Gordon Institute of Business Science
University of Pretoria

The impact of re-industrialization on economic growth and employment in South Africa

Motlatjo Moholwa
02606356

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration

06 November 2017

ABSTRACT

The South African economy has an enormous task of addressing the triple challenges of high unemployment, poverty and inequality. There is a growing concern that sluggish economic performance and these challenges are putting the country's young democracy at risk. There is a belief that manufacturing sector growth spurs economic growth and employment. Re-industrialization is an important policy to promote economic growth and the government has adopted a National Industrial Policy Framework to promote and facilitate re-industrialization. This study is an attempt to enhance and inform the robustness of the industrial policy design and implementation in South Africa.

The study utilized a Vector Error Correction model to evaluate the impact of re-industrialization on economic growth and employment in South Africa. The sectoral output and employment data series were obtained from Statistics South Africa. The output and employment data covered the periods 1993 first quarter to 2016 fourth quarter and 2012 third quarter to 2017 first quarter respectively. The results revealed that the manufacturing sector output growth had a significant impact on trade, transport and mining sectors while the manufacturing sector's employment growth does not necessarily guarantee employment growth in other sectors of the economy with the exception of the transport sector.

KEY WORDS: Industrialization, VEC, Economic Growth and Employment.

DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorization and consent to carry out this research.

……………………

Motlatjo Moholwa

06 November 2017

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION TO RESEARCH PROBLEM

1.1 Introduction

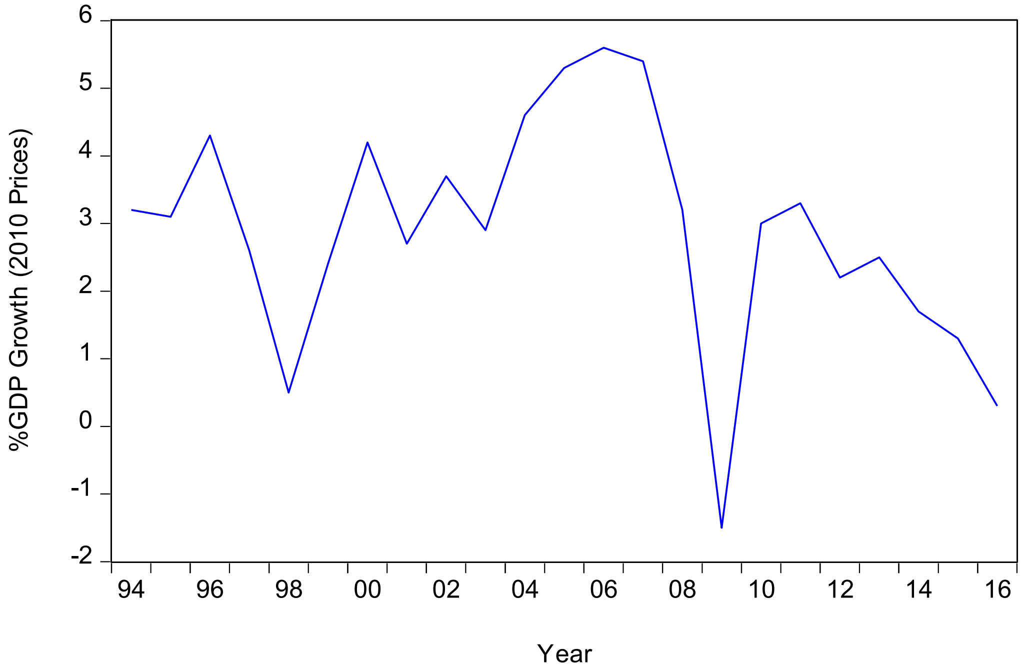
The South African economy has an enormous task of addressing the triple challenges of high unemployment, poverty and inequality. There is a growing concern that sluggish economic performance and the persistence of these challenges are putting the country's young democracy at risk. The growth of the South African economy has relied mainly on the household consumption and exports of primary commodities. An economic model dependent on household consumption and exports of primary commodities cannot be relied upon in the long-term as the basis for an inclusive and sustainable economic growth (Department of Economic Development, 2010).

Consumption growth is only sustainable if is underpinned by growing productive capacity, while on the other hand economic growth and development based on commodities is making the economy more vulnerable to international economic shocks (Department of Trade and Industry, 2007). The main disadvantage of the South African economy is its relatively poor performance of generally low-skill intensive tradable goods and services that have a key role to play in addressing the triple challenges of high unemployment, poverty and inequality (Fedderke, 2012).

1.2 Economic Growth and Unemployment Trends in South Africa

The National Development Plan (NDP) outlines an overarching framework to provide guidance for transforming and growing the South African economy. It aims to eliminate poverty and inequality in the country through inclusive and sustainable economic growth by 2030 (National Planning Commission, 2012). The NDP highlights that inclusive economic growth can be achieved through effective leadership, functional partnerships with all key social partners, building the capabilities of the economy and the capacity of the state to deliver. In line with the NDP 2030 targets, the economy needs to grow by at least 5.4% per annum in order to increase employment to 24 million, reduce income poverty to zero from 39 percent and reduce income inequality to 0.60 from 0.69 Gini Coefficient.

Figure 1-1: GDP Growth Trend (1994-2016)

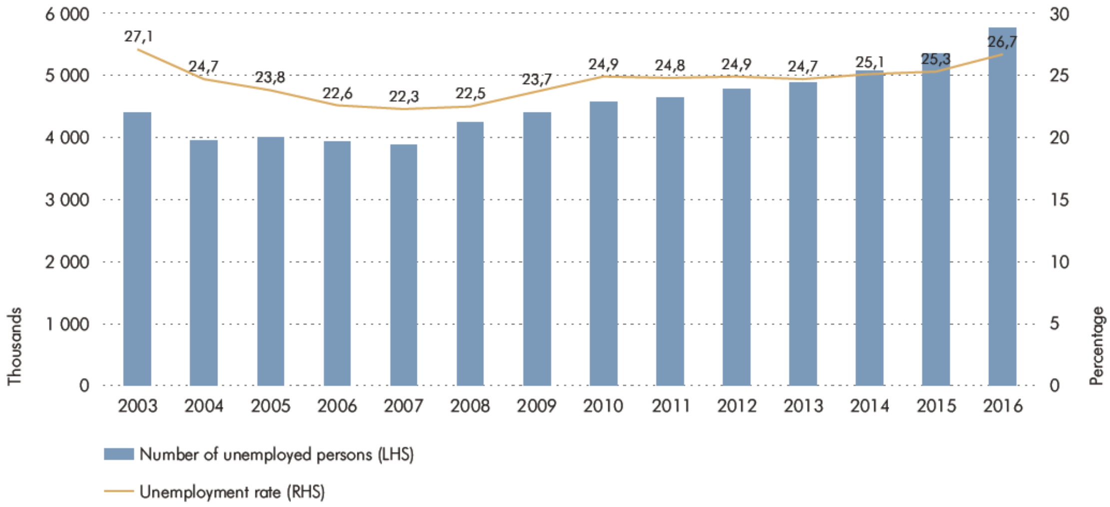


Source: Author generated (Statistics South Africa data)

The economic growth trend (1994-2016) for South Africa is presented in Figure 1.1. Contrary to the NDP's economic growth target of 5.4%, the South African economy has recorded a mean growth rate of 1.6% in the last five years with an overall overage of 2.9% per annum in the last twenty-two years. This growth rate is far below the required economic rate to enable South Africa to address its challenges and achieve NDP targets. The highest economic growth rate since 1994 was achieved in 2006 at 5.6% per annum while the lowest was -1.5% per annum during the 2008 global financial crisis.

The economy rebounded to 3.3% growth rate per annum in 2011 and has since been on a downwards trend recording 0.3% in 2016. The global financial crisis exacerbated the unemployment situation in South Africa. Figure 1.2 presents the unemployment trend in South Africa for 2003-2016 period. Clearly, the high unemployment rate is a crisis and has been worsening since 2007, from 22.3% (the lowest unemployment rate since 2003), to 26.7% in 2016. The number of unemployed persons during this period increased from about 4 million to about 5.8 million, making it the highest number in thirteen years.

Figure 1-2: Number of Unemployed Persons and the Unemployment Rate (2003-2016)



Source: Statistics South Africa (2017)

1.3 Poverty and Inequality Trends in South Africa

The National Planning Commission (2012) stipulates that South Africa will have to register 5.4% per annum minimum economic growth in order to achieve NDP targets. The poverty headcounts and the number of poor persons in South Africa trends are presented in Table 1.1 (Inflation-adjusted poverty lines are given in Appendix A). Poverty levels in South Africa declined between 2006 and 2011, but increased between 2011 and 2015. The number of South Africans living below the upper-bound poverty line (UBPL) increased from 27 million in 2011 to approximately 30 million in 2015 (Statistics South Africa, 2017).

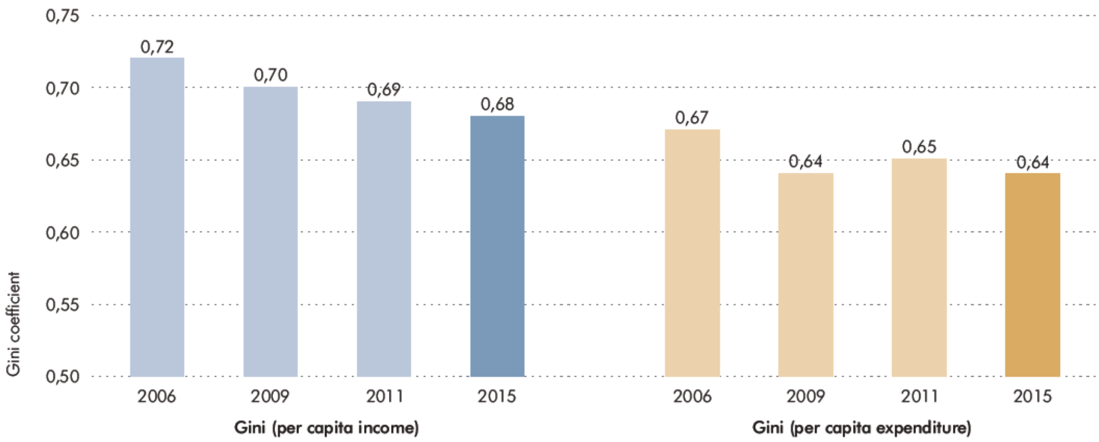
Table 1-1: Poverty Headcounts and the Number of Poor Persons in South Africa

Poverty headcounts	2006	2009	2011	2015
Percentage of the population that is UBPL poor	66,6%	62,1%	53,2%	55,5%
Number of UBPL poor persons (in millions)	31,6	30,9	27,3	30,4
Percentage of the population that is LBPL poor	51,0%	47,6%	36,4%	40,0%
Number of LBPL poor persons (in millions)	24,2	23,7	18,7	21,9
Percentage of the population living in extreme poverty (below FPL)	28,4%	33,5%	21,4%	25,2%
Number of extremely poor persons (in millions)	13,4	16,7	11,0	13,8

Source: Statistics South Africa (2017)

Approximately 21 million people are living below the lower-bound poverty line (LBPL), up from about 18 million people in 2011. During the same period, the number of people living below the food poverty line (FPL) increased from 11 million to about 13 million (Statistics South Africa, 2017). On the other hand, income inequality has improved since 2006, but South Africa is still one of the most unequal countries world. Income inequality improved from 0.72 in 2006 to 0.68 (Gini Coefficient). The implication is that effective economic interventions are required to transform and grow an inclusive and sustainable economy in order to address challenges bedeviling the South African economy.

Figure 1-3: Gini Coefficient Measures for South Africa



Source: Statistics South Africa (2017)

1.4 Problem Statement

The Achilles heel of South Africa is that the economy is experiencing de-industrialization characterized by sluggish economic growth and triple challenges of high unemployment, poverty and inequality (Fedderke, 2012). There is a belief that manufacturing sector is a driver of economic growth and employment (Szirmai, 2012; Moavenzadeh, Philip, Giffi & Thakker, 2012; Herman, 2016). Re-industrialization is an important South African government policy to promote an inclusive and sustainable economy and the government has adopted a National Industrial Policy Framework (NIPF) to promote and facilitate re-industrialization. The NIPF is being implemented through the Industrial Policy Action Plan (IPAP). According to the Department of Trade and Industry (2007), the vision of the NIPF, as articulated in the framework, includes the following:

- To facilitate economic diversification and improved international trade;

- To accelerate industrialization process and knowledge economy;
- To stimulate a broad-based and employment creation industrialization path; and
- To promote industrial development and revolution of the African continent.

The NIPF addresses cross-cutting constraints and opportunities in different sector of the South African economy by focusing on 13 Strategic Programmes (SPs). These are outlined as follows (Department of Trade and Industry, 2007): Sector Strategies, Industrial Financing, Trade Policy, Skills Development for Industrialization, Competition Policy and Regulation, Leveraging Public Expenditure, Industrial Upgrading, Innovation and Technology, SP9: Spatial and Industrial Infrastructure, SP10: Finance and Services to Small Enterprises, SP11: Leveraging Empowerment for Growth and Employment, SP12: Regional and African Industrial Framework and SP13: Coordination, Capacity and Organization.

According to Tregenna (2013) and Rodrik (2016), it is advisable for developing economies to implement an industrial policy strategy in order to prevent premature de-industrialization, especially during the globalization era. Rodrik (2016) holds that a combination of an under-performing manufacturing sector with a high performing services sector is a disastrous recipe and not ideal for inclusive and sustainable economy in the long run. The services sector is already the main contributor to both total output and employment, while the manufacturing sector contribution to the total output and employment is declining (Fedderke, 2012). However, there is a scarcity of published empirical research work on industrial development and policy in South Africa to enhance and inform the robustness of the industrial policy design and implementation.

It is the intention of this study to close this gap and contribute to economic development literature on industrial policy and development in South Africa. The outcomes of this study will serve as a contribution to a set of tools required by government policy makers to design and implement a robust and effective industrial policy and possibly a suite of investment incentives required to improve economic growth and employment creation in South Africa. The main purpose of this study is to evaluate the impact of re-industrialization on economic growth and employment in South Africa. The impact of re-industrialization on poverty and inequality is beyond the scope of this study and is suggested as an area for future research. The central research question for this study is outlined as follows: Is re-industrialization an engine of economic growth and employment creation in South Africa?

1.5 Organization of the Study

This research report consists of seven chapters. This chapter provided an introduction to the research problem and an overview of the study. Chapter two deals with the literature review on theory of economic growth (historical overview) and the roles of the manufacturing and services sectors in economic development. Chapter three outlines the research question and hypotheses of the study. The research methodology is outlined in Chapter four while the empirical results of the study and discussion of the results are presented in chapters five and six, respectively. Chapter seven summarizes the results of the study, outlines the limitations of the study, proposes areas of further research and draws conclusions with regard to the relevant policy implications.

2 LITERATURE REVIEW

2.1 Introduction

Chapter one offered an introduction to the research problem and this chapter presents a review of literature on the theory of economic growth (historical overview), industrialization and the role of manufacturing and services sectors in economic development. The chapter is divided into six sections. Section 2.2 provides a historical overview of economic growth theory, section 2.3 describes concepts of re-industrialization and de-industrialization and sections 2.4 and 2.5 provide empirical evidence from past studies on the role of the manufacturing and services sectors in economic development, respectively. The conclusion is provided in section 2.6 while the summary of this chapter is provided in section 2.7.

2.2 Economic Growth Theory: Historical Overview

2.2.1 Background

Economic growth is measured by a quarterly or annual increase in Gross Domestic Product (GDP). It should be noted that economic growth is a necessary but not necessarily a guarantee for an inclusive and sustainable economic development. Sustainable economic development can be described an intervention or interventions to ensure prosperity of the current generation without compromising the prosperity of the future generations. The main objective for a sustainable economic development is to enhance and improve the quality of life for all.

Adam Smith and Karl Marx are regarded as pioneers of capitalism and socialism economic systems, respectively. Adam Smith, through his “Wealth of Nations” doctrine, viewed the division of labour as a source of productive processes (Smith, 1976). Smith opined that competitive markets ensure that actions by all markets participants lead to economic prosperity while on the other hand Marx (1933) posited that competitive markets are exploitative by design and that central planning by the state is the way to go. However, capitalism is often criticized for making the poor poorer and the rich richer (Dang & Pheng, 2015).

Economists did not pay much attention to economic growth theories till after World War II (WWII). According to Dang & Pheng (2015), economic growth theory has moved through six main models, namely linear stages models, structural change models, international dependence models, neoclassical counter-revolutionary models, endogenous models and coordination failure models.

2.2.2 The Linear Stages Models

The linear stages models were developed in the 1950s and early 1960s. They prescribed savings and investments as drivers of economic growth and development. The most common models were Rostow and Harrod-Domar models. Rostow (1960) theorized that countries will go through the following distinct stages in the process economic development: Traditional society, transitional stage, the take-off, the drive to maturity and mass consumption. The critical stage is take-off and for foreign direct investments to occur in stage 3 it is important for the economy to have reached stage 2 in order to increase per-capita growth (Dang & Pheng, 2015).

The second most popular economic growth model in this category is the Harrod-Domar model. This model proposed the level of savings and investment as key determinants for economic growth and development (Domar, 1947; Harrod, 1948). They postulated that developing nations have over-supply of labour but lack physical capital to facilitate economic growth, thus increased investment will lead to increased output, income, savings and investments (Dang & Pheng, 2015). These models have been criticized for assuming a single production function and that the economic growth path is similar across all countries. According to Todaro & Smith (2009), the development process is not linear and countries may jump stages or become trapped in a given stage, depending on the prevailing macroeconomic environment.

2.2.3 Structural Change Models

The structural change models were developed during the 1960s and early 1970s. These models treated the transfer of resources, especially labour, from the agricultural sector to the manufacturing sector as a source of growth. The most popular models in this category are the dual-sector models and the structural change models by Lewis and Chenery, respectively. The Lewis (1954) model assumes that the agricultural sector is characterized by low productivity, incomes, savings and underemployment, while on the other hand the manufacturing sector is assumed to be the opposite and operating in an urban environment.

The theory is that as workers are transferred from a traditional sector to an industrial sector, they continue to receive a subsistence wage. The profit from wages in the industrial sector is re-invested and in that way generates the expansion of the industrial sector and promotes economic growth. This leads to the structural transformation of the economy to a modernized industrial economy (Dang & Pheng, 2015). The structural change model postulated that to ensure prosperity, physical and human capital accumulation are required supplements to savings and investments (Chenery, 1960). Chenery (1960) also recognized that the structural changes are not only confined to two sectors but to the rest of the economy, including socio-economic factors.

While Lewis' model was criticized for its invalid assumptions, such as surplus labour in the agricultural sector (Todaro & Smith, 2009), the structural change model had a potential to mislead policy makers. Most countries adopted economic strategies that promoted the manufacturing sector at the expense of the agricultural sector due to structural change models prescription.

2.2.4 International Dependence Models

The international dependence models gained prominence during 1970s and early 1980s. They used Marxist theory as foundation and their proponents theorized that the growth of multinational corporations caused the exploitation of poor countries and led to a dependence on developed countries. According to the international dependence economic growth models, developing countries were advised to cut ties with developed countries (Ferraro, 2008).

The international dependence models gained prominence due to the failure of the linear stages and structural models for economic growth and development. The failures of the international dependence economic growth models were evident in countries like Chile, Tanzania and India, which experienced stagnant economic growth due to their autarky policy while the experience of newly industrialized countries such as Singapore highlighted the importance of international trade (Todaro & Smith, 2009).

2.2.5 Neoclassical Counter-Revolutionary Models

The neoclassical counter-revolution models were developed in the 1980s to replace international dependence models. The proponents of these models posited that underdevelopment was not due to the dominance of multinational corporations but the distortionary domestic policies (Meier, 2000). The neoclassical counter-revolution models advocated free markets promotion in order to eliminate government-imposed policy distortions.

Solow (1956) expanded the Harrod-Domar model and emphasized increases in labour quantity and quality, capital accumulation and technology improvements. The implication of the Solow model is that economies should converge in the long-run if they are subjected to similar set of conditions such as technological progress. Neoclassical economists regarded markets as a panacea for economic growth and development in developing countries and expected increased liberalization to attract foreign direct investments and better economic performance (Dang & Pheng, 2015). Unfortunately, due to history and socio-economic factors of the developing countries, neoclassical counter-revolution models failed to stimulate economic growth and development (Johnson, Toledano, Strauss & James, 2013).

2.2.6 Endogenous Models

The endogenous economic growth models were formulated in the 1990s. Their main objective was to explain the failure of economic interventions prescribed in neoclassical theories (Johnson et al., 2013; Dang & Pheng, 2015). The endogenous economic growth models treated technological progress or change as endogenously determined, compared to neoclassical theories of economic growth. These models argued that investments in skills development and socio-economic infrastructure as well as innovation (technological progress) can bring about sustained economic prosperity.

The endogenous models further advocated that due to market failures associated with benefits from investment in skills development, socio-economic infrastructure and innovation, policy interventions are required to influence sustained economic prosperity in the long run (Meier, 2000). Endogenous growth models were praised for their ability to explain growth divergence across countries but criticized for overlooking complementary factors required for economic growth and development to take place (Dang & Pheng, 2015).

2.2.7 Coordination Failure Models

The coordination failure models only became more popular in the 1990s and are premised on the notion that the market failure may frustrate coordination among complementary factors referred to under endogenous economic growth models (Dang & Pheng, 2015). This will lead to multiple equilibria, which are not optimal. It then becomes the responsibility of the state to coordinate all complementary activities in the rest of the economy to reach an optimum equilibrium and promote economic growth and development. This theory has been criticized for assuming that government intervention lead to optimal equilibrium as there is a possibility of worsening the situation (Stiglitz, 2000).

2.3 Industrialization Defined

According to Szirmai, Naudé & Alcorta (2013), industrialization can be defined as an increase in the sustained structural transformation of a traditional economy into a modern economy driven by high-productivity activities in manufacturing sector. Most of the slowdown or decline in economic performance around the world is explained by the performance of the manufacturing sector (Moavenzadeh et al., 2012). Unfortunately, most countries around the world, both developed and developing countries, have been experiencing de-industrialization with an increasing share of services sector in their economies, hence the concept of re-industrialization. Economic development literature provides the following as explanation for de-industrialization (Palma, 2008):

- Specialization in the manufacturing sector;
- A decline in the relative prices in the manufacturing sector;
- Productivity in the manufacturing sector relative to the services sector;
- The displacement of the domestic manufacturing due to international competition;
- Declining investments in the manufacturing sector; and
- Dutch Disease (de-industrialization caused by the discovery of a significant natural resource, developed export finance or markets liberalization).

An early contribution to the literature on de-industrialization was by Singh (1977). Singh described de-industrialization as a structural disequilibrium in the economy whereby manufacturing sector is not able to both satisfy domestic and export demand required to pay for imports. Tregenna (2013) differentiates between positive and negative de-industrialization. Positive de-industrialization is mainly caused by improved productivity in the manufacturing sector leading to higher production but lower employment level and share of the total employment while negative de-industrialization, on the other hand, is mainly caused by declining manufacturing sector output or rising productivity and displaced labour is unable to secure employment in the services sector (Tregenna, 2013).

2.4 The Role of Manufacturing Sector in Economic Development

The sector has reputation of being transformative for countries and companies across the globe since the dawn of the industrial revolution (Moavenzadeh et al., 2012). Those who could take advantage of manufacturing power achieved greater prosperity and profitability and this led to an increase in economic growth, middle income stratum and services sector. According to Tybout (2000), the manufacturing sector in developing countries is historically characterized by protectionism policies biased towards large businesses instead of small businesses. It is often theorized that manufactures in developing countries perform poorly due to a number of reasons, including protection of inefficient businesses and monopolistic nature of the economy (Tybout, 2000). As advocated by the theory of coordination failure, stagnation in the manufacturing sector may not necessarily be due to challenges around inefficient firms and monopolistic nature of the economy, but policy uncertainty, poor rule of law and corruption, amongst other macroeconomic factors (Dang & Pheng, 2015).

Ojo & Ololade (2013) studied the impact of globalization on the Nigerian manufacturing sector, hence economic growth and development, using the Ordinary Least Squares (OLS) econometric technique for the 1980 to 2009 period. The study revealed that globalization enhanced the manufacturing sector performance, but was negatively affected by the poor macroeconomic, socio-infrastructural and institutional environment of the Nigerian economy. The study advocated for the strengthening of these factors to ensure that a linkage between domestic and external institutions are optimized to fully benefit from globalization and for the manufacturing sector to take center stage as the economic growth stimulus.

Research conducted by Su & Yao (2017) revisited the role of the manufacturing sector in developing economies using an annual internationally comparable dataset covering

187 economies for the period 1950 to 2013. The study tested and proved the following three hypotheses in developing countries: (1) the manufacturing sector pulls the services sector, (2) manufacturing sector growth promotes the incentives of savings important for improved economic performance, and (3) manufacturing sector performance increases the pace of technological progress. The results of this study provide important policy implications for developing countries. Firstly, in line with Rodrik (2016), it is advisable for developing countries to develop and implement industrial policy strategy to prevent premature de-industrialization, especially during the globalization era. Secondly, a combination of an under-performing manufacturing sector and a high performing services sector is not good for sustainable economic growth and development (Carmignani & Mandeville, 2014).

Szirmai & Verspagen (2015) tested the manufacturing sector-economic growth hypothesis using the panel data on the shares of manufacturing and services sectors in gross domestic product for the period 1950-2005. The results revealed that the manufacturing sector had a positive impact on economic performance. Su & Yao's (2017) research results further indicated that developing economies benefit more from manufacturing sector performance than developed economies and more so with higher levels of education. The higher level of education finding is supportive of the economic growth theory advocated by endogenous economic growth models. The endogenous models are of the view that investments in skills development and socio-economic infrastructure as well as innovation (technological progress) can bring about sustained economic prosperity.

A study by McCausland & Theodossiou (2012) investigated the hypothesis that increasing returns to manufacturing production are the drivers of economic performance. The study used a panel data from eleven representative countries spanning about two decades. The results indicated that manufacturing sector output growth is an important stimulus of economic growth and development. The results further indicated that although the services sector experienced an increased share in the economy, it does not appear to have a similar power as the manufacturing sector.

An alternative way of testing if the manufacturing sector acts as a driver of economic performance involves regression of the growth rates of Gross Domestic Product on the manufacturing sector growth rates (Kathuria & Natarajan, 2013). If the parameter estimate of the manufacturing sector growth rate is higher than the share of the manufacturing sector in Gross Domestic Product, then this is interpreted as supportive of the manufacturing sector as s driver of economic performance. Kathuria & Natarajan (2013) tested this hypothesis for the post-1990s Indian economy, and their results revealed that the manufacturing sector is indeed an engine of economic performance in the post-1990s Indian economy, despite its declining share over the same period. These results were attributed to factor accumulation rather than economies of scale and productivity growth.

The structural change models regarded labour flow from the agricultural sector to the industrial sector as a source of economic success. McMillan, Rodrik & Verduzco-Gallo (2014) investigated the flow of labour hypothesis and demonstrated that the structural change was not growth enhancing in both Africa and Latin America since 1990. McMillan et al. (2014) posited that most of the difference between these continents' (Africa and Latin America) productivity and that of Asia was explained by structural change patterns differences, with Asia experiencing growth-enhancing structural change and the opposite direction in Africa and Latin America.

The results, however, also indicated that after the year 2000 things began turning around in Africa with structural change contributing positively to economic growth and development. According to McMillan et al. (2014), Africa has a great potential for growth and development due to its very low levels of productivity and industrialization compared to Latin America. The policy implication is that, as advocated by the neoclassical counter-revolutionary economic growth model, African countries need to support labour productivity improving strategies and guide structural change direction. It has recently been postulated that the manufacturing sector status as as a driver of economic performance has been declining or it is becoming increasingly difficult to pursue economic growth and development through a conventional path of industrialization (Szirmai & Verspagen, 2015; Haraguchi, Cheng & Smeets, 2017).

Cheremukhin, Golosov, Guriev & Tsyvinski (2017) used the two-sector neoclassical economic growth model to study the structural transformation of Russia from the late 19^{th} to early 20^{th} century period. The study used the dataset that covered Tsarist Russia from 1885 to 1913 period and the Soviet Union from 1928 to 1940 period. The results revealed that the monopoly power in the non-agricultural sector held back Tsarist Russia's industrialization prospects prior to World War I, while on the other hand, the Soviet Union's industrial transformation after 1928 was achieved through a reduction of these impediments.

Haraguchi et al. (2017) explored whether the low levels of industrialization in developing countries are attributable to long-term changes in the development characteristics of the manufacturing sector or to the manufacturing sector's general global prospects. Their findings indicated that the decline in both sector output and employment shares in many developing countries has not been caused by changes in the manufacturing sector's ability as a stimulus of economic growth but by its development failure in the majority of developing countries against the backdrop of rapid manufacturing development in a few developing countries.

This led to a concentration of manufacturing activities in a few developing countries. Haraguchi et al. (2017) asserted that there is an opportunity for the majority of the developing countries to catch up with successful emerging economies like China, through industrialization. This is driven by the fact that successful emerging economies will be reaching their industrialization peak soon if they have not yet done so. The implication is that as most successful emerging countries reach their industrialization peak and follow a normal pattern of de-industrialization experienced by developed economies, it will be an opportunity for most of the developing countries to take advantage of these developments and grow their economies through industrialization (Su & Yao, 2017; Haraguchi et al., 2017).

Rodrik (2013) used a dataset consisting of 118 countries to investigate whether the manufacturing sector exhibited unconditional convergence in labour productivity, unlike economies as a whole. The implication for unconditional convergence is that poorer countries will grow faster than wealthier countries, and eventually reach a catch-up state. The study estimated the coefficient of unconditional convergence to be between 2% and 3% a year. However, aggregate convergence fails, despite a strong convergence within the manufacturing sector due to a slow pace of industrialization and the size of manufacturing sector employment in developing countries. There is a number of compelling reasons in favour of industrialization and these include the following:

- **Empirical correlations between industrialization and economic development**: There is a positive correlation between industrialization and economic performance (Szirmai, 2012; Herman 2016). Using Vector Auto-Regression analysis, Chakravarty & Mitra (2009) concluded that the manufacturing sector is the engine of economic growth and development. The research results by Rodrik (2013) also revealed that faster economic growth in developing economies is explained by structural change of the economy.

- **Structural change bonus and burden**: The structural change bonus is provided by productivity differential between the manufacturing sector and traditional sector while the structural change burden occurs when the services sector contributes more to the economy than the manufacturing sector (Herman, 2016).
- **Opportunities for capital accumulation**: Manufacturing sector has a greater potential or opportunities for capital accumulation which are more pronounced in developing countries as a source of economic growth (Su & Yao, 2017). The implication is that industrialization will be more effective in developing countries than in developed countries as a driver of economic performance.
- **Opportunities for scale economies**: It is argued in this case that the manufacturing sector benefits more from large production scale than other sectors of the economy and production expansion provides more scope for learning by doing (McCausland & Theodossiou, 2012). Szirmai (2012) holds that even though manufacturing sector is regarded as the engine of growth, technological developments in the services sector are such that the marginal cost in the services sector is close to zero. Moving forward the services sector is likely to become the new driver of growth even though most of the services' sub-sectors still suffer from Baumol's law (Baumol's law asserts that as the share of services sector increases, aggregate per capita growth will tend to slow down).
- **Technological advance**: According to Szirmai (2012), the growth of the manufacturing sector fuels technological change in the rest of the economy.
- **Linkage and spillover effects**: These effects are stronger, through forward and backward linkages between sectors, within manufacturing sector than within other sectors (Moavenzadeh et al., 2012; Herman, 2016).
- **The Engel law**: The Engel law states that the proportion of income spent on food decreases as income increases. Hence, demand for agricultural output declines while that the demand for manufacturing sector output increases as the income per capita increases (Chakravarty & Mitra, 2009).

2.5 The Role of the Services Sector in Economic Development

Services sector is the fastest growing and the biggest sector in terms of global output and employment (Iashmi & Kumar, 2012). This can be attributed to technological advancements which led to possible exportation of services. Rodrik (2016) holds that a combination of a poor performing manufacturing sector and a high performing services sector is not good for sustainable economic growth and development in developing countries and can lead to premature de-industrialization. The implication is that growth of the manufacturing sector is required to provide a boost to the performance of the services sector. Ghani & O'Connell (2014) discovered that as services are traded across the borders with technology advancement and globalization, there is opportunity for improved economic performance in the developing countries. Their argument was that growth drivers faced by Africa may be different from those experienced by East Asia.

Studies by Singh (2012), Iashmi & Kumar (2012) and Das & Raut (2014), provided empirical evidence to the effect that the services sector have a stronger impact on overall economic performance compared to the manufacturing sector in India. Singh (2012) posited that a services-led economic growth model is sustainable from economic, social and environmental perspectives. Consequently, the Indian economic policy included market liberalization and fiscal consolidation (Iashmi & Kumar, 2012).

Mujahid & Alam (2014) employed cointegration technique and Vector Error Correction model to test the determinants of services sector growth in Pakistan for the period 1976 to 2010. Their results indicated that factors such as foreign direct investment and government expenditure had a significant effect on the growth and development of the services sector in Pakistan. According to Cheng (2013), the under development of transacted-through-market services in China was mainly due to problems with low levels of specialized division of labour, innovation and demand-induced mechanisms crucial for growth of the services sector in a modern economy.

Uwitonze & Heshmati (2016) investigated the factors behind the development and growth of the services sector in Rwanda using the Rwanda Enterprise Survey 2011 and the 2014 Established Census. Their results indicated that the growth and development of the services sector in Rwanda is driven by access finance, skills development, information and communication technology applications, and innovations among other factors. Their theory was that the enhancement of these factors can lead to the services sector growth as a driver for economic transformation in developing economies.

Heshmati & Kim (2011) studied the competitiveness of the Korean services sector and deduced that the key drivers were the incentives for skilled workers and investment in research and development to improve labour productivity. Noland, Park & Estrada (2012) studied developing economies of Asia's services sector to assess its potential as a driver for inclusive and sustainable economic growth. Their assessment indicated that the services sector is also an important source of economic performance in the developing Asia, but lagged behind that of advanced economies. The implication is that there is ample room for further services sector growth. Noland et al. (2012) recommended the removal of all internal and external distortions in order to leverage on the potential growth of the services sector.

2.6 Conclusion

The review of the literature indicates that manufacturing sector plays a critical role in economic growth and development, especially in developing countries, with the exception of India (India' services sector has a stronger impact on overall economic performance compared to the manufacturing sector). Developing countries have a great potential to benefit from industrialization due to the fact that successful emerging economies like China will be reaching their industrialization peak if they have not yet done so. However, it is evident that the performance of the manufacturing sector in developing countries has been negatively affected by factors such as protectionist policies, monopolistic nature of the economy, lack of rule of law, corruption and generally poor macroeconomic environment amongst other factors. Hence, developing countries should address these factors amongst others in order to develop and grow their economies through industrialization.

The review of the literature further revealed that the power of the manufacturing sector as a driver of economic performance is declining or it is becoming increasingly difficult to pursue economic growth and development through a conventional path of industrialization. This is further complicated by the fact that a combination of an under-performing manufacturing sector and a high performing services sector is not good for sustainable economic growth and development. Given that re-industrialization is a policy priority in South Africa to promote economic growth and development, the question is will South Africa be able to revitalize the manufacturing sector performance by developing and implementing an effective industrial policy to fully benefit from re-industrialization agenda?

There is a scarcity of published empirical research work on industrial policy and development in South Africa to enhance and inform the robustness of the industrial policy design and implementation. It is the intention of this study to close this gap and contribute to economic development literature on industrial policy and development in South Africa. The main purpose of this study is to evaluate the impact of re-industrialization on economic growth and employment in South Africa. The impact of re-industrialization on poverty and inequality is beyond the scope of this study and is suggested as an area for future research.

2.7 Summary

This chapter covered relevant economic growth theories from the era of Adam Smith and Karl Marx, who are regarded as pioneers of capitalist and socialist economic systems, to the contemporary theories or models (endogenous and coordination failure models). This chapter also defined concept of industrialization while the last three sections of the chapter covered empirical evidence of the role of the manufacturing and services sectors and their interaction in the course of economic development. The research question and hypotheses are detailed in chapter three.

3 RESEARCH QUESTION AND HYPOTHESES

3.1 Introduction

Chapter two presented the literature review on theory of economic growth (historical overview), industrialization and the role of the manufacturing and services sectors in economic growth and development. This chapter presents the research question and research hypotheses formulated to assess the impact of re-industrialization on economic growth and employment in South Africa. The study covers the period from the first quarter of 1993 to the fourth quarter of 2016 for economic growth and from the third quarter of 2002 to the first quarter of 2017 for employment growth. This chapter is divided into three sections. Section 3.2 outlines the purpose of the study and section 3.3 presents the research hypotheses while the summary is presented in section 3.4.

3.2 Research Question

The main purpose of this study is to assess the impact of re-industrialization on economic growth and employment in South Africa. The research question is outlined as follows: Is re-industrialization an engine of economic growth and employment in South Africa?

3.3 Research Hypotheses

The research hypotheses of this study, based on the research question, are outlined as follows:

a) **Null Hypothesis 1 (H_{01}):** Manufacturing sector output growth does not have a positive and significant impact on the output growth in other economic sectors.
Alternative Hypothesis 1 (H_{11}): Manufacturing sector output growth has a positive and significant impact on the output growth in other economic sectors.

b) **Null Hypothesis 2 (H_{02})**: Manufacturing sector employment growth does not have a positive and significant impact on the employment growth in other economic sectors.

Alternative Hypothesis 2 (H_{12}): Manufacturing sector employment growth has a positive and significant impact on the employment growth in other economic sectors.

3.4 Summary

This chapter covered the purpose, research question and hypotheses formulated for studying the impact of re-industrialization on economic growth and employment in South Africa. The research methodology for conducting the study and testing the research hypotheses is covered in chapter four.

4 RESEARCH METHODOLOGY

4.1 Introduction

Chapter three presented the research question and hypotheses of the study. This chapter discusses the research methodology and method of analysis employed in the study to address the research question and test the hypotheses outlined in chapter three. The main objective of this study is to assess the impact of re-industrialization on economic growth and employment in South Africa. The chapter is divided into six sections. Section 4.2 describes the population and unit of analysis, section 4.3 covers the sampling method and size while data gathering and measurements are covered in section 4.4. The method of analysis used in the study, limitations and the summary are presented in sections 4.5, 4.6 and 4.7, respectively.

4.2 Population and Unit of Analysis

The population under consideration for this study was quarterly time series data for the South African economy. The unit of analysis was output and employment data in the broad economic sectors (agriculture; mining; manufacturing; utilities; construction; trade; transport; finance and business services and community and social services) of the South African economy. The focus was on the analysis of the interactions and contributions of the broad economic sectors output growth and employment creation in South Africa.

4.3 Sampling Method and size

The sampling method utilized in this study is census sampling as the sample is comprised of the entire population under consideration. The study focused on output and employment in the broad economic sectors as per Statistics South Africa's (2012) Standard Industrial Classification (SIC). These sectors are agriculture; mining; manufacturing; utilities; construction; trade; transport; finance and business services and community and social services. In the case of output, the quarterly data covered the period from 1993 to 2016 while the employment data covered the period from 2002 third quarter to 2017 first quarter.

4.4 Data Gathering and Measurements

The study was based on a quarterly time series data on the employment and Gross Domestic Product (GDP) in the broad South African economic sectors (agriculture; mining; manufacturing; utilities; construction; trade; transport; finance and business services and community and social services). The data was obtained directly from Statistics South Africa as the official source of the economic data on employment and GDP in South Africa. The quarterly data on GDP per sector covered the period from 1993 to 2016.

Statistics South Africa conducts two types of surveys on employment, namely the Quarterly Labour Force Survey (QLFS) and the Quarterly Employment Statistics (QES). The QLFS focuses on private households while QES focuses on formal businesses excluding agriculture, forestry and fishing. QLFS has undergone a number of changes since 1994 and for this reason consistent quarterly data on QLFS is only available from 2008. QES employment data on the other hand, is available from 2002 and for this reason this study utilized quarterly employment data based on the QES for the period 2002 third quarter to 2017 first quarter. The QES does not include the agricultural sector.

4.5 Method of Analysis

The main purpose of this study is to assess the impact of re-industrialization on economic growth and employment in South Africa and the key research question is outlined as follows: Is re-industrialization an engine of economic growth and employment in South Africa?

In order to address this research question, variables of interest are employment and output in different sectors of the economy. The implication is that both independent and dependent variables are quantitative numeric time series variables amenable to extensive choice of statistical methods (Wegner, 2012). Given that much of the econometric theory is based on the assumption that the data series is stationary (a stationary implies that the mean and variance are constant over time), for this kind of analysis one may be tempted to apply simple regression analysis using the Ordinary Least Squares (OLS) method (Chakravarty & Mitra, 2009; Kilian & Lütkepohl, 2016). However, most economic time series data have unit root and are integrated of order one (I (1)). The implication is that conducting regression analysis with non-stationary variables leads to a spurious regression (Boisseleau & Hewicker, 2002), which may lead to inappropriate policy implications or recommendations. Hence, it becomes useful to conduct OLS regression using growth rates instead of levels. The disadvantage of this kind of analysis is that it ignores the importance of other sectors (inter-sectoral linkages), in the stimulation of economic growth and employment. The analysis of inter-sectoral dynamics can be studied through a macro-econometric model (Chakravarty & Mitra, 2009).

The main disadvantages of macro-econometric model are its extensive data requirements and difficulty in quantifying the determinants of growth dynamics in different sectors of the economy. For these reasons, a time series econometric methodology was used in this study in order to reduce data requirements, capture the inter-sectoral linkages and counteract the difficulty in quantifying the determinants of growth dynamics in different sectors of the economy. A time series econometric methodology used in this study involves unit root tests, lag length selection criteria, cointegration test and Vector Auto-regression or Vector Error correction model discussed in sections 4.5.1 to 4.5.4 below

4.5.1 Unit Root Tests

Time series data generally contain stochastic trends or unit roots (Brooks, 2014). Conducting regression analysis with non-stationary variables leads to a spurious regression (Boisseleau & Hewicker, 2002), which may lead to inappropriate policy implications or recommendations. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are commonly for testing unit roots and were both used in this study. The Augmented Dickey-Fuller (ADF) test includes additional lagged difference terms to account for the problem of auto-correlation (Mashamaite & Moholwa, 2005). The logarithm of quarterly data on output and employment for each sector were tested for a unit root using the ADF in the following model:

$$\Delta\ln(y_t) = \alpha + \beta T + \rho\ln(y_{t-1}) + \sum_{i=1}^{k}\lambda_i\Delta\ln(y_{t-i}) + \mu_t \quad (4.1)$$

Where $\Delta\ln(y_t)$ = first difference of logarithm of output or employment of a given sector in period t; T = trend; α, β, ρ, λ_i = coefficients and μ_t = an error term. The null hypothesis and alternative hypothesis are:

H_0: $\rho = 0$ (Non-stationary or unit root)
H_1: $\rho < 0$ (Stationary or unit root)

The ADF unit root test computes the tau statistic (τ) for each estimated coefficient, in the same way as a student's t statistic is calculated, in order to test the significance of the estimated ρ coefficients. The estimated τ values do not follow the same distribution as t statistic. The statistical significance of the estimated τ values are assessed by comparing them with critical values derived for the τ distribution. If the estimated τ value is less than the critical value in absolute terms, then the null hypothesis of the existence of unit root cannot be rejected (Dickey and Fuller, 1981)

The PP method, an alternative for testing unit root, estimates the non-augmented DF test equation and modifies the t-ratio of the coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic (Mashamaite & Moholwa, 2005). The PP test is based on the statistic (Eviews, 2015):

$$Z_t = t_\rho\left(\frac{\gamma_0}{f_0}\right)^{\frac{1}{2}} - \frac{N(f_0-\gamma_0)(Se(\hat{\rho}))}{2f_0^{\frac{1}{2}}S} \quad (4.2)$$

where ρ = coefficient estimator, t_ρ= the t ratio of ρ, Se($\hat{\rho}$) = coefficient standard error, S = standard error of the test regression, N = sample size, γ_0= error variance = (N-K)S^2/N and f_0= an estimator of the residual spectrum at frequency 0.

4.5.2 Lag Length Selection Criteria

Once the integration order is determined for each variable using the unit root tests, the next step is to select the appropriate lag length (Chakravarty & Mitra, 2009). The optimal lag length was chosen based on the LR test statistic, Final Prediction Error (FPE), Akaike

Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQIC). The procedure was to select a lag length with the largest penalized maximized log-likelihood function or the specification with the lowest value of the criterion (Hossain, 2002). The optimal lag length was then used for the cointegration test and in the estimation of Vector Error Correction (VEC) model.

4.5.3 Cointegration Test

Most economic variables exhibit persistent upward or downward movement, which is normally generated by stochastic trends in integrated variables. A set of variables are said to be cointegrated if the same stochastic trend is jointly driving a set of integrated variables (Kilian & Lütkepohl, 2016). If two time-series variables are cointegrated, the implication is that there is a long run relationship between them and an error-correction representation describing short run dynamics of the data (Boisseleau & Hewicker, 2002; Verbeek, 2004). There are two approaches commonly used for testing cointegration, namely the Engle-Granger two-step procedure (Engle and Granger, 1987) and the Johansen procedure (Johansen, 1988). The Engle-Granger two-step procedure for testing cointegration is a bivariate model, (provides a causality relationship as well as the direction of the relationship), while the Johansen procedure is a multivariate model.

The Johansen procedure for testing cointegration, which uses Johansen Trace and Max-Eigen statistics, was adopted in this study as there are more than two variables in a model. The test statistics for the Johansen cointegration approach are formulated as follows (Johansen, 1988):

$$\lambda_{trace}(r) = -T \sum_{\mathrm{i}=r+1}^{n} \ln(1 - \hat{\lambda}_1) \tag{4.3}$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \tag{4.4}$$

where λ = the estimated value of the ith ordered eigenvalue from the long run coefficient matrix, T = the number of usable observations and r = the number of cointegrating relationships. The λ_{trace} statistic tests the null hypothesis that the number of cointegrating vectors is less than, or equal to r against an unspecified alternative hypothesis. The λ_{max} statistic on the other hand, tests the null hypothesis that the number of cointegrating vectors is r against an alternative of $r + 1$ cointegrating vectors. The further the eigenvalues are from zero, the more negative is $\ln(1 - \hat{\lambda}_1)$ and $\ln(1 -$

$\hat{\lambda}_{r+1}$) the larger the λ_{trace} and λ_{max} statistics, respectively. If there is cointegration it is then appropriate to estimate Vector Error Correction (VEC) model rather than the Vector Auto-regression (VAR) model.

4.5.4 Vector Auto-regression and Vector Error Correction Models

The Vector Auto-regression (VAR) model consists of a system of regression equations that are estimated by regressing each model variable on lags of its own as well as lags of other variables up to some pre-determined maximum lag order (Kilian & Lütkepohl, 2016). The VAR model allows variables to interact without imposing theoretical structure on estimates and captures both the short-term and long-term interrelationships among given variables (Abushhewa & Zarook, 2016). The VAR model in this study assumed that the employment or output growth rate in one sector is dependent on its past values and the past values of the employment or output growth rate in other sectors. The simplest case is the bivariate VAR, which contains two variables (y_{1t} and y_{2t}), and is represented as follows (Brooks, 2014):

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \propto_{11} \\ \propto_{21} & \beta_{21} \end{pmatrix} \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \end{pmatrix} + \begin{pmatrix} \mu_{1t} \\ \mu_{2t} \end{pmatrix} \tag{4.5}$$

Where μ_{1t} and μ_{2t} are white noise error terms and both have zero mean and constant variances and are individually, serially uncorrelated. The VAR estimation involves two steps: The first step is the selection of the variables to be included in the system, (in this case the past values of employment or output growth rate in a given sector and the past values of the employment or output growth rate in other sectors), and secondly to select the appropriate lag length (Chakravarty & Mitra, 2009). According to Kilian & Lütkepohl (2016), the VAR model has proved useful for summarizing the properties of the data, forecasting, testing for the existence of equilibrium relationships tying together two or more variables, and quantifying the speed with which the model's variables revert to equilibrium following a disturbance.

As the coefficients estimated by the VAR cannot be directly interpreted, the use of a Granger Causality or Block Exogeneity Wald Test and the innovation accounting technique are commonly used. The Granger Causality or Block Exogeneity Wald Test is used to determine whether an exogenous shock generated from a particular sector is transmitted to another sector. The innovation accounting technique consists of Impulse Response Functions (IRFs) and Variance Decomposition (VD). IRFs measure the effects of a shock to an endogenous variable on itself or on another endogenous variable while the VD measures the fraction of the forecast error variance of an endogenous variable that can be explained by shocks to itself or to other endogenous variables (Chakravarty & Mitra, 2009; Brooks, 2014).

Given the existence of cointegration in the VAR variables, in this study the Vector Error Correction (VEC) model was estimated rather than the VAR model. If two variables are cointegrated, then there is a long run relationship between them and according to the Granger representation theorem, a valid error-correction representation exists describing the short run dynamics of the data that pulls the equilibrium error back towards zero (Verbeek, 2004). Consider the VAR (p) model of I (1) endogenous variables denoted by Z (Kilian & Lütkepohl, 2016):

$$Z_t = \Phi_1 Z_{t-1} + \cdots + \Phi_p Z_{t-} + \mathcal{E}_t \qquad (4.6)$$

The VEC model of equation (4.6) is then given by

$$\Delta Z_t = \Pi Z_{t-1} + \sum_{i=1}^{p-1} \Phi_i Z_{t-i} + \mathcal{E}_t \qquad (4.7)$$

Where Z_t = k x 1 vector for endogenous variables, Π = k x k long run multiplier matrix, Φ_i= k x k coefficient matrices describing the short run dynamic effects, p = VAR order or lag length, $\mathcal{E}_t$= vector of independently and identically distributed innovations with zero mean, and ΠZ_{t-1} = vector error correction mechanism, which captures the long run relationship between variables and the short run adjustments consistent with the long run relationship.

4.6 VAR Modelling Limitations

The VAR modelling boasts a number of advantages in economic analysis (such as easy to estimate – all variables are endogenous and Ordinary Least Squares method can be applied to each equation separately, light on data requirements, and superior forecasting capabilities) but is not exempted from any limitations. According to Gujarati (2003), the following can be outlined as key VAR modelling limitations:

- VAR model is a-theoretic because it uses little economic theory and for this reason it is not appropriate for economic policy prescription;
- VAR models are less suited for economic policy analysis since their focus is on forecasting;
- Large number of parameters to be estimated: If there are *K* equations, one of each *K* variables and ρ lags of each of the variables in each equation, $(K + \rho K^2)$ parameters will have to be estimated;
- All *K* variables should be jointly stationary in a *K*-variable VAR model and data transformation becomes difficult if there is a mix of stationary and non-stationary variables; and
- The VAR parameter estimates cannot be directly interpreted and for this reason the Granger Causality or Block Exogeneity Wald Test and the innovation accounting technique (Impulse Response Functions and Forecast Error Variance Decomposition) are commonly used.

4.7 Summary

This chapter outlined the research methodology employed in this study by describing the population and unit of analysis, sampling method and size and how the study data was gathered and measured. The last two sections of the chapter dealt with the method of analysis (which covered unit root tests, the cointegration test, Vector Auto-regression Model and Vector Error Correction Model) and limitations of the VAR modelling. The results of the study are presented in chapter five.

5 EMPIRICAL RESULTS

5.1 Introduction

The research methodology employed to assess the impact of re-industrialization of economic growth and employment in South Africa was presented in chapter four and the empirical results of the study are presented in this chapter. The results are presented in two broad sections in line with the research question and hypotheses of the study. The chapter is divided into three sections. Section 5.2 discusses the manufacturing sector output and economic growth, section 5.3 with the manufacturing sector and employment growth and section 5.4 provides a summary of the empirical results of the study.

5.2 Manufacturing Sector and Economic Growth

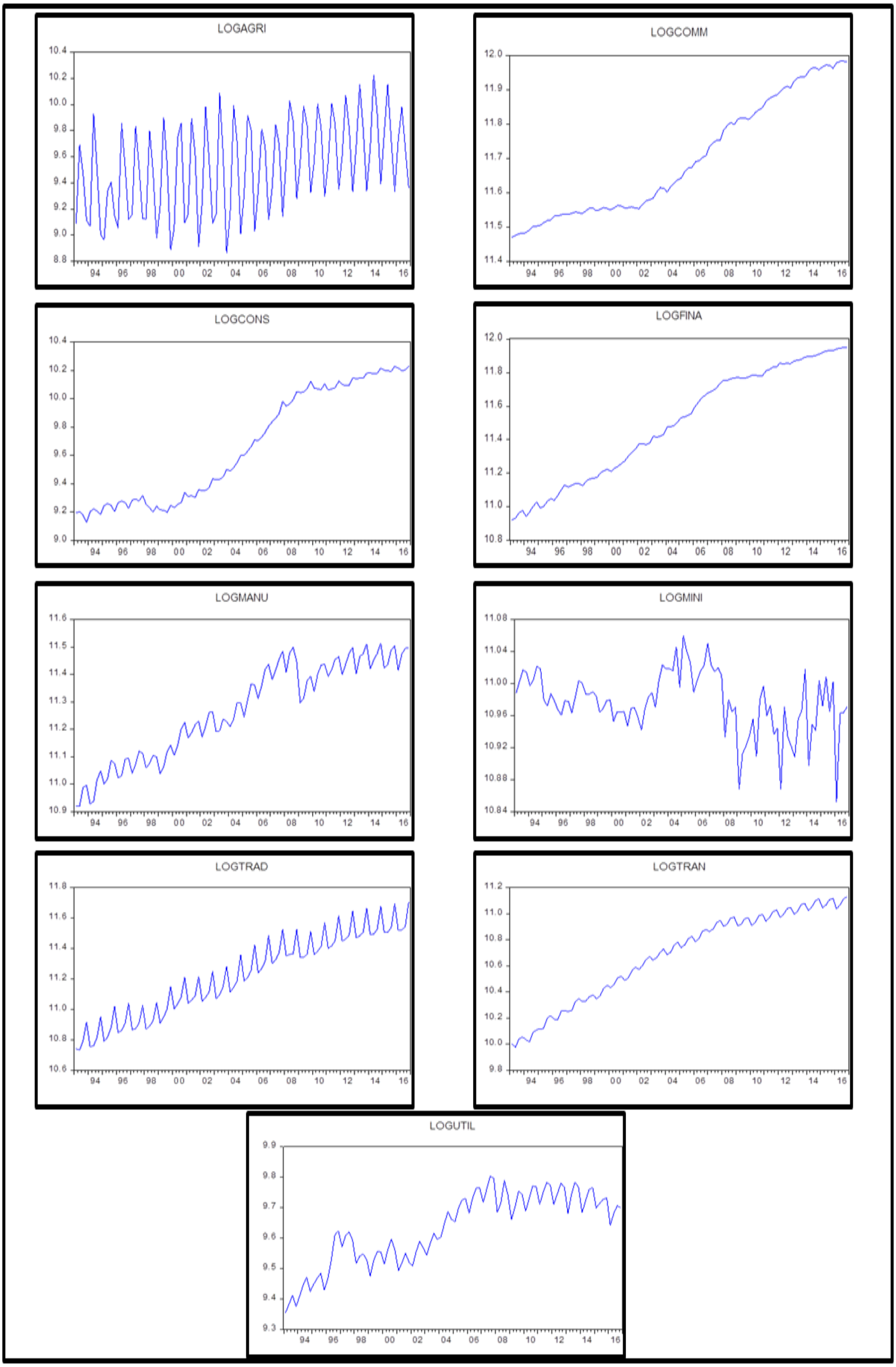
5.2.1 Data Description

It is useful to carry out a preliminary analysis of the data series being investigated in order to gain insight into the characteristics and behavior of the variables before conducting any econometric analysis. Data series is described in the form of graphical analysis, descriptive statistics and correlation analysis.

5.2.1.1 Graphical Analysis

Graphical plots (in levels against time), of logarithmic functions for each quarterly time series data for the period 1993-2016 are illustrated in Figure 5.1. An inspection of Figure 5.1 reveals that all series are likely to be non-stationary and characterized by an upward trend with the exception of agriculture (LOGAGRI) and mining (LOGMINI). Agriculture and mining series appear to be volatile with no clear trend. In contrast to Figure 5.1, all variables appear to be stationary when the variables are plotted in first differences (see Appendix B). Formal tests for stationarity are conducted in section 5.2.2 of this chapter.

Figure 5-1: Graphic Plots of Variables in Levels (Sector Output)



Source: Author generated (Statistics South Africa data)

5.2.1.2 Descriptive Statistics

Different statistical measures for describing the data series are presented in Table 5.1. In this case both the mean and the median are almost the same. The highest mean value was recorded by the community services (LOGCOMM) sector and the finance and business services (LOGFINA) sector respectively, while the agriculture (LOGAGRI) and utilities (LOGUTIL) sectors recorded the lowest in terms of output during the period under analysis. Standard deviation is the most widely used and reliable measure of dispersion of data series from its mean (Wegner, 2012). Using standard deviation as a measure, the most volatile sector output was in construction (LOGCONS) while the most stable sector output was in mining (LOGMINI).

Skewness measures the symmetry of a distribution while the kurtosis measures of whether the distribution of a data series has thin tails or heavy tails as compared the standard normal distribution (Wegner, 2012). The standard normal distribution has skewness of zero and kurtosis of three. If the skewness is less than zero it is referred to as negative skewness, while if it more than zero it is referred to as positive skewness. If the kurtosis is greater than three it is said to have heavy tails and if it less than three it is said to have thin tails. Table 5.1 indicates that all variables have a negative skewness close to zero, with the exception of the community and social services (LOGCOMM) sector. All variables have thin tails except for the mining (LOGMINI) sector that has heavy tails. The implication is that variables under consideration may not be normally distributed. The Jarque-Bera (JB) test statistic is used test whether the data series is normally distributed or not. The JB test statistic is formulated as follows (Eviews, 2015):

$$JB = N\left(\frac{S^2}{6} + \frac{K^2}{24}\right) \qquad (5.1)$$

where N is the sample size, S is the skewness and K is the kurtosis. Under the null hypothesis of normally distributed data series, the JB test statistic is asymptotically Chi-squared ($\chi 2$) distributed with 2 degrees of freedom. The results of the JB test statistic (Table 5.1), indicate that the null hypothesis of normality in data series can only be accepted at the 5% level of probability for the agriculture (LOGAGRI) and trade (LOGTRAD) sectors.

Table 5-1: Descriptive Statistics (Sector Output)

	LOGAGRI	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
Mean	9.525090	11.69855	9.666496	11.49400	11.26994	10.97695	11.22243	10.67688	9.631143
Median	9.557750	11.64089	9.601909	11.51964	11.29660	10.97852	11.24542	10.76064	9.657677
Maximum	10.22789	11.98452	10.23240	11.95094	11.51470	11.05991	11.70710	11.13408	9.803225
Minimum	8.860073	11.47105	9.128696	10.92091	10.91982	10.85252	10.73359	9.976041	9.355479
Std. Dev.	0.355603	0.170625	0.396628	0.334839	0.176960	0.038420	0.268588	0.346262	0.118223
Skewness	-0.040540	0.380415	0.139297	-0.186077	-0.293904	-0.708224	-0.115765	-0.480524	-0.458683
Kurtosis	1.844642	1.612095	1.310612	1.570549	1.763118	4.059000	1.842876	1.903840	2.107337
Jarque-Bera	5.365706	10.02057	11.72659	8.727312	7.501584	12.51123	5.570171	8.500721	6.553636
Probability	0.068368	0.006669	0.002842	0.012732	0.023499	0.001920	0.061724	0.014259	0.037748
Sum	914.4086	1123.060	927.9836	1103.424	1081.914	1053.787	1077.353	1024.980	924.5897
Sum Sq. Dev.	12.01311	2.765709	14.94477	10.65115	2.974915	0.140229	6.853232	11.39028	1.327785
Observations	96	96	96	96	96	96	96	96	96

Source: Author generated (Statistics South Africa data)

Table 5-2: Correlation Matrix (Sector Output)

	LOGAGRI	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
LOGAGRI	1.000000								
LOGCOMM	0.429814	1.000000							
LOGCONS	0.400032	0.981556	1.000000						
LOGFINA	0.412010	0.959838	0.971920	1.000000					
LOGMANU	0.364479	0.909311	0.930171	0.969606	1.000000				
LOGMINI	-0.180869	-0.393782	-0.359327	-0.323488	-0.214593	1.000000			
LOGTRAD	0.242783	0.923490	0.935339	0.960227	0.967734	-0.262184	1.000000		
LOGTRAN	0.373606	0.918085	0.933074	0.987424	0.978472	-0.274467	0.963642	1.000000	
LOGUTIL	0.397325	0.820384	0.861401	0.894275	0.930674	-0.128407	0.877381	0.909784	1.000000

Source: Author generated (Statistics South Africa data)

5.2.2 Correlation Analysis

Correlation analysis measures the strength of the linear relationship or association between any two numeric variables (Wegner, 2012). The correlation analysis results for the logarithm of all the variables are presented in Table 5.2. There is a strong and positive correlation between the output of the following sectors: community and social services (LOGCOMM); construction (LOGCONS); finance and business services (LOGFINA); manufacturing (LOGMANU); trade (LOGTAD); transport (LOGTRAN) and utilities (LOGUTIL).

The mining (LOGMINI) sector output has a weak and negative linear relationship with output in all sectors while the agriculture (LGOGAGRI) sector output has a weak and positive linear relationship with output in all sectors, except for the mining (LOGMINI) sector output, which is weak and negative. The relationship between any two variables does not necessarily imply causality. This exercise is conducted in section 5.2.5 using the Granger Causality Wald Test to determine if the lags of one variable are part of the other variable's equation (Enders, 2010).

5.2.3 Stationarity Tests

The results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) for a unit root for each sector output series are presented in Table 5.3. If the two tests support each other then we can have more certainty in the results. The results indicate that in the case of the community and social services (LOGCOMM) sector, the construction (LOGCONS) sector and the finance and business services (LOGFINA) sector, the two tests support each other so that the hypothesis of the existence of unit root cannot be rejected.

However, the two tests contradict each other in the case of the agriculture (LOGAGRI,) manufacturing (LOGMANU), trade (LOGTRAD) and utilities (LOGUTIL) sectors. As only the output series of the mining (LOGMINI) sector and transportation (LOGTRAN) sector appear to be stationary, this suggests that there may be one or more cointegrating vectors between variables. The implication is that the Vector Error Correction (VEC) model may be more appropriate than the Vector Auto-Regressive (VAR) model. A formal cointegration test is conducted in section 5.2.4 to justify the use of the VEC model.

Table 5-3: ADF and PP Unit Root Test Statistics (Sector Output)

Variable	Test	Restriction	τ/ Z_t Stat	Result
LOGAGRI	ADF	Constant	-1.13	Unit Root
	PP	Constant, Trend	-11.93	No Unit Root
LOGCOMM	ADF	Constant, Trend	-2.07	Unit Root
	PP	Constant	1.04	Unit Root
LOGCONS	ADF	Constant	-0.76	Unit Root
	PP	Constant	-0.13	Unit Root
LOGFINA	ADF	Constant	-1.62	Unit Root
	PP	Constant	-1.54	Unit Root
LOGMANU	ADF	Constant	-1.66	Unit Root
	PP	Constant, Trend	-5.03	No Unit Root
LOGMINI	ADF	Constant	-3.26	No Unit Root
	PP	Constant, Trend	-5.99	No Unit Root
LOGTRAD	ADF	Constant, Trend	-3.38	Unit Root
	PP	Constant, Trend	-10.20	No Unit Root
LOGTRAN	ADF	Constant	-.2.87	No Unit Root
	PP	Constant	-2.87	No Unit Root
LOGUTIL	ADF	Constant	-1.95	Unit Root
	PP	Constant, Trend	-3.80	No Unit Root

Note: Critical values (τ_c or Z_t = -2.86 at 5% and τ_{ct} or Z_t = -3.41 at 5%)

Source: Author generated (Statistics South Africa data)

5.2.4 Lag Length Selection

Now that the order of integration for each sector output series has been established, it is necessary to select an appropriate lag length to be used in the cointegration test and the Vector Error Correction model. The optimal lag length was chosen based on the LR test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQIC). The procedure involves the estimation of an unrestricted VAR model with all variables in levels and the selection of a lag length with the largest penalized maximized log-likelihood function or the specification with the lowest value of the criterion (Hossain, 2002). The results of the lag order selection criteria generated from an unrestricted VAR output are presented in Table 5.4.

Table 5-4: The Optimal Lag Length Results (Sector Output)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1107.224	NA	3.46e-22	-23.87444	-23.62775	-23.77487
1	1991.132	1575.661	9.17e-30	-41.32895	-38.86198*	-40.33326
2	2159.931	267.8772	1.42e-30	-43.23763	-38.55039	-41.34582
3	2327.340	232.9167	2.47e-31	-45.11609	-38.20858	-42.32816*
4	2440.520	135.3243*	1.58e-31*	-45.81566*	-36.68788	-42.13161

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

Source: Author generated (Statistics South Africa data)

The majority of the lag length selection criteria (LR, FPE and AIC), suggest that the optimal lag length is four lags. The implication of the results is that the fourth order VAR (p=4) model is most appropriate and cointegration will be tested using p – 1 lags (Lütkepohl, 2004). If there is one or more cointegrating vector between variables, then p – 1 the Vector Error Correction (VEC) model will be estimated. The associated VAR estimates and diagnostic tests results are presented in Appendices C and D respectively.

5.2.5 Cointegration Test

Now that the optimal lag length has been established, it is appropriate to test for the existence of at least one cointegrating vector using the Johansen procedure. The Johansen procedure for testing cointegration uses Johansen Trace and Max-Eigen statistics to test the null hypothesis of no cointegrating vector. If the computed Johansen Trace and Max-Eigen statistics are greater than their respective critical values at the 5% level of probability, then the null hypothesis of no cointegrating vector is rejected. The results of the cointegration test are presented in Table 5.5. The Johansen Trace statistic (five cointegrating vectors) and Max-Eigen statistic (three cointegrating vectors), indicate that the null hypothesis of no cointegrating vector is rejected by both tests at the 5% level of probability. Hence, it is appropriate to estimate the Vector Error Correction (VEC) model instead of the Vector Auto-regression (VAR) model. The VEC model is estimated in section 5.2.5.

Table 5-5: Johansen Cointegration Test Results (Sector Output)

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.649630	313.9565	197.3709	0.0000
At most 1 *	0.506910	217.4699	159.5297	0.0000
At most 2 *	0.424461	152.4201	125.6154	0.0004
At most 3 *	0.273058	101.5949	95.75366	0.0186
At most 4 *	0.242194	72.25536	69.81889	0.0315
At most 5	0.201505	46.74125	47.85613	0.0634
At most 6	0.141265	26.03876	29.79707	0.1275
At most 7	0.102913	12.02764	15.49471	0.1556
At most 8	0.021890	2.036235	3.841466	0.1536
Trace test indicates 5 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.649630	96.48652	58.43354	0.0000
At most 1 *	0.506910	65.04981	52.36261	0.0016
At most 2 *	0.424461	50.82523	46.23142	0.0151
At most 3	0.273058	29.33955	40.07757	0.4681
At most 4	0.242194	25.51411	33.87687	0.3511
At most 5	0.201505	20.70249	27.58434	0.2946
At most 6	0.141265	14.01112	21.13162	0.3641
At most 7	0.102913	9.991405	14.26460	0.2125
At most 8	0.021890	2.036235	3.841466	0.1536
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Author generated (Statistics South Africa data)

5.2.6 Vector Error Correction Model Results

The null hypothesis of no cointegrating vector was rejected by both cointegration tests (Johansen Trace and Max-Eigen statistics), at the 5% level of probability as discussed in section 5.2.4. Hence, it is appropriate to estimate the Vector Error Correction (VEC) model instead of the Vector Auto-regression (VAR) model. The nine-variable VEC model estimates with five cointegrating equations and diagnostic tests are presented in Appendices E and F, respectively. The diagnostic tests reveal that the residuals of the VEC model are normally distributed, homoscedastic with no autocorrelation in the majority of the lags. Based on the results presented in Appendix E, there is no significant relationship between the manufacturing (LOGMANU) sector output growth and output growth in the following sectors: agriculture (LOGAGRI), community and social services (LOGCOMM), construction (LOGCONS), finance and business services (LOGFINA), and utilities (LOGUTIL). However, the results indicate a positive and significant relationship between the manufacturing (LOGMANU) sector output growth and the growth of the output in the mining (LOGMINI), trade (LOGTRAD), and transport (LOGTRAN) sectors.

Given the possibility of multiple relationships and direction of causality between different sector output series and the fact that the coefficients estimated from VAR or VEC cannot be directly interpreted, the use of the Granger Causality or Block Exogeneity Wald Tests and the innovation accounting technique were used. The Granger Causality or Block Exogeneity Wald Tests were conducted to determine whether an exogenous shock generated from a particular sector is transmitted to another sector. These test whether or not the null hypothesis on non-causality between the dependent and independent variables is significant at a given level of probability (usually 5%), against the alternative hypothesis of the presence of causality based on the chi-squared (χ^2) criterion. The results of Vector Error Correction Granger Causality or Block Exogeneity Wald Tests are presented in Table 5.6.

The results indicate that sector output growth in the agriculture (LOGAGRIC) and mining (LOGMINI) sectors are not Granger caused by output growth in any of the sectors. The important result for this study is that the manufacturing sector (LOGMANU) output growth is Ganger caused by output growth in the community and social services (LOGCOMM), mining (LOGMINI), trade (LOGTRAD), transport (LOGTRAN) and utilities (LOGUTIL) sectors, while only trade (LOGTRAD) and transport (LOGTRAN) are Granger caused by the output growth in the manufacturing sector. The implication of the results is that there is a unidirectional causality between the output growth in the manufacturing sector and output growth in the community and social services, mining, and utilities sectors, but bi-directional causality between manufacturing sector output growth and output growth in both trade and transport sectors.

The Granger Causality or Block Exogeneity Wald Tests provided the relationships among the variables but no information on the impact of one-standard deviation innovation of one variable on itself and another variable. This information is provided through the use of innovation accounting techniques (Impulse Response Functions and Forecast Error Variance Decomposition). The Impulse Response Functions (IRFs) measure the effects of a shock to an endogenous variable on itself or on another endogenous variable, while the Forecast Error Variance Decomposition (FEVD), measures the fraction of the forecast error variance of an endogenous variable that can be attributed to shocks to itself or to other endogenous variables.

Table 5-6: Vector Error Correction Granger Causality Tests (Sector Output)

Dependent variable: D(LOGAGRI)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	5.325835	3	0.1494
D(LOGCONS)	1.631386	3	0.6523
D(LOGFINA)	4.612080	3	0.2025
D(LOGMANU)	0.406187	3	0.9390
D(LOGMINI)	0.131780	3	0.9878
D(LOGTRAD)	5.015605	3	0.1707
D(LOGTRAN)	2.473906	3	0.4800
D(LOGUTIL)	2.623622	3	0.4534
All	30.85155	24	0.1581

Dependent variable: D(LOGCOMM)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	26.85558	3	0.0000
D(LOGCONS)	2.058259	3	0.5604
D(LOGFINA)	2.950904	3	0.3993
D(LOGMANU)	3.367746	3	0.3383
D(LOGMINI)	0.211504	3	0.9757
D(LOGTRAD)	6.419583	3	0.0929
D(LOGTRAN)	4.913161	3	0.1783
D(LOGUTIL)	5.270111	3	0.1531
All	104.7717	24	0.0000

Dependent variable: D(LOGCONS)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	5.570479	3	0.1345
D(LOGCOMM)	5.965391	3	0.1133
D(LOGFINA)	14.27089	3	0.0026
D(LOGMANU)	1.862077	3	0.6015
D(LOGMINI)	3.564349	3	0.3125
D(LOGTRAD)	24.08129	3	0.0000
D(LOGUTIL)	5.411545	3	0.1440
All	104.6926	24	0.0000

Dependent variable: D(LOGFINA)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	1.417774	3	0.7014
D(LOGCOMM)	0.391078	3	0.9421
D(LOGCONS)	3.369819	3	0.3380
D(LOGMANU)	0.791890	3	0.8514
D(LOGMINI)	4.173821	3	0.2433
D(LOGTRAD)	9.961615	3	0.0189
D(LOGTRAN)	11.61897	3	0.0088
D(LOGUTIL)	1.048856	3	0.7894
All	82.90633	24	0.0000

Dependent variable: D(LOGMANU)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	4.829837	3	0.1847
D(LOGCOMM)	11.31820	3	0.0101
D(LOGCONS)	2.064811	3	0.5591
D(LOGFINA)	4.131185	3	0.2476
D(LOGMINI)	8.149055	3	0.0430
D(LOGTRAD)	66.93982	3	0.0000
D(LOGTRAN)	11.70030	3	0.0085
D(LOGUTIL)	13.40968	3	0.0038
All	223.5940	24	0.0000

Dependent variable: D(LOGMINI)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	3.120655	3	0.3734
D(LOGCOMM)	1.520704	3	0.6775
D(LOGCONS)	2.350365	3	0.5029
D(LOGFINA)	1.507021	3	0.6807
D(LOGMANU)	5.739972	3	0.1250
D(LOGTRAD)	4.719510	3	0.1935
D(LOGTRAN)	1.184636	3	0.7567
D(LOGUTIL)	1.189787	3	0.7555
All	19.98465	24	0.6976

Dependent variable: D(LOGTRAD)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	35.13911	3	0.0000
D(LOGCOMM)	7.429369	3	0.0594
D(LOGCONS)	1.990234	3	0.5744
D(LOGFINA)	3.045824	3	0.3846
D(LOGMANU)	14.65395	3	0.0021
D(LOGMINI)	0.758314	3	0.8594
D(LOGTRAN)	6.269439	3	0.0992
D(LOGUTIL)	4.128560	3	0.2479
All	123.4508	24	0.0000

Dependent variable: D(LOGTRAN)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	8.984770	3	0.0295
D(LOGCOMM)	14.00010	3	0.0029
D(LOGCONS)	8.385514	3	0.0387
D(LOGFINA)	11.67349	3	0.0086
D(LOGMANU)	7.661763	3	0.0535
D(LOGMINI)	4.391549	3	0.2222
D(LOGTRAD)	10.63345	3	0.0139
D(LOGUTIL)	2.128092	3	0.5463
All	136.3870	24	0.0000

Dependent variable: D(LOGUTIL)			
Excluded	Chi-sq	df	Prob.
D(LOGAGRI)	3.675867	3	0.2987
D(LOGCOMM)	17.17263	3	0.0007
D(LOGCONS)	3.664032	3	0.3001
D(LOGFINA)	0.623648	3	0.8910
D(LOGMANU)	2.602295	3	0.4571
D(LOGMINI)	1.701092	3	0.6367
D(LOGTRAD)	15.82189	3	0.0012
D(LOGTRAN)	1.531271	3	0.6751
All	80.52987	24	0.0000

Source: Author generated (Statistics South Africa data)

The Variance Decomposition (VD) results are presented in Table 5.7. The forecast error variance (at the tenth time horizon and ascending order), in the manufacturing sector output growth is explained by output growth in other sectors as follows: trade (29.66%), utilities (16.20%), manufacturing (15.17%), community and social services (10.35%), agriculture (9.65%), finance and business services (9.18%), mining (3.98%), transport (3.41%) and construction (1.87%). Interestingly, the forecast error variance in the output growth of other sectors explained by manufacturing sector output growth is lower, with the exception of the construction sector output growth (construction - 7.75%, trade - 4.10%, mining - 3.80%, utilities - 3.75%, finance and business services - 3.67%, community and social services - 2.16%, transport - 1.21% and agriculture - 0.98%).

Table 5.8 presents the results of Impulse Response Functions (IRFs), which measure the effects of unit change in the error at time *t* on the variable *y* at different points of time, holding all other variables constant. In the third (3^{rd}) period, a one standard deviation shock in the output growth of the manufacturing (LOGMANU) sector increases output growth in the finance and business services (LOGFINA) sector by 0.00540 units, the trade (LOGTRAD) sector by 0.00323 units, the manufacturing (LOGMANU) sector by 0.00240 units, the transport (LOGTRAN) sector by 0.00170 units, the utilities (LOGUTIL) sector by 0.00189 units and the mining (LOGMINI) sector by 0.00035 units. However, during the same period a one standard deviation shock in the output growth in the manufacturing (LOGMANU) sector decreases output growth in the agriculture (LOGAGRI) sector by 0.00330 units and the community and social services (LOGCOMM) sector by 0.00074 units.

In the eighth (8^{th}) period, a one standard deviation shock in the output growth of the manufacturing (LOGMANU) sector increases output growth in the trade (LOGTRAD) sector by 0.01229 units, the utilities (LOGUTIL) sector by 0.00791 units, the community and social services (LOGCOMM) sector by 0.00701 units, the finance and business services (LOGFINA) sector by 0.00609 units, the mining (LOGMINI) sector by 0.00492 units and the construction (LOGCONS) sector by 0.00009 units. A similar trend is observed in the tenth (10^{th}) period, with the exception of the construction sector in which a one standard deviation shock in the output growth of the manufacturing (LOGMANU) sector decreases output growth in the construction sector by 0.00096 units.

Table 5-7: VEC Tenth Time Horizon Variance Decomposition (Output)

Variance Decomposition of LOGAGRI:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	68.29841	7.175168	3.027317	2.167734	0.975226	2.028569	10.28027	3.760568	2.286738
Variance Decomposition of LOGCOMM:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	3.240414	37.54462	1.458316	23.14039	2.156879	15.72842	4.788106	2.415232	9.527618
Variance Decomposition of LOGCONS:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	6.612381	1.405545	16.32207	9.313071	7.750235	24.71469	21.99475	6.761194	5.126067
Variance Decomposition of LOGFINA:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	10.52089	11.90482	1.824305	32.11904	3.665325	10.49139	20.24475	0.663369	8.566101
Variance Decomposition of LOGMANU:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	9.652669	10.34928	1.869381	9.177879	15.70667	3.977475	29.65612	3.414431	16.19609
Variance Decomposition of LOGMINI:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	1.874572	1.793647	1.016381	6.081197	3.798477	80.39207	2.929977	0.804348	1.309326
Variance Decomposition of LOGTRAD:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	17.09238	16.53787	1.207754	4.163394	4.096540	0.876259	47.64519	1.558064	6.822548
Variance Decomposition of LOGTRAN:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	27.44829	10.99981	5.719164	12.46682	1.212037	0.619336	14.86689	25.66570	1.001957
Variance Decomposition of LOGUTIL:									
Component	**LOGAGRI**	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	1.202844	9.816336	0.904405	19.48810	3.753078	0.602683	2.975323	3.597497	57.65974

Source: Author generated (Statistics South Africa data)

Table 5-8: VEC Impulse Response Function Results (Output)

Shocks	Period	LOGAGRI	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
LOGAGRI	3	-0.018624	-0.019584	-0.008365	-0.005489	0.005734	-0.007693	0.002350	0.004995	0.000565
	8	0.002004	0.007740	-0.014251	0.005542	0.008457	-0.012050	0.018859	0.011063	0.011106
	10	0.002393	-0.000498	0.003973	0.002757	-0.000979	0.004569	-0.021728	-0.009480	0.006300
LOGCOMM	3	0.001520	0.003836	-0.000259	0.001534	0.000889	0.000891	0.000270	0.000436	0.001323
	8	-0.000600	0.003565	-0.001136	0.004270	-0.001118	0.003559	0.002049	-0.001385	0.003211
	10	0.000829	0.004681	-0.000479	0.004688	-0.001802	0.005093	0.002814	-0.002115	0.003277
LOGCONS	3	0.001695	-0.000677	0.008247	0.004492	-0.002825	0.003965	0.005701	-0.001065	0.003507
	8	-0.007187	0.003739	0.006137	0.011028	-0.008899	0.015897	0.014355	-0.007675	0.004796
	10	-0.010504	0.004684	0.008626	0.009262	-0.010746	0.019125	0.017576	-0.009102	0.009909
LOGFINA	3	-0.000618	-0.000634	-0.000873	0.005645	-0.001635	0.002214	0.001541	-0.002035	0.002823
	8	-0.004662	0.005760	-0.000548	0.006125	-0.002978	0.004556	0.007390	0.001002	0.004904
	10	-0.007372	0.007244	-0.000965	0.007275	-0.004568	0.005999	0.009365	-9.66E-05	0.005560
LOGMANU	3	-0.003304	0.003111	-0.000740	0.005401	0.002400	0.000350	0.003227	0.001703	0.001887
	8	-0.006345	0.007056	8.60E-05	0.006094	-0.007150	0.004924	0.012294	-0.005402	0.007908
	10	-0.004772	0.010131	-0.000958	0.002576	-0.005683	0.003522	0.008842	-0.002220	0.008285
LOGMINI	3	0.003030	0.001036	0.003640	0.004759	7.28E-05	0.016661	-0.000667	0.001693	-0.000305
	8	0.002940	0.003100	0.000679	0.005342	-0.002943	0.011592	-0.002951	-0.001125	-0.002413
	10	0.003765	0.001079	-0.000952	0.002964	-0.001281	0.010136	-0.005850	0.001421	-0.002640
LOGTRAD	3	-0.004876	0.005878	0.000292	0.002118	-0.003247	-0.000521	0.006655	-0.000866	0.003943
	8	-0.009761	0.007972	-0.001321	0.001658	-0.004153	0.002712	0.005190	-0.003005	0.003361
	10	-0.005286	0.008766	-0.001468	0.001921	-0.002273	0.000839	0.008603	0.001322	0.006219
LOGTRAN	3	-0.004289	0.004783	0.000451	0.002806	0.000838	0.001301	-0.000400	0.005670	-0.000620
	8	-0.006933	0.003049	-0.002659	0.003969	-0.001000	0.000135	0.005145	0.002196	0.000468
	10	-0.005768	0.005376	-0.003486	0.002880	-0.001335	-0.000781	0.005209	0.004138	0.001276
LOGUTIL	3	0.004693	0.004873	0.001116	0.010338	-0.005273	0.001425	0.002429	-0.000631	0.018425
	8	0.001174	0.011813	-0.003513	0.015110	-0.004845	0.001324	0.006387	-0.007130	0.018429
	10	0.002120	0.009092	-0.003608	0.011826	-0.005191	0.000391	0.001816	-0.006555	0.021520

Source: Author generated (Statistics South Africa data)

5.3 Manufacturing Sector and Employment Growth

5.3.1 Data Description

It is useful to carry out a preliminary analysis of the data series being investigated in order to gain insight into the characteristics and behavior of the variables before conducting any econometric analysis. Data series is described in the form of graphical analysis, descriptive statistics and correlation analysis.

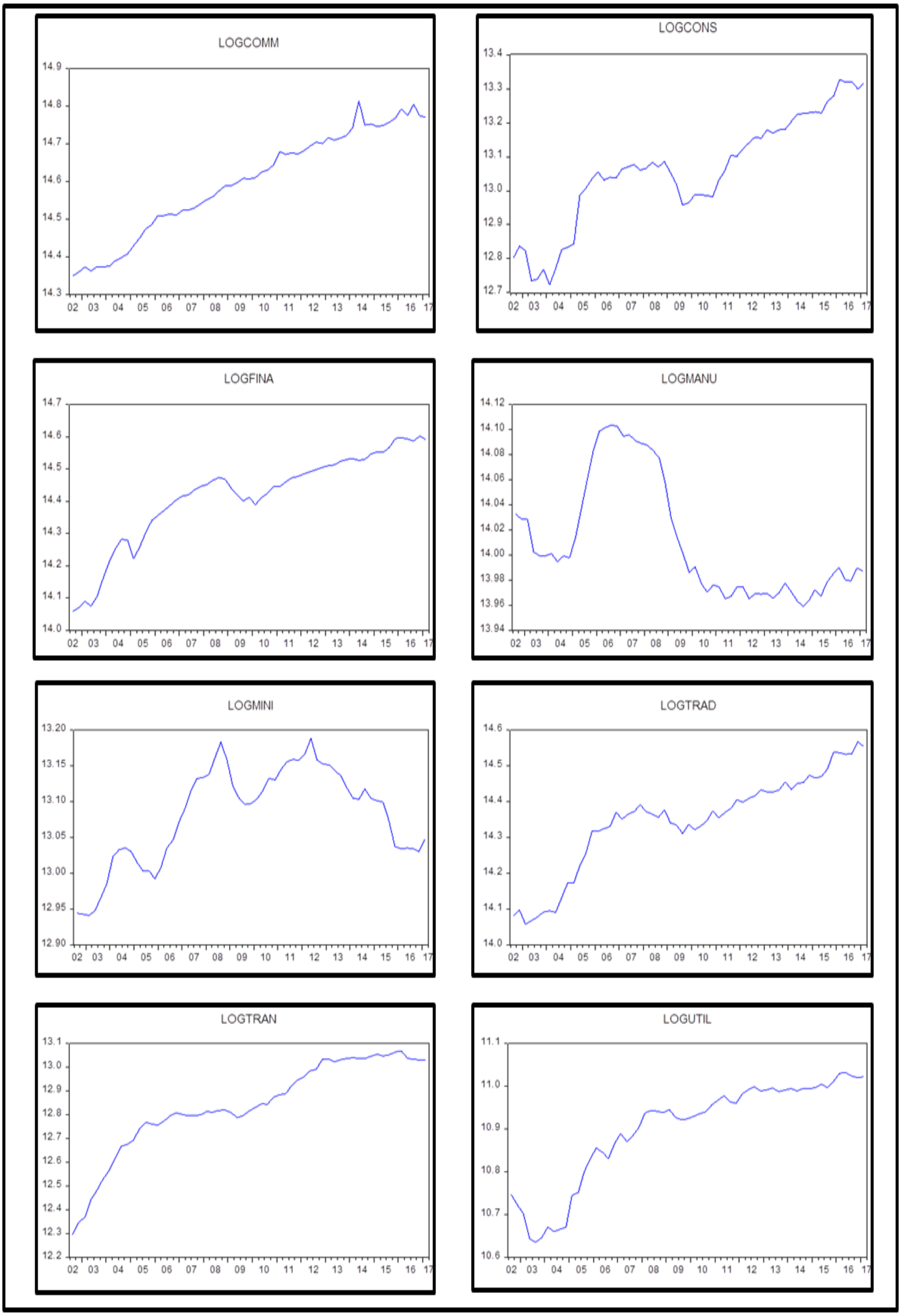
5.3.1.1 Graphical Analysis

Graphical plots (in levels against time), of logarithmic functions for each quarterly employment time series data for the period 1993-2016 are presented in Figure 5.2. An inspection of Figure 5.2 reveals that all series appear to be non-stationary and characterized by an upward trend with the exception of manufacturing and mining. The mining (LOGMINI) sector time series exhibits an upward trend until around 2012 and a declining trend thereafter. The manufacturing (LOGMANU) sector series on the other hand, exhibited a declining trend from 2004 and flattened from 2010 onwards before reverting to an upward trend again from 2014. In contrast to Figure 5.2, all variables appear to be stationary when plotted in first differences (see Appendix G). Formal tests for stationarity are conducted in section 5.3.2 of this chapter.

5.3.1.2 Descriptive Statistics

Various statistical measures for describing the data series are presented in Table 5.9. As in the sector output in section 5.2.1.2, the mean and the median are almost the same. The highest mean value was recorded by the community and social services sector (LOGCOMM), the finance and business services (LOGFINA) sector and the trade (LOGTRD) sector respectively, while the utilities (LOGUTIL), and transport (LOGTRAN) sectors recorded the lowest in terms of employment respectively, during the period under analysis. Standard deviation is the most widely used and reliable measure of dispersion of data series from its mean. Using standard deviation as a measure, the most volatile sector employment was in construction (LOGCONS), while the most stable sector was in manufacturing (LOGMANU) during the period under analysis.

Figure 5-2: Graphic Plots of Variables in Levels (Sector Employment)



Source: Author generated (Statistics South Africa data)

An inspection of Table 5.9 indicates that all variables have a negative skewness, but close to zero, with the exception of the manufacturing (LOGMANU) sector. The kurtosis indicates that all variables have thin tails with the exception of the finance and business services (LOGFINA) and transport (LOGTRAN) sectors, which have heavy tails. The implication is that all variables under consideration may not be normally distributed. The Jarque-Bera (JB) test statistic is used to test whether the data series is normally distributed or not. The results of the JB test statistic presented in Table 5.9 indicate that the null hypothesis of normality in data series cannot be rejected at the 5% level of probability for the community and social services (LOGCOMM), construction (LOGCONS), mining (LOGMINI) and trade (LOGTRAD) sectors, but can be rejected for the financial and business services (LOGFINA), manufacturing (LOGMANU), transport (LOGTRAN) and utilities (LOGUTIL) sectors.

5.3.1.3 Correlation Analysis

Correlation analysis measures the strength of the linear relationship or association between any two numeric variables (Wegner, 2012). The correlation analysis results for the logarithm of all the variables are presented in Table 5.10. There is a strong and positive correlation between employment in the following sectors: community and social services (LOGCOMM); construction (LOGCONS); finance and business services (LOGFINA); trade (LOGTRAD); transport (LOGTRAN) and utilities (LOGUTIL).

The mining (LOGMINI) sector employment has a moderate and positive linear relationship with employment in all sectors except for manufacturing. Surprisingly, manufacturing sector employment is weakly and negatively correlated with employment in all other sectors. The relationship between any two variables does not necessarily imply causality. This exercise is conducted in section 5.3.5 using the Granger Causality Wald Test to determine if the lags of one variable are part of the other variable's equation (Enders, 2010).

Table 5-9: Descriptive Statistics (Sector Employment)

	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
Mean	14.59863	13.05886	14.41476	14.01089	13.08151	14.34513	12.83925	10.89835
Median	14.60881	13.06429	14.44638	13.99070	13.10173	14.37000	12.82033	10.94095
Maximum	14.81447	13.32769	14.60274	14.10378	13.18880	14.56862	13.06898	11.03231
Minimum	14.34944	12.72268	14.05902	13.95911	12.94135	14.05817	12.29690	10.63509
Std. Dev.	0.140056	0.163029	0.145236	0.047475	0.067439	0.137002	0.195173	0.120607
Skewness	-0.292977	-0.357302	-0.999785	0.860701	-0.469380	-0.691990	-0.944774	-0.973322
Kurtosis	1.861391	2.432295	3.234091	2.232266	2.184783	2.696698	3.458620	2.613026
Jarque-Bera	4.031109	2.047666	9.963825	8.733575	3.800212	4.934843	9.294271	9.683791
Probability	0.133246	0.359215	0.006861	0.012692	0.149553	0.084803	0.009589	0.007892
Sum	861.3192	770.4728	850.4706	826.6422	771.8093	846.3628	757.5155	643.0027
Sum Sq. Dev.	1.137703	1.541545	1.223422	0.130726	0.263788	1.088642	2.209360	0.843669
Observations	59	59	59	59	59	59	59	59

Source: Author generated (Statistics South Africa data)

Table 5-10: Correlation Matrix (Sector Employment)

	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
LOGCOMM	1.000000							
LOGCONS	0.920919	1.000000						
LOGFINA	0.934398	0.931547	1.000000					
LOGMANU	-0.535706	-0.244048	-0.293437	1.000000				
LOGMINI	0.578220	0.465275	0.672893	-0.197684	1.000000			
LOGTRAD	0.937087	0.970610	0.974038	-0.243313	0.572746	1.000000		
LOGTRAN	0.943831	0.911356	0.967056	-0.412935	0.640425	0.940464	1.000000	
LOGUTIL	0.946241	0.910075	0.934039	-0.332688	0.690661	0.948152	0.896508	1.000000

Source: Author generated (Statistics South Africa data)

5.3.2 Stationarity Tests

The results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) for a unit root for each sector employment series are presented in Table 5.11. If these two tests support each other we can have more certainty in the results. The results indicate that in the case of the community and social services (LOGCOMM), construction (LOGCONS), manufacturing (LOGMANU), mining (LOGMINI) and utilities (LOGUTIL) sectors the two tests reinforce each other so that the hypothesis of the existence of unit root cannot be rejected. The two tests also reinforce each other so that the employment series of the finance and business services (LOGFINA), trade (LOGTRAD) and transport (LOGTRAN) sectors are stationary.

Table 5-11: ADF and PP Unit Root Test Statistics (Sector Employment)

Variable	Test	Restriction	τ/ Z_t Stat	Result
LOGCOMM	ADF	Constant, Trend	-2.30	Unit Root
	PP	Constant, Trend	-2.03	Unit Root
LOGCONS	ADF	Constant, Trend	-1.82	Unit Root
	PP	Constant	-0.84	Unit Root
LOGFINA	ADF	Constant, Trend	-3.61	No Unit Root
	PP	Constant	-3.00	No Unit Root
LOGMANU	ADF	Constant	-1.45	Unit Root
	PP	None	-0.34	Unit Root
LOGMINI	ADF	Constant	-2.40	Unit Root
	PP	Constant	-2.06	Unit Root
LOGTRAD	ADF	Constant, Trend	-4.82	No Unit Root
	PP	None	-2.98	No Unit Root
LOGTRAN	ADF	Constant, Trend	-3.01	No Unit Root
	PP	Constant	-4.87	No Unit Root
LOGUTIL	ADF	Constant	-0.82	Unit Root
	PP	Constant, Trend	1.59	Unit Root

Note: Critical values (τ_c or Z_t = -2.86 at 5% and τ_{ct} or Z_t = -3.41 at 5%)

Source: Author generated (Statistics South Africa data)

As only the employment series of the finance and business services (LOGFINA), trade (LOGTRAD) and transport (LOGTRAN) sectors appear to be stationary, this suggests that there may be one or more cointegrating vectors between variables. The implication is that the Vector Error Correction (VEC) model may be more appropriate than the Vector Auto-Regressive (VAR) model. A formal cointegration test is conducted in section 5.3.4 to justify the use of the VEC model.

5.3.3 Lag Length Selection

Now that the order of integration for each sector employment series has been established, it is necessary to select an appropriate lag length to be included in the cointegration test and the Vector Error Correction Model. The optimal lag length was chosen based on the LR test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQIC). The procedure involves the estimation of an unrestricted Vector Auto-regression (VAR) model with all variables in levels and the selection of a lag length with the largest penalized maximized log-likelihood function or the specification with the lowest value of the criterion (Hossain, 2002). The results of the lag order selection criteria generated from an unrestricted VAR output are presented in Table 5.12.

Table 5-12: The Optimal Lag Length Results (Sector Employment)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	871.7481	NA	3.16e-24	-31.40902	-31.11705	-31.29611
1	1321.256	751.9046	2.64e-30	-45.42750	-42.79972*	-44.41132*
2	1394.246	100.8580	2.20e-30	-45.75439	-40.79080	-43.83493
3	1482.268	96.02390*	1.38e-30*	-46.62791	-39.32852	-43.80518
4	1571.363	71.27623	1.38e-30	-47.54047*	-37.90527	-43.81446

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

Source: Author generated (Statistics South Africa data)

The SC and HQ selection criteria suggest that the optimal lag length is one while LR and FPE selection criteria suggest that the optimal lag length is three. Based on the associated VAR estimates and diagnostic tests results (given in Appendices H and I, respectively), a lag length of three was used. The implication of the results is that the third order VAR (p = 3) model is most appropriate and cointegration will be tested using p – 1 lags (Lütkepohl, 2004). Hence, if there is one or more cointegrating vectors between variables, then p – 1 Vector Error Correction (VEC) model will be estimated.

5.3.4 Cointegration Test

Now that the optimal lag length has been established, it is appropriate to test for the existence of at least one cointegrating vector using the Johansen procedure. The Johansen procedure for testing cointegration uses Johansen Trace and Max-Eigen statistics to test the null hypothesis of no cointegrating vector. If the computed Johansen

Trace and Max-Eigen statistics are greater than their respective critical values at the 5% level of probability, then the null hypothesis of no cointegrating vector is rejected. The results of the cointegration test are presented in Table 5.13. The Johansen Trace statistic (five cointegrating vectors) and Max-Eigen statistic (four cointegrating vectors), indicate that the null hypothesis of no cointegrating vector is rejected by both tests at the 5% level of probability. Hence, it is appropriate to estimate the Vector Error Correction (VEC) model instead of the Vector Auto-regression (VAR) model. The VEC model is estimated in section 5.3.5.

Table 5-13: Johansen Cointegration Test Results (Sector Employment)

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.786351	282.1663	159.5297	0.0000
At most 1 *	0.679944	195.7347	125.6154	0.0000
At most 2 *	0.527245	131.9363	95.75366	0.0000
At most 3 *	0.466520	89.98229	69.81889	0.0006
At most 4 *	0.366223	54.79557	47.85613	0.0097
At most 5	0.289887	29.25631	29.79707	0.0576
At most 6	0.144782	10.08574	15.49471	0.2742
At most 7	0.023425	1.327394	3.841466	0.2493
Trace test indicates 5 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None *	0.786351	86.43161	52.36261	0.0000
At most 1 *	0.679944	63.79844	46.23142	0.0003
At most 2 *	0.527245	41.95397	40.07757	0.0304
At most 3 *	0.466520	35.18672	33.87687	0.0347
At most 4	0.366223	25.53926	27.58434	0.0893
At most 5	0.289887	19.17057	21.13162	0.0920
At most 6	0.144782	8.758346	14.26460	0.3068
At most 7	0.023425	1.327394	3.841466	0.2493
Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Author generated (Statistics South Africa data)

5.3.5 Vector Error Correction Model Results

The null hypothesis of no cointegrating vector was rejected by both cointegration tests (Johansen Trace and Max-Eigen statistics) at the 5% level of probability as discussed in section 5.3.4. Hence, it is appropriate to estimate the Vector Error Correction (VEC) model instead of the Vector Auto-regression (VAR) model. The eight-variable VEC model estimates with five cointegrating equations and diagnostic tests are presented in

Appendices J and K, respectively. The diagnostic tests reveal that the residuals of the VEC model are homoscedastic and not auto-correlated, but fails the test for normality. Based on the results presented in Appendix J, there is no significant relationship between the manufacturing (LOGMANU) sector employment growth and employment growth in all sectors except for the transport (LOGTRAN) sector.

Given the possibility of multiple relationships and direction of causality between different sector employment series and the fact that the coefficients estimated from VAR or VEC cannot be directly interpreted, the Granger Causality or Block Exogeneity Wald Tests and the innovation accounting technique were used. The Granger Causality or Block Exogeneity Wald Tests were conducted to determine whether an exogenous shock generated from a particular sector is transmitted to another sector. These tests are to explore whether or not the null hypothesis on non-causality between the dependent and independent variables is significant at a given level of probability (usually 5%), against the alternative hypothesis of the presence of causality based on the chi-squared (χ^2) criterion. The results of Vector Error Correction Granger Causality or Block Exogeneity Wald Tests are presented in Table 5.14.

The results indicate that sector employment growth in manufacturing (LOGMANU) and utilities (LOGUTIL) are not Granger caused by employment growth in any of the sectors. The employment growth in the manufacturing (LOGMANU) sector Granger causes employment growth in the transport (LOGTRAN) sector. The employment growth in the trade (LOGTRAD) sector is Granger caused by employment growth in the community and social services (LOGCOMM), mining (LOGMINI), transport (LOGTRAN), and utilities (LOGUTIL) sectors. On the other hand, there is causality between employment growth in the trade sector (LOGTRAD) and employment growth in the community and social services (LOGCOMM), finance and business services (LOGFINA) and mining sectors (LOGMINI). The implication of the results is that there a bi-directional causality between the employment growth in the trade (LOGTRAD) sector (LOGTRAD) and employment growth in the community and social services (LOGCOMM) and mining (LOGMINI) sectors, but unidirectional with employment growth in the transport (LOGTRAN) and utilities (LOGUTIL) sectors.

Table 5-14: Vector Error Correction Granger Causality Tests (Sector Employment)

Dependent variable: D(LOGCOMM)			
Excluded	Chi-sq	df	Prob.
D(LOGCONS)	0.146854	2	0.9292
D(LOGFINA)	0.354368	2	0.8376
D(LOGMANU)	3.082254	2	0.2141
D(LOGMINI)	1.591089	2	0.4513
D(LOGTRAD)	0.677690	2	0.7126
D(LOGTRAN)	0.135407	2	0.9345
D(LOGUTIL)	0.006500	2	0.9968
All	5.258116	14	0.9819

Dependent variable: D(LOGCONS)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	2.178512	2	0.3365
D(LOGFINA)	6.121131	2	0.0469
D(LOGMANU)	2.785553	2	0.2484
D(LOGMINI)	2.518172	2	0.2839
D(LOGTRAD)	1.759566	2	0.4149
D(LOGTRAN)	7.260319	2	0.0265
D(LOGUTIL)	14.93955	2	0.0006
All	39.97954	14	0.0003

Dependent variable: D(LOGFINA)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	0.706207	2	0.7025
D(LOGCONS)	0.960372	2	0.6187
D(LOGMANU)	5.164027	2	0.0756
D(LOGMINI)	0.796236	2	0.6716
D(LOGTRAD)	10.46085	2	0.0054
D(LOGTRAN)	5.201401	2	0.0742
D(LOGUTIL)	7.951002	2	0.0188
All	44.89862	14	0.0000

Dependent variable: D(LOGMANU)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	1.691549	2	0.4292
D(LOGCONS)	0.405749	2	0.8164
D(LOGFINA)	0.596839	2	0.7420
D(LOGMINI)	3.129196	2	0.2092
D(LOGTRAD)	1.836072	2	0.3993
D(LOGTRAN)	3.664294	2	0.1601
D(LOGUTIL)	1.763266	2	0.4141
All	21.58168	14	0.0876

Dependent variable: D(LOGMINI)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	2.024116	2	0.3635
D(LOGCONS)	2.640466	2	0.2671
D(LOGFINA)	8.004170	2	0.0183
D(LOGMANU)	0.451352	2	0.7980
D(LOGTRAD)	8.961225	2	0.0113
D(LOGTRAN)	0.433076	2	0.8053
D(LOGUTIL)	0.665031	2	0.7171
All	18.27639	14	0.1945

Dependent variable: D(LOGTRAD)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	15.10084	2	0.0005
D(LOGCONS)	1.219477	2	0.5435
D(LOGFINA)	1.294954	2	0.5234
D(LOGMANU)	3.284180	2	0.1936
D(LOGMINI)	16.33740	2	0.0003
D(LOGTRAN)	7.632915	2	0.0220
D(LOGUTIL)	9.657645	2	0.0080
All	40.07736	14	0.0002

Dependent variable: D(LOGTRAN)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	1.394737	2	0.4979
D(LOGCONS)	2.734269	2	0.2548
D(LOGFINA)	0.296480	2	0.8622
D(LOGMANU)	11.88606	2	0.0026
D(LOGMINI)	5.445520	2	0.0657
D(LOGTRAD)	0.889199	2	0.6411
D(LOGUTIL)	0.462679	2	0.7935
All	24.76270	14	0.0370

Dependent variable: D(LOGUTIL)			
Excluded	Chi-sq	df	Prob.
D(LOGCOMM)	0.158585	2	0.9238
D(LOGCONS)	1.445655	2	0.4854
D(LOGFINA)	3.087100	2	0.2136
D(LOGMANU)	1.435877	2	0.4878
D(LOGMINI)	0.624839	2	0.7317
D(LOGTRAD)	1.806046	2	0.4053
D(LOGTRAN)	1.101632	2	0.5765
All	22.72786	14	0.0648

Source: Author generated (Statistics South Africa data)

The Granger Causality or Block Exogeneity Wald Tests provided the relationships among variables but no information on the impact of one-standard deviation innovation of one variable on itself and another variable. This information is provided through the use of innovation accounting techniques (Impulse Response Functions and Forecast Error Variance Decomposition). The Impulse Response Functions (IRFs) measure the effects of a shock to an endogenous variable on itself or on another endogenous variable, while the Forecast Error Variance Decomposition (FEVD) measures the fraction of the forecast error variance of an endogenous variable that can be attributed to shocks to itself or to other endogenous variables.

The Variance Decomposition (VD) results are presented in Table 5.15. The forecast error variance in manufacturing sector employment growth (at the tenth time horizon and ascending order), is explained by employment growth in other sectors as follows: community and social services (22.93%), construction (16.55%), manufacturing (18.40%), financial and business services (15.60%), mining (13.67%), transport (7.99%), trade (4.03%) and utilities (0.83%). Interestingly, the forecast error variance in the employment growth of other sectors, explained by manufacturing sector employment growth, is lower with the exception of construction sector output growth (utilities – 8.07%, mining - 6.12%, community and social services – 5.16%, trade – 4.48%, construction – 4.39%, finance and business services – 2.57% and transport – 1.79%).

Table 5.16 presents the results of Impulse Response Functions (IRFs). In the third (3^{rd}) period, a one standard deviation shock in the employment growth of the manufacturing (LOGMANU) sector increases employment growth in the construction (LOGCONS) sector by 0.00308 units, the mining (LOGMINI) sector by 0.00201 units, the trade (LOGTRAD) sector by 0.00329 units, the transport (LOGTRAN) sector by 0.00069 units, and the utilities (LOGUTIL) sector by 0.00151 units. However, during the same period, a one standard deviation shock in the employment growth of the manufacturing (LOGMANU) sector decreases employment growth in the community and social services (LOGCOMM) sector by 0.00433 units and finance and business services (LOGFINA) by 0.00133 units.

In the eighth (8^{th}) period, a one standard deviation shock in the employment growth of the manufacturing (LOGMANU) sector increases employment growth in the construction (LOGCONS) sector by 0.00500 units, the mining (LOGMINI) sector by 0.00500 units, the trade (LOGTRAD) sector by 0.00082 units, the transport (LOGTRAN) sector by 0.00386 units and the utilities (LOGUTIL) sector by 0.00009 units. A similar trend is observed in the tenth (10^{th}) period, with the exception of the trade (LOGTRAD) and utilities (LOGUTIL) sectors in which a one standard deviation shock in the employment growth of the manufacturing sector (LOGMANU) decreases employment growth in the trade (0.00046 units) and utilities (0.00205 units) sectors.

Table 5-15: VEC Tenth Time Horizon Variance Decomposition (Sector Employment)

Variance Decomposition of LOGCOMM:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	50.30094	5.262145	22.44373	5.157333	12.46655	1.054315	0.815402	2.499581
Variance Decomposition of LOGCONS:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	2.824473	40.15223	13.33504	4.385164	23.39765	1.074643	10.16513	4.665660
Variance Decomposition of LOGFINA:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	11.43242	14.27069	28.31986	2.570776	12.94607	12.68233	14.03878	3.739067
Variance Decomposition of LOGMANU:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	22.92957	16.55012	15.60249	18.39712	13.67249	4.027091	7.992847	0.828260
Variance Decomposition of LOGMINI:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	24.75694	0.146356	9.877344	6.119686	37.89317	17.03960	0.588318	3.578589
Variance Decomposition of LOGTRAD:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	18.92578	21.96116	5.123181	4.476714	14.24209	18.50321	15.44690	1.320964
Variance Decomposition of LOGTRAN:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	0.798532	5.876709	27.94887	1.785545	38.38710	0.252177	19.59389	5.357178
Variance Decomposition of LOGUTIL:								
Component	**LOGCOMM**	**LOGCONS**	**LOGFINA**	**LOGMANU**	**LOGMINI**	**LOGTRAD**	**LOGTRAN**	**LOGUTIL**
%	33.59243	2.555362	6.892889	8.067311	5.129308	30.37119	4.227749	9.163763

Source: Author generated (Statistics South Africa data)

Table 5-16: VEC Impulse Response Function Results (Sector Employment)

Shocks	Period	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
LOGCOMM	3	0.005601	-0.000601	0.003320	0.002708	-0.004440	0.000661	-0.000305	0.001120
	8	0.001799	-0.002279	0.005162	-0.001985	-0.002312	0.001040	0.000593	0.000989
	10	0.001899	-0.002750	0.003920	-0.003043	-0.001971	0.001075	0.000658	0.000484
LOGCONS	3	0.005547	0.011651	-0.004998	0.009124	0.007929	0.003697	0.006557	-0.002287
	8	-0.002415	0.015481	-0.010638	-0.001722	0.014424	0.000477	0.008954	-0.006969
	10	0.001517	0.015626	-0.015437	-0.005249	0.016509	-0.001063	0.008003	-0.008519
LOGFINA	3	0.000523	-0.000267	0.005387	0.002244	0.003038	0.001673	0.002608	-0.000654
	8	-0.006244	0.004578	-0.003808	0.001760	0.003376	0.004200	0.005800	0.001955
	10	-0.004496	0.005792	-0.002699	0.001406	0.005606	0.004249	0.004820	0.001979
LOGMANU	3	-0.004332	0.003080	-0.001333	0.006023	0.002013	0.003292	0.000687	0.001505
	8	-0.006188	0.004989	-0.005215	0.003012	0.004993	0.000818	0.003855	9.93E-05
	10	-0.004014	0.005652	-0.006860	0.001450	0.006768	-0.000464	0.003574	-0.002053
LOGMINI	3	-0.002770	-0.001404	-0.003464	0.004348	0.012826	0.003312	0.000853	-0.004609
	8	-0.013653	-0.000457	-0.006101	0.007035	0.009295	0.010692	0.002299	0.002606
	10	-0.016098	-0.000852	-0.004046	0.007956	0.010052	0.011987	0.002414	0.005075
LOGTRAD	3	-0.004321	0.006238	-0.000435	0.002725	0.004907	0.006905	0.002545	0.001674
	8	-0.008045	0.006548	-0.003746	-0.000332	0.007576	0.004455	0.007434	0.000836
	10	-0.005900	0.007810	-0.003918	-0.001497	0.008543	0.003636	0.006602	-0.000755
LOGTRAN	3	-0.000847	0.000901	-0.005667	0.001900	0.008334	0.000112	0.005392	-0.001045
	8	0.001057	0.002927	-0.008942	-0.002189	0.010436	1.26E-05	0.003261	-0.003846
	10	0.002221	0.002783	-0.007587	-0.001414	0.010037	0.001016	0.002528	-0.003980
LOGUTIL	3	-0.001654	0.001452	0.004168	0.007495	0.000469	0.008951	0.002620	0.003552
	8	-0.010813	-0.001986	0.003375	0.001306	0.003950	0.008472	0.003024	0.003402
	10	-0.010722	-0.001736	0.001439	0.000361	0.004273	0.008233	0.003561	0.002475

Source: Author generated (Statistics South Africa data)

5.4 Summary

This chapter presented empirical results on the impact of re-industrialization on economic growth and employment in South Africa using a Vector Error Correction model. The study focused on broad economic sectors (community and social services; construction; finance and business services; manufacturing; mining; trade; transport and utilities) as per Statistics South Africa's Standard Industrial Classification. The study utilized quarterly output data from 1993 first quarter to 2016 fourth quarter and quarterly employment data from 2002 third quarter to 2017 first quarter obtained directly from Statistics South Africa. The descriptive analysis, stationary and cointegration tests were conducted prior to the estimation of the Vector Error Correction model and the resultant Granger Causality tests and the innovation accounting technique, consisting of Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD), for output and employment series. The results of this study are discussed in chapter six.

6 DISCUSSION OF RESULTS

6.1 Introduction

This chapter presents a discussion of the empirical results obtained from econometric analysis conducted and reported in chapter five. The econometric analysis was conducted in line with the key research question and hypotheses of the study. Hence, the empirical results of the study discussed in this chapter are based on the research question, hypotheses and relevant literature reviewed in chapter two. The main purpose of this study was to assess the impact of re-industrialization on economic growth and employment in South Africa. The two hypotheses related to the main purpose of the study were outlined in chapter three as follows:

Null Hypothesis 1 (H_{01}): Manufacturing sector output growth does not have a positive and significant impact on the output growth in other economic sectors.
Alternative Hypothesis 1 (H_{11}): Manufacturing sector output growth has a positive and significant impact on the output growth in other economic sectors.

Null Hypothesis 2 (H_{02}): Manufacturing sector employment growth does not have a positive and significant impact on the employment growth in other economic sectors.
Alternative Hypothesis 2 (H_{12}): Manufacturing sector employment growth has a positive and significant impact on the employment growth in other economic sectors.

This chapter is divided into three sections. Section 6.2 discusses the relationship between the manufacturing sector and economic growth, section 6.3 discusses the relationship between the manufacturing sector and employment growth and a summary is provided in section 6.4. Summary, conclusions and policy implications of the study are provided in chapter seven.

6.2 The Impact of the Manufacturing Sector on Economic Growth

This section discusses the empirical results of the study in relation to **Alternative Hypothesis 1**: Manufacturing sector output growth has a positive and significant impact on the output growth in other economic sectors. This hypothesis was preliminarily tested using correlation analysis and formally tested using the Vector Error Correction (VEC)

Model. As the coefficients estimated from the VEC model cannot be directly interpreted, the use of the Granger Causality or Block Exogeneity Wald Test and the innovation accounting technique consisting of Impulse Response Functions (IRFs) and Variance Decomposition (VD) were used (Chakravarty & Mitra, 2009; Brooks, 2014).

The correlation analysis revealed the existence of a strong and positive linear relationship between the manufacturing sector output and output in the community and social; construction; finance and business services; trade; transport and utilities sectors. The mining sector output has a weak and negative linear relationship with manufacturing sector output while the agricultural sector output has a weak and positive linear relationship with the manufacturing sector output. The implication of these results is that, based on correlation analysis, the increase in manufacturing sector output will increase output in all other sectors of the economy but reduce the output of the mining sector. The least increase in output growth will occur in the agriculture sector.

It is, however, important to note that the existence of a relationship between any two variables does not necessarily imply causality. Granger Causality Tests were conducted to determine whether an exogenous shock generated from a particular sector is transmitted to another sector. The results revealed that the output growth in the trade and transport sectors are Granger caused by the output growth in the manufacturing sector, and that the manufacturing sector output growth is Ganger caused by output growth in the community and social services, mining, trade, transport and utilities sectors. The implication of the results is that there is a bi-directional causality between manufacturing sector output growth and output growth in the trade and transport sectors, but unidirectional with output growth in the community and social services, mining and utilities sectors.

The results of the Vector Error Correction model estimates indicated a positive and significant relationship between the manufacturing sector output growth and the growth of the output in the trade, transport and mining sectors. The results further indicated that there is no significant relationship between the manufacturing sector output growth and output growth in the following sectors: agriculture, community and social services, construction, finance and business services, and utilities. Hence, the research hypothesis that the manufacturing sector output growth has a positive and significant impact on the output growth in other economic sectors is rejected for all sectors with the exception of the trade, transport and mining sectors. The implication of the results is that stimulating output growth in the manufacturing sector will increase output growth in the trade, transport and mining sectors but not in agriculture, community and social services, construction, finance and business services and utilities.

The Variance Decomposition results indicated that the manufacturing sector output growth explains a lower proportion of output growth variation in other sectors than manufacturing sector output growth is explained by output growth in other sectors. However, in the case of Impulse Response Functions, a one standard deviation shock emanating from the manufacturing sector output growth to output growth in other sectors is mostly better than one standard deviation shocks emanating from output growth in other sectors to manufacturing output growth.

Taking into account the results of correlation analysis, Granger Causality tests, VEC model estimates, Variance Decomposition and Impulse Response Functions, it can be concluded that manufacturing sector output growth had a moderate impact on economic growth and the potential to drive economic growth and development going forward in South Africa, albeit not completely straightforward. Most of the slowdown in the economic growth and development of many countries around the world has been explained by the performance of the manufacturing sector (Tregenna, 2013). This potential will only be realized if, amongst other issues, the recommendations of the theory of coordination failure in economic development are in place (Ojo & Ololade, 2013; Dang & Pheng, 2015 and Cheremukhin et al., 2017). The coordination failure theory in economic development is based on the premise that the market may fail to achieve coordination among complementary activities recommended by the endogenous models and may lead to multiple equilibria which are not optimal.

Stagnation in the manufacturing sector may not be primarily caused by challenges around small inefficient firms, barriers to entry and exit and market power but rather policy uncertainty, poor rule of law and corruption, amongst other important social and macroeconomic factors (Dang & Pheng, 2015). The findings of this study are supported by a number of authors in the economic development literature. These include key studies by Moavenzadeh et al. (2012); McCausland & Theodossiou (2012); McMillan et al. (2014); Szirmai & Verspagen (2015); Rodrik (2016); Haraguchi et al. (2017); Su & Yao (2017) and Cantore et al. (2017). These studies tested the hypothesis that manufacturing acted as an engine of economic growth and revealed that the manufacturing sector had a varied but positive impact on economic growth and development.

It is believed that as most successful emerging countries will be reaching their industrialization peak (if they have not yet done so), it will be an opportunity for most of the developing countries to take advantage of the developments and grow their economies through industrialization (Haraguchi et al., 2017). It follows that in developing countries (like South Africa), which experienced premature de-industrialization and the growth of the services sector at the expense of the manufacturing sector, it is advisable to develop and implement industrial policy strategy to prevent premature de-industrialization. This is reinforced by the economic development literature indicating that a combination of a poor performing manufacturing sector with a high performing services sector is not good for sustainable and inclusive economic growth in the long run (McMillan et al., 2014; Rodrik, 2016).

6.3 The Impact of the Manufacturing Sector on Employment Growth

This section discusses the empirical results of the study in relation to **Alternative Hypothesis 2**: Manufacturing sector employment growth has a positive and significant impact on the employment growth in other economic sectors. This hypothesis was preliminarily tested using correlation analysis and formally tested using the Vector Error Correction (VEC) Model. As the coefficients estimated from the VEC model cannot be directly interpreted, the use of the Granger Causality or Block Exogeneity Wald Test and the innovation accounting technique consisting of Impulse Response Functions (IRFs) and Variance Decomposition (VD) were used (Chakravarty & Mitra, 2009; Brooks, 2014).

The correlation analysis results revealed that there is a strong and positive correlation between employments in the following sectors: community and social services; construction; finance and business services; trade; transport and utilities. Surprisingly, manufacturing sector employment is weakly and negatively correlated with employment in all other sectors. The implication of the results is that, based on the correlation analysis of the employment data series, stimulating employment growth in the manufacturing sector will actually decrease employment growth in all sectors of the economy.

Again, it is important to note that the existence of a relationship between any two variables does not necessarily imply causality. Granger Causality Tests were conducted to determine whether an exogenous shock generated from a particular sector is transmitted to another sector. The Granger Causality results revealed that employment growth in the manufacturing sector Granger caused employment growth in the transport sector, but not the rest of the economic sectors. These results were confirmed by Vector Error Correction model estimates, which indicated that there is no significant relationship between the manufacturing sector employment growth and employment growth in all sectors except for the transport sector.

Hence, the research hypothesis that the manufacturing sector employment growth has a positive and significant impact on employment growth in other economic sectors is rejected for all other sectors with the exception of the transport sector. The implication of the results is that stimulating employment growth in the manufacturing sector will increase employment growth only in the transport sector but not in the rest of the economic sectors.

The Variance Decomposition results indicated that the manufacturing sector employment growth explains a lower proportion of employment growth variation in others sectors than manufacturing sector employment growth is explained by employment growth in other sectors. However, in the case of Impulse Response Functions, a one standard deviation shock emanating from the manufacturing sector employment growth to employment growth in other sectors are mostly better compared to one standard deviation shocks emanating from employment growth in other sectors to manufacturing employment growth. Taking the results of correlation analysis into account, Granger Causality tests, VEC model estimates, Variance Decomposition and Impulse Response Functions, it can be concluded that manufacturing sector employment growth had no significant impact on employment growth in other economic sectors of the South African economy with the exception of the transport sector.

The implication of these results is that manufacturing sector employment growth does not necessarily guarantee employment growth in other sectors of the economy (with the exception of the transport sector), in South Africa. These findings are in contradiction to a number of studies on the role of manufacturing sector employment growth in economic growth and development, such as Szirmai & Verspagen (2015) and Su & Yao, (2017). This finding warrants a further research by investigating growth-employment dynamics between manufacturing sector and other sectors of the South African economy.

However, these findings are explained by studies such as those by Rodrik (2013) and Cantore et al. (2017). Rodrik (2013) argued that aggregate convergence in developing countries may fail despite a strong convergence within the manufacturing sector due to a small share of manufacturing sector employment and a slow pace of industrialization.

This is further supported by Cantore et al. (2017), who postulated that it is the structural transformation component of the manufacturing growth that promotes economic growth and development, rather than the employment scale component. The structural transformation manufacturing sector growth component is based on drivers that strengthen the manufacturing industries in terms of productivity and labour share. According to Cantore et al. (2017), the employment scale component can be defined as manufacturing growth based on drivers that do not promote the manufacturing sector as an engine of economic growth and development.

6.4 Summary

This chapter discussed the empirical results of the study obtained from econometric analysis, focusing on the main purpose and hypotheses of the study. The main purpose of this study was to assess the impact of re-industrialization on economic growth and employment in South Africa. The two hypotheses tested were outlined as follows: Hypothesis 1: Manufacturing sector output growth has a positive and significant impact on the output growth in other economic sectors and Hypothesis 2: Manufacturing sector employment growth has a positive and significant impact on the employment growth in other economic sectors. The results revealed that manufacturing sector output growth had a moderate impact on economic growth, albeit not straight forward, while manufacturing sector employment growth does not necessarily guarantee employment growth in other sectors of the economy with the exception of the transport sector. Policy implications, limitations of the study and suggestions for future research are outlined in chapter 7.

7 SUMMARY AND CONCLUSIONS

7.1 Introduction

Chapter six presented a discussion of the study's results. This chapter provides a summary and the conclusions of the study in line with the research purpose, research question and research hypotheses. The focus is on key research findings, policy implications, limitations of the study and suggestions for future research.

7.2 Key Findings and Policy Implications

The South African economy has an enormous task of addressing the triple challenges of high unemployment, poverty and inequality. There is a growing concern that sluggish economic performance and the persistence of these challenges are placing the country's young democracy at risk. The growth of the South African economy has relied mainly on household consumption and exports of primary commodities. An economic model dependent on household consumption and exports of primary commodities cannot be relied upon in the long-term as the basis for an inclusive and sustainable economic growth. There is a belief that manufacturing is a driver of economic growth and employment.

Re-industrialization is an important government policy to promote an inclusive and sustainable economy in South Africa and the government has adopted a National Industrial Policy Framework to promote and facilitate re-industrialization. According to Tregenna (2013) and Rodrik (2016), it is advisable for developing economies to implement industrial policy strategies in order to prevent premature de-industrialization, especially during the globalization era. There is a scarcity of published empirical research work in this area, including inter-sectoral linkages, to enhance and inform the robustness of the industrial policy design and implementation. It is the intention of this study to close this gap and contribute to economic development literature in this area.

The study utilized a Vector Error Correction model to assess the impact of re-industrialization on economic growth and employment in South Africa. The sectoral output and employment data series were obtained from Statistics South Africa. The output and employment data covered the period from the first quarter of 1993 to the fourth quarter of 2016 and 2012 third quarter to 2017 first quarter, respectively.

The results revealed that manufacturing sector output growth had a positive and significant impact on economic growth; mainly through the trade, transport and mining sectors, while manufacturing sector employment growth had no significant impact on employment growth in other economic sectors of the South African economy with the exception of the transport sector. The implication of the results is that stimulating output growth in the manufacturing sector is likely to lead to improved economic performance in South Africa, while promoting manufacturing sector employment growth does not necessarily guarantee employment growth in other sectors of the economy with the exception of the transport sector.

It is recommended that South Africa continues with its policy for re-industrialization and moves to foster productivity-enhancing structural transformation in the manufacturing sector (trade, transport, and mining sectors) to stimulate economic growth and development. In line with Ojo & Ololade (2013), Dang & Pheng (2015) and Rodrik (2016), it is further advised that South Africa should develop and implement a coherent industrial policy strategy and strengthen complementary factors such as poor macroeconomic, socio-infrastructural and institutional environments to prevent premature de-industrialization and enable the manufacturing sector to play its role as the engine of economic growth and development.

7.3 Limitations and Suggestion for Future Research

The primary limitation for this study was a lack of large annual data series on sector output and employment in South Africa. A large annual data series would have been more appropriate for this kind of study to allow for a robust econometric analysis as well as pre- and post-democracy analysis considerations. To compensate for this shortcoming, the author used quarterly data to ensure that there are enough observations for a credible econometric analysis. The study further utilized Quarterly Employment Statistics (QES) data from 2002 since Quarterly Labour Force Survey (QLFS) has undergone a number of changes since 1994 and for this reason consistent quarterly data on QLFS is only available from 2008. The QES does not include the agricultural sector, hence the exclusion of the agricultural sector on the impact of the manufacturing sector on employment growth analysis.

The impact of re-industrialization on poverty and inequality is beyond the scope of this study and is suggested as an area for future research. The study focused on broad economic sectors. It will be insightful for future research on industrial policy and development to focus on both manufacturing and services sub-sectors. This will allow the industrial policy design and implementation to be more targeted and effective in dealing with the triple challenges of high unemployment, poverty and inequality in the South African economy. The study also revealed that the manufacturing sector's employment growth does not necessarily guarantee employment growth in other sectors of the economy with the exception of the transport sector. This finding is contrary to the expectation and warrants a further research by investigating growth-employment dynamics between manufacturing sector and other sectors of the South African economy at a sub-sector level.

8 REFERENCES

Abushhewa, A. A. & Zarook, T. (2016). The effects of foreign direct investment on economic growth in Libya: A causality analysis. *Open Science Journal*, 1(2), 1-15.

Boisseleau, F. & Hewicker, C. (2002). European Electricity and its Impact on Market integration. *KEMA Consulting*, Germany.

Brooks, C. (2014). *Introductory econometrics for finance.* Cambridge University Press.

Camignani, F., & Mandeville, T. (2014). Never been industrialized: A tale of African structural change. *Structural Change and Economics Dynamics, 31*, 124-137.

Cantore, N., Clara, M., Lavopa, A., & Soare, C. (2017). Manufacturing as an engine of growth: Which is the best fuel? *Sructural Change and Economic Dynamics, 42*(), 56-66.

Chakravarty, S. & Mitra, A. (2009). Is Industry still the Engine of growth? An Econometric Study of the Organized Sector Employment in India. *Journal of Policy Modeling, 31*, 22-35.

Chenery, H. B. (1960). Patterns of industrial growth. *The American Economic Review, 50*(4), 624-654.

Cheng, D. (2013). The development of the service industry in the modern economy: mechanisms and implications for China. *China Finance and Economic Review, 1*(3).

Cheremukhin, A., Golosov, M., Guriev, S., & Tsyvinski, A. (2017). The industrialization and economic development of Russia through the lens of a neoclassical growth model. *The Review of Economic Studies, 84*(2), 613-649.

Dang, G., & Pheng, L. S. (2015). *Infrastructure investments in developing economies: The Case of Vietnam*. Springer: Singapore.

Das, L. & Raut, R (1960). Impact of changes in service sector in India in shaping the future of business and society. *Procedia Economics and Finance, 11,* 795-803.

Department of Trade and Industry (2007). *National Industrial Policy Framework*. Pretoria: Department of Trade and Industry. Republic of South Africa.

Department of Economic Development (2010). *New Growth Path*. Pretoria: Department of Economic Development. Republic of South Africa.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series model specification. *Econometrica, 48*, 1057-1072.

Domar, E. D. (1947). Expansion and employment. *The American Economic Review, 37*(1), 34-55.

Enders, W. (2010). *Applied Econometric Time Series.* John Wiley & Sons: USA.

Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation and testing. *Econometrica, 55*(2), 251-276.

Eviews (2015). *Eviews 9.5 Users' Guide*. Quantitative Micro Software, LLC.

Fedderke, J. W. (2012). The Cost of Rigidity: The Case of the South Africa Labour Market. *Comparative* Economic Studies, 54, 809-842.

Ferraro, V. (2008). Dependency theory: An introduction. In G. Secondi(Ed.), *The development economics reader* (pp. 58-64). London: Routledge.

Ghani, E., & O'Conwell, S. D. (2014). *Can service be a growth escalator in low income countries*. Policy Research Working Paper, Macroeconomics and Fiscal Management Global Practice Group.

Gujarati, D. N. (2003). Basic *Econometrics, 4th Edition*. McGraw-Hill/Irwin: New York.

Haraguchi, N., Cheng, C. F. C., & Smeets, E. (2017). The importance of manufacturing in economic development: Has this changed? *World Development, 93*, 293-315.

Harrod, R. F. (1948). *Towards a dynamic economics: Some recent developments of economic theory and their application to policy*. London: Routledge.

Herman, E. (2016). The Importance of the Manufacturing Sector in the Romanian Economy. *Procedia Technology, 6, 976-983.*

Heshmati. A., & Kim, H. (2011). The R & D and productivity relationship of Korean listed firms. *Journal of Productivity Analysis, 36*(2), 125-142.

Hossain, M. Z. (2002). Modified Akaike Information Criterion (MAIC) for statistical model selection. *Pakistan Journal of Statistics, 18*(3), 383-393.

Iashmi, P., & Kumar, S. (2012). Economic growth and impact of service's sector in India. *International Journal of Business Management, Economics, and Resource, 3*(5), 627-632.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*, 231-254.

Johnson, L., Toldano, P., Strauss, I., & James, S. (2013). *Background paper on investment incentives: The good, the bad and the ugly: Assessing the costs., benefits and options for policy reform.* Vale Columbia Center on Sustainable International Investment.

Kathuria, V., & Natarajan, R. R. (2013). Is manufacturing an engine of growth in India in the post-nineties? *Journal of South Asian Development, 8*(3), 385-408.

Kilian, L., & Lütkepohl, H. (2016). *Structural vector Autoregressive analysis*. Cambridge: Cambridge University Press.

Lewis, W. A. (1954). Economic Development with unlimited supply of labour. *The Manchester School, 22*(2), 139-191.

Lütkepohl, H. (2004). Vector Autoregressive and Vector Error Correction Models. In Lütkepohl, H. & Kratzig, M. (Eds.), *Applied Time Series Econometrics* (pp. 86-158). Cambridge: Cambridge University Press.

MacKinnon, J. G., Haug, A. A., & Michelis, L. (1999). Likelihood ratio tests for cointegration. *Journal of Applied Econometrics, 14*(5), 563-577.

Marx, K. (1933). *Capital*. London:J. M. Dent.

Mashamaite, P., & Moholwa, B. (2005). Price asymmetry in South African futures markets for agricultural commodities. *Agrekon, 44*(3), 423-433.

McCausland, W. D., &Theodossiou, I. (2012). Is manufacturing still the engine of growth? *Journal of Post Keynesian, 35*(1), 79-92.

McMillan, M., Rodrik, D., & Verduzco-Gallo, I. (2014). Globalization, structural change, and productivity growth with update on Africa. *World Development*, *63*, 11-32.

Meier, G. M. (2000). The old generation of development economists and the new. In G. M. Meier & J. E. Stiglitz (Eds.), *Frontiers of development economics: The future in perspective* (pp. 13-50). Washington, D.C.: Oxford University Press.

Moavenzadeh, J., Philip, R., Giffi, C. A., & Thakker, A. (2012). The future if manufacturing opportunities to drive economic growth. *World Economic Forum.*

Mujahid, H., & Alam, S. (2014). Service sector as an engine of growth: Empirical analysis of Pakistan. *Asian Economic and Financial Review, 4*(3), 377-386.

National Planning Commission. (2012). *National Development Plan 2030.* Pretoria: The Presidency. Republic of South Africa.

Noland, M., Park, D., & Estrada, G. B. (2012). *Developing the service sector as engine of growth for Asia: An overview*. Asian Development Bank, ADB Economics Working Paper Series N. 320.

Ojo, A. S., & Ololade, O. F. (2013). An assessment of the Nigerian manufacturing sector in the era of globalization. *American Journal of Social and Management Sciences, 5*(1), 27-32.

Palma, G. (2008). Deindustrialisation, Premature Deindustrialisation, and the Dutch Disease. In L. Blume & S. Durlauf (eds), *The New Palgrave: A Dictionary of Economics*, 2nd edition. Basingstoke: Palgrave Macmillian.

Rodrik, D. (2013). Unconditional convergence in manufacturing. *Quarterly Journal of Economics, 128*(1), 165-204.

Rodrik, D. (2016). Premature deindustrialization. *Journal of Economic Growth, 211(1)*, 1-33.

Rostow, W. W. (1960). *The stages of economic growth: A Non-commercial Manifesto*. Cambridge: Cambridge University Press.

Singh, A. (1977). UK Industry and the World Economy: A Case of De-industrialisation? *Cambridge Journal of Economics, 1(2)*, 113-1136.

Smith, A. (1976). *An inquiry into the nation and causes of the wealth nations*. Oxford: Clarendon Press.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70(1)*, 65-94.

Statistics South Africa (2017). *Poverty Trends in South Africa*. Pretoria: Republic of South Africa.

Statistics South Africa (2012). *Standard Industrial Classification of All Economic Activities,* 7th Ed. Pretoria: Republic of South Africa.

Stiglitz, J. E. (2000). The contributions of the economics of information to twentieth century economics. *The Quarterly Journal of Economics,115*(4), 1441-1478.

Su, D., & Yao, Y. (2017). Manufacturing as the key engine of economic growth for middle-income economies. *Journal of Asia Pacific Economy, 22*(1), 47-70.

Szirmai, A. (2012). Industrialisation as an engine of growth in developing countries, 150-2005. *Structural change and Economic* Dynamics, 23, 406-420.

Szirmai, A., Naudé, W., & Alcorta, L. (2013). Introduction and Overview: The Past, Present, and Future of Industrialization. In A. Szirmai, W. Naudé, & L. Alcorta (Eds.), *Pathways to Industrialization in the Twenty-First Century: New Challenges and Emerging Paradigms* (1st ed., pp. 3-50). Oxford University Press.

Szirmai, A., & Verspagen, B. (2015). Manufacturing and economic growth in developing countries, 1950-2005. *Structural change and Economic* Dynamics, 34, 46-59.

Todaro, M., & Smith, S. (2009). *Economic development* (10th ed.). Boston: Addison Wesley.

Tregenna, F. (2013). Deindustrialization and Reindustrialization. In A. Szirmai, W. Naudé, & L. Alcorta (Eds.), *Pathways to Industrialization in the Twenty-First Century: New Challenges and Emerging Paradigms* (1st ed., pp. 76-101). Oxford University Press.

Tybout, J. R. (2000). Manufacturing firms in developing countries: How well do they do and why? *Journal of Economic Literature, 38*(1), 11-44.

Uwitonze, E., & Heshmati, A. (2016). *Service sector development and its determinant in Rwanda*. Institute for the study of Labor, Discussion Paper No. 10117.

Verbeek, M. (2004). *A guide to modern econometrics* (2nd ed.). Chichester: John Wiley & Sons.

Wegner, T. (2012). *Applied Business Statistics: Methods and Excel-based Applications* (3rd Ed.). Juta & Company Ltd.

9 APPENDICES

APPENDIX A

Inflation-Adjusted Poverty Lines, 2006 to 2017 (per person per month in Rand)

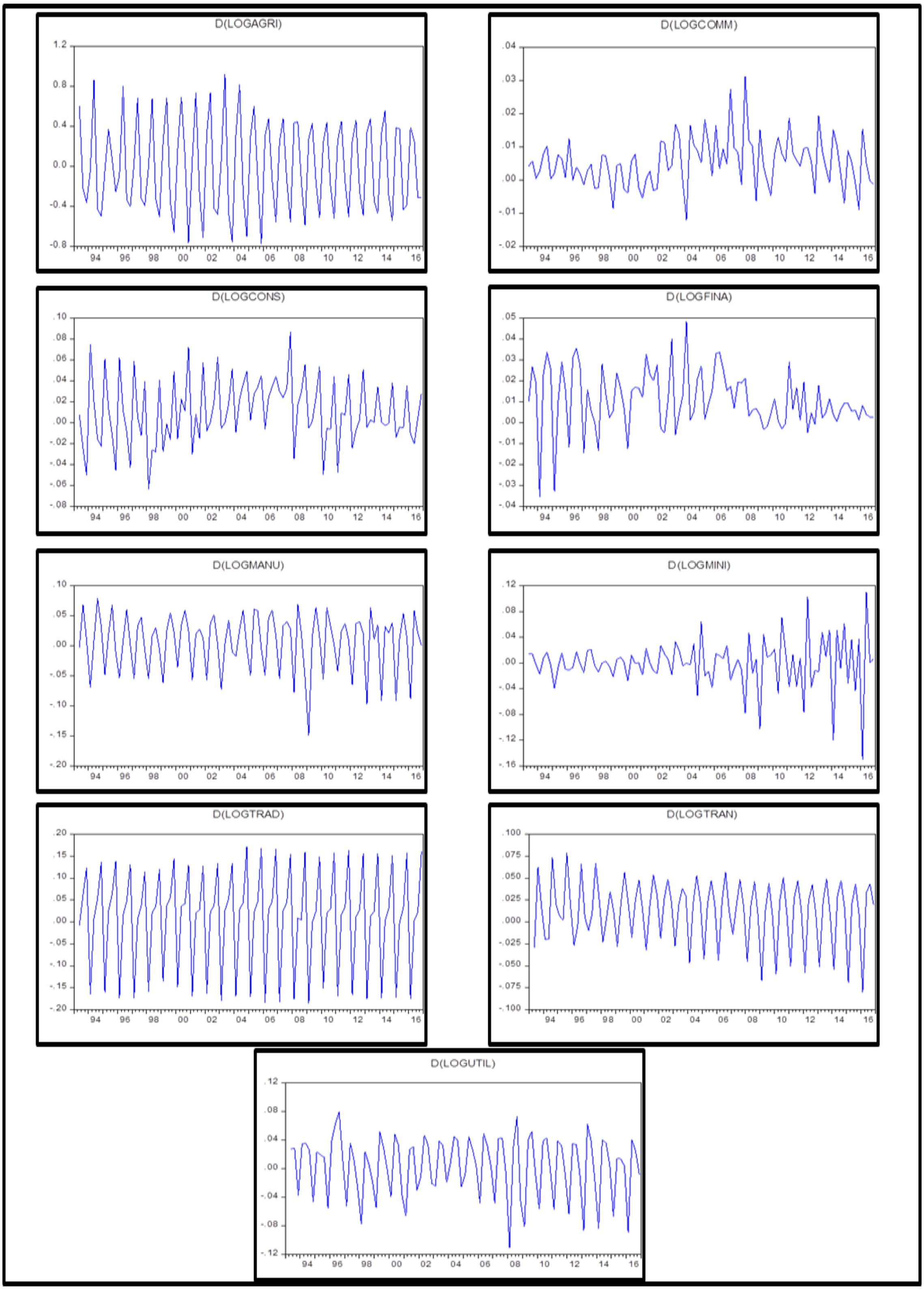
Year*	Food poverty line *(FPL)*	Lower-bound poverty line *(LBPL)*	Upper-bound poverty line *(UBPL)*
2006	219	370	575
2007	237	396	613
2008	274	447	682
2009	318	456	709
2010	320	466	733
2011	335	501	779
2012	366	541	834
2013	386	572	883
2014	417	613	942
2015 (April)	441	647	992
2016 (April)	498	714	1 077
2017 (April)	531	758	1 138

* Unless otherwise indicated, the values are linked to March prices in the respective years

Source: Statistics South Africa (2017)

APPENDIX B

Graphic Plots of Variables in First Difference (Sector Output)



Source: Author generated (Statistics South Africa data)

APPENDIX C

Vector Auto-regression Model Estimates (Sector Output)

Standard errors in ( ) & t-statistics in [ ]									
	LOGAGRI	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
LOGAGRI(-1)	0.074460 (0.15430) [0.48255]	0.004944 (0.00602) [0.82099]	0.013325 (0.02409) [0.55303]	-0.022005 (0.01369) [-1.60753]	-0.015600 (0.02004) [-0.77858]	-0.014969 (0.03714) [-0.40308]	-0.013544 (0.02137) [-0.63386]	-0.006831 (0.01265) [-0.53994]	-0.000558 (0.02583) [-0.02159]
LOGAGRI(-2)	-0.168347 (0.15154) [-1.11089]	-0.002911 (0.00591) [-0.49228]	-0.001408 (0.02366) [-0.05950]	0.003475 (0.01344) [0.25847]	-0.014488 (0.01968) [-0.73626]	0.042678 (0.03647) [1.17018]	-0.054781 (0.02099) [-2.61044]	-0.018605 (0.01242) [-1.49749]	-0.021581 (0.02537) [-0.85069]
LOGAGRI(-3)	-0.099986 (0.13912) [-0.71871]	-0.020463 (0.00543) [-3.76896]	-0.027269 (0.02172) [-1.25524]	0.004300 (0.01234) [0.34839]	-0.028219 (0.01806) [-1.56215]	-0.003240 (0.03348) [-0.09677]	-0.072558 (0.01926) [-3.76634]	-0.018717 (0.01141) [-1.64106]	-0.034490 (0.02329) [-1.48092]
LOGAGRI(-4)	0.066961 (0.16656) [0.40201]	0.016639 (0.00650) [2.55972]	-0.040590 (0.02601) [-1.56059]	-0.013260 (0.01478) [-0.89737]	-0.027844 (0.02163) [-1.28743]	-0.027109 (0.04009) [-0.67626]	-0.013908 (0.02307) [-0.60296]	-0.001729 (0.01366) [-0.12658]	-0.037225 (0.02788) [-1.33501]
LOGCOMM(-1)	-5.161064 (3.40117) [-1.51744]	0.886043 (0.13273) [6.67528]	-0.519545 (0.53110) [-0.97824]	-0.257904 (0.30172) [-0.85478]	0.735798 (0.44163) [1.66609]	1.014095 (0.81856) [1.23888]	0.610275 (0.47099) [1.29573]	0.584007 (0.27885) [2.09437]	0.121391 (0.56937) [0.21320]
LOGCOMM(-2)	2.034716 (4.19792) [0.48470]	-0.003310 (0.16383) [-0.02020]	1.016124 (0.65551) [1.55012]	0.047488 (0.37240) [0.12752]	-0.515723 (0.54509) [-0.94613]	-0.541391 (1.01031) [-0.53586]	0.165508 (0.58132) [0.28471]	0.125822 (0.34417) [0.36558]	1.274482 (0.70275) [1.81355]
LOGCOMM(-3)	4.791930 (4.13470) [1.15895]	-0.017703 (0.16136) [-0.10971]	-0.425064 (0.64564) [-0.65836]	0.191419 (0.36679) [0.52187]	-0.273239 (0.53688) [-0.50894]	0.405051 (0.99510) [0.40705]	-0.297844 (0.57257) [-0.52019]	-0.984518 (0.33898) [-2.90431]	-0.256510 (0.69217) [-0.37059]
LOGCOMM(-4)	-1.321455 (2.97138) [-0.44473]	0.075182 (0.11596) [0.64834]	-0.637577 (0.46399) [-1.37412]	-0.114335 (0.26359) [-0.43375]	-0.301883 (0.38583) [-0.78243]	-0.878377 (0.71512) [-1.22829]	-0.404537 (0.41147) [-0.98315]	0.298137 (0.24361) [1.22383]	-1.401714 (0.49743) [-2.81794]
LOGCONS(-1)	0.540701 (0.80603) [0.67082]	-0.011582 (0.03146) [-0.36817]	0.479066 (0.12586) [3.80622]	0.057884 (0.07150) [0.80951]	-0.098419 (0.10466) [-0.94036]	-0.038857 (0.19399) [-0.20031]	-0.100335 (0.11162) [-0.89891]	-0.115069 (0.06608) [-1.74128]	-0.195451 (0.13493) [-1.44849]
LOGCONS(-2)	-0.747227 (0.93964) [-0.79522]	0.040098 (0.03667) [1.09346]	0.127656 (0.14673) [0.87002]	-0.038191 (0.08336) [-0.45816]	0.166458 (0.12201) [1.36430]	0.171427 (0.22614) [0.75804]	0.152465 (0.13012) [1.17172]	0.179818 (0.07704) [2.33418]	0.113551 (0.15730) [0.72187]

LOGCONS(-3)	0.714493 (0.94426) [0.75667]	-0.043025 (0.03685) [-1.16755]	0.190299 (0.14745) [1.29061]	-0.092533 (0.08377) [-1.10465]	-0.053608 (0.12261) [-0.43722]	-0.046977 (0.22726) [-0.20671]	-0.131166 (0.13076) [-1.00311]	-0.062801 (0.07742) [-0.81123]	0.238145 (0.15807) [1.50654]
LOGCONS(-4)	-0.368221 (0.80600) [-0.45685]	0.031060 (0.03146) [0.98743]	0.083435 (0.12586) [0.66292]	0.139736 (0.07150) [1.95433]	-0.011856 (0.10466) [-0.11328]	-0.134948 (0.19398) [-0.69568]	0.029234 (0.11161) [0.26192]	-0.103960 (0.06608) [-1.57324]	-0.104281 (0.13493) [-0.77286]
LOGFINA(-1)	-0.733986 (1.61973) [-0.45315]	-0.006606 (0.06321) [-0.10450]	-0.314976 (0.25292) [-1.24533]	0.860211 (0.14369) [5.98666]	0.567092 (0.21032) [2.69636]	0.610234 (0.38982) [1.56542]	0.103852 (0.22430) [0.46301]	0.431203 (0.13279) [3.24715]	0.399618 (0.27115) [1.47378]
LOGFINA(-2)	0.254189 (1.94862) [0.13045]	0.036513 (0.07605) [0.48013]	0.892989 (0.30428) [2.93475]	-0.362647 (0.17286) [-2.09787]	-0.457186 (0.25302) [-1.80690]	-0.358748 (0.46897) [-0.76496]	-0.291988 (0.26984) [-1.08207]	-0.357337 (0.15976) [-2.23674]	-0.078336 (0.32621) [-0.24014]
LOGFINA(-3)	-2.049139 (2.04871) [-1.00021]	-0.032592 (0.07995) [-0.40764]	-0.060850 (0.31991) [-0.19021]	0.070051 (0.18174) [0.38544]	0.358263 (0.26602) [1.34675]	-0.030383 (0.49306) [-0.06162]	0.480349 (0.28370) [1.69315]	0.496684 (0.16796) [2.95708]	0.184597 (0.34297) [0.53824]
LOGFINA(-4)	2.396302 (1.60579) [1.49229]	0.063890 (0.06267) [1.01950]	0.027806 (0.25075) [0.11089]	0.108388 (0.14245) [0.76088]	-0.238796 (0.20851) [-1.14526]	0.009906 (0.38647) [0.02563]	-0.242978 (0.22237) [-1.09269]	-0.309473 (0.13165) [-2.35070]	-0.356325 (0.26882) [-1.32552]
LOGMANU(-1)	0.488834 (1.06145) [0.46054]	0.035911 (0.04142) [0.86691]	-0.149917 (0.16575) [-0.90449]	-0.075325 (0.09416) [-0.79995]	0.436277 (0.13783) [3.16542]	-0.258817 (0.25546) [-1.01315]	-0.052445 (0.14699) [-0.35680]	-0.033926 (0.08702) [-0.38985]	-0.402356 (0.17769) [-2.26434]
LOGMANU(-2)	0.085851 (1.18745) [0.07230]	0.021602 (0.04634) [0.46614]	-0.122036 (0.18542) [-0.65815]	0.014782 (0.10534) [0.14033]	-0.173267 (0.15419) [-1.12375]	0.171700 (0.28578) [0.60080]	-0.227706 (0.16444) [-1.38477]	-0.003800 (0.09735) [-0.03903]	-0.093601 (0.19879) [-0.47087]
LOGMANU(-3)	-0.146886 (1.16432) [-0.12616]	0.052855 (0.04544) [1.16322]	-0.107844 (0.18181) [-0.59317]	0.049930 (0.10329) [0.48341]	-0.317596 (0.15118) [-2.10073]	-0.472042 (0.28022) [-1.68456]	0.046504 (0.16123) [0.28843]	-0.095949 (0.09546) [-1.00515]	-0.077895 (0.19491) [-0.39964]
LOGMANU(-4)	0.516145 (0.95807) [0.53873]	-0.038826 (0.03739) [-1.03841]	0.141056 (0.14960) [0.94285]	-0.018610 (0.08499) [-0.21896]	-0.133298 (0.12440) [-1.07150]	-0.052031 (0.23058) [-0.22565]	-0.302071 (0.13267) [-2.27682]	-0.068191 (0.07855) [-0.86815]	-0.124405 (0.16039) [-0.77566]
LOGMINI(-1)	-0.080886 (0.57588) [-0.14046]	0.034125 (0.02247) [1.51839]	0.128906 (0.08992) [1.43349]	0.036944 (0.05109) [0.72316]	0.005131 (0.07478) [0.06861]	0.300753 (0.13860) [2.17000]	-0.048114 (0.07975) [-0.60334]	-0.048618 (0.04721) [-1.02976]	-0.101648 (0.09640) [-1.05439]
LOGMINI(-2)	-0.198590 (0.63081) [-0.31482]	-0.009141 (0.02462) [-0.37132]	0.016654 (0.09850) [0.16907]	0.033729 (0.05596) [0.60273]	0.002996 (0.08191) [0.03658]	0.272924 (0.15182) [1.79773]	0.078234 (0.08735) [0.89561]	0.057899 (0.05172) [1.11954]	0.045008 (0.10560) [0.42621]

LOGMINI(-3)	-0.082397 (0.60915) [-0.13527]	-0.000699 (0.02377) [-0.02940]	0.166731 (0.09512) [1.75284]	-0.012798 (0.05404) [-0.23684]	-0.080437 (0.07910) [-1.01695]	-0.032487 (0.14660) [-0.22159]	0.013931 (0.08435) [0.16515]	-0.092135 (0.04994) [-1.84487]	0.070309 (0.10198) [0.68947]
LOGMINI(-4)	-0.162245 (0.63471) [-0.25562]	0.012264 (0.02477) [0.49510]	-0.060983 (0.09911) [-0.61529]	0.080819 (0.05631) [1.43535]	0.200042 (0.08242) [2.42722]	0.042675 (0.15276) [0.27937]	0.024696 (0.08789) [0.28098]	0.003393 (0.05204) [0.06519]	-0.091386 (0.10625) [-0.86007]
LOGTRAD(-1)	-1.483841 (0.76947) [-1.92840]	0.048396 (0.03003) [1.61161]	0.165953 (0.12015) [1.38117]	0.065558 (0.06826) [0.96041]	-0.078788 (0.09991) [-0.78857]	-0.321543 (0.18519) [-1.73631]	0.283661 (0.10655) [2.66213]	-0.129188 (0.06308) [-2.04785]	-0.130734 (0.12881) [-1.01491]
LOGTRAD(-2)	1.202369 (0.73956) [1.62580]	-0.023599 (0.02886) [-0.81766]	0.300516 (0.11548) [2.60224]	0.035799 (0.06561) [0.54566]	0.225118 (0.09603) [2.34426]	0.061214 (0.17799) [0.34392]	0.313829 (0.10241) [3.06437]	-0.006587 (0.06063) [-0.10864]	0.304214 (0.12381) [2.45719]
LOGTRAD(-3)	1.058819 (0.75943) [1.39422]	-0.052257 (0.02964) [-1.76317]	0.138066 (0.11859) [1.16426]	0.081981 (0.06737) [1.21688]	0.441808 (0.09861) [4.48035]	0.402618 (0.18277) [2.20283]	-0.178630 (0.10516) [-1.69858]	0.162043 (0.06226) [2.60258]	0.310004 (0.12713) [2.43842]
LOGTRAD(-4)	-1.062322 (0.94922) [-1.11915]	-0.026142 (0.03704) [-0.70570]	0.113724 (0.14822) [0.76725]	0.132905 (0.08421) [1.57832]	0.326349 (0.12325) [2.64777]	-0.067013 (0.22845) [-0.29334]	0.847640 (0.13145) [6.44854]	0.087771 (0.07782) [1.12784]	-0.016412 (0.15891) [-0.10328]
LOGTRAN(-1)	-1.578218 (1.73837) [-0.90787]	-0.064657 (0.06784) [-0.95305]	-0.497353 (0.27145) [-1.83220]	0.078433 (0.15421) [0.50860]	0.242517 (0.22572) [1.07440]	0.225838 (0.41837) [0.53980]	0.471935 (0.24073) [1.96046]	0.861283 (0.14252) [6.04320]	0.093568 (0.29101) [0.32153]
LOGTRAN(-2)	2.789566 (2.05546) [1.35715]	0.142739 (0.08022) [1.77942]	0.522361 (0.32096) [1.62747]	-0.385011 (0.18234) [-2.11148]	-0.185498 (0.26690) [-0.69502]	0.166364 (0.49469) [0.33630]	-0.648861 (0.28464) [-2.27961]	-0.106692 (0.16852) [-0.63312]	0.078639 (0.34410) [0.22854]
LOGTRAN(-3)	-0.158150 (2.01515) [-0.07848]	-0.106485 (0.07864) [-1.35402]	-0.457002 (0.31467) [-1.45232]	0.610308 (0.17877) [3.41401]	0.368035 (0.26166) [1.40653]	-0.043915 (0.48499) [-0.09055]	0.098068 (0.27905) [0.35143]	0.030054 (0.16521) [0.18191]	-0.208918 (0.33735) [-0.61930]
LOGTRAN(-4)	-0.986243 (1.72416) [-0.57202]	-0.002187 (0.06729) [-0.03250]	-0.100354 (0.26923) [-0.37274]	-0.215553 (0.15295) [-1.40929]	-0.617974 (0.22388) [-2.76033]	-0.304291 (0.41495) [-0.73332]	0.139306 (0.23876) [0.58346]	0.055030 (0.14136) [0.38930]	-0.010344 (0.28863) [-0.03584]
LOGUTIL(-1)	0.619954 (0.81216) [0.76334]	0.049867 (0.03170) [1.57330]	0.072484 (0.12682) [0.57154]	0.024005 (0.07205) [0.33318]	-0.107999 (0.10546) [-1.02411]	-0.002277 (0.19546) [-0.01165]	0.179995 (0.11247) [1.60043]	-0.027079 (0.06659) [-0.40669]	0.803067 (0.13596) [5.90663]

LOGUTIL(-2)	-0.195335 (1.08839) [-0.17947]	-0.047834 (0.04248) [-1.12614]	0.077842 (0.16995) [0.45802]	0.069841 (0.09655) [0.72335]	0.223959 (0.14132) [1.58472]	0.009768 (0.26194) [0.03729]	-0.033082 (0.15072) [-0.21950]	0.035602 (0.08923) [0.39899]	0.126934 (0.18220) [0.69667]
LOGUTIL(-3)	0.610278 (1.05994) [0.57577]	0.010914 (0.04137) [0.26385]	-0.318377 (0.16551) [-1.92359]	-0.056762 (0.09403) [-0.60367]	-0.096068 (0.13763) [-0.69801]	-0.060938 (0.25510) [-0.23888]	-0.211326 (0.14678) [-1.43975]	-0.039969 (0.08690) [-0.45995]	-0.161358 (0.17744) [-0.90936]
LOGUTIL(-4)	-1.019134 (0.84520) [-1.20579]	-0.029353 (0.03299) [-0.88988]	0.228049 (0.13198) [1.72791]	-0.023175 (0.07498) [-0.30909]	0.236214 (0.10975) [2.15235]	0.119605 (0.20341) [0.58799]	0.186704 (0.11704) [1.59519]	0.088926 (0.06929) [1.28331]	0.169483 (0.14149) [1.19784]
C	4.400335 (10.6383) [0.41363]	-0.262472 (0.41517) [-0.63220]	-0.956299 (1.66119) [-0.57567]	-0.897082 (0.94373) [-0.95057]	3.616484 (1.38135) [2.61808]	7.328194 (2.56031) [2.86223]	1.013141 (1.47317) [0.68773]	1.179089 (0.87218) [1.35188]	6.301063 (1.78090) [3.53812]
R-squared	0.932725	0.999535	0.998633	0.999346	0.994854	0.667702	0.997533	0.999452	0.979456
Adj. R-squared	0.888691	0.999231	0.997738	0.998917	0.991485	0.450197	0.995919	0.999093	0.966008
Sum sq. resids	0.781565	0.001190	0.019057	0.006151	0.013177	0.045270	0.014987	0.005253	0.021903
S.E. equation	0.119207	0.004652	0.018614	0.010575	0.015479	0.028690	0.016508	0.009773	0.019956
F-statistic	21.18174	3285.663	1115.933	2333.164	295.3419	3.069831	617.8156	2784.345	72.83693
Log likelihood	88.79696	387.2008	259.6340	311.6551	276.6055	219.8352	270.6848	318.9088	253.2319
Akaike AIC	-1.126021	-7.613061	-4.839869	-5.970763	-5.208815	-3.974678	-5.080104	-6.128451	-4.700693
Schwarz SC	-0.111823	-6.598863	-3.825671	-4.956566	-4.194617	-2.960480	-4.065907	-5.114254	-3.686496
Mean dependent	9.533052	11.70817	9.687803	11.51780	11.28355	10.97570	11.24093	10.70549	9.641995
S.D. dependent	0.357302	0.167765	0.391378	0.321384	0.167744	0.038692	0.258392	0.324450	0.108239

Determinant resid covariance (dof adj.)	7.54E-33
Determinant resid covariance	7.35E-35
Log likelihood	2440.520
Akaike information criterion	-45.81566
Schwarz criterion	-36.68788

Source: Author generated (Statistics South Africa data)

APPENDIX D

Vector Auto-regression Model Diagnostic Tests (Sector Output)

VAR Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Lags	LM-Stat	Prob
1	177.4540	0.0000
2	134.9089	0.0002
3	142.8995	0.0000
4	86.16982	0.3264
5	70.20082	0.7985
6	85.90624	0.3336
7	84.84249	0.3634
8	73.69218	0.7053
9	81.37491	0.4674
Probs from chi-square with 81 df.		

VAR Residual Normality Tests			
Null Hypothesis: residuals are multivariate normal			
Component	Jarque-Bera	df	Prob.
1	20.42035	2	0.0000
2	3.500202	2	0.1738
3	1.354354	2	0.5080
4	0.064575	2	0.9682
5	1.315136	2	0.5181
6	2.755178	2	0.2522
7	1.644358	2	0.4395
8	0.313070	2	0.8551
9	2.653135	2	0.2654
Joint	641.7347	660	0.6876

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)		
Joint test:		
Chi-sq	df	Prob.
3249.858	3240	0.4480

Source: Author generated (Statistics South Africa data)

APPENDIX E

Vector Error Correction Model Estimates (Sector Output)

Standard errors in ( ) & t-statistics in [ ]					
Cointegrating Eq:	**CointEq1**	**CointEq2**	**CointEq3**	**CointEq4**	**CointEq5**
LOGAGRI(-1)	1.000000	0.000000	0.000000	0.000000	0.000000
LOGCOMM(-1)	0.000000	1.000000	0.000000	0.000000	0.000000
LOGCONS(-1)	0.000000	0.000000	1.000000	0.000000	0.000000
LOGFINA(-1)	0.000000	0.000000	0.000000	1.000000	0.000000
LOGMANU(-1)	0.000000	0.000000	0.000000	0.000000	1.000000
LOGMINI(-1)	-0.585129 (0.58871) [-0.99392]	-0.744604 (0.13457) [-5.53319]	0.697060 (1.11219) [0.62675]	-0.226053 (0.18970) [-1.19164]	0.117998 (0.08792) [1.34210]
LOGTRAD(-1)	-0.377746 (0.36164) [-1.04453]	-1.372715 (0.08267) [-16.6055]	-2.804909 (0.68321) [-4.10548]	-0.906564 (0.11653) [-7.77959]	-0.491028 (0.05401) [-9.09156]
LOGTRAN(-1)	-0.143432 (0.27955) [-0.51308]	0.559955 (0.06390) [8.76284]	1.441832 (0.52812) [2.73010]	-0.214253 (0.09008) [-2.37851]	-0.062055 (0.04175) [-1.48637]
LOGUTIL(-1)	-0.556962 (0.32241) [-1.72749]	-0.100119 (0.07370) [-1.35849]	0.432386 (0.60910) [0.70988]	-0.050406 (0.10389) [-0.48519]	-0.139182 (0.04815) [-2.89058]
C	8.037186	6.865969	-5.407278	3.933848	-5.052781

Error Correction:	**D(LOGAGRI)**	**D(LOGCOMM)**	**D(LOGCONS)**	**D(LOGFINA)**	**D(LOGMANU)**	**D(LOGMINI)**	**D(LOGTRAD)**	**D(LOGTRAN)**	**D(LOGUTIL)**
CointEq1	-0.946849 (0.30853) [-3.06891]	-4.57E-05 (0.01193) [-0.00383]	-0.070568 (0.04778) [-1.47704]	-0.020830 (0.02732) [-0.76233]	-0.077728 (0.03953) [-1.96635]	-0.031203 (0.07605) [-0.41031]	-0.172213 (0.04287) [-4.01732]	-0.053137 (0.02523) [-2.10630]	-0.078659 (0.05415) [-1.45267]
CointEq2	0.755731 (0.80402) [0.93994]	-0.051784 (0.03108) [-1.66624]	-0.577743 (0.12450) [-4.64037]	-0.090162 (0.07121) [-1.26619]	-0.359036 (0.10301) [-3.48541]	0.138235 (0.19818) [0.69754]	0.025067 (0.11171) [0.22439]	-0.000640 (0.06574) [-0.00973]	-0.151654 (0.14111) [-1.07473]
CointEq3	-0.317633 (0.23443) [-1.35489]	0.000554 (0.00906) [0.06109]	-0.072496 (0.03630) [-1.99700]	0.016239 (0.02076) [0.78213]	-0.010440 (0.03004) [-0.34758]	-0.017719 (0.05778) [-0.30665]	-0.040853 (0.03257) [-1.25420]	-0.068832 (0.01917) [-3.59074]	-0.093760 (0.04114) [-2.27883]

CointEq4	0.847824 (1.23143) [0.68849]	0.084689 (0.04760) [1.77920]	0.473798 (0.19069) [2.48467]	-0.237866 (0.10906) [-2.18105]	0.247122 (0.15777) [1.56633]	0.208335 (0.30353) [0.68638]	-0.005656 (0.17110) [-0.03306]	0.194691 (0.10069) [1.93354]	0.405461 (0.21612) [1.87609]
CointEq5	1.234136 (1.17015) [1.05469]	0.072485 (0.04523) [1.60256]	-0.254580 (0.18120) [-1.40497]	-0.018910 (0.10363) [-0.18247]	-1.177515 (0.14992) [-7.85430]	-0.598928 (0.28842) [-2.07657]	-0.578286 (0.16258) [-3.55688]	-0.209881 (0.09568) [-2.19356]	-0.684853 (0.20537) [-3.33480]
D(LOGAGRI(-1))	0.079865 (0.24921) [0.32047]	0.005185 (0.00963) [0.53820]	0.079996 (0.03859) [2.07291]	0.000522 (0.02207) [0.02366]	0.064798 (0.03193) [2.02941]	0.014351 (0.06143) [0.23362]	0.150492 (0.03463) [4.34617]	0.044838 (0.02038) [2.20033]	0.079625 (0.04374) [1.82050]
D(LOGAGRI(-2))	-0.029982 (0.20821) [-0.14400]	0.002469 (0.00805) [0.30675]	0.075524 (0.03224) [2.34240]	0.005847 (0.01844) [0.31706]	0.052170 (0.02668) [1.95565]	0.054816 (0.05132) [1.06810]	0.088177 (0.02893) [3.04801]	0.024024 (0.01703) [1.41110]	0.061983 (0.03654) [1.69621]
D(LOGAGRI(-3))	-0.087095 (0.16050) [-0.54265]	-0.017645 (0.00620) [-2.84410]	0.045552 (0.02485) [1.83281]	0.011744 (0.01421) [0.82619]	0.025327 (0.02056) [1.23164]	0.045495 (0.03956) [1.15003]	0.011571 (0.02230) [0.51886]	0.003144 (0.01312) [0.23955]	0.032384 (0.02817) [1.14965]
D(LOGCOMM(-1))	-5.971737 (3.08428) [-1.93619]	-0.033539 (0.11922) [-0.28132]	-0.022900 (0.47761) [-0.04795]	-0.117447 (0.27316) [-0.42996]	1.122336 (0.39516) [2.84021]	0.639284 (0.76022) [0.84092]	0.707833 (0.42854) [1.65175]	0.566304 (0.25220) [2.24549]	0.426586 (0.54130) [0.78807]
D(LOGCOMM(-2))	-3.748313 (2.94625) [-1.27223]	-0.036606 (0.11389) [-0.32143]	0.987993 (0.45623) [2.16554]	-0.056676 (0.26093) [-0.21720]	0.611455 (0.37748) [1.61985]	0.219696 (0.72620) [0.30253]	0.824759 (0.40936) [2.01476]	0.694910 (0.24091) [2.88453]	1.700002 (0.51708) [3.28770]
D(LOGCOMM(-3))	1.464953 (2.88156) [0.50839]	-0.066588 (0.11138) [-0.59782]	0.534933 (0.44622) [1.19882]	0.106807 (0.25520) [0.41852]	0.379404 (0.36919) [1.02767]	0.600713 (0.71026) [0.84577]	0.410763 (0.40037) [1.02596]	-0.268966 (0.23562) [-1.14153]	1.288058 (0.50573) [2.54695]
D(LOGCONS(-1))	0.671817 (0.78688) [0.85377]	-0.020265 (0.03042) [-0.66624]	-0.404666 (0.12185) [-3.32100]	0.025730 (0.06969) [0.36920]	-0.112868 (0.10082) [-1.11954]	0.065660 (0.19395) [0.33853]	-0.060791 (0.10933) [-0.55602]	-0.042450 (0.06434) [-0.65976]	-0.123810 (0.13810) [-0.89651]
D(LOGCONS(-2))	-0.273904 (0.79622) [-0.34401]	0.016691 (0.03078) [0.54231]	-0.264443 (0.12330) [-2.14478]	-0.024325 (0.07052) [-0.34496]	0.049625 (0.10201) [0.48646]	0.264030 (0.19626) [1.34534]	0.104066 (0.11063) [0.94068]	0.150819 (0.06511) [2.31653]	-0.051313 (0.13974) [-0.36721]
D(LOGCONS(-3))	0.508443 (0.77040) [0.65997]	-0.025987 (0.02978) [-0.87265]	-0.079145 (0.11930) [-0.66342]	-0.115284 (0.06823) [-1.68965]	-0.000851 (0.09870) [-0.00863]	0.203764 (0.18989) [1.07306]	-0.034158 (0.10704) [-0.31912]	0.085325 (0.06299) [1.35450]	0.190631 (0.13521) [1.40991]
D(LOGFINA(-1))	-1.510245 (1.56008) [-0.96806]	-0.087338 (0.06030) [-1.44831]	-0.794070 (0.24158) [-3.28697]	0.114091 (0.13817) [0.82575]	0.318900 (0.19988) [1.59547]	0.456566 (0.38453) [1.18732]	0.103923 (0.21676) [0.47944]	0.232117 (0.12756) [1.81960]	0.030447 (0.27380) [0.11120]

D(LOGFINA(-2))	-1.108783 (1.50492) [-0.73677]	-0.046415 (0.05817) [-0.79790]	0.093092 (0.23304) [0.39947]	-0.232953 (0.13328) [-1.74782]	-0.142075 (0.19281) [-0.73686]	0.078966 (0.37094) [0.21288]	-0.186069 (0.20910) [-0.88987]	-0.142974 (0.12305) [-1.16187]	0.017871 (0.26412) [0.06766]
D(LOGFINA(-3))	-3.142202 (1.50972) [-2.08131]	-0.075651 (0.05836) [-1.29634]	0.017755 (0.23378) [0.07595]	-0.154477 (0.13371) [-1.15533]	0.224952 (0.19343) [1.16298]	0.068922 (0.37212) [0.18521]	0.293098 (0.20976) [1.39728]	0.359070 (0.12345) [2.90869]	0.201787 (0.26496) [0.76157]
D(LOGMANU(-1))	-0.484909 (0.96180) [-0.50417]	-0.039064 (0.03718) [-1.05075]	0.083582 (0.14894) [0.56119]	-0.061041 (0.08518) [-0.71660]	0.634135 (0.12323) [5.14609]	0.302643 (0.23707) [1.27661]	0.478143 (0.13363) [3.57800]	0.177625 (0.07864) [2.25858]	0.242322 (0.16880) [1.43556]
D(LOGMANU(-2))	-0.336013 (0.95522) [-0.35177]	-0.017005 (0.03692) [-0.46056]	-0.031486 (0.14792) [-0.21286]	-0.039789 (0.08460) [-0.47034]	0.453143 (0.12238) [3.70267]	0.500095 (0.23544) [2.12404]	0.244780 (0.13272) [1.84434]	0.164934 (0.07811) [2.11166]	0.180312 (0.16764) [1.07556]
D(LOGMANU(-3))	-0.468571 (0.93697) [-0.50009]	0.035997 (0.03622) [0.99391]	-0.142269 (0.14509) [-0.98055]	0.009118 (0.08298) [0.10988]	0.137480 (0.12004) [1.14524]	0.004960 (0.23095) [0.02148]	0.292881 (0.13018) [2.24975]	0.067809 (0.07661) [0.88508]	0.102272 (0.16444) [0.62194]
D(LOGMINI(-1))	0.156053 (0.67429) [0.23143]	0.002276 (0.02606) [0.08734]	-0.126161 (0.10441) [-1.20827]	-0.104700 (0.05972) [-1.75325]	-0.125063 (0.08639) [-1.44765]	-0.381438 (0.16620) [-2.29505]	-0.046303 (0.09369) [-0.49424]	0.033381 (0.05514) [0.60544]	-0.008204 (0.11834) [-0.06933]
D(LOGMINI(-2))	-0.057645 (0.69377) [-0.08309]	-0.007498 (0.02682) [-0.27960]	-0.097960 (0.10743) [-0.91184]	-0.067361 (0.06144) [-1.09632]	-0.130704 (0.08889) [-1.47047]	-0.046862 (0.17100) [-0.27404]	0.026483 (0.09639) [0.27474]	0.090194 (0.05673) [1.58995]	0.048631 (0.12176) [0.39941]
D(LOGMINI(-3))	-0.020019 (0.59395) [-0.03371]	-0.007469 (0.02296) [-0.32533]	0.061881 (0.09197) [0.67281]	-0.074478 (0.05260) [-1.41586]	-0.206889 (0.07610) [-2.71874]	-0.065470 (0.14640) [-0.44720]	0.022282 (0.08252) [0.27001]	-0.004878 (0.04857) [-0.10045]	0.126156 (0.10424) [1.21024]
D(LOGTRAD(-1))	-0.683538 (1.01394) [-0.67414]	0.095463 (0.03919) [2.43572]	-0.540581 (0.15701) [-3.44296]	-0.244880 (0.08980) [-2.72698]	-0.998932 (0.12991) [-7.68962]	-0.324114 (0.24992) [-1.29688]	-1.077071 (0.14088) [-7.64539]	-0.266936 (0.08291) [-3.21967]	-0.570660 (0.17795) [-3.20685]
D(LOGTRAD(-2))	0.464004 (1.21645) [0.38144]	0.073199 (0.04702) [1.55673]	-0.236134 (0.18837) [-1.25356]	-0.205258 (0.10773) [-1.90522]	-0.778705 (0.15585) [-4.99641]	-0.244479 (0.29984) [-0.81538]	-0.752126 (0.16902) [-4.45002]	-0.274299 (0.09947) [-2.75768]	-0.251262 (0.21349) [-1.17691]
D(LOGTRAD(-3))	1.436373 (0.89408) [1.60653]	0.022854 (0.03456) [0.66127]	-0.111746 (0.13845) [-0.80712]	-0.125435 (0.07918) [-1.58411]	-0.326364 (0.11455) [-2.84908]	0.126800 (0.22038) [0.57538]	-0.915581 (0.12423) [-7.37032]	-0.102140 (0.07311) [-1.39713]	0.034261 (0.15691) [0.21834]
D(LOGTRAN(-1))	-1.669225 (1.60363) [-1.04090]	-0.023356 (0.06199) [-0.37679]	0.008591 (0.24833) [0.03460]	0.016377 (0.14202) [0.11531]	0.444368 (0.20546) [2.16282]	0.207454 (0.39527) [0.52484]	0.437642 (0.22281) [1.96419]	0.023110 (0.13113) [0.17624]	0.188981 (0.28144) [0.67147]

D(LOGTRAN(-2))	1.357819 (1.57796) [0.86049]	0.124986 (0.06099) [2.04913]	0.498587 (0.24435) [2.04046]	-0.353491 (0.13975) [-2.52944]	0.277072 (0.20217) [1.37050]	0.328093 (0.38894) [0.84356]	-0.227174 (0.21924) [-1.03617]	-0.090605 (0.12903) [-0.70222]	0.292538 (0.27694) [1.05633]
D(LOGTRAN(-3))	0.858089 (1.66991) [0.51385]	0.008238 (0.06455) [0.12762]	0.073049 (0.25859) [0.28249]	0.224947 (0.14789) [1.52100]	0.636867 (0.21395) [2.97672]	0.339806 (0.41160) [0.82556]	-0.124006 (0.23202) [-0.53446]	-0.033400 (0.13654) [-0.24461]	-0.020419 (0.29308) [-0.06967]
D(LOGUTIL(-1))	0.692449 (0.81528) [0.84934]	0.068696 (0.03151) [2.17987]	-0.016520 (0.12625) [-0.13085]	0.013050 (0.07220) [0.18073]	-0.341551 (0.10445) [-3.26987]	-0.087856 (0.20095) [-0.43720]	0.042154 (0.11328) [0.37214]	-0.073744 (0.06666) [-1.10622]	-0.169366 (0.14308) [-1.18368]
D(LOGUTIL(-2))	0.564338 (0.81341) [0.69379]	0.017941 (0.03144) [0.57061]	0.053311 (0.12596) [0.42324]	0.073684 (0.07204) [1.02284]	-0.106478 (0.10421) [-1.02172]	-0.103158 (0.20049) [-0.51452]	-0.011820 (0.11302) [-0.10459]	-0.031688 (0.06651) [-0.47643]	-0.085482 (0.14276) [-0.59880]
D(LOGUTIL(-3))	1.104486 (0.78400) [1.40877]	0.028996 (0.03031) [0.95679]	-0.267421 (0.12140) [-2.20273]	0.012851 (0.06943) [0.18508]	-0.200173 (0.10045) [-1.99281]	-0.190524 (0.19324) [-0.98593]	-0.210790 (0.10893) [-1.93508]	-0.067677 (0.06411) [-1.05569]	-0.259057 (0.13760) [-1.88273]
C	0.084621 (0.06597) [1.28278]	0.005769 (0.00255) [2.26247]	0.020271 (0.01022) [1.98437]	0.021487 (0.00584) [3.67781]	-0.013664 (0.00845) [-1.61666]	-0.031739 (0.01626) [-1.95203]	0.011672 (0.00917) [1.27343]	0.003896 (0.00539) [0.72232]	-0.018957 (0.01158) [-1.63740]
R-squared	0.957110	0.767511	0.778251	0.653484	0.935132	0.639083	0.986845	0.951254	0.849210
Adj. R-squared	0.933847	0.641416	0.657980	0.465543	0.899950	0.443332	0.979711	0.924815	0.767426
Sum sq. resids	0.819283	0.001224	0.019646	0.006426	0.013448	0.049775	0.015816	0.005478	0.025235
S.E. equation	0.117840	0.004555	0.018248	0.010436	0.015098	0.029046	0.016373	0.009636	0.020681
F-statistic	41.14375	6.086744	6.470821	3.477069	26.57954	3.264770	138.3170	35.97958	10.38354
Log likelihood	86.62889	385.9141	258.2352	309.6393	275.6689	215.4712	268.2093	316.9848	246.7175
Akaike AIC	-1.165845	-7.672045	-4.896417	-6.013898	-5.275411	-3.966766	-5.113245	-6.173582	-4.646033
Schwarz SC	-0.261291	-6.767491	-3.991862	-5.109344	-4.370856	-3.062211	-4.208691	-5.269028	-3.741479
Mean dependent	0.002691	0.005451	0.011997	0.010588	0.005432	-0.000472	0.008570	0.011718	0.003518
S.D. dependent	0.458159	0.007607	0.031202	0.014276	0.047731	0.038930	0.114945	0.035141	0.042884

Determinant resid covariance (dof adj.)	6.66E-33
Determinant resid covariance	1.22E-34
Log likelihood	2417.150
Akaike information criterion	-45.11195
Schwarz criterion	-35.73748

Source: Author generated (Statistics South Africa data)

APPENDIX F

Vector Error Correction Model Diagnostic Tests (Sector Output)

VEC Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Lags	LM-Stat	Prob
1	148.2599	0.0000
2	107.6631	0.0255
3	119.1543	0.0037
4	75.53070	0.6506
5	76.69466	0.6148
6	68.28216	0.8423
7	84.56642	0.3713
8	79.40938	0.5292
9	84.61391	0.3699
Probs from chi-square with 81 df.		

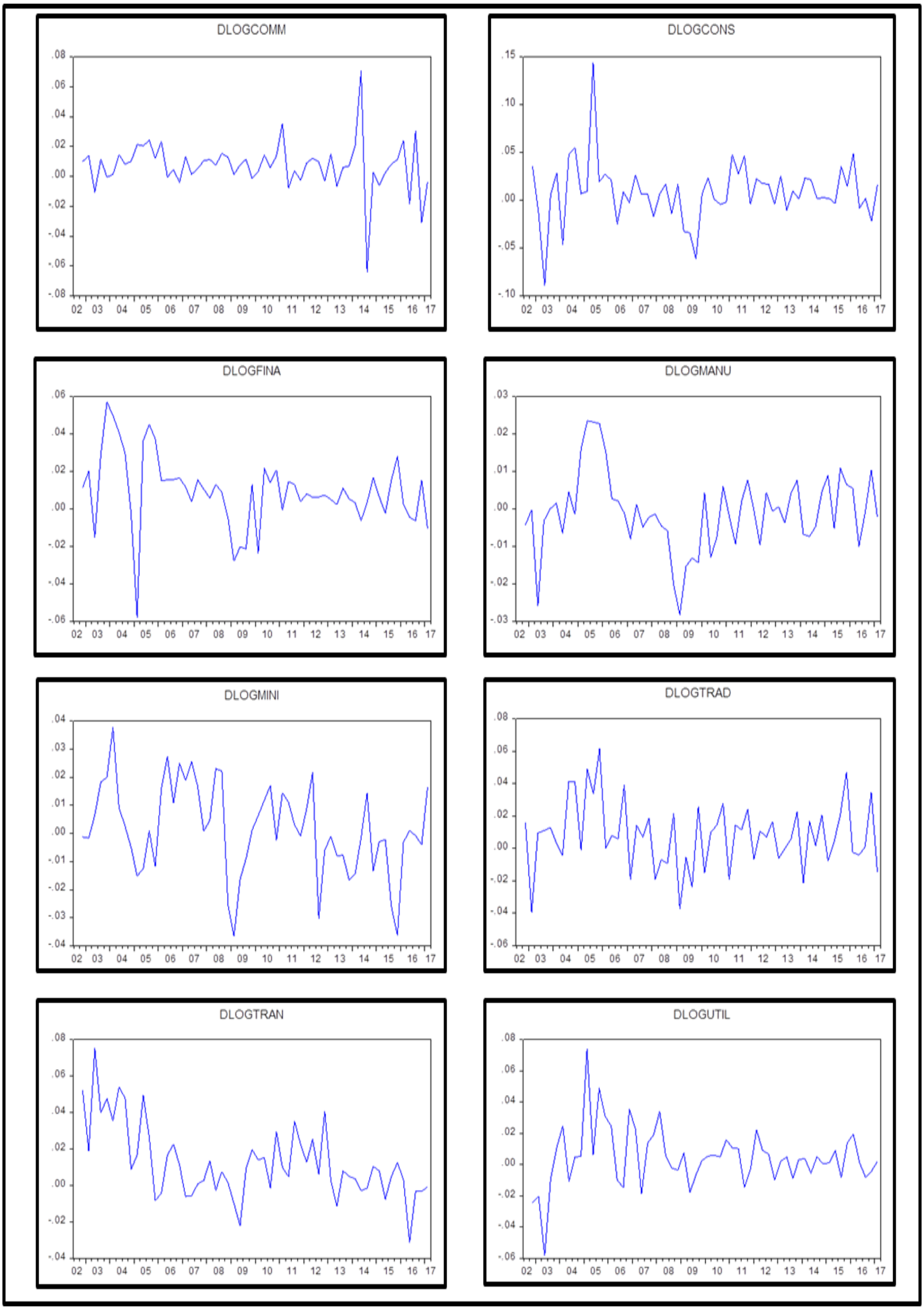
VEC Residual Normality Tests			
Null Hypothesis: residuals are multivariate normal			
Component	**Jarque-Bera**	**df**	**Prob.**
1	13.67666	2	0.0011
2	4.597527	2	0.1004
3	0.995170	2	0.6080
4	0.086213	2	0.9578
5	1.269148	2	0.5302
6	3.415191	2	0.1813
7	3.205936	2	0.2013
8	0.165318	2	0.9207
9	2.683413	2	0.2614
Joint	703.9148	660	0.1148

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)		
Joint test:		
Chi-sq	**df**	**Prob.**
2915.023	2880	0.3197

Source: Author generated (Statistics South Africa data)

APPENDIX G

Graphic Plots of Variables in First Difference (Sector Employment)



Source: Author generated (Statistics South Africa data)

APPENDIX H

Vector Auto-regression Model Estimates (Sector Employment)

Standard errors in ( ) & t-statistics in [ ]								
	LOGCOMM	LOGCONS	LOGFINA	LOGMANU	LOGMINI	LOGTRAD	LOGTRAN	LOGUTIL
LOGCOMM(-1)	0.268087 (0.20299) [1.32070]	0.130897 (0.27723) [0.47216]	0.048737 (0.17498) [0.27854]	-0.116473 (0.09078) [-1.28307]	0.195205 (0.16431) [1.18806]	-0.061796 (0.19744) [-0.31298]	0.036098 (0.15385) [0.23463]	0.242381 (0.15811) [1.53302]
LOGCOMM(-2)	0.139735 (0.20736) [0.67389]	0.193160 (0.28320) [0.68206]	0.144646 (0.17874) [0.80925]	-0.102853 (0.09273) [-1.10917]	0.186042 (0.16784) [1.10843]	-0.257251 (0.20169) [-1.27546]	0.171986 (0.15716) [1.09433]	-0.030129 (0.16151) [-0.18655]
LOGCOMM(-3)	-0.038050 (0.20324) [-0.18722]	-0.326529 (0.27757) [-1.17637]	-0.054251 (0.17519) [-0.30967]	0.018342 (0.09089) [0.20181]	0.146516 (0.16451) [0.89063]	-0.316937 (0.19768) [-1.60324]	-0.065134 (0.15404) [-0.42284]	0.026177 (0.15830) [0.16536]
LOGCONS(-1)	-0.066945 (0.14467) [-0.46275]	0.512457 (0.19758) [2.59361]	0.011284 (0.12471) [0.09049]	0.019019 (0.06470) [0.29398]	-0.168465 (0.11710) [-1.43863]	0.219900 (0.14072) [1.56270]	-0.064815 (0.10965) [-0.59111]	-0.162486 (0.11268) [-1.44197]
LOGCONS(-2)	-0.053418 (0.15445) [-0.34586]	0.050210 (0.21094) [0.23803]	-0.118127 (0.13314) [-0.88726]	0.044541 (0.06907) [0.64486]	-0.172360 (0.12502) [-1.37867]	0.074180 (0.15023) [0.49376]	0.021207 (0.11706) [0.18116]	-0.032954 (0.12030) [-0.27393]
LOGCONS(-3)	0.000344 (0.10798) [0.00318]	0.197499 (0.14747) [1.33922]	-0.005649 (0.09308) [-0.06069]	-0.015371 (0.04829) [-0.31831]	-0.063049 (0.08740) [-0.72137]	-0.142221 (0.10503) [-1.35410]	0.087095 (0.08184) [1.06421]	-0.055699 (0.08410) [-0.66225]
LOGFINA(-1)	0.126762 (0.19385) [0.65391]	-0.576025 (0.26476) [-2.17568]	0.844051 (0.16710) [5.05116]	-0.102687 (0.08669) [-1.18452]	-0.085778 (0.15691) [-0.54667]	0.052386 (0.18856) [0.27783]	-0.074508 (0.14693) [-0.50711]	-0.068761 (0.15099) [-0.45539]
LOGFINA(-2)	-0.143996 (0.27911) [-0.51591]	0.554339 (0.38120) [1.45420]	-0.196040 (0.24059) [-0.81482]	-0.088307 (0.12482) [-0.70749]	-0.127375 (0.22592) [-0.56380]	-0.148501 (0.27149) [-0.54699]	-0.087812 (0.21155) [-0.41510]	-0.296128 (0.21740) [-1.36214]
LOGFINA(-3)	0.038041 (0.22194) [0.17140]	0.166436 (0.30312) [0.54908]	-0.255410 (0.19131) [-1.33503]	0.073344 (0.09925) [0.73896]	-0.194986 (0.17965) [-1.08537]	0.280751 (0.21588) [1.30049]	0.077873 (0.16822) [0.46293]	0.290739 (0.17287) [1.68183]
LOGMANU(-1)	-0.426254 (0.43187) [-0.98699]	0.700769 (0.58984) [1.18808]	0.571944 (0.37227) [1.53635]	0.773325 (0.19313) [4.00409]	0.490256 (0.34957) [1.40244]	0.029974 (0.42008) [0.07135]	0.745862 (0.32733) [2.27863]	0.117570 (0.33639) [0.34951]

LOGMANU(-2)	0.655860 (0.51116) [1.28307]	-0.068877 (0.69813) [-0.09866]	-0.909400 (0.44062) [-2.06390]	-0.120371 (0.22859) [-0.52657]	0.109909 (0.41376) [0.26564]	-0.771025 (0.49720) [-1.55073]	-0.679627 (0.38743) [-1.75421]	0.315512 (0.39815) [0.79245]
LOGMANU(-3)	-0.661982 (0.39740) [-1.66578]	-0.693182 (0.54276) [-1.27715]	0.471518 (0.34256) [1.37646]	0.165819 (0.17772) [0.93304]	-0.234388 (0.32167) [-0.72865]	0.484492 (0.38655) [1.25339]	-0.275163 (0.30120) [-0.91355]	-0.306944 (0.30954) [-0.99163]
LOGMINI(-1)	-0.300595 (0.21973) [-1.36801]	-0.124292 (0.30010) [-0.41417]	-0.006602 (0.18941) [-0.03485]	0.063018 (0.09826) [0.64132]	1.017741 (0.17786) [5.72217]	0.023632 (0.21373) [0.11057]	-0.027149 (0.16654) [-0.16301]	0.109529 (0.17115) [0.63996]
LOGMINI(-2)	0.170312 (0.31461) [0.54135]	0.582233 (0.42968) [1.35503]	0.144331 (0.27119) [0.53221]	-0.003420 (0.14069) [-0.02431]	-0.165878 (0.25466) [-0.65138]	0.229480 (0.30602) [0.74990]	0.544503 (0.23845) [2.28350]	-0.040716 (0.24505) [-0.16615]
LOGMINI(-3)	0.061187 (0.21680) [0.28223]	-0.604277 (0.29610) [-2.04081]	-0.131536 (0.18688) [-0.70385]	-0.119243 (0.09695) [-1.22991]	0.260194 (0.17549) [1.48271]	-0.693489 (0.21088) [-3.28859]	-0.400708 (0.16432) [-2.43861]	0.194045 (0.16887) [1.14911]
LOGTRAD(-1)	0.052357 (0.17962) [0.29149]	0.099230 (0.24532) [0.40449]	-0.239195 (0.15483) [-1.54487]	0.202185 (0.08033) [2.51705]	0.118102 (0.14539) [0.81230]	0.351336 (0.17471) [2.01092]	-0.179092 (0.13614) [-1.31551]	0.709187 (0.13991) [5.06902]
LOGTRAD(-2)	0.206489 (0.24382) [0.84689]	-0.341249 (0.33300) [-1.02477]	0.127460 (0.21017) [0.60646]	-0.078992 (0.10904) [-0.72445]	0.402922 (0.19736) [2.04158]	0.234883 (0.23716) [0.99040]	0.046652 (0.18480) [0.25245]	0.115322 (0.18991) [0.60724]
LOGTRAD(-3)	0.056385 (0.24530) [0.22986]	0.370806 (0.33503) [1.10679]	0.554563 (0.21145) [2.62263]	-0.085705 (0.10970) [-0.78126]	0.291806 (0.19856) [1.46962]	-0.191109 (0.23860) [-0.80094]	0.127664 (0.18592) [0.68665]	-0.256729 (0.19107) [-1.34365]
LOGTRAN(-1)	0.020893 (0.22010) [0.09492]	0.913081 (0.30061) [3.03744]	0.443752 (0.18973) [2.33888]	0.102021 (0.09843) [1.03648]	-0.087132 (0.17816) [-0.48906]	0.538650 (0.21409) [2.51598]	0.790375 (0.16682) [4.73782]	-0.089265 (0.17144) [-0.52069]
LOGTRAN(-2)	0.023462 (0.25338) [0.09260]	-0.463575 (0.34605) [-1.33960]	-0.445646 (0.21841) [-2.04040]	-0.137798 (0.11331) [-1.21611]	0.149587 (0.20509) [0.72936]	-0.603943 (0.24646) [-2.45050]	-0.069913 (0.19204) [-0.36405]	0.186809 (0.19736) [0.94656]
LOGTRAN(-3)	0.076835 (0.21727) [0.35364]	-0.272887 (0.29674) [-0.91962]	0.232744 (0.18729) [1.24272]	0.171110 (0.09716) [1.76106]	-0.122590 (0.17587) [-0.69706]	0.423258 (0.21133) [2.00279]	0.128310 (0.16467) [0.77917]	-0.100654 (0.16923) [-0.59478]

LOGUTIL(-1)	0.088914 (0.24304) [0.36585]	0.830533 (0.33193) [2.50213]	0.305351 (0.20950) [1.45754]	0.094846 (0.10869) [0.87266]	-0.340045 (0.19672) [-1.72855]	0.250605 (0.23640) [1.06010]	-0.000683 (0.18420) [-0.00371]	0.302964 (0.18930) [1.60043]
LOGUTIL(-2)	0.048678 (0.26172) [0.18599]	-0.753499 (0.35744) [-2.10803]	-0.454338 (0.22560) [-2.01392]	0.056021 (0.11704) [0.47865]	0.057289 (0.21184) [0.27043]	-0.144364 (0.25457) [-0.56710]	-0.016778 (0.19836) [-0.08458]	0.195026 (0.20385) [0.95671]
LOGUTIL(-3)	0.093089 (0.20767) [0.44826]	-0.194068 (0.28362) [-0.68424]	-0.018515 (0.17901) [-0.10343]	-0.116873 (0.09287) [-1.25847]	-0.164327 (0.16809) [-0.97759]	0.444188 (0.20199) [2.19901]	-0.077307 (0.15740) [-0.49116]	-0.086336 (0.16175) [-0.53376]
C	8.851035 (5.22209) [1.69492]	1.014665 (7.13215) [0.14227]	-1.247612 (4.50144) [-0.27716]	4.672771 (2.33533) [2.00091]	-9.149003 (4.22697) [-2.16444]	12.08522 (5.07946) [2.37923]	3.027573 (3.95798) [0.76493]	-6.028252 (4.06749) [-1.48206]
R-squared	0.991815	0.989250	0.993179	0.987888	0.974680	0.991412	0.996808	0.993622
Adj. R-squared	0.985479	0.980928	0.987897	0.978510	0.955077	0.984764	0.994337	0.988685
Sum sq. resids	0.007846	0.014635	0.005830	0.001569	0.005141	0.007423	0.004507	0.004760
S.E. equation	0.015909	0.021728	0.013714	0.007115	0.012877	0.015474	0.012058	0.012392
F-statistic	156.5223	118.8688	188.0620	105.3495	49.72173	149.1188	403.3485	201.2340
Log likelihood	168.9865	151.5305	177.3026	214.0523	180.8256	170.5374	184.5078	182.9793
Akaike AIC	-5.142376	-4.518947	-5.439377	-6.751868	-5.565202	-5.197764	-5.696706	-5.642119
Schwarz SC	-4.238201	-3.614772	-4.535203	-5.847693	-4.661027	-4.293589	-4.792531	-4.737944
Mean dependent	14.61137	13.07162	14.43304	14.00986	13.08894	14.35938	12.86611	10.90770
S.D. dependent	0.132020	0.157334	0.124655	0.048532	0.060757	0.125365	0.160225	0.116490
Determinant resid covariance (dof adj.)		1.26E-31						
Determinant resid covariance		1.11E-33						
Log likelihood		1489.025						
Akaike information criterion		-46.03662						
Schwarz criterion		-38.80322						

Source: Author generated (Statistics South Africa data)

APPENDIX I

Vector Auto-regression Model Diagnostic Tests (Sector Employment)

VAR Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Lags	LM-Stat	Prob
1	83.87382	0.0485
2	67.80411	0.3488
3	52.81409	0.8397
4	71.11367	0.2529
5	54.85289	0.7855
6	53.85375	0.8131
7	56.26255	0.7434
8	58.33953	0.6760
Probs from chi-square with 64 df.		

VAR Residual Normality Tests			
Null Hypothesis: residuals are multivariate normal			
Component	Jarque-Bera	df	Prob.
1	325.7077	2	0.0000
2	1.893402	2	0.3880
3	5.119152	2	0.0773
4	0.414684	2	0.8127
5	0.129940	2	0.9371
6	0.362165	2	0.8344
7	0.646322	2	0.7239
8	3.932630	2	0.1400
Joint	338.2060	16	0.0000

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)		
Joint:		
Chi-sq	df	Prob.
1773.480	1728	0.2182

Source: Author generated (Statistics South Africa data)

APPENDIX J

Vector Error Correction Model Estimates (Sector Employment)

Standard errors in ( ) & t-statistics in [ ]								
Cointegrating Eq:	**CointEq1**	**CointEq2**	**CointEq3**	**CointEq4**	**CointEq5**			
LOGCOMM(-1)	1.000000	0.000000	0.000000	0.000000	0.000000			
LOGCONS(-1)	0.000000	1.000000	0.000000	0.000000	0.000000			
LOGFINA(-1)	0.000000	0.000000	1.000000	0.000000	0.000000			
LOGMANU(-1)	0.000000	0.000000	0.000000	1.000000	0.000000			
LOGMINI(-1)	0.000000	0.000000	0.000000	0.000000	1.000000			
LOGTRAD(-1)	0.259544 (1.32921) [0.19526]	-1.699025 (0.46989) [-3.61577]	-0.624460 (0.09223) [-6.77056]	-0.494748 (1.23122) [-0.40184]	0.069528 (1.80208) [0.03858]			
LOGTRAN(-1)	2.519859 (0.66745) [3.77534]	-1.163563 (0.23595) [-4.93134]	-0.161299 (0.04631) [-3.48279]	-2.450731 (0.61824) [-3.96401]	-4.233786 (0.90490) [-4.67874]			
LOGUTIL(-1)	-3.653358 (1.16776) [-3.12851]	1.869771 (0.41282) [4.52928]	-0.088183 (0.08103) [-1.08829]	3.236492 (1.08167) [2.99212]	3.632139 (1.58320) [2.29418]			
C	-10.89095	5.891622	-2.428008	-10.69253	0.739891			
Error Correction:	**D(LOGCOMM)**	**D(LOGCONS)**	**D(LOGFINA)**	**D(LOGMANU)**	**D(LOGMINI)**	**D(LOGTRAD)**	**D(LOGTRAN)**	**D(LOGUTIL)**
CointEq1	-0.322216 (0.22032) [-1.46251]	0.018002 (0.30509) [0.05901]	-0.001111 (0.18313) [-0.00606]	-0.210734 (0.09450) [-2.23000]	0.400884 (0.17893) [2.24050]	-0.929749 (0.21115) [-4.40326]	0.033040 (0.16693) [0.19793]	0.178570 (0.17466) [1.02237]
CointEq2	-0.142433 (0.11646) [-1.22299]	-0.108218 (0.16128) [-0.67100]	-0.092610 (0.09680) [-0.95666]	0.045317 (0.04995) [0.90718]	-0.339134 (0.09458) [-3.58556]	0.208679 (0.11162) [1.86959]	0.116109 (0.08824) [1.31584]	-0.319579 (0.09233) [-3.46129]
CointEq3	0.102085 (0.17371) [0.58769]	0.079922 (0.24055) [0.33225]	-0.610265 (0.14438) [-4.22665]	-0.126195 (0.07451) [-1.69374]	-0.495629 (0.14107) [-3.51332]	0.114584 (0.16648) [0.68828]	-0.146992 (0.13161) [-1.11688]	-0.031110 (0.13771) [-0.22591]
CointEq4	-0.184661 (0.12573) [-1.46869]	-0.036820 (0.17411) [-0.21147]	-0.003073 (0.10451) [-0.02940]	-0.184290 (0.05393) [-3.41724]	0.282776 (0.10211) [2.76932]	-0.507305 (0.12050) [-4.21000]	-0.293790 (0.09526) [-3.08403]	0.060646 (0.09968) [0.60843]

CointEq5	-0.066083 (0.11870) [-0.55670]	0.019221 (0.16438) [0.11693]	-0.002754 (0.09867) [-0.02791]	-0.060264 (0.05091) [-1.18361]	0.192117 (0.09640) [1.99286]	-0.412285 (0.11376) [-3.62402]	0.195577 (0.08994) [2.17460]	0.161639 (0.09411) [1.71764]
D(LOGCOMM(-1))	-0.311386 (0.21363) [-1.45757]	0.139609 (0.29584) [0.47191]	0.017104 (0.17757) [0.09632]	0.088493 (0.09163) [0.96574]	-0.244407 (0.17350) [-1.40871]	0.786597 (0.20474) [3.84186]	-0.022076 (0.16186) [-0.13639]	0.039161 (0.16936) [0.23122]
D(LOGCOMM(-2))	-0.078228 (0.17742) [-0.44092]	0.351571 (0.24569) [1.43097]	0.111147 (0.14747) [0.75369]	-0.015857 (0.07610) [-0.20838]	-0.085941 (0.14409) [-0.59645]	0.437610 (0.17004) [2.57363]	0.122560 (0.13442) [0.91175]	-0.020685 (0.14065) [-0.14706]
D(LOGCONS(-1))	0.055307 (0.15656) [0.35326]	-0.320558 (0.21681) [-1.47854]	0.118296 (0.13014) [0.90902]	-0.027445 (0.06715) [-0.40870]	0.203517 (0.12715) [1.60061]	0.047037 (0.15005) [0.31348]	-0.144528 (0.11862) [-1.21839]	0.128580 (0.12412) [1.03594]
D(LOGCONS(-2))	0.027968 (0.10459) [0.26742]	-0.238238 (0.14483) [-1.64493]	-0.000731 (0.08693) [-0.00841]	0.013696 (0.04486) [0.30532]	0.027560 (0.08494) [0.32447]	0.110276 (0.10024) [1.10017]	-0.117755 (0.07924) [-1.48603]	0.078507 (0.08291) [0.94684]
D(LOGFINA(-1))	0.049230 (0.19147) [0.25712]	-0.650257 (0.26514) [-2.45247]	0.452172 (0.15915) [2.84119]	0.020871 (0.08213) [0.25413]	0.395925 (0.15550) [2.54619]	-0.078706 (0.18350) [-0.42891]	0.065818 (0.14507) [0.45370]	-0.040092 (0.15179) [-0.26413]
D(LOGFINA(-2))	-0.111665 (0.21656) [-0.51563]	-0.153915 (0.29989) [-0.51324]	0.261634 (0.18001) [1.45348]	-0.065760 (0.09289) [-0.70795]	0.250569 (0.17587) [1.42470]	-0.224939 (0.20755) [-1.08379]	-0.043550 (0.16408) [-0.26542]	-0.300821 (0.17168) [-1.75218]
D(LOGMANU(-1))	-0.058539 (0.37017) [-0.15814]	0.729220 (0.51261) [1.42256]	0.469456 (0.30769) [1.52575]	-0.043476 (0.15878) [-0.27382]	0.136561 (0.30063) [0.45425]	0.343408 (0.35477) [0.96797]	0.964066 (0.28046) [3.43739]	0.021798 (0.29346) [0.07428]
D(LOGMANU(-2))	0.674498 (0.39374) [1.71306]	0.572789 (0.54524) [1.05052]	-0.481509 (0.32728) [-1.47126]	-0.163859 (0.16888) [-0.97025]	0.175830 (0.31977) [0.54987]	-0.525694 (0.37735) [-1.39311]	0.211904 (0.29832) [0.71033]	0.373164 (0.31215) [1.19548]
D(LOGMINI(-1))	-0.293579 (0.24255) [-1.21040]	-0.036503 (0.33588) [-0.10868]	0.016747 (0.20161) [0.08307]	0.125044 (0.10403) [1.20195]	-0.094733 (0.19698) [-0.48093]	0.512214 (0.23246) [2.20349]	-0.147991 (0.18377) [-0.80531]	-0.108779 (0.19229) [-0.56571]
D(LOGMINI(-2))	-0.085396 (0.20613) [-0.41427]	0.449834 (0.28545) [1.57586]	0.152742 (0.17134) [0.89146]	0.119856 (0.08842) [1.35559]	-0.327370 (0.16741) [-1.95553]	0.690079 (0.19756) [3.49307]	0.335445 (0.15618) [2.14782]	-0.094672 (0.16342) [-0.57932]
D(LOGTRAD(-1))	-0.224078 (0.29506) [-0.75943]	-0.066335 (0.40860) [-0.16235]	-0.737296 (0.24525) [-3.00626]	0.171488 (0.12656) [1.35501]	-0.705235 (0.23963) [-2.94307]	-0.114423 (0.28278) [-0.40463]	-0.207760 (0.22355) [-0.92935]	0.137308 (0.23392) [0.58699]

D(LOGTRAD(-2))	-0.057022 (0.24325) [-0.23442]	-0.378028 (0.33685) [-1.12225]	-0.571359 (0.20219) [-2.82586]	0.089237 (0.10434) [0.85528]	-0.284104 (0.19755) [-1.43814]	0.178760 (0.23313) [0.76679]	-0.131157 (0.18430) [-0.71165]	0.252158 (0.19284) [1.30758]
D(LOGTRAN(-1))	-0.071854 (0.20001) [-0.35926]	0.746243 (0.27697) [2.69435]	0.239433 (0.16624) [1.44024]	-0.042218 (0.08579) [-0.49213]	-0.059931 (0.16243) [-0.36897]	0.181599 (0.19168) [0.94739]	-0.064164 (0.15154) [-0.42343]	-0.075748 (0.15856) [-0.47773]
D(LOGTRAN(-2))	-0.037759 (0.21405) [-0.17640]	0.230103 (0.29642) [0.77627]	-0.230951 (0.17792) [-1.29805]	-0.175710 (0.09181) [-1.91378]	0.073153 (0.17384) [0.42081]	-0.457353 (0.20515) [-2.22939]	-0.163963 (0.16218) [-1.01100]	0.129790 (0.16970) [0.76483]
D(LOGUTIL(-1))	-0.015446 (0.19575) [-0.07890]	1.046267 (0.27108) [3.85967]	0.454128 (0.16271) [2.79102]	0.047968 (0.08396) [0.57130]	0.072361 (0.15898) [0.45517]	-0.374770 (0.18761) [-1.99763]	0.093309 (0.14831) [0.62913]	-0.165854 (0.15519) [-1.06872]
D(LOGUTIL(-2))	-0.005599 (0.20085) [-0.02788]	0.213256 (0.27814) [0.76673]	0.001630 (0.16695) [0.00977]	0.109341 (0.08615) [1.26919]	0.120019 (0.16312) [0.73578]	-0.509417 (0.19249) [-2.64640]	0.052891 (0.15218) [0.34756]	0.073459 (0.15923) [0.46133]
C	0.014955 (0.00594) [2.51861]	0.002642 (0.00822) [0.32124]	0.008290 (0.00494) [1.67964]	-0.001445 (0.00255) [-0.56725]	0.004295 (0.00482) [0.89059]	0.006583 (0.00569) [1.15684]	0.018631 (0.00450) [4.14123]	0.004262 (0.00471) [0.90532]
R-squared	0.469231	0.710680	0.716964	0.741003	0.614746	0.642935	0.770507	0.719940
Adj. R-squared	0.141403	0.531983	0.542148	0.581034	0.376795	0.422394	0.628762	0.546962
Sum sq. resids	0.008586	0.016464	0.005932	0.001580	0.005663	0.007886	0.004929	0.005396
S.E. equation	0.015891	0.022005	0.013208	0.006816	0.012905	0.015230	0.012040	0.012598
F-statistic	1.431331	3.977002	4.101247	4.632171	2.583498	2.915270	5.435856	4.162025
Log likelihood	166.4639	148.2331	176.8173	213.8665	178.1173	168.8440	182.0052	179.4678
Akaike AIC	-5.159426	-4.508327	-5.529190	-6.852374	-5.575620	-5.244427	-5.714470	-5.623850
Schwarz SC	-4.363752	-3.712653	-4.733516	-6.056701	-4.779946	-4.448753	-4.918796	-4.828176
Mean dependent	0.007110	0.008803	0.008953	-0.000733	0.001896	0.008852	0.011840	0.005719
S.D. dependent	0.017150	0.032166	0.019520	0.010530	0.016348	0.020039	0.019760	0.018717
Determinant resid covariance (dof adj.)		1.01E-31						
Determinant resid covariance		1.87E-33						
Log likelihood		1474.397						
Akaike information criterion		-44.94275						
Schwarz criterion		-37.13068						

Source: Author generated (Statistics South Africa data)

APPENDIX K

Vector Error Correction Model Diagnostic Tests (Sector Employment)

VEC Residual Normality Tests			
Null Hypothesis: residuals are multivariate normal			
Component	Jarque-Bera	df	Prob.
1	37.78745	2	0.0000
2	1.672090	2	0.4334
3	5.165355	2	0.0756
4	0.088996	2	0.9565
5	0.809856	2	0.6670
6	0.285381	2	0.8670
7	1.559145	2	0.4586
8	0.822411	2	0.6629
Joint	48.19069	16	0.0000

VEC Residual Serial Correlation LM Tests		
Null Hypothesis: no serial correlation at lag order h		
Lags	LM-Stat	Prob
1	77.38243	0.1216
2	64.26888	0.4671
3	48.66789	0.9224
4	75.72863	0.1498
5	53.14844	0.8314
6	50.24804	0.8953
7	62.35018	0.5351
8	54.53703	0.7944
Probs from chi-square with 64 df.		

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)		
Joint:		
Chi-sq	df	Prob.
1522.802	1512	0.4176

Source: Author generated (Statistics South Africa data)