331). As such, in the long run, sustained growth per capita output is a result of exogenous technological progress (Sorensen, *et al*., 2010:127).

2.3.1.4 New growth theory

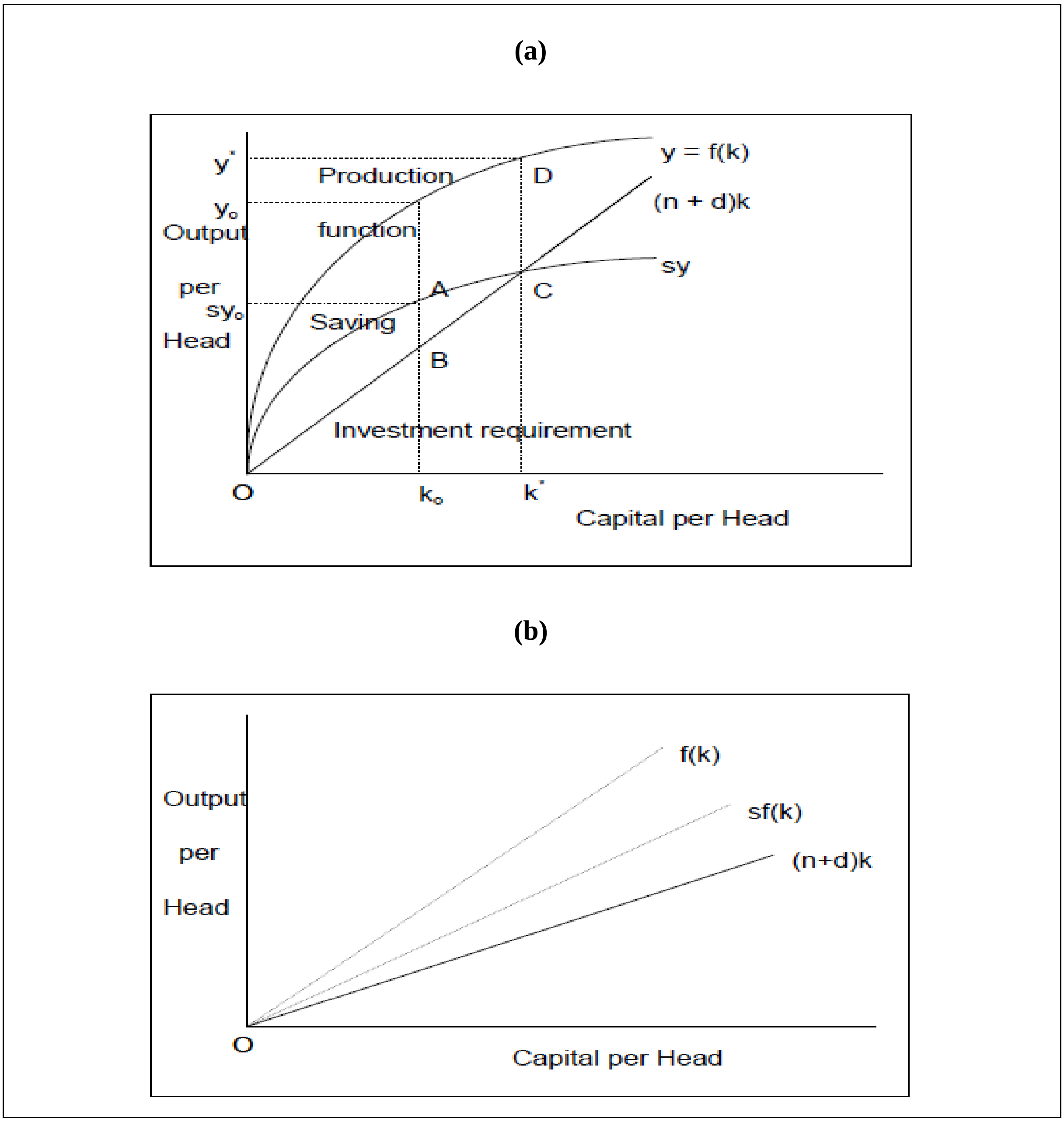
In explaining the operational mechanisms of economic growth, there are two predominant theories that incorporate the effects of technological knowledge − the exogenous growth theory (i.e. the neoclassical growth theory) and the endogenous growth theory (i.e. new growth theory) (Sredojević, *et al*., 2016:182). These two theories have different views in terms of explaining the nature of technology and the effect it has on growth (Zaman & Goschin, 2010:31). In the sense that, the new growth theory is considered a theory that has improved upon the neoclassical theory's viewpoint on growth, as it was put forward to cater for deficiencies and omissions in the neoclassical growth theory. When comparing the two growth theories, the neoclassical growth theory enunciates that technological innovations and advancements are only derived outside economic activity (Adigüzel, 2016:66).

Conversely, the new growth theory enunciates that technological innovations and advancements are not only derived outside economic activity. Since any economic activity inclusive of technological innovations and advancements involves labour, labour needs incentives in order to participate productively in economic activity (Samans, *et al*., 2015:7). As such, it is improbable for people outside the economic activity to offer technological innovations and advancements continuously without any benefit in doing so − which would be the case if the technological innovations and advancements were derived from innovators and researchers outside economic activity (Cortright, 2001:2). Taking this into consideration, the neoclassical theory of growth enunciates that in the long run, growth in output is a result of exogenous factors, while the new growth theory enunciates that in the long run, growth in output is a result of endogenous factors (Kurz & Salvador, 1998:17).

As mentioned before, the new growth theory serves to improve the deficiencies in the neoclassical growth theory, in doing so, Dornbusch *et al*. (2014:80) points out that the new growth theory made partial alterations to the neoclassical production function, in order to make it accommodate self-sustaining endogenous growth. In light of this, Figure 2.7(a) depicts the neoclassical growth scenario and it should be noted that at any point where saving is higher than the investment required, the economy keeps growing due to the added capital (Mallet, 2012:24). However, the economy will cease to grow when it reaches a steady-state rate of output at point C (i.e. where investment required and saving lines intersect), as the saving curve together with the production function curve eventually will become flat due to the neoclassical assumption of diminishing marginal product of capital (Dornbusch, *et al*., 2014:83). This situation is inevitable since the investment required will always intersect with the saving line, due to the constant slope of the investment line.

On the contrary, Figure 2.7(b) depicts the growth scenario as suggested by the new growth theory and unlike the growth scenario in the neoclassical growth theory, the new growth theory rejects the assumption of diminishing marginal product of capital and sets in motion the assumption of constant marginal product of capital (Kurz & Salvador, 1998:24). Consequently, Figure 2.5(b) depicts both the production and saving lines as straight lines with constant slopes; this implies that at any point saving will always be higher than the required investments. In view of the new growth theory, higher saving results in a bigger gap between savings and investments required, thus a faster rate of growth (Dornbusch, *et al*., 2014:80).

Figure 2.7: Neoclassical theory (a) versus new growth theory (b)



Source: Dornbusch *et al*. (1998:52)

Moreover, unlike the neoclassical theory that draws attention solely on growth opportunities in physical capital, the new growth theory draws attention to growth opportunities in both physical- (e.g. machinery, equipment) and human capital (Cortright, 2001:6). The reason is that physical capital is subjected to diminishing marginal returns, while human capital is an indispensable input with a distinctive feature of providing increasing returns owing to its non-rival nature (Kurz & Salvador, 1998:26). In addition, Baetjer (2000:147) points out that once the human capital is accumulated, it can be reused at no cost and without any subjection to depreciation, as old human capital can be used to produce new human capital. In light of this, the new growth theorists accentuate that technological progress is determined by the rate of investment, the size of physical capital and human capital (Chand, 2016). As such, the new growth theory assumes that a production function has a constant marginal product of capital and capital is the only factor (Mishra, 2016:51).

By its very nature, the new growth theory can be expressed with an algebraic model (Dornbusch, *et al*., 2014:80):

$$Y=aK \quad (2.24)$$

Where output is equivalent to capital and the marginal product of capital is the constant a. This implies that one unit of capital is increased 'a' number of times due to technological progress.

Now suppose that the saving rate is constant at 's' and it is also a constant portion of the output. Also, assume that there is no growth in population or capital does not depreciate. With all this assumed, then capital will be increased by saving:

$$S=sY=saK \quad (2.25)$$

Or

$$\Delta K/K=sa$$

As such, the saving rate is equivalent to the growth rate of capital. In addition, since capital is equivalent to output, the growth rate of output is then:

$$\Delta Y/Y=sa \quad (2.26)$$

Therefore, from the new growth model, it can be deduced that an increase in the saving rate will result in a higher rate of output. In addition, since the model has no steady state, a higher saving rate will also result in a long run increase in output per capita. In retrospect, the new growth theory is in support of the idea that increased investment in human capital results in increased growth and this idea is a fundament in relating higher saving rate to higher equilibrium growth rates.

2.3.1 Theorising employment creation

This section of Chapter 2 explores a set of ideas that attempts to explain ways in which employment is created and to lay a theoretical foundation for employment as it is amongst the variables under study. According to Zalk (2014), the role of manufacturing in inducing employment especially – directly and indirectly – is complex and need a cautious analysis. In doing so, it should be noted that reviewing the theoretical relationship between economic growth (i.e. GDP) and employment is a fundamental approach in understanding how employment is created (Okun, 1962). As such, this study section will draw attention to two prominent theorists that contributed wholly to the economic theory that serves to explain how economic growth is related to employment (i.e. Okun's law and Phillips curve).

Okun's law is an economic theory proposed by an American economist, Arthur Okun, in 1962 and the theory reflects on findings obtained when Okun investigated the market relationship between production and unemployment (or employment) (Okun, 1962). In investigating this relationship, Okun estimated two models, that is, a different model and a gap model (Apap & Gravino, 2014:3). As such, a difference model relates an economy's growth in output to changes in its rate of unemployment and the model can be expressed as follows (Okun, 1962):

$$\Delta u = \alpha + \beta \Delta Y \qquad (2.27)$$

Where Δu denotes the changes in the rate of unemployment and ΔY denotes real growth in output. While α reflects the change in the rate of unemployment in the absence of changes in real output and the β parameter (i.e. the Okun coefficient) denotes a measure of the elasticity of the rate of unemployment with regards to output. In light of this, Apap and Gravino (2014:3) point out that the lowest level of output required to sustain a fixed rate of unemployment is denoted by $-\frac{\alpha}{\beta}$, this implies that the unemployment rate may still increase even if real growth in output is positive. Thus, the employment rate may still decrease in spite of the positive real growth in output.

Furthermore, Okun made slight adjustments to the difference model (i.e. Equation 2.27), thus resulting in the gap model that relates the gap between the natural and the actual unemployment rate to the gap between the potential and actual output (Akram, *et al.*, 2014:175). Succinctly (Okun, 1962):

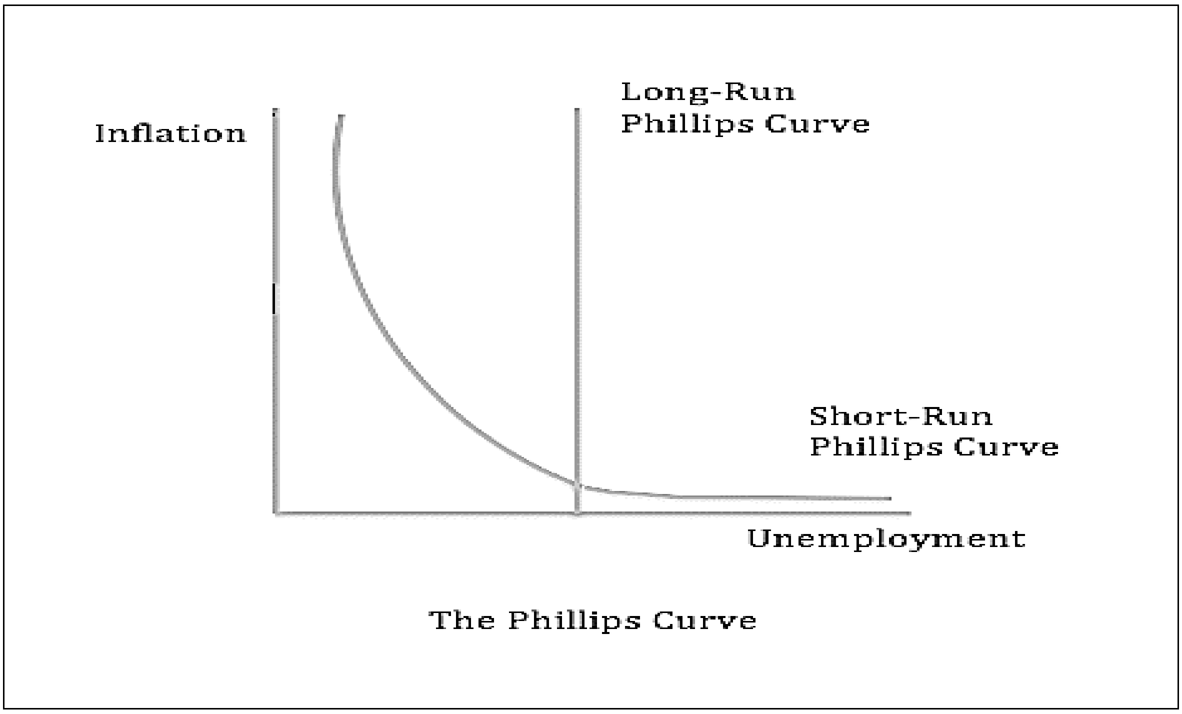
$$(u - u^*) = \beta (\Delta Y - \Delta Y^*) \qquad (2.28)$$

Okun introduced two components to the initial model, that is, u^* and ΔY^*. As such, u^* denotes the natural unemployment rate while ΔY^* denotes the potential growth in output. Equation 2.28 signifies that for a negative β, any real growth in the rate of output below the potential growth rate would be related with an unemployment rate that is higher than the natural rate of unemployment (Apap & Gravino, 2014:3). Consequently, Okun estimated the two equations using data of the United States (US) economy for the period between 1947 and 1960 and discovered that for every 1 percent increase in GDP, the unemployment rate decreased by 3 percent (Okun, 1962). In other words, for every 1 percent increase in an economy's GDP, the employment rate of that economy increases by 3 percent.

Now that Okun's law and its findings are reviewed, the study further reviews the Phillips curve, since it is also one of the theories that reflects on the relationship between GDP and employment. In doing so, Phillips (1958) investigated the relationship between inflation (i.e. general increase in the price level) and unemployment in the United Kingdom (UK) between the period of 1861 to 1957 (i.e. a period where high rates of unemployment were corresponding with low rates of inflation). As a result, Philips (1958) discovered that in the short run, there is a negative relationship between inflation and unemployment, in the sense that an increase in the aggregate demand of the economy, will elicit an increase in the inflation and employment of that economy. While a decrease in aggregate demand results in a decrease in inflation and an increase in unemployment.

However, the Philips curve theory was later confronted by other mainstream economists (e.g. Friedman, 1967; Phelps, 1968), that argued that the Philips curve theory does not apply in the long run. As such, Friedman (1967) and Phelps (1968) point out that any simulative effect arising from increased aggregate demand (or low rates) will soon wear off and unemployment will gravitate back to its natural rate, leaving behind a high rate of inflation. Thus, the Philips curve tends to be a vertical line in the long run, since unemployment rate will be at its natural rate (Phelps, 1968). Considering this, Figure 2.8 depicts a graphical representation of both the short- and long-run relationship between inflation and unemployment.

Figure 2.8: The short- and long-run Phillips curves



Source: Philips (1958); Phelps (1968)

Furthermore, to clarify the relevance of the Phillips curve theory in explaining the relationship between GDP and employment, the study will review empirical studies that investigated the relationship between inflation, GDP and employment. In terms of GDP and inflation, Umaru and Zubairu (2012) discovered that there is a one-way causation flowing from GDP to inflation when they investigated the effects of unemployment and inflation on wages. Similarly, Gokal and Hanif (2004) investigated the relationship between inflation and economic growth and the result of their Granger causality test uncovered a causality running from economic growth to inflation. As such, Mallik and Chowdhury (2001) maintain that there exists a positive relationship between GDP and inflation.

The findings from the reviewed empirical studies indicate that GDP growth increases inflation. Now, from a viewpoint of the Philips curve theory, the relationship between inflation and unemployment is negative, which implies if GDP has a positive relationship with inflation, then the relationship between GDP and unemployment is also negative. To substantiate this empirically, Boltho and Glyn (1995) used a sample of 16 Organisation for Economic Co-operation and Development (OECD) countries for the period 1960-1993, to analyse if macroeconomic policies increase employment. Their findings indicate that during the periods of high GDP, growth is inevitably associated with an increase in the number of jobs and low

GDP growth results in the high unemployment rate. Similarly, Hussain *et al*. (2010) discovered that GDP growth has an inverse relationship with unemployment when they investigated a coherent relationship between economic growth and unemployment in Pakistan.

Therefore, the empirical findings from these studies indicate that there is an existence of a positive relationship between GDP and inflation and a negative relationship between GDP and unemployment. Corresponding to these empirical findings, Jaradat (2013) confirms that GDP and unemployment have an inverse significant relationship, while GDP and inflation have a strong direct significant relationship when he investigated the impact of unemployment and inflation on GDP in Jordan. A conclusion can be drawn that the theory of the Phillips curve also implicates GDP, thus an increase in GDP will reduce unemployment, leading to an increase in employment. Nonetheless, Desnoyers (2011) points out that employment, in exceptional cases, can be carried by its own momentum, in its response to GDP growth. As such, to ensure employment responds positively (i.e. increases) to the impetus arising from the growth in GDP, the GDP growth must be sustainable (Desnoyers, 2011). In light of this, it should be noted that manufacturing is amongst the economic dynamics that induce sustainable economic growth (Herman, 2016:976).

2.3.2 Theoretical arguments for manufacturing − driven economic growth and employment

As mentioned in Section 2.2.2 of this chapter, industry is a concept encompassing mining, construction and manufacturing. It has to be clarified that the study follows the notion that industry refers to the manufacturing sector, as manufacturing is inclusive of all the processes within the industry. As such, the study reviewed economic growth and employment theories in the preceding sections of this chapter and now explores the theoretical arguments underpinning the important role manufacturing plays in resulting economic growth and employment. According to Organisation for Economic Co-operation and Development (OECD, 1996:9), innovation and technologies are the key ingredients for economic growth and employment. As such, the manufacturing sector is a central component of various economies where innovation is sustained and technology is employed in its production value chains (Morrar, 2014). Correspondingly, Manufacturing Institute (2015:5) highlights that the manufacturing sector possesses more potential for growth that is productive as compared to other economic sectors, as it remains a paramount platform for job creation, innovation and inclusive economic progression. Therefore, the manufacturing sector accommodates both key ingredients for economic growth and employment, thus it plays a crucial role in generating productive jobs and sustainable economic growth (Herman, 2015:977).

Furthermore, United Nations Industrial Development Organization (UNIDO, 2011) point out that manufacturing plays a strategic role in growing and developing the modern-day economies since more often than not, economic growth and development is attributed to different manufacturing sector characteristics. This involves the sector's (1) high magnitude of capital; (2) technology, increasing returns as well as the spillover effects; (3) employment potential; and (4) forward and backward linkages (Aldaba, 2014:1). On the same topic, the first manufacturing sector characteristic implies that manufacturing is generally capital-intensive in its methods of production as compared to other economic sectors (e.g. agriculture, service) (Helper, *et al*., 2016). The reason is that, in the intensive manufacturing space, the accumulation of capital (both physical and knowledge capital) is with ease (Fedderke, 2005:37). Not to mention, Faulkner *et al*. (2013:2) pointed out that manufacturing is more susceptible to avoid the diminishing returns to investment, as an increasing proportion of manufacturing will prompt an increase in the accumulation of capital.

Continuing in this line, the second manufacturing characteristic implies that manufacturing mostly lead to increasing returns to scale − fewer inputs, more output. This was substantiated by Collier and Venables (2007) that highlight manufacturing as being less likely to undergo decreasing returns to scale (i.e. more inputs, less output), as compared to agriculture that is subjected to the fixed supply of land of varying qualities. Equally important, manufacturing is not only associated with increasing returns to scale, but also drives the generation of technological knowledge and skills development, thus creating an enabling environment for innovations (Smith, 1904). In fact, there are studies that substantiate the notion that manufacturing is the principal source of innovation and technological progress in various economies (e.g. Gault and Zhang, 2010; Lall, 2005). The reason is that new ways coupled with profound improvements in technology usually are encountered through the research and developments (R & D) in manufacturing activities (Shen, *et al*., 2007).

Consequently, these new ways and technological improvements obtained through manufacturing R & D are key constituents of economic growth and developments (Mokyr, 2010). As such, the manufacturing sector plays a holistic role within various economies, since the sector also diffuses the technological improvements to other sectors of the economy, by means of embodied knowledge (Cornwall, 1977). Furthermore, the third characteristic underpins the manufacturing sector's potential to create employment, since the sector provides the greater division of labour and this was amongst the reasons why the sector is considered an engine of economic growth (Smith, 1904). Into the bargain, as mentioned before, the manufacturing sector is also not subjected to diminishing returns to scale, therefore, manufacturing output can expand without any decrease in worker productivity.

As matter of fact, post the inception of industrialisation, the manufacturing sector showed greater potential for employment in developing countries, as more of the surplus labour in the agricultural sector was absorbed by the manufacturing sector as compared to the formal service sector (Athukorala & Sen, 2014:1). This was due to the flexibility of the manufacturing sector, which made it possible for the sector to absorb even the unskilled labour coming from the agricultural sector (Nattrass & Seekings, 2015:6). However, it was impossible for the formal service sector (e.g. banking, communication, information technology) to absorb the unskilled labour coming from the agricultural sector because the formal service sector requires at least upper secondary level of education (Mohamed & Motinga, 2002:8).

In that case, as a country industrialises its overall productivity increases, now that more people will be withdrawn from the agricultural sector, where they received insufficient compensation, to the manufacturing sector, where they receive sufficient compensation (Shafaeddin, 1998:3). It is for this reason productivity increases since the pressure restricting people's consumption patterns will be reduced by the jobs in the manufacturing sector that offer higher income as compared to the jobs in the agricultural sector. Taking this into account, a change in the manufacturing output is able to predict the national income (Warburton, 2012:91). As a result, this will encourage economic savings that will later enable people to re-invest back into the economy, resulting in economic growth. Thus, it is believed conventionally that both the formal service and agricultural sectors have a lower potential for employment creation as compared to the manufacturing sector.

In line with the latter, Athukorala and Sen (2014:3) contribute the most compelling evidence with regards to the manufacturing sector's potential to create employment, when they propose a model expressing that the general level of manufacturing employment within a typical economy is by definition equivalent to the level of manufacturing output multiplied by the average employment coefficient for the manufacturing sector. Succinctly:

$$L = Q.\sum w_i \left(\frac{L}{Q}\right)_i \quad (2.29)$$

Where L denotes the total level of manufacturing employment, Q denotes the total manufacturing output, w_i denotes Q_i/Q and i denotes manufacturing sub-sectors. As such, manufacturing can affect employment in two ways: First, there is a direct relationship between manufacturing sector production and employment; this implies that an increase in manufacturing production is associated with an increase in employment (Q) (Jenkins & Sen, 2007). Secondly, any changes to shares of various sub-sectors (e.g. automotive, metal, chemical food and beverage and clothing) within the overall manufacturing sector production may occur, thus leading to an increase in the production of labour-intensive sectors and a reduction of output of capital-intensive sectors (w_i) (Athukorala & Sen, 2014:3). This will increase employment by increasing both the labour intensity and labour coefficients of production in sub-sectors ($(\frac{L}{Q})_i$) (Jenkins & Sen, 2007). Therefore, the model proposes that these two effects reflect how the manufacturing sector lead to employment.

Moreover, from a development viewpoint, a crucial characteristic of any economic sector is the extent to which it is able to create demand for products produced in other economic sectors (Aldaba, 2014:6). This phenomenon is referred to as a linkage and can be understood as input-output relationships between economic sectors (Chui & Lin, 2012). According to Tesafa (2014:16), a sector may encourage investment in both the subsequent stages of production through forwarding linkages and in earlier stages through backward linkages. In line with this, Hirschman (1958) highlights the significance of linkages between economic sectors and suggests that, to result in development, establishing a sector that has the highest potential for linkage creation is necessary. In light of this, the last characteristic of the manufacturing sector underpins the existing links between the manufacturing sector and other sectors of the economy. Thus, the manufacturing sector fosters economic growth and development through its strong forward linkages (e.g. demands transportation, insurance, banking and in turn supplies inputs to these sectors) and backwards linkages (e.g. demands inputs from agricultural, mining sector and in turn supplies inputs to these sectors) with other economic sectors (Ciarli & Di Maio, 2013:5).

As such, these linkages are crucial demand stimulators, hence firms operating within the scope of the manufacturing sector (i.e. manufacturing firms) demand more of what is produced in other economic sectors, as compared to firms that operate within the scope of other economic sectors (e.g. agricultural, service firms etc.). In addition, the point often overlooked is that the forward and backward linkages are also embedded within the manufacturing sector; hence, allocated investment in the manufacturing sector will lead to a demand for investments in the manufacturing sub-sectors (Aldaba, 2014:2). In essence, the manufacturing sector can not only create its employment and result in growth in its output – but can also elicit employment creation and output growth in other sectors of the economy, thus resulting in inclusive economic growth and employment.

2.4 EMPIRICAL BACKGROUND

2.4.1 The link between manufacturing, GDP and employment

According to McCarthy (1994:66), manufacturing plays a critical role in the South African economy. This is also mentioned in South Africa's Industrial Policy Action Plan (IPAP), that identifies the manufacturing sector as a sector that has the highest economic and employment multipliers (DTI, 2014). Therefore, this section of the study reviews the empirical findings indicating the role played by the manufacturing sector in driving economic growth and employment in South Africa and other countries. In doing so, the study provides two sections; the first section reviews empirical findings underpinning manufacturing as an engine of economic growth in South Africa and other countries. While the second section reviews the empirical finding underpinning manufacturing as a sector that yields employment in South Africa and other countries.

2.4.1.1 Empirical findings linking manufacturing and economic growth

- **Empirical findings on South Africa**

This section reviews empirical findings underpinning manufacturing as an engine of economic growth in the context of the South African economy. It should be noted that there is a lack of empirical studies that investigate the impact or relationship of manufacturing and GDP in South Africa. Therefore, the existing empirical studies involve Viljoen (1983), Millin (2003), Tsoku *et al*. (2017), Mahonye and Mandishara (2015) and Awolusi (2016). As such, Viljoen (1983) discovered that South Africa was rapidly advancing towards the stage of industrial maturity when he investigated the contribution of the manufacturing sector to the South African GDP and the slowing share of the sector in GDP since 1960. Millin (2003) investigated economic growth in South Africa using a Kaldorian approach and the findings indicate that manufacturing is a driver of the South African economic growth, in a sense that the faster rate of manufacturing growth leads to a faster rate of productivity growth within the overall South African economy.

In a more recent study, Tsoku *et al*. (2017) discovered that there is a long-run relationship between growth in manufacturing and GDP in South Africa when they analysed the relationship between growth in manufacturing and GDP in South Africa. Tsoku *et al*. (2017:418) findings further conclude that the Kaldor's first law of growth is relevant in the South African economy, in a sense that the direction of causation between manufacturing and GDP growth emerges from manufacturing to GDP. In addition, findings of a study by Mahonye and Mandishara (2015) point out that manufacturing growth is a crucial determinant of GDP growth in Southern economies. Similarly, Awolusi (2016) investigated the mining sector and GDP growth in the Southern economies, using the manufacturing sector as one of the study variables and discovered that real growth in manufacturing is significantly associated with GDP growth in Southern African economies.

The empirical findings encountered by the reviewed studies indicate that the manufacturing sector provides a growth impetus for GDP. As such, the study aims to investigate the impact that the manufacturing and its sub-sectors have on GDP in South Africa, at the same time adding to the existing empirical literature on manufacturing and GDP in South Africa.

- **Empirical findings on other countries**

In developed and developing countries, there has been many studies have explored the role of manufacturing as a driver of economic growth (Du & Yao, 2016:3). This section reviews empirical findings that highlight manufacturing as a propelling force of economic growth in both developed and developing countries over the years. As such, Wells and Thirlwall (2003) estimated data from 45 African countries for the period 1980 to 1996 and discovered that the GDP growth rate was directly and significantly related to the extent to which manufacturing grows faster than other growth driving sectors (i.e. service and agriculture). In addition, Necmi (1999) investigated whether Kaldor's prepositions were still valid beyond the height of rapid industrialisation and gains of the 1970s, using a cross-country data predominantly from 45 developing countries for the period 1960-1994. Necmi (1999) results confirmed Kaldor's proposition that manufacturing is an engine of growth in most of the developing countries that were under study. With regards to developed countries, McCausland and Theodossiou's (2012) findings indicate that Kaldor's proposition was also the case in developed countries for the period 1992-2007, when they investigated manufacturing as an engine of growth.

In spite of this, Szirmai (2012) investigated manufacturing as an engine of growth in developing countries, using data from 60 developing countries and 21 developed countries in Asia and Latin America over the period of 1950 to 2005. Szirmai's (2012:471) findings point out that manufacturing is more of a driver of economic growth in developing countries than in developed countries. Equally so, a former study by Fagerberg and Verspagen (1999) encountered similar findings when they investigated the relationship between the real GDP growth rates and manufacturing growth rates in developing economies in the East Asia and Latin America. Fagerberg and Verspagen (1999) findings confirm that manufacturing drives growth in developing countries in East Asia and Latin America; however, it revealed that the effect of manufacturing in developed countries was not significant.

Furthermore, Fagerberg and Verspagen (2002) found out that manufacturing contributed more to GDP growth in periods before 1973 than in periods post 1973, when they investigated the impact of shares of manufacturing and service on growth in 76 countries over three periods: 1966–1972, 1973–1983 and 1984–1995. Nonetheless, Kathuria and Raj (2009) found that manufacturing is still a performing engine of growth in more industrialised regions, when they investigated the relationship between manufacturing growth and GDP, focusing on growth in different regions of India. In addition, a recent study Kathuria and Raj (2013) also held true to the conclusion that manufacturing had indeed acted as an engine of growth in India, even in the midst of its declining share in GDP.

Correspondingly, a study by Haraguchi *et al.* (2016) investigated if the importance of manufacturing in economic development has changed. The findings of their study point out that post 1990, the manufacturing sector still qualifies to be described as a driver of economic growth and development in developing countries, substantially in achieving high sustained growth while retaining at least the same size in GDP as in the period from 1970 to 1990 (Haraguchi, *et al.*, 2016:22). Szirmai and Verspagen (2010) discovered that the relationships between the shares of manufacturing in GDP at the starting point of five-year periods and average growth rates in five-year periods were highly significant when they investigated if manufacturing is still an engine of growth in developing countries using a panel dataset of 90 countries over a period of 1950 to 2005. In support was a study by Dasgupta and Singh (2006) that investigated manufacturing, services and untimely de-industrialisation in developing countries using data from 48 developing countries for the period 1990 to 2000 and their finding indicate that manufacturing continues to be a key sector in economic growth and development.

In a more recent study Chete *et al*. (2016) investigated the industrial development and growth in Nigeria and discovered that the overall industrial sector (i.e. manufacturing, mining and utilities) accounted for 6 percent of the Nigerian economic activity. Having found that, Chete *et al*. (2016:30) pointed out that the manufacturing sector alone, contributed 4 percent to the GDP, making the sector the largest contributing sector to GDP when compared to other sectors within the overall industrial sector.

Moreover, it should be noted that the clothing sector as a sub-sector of manufacturing is known to be the first step into industrialisation (Gereffi, 1999; Kamau, 2010). According to Keane and Velde (2008:7), the clothing sector forms a crucial part of manufacturing production in various developing countries. This can be witnessed in the cases of poor countries (e.g. Bangladesh, Vietnam, Mauritius and Sri Lanka) that encountered overwhelming rates of growth in the clothing sector's output and have since graduated to middle-income countries (Keane & Velde, 2008:7).

On the other hand, the chemical sector as a sub-sector of manufacturing is crucial for economic growth, as the sector produces products that serve as technical solutions to nearly all sectors of the economy (European Commission, 2009:5). Carpenter and Ng (2013:56) analysed Singapore's chemical industry and their findings highlight that in Singapore, manufacturing is still a key driver of the country's GDP, attributing this to the chemical industry that produced a large share of Singapore's manufacturing output. Correspondingly, South Korea was amongst the countries where manufacturing played a crucial role in bringing about economic growth (Moon & Cho, 2011). Moon and Cho (2011:40) point out that within the manufacturing sector, the chemical sub-sector has been a source of economic growth and economic development post- the Korean War.

For the most part, the reviewed empirical findings underpin that growth in the manufacturing sector production is related significantly and positively to GDP growth, as it points out that the sector is an engine for GDP growth virtually in developing countries as compared to developed countries.

2.4.1.2 Empirical findings linking manufacturing and employment

- **Empirical findings on South Africa**

As in the preceding Section 2.4.1.1 that pointed out that there is a lack of empirical studies linking manufacturing performance to GDP in South Africa, there is also a lack of empirical studies that are concerned with investigating the impact or relationship between manufacturing and employment or unemployment in South Africa. In which case, this represents a gap in the empirical literature underpinning manufacturing-driven employment in South Africa. Nonetheless, the existing empirical studies (Muzindutsi and Maepa, 2014; Mkhize, 2015; Tsoku, *et al*., 2017) found a positive relationship between manufacturing and employment in South Africa.

As such, Muzindutsi and Maepa (2014) investigated manufacturing production and non-agricultural employment rate in South Africa. Their findings indicate that growth in the manufacturing sector is positively linked with employment in the short run but not in the long run. In contrast, a study by Mkhize (2015:153) found that there is a long-run relationship between employment and growth in the manufacturing sector in South Africa for the period 2000 to 2012. Equally so, a recent study by Tsoku *et al*. (2017) also confirmed that there is a cointegration (i.e. long-run) relationship between growth in manufacturing and employment in South Africa when they analysed the relationship between manufacturing growth and economic growth in South Africa.

In spite of the lacking empirical literature on manufacturing and employment in South Africa, the reviewed empirical findings indicated that manufacturing does have an impact employment, in both the short- and long run.

- **Empirical findings on other countries**

Correspondingly, this section also reviews the empirical studies on manufacturing and employment or unemployment. However, unlike the preceding section, this section focuses on studies that assess the relationship or the impact of manufacturing on employment in other countries, except South Africa (i.e. in both developed and developing economies). As such, a former study by Lewis-Wren (1986) analysed manufacturing employment in the UK and found that the anticipated output is highly significant in the forecast of employment in the manufacturing sector. During the same year, Smyth (1986) analysed the cyclical response of employment to output change in the US manufacturing sub-sectors and found that there is a relationship between total employment and cyclical shocks encountered in manufacturing sub-sectors production processes. Similar findings were encountered in a study by Pehkonen (2000) that analysed employment, unemployment and output growth in booms and recessions in Finland for the period 1997 to 1996.

According to McCormick and Rogerson (2004), the manufacturing sector is a crucial aspect in creating employment in developing countries, owing it to its sub-sectors (e.g. clothing, food & beverages, chemical, automotive and metals) that absorb both the skilled and unskilled labour. These sub-sectors of manufacturing are known to have higher employment multipliers, as they create direct and induced jobs (Williams, 2014:8). This is due to the manufacturing sector's ability to generate sturdy forward and backward linkages with other sectors of the economy (Ciarli & Di Maio, 2013:5). In light of this, Uzoigwe (2007) investigated economic development in Nigeria through the agricultural, manufacturing and mining sectors and the findings indicate a positive relationship between the manufacturing sector's output and overall employment level. As such, the manufacturing sector is amongst the sectors that assist to propel other economic sectors through the linkage effects in Nigeria.

In Malaysia, Chew (2005) points out that employment and skill improvement opportunities were created by the Malaysian manufacturing sector. A more recent study on Malaysia indicates that the manufacturing sector contributed the highest number of employment opportunities as compared to economic and other sectors during the first eight months of the year in 2014 (Hooi, 2016:32). Furthermore, Pianta *et al.* (1996) investigated the dynamics of innovation and employment in Germany and Italy, focusing on their manufacturing sectors. Their findings indicate that on average there is a positive and significant relationship between the value-added in the manufacturing sector and employment in Germany.

Correspondingly, Chang and Hong (2006) discovered that manufacturing production is related positively to employment when they investigated the relationship between the productivity and employment in the US manufacturing sector. Similarly, findings from a study by Nordhaus (2005) indicate that production in the manufacturing sector increases employment when he investigated the productivity growth to employment growth in the US manufacturing sector. Equally so, Mollick and Cabral (2008) investigated the effects of labour productivity and total factor productivity on employment considering 25 Mexican manufacturing sub-sectors over the period of 1984 to 2000. The findings of their study indicate that higher productivity in the manufacturing sub-sectors results in a positive effect on employment within the manufacturing sector. Apropos to this, it can be acknowledged that a higher manufacturing production corresponds with an increase in employment, which in turn results in greater manufacturing output.

On the contrary, there are empirical studies that take exception to the reviewed empirical findings on manufacturing and employment. As such, Laaksonen (2014) investigated how productivity in manufacturing affects employment in the sub-Saharan Africa. The findings uncovered that the labour productivity in the sub-Saharan African manufacturing has a negative effect on employment in the short-medium term. Nonetheless, the study further noted that this finding serves to give a partial answer and points out that conclusion cannot be taken without further research (Laaksonen, 2014:72). Considering this, studies by Cavelaars (2005) and Van der Horst *et al.* (2009) suggest that a causal relationship between employment and manufacturing productivity is endogenous and it is likely to run into other direction – from employment to manufacturing production.

This implies that the negative relationship between manufacturing production and employment might be more as the result of the causal effect running from employment to manufacturing production, than a result of the causal effect running from manufacturing production to employment. To add to the existing empirical studies, this study seeks to uncover the impact of production in the manufacturing sector and its sub-sectors on employment in South Africa.

2.5 SUMMARY AND CONCLUSION

This chapter presents three extensive sections (sections 2.2 – 2.4) that collectively play a crucial role in the construction of both the theoretical and empirical foundation for the study. As such, the first section (Section 2.2) provided a conceptual clarification of the important concepts used in the study: this involved contradistinguishing between economic growth and economic development; manufacturing and industry; as well as employment and unemployment. The reason for this was to ensure the reader is capacitated with a greater understanding of these concepts in order to effortlessly comprehend the use of these concepts in the study. Therefore, it can be deduced that the difference between economic growth and economic development is that economic growth refers to an overall increase in the national product, either aggregate or per capita, as it is determined by the market values of goods produced within the borders of a particular economy in a specified period. While, economic development refers to a broader process that subsumes economic growth, at the same time concerned with alleviating poverty, inducing equality and generating decent employment with a particular economy.

Continuing in this line, distinguishing between industry and manufacturing was found by the study to be necessary, due to the conventional use of the concepts as synonymous. Therefore, it can also be deduced that what differentiates manufacturing from industry is the fact that industry is a broad concept used to address processes included in manufacturing, mining and construction sectors of the economy. However, amongst the economic sectors subsumed within the industry, the literature has put forward that only the manufacturing sector is inclusive of all processes involved in the industry. As a matter of fact, the manufacturing sector is the only sector ensuring sustainable production growth in other sectors of the economy. Moreover, with regards to the difference between employment and unemployment, it can be deduced that unemployment refers to the state of being willing, but unable to engage in a financially compensated activity, while employment refers to the state of being able to engage in a financially compensated activity. As such, there is a trade-off between the two concepts, implying when unemployment increases, employment decreases.

Section 2.3 of this chapter presents the theoretical background of the study. In light of this, the theoretical background of the study presents three sub-sections, which include Section 2.3.1 that presents growth theories from the perceptive of prominent school of thoughts (i.e. the classical, neo-classical and new growth theorists); Section 2.3.2 that theorised employment, where the theories crucial for the creation of employment were discussed; and Section 2.3.3 that theorised arguments for manufacturing-driven economic growth and employment. As such, growth from the viewpoint of the classical school of thought is generated mainly through the division of labour that results in increasing returns, that is, a situation where labour productivity and per capita income increases, as GDP and employment expand. In this case, the manufacturing sector presents a wider scope for the division of labour, thus facilitating the generation of growth. In addition, growth from the viewpoint of the neo-classical school of thought is generated through capital accumulation (i.e. capital stock and capital-labour ratio) that depends on both the rate of savings and investment. Not to mention, the neoclassical theorists presume technology is exogenous, on the contrary, the new growth theorists presume technology is endogenous and emphasised the significance of human and physical capital stock.

Equally important, Section 2.3.2 reviewed Okun's law and Philips' curve as theories of employment in order to highlight conditions for employment creation. Lastly, Section 2.3.3 theorised the importance of manufacturing in driving growth in GDP and employment, as it highlighted and discussed the characteristics of the manufacturing sector and how they enable the sector to induce growth in GDP and employment. Moreover, the last section of this chapter (Section 2.4) presents the empirical background of the study, as it reviewed empirical findings of studies that investigated the impact manufacturing has on GDP and employment in South Africa and in other countries. As such, the empirical findings of these studies indicated that the manufacturing sector is still an engine of economic growth and employment in South Africa and mostly in developing counties as compared to developed countries. Furthermore, the following chapter reviews the production performance of the manufacturing sector and its predominant sub-sectors in the South African economy together with support measures put in place to enhance the competitiveness of the manufacturing sector.

CHAPTER 3: A REVIEW OF MANUFACTURING PERFORMANCE AND SUPPORT MEASURES IN SOUTH AFRICA

3.1 INTRODUCTION

South Africa is currently the third biggest economy in a technical recession within the broader African continent, with its economy slowly moving towards de-industrialisation (Van Wyngaardt, 2017). In this regard, the current state of the South African economy can be delineated by its fundamental need to develop both its upstream and downstream industries using the wealth derived from its resource base (Zalk, 2014). This entails the use of technology, minerals and labour resources as inputs to manufacturing value-added domestic products (DTI, 2015). As such, with the current unsustainably low economic growth and high unemployment in South Africa, the country needs to look for new platforms of opportunity and believe that the manufacturing sector is invested with the potential to reinforce a substantial improvement to the economy's misfortunes (IDC, 2016). By means of a strong focus on the manufacturing sector, South Africa can induce sustainable economic growth, employment and achieve its long-term vision of alleviating poverty, inequality and ultimately raising the standards of living for all South Africans (National Planning Commission, 2012).

To substantiate the latter, the manufacturing sector provides substantial employment at decent pay scales (US Department of Commerce, 2012). As such, manufacturing-driven employment generates extensive opportunities, inducing higher levels of equality and broadening the tax base in South Africa (OECD 2015), consequently, also contributing to improved service delivery and greater support to South Africans below the poverty line. Although this may be true, Stats SA (2016) points out that the South African economy was afflicted by the global economic crisis of 2008/2009. This resulted in a sharp contraction of production in the South African manufacturing sector and its subsequent recuperation has been lacklustre for the volume of manufacturing production to restore it to its pre-crisis level (Stats SA, 2016). It is also important to realise that the South African manufacturing production is not only insufficient due to the global financial crisis, but also the domestic challenges (e.g. high administrative costs, unstable electricity supply, globally incompetent manufacturing products) (BER, 2016).

Despite the global and domestic challenges facing manufacturing in South Africa, the sector can be revived by reviewing and making necessary adjustments to the solution-based approaches to economic policy development and implementation (Salazar-Xirinachs, *et al*., 2014:1) and by reviewing the industrial financial support available to ensure a competitive manufacturing sector in both the domestic and global markets (Sako, *et al*., 2016:22). In this regard, a competent and well-performing manufacturing sector necessitates intentional and constructive support measures from the South African government and all the other participating stakeholders, in order to induce an enabling environment where the manufacturing sector can facilitate sustainable economic growth and employment (Public-services South Africa, 2017).

This chapter reviews the performance of the manufacturing sector and support measures put in place to boost the manufacturing sector's competitiveness. In doing so, the chapter will highlight the emergence of the manufacturing sector in the South African economy. This will be followed by a review of the manufacturing sector and its predominant sub-sectors (i.e. food and beverages; clothing; chemical; metals; automotive sectors of manufacturing) production performance in the South African economy over time (Brand South Africa, 2017). Lastly, the chapter will review available support measures provided by the South African government, which will include a review of policies and incentive schemes formulated to improve the manufacturing sector's performance in the South African economy.

3.2 THE EMERGENCE OF THE MANUFACTURING SECTOR IN SOUTH AFRICA

Prior 1920, South Africa had no official manufacturing sector and its economy depended largely on imports derived from Britain, this involved goods such as mining equipment, textiles and clothing (Coutsoukis, 2004). It was only after 1920 that the South African government entrenched two state-owned firms that began the development of a strong manufacturing base in South Africa, first the Electricity Supply Commission (Eskom) that mainly manufactured electricity and later the South African Iron and Steel Corporation (Iscor) that manufactured steel (Mapenzauswa, 2015). The South African government's intervention together with large investments made by mining companies and big commercial farmers inaugurated the manufacturing sector in the South African economy (Coutsoukis, 2004). According to Schneider (2000:413), it is a much-needed boost to provide some amounts of protectionism coupled with strategic interventions to infant industries in their early stages of establishment.

Thus, from 1925 to 1973 the South African government imposed the 1925 Customs Tariff and Exercise Duty Amendment Act that was tailor-made to retain the domestic demand and protect the domestic manufacturing firms (Kaplinsky & Morris, 1999:718).

Not only did the South African government impose the 1925 Customs Tariff and Exercise Duty Amendment Act (hereinafter Tariff Act), but also followed a dynamic policy of import substitution to impel the manufacturing sector and stimulate investments in the sector (Schneider, 2000:414). Consequently, Innes (1984) points out that the Tariff Act together with the policy of import substitution succeeded to bestow incessant foreign investment into the South African economy and beyond question, there was an increase in the level of both foreign and mining investment into manufacturing production. This placed the manufacturing sector in a more predominant position in South Africa, as it became the most substantial source of wealth in the South African economy (Innes, 1984). As a result, South Africa's manufacturing sector became the most viable and highly profitable place in which to invest (Coutsoukis, 2004). Under those circumstances, the manufacturing sector emerged to be the utmost productive sector in the early twentieth century (Zalk, 2014).

During the same period, domestic sectors and, later, the economy grew, as the number of manufacturing firms established in South Africa increased significantly by 7.7 percent between the years 1925 to 1929 (Clark, 1994). This became an impetus for job creation, as more manufacturing factories employed workers and unlike other economic sectors (e.g. service, finance) in the manufacturing sector, skilled labour was not a prerequisite since there were machines used to produce the required output (Clark, 1994). Concurrently, notable changes occurred in the manufacturing sector. These involved advancements in the techniques employed in the manufacturing production value chains as well as the changes in the scope of output produced in the sector (Coutsoukis, 2004). These changes led to the flourishment of industries such as flour, sugar mills and bakeries, tobacco and dairy in 1939 (Clark, 1994). During the same year, the manufacturing output tripled and the number of jobs generated by the manufacturing sector doubled, this was due to the inception of South Africa's inwards-oriented program of industrialisation, which was introduced in 1925 (Archer, 1981:100).

Nonetheless, this exceptional increase in both manufacturing output and employment resulted in a current account deficit for the South Africa economy (Innes, 1984). Since the import-substituting industries failed to lessen the volume of imports, it simply transformed the configuration of imports from final consumer goods to capital goods such as machinery and equipment (Kaplinsky & Morris, 1999:720). As a result, this constituted a trade deficit for the South African economy. Without delay, the South African government intervened to remedy this undesirable situation and the intervention was in a form of three mandates (Coutsoukis, 2004). The first mandate was to ensure that the Department of Trade and Industry (DTI) give advance assurances to business people that protection would materialise upon the formation of certain pivotal new industries (Coutsoukis, 2004). As such, Jones and Muller (1992:171) points out that advance assurances provided a much-needed boost for the establishment of the domestic manufacturing sub-sectors that specialised in the production of electric motors, agricultural tools, certain chemicals, textiles, pulp and paper.

The second mandate was to influence the capital flows in such a way that they favour the South African economy (Coutsoukis, 2004). In doing so, the South African government imposed new banking laws, import licensing regulations and exchange quotas on imports (Van der Linde, 2012:44). This made it nearly impossible for South African banks to eject funds out of the South economy and restricted importing (Havemann & Fani, 2012:4). Lastly, the third mandate was to ensure that the manufacturing firms in South Africa are able to expand by providing subsidies (Coutsoukis, 2004). At the time, the South African manufacturing firms lacked funds for expansion and the country's capital markets were still under-developed to raise capital for these manufacturing firms (Kaplinsky & Morris, 1999:720). Therefore, the South African government established an industrial financing institution that was and still is known as the Industrial Development Corporation (IDC) in 1940 (IDC, 2016). The IDC was mandated to develop an industrial domestic capacity, thus providing subsidies to new or expanding industrial firms (IDC, 2016).

Consequently, the three mandates that were set forth by the South African government resulted in an enabling environment for an eruptive period of growth in the South African economy. Production in the manufacturing sector grew exceptionally, to an extent that it outstripped the GDP growth for the period 1946 to 1980 (Coutsoukis, 2004). Not to mention, that during this period the manufacturing sector succeeded in being the largest sector of the South African economy (Gutteridge & Spence, 1997:112). Thereupon, a resilient, diversified and globally competitive manufacturing base was established in the South African economy.

3.3 TRENDS IN THE PRODUCTION OF THE MANUFACTURING SECTOR AND ITS SUB-SECTORS IN SOUTH AFRICA

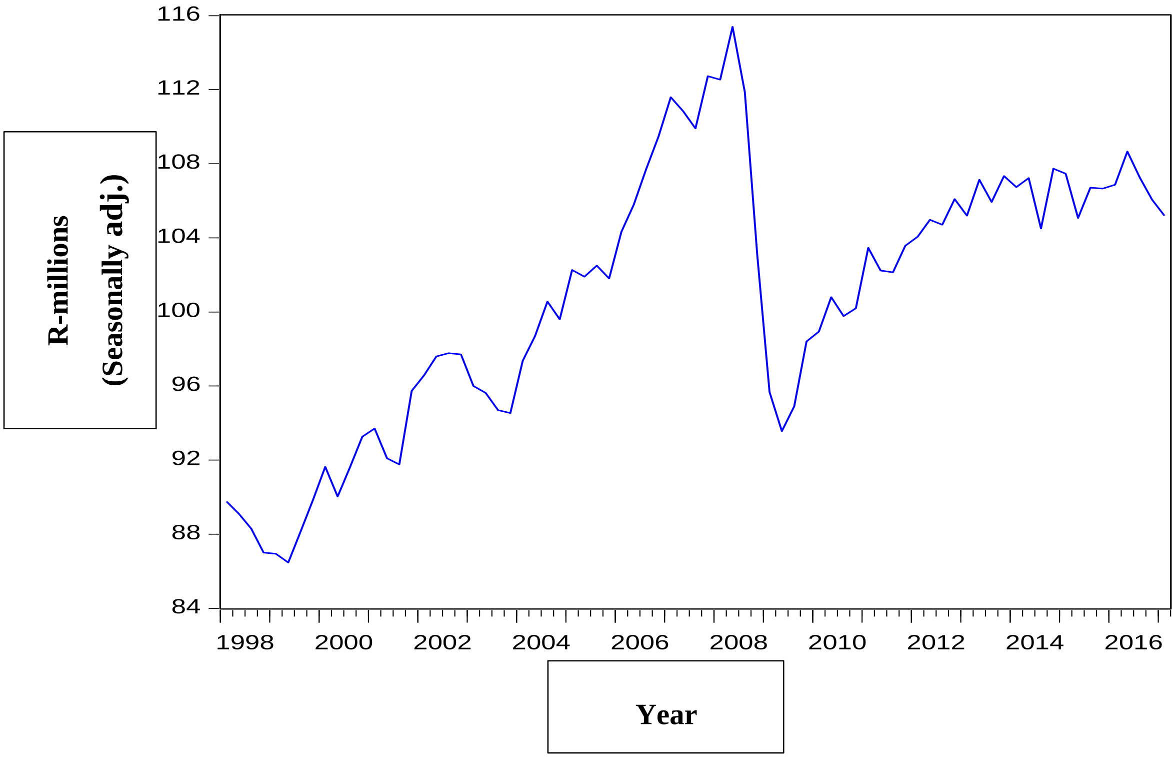
3.3.1 The manufacturing sector

The manufacturing sector is amongst the key sectors that stand to enhance the ability of the South African economy to compete in the global economy (IDC, 2017). The reason for this is the sector's added advantage of generating growth in other sectors of the economy (e.g. services) thereby enabling economic growth and employment creation (Aldaba, 2014:6). Nonetheless, manufacturing statistics show that the sector needs a substantial boost, as the value added by the manufacturing sector to the South African economy has declined from 19.3 percent of GDP in 1998 to 13 percent in 2016, making the sector the fourth largest contributor to GDP in South Africa (Bhorat & Rooney, 2017:2). A decline of this nature in the performance of the manufacturing sector slows down economic growth, decreases employment and leads the South African economy to de-industrialisation (Omilola, *et al*., 2015:2). For this reason, it is imperative to highlight the stumbling blocks that have contributed towards the deprived growth in production of the manufacturing sector that potentially reduces the sector's contribution to GDP and employment in South Africa. In addition, this will draw attention to potential events that can decelerate the sector's performance in the future.

In view of the latter, Stanlib (2015) points out that a complete frailty in South Africa's industrial output reflects an extensive scope of impediments, this includes low productivity, frequent disruptions in the labour market and infrastructure constraints (e.g. electricity). In fact, during the period between 2007/08, the South African economy experienced periods of unstable supply of electricity, which led to incessant electricity blackouts and load-shedding as a repercussion of challenges that were faced in the reticulation and generation of electricity (Wilkinson, 2014). Despite this period of unstable supply of electricity, other domestic factors such as expensive production inputs, high administered prices and high wages jointly exposed the manufacturing sector to substantial cost pressure (Stats SA, 2016). Equally important, the manufacturing sector's competitiveness has been compromised further by other factors, such as skills constraints, lack of success in improving productivity and currency volatility (Faulkner, *et al*., 2013:7). Given these circumstances, the low volume of the manufacturing production together with insufficient sectoral contributions to GDP and employment in the South African economy is inevitable.

In addition to the abovementioned domestic factors compromising the manufacturing sector's performance in South Africa, there are also global economic shocks that have contributed towards not only a decrease in the production of the manufacturing sector but also the sector's contributions to the South African GDP and employment. Amongst these global economic shocks is the 2008/09 global financial crisis (Alcorta & Nixson, 2010:4). Figure 3.1 illustrates the volume of production (gross value added at basic prices of manufacturing) in South Africa's manufacturing sector over the period 1998 to 2016.

Figure 3.1: Gross value of manufacturing production volume (1998 - 2016)



Source: Compiled by the author (Data from SARB, 2017)

Figure 3.1, shows that post-1998 production in South Africa's manufacturing sector started increasing and the increase was sustained up until a severe contraction in 2008. As such, this 2008 severe contraction in South Africa's manufacturing sector production can be attributed to the 2008/09 global financial crisis, as it lasted until the mid-2009 (Gokay, 2009). The crisis did not only affect production in South Africa's manufacturing sector but the overall economy, as it positioned the South African economy into a technical recession (Marais, 2009). Consequently, the manufacturing sector was amongst other South African economic sectors that were affected substantially by the crisis, as the sector's output in the first quarter of 2009 declined by 6.8 percent relative to the preceding quarter (Bhorat, *et al.*, 2014:157).

Furthermore, as shown in Figure 3.1, South Africa's 2008/09 manufacturing catastrophe was accompanied by a period of recovery that commenced in 2010 and lasted until 2011. Even so, it can be deduced that production in the manufacturing sector has been insufficient in restoring to its pre-crisis level. Nonetheless, more recent key growth rates in the volume of the South African manufacturing production are given in Table 3.1.

Table 3.1: Key growth rates in the manufacturing production volume

	Dec-2016	**Jan-2017**	**Feb-2017**	**Mar-2017**	**Apr-2017**	**May-2017**
Year-on-year % change (unadjusted)	-2.2	0.6	-3.7	0.3	-4.2	-0.8
Month-on-month % change (seasonally adjusted)	-0.1	-0.4	-0.4	-0.6	2.3	-0.3
3-month % change (seasonally adjusted)	-1.0	-0.4	-0.8	-0.8	-0.3	0.4

Source: Stats SA (2017)

Table 3.1 shows that a year on year percentage change in manufacturing production figures declined by 0.8 percent in May 2017 relative to May 2016, with month on month seasonally adjusted manufacturing production figures declining by 0.3 percent during the same month as compared to the three preceding month (Stats SA, 2017). Nonetheless, three-month percentage change (seasonally adjusted) in manufacturing production figures increased by a marginal 0.4 percent in the 3 months leading to May 2017 compared to the three preceding months (Stats SA, 2017). From the recent manufacturing production statistics, it is evident that the manufacturing sector in South Africa reported insignificant output growth in the first quarter of 2017, thus it can be deduced that the sector is currently experiencing a period of low performance.

The South African Reserve Bank (SARB, 2017:9) points out that the low production in the manufacturing sector is a result of domestic constraints that are indicated by the lack of fixed investments, this includes inadequate domestic demand, incessantly low business confidence and curtailment of manufacturing firms, including the lack of stability of the South African government together with lenient import duties for manufacturing goods (Gillham, 2017).

Moreover, with regards to the manufacturing sector's contributions to GDP in South Africa, Table 3.2 illustrates manufacturing percentage contributions to GDP in South Africa over a period of the first quarter of 2015 (2015Q1) to the second quarter of 2017 (2017Q2).

Table 3.2: Manufacturing percentage contributions to GDP (2015Q1-2017Q2)

	Quarterly-based % contribution to GDP in South Africa										**Average % contributions to GDP**
	2015				**2016**				**2017**		
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**2015Q1-2017Q2**
Manufacturing production % contribution to GDP	13	12.4	13	12.4	13	13	13	12.4	12.3	12.3	12.7

Source: Compiled by the author, data from SARB (2017)

Table 3.2 shows that in the first quarter of 2016, the manufacturing sector's contribution to GDP increased by 0.6 percent compared to the preceding quarter, that is, from 12.4 percent in the last quarter of 2015 to 13 percent in the first quarter of 2016. The manufacturing sector's contribution to GDP of 13 percent was maintained up until the third quarter of 2016. To clarify, the manufacturing sector's contributions to GDP remained unchanged at 13 percent for both the second and third quarters of 2016 as shown in Table 3.2. In contrast, Table 3.2 also shows that in the fourth quarter of 2016 the manufacturing sector's contributions to GDP declined to 12.4 percent from 13 percent in the preceding quarter. This can be attributed to the seasonally-adjusted manufacturing production decline of 3.2 percent in the fourth quarter of 2016 (Stats SA, 2016).

Moreover, Table 3.2 shows that in the first quarter of 2017, the manufacturing sector's contributions to GDP decreased by 0.1 when compared to the last quarter of 2016. That is to say, the manufacturing sector's contributions to GDP decreased from 12.4 in the fourth quarter of 2016 to 12.3 in the first quarter of 2017. Correspondingly, in the second quarter of 2017, the manufacturing sector's contributions to GDP remained unchanged at 12.3 percent. This suggests that efforts that were undertaken to boost production in the manufacturing sector during the second quarter of 2017 were lacklustre, as the sector's contributions to GDP for both the first and second quarters of 2017 were stagnant at 12.3 percent. To summarise, the average manufacturing contributions to GDP was approximately 12.7 percent for the period starting from the first quarter of 2015 (2015Q1) to the second quarter of 2017 (2017Q2). In other words, the manufacturing contributions to GDP have been marginally stable at around 12.7 percent over a period of 2015Q1 to 2017Q2. This suggests that during the period 2015Q1 to 2017Q2, the manufacturing sector has been lacklustre in growing GDP and this can be attributed to the lack of demand for domestically produced manufacturing goods coupled with higher manufacturing production costs (Menon, 2017). Furthermore, Table 3.3 illustrates manufacturing percentage contributions to employment (i.e. non-agricultural employment) in South Africa over a period of the first quarter of 2015 (2015Q1) to the second quarter of 2017(2017Q2).

Table 3.3: Manufacturing percentage contributions to total non-agricultural employment (2015Q1-2017Q2)

	Quarterly-based % contribution to total non-agricultural employment in South Africa										**Average % contributions to total non-agricultural employment**
	2015				**2016**				**2017**		
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**2015Q1-2017Q2**
Manufacturing production % contributions to total non-agricultural employment	13	13	13	13	12.1	12.8	12.3	12.5	12.8	13	12.8

Source: Compiled by the author, data from Stats SA (2017)

Table 3.3 shows that from the first quarter of 2015 up until the fourth quarter of the same year, the manufacturing sector's contributions to total non-agricultural employment were marginally stable at around 13 percent. Nonetheless, in the first quarter of 2016, the manufacturing sector's contributions to total non-agricultural employment declined to 12.1 percent from 13 percent in the last quarter of 2015. This was due to the fact that during this period, the manufacturing firms operated on a tight profit margin causing them to shed a significant amount of jobs, as the overall manufacturing sector reported a loss of 100 000 jobs in the first quarter of 2016

(South African News Agency, 2016). On the contrary, in the second quarter of 2016 the manufacturing sector's contributions to total non-agricultural employment improved by 0.7 when compared to the preceding quarter as shown in Table 3.3, having increased from 12.1 percent in the first quarter of 2016 to 12.8 in the second quarter of the same year. This increase was fuelled by the reported 8.2 percent growth in manufacturing production that was attributed to the improvements in the production of the chemical and automotive sectors of manufacturing in the second quarter of 2016 (News 24, 2016). As a consequence, this growth in the production of the manufacturing sector provided a much-needed impetus for the sector to generate employment in the second quarter of 2016.

Continuing in this line, Table 3.3 also shows that in the third quarter of 2016 the manufacturing sector's contributions to total non-agricultural employment declined by 0.5 percent compared to the preceding quarter of the same year. To enumerate, Stats SA (2016:8) reported that the manufacturing sector experienced a quarterly decrease of 7 000 jobs in the third quarter of 2016 compared to the preceding quarter of the same year. The decrease in manufacturing jobs during this period was attributed to a decrease in employment in the food and beverages sector of manufacturing. Furthermore, from the fourth quarter of 2016 up until the second quarter of 2017, Table 3.3 shows that the manufacturing sector's contributions to total non-agricultural employment were escalating, from 12.5 percent in the fourth quarter to 13 percent in the second quarter of 2017. Although this may be true, it can be deduced that the manufacturing sector's contributions to total non-agricultural employment have been marginally stable at an average of approximately 12.8 percent over the period starting from the first quarter of 2015 to the second quarter of 2017.

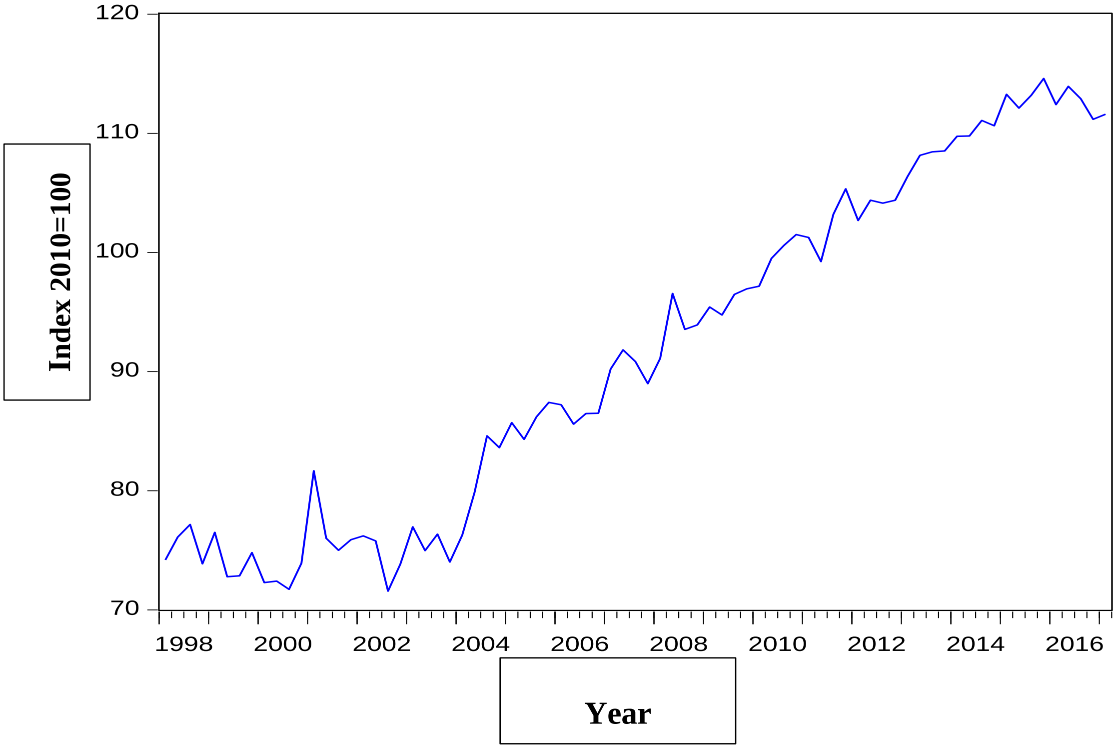
3.3.2 The manufacturing sub-sectors

3.3.2.1 Food and beverages (F&B) sector

In South Africa, the food and beverages (F&B) sector of manufacturing plays a predominant role in the expansion of economic opportunity, as it is crucial for human health and life sustenance (Pfitzer & Krishnaswamy, 2007:6). The South African economy is a food self-sufficient economy that consists of a capable food and beverage production base that respond sufficiently to the incessant population needs for food (Van Zyl & Kirsten, 1992:171). As such, the food and beverage sector has to keep pace with the forever-growing South African consumer base, while facing increasingly complex obstacles throughout its supply chains

(Moeng, 2017). The sector operates at multifarious spheres of the society, where many people grow, transform and sell food (Van Zyl & Kirsten, 1992:174). Thus, inflated production volumes in the food and beverage sector need to be maintained. In light of this, Figure 3.2 illustrates food and beverage production volumes in South Africa over a period of 1998 to 2016.

Figure 3.2: F&B sector's production volume over a period of 1998 to 2016 (seasonally adjusted)



Source: Compiled by the author, data from Stats SA (2017)

Figure 3.2 shows that production levels in the F&B sector of manufacturing grew steadily from 2002 to 2016. This shows clearly that the sector remained resilient even when the manufacturing sector's production levels declined due to both domestic and global innovations. Page (2009:16) points out that between 2008 and 2009, production levels in the manufacturing sector declined sharply due to the global financial crisis. Nevertheless, as shown in Figure 3.2, production in the F&B sector of manufacturing was escalating during this period. As such, this implies that the F&B sector was resilient from economic innovations that occurred between 2008 and 2009, suggesting that the F&B sector is amongst the significant contributors to the total manufacturing sector production in the South African economy. Moreover, the F&B sector can be divided into five main sub-groups, namely meat, fish, fruit, dairy products, beverages, grain mill products and other food products (Stats SA, 2017). As such, Table 3.4 presents production figures together with the average monthly growth rates of production in the total F&B sector and its sub-groups for 2016.

Table 3.4: Total F&B sector's production for 2016 by sub-groups (Index 2010=100. Seasonally adjusted)

2016	F&B sub-groups					Total F&B sector
	Meat, fish, fruit etc.	Dairy products	Grain mill products	Other food products	Beverages	
Jan-16	118.8	115.8	107.1	104.2	112.5	111.1
Feb-16	115.2	117.1	108.7	113.5	117.4	114.7
Mar-16	117.6	119.3	107.1	103.5	114.9	111.4
Apr-16	117.2	115.9	105.2	105.8	123	113.7
May-16	121.4	113.7	106.5	104.7	124	114.6
Jun-16	120.4	112.5	104.7	105.9	120.2	113.5
Jul-16	118.6	113.3	103.6	105.4	122.3	113.4
Aug-16	116	113.7	102.4	109.5	118.9	113.1
Sep-16	116.7	110.7	103.9	105.8	119.7	112.2
Oct-16	118.1	111.2	104.5	108	111.4	111.2
Nov-16	111.7	113.3	105.1	105.8	119.2	111.2
Dec-16	117.1	107.4	102.7	105.9	116.3	111.1
Average monthly growth rate	-0.12	-0.63	-0.35	0.13	0.28	0

Source: Compiled by the author, data from Stats SA (2017)

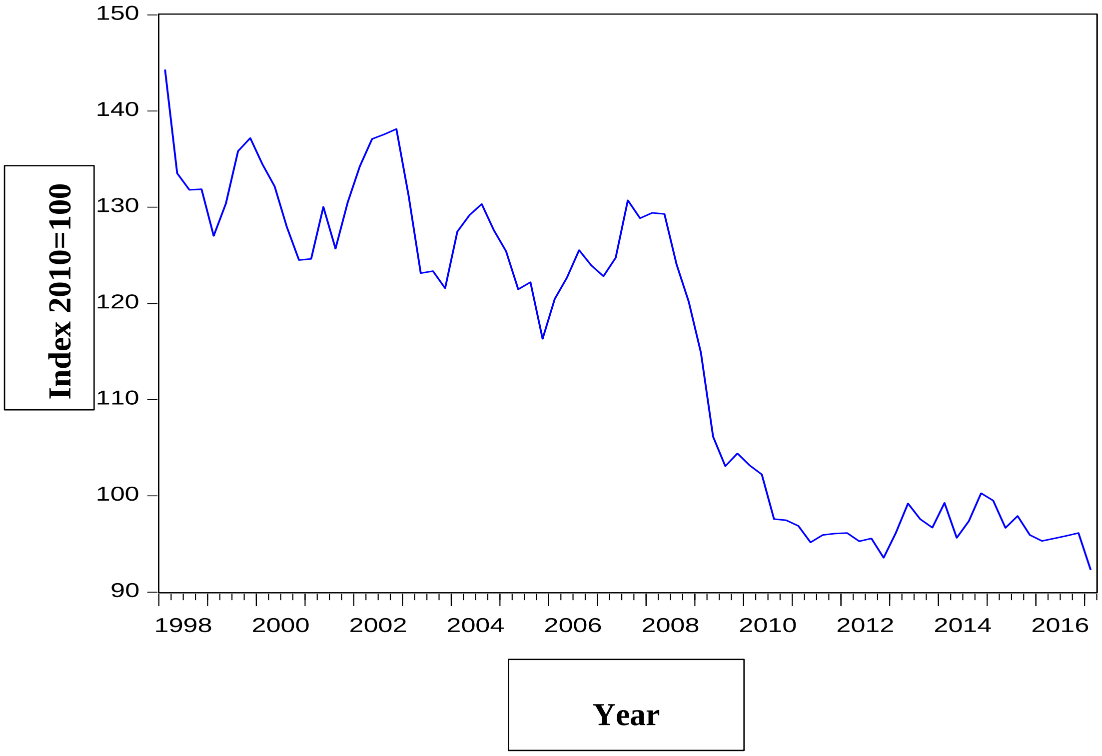
Table 3.4 shows that the average monthly growth rate of production in the total F&B sector was 0 percent for 2016, with most of the sub-groups in the F&B sector experiencing negative average monthly production growth rates: Meat, fish, fruit etcetera (-0.12%); dairy products (-0.63%) and grain mill products (-0.35%). Some of the F&B sub-groups contributed positive, but relatively low average monthly production growth rates for 2016: Beverages (0.28%) and other food products (0.13%). On the contrary, more recent statistics on the sector shows that the F&B sector was the highest contributor to the overall three-month percentage change (seasonally adjusted) in the manufacturing production increase of 0.4 percent in the three months leading to May 2017 (Stats SA, 2017). To enumerate, the F&B sector contributed a substantial 2.6 percent to the total manufacturing production during the three months leading to May 2017 (Stats SA, 2017).

3.3.2.2 Clothing sector

The clothing sector of manufacturing is well established in South Africa (DTI, 2017). With this in mind, the clothing sector consists of approximately 300 manufacturers, based predominately in areas such as Gauteng, KwaZulu-Natal, Eastern Cape and Western Cape (FPM Seta, 2014:2). According to Keane and Te Velde (2008:7), the clothing sector plays a crucial role in our lives and in various sectors of the South African economy; this includes the healthcare, transportation and construction sectors. The clothing sector also offers a wide range of goods, from services (home furnishing, tufting, spinning, non-woven, weaving, knitting, dyeing, etc.) to traditional products such as clothing, leather, textile and foot gear (Mbatha, 2014:41). In addition, the clothing sector is extremely dynamic and has a long history as a source of employment in the South African economy (Vlok, 2006:227). This can be attributed to the sector's characteristics of being extremely diverse and consisting of a geographically dispersed production that enables the sector to present employment opportunities to a variety of workers within the South African economy (Keane & Te Velde, 2008:6).

Although the latter is true, the clothing sector has been experiencing a steady decline in its production levels for at least two decades and this has been followed by thousands of job losses, as a result of many clothing manufacturing firms shutting down (FPM Seta, 2014:5). According to Ndalana (2016), the clothing sector has shed approximately 120 000 jobs over a period of 1998 to 2016, this is to say from 210 000 jobs in 1998 to 90 000 jobs in 2016. For the most part, this can be attributed to the high administration costs coupled with the surge of cheap Chinese, India and Bangladesh clothing imports that left the domestic clothing sector in an inauspicious state (Mbatha, 2014:29). As domestic retailers and other consumers of clothing in South Africa are more inclined to import cheap clothing produced in foreign countries, rather than having to consume clothing produced domestically. Figure 3.3 illustrates the clothing sector's production volumes in South Africa over a period of 1998 to 2016.

Figure 3.3: Clothing sector's production volume over a period of 1998 to 2016 (seasonally adjusted)



Source: Compiled by the author, data from Stats SA (2017)

Figure 3.3 shows that over a period of 1998 to mid-2008, production in the clothing sector was experiencing a steady decline. Not to mention, during the same period the clothing sector reported negative employment figures, as employment in the sector declined from 206 947 in the first quarter of 2003 to 142 203 in the second quarter of 2006 (Stats SA, 2016). Furthermore, from a period leading towards the end of 2008 up until the mid-2009, the clothing sector experienced a drastic decline in its production. This can be attributed to the global financial crisis that induced impediments on the overall production of the manufacturing sector in South Africa. As such, this implies that the clothing sector was amongst sub-sectors of the manufacturing sector that was effected entirely by the 2008/09 global financial crisis, as production levels of the clothing sector have not been restored back to the pre-crisis levels. Furthermore, the South African clothing sector is made up of six sub-groups: Textiles; knitted, crocheted articles; wearing apparel; footwear; leather and leather products; and other textile products. Considering this, Table 3.5 presents production figures together with the average monthly growth rates of production in the total clothing sector and its sub-groups for 2016.

Table 3.5: Clothing sector's production for 2016 by sub-groups (Index 2010=100. Seasonally adjusted)

2016	Clothing sub-groups						Total Clothing sector
	Textiles	Other textile products	Knitted, crocheted articles	Wearing apparel	Leather & leather products	Footwear	
Jan-16	86.1	89.9	56.4	93.8	118.9	103.6	95.2
Feb-16	87.5	92.4	50.1	99.9	113	98	96.2
Mar-16	90.7	92.9	53.5	92	110.3	100.9	94.5
Apr-16	87.2	96.4	53.4	90.2	119	99	94.4
May-16	86.8	95.1	51.6	96.9	113.6	100.2	95.7
Jun-16	85.4	94.5	53.3	98.3	119.7	99.9	96.6
Jul-16	87.1	93.9	55	103.8	98.2	101	95.8
Aug-16	86.8	94.5	50.8	96.8	113.6	99.4	95.5
Sep-16	90.1	100.2	52.4	96.5	111.5	95.8	96.2
Oct-16	96.6	93.6	50.9	94.8	112.7	101.5	97.4
Nov-16	89.7	93.2	48.3	93.1	105.7	102.4	93.9
Dec-16	88.9	91.8	50.8	100.1	105.3	113	97.1
Average monthly growth rate	0.27	0.17	-0.87	0.54	-1.01	0.73	0.16

Source: Compiled by the author, data from Stats SA (2017)

Table 3.5 shows that the average monthly growth rate of production in the total clothing sector was 0.16 percent for 2016, with most clothing sub-groups contributing positively, but low average monthly production growth rates: Textiles (0.27%); wearing apparel (0.54%); footwear (0.73%) and other textile products (0.17%). While some of the sub-groups experienced negative average monthly production growth rates for 2016: knitted, crocheted articles (-0.87%); leather and leather products (-1.01%). Correspondingly, the more recent statistic on the sector shows that clothing sector contributed -0.4 percent to the overall three-month percentage change (seasonally adjusted) in the manufacturing production increase of 0.4 percent in the three months leading to May 2017 (Stats SA, 2017). Nonetheless, Fibre Process and Manufacturing Seta (FPM Seta, 2014:3) points out that despite the clothing sector's insufficient contributions to the overall manufacturing production and challenges encountered by clothing sector. The clothing sector is still committed to its powerful vision of ensuring that natural, human and technological inputs are utilised to make South Africa's manufactured textiles, clothing, leather and footwear competitive in both the domestic and global markets.

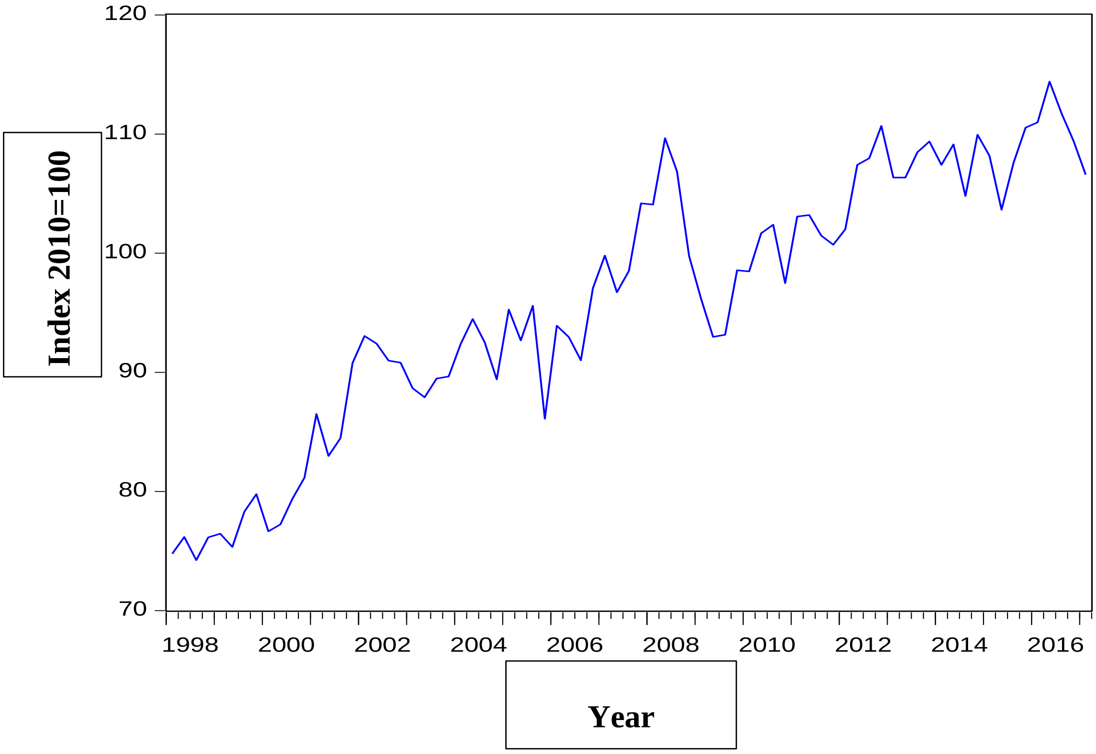
3.3.2.3 Chemical sector

The South African chemical sector of manufacturing is well developed, extremely complex and diversified, with its output composed of a variety of chemicals integrated in some way to meet the essential properties and characteristics (Zyl, 2008:16). According to Penfold (2015), the chemical sector of manufacturing is amongst the apex sectors of manufacturing in the South African economy, as it contributes to downstream value chains both internal and external to the sector itself. This can be attributed to the forward and backward linkages as a characteristic of the manufacturing sector, which enables the manufacturing sector and its sub-sectors to add value to other economic sectors of the South African economy. With this in mind, the establishment of the chemical sector in South Africa is dated back to the use of explosives in mining during the late nineteenth century (Majozi & Veldhuizen, 2015:46).

Prior the chemical sector's establishment, the South African economy used to import dynamite for their mining operations. However, a collective initiative of both the De Beers and British manufacturers succeeded in establishing a dynamite manufacturing factory in one of the suburbs of the city of Johannesburg called the Modderfontein (Davenport, 2013). The factory did not only manufacturer dynamite but also a variety of chemicals such as paints, cyanide, varnishes, sulfuric acid, nitrogen compounds and insecticides (Chemistry International, 1999). It should be noted that since South Africa lacks sufficient upstream oil reserves, the chemical sector was mainly developed by the gasification of South Africa's ample coal reserves (Chartered Alternative Investment Analyst (CAIA), 2010).

Furthermore, in 1950 the South African government made a substantial investment into the establishment of Sasol, the first coal-to-liquid plant (i.e. extraction of synthetic oil and gas from coal through gasification) (Majozi & Veldhuizen, 2015:48). As such, the latter put forward the emergence of the chemical sector in the South African economy. Moreover, the chemical sector has significantly transformed the lives of all South Africans — from the cars driven by people to the accommodation housing people, as it provides Coke, petroleum products, nuclear fuel, basic chemicals, rubber products, plastic products and other chemical products (Stats SA, 2017). In light of this, the chemical sector is amongst the key economic sectors of the South African economy and it is the largest chemical sector in the broader Africa (Majozi & Veldhuizen, 2015:46). Figure 3.4 illustrates South African chemical sector's production volumes over a period of 1998 to 2016.

Figure 3.4: Chemical sector's production volume over a period 1998 to 2016 (seasonally adjusted)



Source: Compiled by the author, data from Stats SA (2017)

Figure 3.4 shows that production levels in the South African chemical sector sustained a steady upward trend, over a period of 1998 to 2008. However, the sharp decline that started in the mid-2008 to mid-2009 confirms that the chemical sector was amongst the manufacturing sub-sectors affected by the 2008/09 global financial crisis. Even so, the production levels of the chemical sector have been restored back to the pre-crisis levels, but have been growing only marginally since the crisis as shown in Figure 3.4. Although this may be true, Penfold (2015) points out that the chemical sector's performance surpasses the performance of the manufacturing sector. Table 3.6 presents production figures together with the average monthly growth of production in the total chemical sector and its sub-groups for 2016.

Table 3.6: Chemical sector's production for 2016 by sub-groups (Index 2010=100. Seasonally adjusted)

2016	Chemical sub-groups					Total chemical sector
	Coke, petroleum products and nuclear fuel	Basic chemicals	Other chemical products	Rubber products	Plastic products	
Jan-16	101.1	114.9	120.2	101.6	105.4	109.1
Feb-16	105.3	117	122	96.4	106.5	111.4
Mar-16	111.8	115.4	120.6	98	99.6	112.4
Apr-16	111.3	113.6	120.9	100.5	98.2	112
May-16	107.5	120.1	126.9	109.1	99.5	113.9
Jun-16	109.7	135.8	127.6	103.3	99.4	117.3
Jul-16	107.2	116.3	126	103.4	102.2	112.9
Aug-16	104.9	115.9	123.1	103.4	98.4	110.7
Sep-16	103.7	123.8	121	103.9	101.5	111.5
Oct-16	101.8	121.9	123.3	103.3	100.1	110.8
Nov-16	102.8	109.6	123.1	101.2	99.3	108.8
Dec-16	99.3	111.6	123.8	104.3	102.9	108.6
Average monthly growth rate	-0.15	-0.24	0.25	0.22	-0.2	-0.04

Source: Compiled by the author, data from Stats SA (2017)

Table 3.6 shows that the average monthly growth rate of production in the total chemical sector was -0.04 percent for 2016, with most chemical sub-groups experiencing negative average monthly production growth rates: Basic chemicals (-0.24%); plastic products (-0.2%); and coke, petroleum products and nuclear fuel (-0.15%). While some of the sub-groups experienced positive average monthly production growth rates for 2016: rubber products (0.22%); and other chemical products (0.25%). Corresponding to the 2016 negative average monthly production growth rate of -0.04 percent for the chemical sector, more recent statistics on the sector point out that the chemical sector was amongst the sub-sectors of the manufacturing sector that contributed negatively to the overall manufacturing production in the second quarter of 2017, contributing -2.6 percent (Stats SA, 2017). This is mainly due to large imported quantities of raw inputs used in the chemical sector and it should be noted that these raw inputs are subjected to exchange rate fluctuation (Stats SA, 2016). In addition, the antiquated technology used in the chemical sector's production processes induces an inauspicious state for the chemical sector in South Africa (Brand South Africa, 2012).

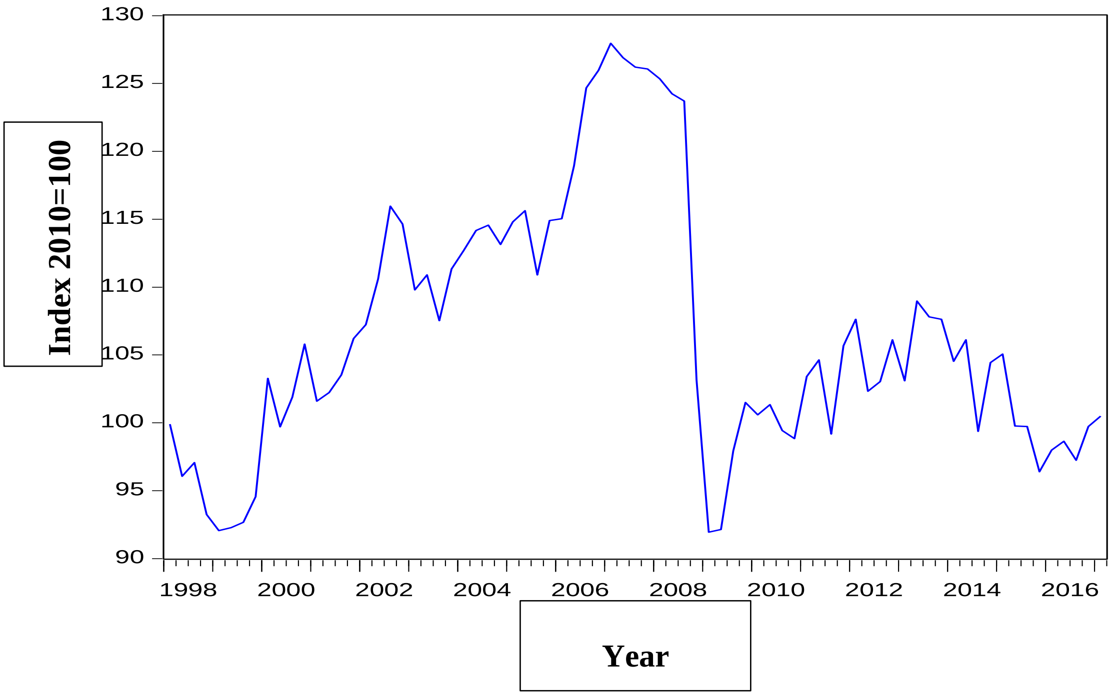
3.3.2.4 Metal sector

The metal sector as one of the manufacturing sub-sectors is well-developed and amongst the leading sectors in the South African economy (Brand South Africa, 2017). Not to mention, in 2001 the sector was rated the world's 19th largest steel producing sector, making South Africa the monumental producer of steel in Africa accounting for approximately 60 percent of Africa's total production (Taylor, 2006). In addition, the metal sector has a variety of natural resources and an enabling infrastructure for the production of iron, steel, metal and machinery (Brand South Africa, 2017). As such, the production of steel and iron includes the production of primary steel and iron through a process of heating and melting metal ore to semi-finished products (Campbell, 2013:4). According to Mcilhone (2017), primary semi-finished products consist of, blooms, billets, slabs, reinforcing bars, wire rod, forgings, railway track material, seamless tubes and plates**.** In South Africa, Iscor is the largest steel producer and other producers include Vanadium and Cisco, Cape Gate, Scaw Metals, Highveld Steel and Columbus Stainless Steel (SA Iron and Steel Institute, 2013).

Furthermore**,** the metal sector also involves the production of non-ferrous metal that includes aluminium, copper, brass, lead, zinc and tin, but amongst these metals, aluminium is the most produced (Stats, SA, 2017). As such, South Africa is rated the eighth in world production of aluminium, with Billiton and Hulett Aluminum being the main producers of aluminium in the country (Brand South Africa, 2017). Nonetheless, the overall production in the metal sector has been declining over the past two decades in both South Africa and the broader world, as a result, a number of South African metals manufacturing firms have shut down. This includes Vanadium and Evraz Highveld metal manufacturing firms, which were shut-down during the first quarter of 2016; this led to a loss of approximately 2 200 jobs coupled with the obstruction of approximately 3 000 job opportunities in Witbank (Fin24, 2016).

In this case, without instituting urgent protectionism, the biggest metal manufacturer in South Africa (i.e. ArcelorMittal) could soon follow in the footsteps of both the mentioned metal manufacturing firms that closed down (Steyn, 2016). This would come with an inimical cost to the South African economy, as Arcelor Mittal accounts for approximately 66 percent of overall employment in the Vaal Triangle (Fin24, 2016). As such, it should be noted that the inauspicious state of the metal sector in South Africa is induced by cheap Chinese steel that is dumped in South Africa. Consequently, this causes metal manufacturers to experience considerable periods of excess supply that induce high administrative costs placing an immense pressure on the production of metals in the South African economy. With this in mind, Figure 3.5 illustrates the metals sector's production volumes in South Africa over a period of 1998 to 2016.

Figure 3.5: Metal sector's production volume over a period of 1998 to 2016 (seasonally adjusted)



Source: Compiled by the author, data from Stats SA (2017)

Figure 3.5 shows that the production levels in the South African metal sector have been increased marginally from 2000 until 2007, but in 2008 to mid-2009 production levels in the metal sector declined drastically. Nonetheless, mid-2009 to 2010 production levels in the metal sector slightly recovered, but from mid-2010 up until recently, production levels in the metals sector have been declining marginally. In light of this, it can be deduced that the metals sector is amongst the sub-sectors of the manufacturing sector that was affected significantly by the 2008/09 global financial crisis and the production levels in the sector have not restored back to the pre-crisis levels. Table 3.7 presents production figures together with the average monthly growth of production in the total metal sector and its sub-groups for 2016.

Table 3.7: Metal sector's production for 2016 by sub-groups (Index 2010=100. Seasonally adjusted)

2016	Metal sub-groups							Total
	Basic iron and steel products	Non-ferrous metal products	Structural metal products	Other fabricated metal products	General purpose machinery	Special purpose machinery	Household appliances	Total Metal Sector
Jan-16	85.7	94.7	82.8	119.5	75.5	106.3	108	97
Feb-16	93.6	95.6	79.4	123.2	74.7	109.8	87.6	99.4
Mar-16	89.6	93.1	78.4	120.4	79	107.6	95	97.6
Apr-16	92.3	93.4	75.1	122.6	76.3	109.2	107.3	98.1
May-16	95.6	93.6	77.9	123.3	76.6	103.2	95.6	98.4
Jun-16	96.7	96.8	78.1	121	83.4	103.3	93.9	99.4
Jul-16	91.7	93.5	74.3	118.6	75.7	112.3	94	97.8
Aug-16	80.4	93.9	73.9	122.4	77.5	100.7	96.4	94.8
Sep-16	90.3	97.5	80.2	122	78.6	104.9	90.6	99.1
Oct-16	93.9	96.2	72.4	120.9	78.4	105.7	91.1	98.1
Nov-16	97.3	103	74.5	128.7	79.5	104.5	96.6	101.2
Dec-16	91.4	101.5	71.6	118.8	78.6	113	97.4	99.9
Average monthly growth rate	0.54	0.58	-1.20	-0.05	0.34	0.51	-0.86	0.25

Source: Compiled by the author, data from Stats SA (2017)

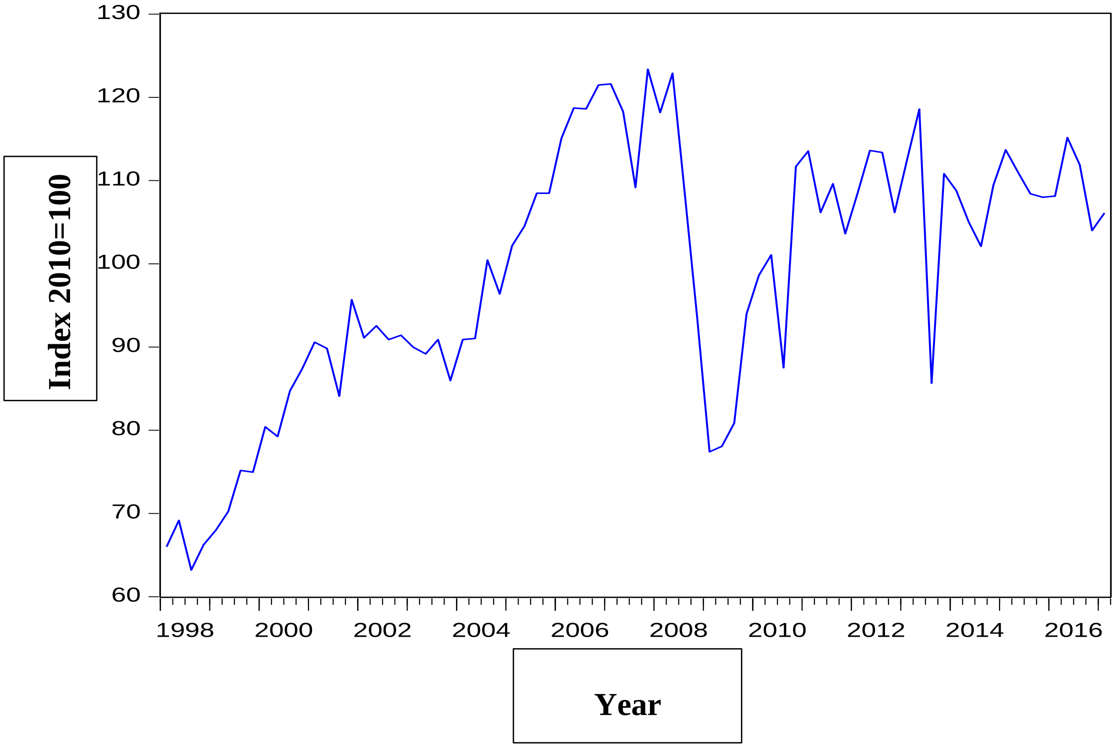
Table 3.7 shows that the average monthly growth rate of production in the total metal sector was 0.25 percent for 2016, with most metal sub-groups contributing positively, but insufficient average monthly production growth rates: Basic iron and steel products (0.54%); non-ferrous metal products (0.58%); general purpose machinery (0.34%); and special purpose machinery (0.51%). Some of the sub-groups experienced negative average monthly production growth rates for 2016: Structural metal products (-1.20%); household appliances (-0.86%); and other fabricated metal products (-0.05%). Correspondingly, the more recent statistic on the sector points out that the metals sector was amongst the largest positive contributor to the overall manufacturing production in the second quarter of 2017, contributing 0.5 percent to the overall manufacturing sector production in May 2017.

3.3.2.5 Automotive sector

The inception of the recent automotive sector in the South African economy can be traced back to 1995 and has since compelled the global motor vehicle manufacturers to confer production contracts to South African automotive manufacturing firms (Kaggwa, 2007:51). According to Brand South Africa (2017), the South African automotive sector constitutes a significant component of the South African manufacturing base. The reason for this is that in the absence of challenges, the sector demonstrates ways in which the value chains can interact domestic production with global markets (Naude & Badenhorst-Weiss, 2011:71). In this regard, the automotive sector is used by key multinationals as a headspring of components and vehicle mustering for both the domestic and global markets. As such, the South African automotive sector, as a sub-sector of the manufacturing sector, is amongst the most crucial sectors of the economy (Brand South Africa, 2017). Thus, South Africa is intent on becoming an automotive investment destination of choice through refurbishing and advancing key components required in the automotive sector to make progress in achieving an automotive sector that can compete both domestically and globally (Engineering News, 2017).

Moreover, it is important to realise that the automotive sector can be categorised into three sub-sectors: the production of the motor vehicle, parts and accessories and other equipment associated with transport (Stats SA, 2017). In light of this, motor vehicle and other equipment associated with transport are manufactured mainly from the Eastern Cape and Gauteng, where there is a concentration of automotive firms with production plants (i.e. Ford, Toyota, BMW, Daimler-Chrysler and Volkswagen) (Barnes & Meadows, 2008:13). Manufacturers (i.e. Senior Flexonics, Corning, Bloxwich and Arvin Exhaust) of parts and accessories needed by these automotive firms have set up production bases in the country (Brand South Africa, 2017). In light of this, Figure 3.6 illustrates production volumes of the automotive sector in South Africa over a period of 1998 to 2016.

Figure 3.6: Automotive sector's production volume over a period of 1998 to 2016 (seasonally adjusted)



Source: Compiled by the author, data from Stats SA (2017)

Figure 3.6 shows that from 1998 until 2007 production levels in the automotive sector sustained an upward trend, during this period the sector produced over 500,000 vehicles annually and this made substantial contributions of 7.5 percent to the GDP (Stats SA, 2016). However, Figure 3.6 also shows that from 2008 to 2009 production in the automotive sector experienced a sharp decline. In other words, the automotive sector is amongst the sub-sectors of the manufacturing sector that were affected by the 2008/09 global financial crisis. On the contrary, from mid-2009 to 2011 the automotive sector sustained an incessant production increase as a result of low production costs and access to new markets. Despite the latter, it should be noted that the production levels in the automotive sector have not restored to the pre-2008/09 global financial crisis levels as shown in Figure 3.6. Not to mention, production levels in the automotive sector have been marginally stable from 2014 to 2016. With this in mind, Table 3.8 presents production figures together with the average monthly growth of production in the total automotive sector and its sub-groups for 2016.

Table 3.8: Automotive sector's production for 2016 by sub-groups (Index 2010=100. Seasonally adjusted)

2016	Automotive sub-groups				Total Automotive sector
	Motor vehicles	Bodies for motor vehicles, trailers and semi-trailers	Parts & accessories	Other transport equipment	
Jan-16	119.3	125.2	93.9	102	106.5
Feb-16	125.7	110.9	93.1	97.7	106.8
Mar-16	135.9	110.3	96.3	94.4	111.1
Apr-16	147.4	107.2	94.4	102.3	115.6
May-16	143.7	111	97.1	96.6	114.7
Jun-16	132.3	110.5	100.4	116.3	115.2
Jul-16	132.7	115.6	101.4	94.2	112.4
Aug-16	134.1	112.2	96.7	93	110.5
Sep-16	126.9	111.9	98.9	116.1	112.7
Oct-16	119.4	108.4	93.3	80.9	101.5
Nov-16	125	118.7	88.5	92.3	104.2
Dec-16	125.8	120	91.2	95.9	106.3
Average monthly growth	0.44	-0.35	-0.24	-0.51	-0.02

Source: Compiled by the author, data from Stats SA (2017)

Table 3.8 shows that the average monthly growth rate of production in the total automotive sector was -0.02 percent for 2016, with most automotive sub-groups experiencing negative average monthly production growth rates: Parts and accessories (-0.24%); bodies for motor vehicles, trailers and semi-trailers (-0.35%); and other transport equipment (-0.51%). One of the sub-groups experienced positive average monthly production growth rates of 0.44 percent for 2016. Nonetheless, more recent statistics on the sector show that the automotive sector is amongst the sub-sectors of the manufacturing sector that reported positive growth rates for the second quarter of 2017, contributing 0.2 percent to the overall manufacturing production in June 2017 (Stats SA, 2017).

3.4 SUPPORTIVE MEASURES FOR MANUFACTURING IN SOUTH AFRICA: POLICIES AND INCENTIVE SCHEMES

In spite of the undesirable performance of the manufacturing sector in South Africa, it is still imperative for the South African government to place its focus on the manufacturing sector in its attempt to bring about GDP growth and employment (Bell & Madula, 2002). The reason for this is that manufacturing in any economy serves to be a catalyst for growth and employment (Zalk, 2014). Historically countries aiming at improving their economic and social standing have tended to give support to the manufacturing sector as it is considered a high value-adding economic sector. In light of this, the South African government has formulated policies and incentive schemes in order to save, sustain and promote South Africa's manufacturing base (DTI, 2013).

3.4.1 Policies regarding manufacturing in South Africa

Policies are formulated to serve as divine rules for decision making. They are formulated and prioritised within countries, institutions, organisations and firms to act as safety nets (Nabutola, 2012:3). In addition, policies can also be viewed as indefinite decisions taken for actions concerning the future status quo of a particular country, thus policies are subjected to too much deliberation and scrutiny prior to implementation (Meiring, 2007:4). According to the United Nations (2007:5), polices are perused to give structure and guidelines to all economic sectors within a country. As such, a country-specific policy must be used as a non-development preventive in order to ensure development is achieved in that particular country. In South Africa, various policies are bringing about economic development through broadening participation in the economy and sustaining economic growth that generates employment.

Considering that fact, Nip (2004:107) asserts that having the ability to understand a policy is crucial to the development of competitive advantage. For this reason, it is imperative for the study to review policies influencing the competitiveness of the manufacturing sector in South Africa; in particular, industrial policies, as in recent times manufacturing is the highlight of industrial policy (Aiginger, 2014:3). Therefore, industrial policies serve to reflect the South African government's endeavour in strengthening its industrial base, in order to promote productivity-based growth. In addition, Rodrik (2007) points out that industrial policy is the only approach that delivers real economic growth and development, as it supports the production of new goods using contemporary technologies and transferring resources from traditional economic activities to modern economic activities.

In light of this, South Africa's industrial policy is steered by the National Development Plan (NDP), New Growth Path (NGP) and the National Industrial Policy Framework (NIPF) through Industrial Policy Action Plan (IPAP). With regard to these three policies, it should be noted that the IPAP is the short-term industrial policy strategy, while the NGP is the medium-term economic development strategy and the NDP is the long-term vision for the South African economy (IDC, 2013:25). The South African Department of Trade and Industry (DTI, 2013) points out that the IPAP provides and facilitates a platform for industrial growth and this is supported by the NDP. As such, the study will review the abovementioned policies and highlight the strategic objectives proposed by these policies in supporting and improving the state of the manufacturing sector in South Africa. In doing so, the study will first unfold the industrial support measures subsumed within the NDP as a long-term vision of the South African economy. This will be followed by unfolding the medium-term industrial development measures subsumed in the NGP and, lastly, the study will unfold industrial development strategy subsumed in the IPAP. In view of the latter, it should be noted that the study will mainly focus on the IPAP, as it is a more definite vehicle of industrialisation for the South African economy.

3.4.1.1 National Development Plan (NDP) as an industrial policy

On 15 August 2012, the South African government adopted the National Development Plan (NDP) that was formulated by the National Planning Commission (NPC) together with South Africans from all walks of life (National Planning Commission, 2012). The reason for this is that the NDP provides a long-term vision for a universal economic and social developmental path of progress in South Africa (Zerenda, 2013:2), as it fuses economic, social, demographic, government and environmental components to produce a plausible framework for inclusive sustainable growth (Human Science Research Council (HSRC), 2017). Equally important, the NDP intends to reduce the number of people that are unemployed and under the poverty line, while minimising the inequality gap in the South African economy by 2030 (National Planning Commission, 2012). To enumerate, the NDP has a target of decreasing the unemployment rate to around 6 percent by 2030, while ensuring the number of persons within households earning a monthly income of only R419 per person must be reduced from 39 percent to zero and the inequality must decrease from 0.69 to 0.6, as measured by the Gini coefficient (National

Planning Commission, 2012). In ensuring the latter, the NDP outlined seven extensive objectives and these objectives are detailed in Table 3.9.

Table 3.9: National Development Plan (NDP) objectives

	Integrating South Africans of all races and classes around a common programme to eradicate poverty and minimise inequality;
	Providing incentives for citizens to be active in their own development, in reinforcing democracy and in holding their government liable;
	Increasing economic growth, promoting exports and labour-intesive economic activities;
	Supporting fundamental capabilities of both people and the country i.e. infrastructure, skills, social security, strong institutions and partnerships both within the country and with key global partners;
	Contructing a capable and developmental economy; and
	Strengthening leadership throughout the society, to result integrated soltions in sloving domestic problems.

Source: National Planning Commission (NPC) (2012)

Equally important, embedded within the NDP is the drive to ensure a decent standard of living is achieved for all South Africans by 2030 (Zerenda, 2013:2). As such, the NDP annunciates that the core components of a decent standard of living include decent housing, adequate nutrition, quality health-care, social security, clean environment, recreation and amusement, quality education and development of skills and, lastly, decent jobs (National Planning Commission, 2012). Furthermore, in 2014 developments were made with regards to the NDP, which involve the introduction of the Medium-Term Strategic Framework (MTSF) which presents a strategic plan that ensures that the NDP policy is consistent with its commitment to achieving the above-detailed objectives in Figure 3.1 by 2030 (South African Presidency, 2014). The MTSF is aligned and integrated across government plans and the budgeting processes. It also consists of two strategic themes, that is, radical economic transformation and ensuring adequate service delivery. These MTSF strategic themes are detailed and broken down into 14 crucial outcomes that are in relation to the NDP objectives in the MTSF document

(South African Presidency, 2014). In fact, it can be deduced that MTSF is a strategic plan subsumed within the NDP, as it forms the first five-year implementation phase of the NDP.

In light of this, the NDP through the MTSFs radical economic transformation theme implicate the development of a productive asset base with a growing capacity for employment creation and value-added exports, in order to enforce a substantial innovations in the structure of the South African economy (South African Presidency, 2014).Therefore, to transition the South African economy from an exploitive exporter of raw material or inputs to an economy that induce economic value through manufacturing and beneficiation (African National Congress (ANC), 2017:2). The Industrial Development Corporation (IDC, 2016) points out that the NDP outlines key proposals to create great intensity in the manufacturing sector through beneficiation, in order to acknowledge the transformative potential of the manufacturing sector. Table 3.10 presents the NDP key proposals for the manufacturing sector in South Africa.

Table 3.10: National Development Plan (NDP) key proposals for manufacturing

	Leveraging public and private sector procurement to stimulate the local production and diversification;
	Plausible incentive polices should continue to be developed as a crucial tools of South Africa's IPAP;
	Support research and development to stimulate product development, innovation and industrial diversification
	Reinforcing network infrastructure and skills supply; and
	Overseeing and influencing the increase in administered prices.

Source: South African Presidency (2014)

In addition to NDP key proposals for manufacturing presented in Table 3.10, Greve (2015) points out that the NDP give credence to the fact that boosting the competitiveness of the manufacturing sector could be achieved by commercialising innovation in South Africa and infusing considerable investments into research and development. For the most part, it is important to realise that the NDP, as a long-term vision of the South African economy, is assisted by the NGP and the IPAP in its quest to achieve its objectives. Taking this into account, the NGP provides support for labour-inclusive sectors to accelerate the labour absorption within these sectors and the IPAP provides solutions and support towards re-industrialisation (Zerenda, 2013:1).

3.4.1.2 New Growth Path (NGP) as an industrial policy

The NGP was launched during the December of the year 2010 as a developmental agenda in a form of an economic strategy that is formulated to transform the South African economy's development path over the medium term (Zerenda, 2013:1). The NGP aims at achieving a faster, inclusive, sustainable and production-led growth path while prioritising job creation by focusing on six job-creation areas, namely manufacturing, agriculture, mining, infrastructure development, green economy and tourism (Hendriks, 2012:8). The NGP aims at decreasing the number of people below the poverty line and ensuring inequality is reduced in South Africa (Fourie, 2013:1). Above all, Nattrass (2013:1) points out that the principal objective of the NGP is to generate five million jobs by 2020. Therefore, the NGP intends to do this by improving the performance of the South African economy through focusing and supporting areas that absorb a substantial amount of labour (South African Department of Economic Development, 2016). In doing so, the NGP has pinpointed key job drivers that need to be given attention in order to establish a complete labour-absorbing economy. These job drivers are presented in Table 3.11.

Table 3.11: NGP job drivers

	Substantial public investment in infrastructure to create employment directly and indirectly by improving efficiency across the economy;
	Targeting and suppporting labour-intensive activities in the main economic sectors such as agriculture, mining value chains, manufacturing and services;
	Seizing new opportunities in emerging economies, e.g. Knowledge and green economies;
	Strengthening social capital in the public services and the social economy; and
	Encouraging rural development and regional integration.

Source: South African Department of Economic Development (2016)

Through the NGP, the South African government has pinpointed various concrete measures with regards to achieving economic growth and generating employment. In addition, it should be noted that to achieve five million jobs, both the rate at which the economy is growing and the employment intensity of that growth (i.e. the employment growth rate relative to the GDP growth rate) will play a major role (Faulkner, *et al*., 2013:14). To clarify, in order to achieve NGPs principal objective of creating five million jobs by 2020, the South African economy is required to generate a GDP growth that is sustainable enough to create a substantial amount of employment (Desnoyers, 2011). To enumerate, the GDP annual growth rate must be kept in a range of 4 to 6 percent, while the intensity of growth in employment must be kept in a range of 0.5 to 0.8 (South African Department of Economic Development, 2016).

In view of the discussion above, McCarthy (2011:2) pointed out that the NGP is not introduced as an industrial policy but on its perusal, any student of industrial policy will acknowledge it as such. The reason for this is that in conduct, industrial policy often possesses a number of objectives that foster development. This involves short- to medium-term employment creation, greater distribution of income and a more equitable regional distribution of activities within the economy (Nabutola, 2012:3). Industrial policy can be conceptualised as an assortment of policy instruments that guide the structure and magnitude of industry. This involves the development of infrastructure and the labour market policies (Zalk, 2014). From these considerations, it can be deduced that the NGP has features of an industrial policy, as it possesses supportive measures that are formulated to develop particular types of economic activities within the economy, especially since it acts as an active labour market policy and ensures the development of infrastructure.

3.4.1.3 National Industrial Policy Framework (NIPF) and Industrial Policy Action Plan (IPAP)

According to South African Department of Trade and Industry (DTI, 2016) in 2007, South Africa adopted a National Industrial Policy Framework (NIPF) that draws attention to the manufacturing sector as a significant driver of economic growth and development. The NIPF reflects the South African government’s initiative in developing the industrial economy and recognises various platforms where employment opportunities and economic growth can be leveraged (DTI, 2006). Equally important, NIPF also sets out the direction and a sustainable vision for the industrial economy in South Africa in the context of the Accelerated and Shared

Growth Initiative for South Africa (ASGI-SA) (DTI, 2011). As such, Table 3.12 presents the NIPF objectives.

Table 3.12: NIPF core objectives

To make certain that the South African economy gradually transforms to a knowledge based economy and that the industrialisation process is sustainable in South Africa;
To induce a more labour-intensive industrialisation pathway, by accentuating economic linkages that create employment and more value adding, tradeable labour-absorbing goods and services;
To ensure a significant contribution towards inclusive industrial development in Africa, with a strong emphasis on strengthening Africa's production capacity; and
To induce industrialisation, characterised by the increased participation of all the marginalised domestic regions within the industrial economy and also ensure participation of those that were historically disadvantaged.

Source: DTI (2006)

The NIPF provides support and rationale for industrial growth in South Africa and beyond the country's borders. Furthermore, the NIPF is implemented through an IPAP that was introduced in 2007, thus the NIPF is acknowledged as a policy foundation for the IPAP (DTI, 2006). The South African Department of Basic Education (2013) describes the IPAP as a component of the larger set of integrative policies and strategies, underpinning the importance of economic sectors to economic growth and employment. Correspondingly, the IPAP is formulated to promote long-term industrialisation and diversification in order to improve South Africa's production of value-adding economic sectors that can promote economic growth and job creation opportunities (IDC, 2014).

In light of this, Steenkamp (2015:67) points out that the key objective of the IPAP is to achieve structural change by inducing growth and development, together with increased competitiveness of the South African manufacturing sector. In other words, the IPAP is an implementation plan that underpins the NIPFs main objectives through strategic interventions to key sub-sectors, mainly within the manufacturing sector (DTI, 2007). These manufacturing sub-sectors involve transport equipment; clothing; green and energy-saving industries; automotive; biofuels; agro-processing; chemicals; and paper, pulp and furniture (DTI, 2007). The manufacturing sector is identified by both the NIPF and IPAP as a sector of focus because of its value-adding nature that stimulates demand for an extensive scope of upstream inputs and services, which also makes the sector a major driver of growth in productivity and innovation (DTI, 2010).

The manufacturing sector plays an essential and dynamic role in the South African economy, as the sector is characterised by its forward and backward linkages that impose direct and indirect effects on other economic sectors (Teka, 2011:2). In the sense that through backward linkages the manufacturing sector pulls through inputs from both the services sectors and primary sectors and transforms them into higher-value products (DTI, 2017). In this way, employment for both the unskilled and semi-skilled persons is generated through the entire value chain (Teka, 2011:3). Also, an additional impetus to economic growth and employment is provided by the manufacturing sector's forward linkages to downstream economic sectors, mainly in services (Lei, *et al*., 2013:454). Thus, by focusing on value adding sectors that are embedded with both high economic growth and employment multipliers such as the manufacturing sector, the IPAP plays a crucial role in inducing economic growth and employment in South Africa.

In light of the latter, since the inception of the IPAP in 2007, the implementation plan has undergone nine annual iterations, with the ninth IPAP iteration being the latest. However, before the inception of the preceding eighth IPAP the following statistics regarding the manufacturing sector as a focus area for the IPAP were reported: In the first quarter of 2016 manufacturing production experienced a positive growth of 0.3 percent and a further 2.1 percent in the second quarter (quarter-on-quarter, seasonally adjusted) (Stats, SA, 2016). Accordingly, in the first quarter of 2016, the South African GDP grew by 3.3 percent and both mining and manufacturing sectors contributed over half of the 3.3 percent. According to Stats SA (2016), an increase in the production of motor vehicles became an impetus for the manufacturing sector to expand by 8.1 percent in the first quarter of 2016.

On the contrary, during the same period the manufacturing sector shed 7 000 jobs, in fact, the manufacturing of food products, beverages and tobacco products and the manufacturing textile, clothing and leather goods lost 5 000 and 3000 jobs respectively (Stats SA, 2016). To assess the effectiveness of the eighth IPAP iteration, the study will review manufacturing statistics reported towards the end of the eighth IPAP iteration and just before the inception of the ninth IPAP iteration. Taking this into account, in the first quarter of 2017 manufacturing production decreased by 0.8 percent, as six manufacturing sub-sectors reported negative growth rates. At the same time, the manufacturing sector contributed -0.5 percent to GDP growth (Stats SA, 2017). Not to mention, the Quarterly Employment Survey (QES) points out that the manufacturing sector lost 4000 jobs in the first quarter of 2017 (Stats SA, 2017). Considering these statistics, it can be deduced that the preceding eighth IPAP iteration did not achieve much success in boosting the manufacturing sector and resulting manufacturing-driven economic growth and employment.

In spite of that, the study will review the latest IPAP iteration in order to highlight the support measures put in place to revitalise the manufacturing sector from its current state. In view of this, the ninth IPAP iteration was launched on 8 May 2017 by the DTI and it builds on its predecessor as it is an updated and reformed version of the eighth IPAP iteration (DTI, 2017). Nonetheless, embedded within the ninth IPAP iteration are two policy contexts, that is, the economic restructuring and employment integration (DTI, 2017). The economic restructuring policy context channels the IPAP 9 to support radical economic transformation through an incessant effort to transform the structure of the South African economy radically (DTI, 2017). While the employment and integration policy context channels the IPAP 9 to prioritise job creation with an incessant emphasis on labour intensity, predominantly in sectors that are labour-intensive and those that have linkages with productive sectors in the South African economy (e.g. the manufacturing sector) (DTI, 2017). Considering these two policy contexts, IPAP 9s core objectives are presented in Table 3.13.

Table 3.13: Industrial Policy Action Plan (IPAP) 9 core objectives

Developmental model focused on radical economic transformation and social inclusion;
Building regional investment, trade and industrial development integration;
Emphasis on R&D and movement towards a knowledge economy;
Diversifying the economy and providing strong support for value-added manufacturing ; and
Working with the private sector to prepare for and adapt to the challenges in digitised production and logistics associated with the 4th Industrial Revolution

Source: DTI (2017)

In addition to these objectives, the IPAP 9 also aim to be a significant impetus for economic progression in the current strenuous economic circumstances, while diagnosing major challenges to industrialisation in order to take constructive and solutions-based approaches in alleviating challenges that are decelerating industrialisation (DTI, 2017). Therefore, the challenges diagnosed by the IPAP 9 are presented in Figure 3.7.

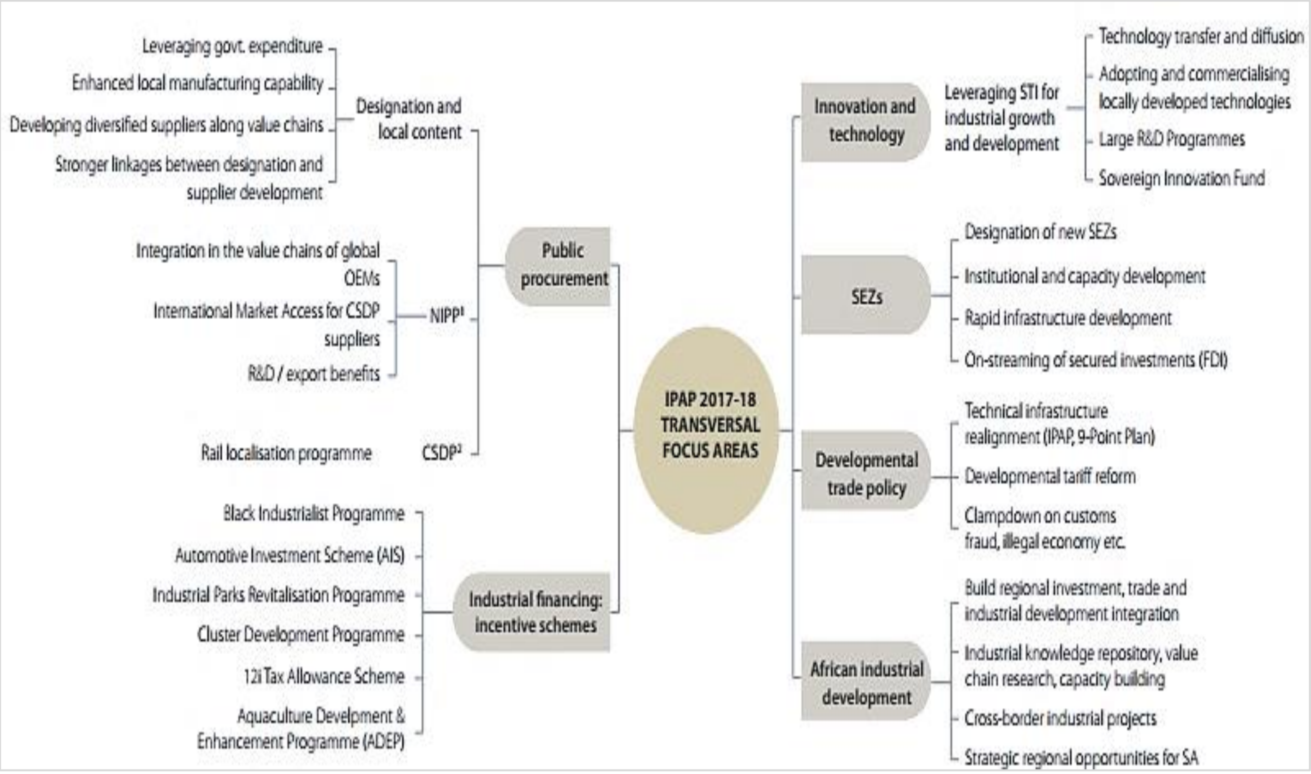
Figure 3.7: Key challenges identified by Industrial Policy Action Plan (IPAP) 9

1. Continuing resource dependence	2. F.I.R.E sectors growing faster than productive sectors	3.De-industrialisation	4. Lagging manufacturing investment & value-add
5. Weak domestic demand/persistent unemployment	6. Deep-seated skills shortages & mismatches	7. Continuing effects of the Great Global Economic Recession	8.Decline in primary sector performance
9. Domestic economic barriers	10. Policy uncertainty & programme misalignment	11. High input costs impose higher prices on key downstream sector.	12. Red tape, legislative and regulatory delays

Source: Compiled by the author from DTI (2017)

The challenges presented in Figure 3.7 impose impediments to industrialisation in South Africa. This involves insufficient manufacturing sector profits that will, in turn, cause low investment, low output and place a strenuous effect on both the export and employment performance (DTI, 2017). Thus, in response to these challenges, the IPAP 9 provides solution-based programmes and key action plans tailor-made to overcome the mentioned challenges in order to boost manufacturing growth. These programmes are categorised into two interventions, namely the transversal and the sector-specific interventions. The transversal interventions are referred to as inclusive or broad, as they are not restricted to focus on one specific sector (DTI, 2013). This involves focusing on industrial financing through incentive schemes, public procurement, special economic zones (SEZs), developmental trade policy, African industrial development, innovation and technology. Figure 3.8 presents all the focus areas incorporated in the transversal intervention.

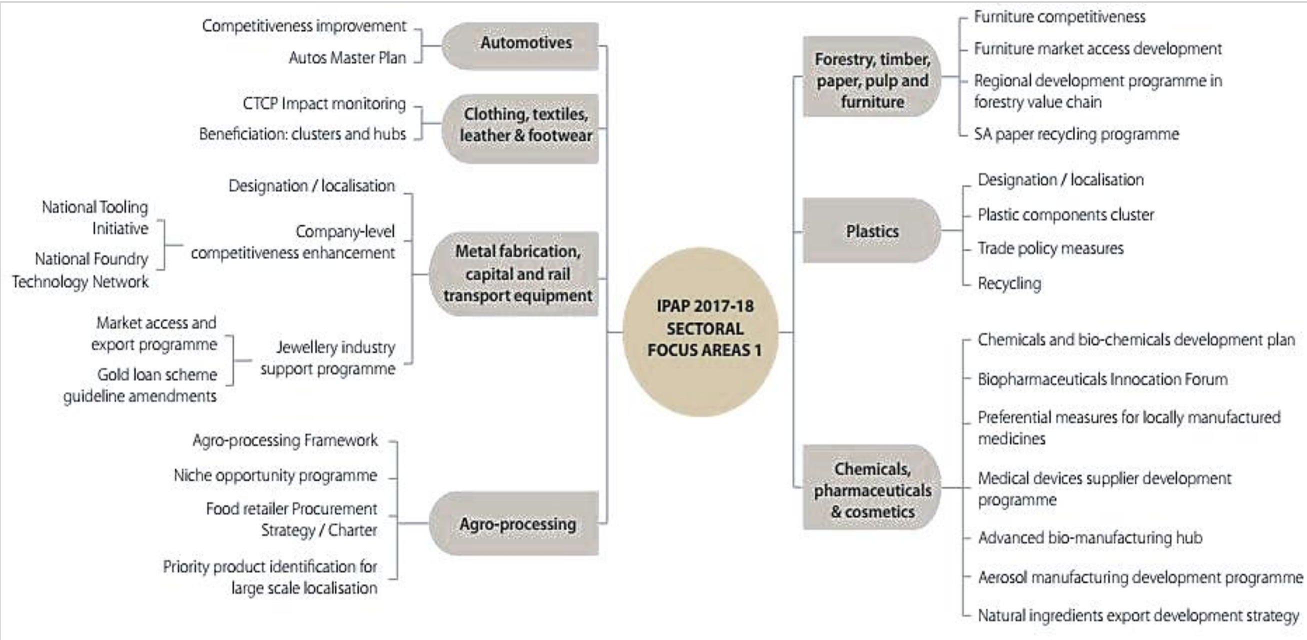
Figure 3.8: Transversal focus areas



Source: DTI (2017)

On the other hand, the sectoral interventions are referred as specific or narrow and are compartmentalised into two focus areas, that is, the sectoral focus areas 1 and 2. Sectoral focus area 1 provides support through programmes that focus on key manufacturing and service sectors in order to obtain higher levels of productivity, employment, export competitiveness, innovation and integrated rural development (DTI, 2013). This includes economic sectors that have been receiving support since the inception of the first IPAP iteration and other newly incorporated economic sectors such as automotive, forestry, timber, paper, pulp and furniture, clothing, textiles, footwear, metal fabrication, plastics, pharmaceuticals and agro-processing. As such, Figure 3.9 presents all the focus areas incorporated in the Sectoral focus area 1.

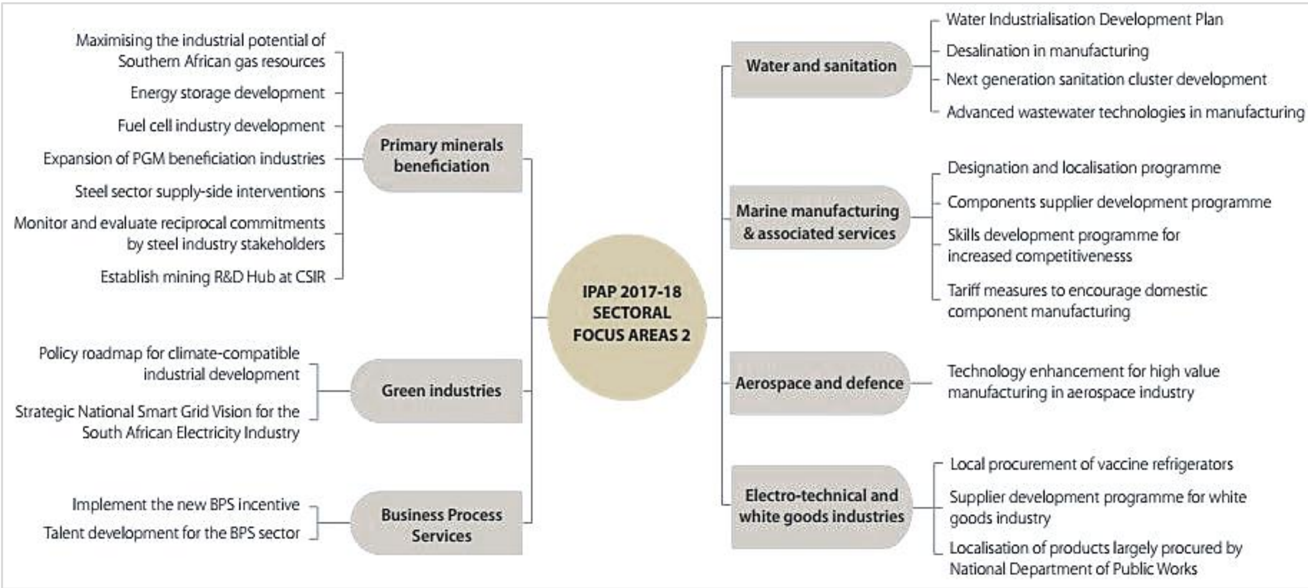
Figure 3.9: Sectoral focus area 1



Source: DTI (2017)

Continuing on this line, the Sectoral focus area 2 provide support through programmes that focus on primary minerals beneficiation, green industries, business process services, water and sanitation, aerospace and defence, electro-technical and white goods industries as well as marine manufacturing (DTI, 2017). Figure 3.10 presents all the focus areas incorporated in the Sectoral focus area 2.

Figure 3.10: Sectoral focus area 2



Source: DTI (2017)

In addition to the solution-based programmes, the IPAP 9 also provides key action plans that will remedy the current challenges facing the industrial economy in South Africa. It is also envisioned that the successful implementation of the aforementioned programmes and key action plans will result in a manufacturing-driven economic growth and employment. Figure 3.11 presents all the key actions plans identified in the ninth IPAP iteration.

Figure 3.11: Key action plans identified by Industrial Policy Action Plan (IPAP) 9

1. BB-BBE & transformation	2.Strengthen the procurement instruments	3. Achieve policy coherence & programme alignment	4. Conducting State Owned Companies oversights
5. Strengthen the national export drive	6. Promote a national buy back SA campaign	7. Build a strong industrial finance incentives & export support	8. Ensure technology is transfered & diffused
9. Preparing for the 4th industrial revolution	10. Ensure clean energy to fuel re-industrialisation	11. Promote value added processing	12. Promote green adaptation

Source: Compiled by the author from DTI (2017)

3.4.2 Incentive schemes available for manufacturing in South Africa

The manufacturing sector is necessary for the wellbeing of every economy because in various countries it has proved to be economic sectors that contribute significantly in stimulating economic growth and employment (Zalk, 2014). Thus, the quest to enhance the manufacturing sector's competitiveness in South Africa requires much sacrifice and effort on the part of the people together with the South African government (Langenhoven, 2016). In light of this, it should be noted that industrial finance is considered the life-force of manufacturing, as in the absence of adequate finance, industrialisation is impossible. By industrial finance, the study refers to the institutions with different types of finance needed by industry for all activities with regards to the production of goods and services.

As such, in South Africa, the lack of adequate industrial finance delays the process of industrialisation and this constitute not only a stumbling block to restoring the manufacturing sector's competitiveness but to the overall performance of the sector as well (DTI, 2013). As such, to accelerate industrialisation in South Africa, short-, medium- and long-term industrial finance must be injected in the manufacturing sector and other sectors within the industry (Maia, *et al*., 2005:1). This will ensure that the fixed capital expenditures, together with the working capital (e.g. purchase of machinery, purchase of raw materials, construction of buildings, repairs) needed in the manufacturing sector and the other sectors within the broader industry are sufficient to enhance the competitiveness of the sector.

To explain, more often than not short-term industrial finance is used to settle sundry expenses of manufacturing project and is offered by commercial banks for a period of one month to a year (Kumaran, 2015). Similarly, medium industrial financing is also offered by commercial banks, however, for a period of a year up to three years (Lang, 2012:5). On the other hand, long-term industrial financing is offered to industry for a period of three years and above, as it is crucial for financing the modernisation and expansion of industrial projects (Sethy, 2016). In addition, long-term industrial financing is available in a wide range of instruments, this involves debt, equity, guarantees, venture capital, bridging finance and trade finance from the South African government's industrial financial institutions like Industrial Development Corporation (IDC) and Department of Trade and Industry (DTI) (Mqoqi, 2014:30).

Both the IDC and DTI set the criteria that need to be met prior to receiving financing, in order to promote industrial participation, while achieving inclusive growth, industrial development and decent employment (Fubbs, 2015). Therefore, a manufacturing firm with the right criteria is eligible to be awarded financing. Moreover, IDC as an industrial financing institution in South Africa is responsible for supplying funds to competitive sectors together with manufacturing firms in its quest to foster industrial development, innovation and ultimately sustainable growth for the South African economy (IDC, 2016). According to IDC (2012), the IDC focuses on supporting productive sectors identified by the IPAP (especially the manufacturing sector) of the South African economy while minimising its support for some of the industries within the service sector.

As such, over a period of 70 years, the IDC has inaugurated and induced large industrial projects in the sub-sectors that are recognised in recent times as fundaments of the manufacturing sector, such as the petrochemical and mineral beneficiation sub-sectors (IDC, 2016). For the most part, the IDC consists of a wide range of special schemes available for the betterment of productive sectors and these schemes are controlled by the Development Funds Department (IDC, 2016). In addition, it should be noted that these special schemes are set out to address what the NGP is set to achieve, that is, employment creation. The special schemes also address other developmental mandates, for instance, economic growth, innovation and improving the competitiveness of the goods produced by the manufacturing sector (IDC, 2016).

In view of the latter, the IDC special incentives involve, the Gro-E Youth Scheme, Technology Venture Capital Fund, EIB SME and MIDCAPS Fund, Agro Processing Competitiveness Fund (APCF) and Youth Pipeline Development Programme (IDC, 2016). Furthermore, considering the contemporary incompetence of the manufacturing sector in South Africa, a joint effort of both the IDC and the DTI facilitate a Manufacturing Competitiveness Enhancement Programme (MCEP) (DTI, 2017). The MCEP provides augmented support to the manufacturing sector, as it was contrived to improve the competitiveness of the manufacturing sector by capacitating the domestic manufacturing firms with the capital needed to advance their respective production facilities (DTI, 2015). Equally important, the MCEP also ensures that the manufacturing sector maximises beneficiation and retains employment in the short-and medium term (IDC, 2016). Table 3.14 clearly outlines the MCEP objectives in improving the manufacturing competitiveness in South Africa.

Table 3.14: Manufacturing Competitiveness Enhancement Programme (MCEP) objectives

Intensify manufacturing firms to advance their production facilities, processes, products and improves their labour's skills;
Ensure the manufacturing sectors and its sub-sectors are upgarded to encourage more output and employment generation;
Supplement the IDC fund for small and medium firms and minimise the cost of capital for struggling firms;
Minimise the cost of working capital for exporters and businesses that contribute to the government infrastructure development programmes; and
Reinforce the responsivenes of accessible incentive schemes to underlying economic challeges

Source: DTI (2017)

To achieve the objectives presented in Table 3.14, the MCEP presented two sub-programmes, that is, the Production Incentive (PI) which is managed by the DTI and the Industrial Financing loan facility managed by the IDC (IDC, 2016). According to Sakoschek and Fuesgen (2016:11), the PI programme receives 80 percent of the value of the rand committed to the MCEP and for every manufacturing firm, the MCEP credits for the PI programme are up to 25 percent of the manufacturing beneficiation. Whereas, the industrial finance loan facility grants working capital at a 6 percent interest rate for a sum of up to R30 million (IDC, 2016). Equally important, DTI as a South African government department with a vision to ensuring a dynamic industrial and internationally competitive South African economy independently provides a financial support programmes aimed at increasing the competitiveness of the manufacturing sector (DTI, 2015). To demonstrate, a guide to the DTI incentive schemes 2015 clearly details all the incentive schemes provided by the DTI in enhancing the manufacturing sector's competitiveness (DTI, 2015). Table 3.15 briefly gives an overview of each of the incentive scheme offered by DTI to enhance the manufacturing sector's competitiveness:

Table 3.15: The Department of Trade and Industry (DTI) manufacturing incentive schemes

Type of incentive scheme	Description and Objectives	Benefits
People-Carrier Automotive Incentive Schemes (P-AIS)	P-AIS aims to stimulate growth for the people-carrier vehicles industry using investments in new and used models and components. This will generate new employment and retain the prevailing employment while reinforcing the automotive vehicles value chain.	A cash grant of 20 to 30 percent of the value of eligible investment in the productive asset.
Manufacturing Investment Programme (MIP)	MIP aims at providing cash grant for local and foreign-owned manufacturers, mainly for the establishment and expansion of production plants and also facilitates upgrades for existing clothing and textile production facilities. MIP has the following objectives: ➢ Inducing investment within the manufacturing sector; ➢ Generate employment; and ➢ Maintaining business growth.	A refundable investment grant of 15 to 30 percent, covering the investment cost of commercial, building, machinery and equipment for new or expanded projects. Nonetheless, the covered eligible assets cost must be below R5 million.
Section 12I Tax Allowance Incentive (12I)	12I aims to support both Brownfield investments (i.e. expansion of industrial projects) and Greenfield investments (i.e. new industrial projects that use only unutilised manufacturing assets). 12I has the following objectives: ➢ To enhance the manufacturing sector productivity through investing in manufacturing assets. ➢ Ensure improved labour productivity and skills of the labour force through training.	➢ R900 million investment allowance for any preferred Greenfield projects, together with R550 million additional investment allowance for any other eligible Greenfield projects. ➢ R550 million investment allowance for any preferred Brownfield projects, together with R350 million additional investment allowance for any other eligible Brownfield projects. ➢ A maximum total personnel training allowance of R20 million for eligible projects and R30 million for preferred projects.

Type of incentive scheme	Description and Objectives	Benefits
Support Programme for Industrial Innovation (SPII)	SPII aims to promote technology development in South Africa's industry, by investing in the development of innovative products and processes.	Investment allowance of up to R2 million to small and micro-industrial firms and individuals in the form of a non-repayable grant.
Aquaculture Development Enhancement Programmes (ADEP)	ADEP aims to develop primary, secondary and ancillary aquaculture activities within both marine and freshwater. ADEP has the following objectives: ➢ Expand production capacity; ➢ Generate and sustain employment; ➢ Promoting geographical spread; and ➢ Deepening participation.	ADEP provides a refundable cost-sharing grant of up to R40 million. Mainly covering the following: ➢ All activities that improve competitiveness; ➢ Machinery and equipment; ➢ Expand infrastructure; ➢ Enhancement of leases; and ➢ Owned building or land.
Clothing & Textile Competitiveness Improvement Programme (CTCIP)	CTCIP aims to capacitate the clothing and textile manufacturers and other areas of apparel value chain in South Africa, in order to ensure that they sufficiently meet the domestic demand and they are competitive in the global market. CTCIP has the following objectives: ➢ Ensuring that domestic clothing and textile manufacturing firms are globally competitive ➢ Ensuring an enabling environment for employment creation.	Provides a cost-sharing grant incentive of 75 percent of the eligible project cost on cluster projects. As such, grant for each eligible project will be limited to a cumulative ceiling of R25-million over the duration of the programme implementation.
Automotive Investment Scheme (AIS)	AIS aims to grow the automotive sector through investments in new and/or replacing models as well as components. AIS has the following objectives: ➢ Expand plant production volumes; ➢ Generate sustainable employment;	Non-taxable cash manufacturing government incentive of 20 percent of productive assets qualifying investment value and 25 percent of productive assets qualifying investment value. Not to mention, non-taxable cash manufacturing government incentive of 5 percent can also be provided to projects that sustain

Type of incentive scheme	Description and Objectives	Benefits
	➢ Strengthen the automotive value chain; and ➢ Improve and bring variety to the automotive output through investment in a new and/or replacing models and components.	their base year employment figures for the whole duration of the incentive.

Source: Compiled by the author from DTI (2015)

In summary, the DTI incentive schemes presented in Table 3.15 are aimed at providing financial assistance through incentives. Although this may be true, Mbatha (2014:59) points out that these incentives are characterised by a condition to comply with the minimum wage set by the South African Bargaining Council for all the sub-sectors within the manufacturing sector. In other words, these government incentives come with the condition that financial support must be granted to eligible manufacturing firms (DTI, 2017).

3.5 SUMMARY AND CONCLUSION

The chapter discussed the production performance of the manufacturing sector in the South African economy during the 1998-2016 period. With this in mind, Chapter 4 presented a trend analysis for manufacturing production over the specified periods and it indicated that production in the manufacturing sector sustained an upward trend that lasted until 2008. However, during the 2008-2009 periods, production in the manufacturing sector declined drastically and this can be attributed to the 2008/09 global financial crisis that induced pressure on the South African economy. That is to say, the manufacturing sector was amongst the economic sectors in the South African economy that were affected greatly by the crisis. Thereupon, production in the manufacturing sector has been insufficient to restore back to its former pre-crisis locality. For this reason, the manufacturing sector's contributions to GDP and employment have been relatively declining from 2008 to 2016. To enumerate, the manufacturing sector contributions to GDP declined from 16 percent in 2008 to approximately 13 percent in 2016, while the manufacturing contributions to non-agricultural employment declined from 18.4 percent in 2008 to approximately 12.4 percent in 2016 (IDC, 2013). The quarterly percentage contributions to both GDP and employment in South Africa have been marginally stable at approximately 13 percent.

Furthermore, the chapter also discussed the production performance in the predominant sub-sectors of manufacturing in the South African economy, *inter alia* food and beverages, clothing, chemical, metal and automotive sectors of manufacturing. As such, a trend analysis for each of these predominant sub-sectors was presented for the 1998-2016 periods and production trends in the food and beverage and chemical production revealed that the two sectors of manufacturing were marginally affected by the 2008/09 global financial crisis. In other words, production in both the food and beverage and chemical sectors of manufacturing managed to restore back to their pre-crisis levels. Although this may be true, most sub-groups of both the food and beverage and chemical sectors of manufacturing reported negative average monthly growth rates for 2016, inducing inauspicious monthly growth rates for the total production of both food and beverage and chemical sectors of manufacturing for 2016.

On the other hand, production trends in the clothing, metal and automotive sectors of manufacturing revealed that these sectors of manufacturing were affected greatly by the 2008/09 global financial crisis. That is to say, production in the clothing, metal and automotive sectors of manufacturing did not restore back to pre-crisis levels. In spite of this, most sub-groups of clothing, metal and automotive sectors of manufacturing reported positive average monthly growth rates for 2016, instigating auspicious but lacklustre monthly growth rates for the total production in the clothing, metal and automotive sectors of manufacturing for 2016. Therefore, it can be deduced that the South African manufacturing sector and its predominant sub-sectors under study are in an inauspicious and inanimate state, thus precluding manufacturing-driven economic growth and employment. This can be attributed to both global and domestic economic constraints. As such, the global constraints include the 2008/09 global financial crisis together with the surge of the abundant supply of cheap imports from China, Bangladesh, India, Indonesia and Vietnam. While domestic constraints include the electricity outages, lenient import duties on manufacturing goods and the lack of stability of the South African government that led to business incredulity, inducing low investments coupled with a curtailment of manufacturing firms.

In view of the above discussion, it was important for the chapter to review support measures available for manufacturing in South Africa. In particular, the policies and incentives schemes put in place to induce an effective manufacturing sector in the South African economy. As such, with regards to policies, the chapter highlighted that the NDP, NGP and the NIPF through IPAP give structure and guidelines to the manufacturing sector in South Africa. Although this may be true, amongst these policies the IPAP was specifically formulated to cater to the manufacturing sector and subsumed in the IPAP are annual iterations that aim to inducing growth and development, together with increasing the competitiveness of the South African manufacturing sector. Correspondingly, due to fact that industrial finance is considered as the life-force of manufacturing, Table 3.15 provided the incentive schemes that aim to increase the competitiveness of the manufacturing sector in the South African economy. Moreover, the next chapter will specify from where the data of the study were derived, the sample size and also methodise the econometric modelling approach adopted by the study in addressing the empirical objectives of the study.

CHAPTER 4: RESEARCH METHODOLOGY AND ECONOMETRIC MODELLING

4.1 INTRODUCTION

A substantial amount of growth in manufacturing production, together with a continual performance of the manufacturing sector, can be regarded as a necessary impetus for the economic performance of a country (South African Government News Agency, 2015). The reviewed literature in Chapter 2 substantiates that a relationship exists between growth in manufacturing and both GDP and employment. Nonetheless, the reviewed empirical literature in Chapter 2 accentuated that there is a gap in the studies that have investigated this relationship in the context of the South African economy. Chapter 2 also revealed that there are little or no empirical studies that investigate the impact of the manufacturing sub-sectors on GDP and employment in South Africa. As such, this suggests that there are still unresolved questions as to how the performance of manufacturing sub-sectors impact or relate to GDP and employment in South Africa. In response to these questions, this chapter explains an econometric approach adopted to analyse the impact of the manufacturing sector and predominant its sub-sectors on GDP and employment.

In light of this, this chapter outlines the econometric methodology used to address the following empirical objectives of the study:

- To establish the effect of production in the manufacturing sector and its predominant sub-sectors on the South African economy.
- To analyse the relationship between GDP, employment and production in the manufacturing sector and its predominant sub-sectors in South Africa.

In doing so, this chapter consists of three main section; the first section specifies from where the data of the study were derived, the sample size and the variables that are captured in the model. This is followed by a section that explains the study model and the multiple break-point test approach used. The last section explains the econometric estimation approach adopted by the study.

4.2 DATA ORIGIN, SAMPLE SIZE AND VARIABLE SPECIFICATION

In achieving the specified empirical objectives, the study makes use of secondary data that are based on 77 quarterly observations, starting from the first quarter of 1998 up until the first quarter of 2017. The choice of using data that starts from 1998 was made deliberately to accommodate some of the study variables that lacked data of pre-1998. Nonetheless, the choice is viable, since any data of pre-1994 are subjected to effects of the economic sections that were enforced by the preceding apartheid government. In addition, using pre-1994 data may result in spurious results, which may lead to inaccurate conclusions. As such, the use of post-1994 data eradicates the effects emanating from the 1994 regime change. On the other hand, the closing data solely depended on the availability of the most recent data. Furthermore, the seasonally adjusted data for variables used in the study are derived from two credible sources, namely Stats SA and the SARB. To specify, GDP and non-agricultural employment data are derived from the SARB, while the manufacturing sector and predominant sub-sectors production volume data are derived from Stats SA.

Prior to the analysis, it should be noted that the data used in the study is transformed to a natural logarithmic (L). This is done to ensure that the data used in the study does not range over several orders of magnitude while reducing variation within the data set and ensuring the growth rates of the variables are determined. Also, to obtain stationarity while ensuring that the elasticity of GDP growth and employment within the manufacturing sector and its predominant sub-sectors under study is captured when responding to changes in production of the manufacturing sector and its predominant sub-sectors under study. As such, to analyse the impact of the manufacturing sector and its predominant sub-sectors (i.e. food and beverages, clothing, chemical, metal and automotive sectors) on GDP and employment, the study uses the specified variables given in Table 4.1.

Table 4.1: Variable specification

Denotations	Variables specification
The symbol (L)	Natural logarithm
GDP	Gross domestic product (economic growth)
EMP	Non-agricultural employment total index (proxy for employment)
MANU	Manufacturing sector production volume index
Manufacturing sector's sub-sectors	
FB	Food and beverage sector production volume index
CL	Clothing sector production volume index
CHEM	Chemical sector production volume index
MET	Metal sector production volume index
AUTO	Automotive sector production volume index

Table 4.1 specified all the variables used in the study and it should be noted that from the specified variables, the dependent and the independent variables of the study are explained below.

4.2.1 Dependent variables specification

The study investigates the impact of production in the manufacturing sector and its predominant sub-sectors on GDP and employment. With this in mind, the study consists of two dependent variables that are GDP and employment. As such, the total non-agricultural employment is used as a proxy for the employment variable and is measured using an index (2000 = 100), while GDP as a measure of economic growth is measured using real values that are seasonally adjusted at an annual rate (constant 2010 prices).

4.2.2 Independent variables specification

As mentioned in Section 4.2 of this chapter, the food and beverages, clothing, chemicals, metals and automotive are the predominant manufacturing sub-sectors in the South African economy

(Brand South Africa, 2017). As such, production in these sub-sectors, together with the total manufacturing sector, is the independent variables of the study that are regressed individually on both GDP and employment and are measured using the index (2010=100). To put it differently, production in the manufacturing sector and its predominant sub-sectors' under study are used to explain both GDP and employment respectively.

4.3 MODEL SPECIFICATION AND MULTIPLE BREAK POINT TEST

The key feature of this study is the use of a dynamic model to capture the behaviour of a system over a period of time, as dynamic models are consistent and accurate (Yuai, *et al*., 1999:1661). According to Brooks (2014:202), dynamic models permit only a contemporaneous relationship between the variables of interest in order to test if a change in one or more independent variable at time *t* causes an immediate change in the dependent variable at time *t*. In addition, these models can be extended by adding lags and a dynamic model that has specifications of lags for both the dependent and independent variables is known as autoregressive distributed lag (ARDL) model (Brooks, 2014:202). As such, this study uses an ARDL model to capture the impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP and employment.

In achieving the primary objective of the study four equations are estimated, the first equation regresses production in the manufacturing sector on GDP, while the second equation regresses production in the predominant manufacturing sub-sectors under study on GDP. Continuing in this line, the third equation regresses production in the manufacturing sector on employment and, finally, the last equation regresses production in the predominant manufacturing sub-sectors under study on employment. As such, the impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP is obtained by estimating the following two equations:

$$\mathrm{LGDP}_t = \mathrm{f}\ (\mathrm{LMANU}_t) \tag{4.1}$$

$$\mathrm{LGDP}_t = \mathrm{f}\,(\mathrm{LAUTO}_t + \mathrm{LCHEM}_t\ \ \mathrm{LCL}_t + \mathrm{LFB}_t + \mathrm{LMET}_t) \tag{4.2}$$

For equations 4.1 and 4.2, an ARDL model is used to estimate the impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP. In addition, the impact of production in the manufacturing sector and its predominant sub-sectors on employment is obtained by estimating the following equations:

$$\text{LEMP}_t = \text{f}\,(\text{LMANU}_t) \quad (4.3)$$

$$\text{LEMP}_t = \text{f}\,(\text{LAUTO}_t + \text{LCHEM}_t \;\; \text{LCL}_t + \text{LFB}_t + \text{LMET}_t) \quad (4.4)$$

For equations 4.3 and 4.4 an ARDL model is used to estimate the impact of production in the manufacturing sector and its predominant sub-sectors under study on employment.

Furthermore, it is of great importance to highlight that the study tests for structural breaks in the data of each variable using a multiple breakpoint test. This is motivated by the fact that, more often than not, time series data may either consist of structural breaks or a stationary trend, as put forward by various studies (Burdekin & Siklos, 1995; Cooper, 1995; Lumsdaine and Papell, 1995; Garcia and Perron, 1996; Emerson, *et al*., 2006; García & Gitau, 2014; Zarei *et al.*, 2015). The multiple break-point test approach adopted by the study is effective when the data employed consists of more than one break and these breaks are unknown (García & Gitau, 2014:9). The study used the Bai-Perron tests procedure of L + 1 vs. L sequential and allowing error distribution to vary across breaks when determining breaks in the study data (Bai & Perron, 2003). The reason is this procedure has the ability to permit specific to general modelling strategy in order to identify incessantly the appropriate number of innovations in the data of the study (Bai & Perron, 2003).

In this case, the Bai and Perron (2003) procedure can be explained using a multilinear regression with *m* breaks and this regression can be expressed as follows (Zarei *et al*., 2015):

$$Y_t = r_t{}'\beta + z'_t\,\delta_1 + \varepsilon_t, \qquad t = 1,\ldots T_1,$$

$$Y_t = r_t{}'\beta + z'_t\delta_2 + \varepsilon_t, \qquad t = T_1 + 1,\ldots, T_2,$$

$$Y_t = r_t{}'\beta + z'_t\delta_{m+1} + \varepsilon_t, \qquad t = T_{m+1}\ldots,\ T \quad (4.5)$$

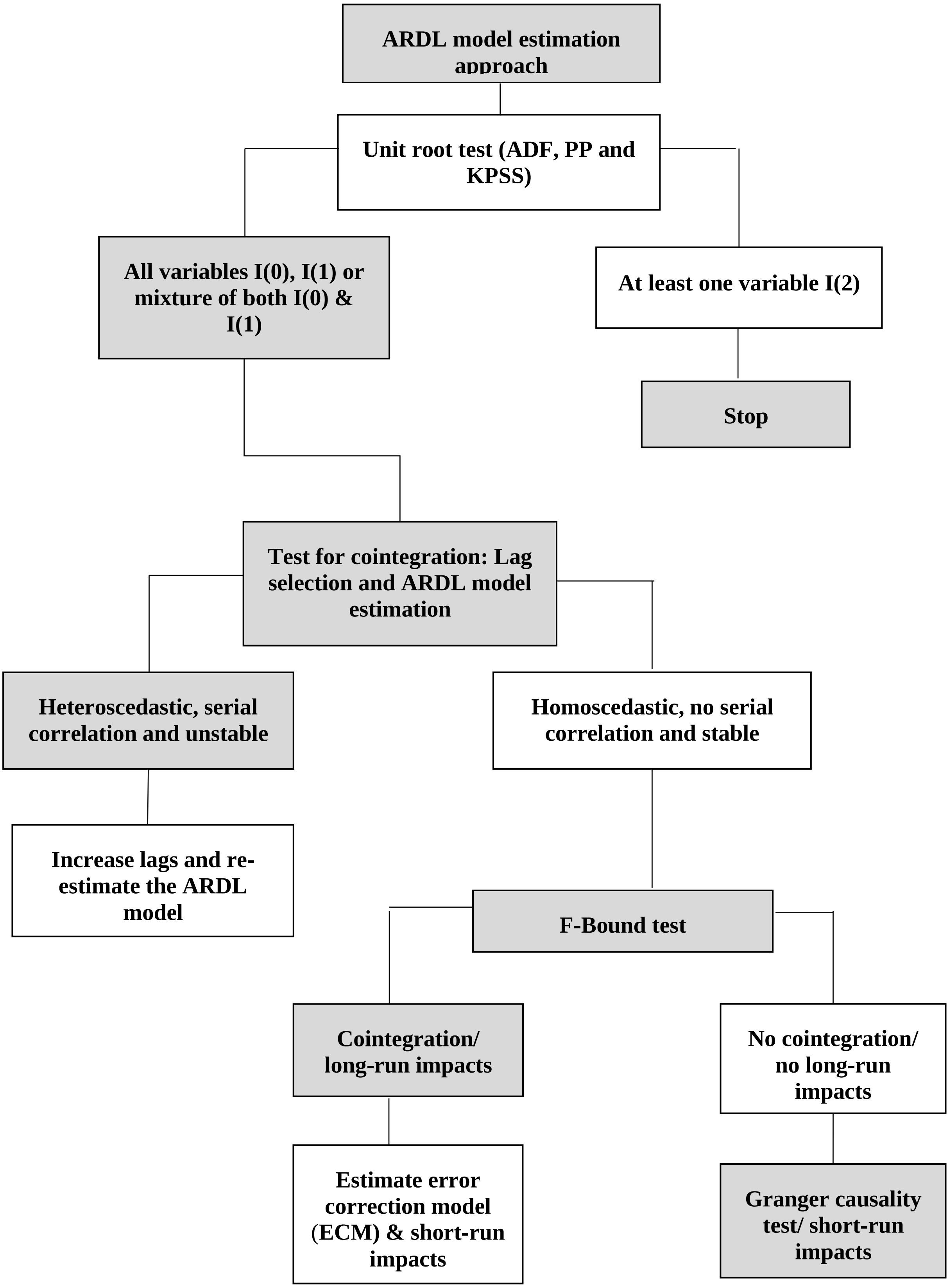
In Equation 4.5, Y_t is the dependent variable under observation at time *t*, m denotes the number of breaks in *m*+1 systems and both $r_t{}'$and z'_t are vectors of independent variables, where β and δ are corresponding coefficients vectors. Not to mention, the unknown break-points are denoted by $T_1 \ldots . T_m$. As such, this procedure aim to estimate the coefficients of the unknown regression and the appropriate break-point when the vectors of the independent variables ($r_t{}'$and z'_t) together with the number of observation on the dependent variable are obtainable. Thus upon the determination of the appropriate break-points, dummy variables are created to account for the breaks in the data, in order to ensure results that are not misleading or spurious.

4.4 ECONOMETRIC ESTIMATION APPROACH

Before methodising the econometric estimation approach adopted by the study, it should be noted that the study methodology is based on quantitative methods that are in support of a functionalist approach to economics. An approach of a functionalist has to do with investigating economic or social dynamics, as functionalist attempts to understand economic phenomena with regards to their relationship to a particular system (Bredemeier, 1955:173). Thus, Lazarsfeld (1951:66) points out that a functionalist approach is used to determine the role of x in maintaining y with the help of t. As such, the study investigates the impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP and employment with the help of a statistical tool, that is, Econometric Views (E-Views) 9.

As mentioned in the preceding Section 4.3 of this chapter, the study uses an ARDL econometric estimation model to analyse the data of the study. All the required statistical tests to ensure that the data of the study is stationary and the model is stable are estimated, such as lag selection, unit root, and residual and stability diagnostics tests. The choice of adopting this econometric approach was motivated by its viability to produce reliable results, as it is able to identify and correct multicollinearity, non-stationarity and serial correlation (Arodoye & Iyoha, 2014:127-129). Furthermore, it is important to realise that the study does not use an ordinary least squares (OLS), solely due to its inefficiencies when it comes to analysing econometric time series (Mina, 2011:202-218). In light of this, this section of the chapter aims to methodise the econometric approach adopted by the study to capture the impact of production in manufacturing and its predominant sub-sectors under study on GDP and employment. Diagram 4.1 unpacks the ARDL model estimation approach adopted by the study.

Figure 4.1: ARDL model estimation approach



Source: Compiled by the author

4.4.1 Unit root/ stationarity tests

More often than not, times series data needs to be tested for the order of integration, namely stationarity (Djoumessi, 2009:102). This ensures that the study produces viable results leading to an accurate conclusion (Harris & Sollis, 2003). According to Gujarati (2010), time series is considered stationary only if there are no systematic disparities in auto-covariance, covariance and mean over time. In other words, time series data are considered stationary when it is integrated of order (d) if it achieves stationarity subsequent to it being differenced (d) times (Djoumessi, 2009:102). As such, the sole purpose of the unit root test or stationarity test is to stabilise the series auto-covariance, variance and mean over a period of time (Brooks, 2014:318). Generally, studies use two types of approaches in their quest to ensure data are stationary; this involves the parametric and non-parametric approaches. According to Bethea and Rhinehart (1991), the parametric is used commonly in economic studies that focus on the time domain and non-parametric approaches are mostly in electrical engineering studies that focus on the frequency domain. In light of this, the study uses a parametric approach in diagnosing unit roots in the data and ensuring the data are stationary.

According to Ogbokor (2015:114), various techniques are conventionally used to detect unit roots and ensure statistical stationarity, this involves the augmented Dickey-Fuller (ADF) unit root test, cointegration regression Durbin-Watson (CRDW) test, Phillips-Perron (PP) unit root test, Kahn and Ogaki test, Leyborne-McCabetest test, as well as the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) stationarity test. However, the ADF unit root test is used commonly in various empirical studies (Nhamo, 2013; Thayaparan, 2014; Adebowale, 2015; Habanabakize, *et al*., 2017; Habanabakize & Muzindutsi, 2015; Muzindutsi & Manaliyo, 2016). Johansen (1988:231-254) pointed out that the reason for this is that the ADF unit root test is general and simple in its nature. Although this may be true, the ADF unit root tests are unreliable in assessing data consisting of a small sample and it is sensitive to structural breaks (Cheung & Chinn, 1997:70). Thus, to correct inefficiencies of the ADF unit root test, it is best to estimate the PP unit root tests coupled with the KPSS stationarity test in order to assess the robustness of the ADF unit test results (Ageli, 2013:27).

The study employs the ADF, PP unit root tests together with the KPSS stationarity test in diagnosing unit roots in the data and ensuring the order of integration for each series in order to avoid spurious results. In addition, the ADF, PP unit root tests together with the KPSS stationarity test is carried out in three steps of differentiating: the first step is to assess a model with nothing more besides a constant, this is followed by assessing a model with nothing more but a trend and lastly an assessment of a model with both a constant and trend. With this in mind, the study methodises the ADF, PP unit root tests together with the KPSS stationarity test below.

4.4.1.1 Augmented Dickey-Fuller (ADF) unit root test

The ADF unit root test is used to assess the existence of unit roots and order of integration in a time series data (Dickey & Fuller, 1981). Therefore, the hypothesis testing for the ADF unit root test can be presented as follows (Dickey & Fuller, 1981):

$\boldsymbol{H_0}$**:** Unit root in the series (not stationary)

$\boldsymbol{H_1}$***:*** No unit root in the series (stationary)

Considering this, the conclusion of no unit root or stationary is reached if the ADF unit root test results are statically significant at 1 or 5 percent significance level, only in this way the null hypothesis can be rejected. As such, like in any other statistical test, when the H_0 of the ADF unit root test is rejected, its H_1 is not rejected on condition that the p-value is statistically significant. However, in cases where the p-value is not statistically significant at 1 or 5 percent significance level, the H_0 of unit root in the series is not rejected. Therefore, the ADF unit root test was then re-estimated following the aforementioned three steps of differentiating until the H_0 of unit root in the series is rejected. Furthermore, Habanabakize (2016:53) points out that ADF unit root test assumes that the regressed (Y) follows a simple test equation of the order (p). In light of this, the simple test equation is expressed as follows:

$$\Delta Y_t = \propto Y_{t-1} + \varphi x_t + ƛ_1 \Delta Y_{t-1} + ƛ_2 \Delta Y_{t-2} + ... + ƛ_n \Delta Y_{t-n} + u_t \quad (4.6)$$

Where:

Δ - The first difference operator;

Y_{t-n} - Variables that rectify serial correlation errors (by means of introducing lags);

x_t- Exogenous variable (or constant);

φ- Coefficient; and

u_t- Error term.

Equally important, using Equation 4.6 as a basis, the null hypothesis (H_0) for the ADF unit root test is that the coefficient is equal to zero, while the alternative hypothesis (H_1) is that the coefficient is less than zero. Succinctly:

$$\boldsymbol{H_0}\boldsymbol{:} \propto = 0$$

$$\boldsymbol{H_1}\boldsymbol{:} \propto < 0$$

In this case, the null hypothesis of the ADF unit root test is rejected on the condition that the coefficient is less than zero and this will imply that the variable does not comprise a unit root. Thus, the alternative hypothesis is not rejected, implying that the variable is stationary. In contrast, the null hypothesis is not rejected in the event that the coefficient is equal to zero, implying that the variable comprises a unit root, meaning that variable is not stationary. As such, it should be noted that any variable of the study that is not stationary would go through the aforementioned three steps of differentiating until they turn out to be stationary.

4.4.1.2 Phillips-Perron (PP) unit root test

Like the ADF unit root test, the PP unit root test is used to assess the unit roots in a time series data, thus it is said to build on the ADF unit root test. The PP unit root test follows the same hypothesis-testing framework as the ADF unit root test, thus more often than not the PP and ADF unit root tests generate the same results (Brooks, 2014:331). However, unlike the ADF unit root test that introduces lags of Y_t as repressors in its simple test equation in order to address serial correlation, the PP unit root test addresses serial correlation by making a non-parametric rectification to the t-statistic (Phillips & Peron, 1988). Therefore, during the structural breaks in the series the PP unit root test is strong in dealing with undefined serial correlation (Phillips & Peron, 1988). In light of this, the simple test process for the PP unit root test can be expressed as follows:

$$Y_t = \propto Y_{t-1} + \varphi x_t + u_t \tag{4.7}$$

$$yt = \beta_0 + \beta_{1yt} + \beta_{2t} + u_t \tag{4.8}$$

Where *t* is the trend and β_0 is a constant, therefore, when β_1 is equal to zero then the series is not stationary (i.e. has unit root). On the contrary, when β_1 is less than zero then the series is stationary (no unit root). Furthermore, like in the ADF unit root test, the PP unit root test follows the same hypothesis-testing framework, thus when using Equation 4.8 as a basis of the null hypothesis (H_0) for the PP unit root test the coefficient is equal to zero, while the alternative hypothesis (H_1) is that the coefficient is less than zero. Succinctly:

$$\boldsymbol{H_0}\text{:}\ \beta_0 = 0$$

$$\boldsymbol{H_1}\text{:}\ \beta_0 < 0$$

Identical to the ADF unit root test, the null hypothesis in the PP unit root test is rejected granted that the coefficient is less than zero and this will imply that the variable does not comprise a unit root, namely stationary. For this reason, the alternative hypothesis is not rejected, thus it can be concluded that the variable is stationary. However, the null hypothesis is not rejected in the event that the coefficient is equal to zero, implying that the variable comprises a unit root, namely not stationary. Therefore, like in the ADF unit root test, when using the PP unit root test the variable that is not stationary will go through the aforementioned three steps of differentiating until it turns out to be stationary.

4.4.1.3 Kwiatkowski, Phillips, Schmidt and Shin (KPSS) stationarity test

The KPSS stationarity test was developed by Kwiatkowski *et al.* (1992) as an alternative approach to test for stationarity. Unlike both the ADF and PP unit root tests, the KPPS stationarity test comprises a plain sailing test of the null hypothesis (H_0) of no unit root or trend stationarity (stationary) in opposition to the alternative hypothesis (H_1) of unit root (not stationary). As such, the KPSS stationarity test is an innovative approach in testing for stationarity as compared to the formerly ADF and PP unit root tests that proposed the H_0 of unit root. Considering this, in their model Kwiatkowski *et al.* (1992) consider three constituents denoting the analysed time series ($Y_1,$) as the sum total of a stationary residual, time trend and a random walk.

$$Y_t = \xi\ t + (r_t + \alpha) + \varepsilon_t \tag{4.9}$$

Where: $r_t\ = r_{t-1} + u_t \sim WN(0,\sigma_\varepsilon^2)$, and $r_0 = \alpha$

In Equation 4.9 $\xi\ t$ is a constant or a constant with a time trend, while *t* denotes a statistical denotation of time trend. The denotation r_t denotes a random walk with a transformative difference of σ_ε^2, at the same time $(0,\sigma_\varepsilon^2)$ denotes white noise with a mean of zero and difference of σ_ε^2. In addition, u_t is stationary at I(0) and may be found to be heteroscedastic, while the inceptive r_0 is equal to α and it denotes an intercept. In the KPSS stationarity test, the decision of whether a variable is stationarity is made with the help of the LaGrange multiplier (LM) (i.e. test statistic), critical value and the hypothesis-testing framework of the KPSS stationarity test. In the event that the LM statistic is found to be greater than the critical values, then H_0 of no unit root or trend stationarity is rejected, implying that the variable is not stationary. In other words, if the LM statistic in found to be less than the critical values, then H_0 of stationary will not be rejected and this will imply the variable is stationary.

According to Brooks (2014:364), more often than not both the ADF and PP unit root tests generate the same unit root results and have a similar weakness of being powerless when a variable is stationary, but comprise a root adjacent to the non-stationary frontier. The reason for that lies in the hypothesis-testing framework of both the ADF and PP unit root tests that fail to accept the null hypothesis and instead rejects or not reject it (Brooks, 2014:364). This implies the null hypothesis may not be rejected in the events where there is too little information to induce rejection (Habanabakize, 2016:54). As such, the solution to overcome this weakness is to employ the KPSS stationarity test, since the hypothesis-testing framework of the KPSS stationarity test is a complete opposite of the hypothesis-testing framework of both the ADF and PP unit root tests (Brooks, 2014:365). In other words, the null hypothesis of the KPSS stationarity test is that the variable is stationary, while the alternative hypothesis is that the variable is not stationary. Taking the latter into account, the study estimated the KPSS stationarity test in order to confirm the results generated by both the ADF and the PP unit root tests.

4.4.2 Cointegration test

The preceding Section 4.4.1 of this chapter dealt with ensuring that variables are free from unit roots and if it is found that the study variables have no unit roots (stationary) at purely I(1) after being the difference, then the study will proceed to test for co-integration. The best way to test for cointegration in this study is by using an ARDL model estimation approach as the study has four single equations and the ARDL model makes use of an OLS technique. This will permit the study to proceed to test for cointegration even when the study consist of variables that are stationary at I(0), I(1) or a mixture of I(0) and I(1) variables (Pesaran & Shin, 1999:371). As such, to determine whether there are long-run impacts running from the independent variables to dependent variables, an ARDL model is used.

4.4.2.1 Autoregressive distributed lag (ARDL)

In the late 1990s, an empirical study done by Pesaran *et al.* (2001) that re-established the ARDL econometric model and since then various time series studies have used this model in their analysis (Pesaran & Shi, (1998:371); Ibrahim *et al.*, 2009; Hassler & Wolters, 2005; Dube & Zhou, 2013; Maqbool & Mahmood, 2013). The reason for that lies in the ability of the model to be applied regardless of whether the data series concerned are stationary at the level I(0), first difference I(1) or at both I(0) and I(1) simultaneously (Pesaran & Shi, 1998:371). As such, the ARDL model succeeds in dealing with the dilemma of non-stationary and varied data series, except when the data series concerned are stationary at the second difference I(2**)** (Pesaran, *et al*., 2001). In addition, the ARDL model is a viable model to employ in studies with small observations (Pesaran & Shin, 1999).

Furthermore, the ARDL model produces long-run impartial estimates for causalities tested coupled with a plausible t-statistic even when there are endogenous data series (Harris & Sollis, 2003). This is to say, the ARDL model is able to distinguish between the dependent and independent variable (Mobin & Masih, 2014:15). In addition, the ARDL model does not follow the conventional use of system equations in cointegration methods, instead Pesaran *et al*. (2001:289-326) pointed out the ARDL model adopts an OLS technique that makes it easy to apply the model in estimating relationships between variables of interest. Taking the latter into account, the ARDL model proposes the following hypothesis-testing framework in testing for cointegration:

$\boldsymbol{H_0}$**:** No cointegration (no long-run impact)

$\boldsymbol{H_1}$**:** Cointegration (long-run impact)

As such, in testing the two hypothesis, the ARDL model comprises an F-test and a set of two critical bounds (i.e. the lower and upper bound). Where I(0) denotes a lower bound whilst I(1) denotes an upper bound and the condition here is if the F-statistic is greater than both the critical values of the lower bound and the upper bound then the H_0 of no long-run impact can be rejected. This will imply that there is an existing long-run impact running from the independent variables to dependent variables of the study. In contrast, if the F-statistic is less than both the critical values of the lower and upper bounds then the H_0 of no long-run impact cannot be rejected, implying that there is no long-run impact running from the independent variables to dependent variables of the study. The decision will remain unchanged even in a situation where the F-statistic is greater than the critical value of the lower bound but lower than that of the upper bound.

In light of this, Mposelwa (2016:44) points out that the ARDL model does not only bestow efficient and impartial estimation of the long-run impacts, but also bestows short-run impacts that are both efficient and impartial. In other words, the ARDL model also generates the error correction model (ECM). The ECM takes into account the short-run adjustments and long-run equilibrium while presenting the error correction term (ECT). As such, the ECT is the short-run adjustments coefficient and it denotes the measure by which the dependent variable's long-run disequilibrium is corrected during each quarter (Masih & Masih, 1997). Thus, in the event where cointegration exists between variables of interest, the study will proceed to estimate the ECM.

On the other hand, in the event where cointegration does not exist between variables of interest, the study will proceed to estimate a Granger causality test to detect causal patterns and short-run relationships between the variables of interest. Equally important, it should be noted that the ARDL model approbates the use of several optimal lags; this implies that the ARDL model uses a general-to-specific modelling approach by taking into account all the sufficient number of lags (Harvey, 1981). In econometrics, the number of lags are selected based on a lag-selection criterion − Schwarz information criterion (SIC), Hannan-Quinn (HQ), Akaike information criterion (AIC), likelihood ratio (LR) and final prediction error (FPE) (Brooks, 2014). However, out of these five lag selection criterions, the study uses the SIC to determine the maximum number of lags to include in estimating the four (4) equations (or models) of the study. The reason for this is that the SIC is consistent and will address the issues of over fitting by instituting a penalty term for the number of parameters in the ARDL models of the study (Schwarz, 1978).

In view of the above discussion, this study investigates whether or not there is a long- and short-run impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP and employment using the ARDL model. As mentioned in Section 4.3 of this chapter, the study will first regress production in the manufacturing sector and predominant its sub-sectors under study on GDP, namely equations 4.1 and 4.2:

$$\Delta LGDP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \Delta LGDP_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LMANU_{t-j} + \varphi_1 LGDP_{t-1} + \varphi_2 LMANU_{t-1} + e_t \quad (4.10)$$

$$\Delta LGDP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \Delta LGDP_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LAUTO_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LCHEM_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LCL_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LFB_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LMET_{t-j} + \varphi_1 LGDP_{t-1} + \varphi_2 LAUTO_{t-1} + \varphi_3 LCHEM_{t-1} + \varphi_4 LFB_{t-1} + \varphi_5 LCL_{t-1} + \varphi_6 LMET_{t-1} + e_t \quad (4.11)$$

Where LGDP is the natural log of GDP; LMANU is the natural log of MANU; LAUTO is the natural log of AUTO; LCHEM is the natural log of CHEM; LCL is the natural log of CL; LFB is the natural log of FB; and LMET is the natural log of MET. While π_1, $\pi_2, \pi_3, \pi_4, \pi_5, \pi_6$, π_7 and π_8 denote the coefficients representing short-run dynamics and φ_1, φ_2, φ_3, φ_4, φ_5, φ_6, φ_7, as well as φ_8 denotes the long-run relationship. Therefore, the cointegration test for equations 4.10 and 4.11 is tested using the ARDL hypothesis test:

$\boldsymbol{H_0}$: $\varphi_1=\varphi_2=\varphi_3=\varphi_4=\varphi_5=\varphi_6=\varphi_7=\varphi_8= 0$ (No cointegration)

$\boldsymbol{H_1}$: $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4 \neq \varphi_5 \neq \varphi_6 \neq \varphi_7 \neq \varphi_8 \neq 0$ (Cointegration)

The rejection of the H_0 implies that there is a long-run impact running from production in the manufacturing sector and its predominant sub-sectors under study to GDP. To put it differently, the rejection of the H_0 means that production in the manufacturing and its predominant sub-sectors under study have a long-run impact on GDP. This will then approbate the study to estimate the ECM, as Banerjee *et al*. (1993) pointed out that the ECM is estimated only if cointegration exists between variables of interest. The ECM equations for equations 4.10 and 4.11 are expressed as follows:

$$\Delta LGDP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \Delta LGDP_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LMANU_{t-j} + \delta ECT_{t-j} + e_t \quad (4.12)$$

$$\Delta LGDP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \Delta LGDP_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LAUTO_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LCHEM_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LCL_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LFB_{t-j} + \sum_{j=1}^{k} \pi_j \Delta LMET_{t-j} + \delta ECT_{t-j} + e_t \quad (4.13)$$

Where ECT denotes the error correction term and it captures the speed of adjustment to equilibrium for ARDL model equations 4.10 and 4.11. Equally important, the formulated hypotheses for the ARDL model that regressed the production in the manufacturing sector and its predominant sub-sectors under study on GDP can be expressed as follows:

$\boldsymbol{H_0}$**:** There is no short- and long-run impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP.

$\boldsymbol{H_1}$**:** There is a short- and long-run impact of production in the manufacturing sector and its predominant sub-sectors on GDP.

Moreover, the ARDL model was also used to estimate equations 4.3 and 4.4, that is, equations that regressed production in the manufacturing sector and its predominant sub-sectors under study on employment:

$$\Delta LEMP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \, \Delta LEMP_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LMANU_{t-j} + \varphi_1 LEMP_{t-1} + \varphi_2 LMANU_{t-1} + e_t \quad (4.14)$$

$$\Delta LEMP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \, \Delta LEMP_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LAUTO_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LCHEM_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LCL_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LFB_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LMET_{t-j} + \varphi_1 LEMP_{t-1} + \varphi_2 LAUTO_{t-1} + \varphi_3 LCHEM_{t-1} + \varphi_4 LFB_{t-1} + \varphi_5 LCL_{t-1} + \varphi_6 LMET_{t-1} + e_t \quad (4.15)$$

Where LEMP is the natural log of EMP and the independents are still the same as in ARDL equations 4.10 and 4.11. By the same token, π_1,π_2, π_3, π_4,π_5, π_6,π_7 , and π_8 also denotes the coefficients representing short-run dynamics, however, in this case they are coefficient for ARDL model equations 4.14 and 4.15. While φ_1,φ_2,φ_3,φ_4,φ_5,φ_6,φ_7, and φ_8 denotes the long-run relationship for ARDL model equations 4.14 and 4.15. As such, the test of cointegration for both equations 4.14 and 4.15 is also tested using the ARDL hypothesis test:

$\boldsymbol{H_0}$**:** $\varphi_1=\varphi_2=\varphi_3=\varphi_4=\varphi_5=\varphi_6=\varphi_7=\varphi_8= 0$ (No co-integration)

$\boldsymbol{H_1}$**:** $\varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4 \neq \varphi_5 \neq \varphi_6 \neq \varphi_7 \neq \varphi_8 \neq 0$ (Co-integration)

Similarly, the H_0 of no cointegration is rejected if there is a long-run impact running from production in the manufacturing sector and its predominant sub-sectors under study to employment. That is to say, production in the manufacturing and its predominant sub-sectors has a long-run impact on employment. Thus, the ECM will be estimated to determine the speed of adjustments to equilibrium with the help of the ECT. The ECM equations for ARDL model equations 4.14 and 4.15 are expressed as follows:

$$\Delta LEMP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \, \Delta LEMP_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LMANU_{t-j} \; + \; \delta ECT_{t-j} + e_t \tag{4.16}$$

$$\Delta LEMP_t = \alpha_0 + \sum_{j=1}^{k} \pi_j \, \Delta LEMP_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LAUTO_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LCHEM_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LCL_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LFB_{t-j} + \sum_{j=1}^{k} \pi_j \, \Delta LMET_{t-j} + \delta ECT_{t-j} + e_t \tag{4.17}$$

Where ECT denotes the error correction term and it captures the speed of adjustment to equilibrium for ARDL equations 4.14 and 4.15. In the same way, the formulated hypotheses for the ARDL model that regressed the production in the manufacturing sector and its sub-sectors under study on non-agricultural employment can be expressed as follows:

$\boldsymbol{H_0}$**:** There is no short- and long-run impact of production in the manufacturing sector and its predominant sub-sectors on employment.

$\boldsymbol{H_1}$**:** There is a short- and long-run impact of production in the manufacturing sector and its sub-sectors on employment.

4.4.3 Model diagnostic tests

The preceding Section 4.4.2 of this chapter methodised the ARDL models used by the study, therefore, it is of great importance that after the ARDL model has been estimated, the model residual and stability diagnostics tests should be performed on the estimated ARDL model prior to reaching conclusions. The reason for this is to ensure that all the model assumptions (i.e. normality distribution, serial uncorrelated homoscedasticity and stability) are valid. If the model assumptions are not valid, then the conclusions reached with the help of that model will be faulty or misleading. As such, model residual and stability diagnostics tests that were performed on all estimated ARDL models of the study are methodised as follows.

4.4.3.1 Residual diagnostic tests

In this study, the residual diagnostic tests (i.e. normality, serial correlation and heteroscedasticity tests) will be employed to estimate the propriety of assumptions underlying the econometric modelling procedure and to identify the abnormal features of the ARDL model that can potentially falsify conclusions (Cook & Weisberg, 1983:1). In this case, the study methodised the normality, serial correlation and heteroscedasticity residual diagnostic tests as follows:

- **Normality test**

More often than not, statistical errors are common in the econometric literature, thus it is imperative for normality and other assumptions mentioned before to be taken seriously. Not to mention, several statistical procedures (e.g. correlation, regression, t-tests and parametric tests) depend on the data being a normal distribution in order to draw reliable conclusions (Ghasemi & Zahediasl, 2012:486). As such to test for normality the Jacque-Bera test is used to assess whether or not the study models are normally distributed. The Jacque-Bera test estimates the difference in the lack of symmetry (or skewness) and kurtosis of a variable compared to a normal distribution (Jarque & Bera, 1980). For this test, the following hypotheses are formulated:

$\boldsymbol{H_0}$**:** Normally distribution

$\boldsymbol{H_1}$: Non-normally distribution

The decision of whether the variables are normally distributed made with the help of a test statistic:

$$JB = \frac{N-k}{6}\left[s^2 + \frac{(K-3)^2}{4}\right] \quad (4.18)$$

In Equation 4.18 *N* denotes the number of captured observations and *k* denotes the number of estimated parameters. While *K* denotes variable kurtosis and *S* denotes variable skewness. Considering this, the H_0 is rejected if the JB is greater than $X^2(2)$ or if the p=value is less or equal to the significance level. This will imply that variables are not normally distributed, on the contrary, variables are normally distributed if P-value > significance level or JB<$X^2(2)$.

- **Serial correlation test**

In the context of time series studies, a serial correlation exists if the error terms of the preceding period carry over into the recent or future periods (Wooldridge 2009:274). In other words, serial correlation occurs when there is a correlation between the error terms of different time periods. This is a repercussion of having the dependent and independent variables that are not stationary or having to manipulate data by means of interpolation of extrapolation (Makuria, 2013:79). The effects of such will result in unreliable ARDL model estimates, thus it is important to ensure that the ARDL models of study are free from serial correlation. In doing so, Ljung and Box (1978) proposed the use of Ljung-box test to assess the assumption that the residuals do not have serial correlation up to any order *k*. The following hypothesis-testing framework is formulated:

$\boldsymbol{H_0}$**:** No serial correlation up to order *k*

$\boldsymbol{H_1}$: Serial correlation up to order *k*

The decision of whether the residuals are correlated serially is made with the help of a test statistic:

$$Q_{LB} = T(T+2)\sum_{j=1}^{k}\frac{r_j^2}{T-j} \tag{4.19}$$

In Equation 4.19, T denotes the number of captured observations and k denotes the tested elevated order of serial correlation, while the r_j^2 denotes the j^{th} serial correlation. In this test the H_0 of no serial correlation is rejected if the p-value is less or equal to the significance level; this will then imply that the residuals are serially correlated. On the contrary, if the P-value > significance level, this will imply that residuals are not serially correlated.

- **Heteroscedasticity test**

Heteroscedasticity occurs when the error terms in the model are not homogeneous in their nature; this implies that error terms do not have a constant variance (Brooks, 2014:181). This is caused by having an outlier in the data, as it implies the presence of small or large observations with respect to other captured observations (Makuria, 2013:81). Not to mention, heteroscedasticity may exist due to data manipulation by means of interpolation or extrapolation. As such, the repercussion associated with heteroscedasticity is having the ARDL estimators that are not the best linear unbiased estimators (BLUE), as they will be inefficient and will lead to unreliable conclusions. Therefore, to test whether heteroscedasticity exists, Engle (1982) proposed a test procedure known as the Engle's arch LM test. This test procedure formulated the following hypothesis-testing framework:

$\boldsymbol{H_0}$**:** Homoscedasticity

$\boldsymbol{H_1}$: Heteroscedasticity

The decision of whether heteroscedasticity exists is made with the help of a test statistic:

$$LM_E = nR^2 \tag{4.20}$$

In Equation 4.20, n denotes the number of captured observations and R^2 denotes the augmented residual regression resolution coefficient. The H_0 of homoscedasticity is rejected if the p-value is less or equals to the significance level, this will then imply the existence of heteroscedasticity. On the contrary, if the P-value > significance level, this will then imply that there is no heteroscedasticity.

4.4.3.2 Stability diagnostic tests

In addition to the residual diagnostic tests, the study performs stability diagnostic tests on all the ARDL models that were estimated. The reason for that is to ensure that the estimated parameters of all the ARDL models of the study persist to remain constant over time (Seddighi, 2012:97). As such, the stability diagnostic tests (i.e. the recursive residual tests) employed in the study are methodised in this section of the chapter. According to Brooks (2014:232), the recursive residual tests illustrate the plots of reiterated or recursive residuals around the zero together with standard errors at every point. Therefore, residuals that lie within the standard error critical lines imply stability, while residuals that lie outside the standard error critical lines imply instability. In light of this, the study will methodise two predominant tests for stability, known as the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squared residuals (CUSUMSQ) tests (Brown, *et al*., 1975).

- **Cumulative sum of recursive residuals (CUSUM) test**

The cumulative sum of recursive residuals (CUSUM) statistic found in the normalised form of the cumulative sum of recursive residuals is tested based on the null hypothesis of quintessential parameter stability (Brooks, 2014:232). With this in mind, more often than not the CUSUM statistic is zero because the anticipated value of interference is usually zero (Brown, *et al*., 1975:153). As such, in the CUSUM test, the null hypothesis of quintessential parameter stability is rejected in the event of residuals falling outside the standard error critical lines. Succinctly, the CUSUM statistic can be expressed as follows (Brown, *et al*., 1975:153):

$$W_t = \sum_{k+1}^{t} {}^{1}/_{s} \qquad (4.21)$$

Where: $t = k + 1, \ldots, T$ and $s = S_T$ / (T-k)

In Equation 4.21 W_t is the reiterated or recursive residual, while s represents the calculated standard deviation and t is the time it takes for a constant to diverge. Therefore, if δ denotes a constant and δ persists to be constant from time to time, then E (W_t) will be equal to zero.

However, in the event where δ diverges, then W_t will correspondingly diverge from the critical line of its zero mean value (E (W_t) =0). As such, the significance of divergence from the critical line of zero mean value will be estimated using a set of two critical lines of 5 percent confidence interval that will measure the level of stability. Thus, determining whether the null hypothesis of quintessential parameter stability is rejected or not.

- **Cumulative sum of squared recursive residuals (CUSUMSQ) test**

The cumulative sum of squared recursive residuals (CUSUMSQ) statistic found in the normalised form of the cumulative sum of squared residuals is also tested based on the null hypothesis of quintessential parameter stability (Brooks, 2014:233). As such, the CUSUMSQ and CUSUM have similar features; however, the distinguishable aspect of the two tests can be attributed to the fact that the CUSUM test plots the cumulative sum of recursive residuals, while the CUSUMSQ test plots the cumulative sum of squared residuals (Brown, *et al*., 1975:154). The CUSUMSQ statistic is based on the aforementioned null hypothesis of quintessential parameter stability and can be expressed as follows (Brown, *et al*., 1975:153):

$$S_t = {}^{S_t}/_{S_T} = (\sum_{j=k+1}^{t} w_j^2) / (\sum_{j=k+1}^{T} w_j^2) \qquad (4.22)$$

Where: t= t = k + 1,…,T and the anticipated value of S_t for the null hypothesis of parameter stability is E(S_t) = (t - k) / (T- k) and the best way to capture the values of significance is to start from zero at $t = k$ to join at $t = T$. As such, the significance of the divergence of S from the anticipated value is estimated using a set of two diagonal critical lines of 5 percent confidence interval that are parallel to each other around the anticipated value.

4.5 SUMMARY AND CONCLUSION

The primary aim of this chapter was to specify the set of data used in the study and methodise the econometric estimation approach adopted to investigate the impact of production in the manufacturing sector and its predominant sub-sectors on GDP and employment in South Africa. As specified in Section 4.2 of this chapter, the study will use secondary data that covers a period of 77 quarters, starting from the first quarter of 1998 and ending in the first quarter of 2017. The choice of this period was prompted by both the availability of data and the fact that data of pre-1994 are not resilient to the effects of economic sanctions that were imposed by the preceding apartheid government. Not to mention, the study consist of seven variables, that is, non-agricultural employment (proxy for employment), GDP, the production in the manufacturing sector and its five predominant sub-sectors (i.e. automotive, food and beverages, clothing, metal and chemical sectors of manufacturing). Section 4.3 specifies the study models and methodises the multiple breakpoint tests.

Therefore, it can be deduced from Section 4.3 of this chapter that equations 4.1 and 4.2 (where GDP is the dependent variable) will regress production in the manufacturing sector and its predominant sub-sectors on GDP, while, equations 4.3 and 4.4 (where employment is the dependent variable) regress production in the manufacturing sector and its predominant sub-sectors on employment. The multiple breakpoint test was conducted on each variable individually and it was estimated following Bai-Perron tests procedure of L + 1 vs. L sequential, in order to identify break-points in the data of the study and assign appropriate dummy variables to account for detected breaks in the data of the study.

The methodology of this study is based on quantitative methods that are in support of a functionalist approach that attempts to understand the effect of manufacturing activity on the South African economy. In doing so, the study will use an ARDL model solely due to its ability to be applied irrespective of whether the data series concerned are stationary at I(0), I(1) or a mixture of I(0) and I(1). Also, the study consists of four single equations and the ARDL model is most useful in testing a single equation. However, before the estimation of the ARDL model, two unit root tests and a stationarity test will be estimated (i.e. ADF, PP and KPSS respectively) to detect unit roots and determine the order of integration.

Furthermore, it should be noted that if a series of second order exit, the ARDL model will not be estimated. Nonetheless, if the analysed series are found to be free from unit roots at I(0), I(1) or a mixture of I(0) and I(1), the ARDL model will then be estimated to detect long-run impacts of the independent variables on dependent variables. As soon as the long-run impacts are detected, corresponding error correction models will then be estimated to capture the speed of adjustment to equilibrium. As such, the hypothesis-testing framework for the ARDL models used is presented and it is mainly based on whether or not there is a short- and long-run impact running from production in the manufacturing sector and its predominant sub-sectors under study to GDP and employment. Lastly, this will be followed by an estimation of the residual and stability diagnostic tests (i.e. normality, serial correlation, heteroscedasticity and stability tests) to assess the reliability of results yield by the ARDL models of the study. In light of this, Chapter 5 will report, interpret and discuss the empirical results obtained when applying the methodised econometric estimation approach.

CHAPTER 5: EMPIRICAL ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS

5.1 INTRODUCTION

The preceding chapter methodised the econometric estimation approach adopted by the study in analysing the long- and short-run impact of production in the total manufacturing sector and its sub-sectors under study on GDP and employment in South Africa. To specify, Chapter 4 did not only methodise the ARDL model as a dynamic model used to achieve the empirical objectives of study, but also methodised other necessary econometric techniques (i.e. unit root tests, stationarity test, multiple-break point test, error correction model and residual and stability diagnostic tests) conditional for ensuring reliable and genuine ARDL model results. As such, this chapter applies the ARDL model to estimate the empirical objectives of the study and discusses the estimated results in detail. The initial section of this chapter will present a descriptive summary, reporting descriptive statistics that will provide scores and features of the data used in the study.

The next section will report correlation results, unit root tests results and the stationarity test results. This will outline mutual relationships between the variables of the study while determining the order of integration. It should be noted that determining the order of integration is a necessary condition when applying an ARDL bound test approach to cointegration. Thus, the ADF unit root test, PP unit root test and KPSS stationarity test were used to diagnose the unit roots in the data and ensure the order of integration is determined.

Equally important, Bai-Berron multiple-breakpoint test procedure was adopted by the study to diagnose breaks in the data of each variable of the study. Moreover, the study consists of four ARDL models that will estimate equations 4.1 to 4.4. With this in mind, the next sections of this chapter will report and discuss results obtained when using an ARDL model to estimate each of the four equations as follows: first the results obtained when estimating long-run impacts using an ARDL bound test approach to cointegration will be reported, following this will be the corresponding error correction models and results of each estimated ARDL bound test. Lastly, the results obtained by the model residual and stability diagnostic tests that were performed on each ARDL model employed by the study will be reported. This will assure the reader that the results generated by all ARDL models employed by the study are unsusceptible to serial correlation, heteroscedasticity and instability.

5.2 DESCRIPTIVE STATISTICS RESULTS

The summary of the descriptive statistics for the data of the variables under study is reported in Table 5.1.

Table 5.1: Estimated descriptive statistics results

	AUTO	CHEM	CL	FB	GDP	MET	MANU	EMP
Mean	98.720	95.945	115.477	91.452	2513099	106.516	100.793	108.196
Max	123.367	114.400	144.300	114.600	3079882	127.967	115.400	117.000
Mini	63.200	74.233	92.300	71.567	1831698	91.933	86.467	98.000
Std. Dev.	15.670	11.045	15.922	14.305	423986.8	9.522	7.199	6.388
Skewness	-0.476	-0.388	-0.134	0.123	-0.205698	0.662	-0.257	-0.236
Kurtosis	2.292	2.129	1.398	1.581	1.601	2.685	2.149	1.403
Jarque-Bera	4.517	4.365	8.467	6.649	6.819	5.943	3.176	8.901
Probability	0.105*	0.113*	0.015	0.036	0.033	0.051	0.204*	0.012
(*) Fail to reject null hypothesis at 1%; 5% & 10% significance levels								

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

Table 5.1 reports the results obtained when estimating descriptive statistics and it can be observed from the first row in Table 5.1 that when the average GDP and employment (EMP) is 2513099 and 108.196 respectively, there is more production in the clothing (CL) sector of manufacturing than in the total manufacturing (MANU) sector and other sectors (i.e. AUTO, CHEM, FB and MET) of manufacturing under study. This is deduced when comparing the average production figures in the total manufacturing (MANU) sector and automotive (AUTO), chemical (CHEM), clothing (CL), food and beverage (FB) and metal (MET) sectors of manufacturing, which are 100.793, 98.720, 95.945, 115.477, 91.452 and 106.516 respectively.

Furthermore, the second row in Table 5.1 indicates that when the maximum GDP and employment figures are 3079882 and 117 respectively, the corresponding maximum production figures for the total manufacturing sector and automotive, chemical, clothing, food and beverages and metal sectors of manufacturing are 115.400, 123.367, 114.400, 144.300, 114.600 and 127.967 respectively. On the other hand, when the minimum GDP and employment figures are 1831698 and 98.000 respectively, the corresponding minimum production figures for the total manufacturing sector, automotive, clothing, food and beverages and metal sectors of manufacturing are 86.467, 63.200, 74.233, 92.300, 71.567 and 91.933 respectively.

Moreover, the fourth row in Table 5.1 shows the value of the standard deviation for each variable of the study. As such, the standard deviation of production figures in the total manufacturing sector and automotive, chemical, clothing, food and beverages, and metal sectors of manufacturing are 7.199, 15.670, 11.045, 15.922, 14.305 and 9.522 respectively. It can be observed that the production data of the automotive sector is greatly dispersed when compared to the production data of the total manufacturing sector and other sectors of manufacturing (i.e. chemical, clothing, food and beverages, and metal) under study. This is an indication that fluctuations in the production of the automotive sector are high.

Continuing on this line, the fifth row in Table 5.1 shows that the values of skewness are reasonably skewed, as the skewness is found to be between -0.476 to 0.662. In addition, GDP, employment, automotive sector, chemical sector and clothing sector are negatively skewed, while food and beverages, and metal sectors of manufacturing are positively skewed. Moreover, Makuria (2013:93) points out that kurtosis estimates both the flatness and peakedness of the distribution of the observations, where a normal distribution has a kurtosis value of three. Taking this into account, the sixth row in Table 5.1 shows the kurtosis and it indicates that the distribution of the study observations are less peaked (i.e. platykurtic) and consist of thinner tails relative to that of the normal distribution, as their kurtosis values are less than three.

Subsequently, the seventh and eighth row in Table 5 shows the Jarque Bera (JB) statistic and its corresponding probability value (p-value) respectively and both the JB statistic and its corresponding p-value determine whether the data of each variable of the study are normally distributed. Before that, it should be noted that the JB test statistic proposes a null hypothesis of normality distribution and if the JB statistic has a corresponding p-value that is statistically significant, then the null hypothesis is rejected. With this in mind, Table 5.1 shows that the null hypothesis is rejected for GDP, employment, clothing sector, food and beverages sector, and metal sector due to the statistically significant p-values corresponding to their respective JB statistics. On the other hand, the null hypothesis is not rejected for the total manufacturing sector, automotive sector and chemical sector since the p-values corresponding to their respective JB statistics are not statistically significant. This is an indication that production data for the total manufacturing sector, automotive sector and chemical sector are normally distributed, whilst the data for GDP and employment together with the production data for the clothing sector, food and beverages sector, and metal sector are not normally distributed. Moreover, the following section of the study will report and interpret the estimated correlation, unit root tests and stationarity test results.

5.3 CORRELATION, UNIT ROOT TESTS AND STATIONARITY TEST RESULTS

The correlation analysis and the unit root tests are foundational for any form of statistical estimation (e.g. regression) (Ogbokor, 2015:124). As such, this section of the chapter will present both the correlation matrix, the unit root tests and the stationarity test results respectively. Equally important, it should be noted that the data of the variables under study are transformed to natural logarithmic (L) in order to reduce variation within the data sets and ensure the growth rates of these variables are determined.

5.3.1 Correlation matrix results

Table 5.2 reports the estimated correlation results, namely a correlation coefficient matrix including all the variables under study.

Table 5.2: Estimated correlation matrix results

Variables	LAUTO	LCHEM	LCL	LEMP	LFB	LGDP	LMANU	LMET
LAUTO	1.0000							

LCHEM	0.768	1.000						
	0.000***	-----						
LCL	-0.467	-0.771	1.000					
	0.000***	0.000***	-----					
LEMP	0.666	0.871	-0.804	1.000				
	0.000***	0.000***	0.000***	-----				
LFB	0.611	0.892	-0.916	0.941	1.000			
	0.000***	0.000***	0.000***	0.000***	-----			
LGDP	0.714	0.944	-0.882	-----	0.972	1.000		
	0.000***	0.000***	0.000***	-----	0.000***	-----		
LMANU	0.921	0.865	-0.485	0.791	0.704	0.829	1.000	
	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	-----	

LMET	0.567	0.173	0.320	0.021	-0.144	0.027	0.576	1.000
	0.000***	0.1323	0.005***	0.859	0.213	0.818	0.000***	-----
(***) P-value significant at 1% significance levels (**) P-value significant at 5% significance levels (*) P-value significant at 10% significance levels								

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

The correlation matrix results given in Table 5.2 report the correlation coefficients with corresponding probability values of all variables under study. In light of this, it should be noted that the strength of the relationship between variables under study will be determined quantitatively using the correlation coefficients. That is to say, the relationships between the variables under study can be determined if the value of the correlation coefficients lies between -1 to +1, where a correlation coefficient with the value adjacent to -1 implies a strong inverse (or negative) linear relationship, while a correlation coefficient with the value adjacent to +1 implies a strong direct (or positive) linear relationship. However, in cases where the value of the correlation coefficient is zero, it implies that there is completely no direct or inverse relationship between variables under study, thus suggesting no valid rationale to investigate the relationship further. In addition, it should be noted that GDP and employment are the dependent variables of the study; therefore, the correlation between them is of no significance to the study.

With the latter in mind, Table 5.2 shows LGDP, LEMP, LMANU, LAUTO, LCHEM, LFB, LMET and LCL as denotations of the natural log of the GDP, employment, total manufacturing sector production, automotive sector production, chemical sector production, food and beverage sector production, metal sector production and clothing sector production respectively. Therefore, with respect to the relationship between GDP and production in the total manufacturing sector and its sub-sectors under study, Table 5.2 shows that the correlation coefficients between GDP and production in the total manufacturing sector and automotive, chemical, food and beverages, and metal sectors of manufacturing are given as 0.829, 0.921, 0.944, 0.972 and 0.027 respectively. These correlations coefficients imply a positive or direct relationship as they all are adjacent to +1.

Although this may be true, the probability values (p-values) corresponding to these correlation coefficients that exhibit positive relationships with GDP are significant at 1 percent significance level, except the positive correlation coefficient of production in the metal sector of manufacturing. As such, production in the total manufacturing sector and four (automotive, chemical, food and beverages, and metal) of five sectors of manufacturing under study have a positive relationship with GDP, but these positive relationships are only statically significant for production in the total manufacturing sector and three (automotive, chemical, food and beverages) of five sectors of manufacturing under study. This suggests that the production in the metal sector has been insufficient in contributing significantly to GDP in the South African economy. This can be attributed to the surge of cheap Chinese steel imports that consume the domestic market and effectuate many domestic steel producers to experience excess supply, resulting in unsold goods and high production costs (Ashman, 2016).

Table 5.2 also shows that the correlation coefficient between GDP and production in the clothing sector of manufacturing is -0.882, indicating a strong negative or inverse relationship, as it is adjacent to -1. The p-value corresponding to this negative correlation coefficient is significant at 1 percent significance level, meaning that production in the clothing sector of manufacturing has a negative and significant relationship with GDP in South Africa. This suggests that the clothing sector in South Africa contributes negatively to GDP in South Africa. Moreover, Table 5.2 shows that the correlation coefficients between employment and production in the total manufacturing sector and automotive, chemical, food and beverages, and metal sectors of manufacturing are given as 0.791, 0.666, 0.871, 0.941 and 0.021 respectively. These correlation coefficients imply a positive or direct relationship, as they are adjacent to +1. As such, the p-values corresponding to these positive correlation coefficients are significant at 1 percent significance level, except the positive correlation coefficient of the metal sector of manufacturing. That is to say, production in the total manufacturing sector and four (automotive, chemical, food and beverages, and metal) of five sectors of manufacturing under study have positive relationships with employment, however, these positive relationships are only statistically significant for production in the total manufacturing sector and three (LAUTO, LCHEM, LFB) of five sectors of manufacturing under study.

This is expected, as mentioned before that production in the metal sector of manufacturing is lacklustre and is often subjected to excess supply induced by China dumping steel in South Africa. Therefore, excess supply leads to the high cost that effectuates shedding jobs as an approach to reduce costs. Continuing in this line, Table 5.2 also shows that the correlation coefficient between employment and production in the clothing sector of manufacturing is -0.804, indicating a negative or inverse relationship as it is adjacent to -1. As such, the p-value corresponding to this negative correlation coefficient is significant at 1 percent significance level, implying that production in the clothing sector of manufacturing has a negative and significant relationship with employment in the South African economy.

5.3.2 Unit root tests and stationarity test results

This section of the chapter will present the results of the unit root tests and the stationarity test in order to determine the order of integration of the variables under study. It should be noted that it is conditional to conduct unit root tests or stationarity tests prior to the estimation of an ARDL model, in order to avoid spurious or illogical results. Therefore, in this study, the ADF and PP unit root tests and KPSS stationarity test will be used to diagnose both unit roots and determine the order of integration. The reason for using a stationarity test as opposed to just using unit root tests only was motivated by the econometric literature that enunciated that there is inconsistency in both the power and features of unit root tests.

As mentioned in Section 4.4.1, more often than not the ADF and PP unit root tests encounter similar results, thus they suffer the same weakness of being biased towards the non-rejection of the null hypothesis. For that reason, the KPSS stationarity test is also used as a confirmatory test and to assess the robustness of the ADF and PP unit root tests results. With the latter in mind, the presentation of these unit root tests and the stationarity test results will be structured as follows: Table 5.3 will report the ADF unit root test results, following this will be Table 5.4 PP unit root test results and, lastly, Table 5.5 will report the KPSS stationarity test results.

Table 5.3: Augmented Dickey-Fuller (ADF) unit roots results

Variables	**At Level I(0)**				**At 1st Difference I(1)**		**Results (order of integration)**
	Without trend		**With trend**		**Without trend**		
	T-statistics	P-value	T-statistics	P-value	T-statistics	P-value	
LGDP	-2.019617	0.2780	-0.234975	0.9911	-4.352845	0.0008***	I(1)
LEMP	-0.558048	0.8727	-2.033153	0.5737	-6.213457	0.0000***	I(1)
LMANU	-2.119818	0.2377	-2.545562	0.3061	-6.363296	0.0000***	I(1)
LAUTO	-2.816601	0.0607	-3.154681	0.1016	-11.26247	0.0001***	I(1)
LCHEM	-1.960998	0.3033	-3.590070	0.0373**	-----	-----	I(0)
LCL	-0.986773	0.7543	-2.066890	0.5554	-7.575886	0.0000***	I(1)

Variables	At Level I(0)				At 1st Difference I(1)		Results (order of integration)
	Without trend		With trend		Without trend		
	T-statistics	P-value	T-statistics	P-value	T-statistics	P-value	
LFB	-0.090822	0.9460	-3.691523	0.0289**	-----	-----	I(0)
LMET	-1.971364	0.2987	-1.984502	0.6001	-7.899965	0.0000***	I(1)
(***) The rejection of the null hypothesis of not stationary at the 1% significance level (**) The rejection of the null hypothesis of not stationary at the 5% significance level (*)The rejection of the null hypothesis of not stationary at the 10% significance level							

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

The ADF unit root test results given in Table 5.3 show that some of the variables used in the study are stationary at level, whilst others are stationary at first difference. To specify, the natural log of GDP, natural log of employment (LEMP), natural log of total manufacturing (LMANU) sector, natural log of automotive sector (LAUTO), natural log of clothing sector (LCL) and natural log of metal sector (LMET) were not stationary at I(0) with or without trend, but became stationary at I(1) without trend after being differenced. Whilst the natural log of the chemical sector (LCHEM) and natural log of food and beverage sector (LFB) were not stationary at I(0) without trend but became stationary at I(0) with the trend. These results were obtained by following the conventional unit root testing approach, where variables are first tested at a level without trend and if they are non-stationary, then the trend is considered. If they are still found non-stationary at level with or without trend, the next step was to difference them to first difference. The methodised decision rule for the ADF unit root test that is provided in Section 4.4.1.1 of Chapter 4 was also taken into account in obtaining the ADF unit root test results. Furthermore, Table 5.4 presents the PP unit root test results.

Table 5.4: Phillips-Perron (PP) unit root test results

Variables	At Level I(0)				At 1st Difference I(1)		Results (order of integration)
	Without trend		With trend		Without trend		
	T-statistics	P-value	T-statistics	P-value	T-statistics	P-value	
LGDP	-1.828046	0.3644	0.101591	0.9968	-4.238227	0.0011***	I(1)

Variables	At Level I(0)				At 1st Difference I(1)		Results (order of integration)
	Without trend		With trend		Without trend		
	T-statistics	P-value	T-statistics	P-value	T-statistics	P-value	
LEMP	-0.622820	0.8585	-2.034685	0.5730	-6.345347	0.0000***	I(1)
LMANU	-1.662649	0.4460	-1.768106	0.7105	-6.183286	0.0000***	I(1)
LAUTO	-2.683043	0.0817	-2.985867	0.1430	-11.32965	0.0001***	I(1)
LCHEM	-1.890033	0.3353	-3.495063	0.0471**	-----	-----	I(0)
LCL	-1.077608	0.7208	-2.418014	0.3676	-7.575886	0.0000***	I(1)
LFB	-0.342842	0.9126	-3.584092	0.0379**	-----	-----	I(0)
LMET	-2.102390	0.2444	-2.086928	0.5445	-7.903796	0.0000***	I(1)
(***) The rejection of the null hypothesis of not stationary at the 1% significance level (**) The rejection of the null hypothesis of not stationary at the 5% significance level (*)The rejection of the null hypothesis of not stationary at the 10% significance level							

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

Correspondingly, the results of the PP unit root test are consistent with that of the ADF unit root test results for all the variables under study; this is expected as enunciated by the econometric literature. As such, Table 5.4 shows that LGDP, LEMP, LMANU, LAUTO, LCL and LMET were not stationary at I(0) with or without trend, but became stationary at I(1) without trend after being differenced. Whilst LCHEM and LFB were not stationary at I(0) without trend but became stationary at I(0) with the trend.

The aforementioned results were obtained following the same aforementioned conventional unit root testing approach and the methodised decision rule for PP unit root test in Section 4.4.1.2. As mentioned before, the ADF and PP unit root tests suffer the same weakness of being biased when it comes to the non-rejection of the null hypothesis. For that reason, the KPSS stationarity test is also estimated to address this weakness and ensure reliable results. Table 5.5 presents KPSS stationarity test results.

Table 5.5: Kwiatkowski, Phillips, Schmidt and Shin (KPSS) stationarity test results

Variables	At Level I(0)				At 1st Difference I(1)		Results (order of integration)
	Without trend		With trend		Without trend		
	LM-statistic	Crit. Value	LM-statistic	Crit. Value	LM-statistic	Crit. Value	
LGDP	1.174961	0.463000	0.259982	0.146000	0.411230*	0.463000	I(1)
LEMP	1.060761	0.463000	0.115203*	0.146000	-----	-----	I(0)
LMANU	0.799498	0.463000	0.167553	0.146000	0.085684*	0.463000	I(1)
LAUTO	0.719300	0.463000	0.172910	0.146000	0.142890*	0.463000	I(1)
LCHEM	1.108076	0.463000	0.188113	0.146000	0.145198*	0.463000	I(1)
LCL	1.078925	0.463000	0.123840*	0.146000	-----	-----	I(0)
LFB	1.169209	0.463000	0.137236*	0.146000	-----	-----	I(0)
LMET	0.206155*	0.463000	-----	-----	-----	-----	I(0)
(*) the null hypothesis of stationarity is rejected if LM > Critic.Value							

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

Contrary to both ADF and PP unit root tests that propose the same null hypothesis of a unit root, the null hypothesis of the KPSS stationarity test is that there is no unit root or stationary as methodised in Section 4.4.1.3 of Chapter 4. In light of this, Table 5.5 shows that LGDP, LMANU, LAUTO and LCHEM are not stationary at I(0) with or without trend, but became stationary at I(1) without trend after being differenced. Whilst LEMP, LCL and LFB are not stationary at I(0) without trend but became stationary at I(0) with the trend. In addition, only LMET is stationary at I(0) without trend. Therefore, the KPSS stationarity test results are consistent with both the ADF and PP unit root tests results only for LGDP, LMANU, LAUTO and LFB.

5.4 BAI-PERRON MULTIPLE-BREAKPOINT TEST RESULTS

Now that the order of integration is determined, the next step was to conduct multiple break-point tests in order to determine potential break dates in the data of each variable under study and assign appropriate dummy variables. As methodised in Section 4.3 of Chapter 4 a Bai-Perron test procedure of L + 1 vs. L sequential was used, where an error distribution was allowed to vary across breaks and five was selected as the maximum number of breaks allowed while using a trimming of 15 percent. In light of this, the Bai-Perron test results indicated the presence of more than four breaks in the data of the variables under study, but the common breaks took place between the second quarter of 2008 and the fourth quarter of 2010.

This suggests that the common breaks in the data of the variables under study took place during the 2008/09 global financial crisis and the 2010 FIFA World Cup, thus implying that the break-dates obtained using the Bai-Perron break-point test procedure would either reflect the positive or negative repercussions induced by the 2008/09 global financial crisis and the 2010 FIFA World Cup. This effectuated the study to use two dummy variables, that is, the FinCrisis (dummy variable 1) denoting the 2008/09 global financial crisis and the FIFA (dummy variable 2) denoting the 2010 FIFA World Cup. According to Habanabakize (2016:70), the values one and zero are conventionally used when dealing with dummy variables. As such, for both in FinCrisis and FIFA, the study will assign the value one to capture the economic disturbances or innovations induced by the 2008/09 global financial crisis (i.e. during 2008Q2 – 2009Q4) and the 2010 FIFA World Cup (i.e. during 2010Q1-2010Q4) respectively, while zero will be assigned to the periods free from breaks. In light of this, the FinCrisis and FIFA as dummy variables of this study will then be employed like any other independent variable in the regression models of the study.

Taking this into account, the next section of this chapter will report and interpret the estimated results of the ARDL models in order to determine the short- and long-run impact of production in the manufacturing sector and its sub-sectors on GDP and employment in the South African economy.

5.5 AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) MODEL RESULTS: LONG- AND SHORT-RUN IMPACTS

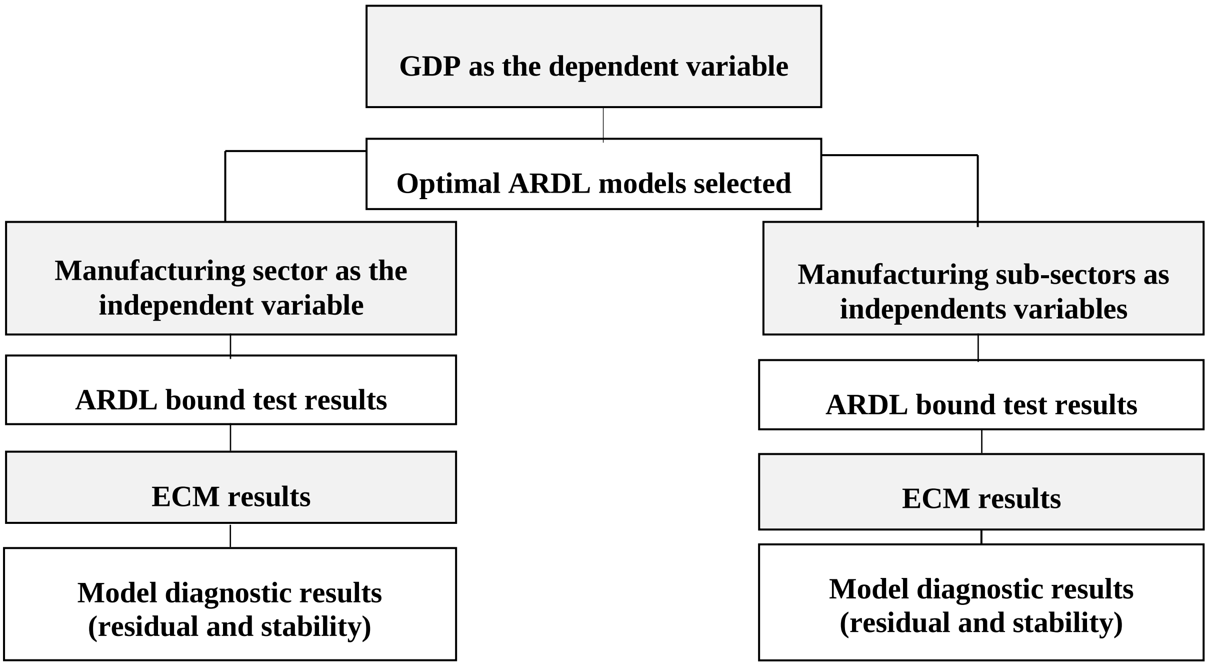
The unit root tests and the stationarity test results in Section 5.3 of this chapter indicate that the study variables consist of a mixture of I(0) and I(1) order of integration and no variable of the study is stationary at I(2). This outcome permits the application of an ARDL bound test approach to cointegration to determine the long-run impact of production in the total manufacturing sector and its sub-sectors under study on GDP and employment in South Africa. Subsequent to the determination of the long-run impacts, the corresponding ECMs will then be reported, interpreted and discussed to determine the short-run impact of production in the total manufacturing sector and its sub-sectors under study on GDP and employment in South Africa.

As such, an ARDL model was applied to determine whether production in the total manufacturing sector and its sub-sectors under study have a long- and short-run impact on GDP and employment in South Africa.

5.5.1 Manufacturing sector and its sub-sectors impact on GDP

Figure 5.1 details how the study will present the results obtained when estimating the long- and short-run impact of production in the total manufacturing sector and its predominant sub-sectors under study on GDP.

Figure 5.1: ARDL model results presentation – GDP as dependent variable



Source: Constructed by the author

Figure 5.1 shows that in this section of the chapter, the study will present the results of two ARDL models, where the first ARDL model will present both the ARDL bound test and the ECM results (i.e. equations 4.10 and 4.12) obtained when regressing the production in the total manufacturing sector on GDP and the second ARDL model will present both the ARDL bound test and ECM results (i.e. equations 4.11 and 4.13) obtained when regressing the production in the manufacturing sub-sectors under study on GDP. As shown in Figure 5.1, the study will start by detailing the two optimal ARDL models selected and this will be followed by the ARDL model bound test and ECM results of the two aforementioned ARDL models. Lastly, the model residual and stability tests performed on the aforementioned ARDL models will be presented.

Before that, the maximum number of lags to include in each of the aforementioned ARDL models was first determined using the Schwarz information criterion (SIC). The reason for that lies in the ability of the SIC to address the issues of over fitting by instituting a penalty term for the number of parameters. As such, the SIC selected two lags as the maximum number of lags to include in the ARDL model regressing the production in the total manufacturing sector on GDP, thus when including 2 as the maximum number of lags, the optimal ARDL model that was selected and that followed the sequence of the variables in Equation 4.10 was ARDL model (2,2). On the other hand, the SIC selected one lag as the maximum number of lags to include in the ARDL model regressing the production in the manufacturing sub-sectors under study on GDP, thus when including 1 as the maximum number of lags, the optimal ARDL model that was selected and that followed the sequence of the variables in Equation 4.11 was ARDL model (1,0,0,0,0,0). As such, Table 5.6 extensively details the optimal ARDL models selected to estimate Equation 4.10 and Equation 4.11.

Table 5.6: Optimal ARDL models selected

ARDL Model	Trend Specification	Max. no. of lags	Optimal model	R-Square	Adj. R-Square
Manufacturing vs GDP	Constant level	2	(2,2)	99.96%	99.96%
Manufacturing sub-sectors vs GDP	Constant level	1	(1,0,0,0,0,0)	99.95%	99.94%

The optimal ARDL models are both estimated at a constant level without trend as given in Table 5.6 with their corresponding R-square and adj. R-square values. The R-square value for the ARDL model (2,2) implies that 99.96 percent of the variation in GDP can be explained by the regression on the production in the total manufacturing sector. While the R-square value for the ARDL model (1,0,0,0,0,0) implies that 99.95 percent of the variation in GDP can be explained by the regression on the production in the manufacturing sub-sectors under study. However, due to the inefficiency of the R-square value of increasing as more independent variables are added regardless of whether the added variables are statistically significant, the study also reported the corresponding adj. R-square that only considers independent variables that are statistically significant in explaining the dependent variables of the study.

As such, the adj. R-square value for the ARDL model (2,2) implies that 99.96 percent of the variation in GDP can be explained by the regression on the production in the total manufacturing sector. While the adj. R-square value for the ARDL model (1,0,0,0,0,0) implies 99.94 percent of the variation in GDP can be explained by the regression on the production of manufacturing sub-sectors under study. Now that the optimal ARDL models used in regressing the production in the total manufacturing sector and its sub-sectors on GDP are profiled, the next step was to report, interpret and discuss the results obtained when estimating the bound tests and their corresponding ECMs for these optimal ARDL models.

5.5.1.1 ARDL bound test results: Long-run impacts on GDP

In this section, the ARDL bound test approach to cointegration is used to determine whether there is a long-run impact running from production in the manufacturing sector and its sub-sectors to GDP in the South African economy. As such, the ARDL bound test results consisting of the lower and upper bound with the corresponding F-value are given in Table 5.7 and 5.8. Where, the long-run impact of production in the total manufacturing sector on GDP is estimated by the ARDL model (2,2), while the long-run impact of production in the manufacturing sub-sectors under study on GDP is estimated by the ARDL model (1,0,0,0,0,0). In this case, Table 5.7 and 5.8 report the bound test results with their corresponding long-run equations for both ARDL model (2,2) and (1,0,0,0,0,0) respectively.

Table 5.7: Estimated ARDL model (2,2) bound test results

ARDL model	**Estimated F-value**	
ARDL model (2,2)	9.03	
Critical Value Bounds		
Significance levels	**Lower bound I(0)**	**Upper bound I(1)**
10%	4.04	4.78
5%	4.94	5.73
1%	6.84	7.84
Note: critical values from Pesaran *et al*. (2001) Table CI (V)		
Long-run Equation: LGDP = 5.9505 + 1.9481*LMANU - 0.0315*FinCrisis + 0.2073*FIFA		

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

Table 5.8: Estimated ARDL model (1,0,0,0,0,0) bound test results

ARDL model	Estimated F-value	
ARDL model (1,0,0,0,0,0)	6.66	
Critical Value Bounds		
Significance levels	**Lower bound I(0)**	**Upper bound I(1)**
10%	2.26	3.35
5%	2.62	3.79
1%	3.41	4.68
Note: critical values from Pesaran *et al*. (2001); Table CI (V)		
Long-run Equation: LGDP = 9.8543 + 0.2964*LAUTO + 0.1765*LCHEM - 0.2818*LCL + 0.3701*LFB + 0.5280*LMET - 0.0101* FinCrisis + 0.0928*FIFA		

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

- **Analysis of the long-run impact of production in the total manufacturing sector and its predominant sub-sectors on GDP**

Table 5.7 shows that the estimated F-value for the ARDL model (2,2) is 9.03 and it exceeds the corresponding critical value bounds at 1 percent significance levels. For this reason, the null hypothesis of no long-run impact is rejected. This implies that there is a long-run impact running from the production in the total manufacturing sector to GDP in the South African economy. This suggests that a faster rate of growth in the manufacturing production will induce a faster rate of growth in GDP as enunciated by the Kaldor's model of growth rate differences (Kaldor, 1967). As such, this is an indication that the manufacturing sector is still an engine of economic growth in the South African economy.

The aforementioned empirical finding is line with empirical findings of other domestic studies (Mahonye & Mandishara, 2015; Awolusi, 2016; Tsoku, *et al*., 2017; Meyer & Mc Camel, 2017) that investigated the impact of manufacturing on GDP in the context of the South African economy. Also, this finding of the study is consistent with other empirical findings of studies (Necmi, 1999; Fagerberg & Verspagen, 1999; Fagerberg & Verspagen, 2002; Wells & Thirlwall, 2003; Dasgupta & Singh, 2006; Kathuria & Raj, 2009; Szirmai & Verspagen, 2010; Szirmai, 2012; Haraguchi, *et al*., 2016; and Chete *et al*., 2016) conducted in the context of various countries, but encountered the same results.

Furthermore, in terms of the role played by production in the manufacturing sub-sectors under study on GDP in the long-run, Table 5.8 shows that the estimated F-value for the ARDL model (1,0,0,0,0,0) is 6.66 and it exceeds the corresponding critical value bounds at 1 percent significance levels. Thus, the null hypothesis of no long-run impact is rejected, implying that there is a long-run impact running from production in the manufacturing sub-sectors under study to GDP. That is to say, production in the automotive, chemical, clothing, food and beverage, and metal sectors of manufacturing have a long-run impact on GDP in the South African economy.

- **Parameter estimation for the long-run impact of production in the total manufacturing sector and its predominant sub-sectors on GDP**

The long-run equation corresponding to the long-run impact determined by the bound test results of the ARDL model (2,2) given in Table 5.7 show that production in the total manufacturing sector has a positive long-run impact on GDP in South Africa. In other words, the long-run equation shows that a 1 percent increase in the production of the total manufacturing sector will increase GDP by 1.95 percent in the long run. In the same way, Table 5.8 also shows the long-run equation corresponding to the long-run impact determined by the bound test results of the ARDL model (1,0,0,0,0,0) and it indicates that production in four (automotive, chemical, food and beverage and metal) of five sectors of manufacturing under study have a positive long-run impact on GDP in the South African economy. To enumerate, a 1 percent increase in the production of the automotive, chemical, food and beverage, and metal sectors of manufacturing will increase GDP by 29.64, 17.65, 37.01 and 52.8 percent respectively in the long run.

On the other hand, the clothing sector of manufacturing has a negative long-run impact on GDP in the South African economy, implying a 1 percent increase in production in the clothing sector decreases GDP by 28.18 percent in the long run. This is an indication of the problem of a struggling clothing sector in the South African economy. The reason for that can be attributed to the surge of cheap clothing imports from China, India and Bangladesh in the late 1990s that have placed pressure on production in the clothing sector (Ndalana, 2016). Not to mention, reasonably low import duties on clothing-related goods that grants foreign clothing suppliers easy access to South African markets (Thamm, 2017). Consequently, domestic clothing manufactures experience high production costs that drives many domestic manufacturing companies to shut down.

Moreover, as mentioned before the dummy variable assigned to capture the economic disturbances or innovations induced by the 2008/09 global financial crisis is denoted by FinCrisis and Table 5.7 and 5.8 shows that a crisis has a negative impact on GDP in South Africa in the long run. As such, it can be deduced from Table 5.7 and 5.8 that the 2008/09 financial crisis decreases GDP in South Africa by approximately 1.01 to 3.15 percent in the long run when compared to periods free from economic disturbances or innovations. This empirical finding is consistent with reality, as Marumoagae (2014:380) points out that the 2008/09 global financial crisis resulted in an economic slowdown (or recession) for the South African economy. Not to mention, the impact of the 2008/09 economic slowdown negatively affected the South African economic activity, as it induced an extreme decline in both the export demand and domestic demand for mining and manufacturing goods (Madubeko, 2010:30). In this case, it was inevitable for the production in the manufacturing sector to decline to post the 2008/09 global financial crisis as shown by the trend analysis in Section 3.3.1 of Chapter 3. As such, it can be deduced that in the long run, the 2008/09 global financial crisis is amongst the economic impediments that debilitate manufacturing-driven economic growth in the South African economy.

However, the dummy variable assigned to capture the economic disturbances or innovations induced by the 2010 FIFA World Cup is denoted by FIFA and Tables 5.8 and 5.9 show that FIFA has a positive impact on GDP in South Africa. To enumerate, the 2010 FIFA World Cup increases GDP in South Africa by approximately 9.28 to 20.73 percent in the long run when compared to periods free from economic disturbances or innovations. The reason for that is the fact that preparations for the 2010 FIFA World Cup induced economic activity in South Africa, thereby minimising the effects of the 2008/09 global financial crisis on the South African economy (Harding, 2011). To clarify, De Aragao (2015:5) points out that the 2010 FIFA World Cup acted as a catalyst for investments that expanded the production capacity in various South African economic sectors and induced economic growth in the South African economy. To enumerate, the South African national government reported that the 2010 FIFA World Cup contributed USD 509 million to real GDP in 2010 (De Aragao, 2015:6). In this case, it can be deduced that investments boost economic activity that will, in turn, result in economic growth as advocated by the Harrod-Domar growth model (Harrod, 1939; Domar, 1947). For the most part, it can be deduced that the estimated bound test results for the ARDL model (2,2) and (1,0,0,0,0,0) determined that there is a long-run impact running from production in the manufacturing sector and its sub-sectors under study to GDP in the South African economy.

Therefore, this result approbates the estimation of the ECM for both the ARDL model (2,2) and (1,0,0,0,0,0) respectively.

5.5.1.2 Error correction model (ECM) results and short-run impacts on GDP

This section will report the short-run dynamic parameters attained by employing the ECM after the long-run impacts have been determined by the bound test results estimated by the ARDL model (2,2) and (1,0,0,0,0,0) in the preceding Section 5.5.1.1 of this chapter. According to Brooks (2014:376), the ECM estimates the time it takes (or speed of adjustment) for the discrepancy in the previous period between the observed variables to be re-established back to equilibrium. Equally important, Gujarati and Porter (2010:764) point out that to a certain extent the ECM rectify disequilibrium that transpired in the previous period, that is, short-run disequilibrium. As such, the previous transpired short-run disequilibrium can be rectified and the speed of adjustment can be estimated on the condition that the error correction term (ECT) subsumed in the ECM is negative and statistically significant. Taking this into account, Table 5.9 reports the ECM results for the ARDL model (2,2) and (1,0,0,0,0,0) respectively.

Table 5.9: Estimated ECM results

ARDL model (2,2)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LGDP(-1))	0.142475	0.111267	1.280483	0.2048
D(LMANU)	0.184175	0.022240	8.281410	0.0000***
D(LMANU(-1))	0.021302	0.027671	0.769834	0.4441
D(FinCrisis)	-0.000789	0.001330	-0.593242	0.5550
D(FIFA)	0.005190	0.001988	2.610198	0.0112**
ECT(-1)	-0.025042	0.006156	-4.067839	0.0001***
ARDL model (1,0,0,0,0,0)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LAUTO)	0.020563	0.007232	2.843213	0.0059***
D(LCHEM)	0.012246	0.013796	0.887657	0.3779
D(LCL)	-0.019552	0.013070	-1.495934	0.1394
D(LFB)	0.025676	0.016799	1.528427	0.1311

D(LMET)	0.036628	0.012474	2.936297	0.0045***
D(FinCrisis)	-0.000702	0.001913	-0.366985	0.7148
D(FIFA)	0.006437	0.002166	2.971969	0.0041***
ECT(-1)	-0.069373	0.020580	-3.370929	0.0012***
(***) denotes significance at 1% level (**) denotes significance 5% level				

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

The estimated ECM results with the short-run dynamic coefficients associated with the ARDL bound test results for the ARDL model (2,2) and (1,0,0,0,0,0) are given in Table 5.9. As such, it should be noted that the previous transpired short-run disequilibrium between the observed variables can be re-established back to equilibrium and the speed of adjustment can be estimated granted that the ECT coefficient is negative and statically significant. In light of this, for the ARDL model (2,2) the ECT coefficient is -0.025042 and significant at 1 percent significance level, implying that around 2.50 percent of any previously transpired disequilibrium between GDP and production in the total manufacturing sector is re-established back to long-run equilibrium each quarter. To put it differently, it takes roughly 39.93 (1/0.025042) quarters for any change in the production of the total manufacturing sector to have a positive impact on GDP.

Therefore, in the long run, causality runs through the ECT from production in the total manufacturing sector to GDP. This result confirms that production in the total manufacturing sector has a long-run impact on GDP in the South African economy. In the short run, the coefficient for GDP is positive, implying that previous innovations in GDP have a positive impact on the present-day GDP. Nonetheless, the impact is not statically significant. Moreover, in the short run the coefficient of production in the total manufacturing sector (LMANU) is positive and significant at 1 percent significance level, implying that causality also runs from the production in the total manufacturing sector to GDP in the short run. As such, production in the total manufacturing sector has a positive short-run impact on GDP in the South African economy.

Furthermore, with regards to the impact of production in the manufacturing sub-sectors under study on GDP, the ECM results for the ARDL model (1,0,0,0,0,0) indicate that the ECT coefficient is -0.069373 and it is significant at 1 percent significance level, meaning that around 6.94 percent of any previously transpired disequilibrium between GDP and production in the manufacturing sub-sectors under study is re-established back to long-run equilibrium each quarter. In other words, it takes roughly 14.41 (1/0.069373) quarters for any change in the production of automotive, chemical, clothing, food and beverage, and metal sectors of manufacturing to have an impact on GDP in the long run.

In this case, causality runs through the ECT from production in the automotive, chemical, clothing, food and beverage, and metal sectors of manufacturing to GDP in the long run. This confirms that production in the manufacturing sub-sectors under study has a long-run impact on GDP in the South African economy. On the contrary, Table 5.9 shows that two (automotive and metal) of five sectors of manufacturing under study have coefficients that are positive and significant at 1 percent significance level. This indicates that causality runs from production in the automotive and metal sectors of manufacturing to GDP in the short run. Thus, it can be deduced that production in automotive and metal sectors of manufacturing has a positive short-run impact on GDP in the South African economy. This suggests that supporting the automotive and metal sectors of manufacturing will induce growth in GDP in the short run.

In addition, Table 5.9 shows that FinCrisis as a proxy for the 2008/09 global financial crisis have negative short-run coefficients of -0.000789 and -0.000702, implying that the 2008/09 global financial crisis would decrease GDP in South Africa by approximately 0.0702 to 0.0789 percent in the short run if the short-run coefficients were statistically significant. This is an indication that in the short run, the 2008/09 global financial crisis has a negative but insignificant impact on GDP in South Africa. On the contrary, Table 5.9 also shows that FIFA, as a proxy for the 2010 FIFA World Cup, have positive short-run coefficients of 0.005190 and 0.006437 that are significant at 5 and 1 percent significance level respectively, this implies that the 2010 FIFA World Cup increases GDP in South Africa by approximately 0.519 to 0.6437 percent in the short run. As such, the 2010 FIFA World Cup has a positive and significant short-run impact on GDP in South Africa.

Moreover, to assure the reader that the bound tests and ECMs result estimated by the ARDL model (2,2) and (1,0,0,0,0,0) are not spurious or misleading, the next section will present model residual and stability diagnostic test results obtained when assessing the viability of the aforementioned ARDL models.

5.5.1.3 ARDL model (2,2) and (1,0,0,0,0,0) diagnostic test results

Having reported, interpreted and discussed the bound tests and ECM results generated by the ARDL model (2,2) and the ARDL model (1,0,0,0,0,0) respectively. This section will report and interpret the results obtained when model residual and stability diagnostic tests were performed on the ARDL model (2,2) and the ARDL model (1,0,0,0,0,0) respectively. This assures the reader that the results generated by both the aforementioned ARDL models are not spurious or misleading. As such, Table 5.10 reports residual diagnostic test results for the ARDL models (2,2) and (1,0,0,0,0,0) respectively.

Table 5.10: Residual diagnostic tests results

Residual diagnostics tests	**ARDL models**			
	ARDL (2,2)		**ARDL (1,0,0,0,0,0)**	
	P-value	**Decision**	**P-value**	**Decision**
Normality Test	0.7156*	Do not reject H_0	0.1443*	Do not reject H_0
Serial-correlation Breusch-Godfrey (LM test)	0.5613*	Do not reject H_0	0.0711*	Do not reject H_0
Heteroscedasticity Test: White	0.9860*	Do not reject H_0	0.8843*	Do not reject H_0
(*) Fail to reject the null hypothesis at 1%; 5% & 10% significance levels				

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

As indicated in Section 4.4.3.1 of Chapter 4, the null hypothesis for the Lagrange multiplier (LM) serial-correlation test is no serial correlation, while the null hypothesis for the Jarque-Bera (JB) normality test is normality distribution and the null hypothesis for White heteroscedasticity test is homoscedasticity. In light of this, the residual diagnostic test results given in Table 5.10 show that variables used in both the ARDL model (2,2) and (1,0,0,0,0,0) are unsusceptible to non-normality distribution, serial correlation and heteroscedasticity. Thus all the aforementioned null hypotheses are not rejected, implying that the bound tests and ECM results generated by the ARDL model (2,2) and (1,0,0,0,0,0) are not spurious or misleading.

Figures 5.1 to 5.4 show the results of the cumulative sum of recursive residuals (CUMU) and the cumulative sum of squared recursive residuals (CUMUSQ) performed on the ARDL model (2,2) and (1,0,0,0,0,0) respectively. With this in mind, the red lines on Figures 5.2 to 5.5 denote the critical lines at 5 percent level of significance, while the blue lines denote statistics of CUMU and CUMUSQ. Therefore, it can be deduced that there is no instability of residuals indicated since the plot (blue lines) of CUMU and CUMUSQ statistics for both the ARDL model (2,2) and (1,0,0,0,0,0) lie within the critical lines of 5 percent significance level of stability.

Figure 5.2: CUMU for model (2,2)

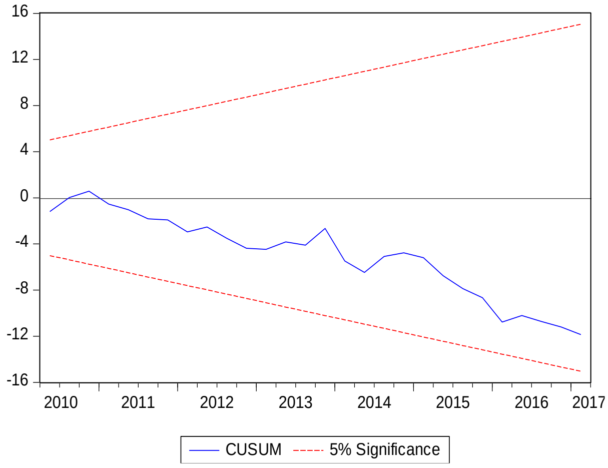


Figure 5.3: CUMUSQ for model (2,2)

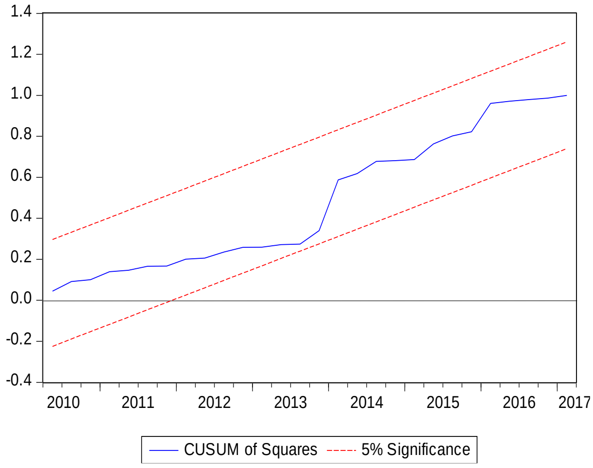


Figure 5.4: CUMU of sq. for model (1,0,0,0,0,0)

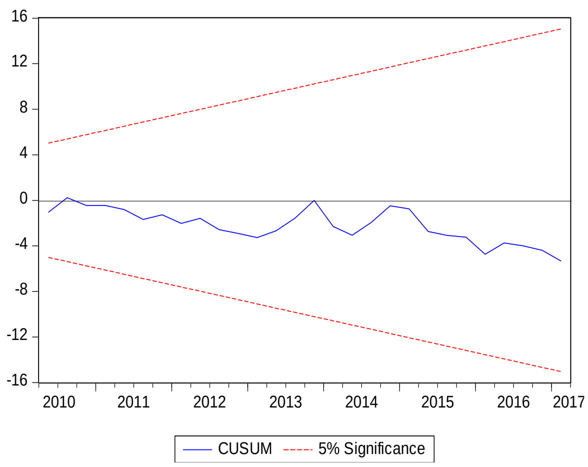
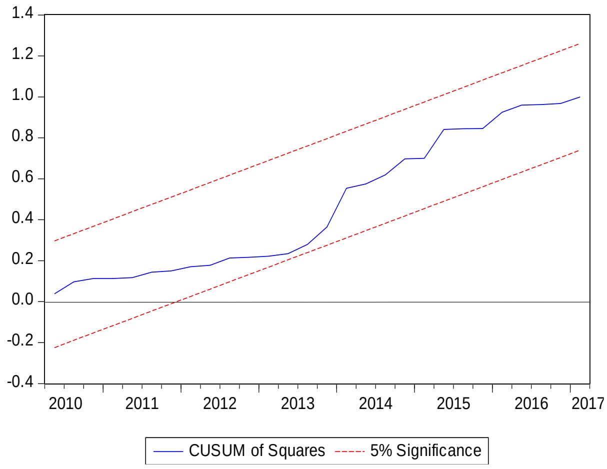


Figure 5.5: CUMU for model (1,0,0,0,0,0)

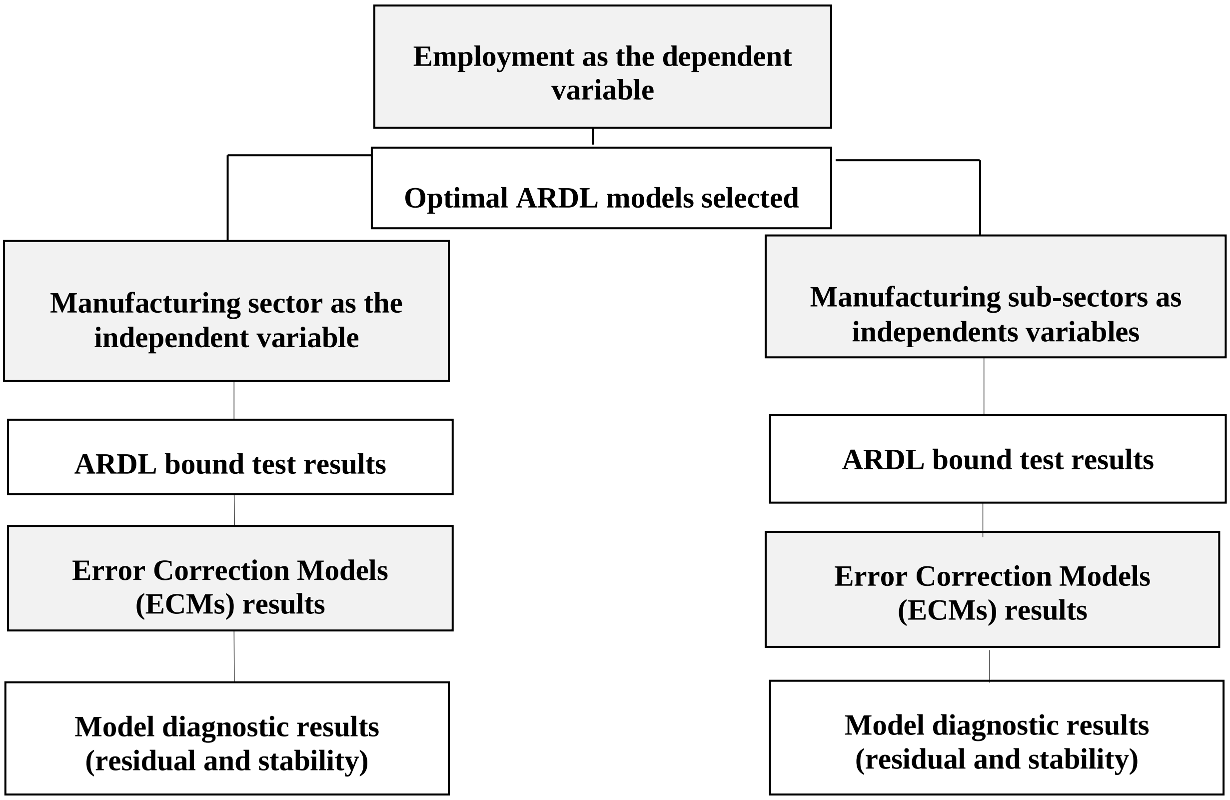


Moreover, the next section of this chapter will report, interpret and discuss the results obtained when estimating the impact of production in the total manufacturing sector and its sub-sectors under study on employment in the South African economy.

5.5.2 Manufacturing sector and its sub-sectors impact on employment

Figure 5.6 details how the study presents the results obtained when estimating the long- and short-run impact of production in the total manufacturing sector and its predominant sub-sectors under study on employment in South Africa.

Figure 5.6: ARDL model results presentation – Employment as dependent variable



Source: Constructed by the author

Figure 5.6 shows that in this section of the chapter the study will present the results of two ARDL models. However, unlike in Section 5.5.1 of this chapter, in this section the dependent variable is employment, thus the first ARDL model will present both the bound test and the ECM results (i.e. equations 4.14 and 4.16) obtained when regressing the production in the total manufacturing sector on employment. The second ARDL model will present both the bound test and ECM results (i.e. equations 4.15 and 4.17) obtained when regressing production in the manufacturing sub-sectors under study on employment. As such, the study will start by detailing the two optimal ARDL models selected and this will be followed by the bound tests and ECMs results of the two aforementioned ARDL models. Lastly, model residual and stability tests performed on the aforementioned ARDL models will then be presented and interpreted.

Nonetheless, before that, the maximum number of lags to include in each of these ARDL models was first determined using SIC. As mentioned before, the reason for that lies in the ability of the SIC to address the issues of over fitting by instituting a penalty term for the number of parameters. As such, the SIC selected three lags as the maximum number of lags to include in the ARDL model regressing the production in the total manufacturing sector on employment. Thus, when including 3 as the maximum number of lags, the optimal ARDL model following the sequence of the variables in Equation 4.14 was ARDL model (3,1). On the other hand, SIC also selected 3 lags as the maximum number of lags to include in the ARDL model regressing the production in the sub-sectors of manufacturing under study and employment, thus when including 3 as the maximum number of lags, the optimal ARDL model following the sequence of the variables in Equation 4.15 was ARDL model (1,0,0,0,0,0). Table 5.11 extensively details the optimal study models selected to estimate equations 4.14 and 4.15

Table 5.11: Optimal ARDL models selected

ARDL Model	Trend Specification	Max. no. of lags	Optimal model	R-Square	Adj. R-Square
Manufacturing vs employment	Constant level	3	(3,1)	99.10%	98.01%
Manufacturing sub-sectors vs employment	None	3	(1,0,0,0,0,0)	99.09%	99.00%

The optimal ARDL model (3.1) is estimated with a constant but without trend, while the optimal ARDL model (1,0,0,0,0,0) is estimated without a constant or trend as shown in Table 5.11. Not to mention, Table 5.11 also presents both the corresponding R-square and adj. R-square values of the ARDL model (3,1) and (1,0,0,0,0,0). As such, the R-square value for the ARDL (3,1) indicates that 99.10 percent of the variation in employment can be explained by the regression on the production in the total manufacturing sector. While the R-square value for the ARDL (1,0,0,0,0,0) indicates that 99.09 percent of the variation in employment can be explained by the regression on the production in manufacturing sub-sectors under study. Although this may be true, due to the R-square value's inefficiencies explained in Section 5.5.1 of this chapter, the study also reported the corresponding adj. R-square value.

As such, the adj. R-square value for the ARDL (3,1) indicates that 98.01 percent of the variation in employment can be explained by the regression on production in the total manufacturing sector. While the adj. R-square value for the ARDL (1,0,0,0,0,0) indicates that

99.00 percent of the variation in employment can be explained by the regression on production in the manufacturing sub-sectors under study. As such, having detailed and explained that the ARDL models used to regress the production in the total manufacturing sector and its sub-sectors under study on employment. The next step was to present the results obtained when estimating the bound tests and their corresponding ECMs of the aforementioned ARDL models.

5.5.2.1 ARDL bound test results: Long-run impacts on employment

The bound test results consisting of the lower and upper bounds with the corresponding F-value are given in tables 5.12 and 5.13. In this section of the chapter, the ARDL bound test approach to cointegration was also used to determine whether there is a long-run impact running from production in the total manufacturing sector and its sub-sectors under study to employment. As such, the long-run impact of production in the total manufacturing sector on employment is estimated using the ARDL model (3,1), while the long-run impact of production in the manufacturing sub-sectors under study on employment is estimated using the ARDL model (1,0,0,0,0,0). Therefore, tables 5.12 and 5.13 report the estimated ARDL model (3,1) and the ARDL model (1,0,0,0,0,0) bound tests results with their corresponding long-run equations.

Table 5.12: Estimated ARDL model (3,1) bound test results

ARDL model	**Estimated F-value**	
ARDL model (3,1)	7.80	
Critical Value Bounds		
Significance levels	**Lower bound I(0)**	**Upper bound I(1)**
10%	4.04	4.78
5%	4.94	5.73
1%	6.84	7.84
Note: critical values from Pesaran *et al*. (2001); Table CI (V)		
Long-run Equation: LEMP = -0.4206 + 1.1105*LMAN – 0.0354* FinCrisis + 0.0591* FIFA		

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

Table 5.13: Estimated ARDL model (1,0,0,0,0,0) bound test results

ARDL model	Estimated F-value	
ARDL model (1,0,0,0,0,0)	5.86	
Critical Value Bounds		
Significance levels	**Lower bound I(0)**	**Upper bound I(1)**
10%	2.26	3.35
5%	2.62	3.79
1%	3.41	4.68
Note: critical values from Pesaran *et al*. (2001); Table CI (V)		
Long-run Equation: LEMP = 0.1532*LAUTO - 0.1655*LCHEM + 0.1311*LCL + 0.5152*LFB + 0.3888*LMET - 0.0297* FinCrisis + 0.0335* FIFA		

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

- **Analysis of the long-run impact of production in the manufacturing sector and its predominant sub-sectors on employment**

Table 5.12 and 5.13 reports the estimated F-values for the ARDL model (3,1) and the ARDL model (1,0,0,0,0,0), with their corresponding critical values of the lower and upper bound. In light of this, Table 5.12 shows that the F-value for the ARDL model (3,1) is 7.80 and is greater than the corresponding critical values of the lower and upper bound at 5 percent significance level. For this reason, the null hypothesis of no long-run impact is rejected, implying that there is a long-run impact running from production in the total manufacturing sector to employment in the South African economy. This can be attributed to nature of the manufacturing sector that permits ample sub-divisions of labour in its production value chains as enunciated by (Smith, 1904:35). This empirical finding of the study is in line with findings of other empirical studies (Lewis-Wren, 1986; Smyth, 1986; Pianta, *et al.*, 1996; Pehkonen, 2000; Nordhaus, 2005; Chang and Hong 2006; Mkhize, 2015; Tsoku, *et al.*, 2017) that encountered that production in the manufacturing sector has a long-run impact on the employment level.

Furthermore, with regards to the role played by production in the manufacturing sub-sectors under study on employment in the long-run, Table 5.13 shows that the estimated F-value for the ARDL model (1,0,0,0,0,0) is 5.86 and it is greater than the corresponding critical values of the lower and upper bound at 1 percent significance levels. For this reason, the null hypothesis of no long-run impact is rejected, implying that there is a long-run impact running from production in the manufacturing sub-sectors under study to employment. That is to say, production in automotive, chemical, clothing, food and beverage, and metal sectors of manufacturing have a long-run impact on employment in the South African economy

- **Parameter estimation for the long-run impact of production in the manufacturing sector and its predominant sub-sectors on employment**

Table 5.12 presents the long-run equation corresponding to the long-run impact determined by the bound test results of the ARDL model (3,1) and it indicates that production in the total manufacturing sector has a positive long-run impact on employment. To enumerate, the long-run equation for the ARDL model (3,1) also indicates that a 1 percent increase in production in the total manufacturing sector will increase employment by 1.11 percent in the long run. Furthermore, Table 5.13 presents the long-run equation corresponding to the long-run impact determined by the ARDL model (1,0,0,0,0,0), and it can be deduced that production in four (i.e. automotive, food and beverage, clothing and metal) of five sectors of manufacturing under study have a positive long-run impact employment in the South African economy.

This empirical finding is consistent with an empirical finding encountered in the study conducted by McCormick and Rogerson (2004) that points out that the sub-sectors of manufacturing play a crucial role in creating employment in developing countries. This suggests that boosting the production in the automotive, clothing, food and beverage, and metal sectors of manufacturing will result in manufacturing-driven employment in the long-run for the South African economy. As such, the long-run equation generated by the ARDL model (1,0,0,0,0,0) given in Table 5.13, also indicates that a 1 percent increase in the production of the automotive, food and beverage, clothing and metal sectors of manufacturing under study will increase employment by 15.32, 51.52, 13.11 and 38.89 percent respectively.

On the other hand, production in one (i.e. chemical sector) of the five sectors of the manufacturing under study has a negative long-run impact on employment in the South African economy. In this case, the long-run equation given in Table 5.13 indicates that in the long run a 1 percent increase in the production of the chemical sector of manufacturing decreases employment by 16.55 percent. The reason for that lies in the fact that South Africa’s chemical sector is dominated by its upstream compartment that is technology based and extensively uses capital-intensive methods over labour-intensive methods in its production value chains (DTI, 2017). Thus, this is amongst the indicatives of the increasing problem of mechanisation in South Africa's manufacturing sector.

Furthermore, the long-run equations subsumed in tables 5.12 and 5.13 show that FinCrisis as a proxy for the 2008/09 global financial crisis has coefficients of -0.0297 and -0.0354, implying that the 2008/09 global financial crisis has a negative long-run impact on employment in the South African economy. In other words, the 2008/09 global financial crisis decreases employment in South Africa by approximately 2.97 to 3.54 percent in the long run when compared to periods free from economic disturbances or innovations.

Continuing in this line, the long-run equations subsumed in tables 5.12 and 5.13 also show that FIFA as a proxy for the 2010 FIFA World Cup has positive coefficients of 0.0335 and 0.0591. This implies that the 2010 FIFA World Cup has a positive long-run impact on employment in South Africa. As such, in the long run, the 2010 FIFA World Cup increases employment by approximately 3.35 to 5.91 percent in South Africa. This is true, as the South African economy had already witnessed the creation of approximately 130 000 jobs induced by the 2010 FIFA World Cup (Brand South Africa, 2010). Now that the existence of long-run impacts between the estimated variables is confirmed, the error correction models estimated by to both the ARDL model (3,1) and (1,0,0,0,0,0) are reported, interpreted and discussed in the next section (Section 5.5.2.2) of this chapter.

5.5.2.2 Error correction model (ECM) results and short-run impacts on employment

This section will report, interpret and discuss the short-run dynamic parameters attained by employing the ECM after the determination of long-run impacts by the ARDL bound test results in the preceding Section 5.5.2.1 of this chapter. The significance and purpose of ECMs are explained in Section 5.5.1.2 of this chapter. As such, Table 5.14 reports the ECM results for the ARDL model (3,1) and (1,0,0,0,0,0) respectively.

Table 5.14: Estimated ECM results

ARDL model (3,1)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LEMP(-1))	0.042106	0.113046	0.372464	0.7107
D(LEMP(-2))	0.113281	0.109903	1.030737	0.3064
D(LMAN)	0.109998	0.035144	3.129912	0.0026***

D(FinCrisis)	-0.002499	0.002090	-1.195392	0.2362
D(FIFA)	0.004176	0.003137	1.331143	0.1877
ECT(-1)	-0.070639	0.020751	-3.404171	0.0011***
ARDL model (1,0,0,0,0,0)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LAUTO)	0.013105	0.010144	1.291934	0.2008
D(LCHEM)	-0.014161	0.017482	-0.810050	0.4207
D(LCL)	0.011215	0.013755	0.815354	0.4177
D(LFB)	0.044086	0.026167	1.684774	0.0966*
D(LMET)	0.033266	0.017507	1.900128	0.0617*
D(FinCrisis)	-0.002545	0.001922	-1.323946	0.1900
D(FIFA)	0.002863	0.003138	0.912450	0.3648
ECT(-1)	-0.085569	0.032657	-2.620217	0.0108**
(***) denotes significance at 1% level (**) denotes significance 5 % level (*) denotes significance 10 % level				

Source: Compiled by the author (Data from Stats SA & SARB, 1998Q1-2017Q1)

Table 5.14 reports estimated ECM results with the short-run dynamic coefficients associated with the ARDL bound test results for the ARDL model (3,1) and (1,0,0,0,0,0). As mentioned before, the previous transpired short-run disequilibrium between the observed variables can be re-established back to equilibrium and the speed of adjustment can be estimated on condition that the ECT coefficients of the two aforementioned ARDL models are negative and statically significant. Given this point, the ECT coefficient for the ARDL model (3,1) is -0.070639 and it is significant at 1 percent significance level, which implies that around 7.06 percent of any previous transpired disequilibrium between employment and production in the total manufacturing sector is re-established back to long-run equilibrium each quarter. In other words, it takes roughly 14.16 (1/0.070639) quarters for any change in the production of the total manufacturing sector to have an impact on employment in the South African economy.

The latter implies that in the long-run causality runs through the ECT from the production in the total manufacturing sector to employment. Therefore, this confirms that production in the total manufacturing sector has a long-run impact on employment in the South African economy. Moreover, the short-run coefficient for employment is positive, implying that previous innovations in employment have a positive impact on the present-day employment. However, this impact is not statistically significant. On the other hand, the short-run coefficient for total manufacturing sector production is positive and significant at 1 percent significance level, meaning that in the short-run causality also runs from production in the total manufacturing sector to employment. Given this point, production in the total manufacturing sector has a short-run impact on employment in the South African economy**.** This suggests that production activities in the manufacturing sector can effectuate the demand for labour in the short run.

Furthermore, with regards to the role played by the production in the sub-sectors of manufacturing under study on employment, the ECM results for the ARDL model (1,0,0,0,0,0) given in Table 5.14 show that the ECT coefficient is -0.085569 and it is statistically significant at 5 percent significance level. This implies that around 8.56 percent of any previously transpired disequilibrium between employment and production in the sub-sectors of manufacturing under study is re-established back to long-run equilibrium each quarter. That is to say, it takes roughly 11.69 (1/0.085569) quarters for any change in the production of automotive, chemical, clothing, food and beverage, and metal sectors of manufacturing to have an impact on employment in the South African economy. Thus, in the long-run causality runs through the ECT from production in the automotive, chemical, clothing, food and beverage, and metal sectors to employment.

As such, this confirms that production in the sub-sectors of manufacturing under study has a long-run impact on employment in the South African economy. This suggests that boosting production in the automotive, food and beverage, chemical, clothing and metal sectors of manufacturing will generate manufacturing-driven employment in the long run for the South African economy. However, the production in two (i.e. metal and food and beverages) of the five sub-sectors of manufacturing under study have short-run coefficients that are positive and significant at 10 percent significance level. This implies that causality runs from production in the metal and food and beverages sectors of manufacturing to employment in the short run. Thus, it can be deduced that production in metal and food and beverages sectors of manufacturing has a positive short-run impact on employment in the South African economy. This suggests that boosting production in metal and food and beverage sectors of manufacturing creates jobs in the short run.

Equally important, Table 5.14 also shows that FinCrisis as a proxy for the 2008/09 global financial crisis has negative short-run coefficients of -0.002499 and -0.002545. However, these coefficients are not statistically significant, meaning that the 2008/09 global financial crisis would decrease employment in the South African economy by approximately 0.2499 to 0.2545 percent in the short-run if the coefficients were statistically significant. This suggests that the 2008/09 global financial crisis have a negative but insignificant short-run impact on employment in the South African economy. On the other hand, Table 5.14 shows that FIFA as a proxy for the 2010 FIFA World Cup has positive short-run coefficients of 0.002863 and 0.004176 that are statistically insignificant. This implies that the 2010 FIFA World Cup would increase employment in the South African economy by approximately 0.2863 to 0.4176 percent in the short run if the coefficients were statistically significant. As such, the 2010 FIFA World Cup has a positive but insignificant short-run impact on employment in the South African economy. In this case, the positive impact of the 2010 FIFA World Cup on employment in South Africa was reflected by the 130 000 jobs that were created through hospitality services, infrastructure developments and the construction of stadiums (Sports and Recreation South Africa, 2012).

Moreover, to ensure the results generated by the ARDL model (3,1) and (1,0,0,0,0,0) are not spurious or misleading, the next section will report the results of model residual and stability diagnostic test performed on both the aforementioned ARDL models.

5.5.2.3 ARDL model (3,1) and (1,0,0,0,0,0) diagnostic test results

The preceding sections 5.5.2.1 and 5.5.2.2 of this chapter presented bound tests and ECMs results generated by the ARDL model (3,1) and (1,0,0,0,0,0) respectively. As such, this section of the chapter will report results obtained when model residual and stability diagnostic tests were performed on both the ARDL model (3,1) and (1,0,0,0,0,0) respectively. This is to assure the reader that the results generated by both the aforementioned ARDL models are not spurious or misleading. In light of this, the residual diagnostic test results for the ARDL model (3,1) and (1,0,0,0,0,0) are given in Table 5.15.

Table 5.15: Residual diagnostic tests results

Residual diagnostics tests	ARDL models			
	ARDL (3,1)		ARDL (1,0,0,0,0,0)	
	P-value	**Decision**	**P-value**	**Decision**
Normality Test (JB)	0.0000	Reject H_0	0.0000	Reject H_0
Serial-correlation Breusch-Godfrey (LM test)	0.1453*	Do not reject H_0	0.7559*	Do not reject H_0
Heteroscedasticity Test: White (CT)	0.9983*	Do not reject H_0	0.9500*	Do not reject H_0
(*) Non-rejection of the null hypothesis at 1%; 5% & 10% significance level				

The residual diagnostic tests results given in Table 5.15 show that the bound tests and ECMs generated by the ARDL model (3,1) and (1,0,0,0,0,0) are susceptible to non-normality distribution but unsusceptible to serially correlation and heteroscedasticity. This implies that results generated by the ARDL model (3,1) and (1,0,0,0,0,0) are not spurious or misleading, even though the normality test results show a p-value that is equal to zero and that implies the rejection of the null hypothesis of normality distribution. The reason for that is more often than not, the null hypothesis for normality tests are rejected when dealing with large data samples because normally tests are without a α-stable distribution (Frain, 2007). In other words, normally tests are vulnerable to large data samples (Kundu, *et al*., 2011). Agung (2008) points out that normally tests do not cater for any model selected because the Jarque-Bera (JB) statistic is assumed to have its own specific distribution function. Considering this, the normality test results given in Table 5.15 does not certainly imply that the ARDL model (3,1) and (1,0,0,0,0,0) are susceptible to non-normality distribution.

Nonetheless, model stability diagnostic tests are required in the event of a failed normality test (Zanini, *et al*., 2000). In light of this, the stability diagnostic test results performed on both the ARDL model (3,1) and (1,0,0,0,0,0) are given in Figures 5.7 to 5.10 and it can be deduced that there is no instability of residuals indicated, since the plot (blue lines) of cumulative sum of recursive residuals (CUMU) and cumulative sum of squared recursive residuals (CUMUSQ) statistics for both the ARDL model (3,1) and (1,0,0,0,0,0) lie within the critical lines of 5 percent significance level of stability. Therefore, the ARDL model (3,1) and (1,0,0,0,0,0) are stable and the results generated by these models are reliable.

Figure 5.7: CUMU for model (3,1)

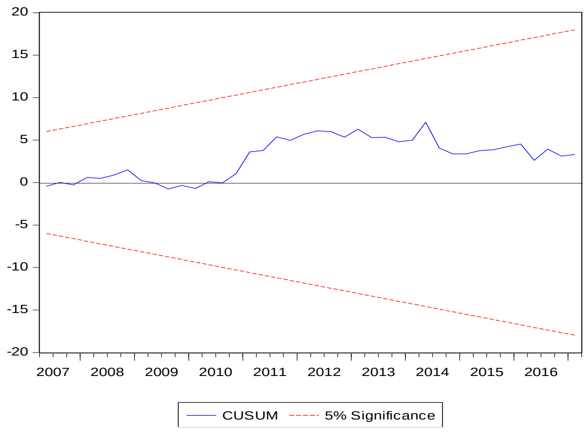


Figure 5.8: CUMU of sq. for model (3,1)

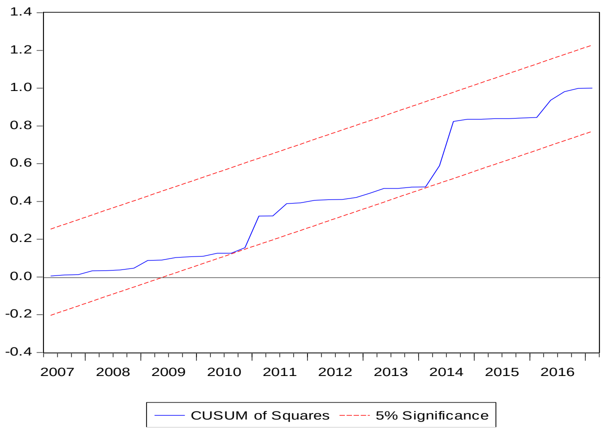


Figure 5.9:CUMU for model(1,0,0,0,0,0)

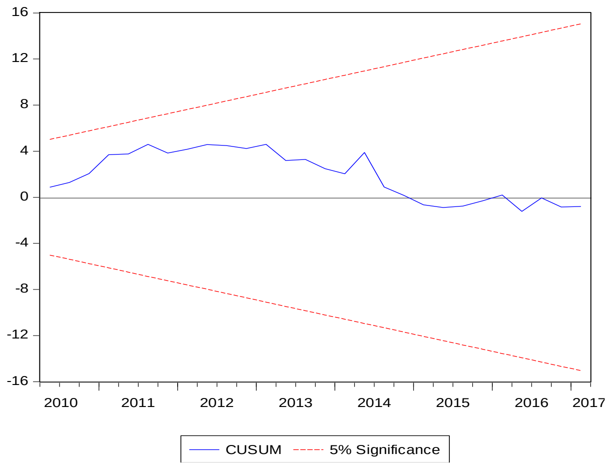
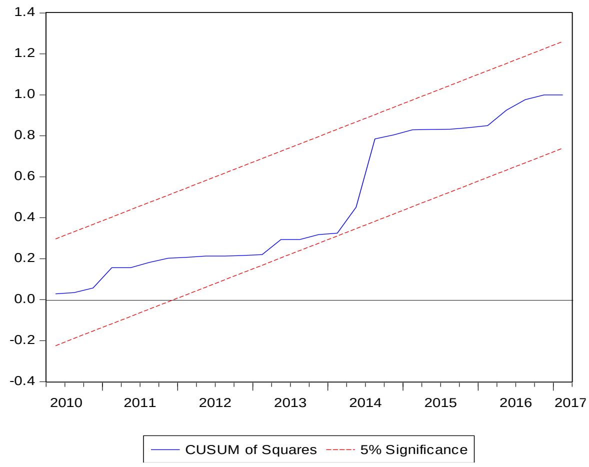


Figure 5.10: CUMU of sq. for model(1,0,0,0,0,0)



5.6 SUMMARY AND CONCLUSION

The main objective of this chapter was to present empirically the impact of production in the total manufacturing sector and its sub-sectors under study on GDP and employment in South Africa. In achieving this objective, an ARDL model and other econometric techniques (i.e. unit root tests, stationarity test, multiple-break point test, error correction model and residual and stability diagnostic tests) were used to estimate the short- and long-run impact of the independent variables on the dependent variables. As such, the chapter started by presenting the descriptive statistics in order to profile the data of the study. This was then followed by a correlation matrix that was used to assess the relationship between the dependent variables and the independent variables of the study and it indicated that production in the total manufacturing sector and four (i.e. automotive, chemical, food and beverage and metal) of five sectors of manufacturing under study has a positive relationship with GDP. However, the only production in the total manufacturing sector and three (i.e. automotive, chemical, food and beverage) of five sectors of manufacturing under study have a positive and statistically significant relationship with GDP.

On the other hand, production in the total manufacturing sector and four (i.e. automotive, chemical, food and beverages, and metal) of five sectors of manufacturing under study have a positive correlation with employment, but this positive correlation is statistically significant for production in total manufacturing sector and three (i.e. automotive, chemical, food and beverages) of five manufacturing sectors under study. Moreover, this chapter also presented both the unit root test results and the stationarity test results generated using the augmented Dickey-Fuller (ADF) unit root test, Phillips-Perron (PP) unit root test and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) stationarity test and the KPPS stationarity test was used as a confirmatory test for both the ADF and PP unit root tests. As such, a common conclusion that was reached by the tests was that the variables of the study consist of a mixture of I(0) and I(1) order of integration and no variables of the study are stationary at I(2).

Subsequently, the chapter pointed out relevant break-dates in the data of the study that were diagnosed using the Bai-Perron's multiple break-point test procedure of L + 1 vs. L sequential. This effectuated the creation of two dummy variables (i.e. FinCrisis and FIFA) to capture the effects of the 2008/09 global financial crisis and 2010 FIFA World Cup since the identified break-dates were between the second quarter of 2008 and the fourth quarter of 2010. Moreover, the chapter then presented the results obtained when using the ARDL models to estimate the long- and short-run impact of the production in the total manufacturing sector and its sub-sectors under study on GDP in South Africa. To begin with, the results revealed that production in the total manufacturing sector and its sub-sectors under study have a long-run impact on GDP. However, production in the total manufacturing sector and production in four (i.e. automotive, chemical, food and beverage and metal) of five sectors of manufacturing under study have a positive long-run impact on GDP. While production in the clothing sector of manufacturing has a negative long-run impact on GDP of the South African economy. With regards to short-run impacts on GDP, only the production in the total manufacturing sector and production in two (i.e. automotive and metal) of the five sectors of manufacturing under study have a positive short-run impact on GDP in the South African economy.

Furthermore, the chapter also presented the results obtained when using the ARDL models to estimate the long- and short-run impact of production in the total manufacturing sector and its sub-sectors under study on employment in South Africa. The results revealed that production in the total manufacturing sector and its sub-sectors under study have a long-run impact on employment in South Africa. Nonetheless, production in four (i.e. automotive, food and beverage, clothing and metal) of five sectors of manufacturing under study have a positive long-run impact on employment, while production in one (i.e. chemical) of five sectors of manufacturing under study has a negative long-run impact on employment in the South African economy. In the short-run, the only production in the total manufacturing sector and two (i.e. metal and food and beverages) of five sectors of manufacturing under study have a positive impact on employment in South Africa.

The economic disturbances or innovations that took place during the period under study (1998Q1-2017Q1) transpired during the 2008/09 global financial crisis and the 2010 FIFA World Cup. As such, the dummy variables created to capture the long- and short-run impacts of these economic disturbances or innovation on GDP and employment were integrated into all the ARDL models that were estimated. Therefore, the chapter revealed that the 2008/09 global financial crisis has a negative and significant long-run impact on both GDP and employment in South Africa. However, in the short-run, the 2008/09 global financial crisis has a negative but insignificant impact on both GDP and employment in South Africa. On the other hand, the chapter also revealed that the 2010 FIFA World Cup had a positive and significant impact on GDP in the long- and short-run, but a positive and significant impact on employment only in the long run. Lastly, the chapter also presented the residual and stability diagnostic tests performed on all estimated ARDL models and the results of these tests revealed that all the estimated ARDL models are unsusceptible to non-normality distribution, serial correlation, heteroscedasticity and instability. This implies results estimated by all the ARDL models of the study are not misleading or spurious.

CHAPTER 6: SUMMARY, RECOMMENDATIONS AND CONCLUSIONS

6.1 INTRODUCTION

The study was motivated by the incessant poor production performance of the manufacturing sector that mirrored low GDP growth rates and employment levels in the South African economy. Thus, the intrinsic features of the manufacturing sector were reviewed and it was deduced that the manufacturing sector is filled with great potential to induce GDP growth and employment (Chapter 2: Section 2.3.3). In other words, a resilient and endurable manufacturing base is vital for economic growth and employment (Chapter 2: Section 2.3.3). As such, manufacturing as an engine for economic advancement is a phenomenon that is tested by many empirical studies in various economies, however, there are not many empirical studies that have tested this phenomenon in the context of the South African economy. There is a dearth of empirical studies that have investigated the impact or relationship between production in the predominant manufacturing sub-sectors (i.e. automotive, metals, food and beverages, clothing and chemicals), GDP and employment in the context of the South African economy. Thus, this study is aimed at contributing towards filling the existing gap in the literature of manufacturing-driven economic growth and employment in the context of the South African economy.

In view of the above discussion, this study had an objective to estimate the impact of production in the total manufacturing sector and its sub-sectors under study on GDP and employment. That is to say, the study had an intention to answer two central research questions:

- Does production in the manufacturing sector have an impact on GDP and employment in the South African economy?

- Which sector of manufacturing induces manufacturing-driven economic growth and employment in the South African economy?

Therefore, to respond to the aforementioned questions, the study reviewed both the theoretical and the empirical literature underpinning the manufacturing sector as an engine of economic growth and employment. This was followed by a review of the production performance of the manufacturing sector and its sub-sectors under study together with the available policies and incentive schemes supporting the manufacturing sector in the South African economy. Lastly, the econometric estimation approach adopted by the study was methodised and applied. As such, Chapter 6 presents a summary, achievements and conclusions of the study, together with logical recommendations for improved manufacturing performance in the South African economy.

6.2 SUMMARY OF THE STUDY

This section of the study unpacks the manner in which the study was conducted. With this in mind, the study is categorised into six chapters that collectively address the primary objective and both the theoretical and empirical objectives of the study. Chapter 1 mainly embodies the foundation of the study. In other words, Chapter 1 presents the introduction, background, problem statement, ethical considerations, objectives and the importance of the study. Subsequently, chapters 2 and 3 presented the theoretical and empirical literature of the study and reviewed the manufacturing production performance and abutments in South Africa respectively. Chapters 4 and 5 unpacked the methodology adopted by the study and presented an interpretation and discussion of results achieved by the study. Lastly, Chapter 6 presents the overall summary, conclusions and achievements of the study, while suggesting recommendations.

6.2.1 Chapter 2: Summary of background/theory and empirical literature of the study

Chapter 2 presented the theoretical and empirical literature of the study. First, the chapter defined and contra-distinguished key concepts of the study in order to ensure the reader is capacitated with a greater understanding of these concepts in order to effortlessly comprehend the use of these concepts in the study. Secondly, the chapter presented the theoretical literature elucidating the generation of GDP growth within an economy; this involved reviewing the growth theory from a viewpoint of prominent schools of thought (i.e. classical, neo-classical, Keynesian and new growth theorists). Thirdly, the chapter presented an attempt to theorise employment creation with the help of two prominent employment theories (i.e. Phillips curve and Okun’s law). This was then followed by theoretical arguments for manufacturing-driven economic growth and employment in order to discuss the intrinsic features of the manufacturing sector that reflect the vast potential of the sector to generate economic growth and employment. As such, this provided a rational basis for the study to consult empirical studies exploring the role of the manufacturing sector in generating economic growth and employment.

Moreover, Chapter 2 also presented the empirical literature of the study, consulting various empirical studies that investigated the relationship or link between the growth in the manufacturing sector, GDP and employment in the context of South Africa and other countries. In light of this, the link between growth in the manufacturing sector and GDP was explored first and it was corroborated by the empirical findings of many reviewed empirical studies that growth in the manufacturing sector induces growth in GDP. On the other hand, regarding the link between growth in the manufacturing sector and employment, most of the empirical studies corroborated that growth in the manufacturing sector induces employment. However, there were a few empirical studies that perpetuated contrary findings. For the most part, many reviewed empirical studies corroborated that growth in the manufacturing sector induces growth in both GDP and employment.

6.2.2 Chapter 3: Summary of manufacturing performance and support measures in South Africa

Chapter 3 reviewed the production performance in the manufacturing sector and the available support measures for manufacturing in the South African economy. To clarify, the chapter discussed the emergence of a solid and resilient manufacturing sector in the South African economy. This was followed by a review of trends in the production of the total manufacturing sector and its predominant sub-sectors under study over the period 1998 Q1 to 2017 Q1. In this case, the chapter used tables, figures and graphs to analyse trends. Quarterly percentage contributions of production in the manufacturing sector to GDP and employment in the South African economy were presented in this chapter. Furthermore, the abutments set out by the South African government for the manufacturing sector were also reviewed and this entailed a review of policies (i.e. NDP, NGP and IPAP) and industrial schemes (i.e. P-AIS, MIP, 12I, SPII, ADEP, CTCIP and AIS) that enhance competitiveness in the South African manufacturing sector.

6.2.3 Chapter 4: Summary of the methodology of the study

Chapter 4 presented and discussed the methodology adopted by the study in investigating the impact of production in the manufacturing sector and its predominant sub-sectors under study on GDP and employment in South Africa. With this in mind, the study used secondary data that were derived from the SARB and Stats SA. The secondary data used covered a period 1998 Q1 to 2017 Q1 (i.e. 77 quarterly observations) and the choice of using data that covers the aforementioned period was motivated by the availability of data. Furthermore, the variables of the study included GDP (economic growth) and non-agricultural employment total index (i.e. the proxy for employment) as the dependent variables of the study, while the production volume indexes of the total manufacturing sector and its predominant sub-sectors under study were independent variables of the study. In this case, production in the total manufacturing sector and its predominant sub-sectors under study was regressed on GDP and employment.

Considering the latter, the methodology of this study followed a functionalist approach that seeks to understand economic phenomena regarding its relationship with a particular system. As such, an ARDL model is employed in this study to capture the response of GDP and employment to changes in the production of the manufacturing sector and its predominant sub-sectors under study in South Africa. In this regard, the study methodised ARDL models and all the necessary econometric techniques (unit root tests, stationarity test, multiple-break point test, error correction model and residual and stability diagnostic tests) conditional to ensure quality and accurate results. To summarise, Chapter 4 presents the origin of the data of the study, the sample size, the specification of variables of the study and methodised the econometric estimation approaches adopted by the study.

6.2.4 Chapter 5: Summary of results / Empirical findings of the study

Chapter 5 presented and discussed results obtained from all the employed econometric techniques for the estimation of the impact of production in the manufacturing sector and its predominant sub-sectors under study in South Africa. As mentioned before, the econometric techniques employed by the study included unit root tests, a stationarity test, a multiple-break point test, ARDL models, ECMs and residual and stability diagnostic tests. In brief, the variables of the study comprised variables that are stationary at I (0) and I (1), with no variable stationary at I (2). For that reason, an ARDL model was used and it produced results that indicated that the manufacturing sector is still embedded with the potential to induce GDP growth and employment in South Africa. Results indicated that production in the manufacturing sector and its predominant sub-sectors under study have a long-run impact on GDP and employment in the South African economy.

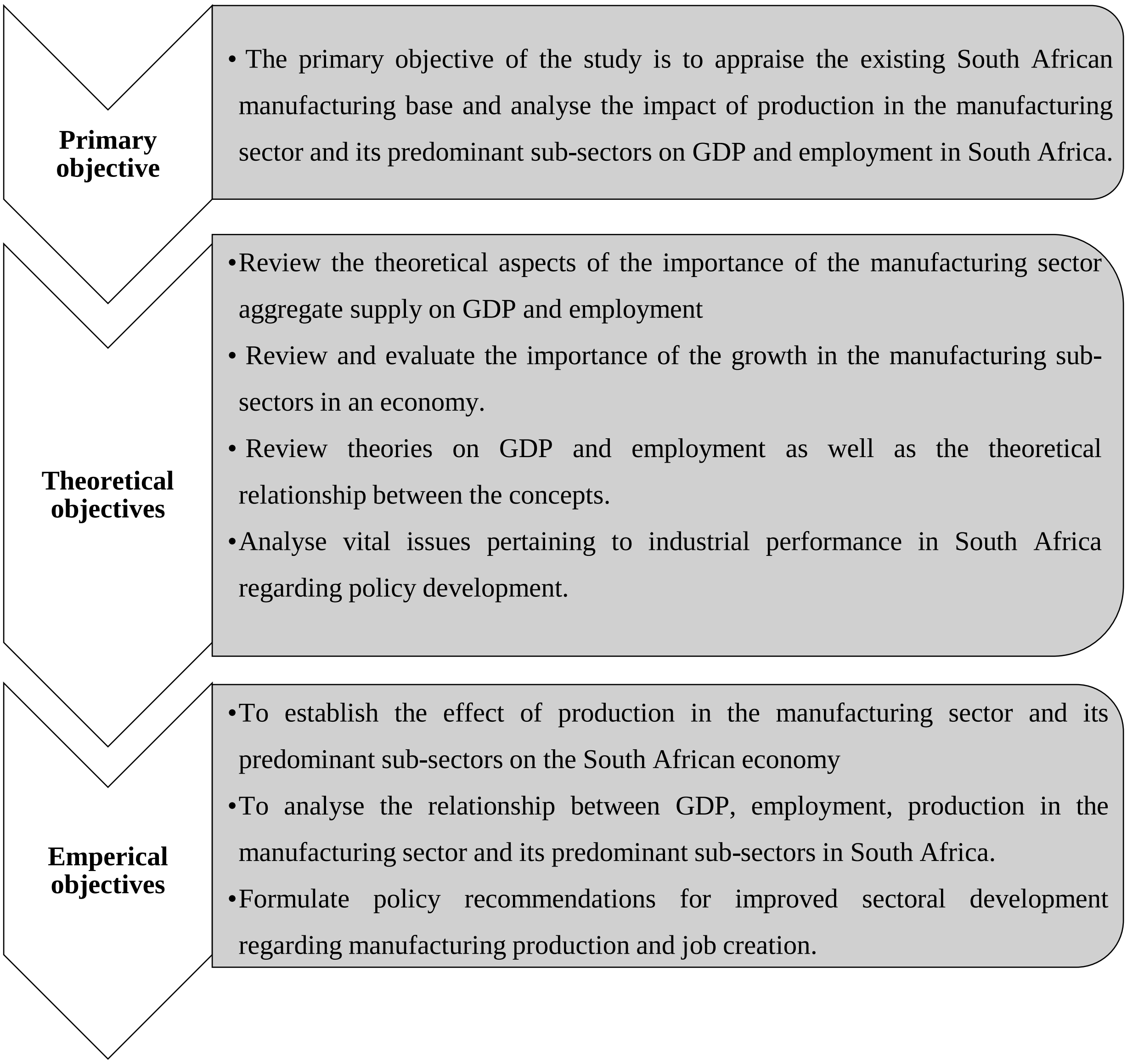
However, production in the total manufacturing sector and four (automotive, chemical, food and beverage and metal) of the five predominant sectors of manufacturing under study increases South Africa’s GDP in the long run. In other words, production in the clothing sector decreases South Africa’s GDP in the long run. At the same time, production in the total manufacturing sector and four (i.e. automotive, food and beverage, clothing and metal) of the five predominant sectors of manufacturing under study has a positive long-run impact on employment in the South African economy. That is to say, production in the chemical sector of manufacturing decreases employment in the long run. In the short run, production in the manufacturing sector increases both GDP and employment, however, only production in the automotive and metal sectors of manufacturing increase GDP in the short run. While production in the metal and food and beverages sectors of manufacturing increases employment in the short run.

Furthermore, the Bai-Perron multiple-breakpoint results effectuated the creation of dummy variables to account for the economic innovations or disturbances induced by the 2008/09 global financial crisis and the 2010 FIFA World Cup. The two dummy variables (i.e. FinCrisis and FIFA) were integrated into every ARDL model that was estimated in the study and the results indicated that the global financial crisis has a negative and significant long-run impact on both GDP and employment in South Africa. In the short run, the crisis has a negative and insignificant impact on GDP and employment in South Africa. On the other hand, the 2010 FIFA World Cup has a significant and positive long-run impact on both GDP and employment in South Africa. In the short run, the 2010 FIFA World Cup has a positive and significant impact on GDP but has a positive and insignificant impact on employment in the South African economy. Equally important, the results of residual and stability diagnostics performed on all the models of the study indicated that none of the study models are non-normality distribution, serially correlated, heteroscedastic and unstable. This confirms that the results of the study are accurate and reliable.

6.3 ACHIEVEMENT OF STUDY OBJECTIVES

The objectives of the study were presented in Section 3.1 of Chapter 1 and they were categorised into three various objectives, namely the primary, theoretical and empirical objectives. This section of Chapter 6 revises the objectives of the study and highlights the manner in which these objectives were achieved. In this case, Figure 6.1 presents the objectives of the study.

Figure 6.1: Objectives of the study



Source: Compiled by the author

6.3.1 Primary objective of the study

The primary objective of the study was to appraise the existing South African manufacturing base and analyse the impact of production in the manufacturing sector and its sub-sectors on GDP and employment in South Africa. As such, the summary of the study given in Section 6.2 of this chapter indicates the manner in which the primary objective was achieved.

6.3.2 Theoretical objectives of the study

The four theoretical objectives given in Figure 6.1 were all achieved in Chapters 2 and 3. Section 2.3.3 of Chapter 2 achieved the first and second theoretical objectives by presenting theoretical arguments for manufacturing-driven economics and employment; this entailed discussing the intrinsic features of the manufacturing sector (i.e. high magnitude of capital, technology, increasing returns, the spillover effect, employment creator as well as the forward and backward linkages) that induce growth in GDP and employment. Furthermore, Sections 2.3 and 2.4 of Chapter 2 achieved the third theoretical objective of the study. To clarify, Section 2.3 of Chapter 2 reviewed growth theories (classical, neo-classical, Keynesian and new growth theorists) and employment theories (Phillips curve and Okun's law) in order to shed light on how economic growth and employment are generated in an economy. While Section 2.4 of Chapter 2 presented empirical findings linking manufacturing with GDP and employment. Furthermore, Section 3.4 of Chapter 3 achieved the fourth and last theoretical objective of the study, as it outlined support measures (policies and incentive schemes) formulated by the South African government regarding the improvement of manufacturing competitiveness.

6.3.3 Empirical objectives of the study

The two empirical objectives given in Figure 6.1 were all achieved in chapters 5. The first and second empirical objectives of the study were achieved by both the correlation matrix and econometric models given in Section 5.3 and 5.5 of Chapter 5. As such, the results of the correlation matrix indicated that production in the manufacturing sector and three (i.e. automotive, chemical, food and beverage) of the five predominant sectors of manufacturing under study increases with GDP and employment in the South African economy. While the results of the econometric estimation approach employed indicated that production in the manufacturing sector and four (automotive, chemical, food and beverage and metal) of the five predominant sectors of manufacturing under study induce GDP growth in South Africa in the long run. In addition, production in the manufacturing sector and four (i.e. automotive, food and beverage, clothing and metal) of the five predominant sectors of manufacturing under study induce employment in the South Africa in the long run.

In the short run, production in the manufacturing sector generates GDP growth and employment, however, only the production in the automotive and metal sectors of manufacturing generates GDP growth in short run. While production in the metal and food and beverages sectors of manufacturing generates employment in South Africa in the short run.

Moreover, Section 6.4 of Chapter 6 will achieve the third and last empirical objective of the study by presenting recommendations regarding the improved manufacturing performance in the South African economy.

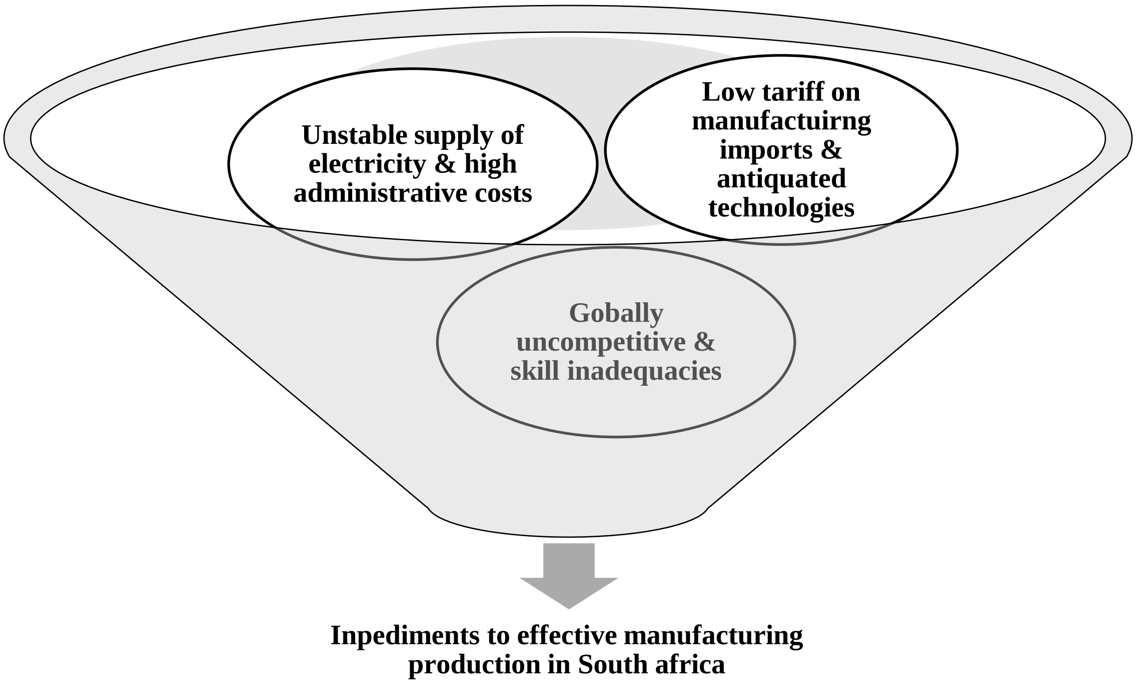
6.4 RECOMMENDATIONS

In recent times the South African economy has been characterised by low GDP growth rates and high unemployment levels, this effectuates the country to search for new opportunities that can generate GDP growth and employment. In this case, the study believes that the manufacturing sector is embedded with vast potential to induce a substantial increase in the growth of GDP and employment in the South African economy. The reason for that is that the manufacturing sector gives rise to greater division of labour that increases demand for the low, medium and high skilled labour in manufacturing value-chains (Chapter 2: Section 2.3.3). Also, the manufacturing sector presents remarkable opportunities for technological advancements coupled with increasing returns to scale that results in growth in GDP of a country (Chapter 2: Section 2.3.1.1). However, in reality, the South African manufacturing sector is struggling, as the sector continues to perform less than expected given its developmental stage (Odendaal, 2017).

This is due to the challenges induced by the unstable electricity supply, high administrative costs, skills inadequacies, global competition and antiquated technologies (Engineering News, 2013). For years, these challenges have served as impediments to effective manufacturing production in the South African economy and this has made the sector less competitive (Fin24, 2015). As a consequence of the aforementioned challenges undermining the production in the South African manufacturing sector, Stats SA (2017) points out that in 2016 the manufacturing sector was amongst the main economic sectors that contributed to negative economic growth in the South African economy. During the same period, Stats SAs Quarterly Labour Force Survey indicated that unemployment levels rose to a record high (Stats SA, 2017).

As such, the South African manufacturing sector has been underperforming and this has mirrored the country's GDP and employment levels. Given these points, the study succinctly presents the challenges that serve as impediments to effective manufacturing production in the South African economy. This is done to accentuate the key focus areas that need to be given attention for the betterment of manufacturing production and consequentially GDP growth and employment in the South African economy. Figure 6.2 presents key challenges faced by the manufacturing sector in the South African economy.

Figure 6.2: Key challenges facing the manufacturing sector in South Africa



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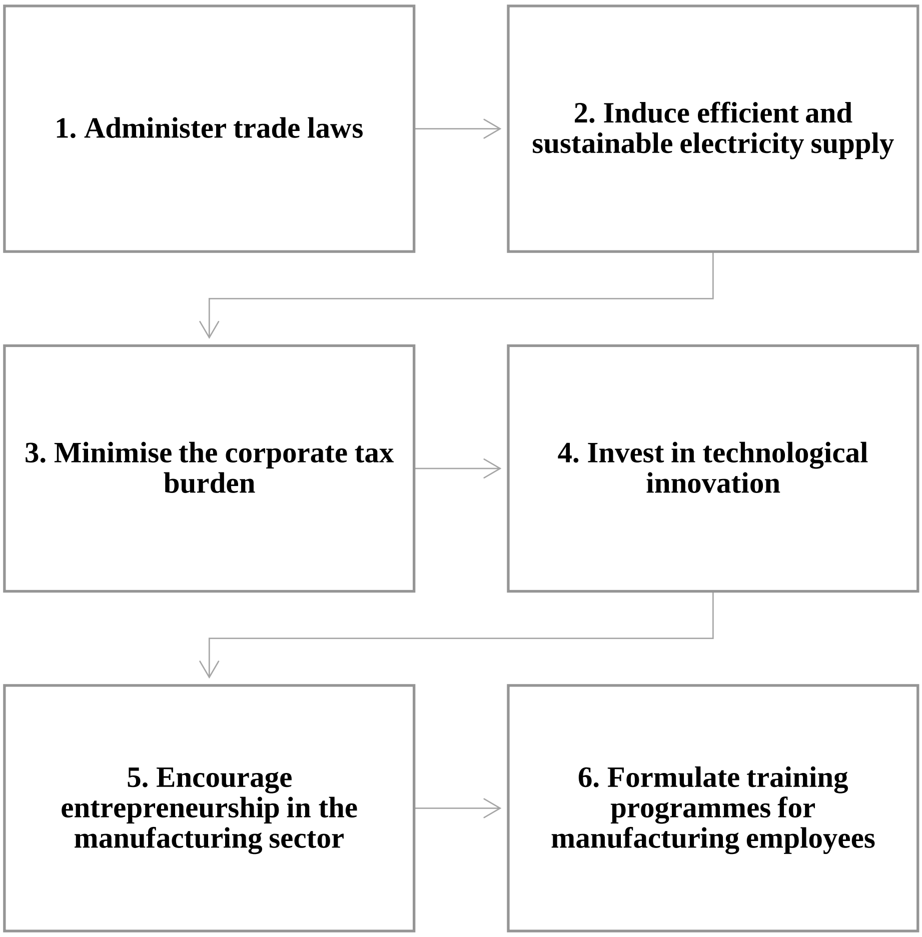
Nonetheless, it should be noted that the manufacturing sector has long been a driver of GDP growth and employment in South Africa. Between 1945 and mid-1970s, the highest growth in GDP was induced by a 2.6 percent growth in manufacturing that exceeded GDP growth during the aforementioned period (Chapter 3: Section 3.2). During the same period, employment in the manufacturing sector experienced a growth of 4.2 percent that was higher than the period of 1993 to 2012 (Zalk, 2014). As such, the latter accentuates the potential of the manufacturing sector and justifies that supporting the manufacturing sector can boost GDP and employment growth in the South African economy. The empirical results of the study indicated that production in the manufacturing sector and some of its predominant sub-sectors under study can induce GDP growth and employment in both the short- and long run. This necessitates the need to strengthen, support and create an environment where the manufacturing sector can materialise its potential to create economic growth and employment in the South African economy. Therefore, in assisting the South African manufacturing sector to surmount its aforementioned challenges, the study recommends six action plans for revitalising the manufacturing sector in South Africa. As such, Figure 6.3 illustrates six action plans that can collectively serve as a turnaround strategy for effective manufacturing production in the South African economy.

Figure 6.3: Six action plans for effective manufacturing production in South Africa



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6.4.1 Administer trade laws

The South African trade laws must be administered in order to safeguard the manufacturing firms in South Africa from the surge of cheap manufacturing imports from countries with extensive production capacities. As such, this can be achieved by imposing a safeguard duty on imported manufacturing goods in the form of a protective tariff. This will make it more expensive to import manufacturing goods into the South African economy, thus discouraging manufacturing imports while safeguarding domestic manufacturing firms. This will not only serve to protect domestic manufacturing firms, but will serve as both a revenue and punitive function for the South African economy. In other words, imposing import tariffs on manufactured goods will generate revenue for the South African government and serve as a restorative measure for trade deformations that might have materialised as a result of over-producing countries dumping manufacturing goods in the South African economy.

Considering the latter, the review of production performance in the manufacturing sector and its predominant sub-sectors under study presented in Section 3.3 of Chapter 3 has indicated that out of the five predominant sectors of manufacturing under study, the clothing and the metal sectors are the worst performing sectors of manufacturing in the South African economy. As mentioned before the reason for that is the surge of cheap clothing and metal goods from over-producing countries such as China, India and Bangladesh (Chapter 3: Section 3.3). Therefore, focusing on trade laws in the manner suggested by the study will remedy the underlying impediments to the production in the clothing and metal sectors of manufacturing. This will boost the overall production in the manufacturing sector and induce GDP growth and employment as suggested by the empirical findings of the study.

6.4.2 Induce efficient and sustainable electricity supply

The Energy Information Administration (EIA, 2008) pointed out that the South African economy experienced inefficiencies in its electricity supply in 2008 when power shortages induced load-shedding or electricity black-outs that in turn affected production in the manufacturing and mining sectors. Consequently, estimated economic losses of $253 million and $282 million were incurred in the manufacturing and mining sectors respectively (EIA, 2008). In this case, inducing an efficient and continuous supply of electricity is amongst the key initiatives towards the improvement of the production in the manufacturing sector (Mpatane, 2015:1). This implies that maintaining an efficient and continuous supply of electricity is imperative for manufacturing-driven economic growth and employment in South Africa, since the empirical findings of the study confirmed that there is a positive and significant long-run impact running from production in the manufacturing sector to both GDP and employment in the South African economy.

That is to say, the implications of an inefficient supply of electricity in South Africa not only put production in the manufacturing sector at risk, but also GDP growth and the creation of employment. This effectuates the need to enforce an efficient and sustainable electricity supply in South Africa, therefore, the South African economy should consider investing moderately in fossil fuels (e.g. coal etc.) and heavily in renewable energy (e.g. solar power, wind power etc.) to generate electricity. The reason for that lies in the nature of the renewable energy that is inexhaustible; which will not only induce sustainable electricity supply but will prevent high priced energy imports. In spite of the latter, a joint effort of all South Africans to use the supplied electricity efficiently and with caution needs to be emphasised and this can be achieved by launching social awareness programmes or incentives that are aimed at encouraging efficient use of electricity.

6.4.3 Minimise the corporate tax burden

Investments can be seen as a double-edged sword, as they give rise to both demand and supply, where demand is raised by the multiplier and supply is raised by its effect on amplifying capacity (Chapter 2: Section 2.3.1.1.). Considering this, investments are necessary for achieving a competitive manufacturing sector, as they can potentially induce demand for manufacturing goods, expand the sector's production capacity and diversify manufacturing exports (Chidede, 2017). In this case, Dreßler (2012:2) pointed out that investments are susceptible to corporate tax, in the sense that a high corporate rate discourages investments, while a low corporate tax encourages investments. According to World Bank (2015:34), the manufacturing sector has marginal effective tax rates (METR) of 19.6 percent, making it the second-most taxed sector after the electricity sector, which has a METR of 23 percent. This indicates that a high corporate tax is amongst the factors giving rise to high administration costs that hinder effective manufacturing production in the South African economy. Therefore, the study recommends that reducing the rate of corporate tax will encourage more investments in the South African manufacturing sector, as the cost of acquiring capital and labour for manufacturing production will be minimal.

6.4.4 Invest in technological innovation

Technological innovation refers to a process that consists of various distinguishable stages (i.e. invention, realisation and implementation) that collectively use technological knowledge to devise new and transformed approaches towards overcoming a perceived challenge (Mentz, 2006:8). As such, the modern-day business practices that depend heavily on competitiveness necessitate the adoption of technological innovations. According to Singh *et al*. (2015:402), technological innovation is the most important aspect of improving the performance of manufacturing firms. The reason for that is most manufacturing sectors are technology intensive (Flaherty, 1992:273). That is to say, the performance of the manufacturing sector relies on technological innovation. Taking this into account, the production performance of the manufacturing sector in the South African economy has been lacklustre post the 2008/09 global financial crisis (Chapter 3: Section 3.3).

Since the crisis, the domestic economic conditions induced an unfavourable environment for production in the manufacturing sector to regain its momentum. As such, considering the empirical findings of the study, this has both short- and long-run negative implications on GDP and employment in South Africa. Thus, the study recommends that investing in technological innovation will provide a much-needed boost in the manufacturing production. Consequently, a competitive manufacturing sector that practices modern-day technological approaches to manufacture value-added goods will be established. This will increase GDP in South Africa, as it is self-evident that technological innovation has been the pivotal ingredient of economic growth (Rosenberg, 2004:1). Equally important, Winthrop *et al*. (2016:8) point out that one of the things that technological innovations depend on are the skills and resourcefulness of people using the new technology. In this case, manufacturing employees will need to be equipped with necessary technical skills that will enable them to be resourceful in technology-intensive value chains.

6.4.5 Encourage entrepreneurship in the manufacturing sector

High administrative costs coupled with weak protective measures have made it hard for the South African manufacturing firms to succour their manufacturing operations (Chapter 3: Section 3.3). This causes a number of manufacturing firms to close their respective operations, resulting in jobs losses and declines in the aggregate South African manufacturing output. As such, to retain and create manufacturing-driven economic growth and employment, the study suggests that creating an enabling environment that will enable and encourage the inception of new manufacturing firms and ensure effective production activities in existing manufacturing firms. This can be achieved by investing in infrastructure (e.g. transportation, waste removal, utilities, electricity, health care and education), supplementing existing manufacturing incentives schemes and inaugurating special incentives for all predominant sectors of manufacturing in South Africa. In this case, entrepreneurs that are looking to venture into manufacturing can be lured by a well-developed infrastructure and access to finance needed to start manufacturing firms. Therefore, South Africa’s aggregate manufacturing production will increase as manufacturing firms are launched; thus, boosting economic growth and employment as suggested by the empirical findings of the study.

6.4.6 Formulate training programmes for manufacturing employees

Human capital is an imperative input in every production activity, as it instigates increasing returns, that is, a state where labour productivity and per capita income increases, as GDP and employment expand (Chapter 2: Section 2.3.1.1). Equally important, once human capital is accumulated, it can be reused at no cost and without depreciating. For that reason, the study suggests that training programmes are vital for the improvement of production in South Africa's manufacturing sector. This is motivated by the fact that training programmes will equip manufacturing employees with knowledge and technical expertise that will enable them to perform their respective jobs in various manufacturing value-chains efficiently. This will not only reduce the cost of production in the manufacturing sector, but will result in effective manufacturing production and skilled manufacturing employees. Therefore, this will address the skill shortages across the manufacturing sectors, while alleviating the job losses that will be induced by the forthcoming third industrial revolution.

6.5 LIMITATIONS OF THE STUDY AND FURTHER RESEARCH

The major challenge that was encountered by the study was a time limit, this impelled the study to focus only on predominant sub-sectors of the South African manufacturing sector as opposed to analysing all the manufacturing sub-sectors in the South African economy. In this regard, it should be noted that production in all the sectors of manufacturing in South Africa have distinctive contributions to both GDP and employment. Therefore, being impelled to focus on only predominant sectors as opposed to all sub-sectors of manufacturing may induce incompatible results. Again, the study mainly analyses the impact of production in only the manufacturing sector on GDP and employment, disregarding the impact of production in other economic sectors of the South African economy on GDP and employment.

Furthermore, the non-agricultural employment data used as a proxy for employment may not account for aggregate employment levels in South Africa, since the agricultural sector also accounts for creating a substantial amount of jobs in the South African economy. Thus, discounting employment created by the agricultural sector may not result in definite contributions of the manufacturing sector to aggregate employment in the South African economy, but yield definite manufacturing sector contributions to employment that is created by all the economic sectors in the South African economy except the agricultural sector. As such, to respond to the aforementioned limitation of this study, future study should consider the following:

- Incorporating other sub-sectors of manufacturing to assess their respective impact on GDP and employment in South Africa.

- Analyse the impact of all economic sectors in South Africa on the country's GDP and employment.
- Capture the data of both non-agricultural employment and agricultural employment when analysing employment drivers within an economy.

6.6 CONCLUSIONS

The manufacturing sector was amongst the economic sectors of the South African economy hit hard by the 2008/09 global financial crisis and since the crisis, production in the sector has been lacklustre, failing to re-establish its pre-crisis level. This still remains the case with the manufacturing sector in South Africa, despite the economic investments that came with the 2010 FIFA World Cup together with policies (NDP, NGP and IPAP) and incentive schemes (P-AIS, MIP, SPII, CTCIP, etc.) formulated to enhance the competitiveness of the manufacturing sector. As such, this holds negative implications for GDP and employment in South Africa, as it was accentuated in the reviewed literature that the manufacturing sector of an economy is one of the main platforms where economic growth and job creation can be leveraged. In this case, more extensive measures have to be undertaken to revitalise the manufacturing sector in order to generate manufacturing-driven GDP growth and employment in South Africa.

The primary objective of the study was to analyse the impact of production in the manufacturing sector and its predominant sub-sectors on GDP and employment in the South African economy. As a result, the study discovered that production in the manufacturing sector and its predominant sub-sectors under study can be strategically supported to create GDP growth and employment in the long run. However, urgent support should be given to the clothing sector of manufacturing, as the empirical results of the study indicated that the clothing sector has a long-run negative impact on both GDP and employment in South Africa. This is an indication of a struggling clothing sector in the South African economy, therefore, this signified a need for the South African clothing sector to be supported and fortified from factors hindering productivity growth in the sector. In addition, the chemical sector of manufacturing has a negative long-run impact on employment, implying that capital-intensive methods of production are extensively employed in the South African chemical sector. This signifies the need to promote the downstream sector (i.e. embedded with labour dependent operations) in the chemical sector.

On the other hand, the empirical results of the study also discovered that production in the manufacturing sector and two (automotive and metal) of five predominant sectors of manufacturing under study can be improved to generate GDP growth in the short run, while production in the South African metal, and food and beverages sectors of manufacturing can be supported to generate employment in the short run. As such, it can be concluded that despite the continuous underperformance of the South African manufacturing sector, productivity growth in the sector and its predominant sub-sectors under study can still be leveraged and supported through strategic interventions to induce GDP growth and employment in the South African economy.

Furthermore, the discussed empirical findings were attained using ARDL and ECM models and the reliability and correctness of these empirical findings were confirmed using the residual and stability diagnostic tests, where all residuals were homoscedastic and serially correlated. All models employed showed signs of stability. Therefore, the veracious empirical findings of the study do not only add to the existing literature on the investigated subject matter but also recommend precisely on which sectors of manufacturing the South African government should spend its limited fiscal resources. The empirical findings of the study also uncover fundamental implications for policymakers in South Africa.

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ANNEXURE A: LETTER FROM THE LANGUAGE EDITOR

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16 November 2017

To whom it may concern

This is to confirm that I, the undersigned, have language edited the **dissertation** of

Richard T. Mc Camel
for the degree

Magister Commercii − Economics
entitled:

The impact of manufacturing and its sub-sectors on GDP and employment in South Africa: A time-series analysis

The responsibility of implementing the recommended language changes rests with the author of the dissertation.

Yours truly,

Linda Scott