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Employment Growth Intensity in South Africa

by

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DECLARATION

I declare that "*Employment Growth Intensity in South Africa*" is my work, that it has not been submitted for any degree or examination in any university, and that all the sources that I have used or quoted have been indicated and acknowledged by complete references.

Caelem Jesse Hendricks

Signature:

Date: 1 May 2021

ABSTRACT

The following research paper is based on employment intensity, arguing the notion that an increase in economic growth alone does not necessary increase the rate of employment in South Africa. In fact, other additional macroeconomic factors determine changes in the rate of employment, along with economic growth. This research measured the employment numbers in each South African sector with reference to sector-specific gross value added, to determine the level of elasticity of employment in each sector. This was done by extracting quarterly data in-between the year 1995 to 2019. For each sector, a unit root test was estimated, an ARDL bound test for cointegration, an error correction model. A stability and diagnostic test were conducted to test the fluidity of each regression model. The coefficient of each sector modelled indicated no correlation between employment and economic growth. In "all sectors", the results of GVA were not influential enough to implement positive change in the levels of employment, thus, leading to jobless growth. Structural change in South Africa is, thus, becoming less labour-concentrated and more capital-concentrated leading gaps between the type of skills in the entering the labour market and skills demanded by employers. The recommendations made herewith offer viable resolutions for job creation in South Africa and should be considered when formulating future policies.

KEYWORDS: Autoregression distributive lag modelling technique, error correction model, employment rate, unit root, and economic growth.

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

ARDL	Autoregressive Distributed Lag
ADF	Augmented Dicky-Fuller Test
CPI	Consumer Price Index
CUSUM	Cumulative sum control chart
ECM	Error Correction Model
EMP	Employment rate
GDP	Gross Domestic Product
HPI	Human Poverty Index
IES	Income and Expenditure Survey
KPSS	Kwiatkowski-Phillips-Schmidt-Shin Test
OECD	Organisation for Economic Co-operation and Development
Stats SA	Statistics South Africa
Wit	Nominal wages, measured in Rands.
r_t	Long-term interest rates.
π_t	Inflation rate.
PG_t	Population Growth
PP	Phillips-Perron Test
D_t	1 (recession) = 0 (no recession)
GVA_{it}	Sector-specific gross value added (GVA) in constant 2010 prices.

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE: INTRODUCTION

1.1 Introduction and Background

Recent studies from Mkhize (2019), Leshoro (2013) and Bhorat, and Oosthuizen (2008), have argued that the economic growth rate in South Africa has not proportionately corresponded to the country's rate of employment. According to Trading Economics (2020), recent statistics revealed South Africa's unemployment rate's average high has been 28% in the last three years, keeping in mind the average unemployment rate of other emerging economies in the BRICS association like Brazil (12.5%), Russia (5.5%), India (11%), and China (5.8%). In the year 2017, for the last three consecutive quarters, South Africa's unemployment rate remained stagnated, with the country's output growing below the potential output. According to Yu and Swanepoel (2021), ever since the 2008 global recession ended, South Africa has not seen sustained periods of growth. The 2008 global recession thus ended the 4% growth period that lasted for 11 years. Structural impediments and economic challenges have led to subpar economic growth and technical recession, manifesting as political uncertainty, persistent corruption, energy and water crises, poor investment spending, infrastructure blockage, and government implementation challenges. These structural impediments induce high levels of unemployment (Financial24, 2019). The 2020 final quarter data presented high unemployment, the number rose to "7.23 million from 6.53 million and the unemployment rate increased from 30.8% to an alarming 32.5%".

The labour force is constantly expanding with the intake of new graduates coming from multiple tertiary institutions. South Africa comprises a job scarce economic structure with labour-intensive sectors that are transforming into capital intensive sectors. Dysfunctional educational systems are one of the major reasons why workers do not have the competitive skills to grow with the South African economy. The labour force is not growing faster than the demand for technologically advanced jobs. The supply of labour is, thus, more than the demand for labour (Lauder & Ken, 2020). Oppositely, the growth rate in capital-intensive industries is not growing fast enough to accommodate the new intake of highly skilled workers, whose knowledge and skills do not meet the industry's demands and requirements (Lauder et al, 2020). Moreover, new workers are unable to find work in their respective South African industry. If they do find employment, then their skills and expertise are underutilised and/or misplaced within a specific job title. This frustration, therefore, causes young individuals to move abroad to find better work opportunities catered to their skills.[1]

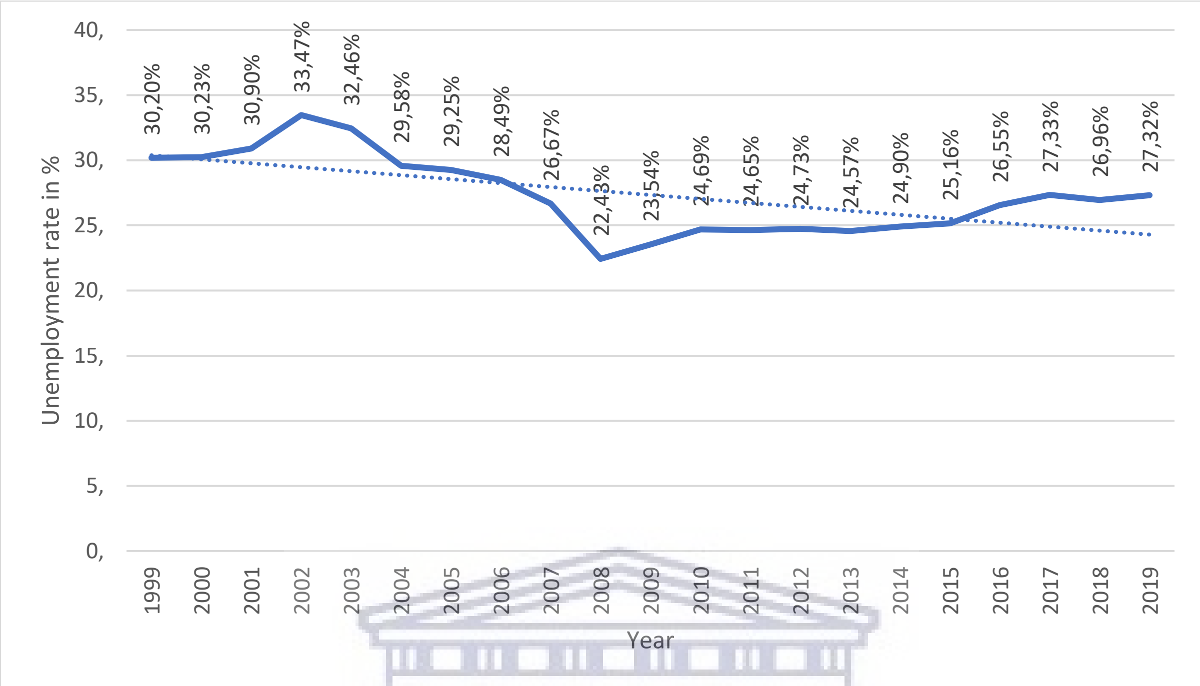
Today, South Africa's emerging industries and entrepreneurs are competing with established enterprises from abroad, thus, making it harder for domestic producers to enter the market forces and compete on an equal scale (StatsSA, 2019). South Africa has a relatively labour-intensive country, with highly competitive industries functioning in the economy. However, the employment rate of labour-intensive industries has slowed down considerably between the years 2017 and 2020, negatively affecting South Africa's employment rate (Trading Economics, 2020). To remedy the situation, incentive measures are needed to draw in foreign enterprises to firstly, create more jobs and enrich employment in the capital-intensive manufacturer's industry (Wagner, 2019). Essentially, improvements in the employment rate leads to a higher level of production/output. However, South African employment has not always matched the growth of the economy, because of structural changes caused by recession (Statistics South Africa, 2017). Many existing South African companies struggle to fully recover from these structural changes caused by a recession. These changes cause a shift in the market economy functions, bringing about a move from primary to tertiary production (Acemoglu, 2007). This was evident in the 2016/2017 contraction phase, in which Statistics South Africa (2017) reported that the "South African economy moved into recession with a decrease of 0,7% in GDP during the first quarter of 2017, followed by a 0,3% contraction in the fourth quarter of 2016." This was caused by weak consumer demand, accelerated consumer price inflation, stagnated employment, fixed investment suppression and excessive droughts. Another contraction phase occurred in 2019, in which the agriculture and mining industry drove slow growth, because of the electricity shortage and prolonged strikes. The suppression in the production output was due to negative growth rates in the secondary and tertiary industries, specifically within the manufacturing and trade sector.

[1] For example, South African born Elon Musk is an engineer, industrial designer and technology entrepreneur, and the CEO of multicomponent companies like Tesla, which invents electric cars, integrated with renewable energy solutions, as well as the inventor of many other technological tools. Companies formed by Musk have provided many working opportunities for USA citizens. In 2017, Tesla created more than 50000 jobs in California (Elias, 2018). This resulted in the contribution of about 5.5 billion dollars to the growing manufacturing industries in the US economy, leading to socio-economic growth and standard of living improvements in California rather than in South Africa.

As a result of the maintenance of this status quo, trade fell by 5,9% and manufacturing by 3,7% (Statistics South Africa, 2017). However, the agricultural and mining industry both "contributed large growth rates in the first quarter", but not enough to avoid the 2017 mini recession. This means that many different industries contribute, value-added, to South Africa's total economic growth. Thus, unemployment rate is not the only variable that influences the economy's growth rate. Other factors include inflation and interest rates coupled with external factors, such as a lack of foreign investment (due to costly government regulations, crime, and the inflexible labour cost), and a failure to uphold the government's priorities (Bernstein, 2001). Therefore, the growth of the tertiary sector is not fast enough for the arrival of new tertiary graduates. The logic here is that, when there is economic growth, more jobs should be created to increase more production. However, even though industries are growing, the growth rate is not moving fast enough to intake the newly skilled and, thus, jobless growth occurs. The concept of jobless growth has two different definitions. Example, jobless growth occurs when economic growth happens but absolute employment level declines and/or jobless growth occur when economic growth happens but unemployment rate increases.

According to Statista (2019), results have shown that movements in South Africa's employment rate do not always grow at the same proportion as GDP growth. The succeeding phenomenon refers to jobless growth when an economy experiences growth while decreasing or maintaining its level of employment (Wagner, 2019). This occurrence can be explained by many other factors, like structural change stimulated by technological improvements, government interventions in the local economy and/or environmental factors such as energy and water inefficiencies (Akanbi, 2015). As more technological advancements are employed in business operations, more people become unemployed, the supply of work becomes scarce, and job opportunities become limited. Consequently, the unemployment rate remains undoubtedly high even as the economy grows, as argued by Mkhize (2019), Leshoro (2013) and Bhorat, et al (2008). In South Africa (refer to figure 1.1), the country's unemployment rate experienced a rise between 2008 and 2011, moving from 22.43% to roughly 24.65%. Instead of the unemployment rate decreasing and the employment rate increasing as the GDP growth increases, the unemployment rate expanded. This phenomenon provides evidence that economic growth does not always guarantee instant relief for better employment opportunities over time, but instead, it proves that other factors influence the intensity of employment, and that economic growth may lead to jobless growth in the country.

Figure 1. 1 The unemployment rate from 1999 to 2019



Source: South Africa; World Bank (2019)

It is believed that economic industries have a unique impact on each other, and the growth rate of the economy in which it functions. For example, Deutsch (2019) discussed how five major industries drive the United States economy, namely: health care, corporate, construction, retail, and nondurable manufacturing. These major industries are constantly changing as newer technology is implemented. The technological industry is intertwined with the five major industries in the U.S and is projected to have contributed about 13% to the growth rate from 2016 to 2026, as argued by Deutsch (2019)[2]. In South Africa, the mining, communication and information technology, tourism, manufacturing, and the financial sector are the most established business industries. Each sector: mining and financial, manufacturing, communication and tourism approximately contribute about 22%, 14%, 6% and 2.8%

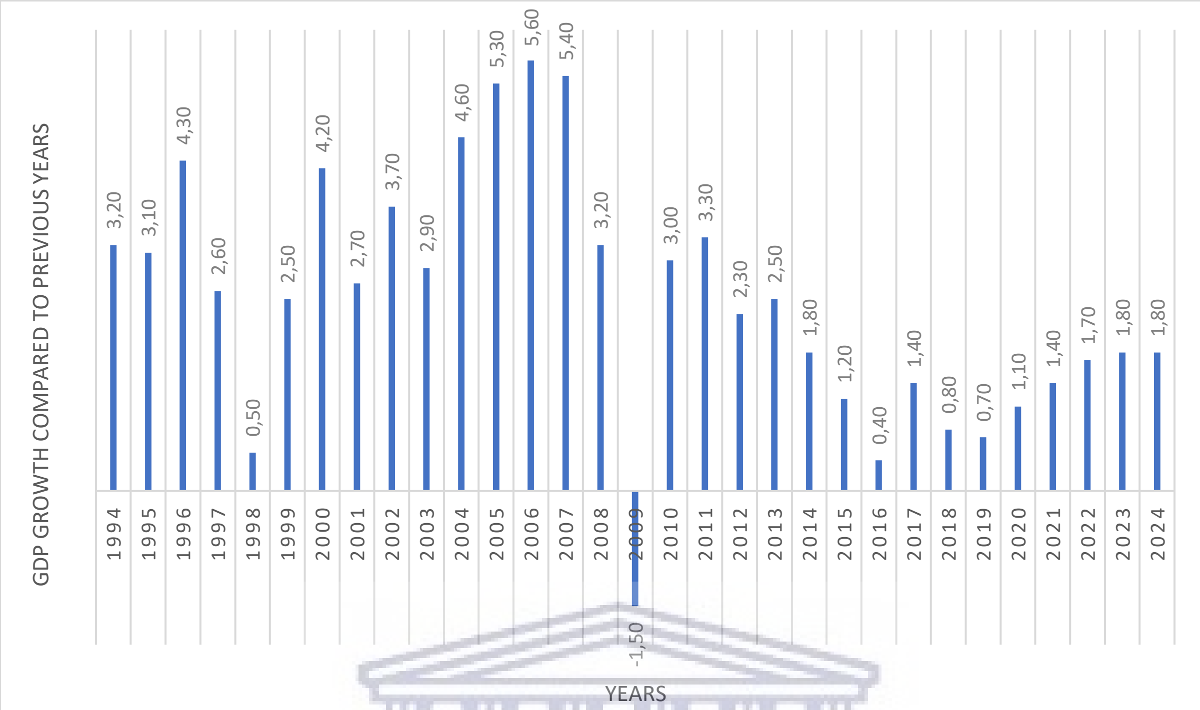
[2] "The impact of the tech industry has affected nearly every state, and, according to Cyberstates 2018, the industry is ranked in the top five economic contributors in 22 states and in the top 10 of 42 states. Technology plays a role in almost all other sectors, such as health care, advanced manufacturing, transportation, education, and energy. The Internet, artificial intelligence, machine learning, autonomous vehicles, and augmented and virtual reality are all changing society and industries."- Wagner, (2019).

respectively, to South Africa's real GDP rate. The manufacturing industry is reported as one of the working sectors with the potential to create jobs for both unskilled and semi-skilled workers (Brand South African Reporter, 2014).

Since the early 1990s, retail trade, tourism and communication have been the main drivers of the economy until technological advancements became more influential in terms of market expansion and innovation. In 2019, representatives from Baylor University wrote an article that argued that implementing technology in business organisations improves overall performance, services rendered, and production output, while assisting businesses to become more efficient and profitable. South Africa, like most developed countries across the world, is evolving into a "knowledge-based economy", focusing on e-commerce, secure online banking, marketing, and educational services (Brand South African Reporter, 2014). The process of weaving modern technology plays a pivotal role in all other sectors which are bi-directly connected. For instance, technological advancements that improves communication, strengthens connections, and manages customer-client relationships and reduces production-rental costs in the tertiary workplace, is manufactured in the secondary sector.

The development of virtual sales is constantly changing the way people live and work for the better. However, the implementation of technology comes with the cost of retrenching others, specifically in the banking and retail sector. According to the former CEO of City Group, Vikram Pandit (2017), robots are predicted to take over "30% of global banking jobs" within five years of his statement. In South Africa, Absa, Standard Bank and Nedbank, the country's three largest banks, have been cutting off staff, particularly in retail units to reduce, high cost-to-income ratio (BBQ online, 2019). According to BBQ online (2019), Absa, Standard Bank and Nedbank have cut over 2 200 South African staff members. The layoff equates to 2.4% of the total staff members in the country (Statistics South Africa, 2019). As more banking and retail stores conform towards digitalisation, more branches and stores are rendered vulnerable towards foreclosure, potentially leading to even more future job losses, indicating the demise of technology development on low -skilled unemployment.

Figure 1. 2 South African GDP growth rate from 1999 to 2024



Source: Author's compilation using data from IMF (2020)

According to Blanchard and Johnson (2014), "Okun's law measures the relationship between output growth and the change in the unemployment rate". In terms of Okun's law, the rising unemployment rates are counted when the annual output growth rate moves around 3% or more a year. Unfortunately, in South Africa (according to Table 1.2), since 2014 and predictively towards 2020, Real GDP, remains below the required growth rate of 3%. Hence, even if the real GDP rate does rise, the intensity of the employment rate will be relatively unchanged (inelastic) with production output, because the Real GDP rate is below the 3% required rate of change.

In most countries, the elasticity of employment is a useful measure of growth. The elasticity of employment is more desirable than a high inelasticity of employment. An elasticity resembles "high responsiveness of employment to changes in growth. An inelasticity resembles the non-responsiveness of employment to changes in growth" (Fuhrmann, 2019). A high elasticity of employment, thus, refers to the intensity of the fully employed working population, meaning that where the working-age population is small, more jobs are available, and the employment wages/salaries are larger, whereas employment inelasticity refers to jobless growth (Andersen and Corley, 2003). Consequently, in low-income countries like South Africa, a high population slows down economic development, because of pressure on limited natural resources due to higher consumption in the present. The benefits of a rising population promote technological change to meet the rising demand for certain goods and services (Wesley and Peterson, 2017). South Africa suffers from low levels of employment according to figures 1.1 and 1.2, respectively, with the growth rate of infant industries in the informal sector supporting about 27% of all employed, working people. Nonetheless, these industries are, contributing less to the country's GDP, with only 8% value-added economically. Therefore, there is a need to study whether South African economic growth is an instance of jobless growth.

1.2 Statement of the problem

Blanchard and Johnson (2014) stated that unemployment and losses in a country's production is one to one. Thus, if a countries unemployment decreases by 1% then production output will increase by 1% - taking into considerations of both labour growth and labour productivity growth. Theoretically, if the employment rate increase, then the growth rate of the economy will increase. However, other factors influence the employment rate in emerging economies such as fixed investments; fluctuations in economic activity; government intervention; and technology improvement and thus Okun's law is not always applicable to developing economy (Ajilore and Yinusa, 2011).

This notion has been backed by the endogenous growth theories which are typically based on macro-econometric models (OLS Estimations of Employment Elasticities to GDP) of endogenous technological change (Kwame, 2013). These theories show that industries will continue to expand and employ more people as new technology improves productivity. The innovations of domestic producers will lead to an expansion in the market industries that will stimulate economic growth (Romer, 1989). According to Okun's law (1970), the relationship that exist between unemployment and output is negative, as proven by the period between (2000-2005), which shows an upward trend in GDP output rate and a downward period in the rate of unemployment. In other words, as output increases, the rate of employment will directly increase, thus, output-employment is correlated. However, growth relationships are not always guaranteed between employment and GDP output in the real world. For instance, the trend for the period 2009-2011 showed an upward trend in the GDP growth rate, and, instead of the South African unemployment rate decreasing as the economy expands, the unemployment rate increased. Naturally, the economic expansion should not only see an increase in the output levels, but more jobs should be available, and more employment opportunities should then follow. However, from 2009 to 2011, that was not the case, showing a contradiction in what the law hypothesises regarding the employment intensity of the growth rate. It is based on this premise that the study, herewith, embarks on an empirical investigation of the employment growth intensity in South Africa while both definitions of jobless growth is the focus of the study. Because different industries have a different impact on employment levels.

1.3 Objectives of the study

The main objective of this study is to measure the impact of GVA growth on the employment rate for each sector (primary, secondary and tertiary) in South Africa. The specific objectives are:

- To examine whether the relationship between employment and economic growth is long-run nature.
- To estimate the elasticity between employment and economic growth.

1.4 Hypothesis

H_0: There is no relationship between employment and economic growth.

H_1: There is a relationship between employment and economic growth.

H_0: There is no long-run relationship between employment and economic growth.

H_1: There is a long-run relationship between employment and economic growth.

1.6 Structure of the thesis

The study will consist of five chapters ordered in the following manner: Chapter one, the introductory chapter, has provided the context, problem statement and a brief overview of the topic of the study. Also, this chapter has stated the research objectives and scope of the study. Chapter two will consist of a literature review and will present the theoretical framework related to the study and a review of past empirical studies. Chapter three will comprise a discussion of the research approach and methodology undertaken to meet the objectives of the study. This section will explain the rationale for choosing the research design and the data collection methods, specifically. Chapter four will be an analysis of the data and the findings of the study. Lastly, chapter five is the conclusion of the study and the implications and limitations of the empirical findings.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

For many years overcoming the high unemployment rate has remained a major economic challenge in South Africa. In the past, a lot of literature has identified numerous effects and consequences regarding increases in the rate of unemployment. Highlighting that the intensity of employment growth is produced by changes in GDP growth rate. However, many studies have investigated other determinants of unemployment, along with key indicators used to measure growth and development in countries where such determinants are unique. Thus, the key objective of this literature review is to analyse macroeconomic variables that influence the elasticity of employment rate, using Okun's law, having regard to its failure to represent the employment-output relation truthfully in the South African context. The intention is that this literature review sets the scene for possible future intervention assessment model development and extension.

This review begins with a detailed discussion of Okun's law (1970), and how differencing economic conditions contradict the (1:1) alleged correlation between the employment rate and growth rate. Thereafter, a synopsis of the key indicators used to incentivise employment growth. Thirdly, the chapter has a diminutive segmentation dedicated to discussing macro-factors and models that seek to determine the cause of employment growth fluctuations in developing countries like South Africa. This is followed by a brief review of 'ease of doing business' indicators, beyond that of a typical analysis. This review then closes with a summary of some international experiences of intervention assessment and practical guidelines from these experiences.

2.2 Theoretical Literature

2.2.1 Okun's Law

Okun's law is an empirical regularity introduced by Arthur Okun in the 1960s (Fofana, 2001 and Okun, 1962). The law is intended to observe the relationship between the unemployment rate and the economic growth rate, using the Okun's coefficient (Khemraj et al, 2006). The law has been supporting several consequent pieces of literature, through validating empirical findings, representing Keynesian macroeconomic conditions, producing aggregate supply curves in conjunction with the Phillips curve to determine the output-unemployment rate relationship (Kapsos, 2005). The law determines the required level of input needed to produce a certain level of output. For instance, the higher the labour input the higher the output growth rate in the long-term (Khemraj, Madrick, and Semmler, 2006). Okun's law is based on an estimation referred to as Okun's coefficient (Loots, 1998). Okun's coefficient is used to determine employment intensity by measuring the rate of change of real output (Ajilore and Yinusa, 2011). Variations in the unemployment rate are, thus, dependent on changes in real output. Similarly, Kapsos (2006) argued, employment intensity refers to the percentage change in the number of people employed in an economy positively correlated with the percentage change in economic output. The required percentage change to decrease the unemployment rate by a percentage point is a 3% improvement in the economic growth rate (Acemoglu, 2007). To decrease the unemployment rate, the real GDP growth must equal or grow more than the potential rate of output.[3]

According to Fuhrmann (2019), developing countries' coefficients tell us how much "gross domestic product (GDP) may be lost when the unemployment rate is below its natural rate". Africa has experienced fast economic growth over the last decade utilizing the export of commodities, however, the exportation of commodities has not rendered into significant job creation (Ancharaz, 2010). The reason for this phenomenon is that export-driven growth "without value-added activities" does not translate into large job opportunities.

The "strong long and short-run relationship" is based on two rationales: Firstly, if the population and the labour force is to increase, so must the growth of the employment rate, to ensure that the unemployment rate remains constant or decreases. Secondly, if the output per worker should increase over time, the amount of production in the economy will also increase and, therefore, citizens will potentially have a higher income and subsequent spending power (Acemoglu, 2007). The demands for workers in the production process will increase, leading to a higher rate of employment opportunities (Dumitrescu, Dedu and Enciu, 2009). However, provided that the potential growth rate of GDP is 2%, then according to (Okun, 1970) the

[3] "The potential rate of growth refers to the rate of growth of real GDP that could be sustained with the economy at full employment and steady inflation" (Ghazali et al., 2018, P. 87)

percentage change in GDP is inefficient to cause a real change in the unemployment rate. As such, the coefficient between growth rate and the unemployment rate is regarded as inelastic.

The model specification for estimating Okun's law is expressed as follows:

$$\Delta\mu_t = \alpha_0 + \alpha_1 \Delta InY_t + \nu_t \tag{2.1}$$

Whereby ΔU_t refer to movements in the unemployment rate, ΔY_t refer to movements in the real GDP, and v_t is an error term. Despite its importance in empirical regularity, Okun's law also attracted immense attention in previously conducted studies, with the relationship between withholding changes in factor-inputs being connected with the employment-output relationship. As such, the conundrum gave rise to various studies that adapted and modified Okun's law, where they included macroeconomic factors like the wage rate, inflation rate, interest rates, and/or a general decline in economic activity. These factors are referenced as independent variables that influence changes in the employment rate, along with the growth rate (Akanbi, 2015). In turn, the behavioural outcome of these factor-inputs performs differently across combined macroeconomic conditions. Each factor-input has a 1:3 effect on the rate of employment. Meaning, the employment-output growth relation is non-linear in the long-run and remains vastly inconsistent (Ajilore et al, 2011). Other macroeconomic conditions, like technological change, explain rifts in the employment-growth rate relationship (Acemoglu, 2007). The "employment elasticity to growth theory was first developed by Keynes" (Biyase & Bonga-Bonga, 2015). The theory "relates to the ratio between the percentage change in employment and the percentage change in economic growth" (World Bank, 2013; Fuhrmann, 2013). Hodge (2009), provided employment coefficient (E) formula:

$$E = \frac{\text{\%change in employment growth } (e)}{\text{\%change in economic growth } (g).} \tag{2.2}$$

E in the above model measures the sensitivity or elasticity of employment to growth. In Bisseker (2018), the argument made was backed up by analysing structural changes during both the upswing and downswing phase. The focus was to make sense of how industries failed or successfully moved from primary to tertiary markets in the short and long-term in South Africa. Differing economic situations explain why the relationship "between employment and output growth rate is asymmetrical" argued Andersen and Corley (2003). Therefore, the employment intensity of growth cannot be explained solely by Okun's law, as the unemployment-output relation is asymmetrical. The elasticity reacts differently to unique market conditions, specifically within developed and developing countries (Flaig and Rottman, 2000). Despite previous investigations, Okun's law has been considered as a beneficial tool for predicting market trends and developing economic policies.

2.2.2 The production function theory

The production function measures the maximum amount of output that is obtainable from a certain number of inputs used in production (Fofana, 2001). According to Ghazali and Mouelhi (2018), the function investigates how certain factor-inputs dictate the production output in each model while explaining the relationship between the employment (input) and production (output) model. Miller (2008) argued that the function, aligned with the technology of production, describes the axioms that govern how much of each commodity will be produced under a single firm, and how much of the same or fewer raw materials or labourers need to be employed to produce the same or more outputs. The relationship between output and inputs is expressed in the following form below:

$$Q = f(L, K) \tag{2.3}$$

In this formula, Q represents the quantity of output produced, and L and K represent the quantities of labour (human resources) and capital (non-human resources) used in the production output process. As mentioned by Karim and Aomar (2016), the production function shows the costs of inputs used and revenues obtained from the production of these outputs. It was indicated that a change in input produces a direct change in output. The Solow Growth Model (1956), set in the neoclassical framework, contributed significantly to the theory of long-run economic growth. The model explains long-run economic growth by looking at "capital accumulation, labour or population growth", and technological progress (Mourre, 2004). Over time, previous studies have combined the Solow Growth Model with the constant elasticity of substitution (CES). The led to the development of a new aggregate production function, recognised as the CES Production Function, Sasaki (2017). Christiaans (2011) referred to the "CES Production Function as the Constant elasticity of substitution", with properties of both production and utility function. The CES production function combines two or more types of consumer goods or production inputs into an aggregate quantity. And the theory of CES production states that a growth rate will be positive in the long run, even when the population growth is negative (Christiaans, 2011). Regardless of the level of employment, developing economies will still experience their maximum output, because of technological change. This phenomenon is referred to as ‘jobless growth’ (Bisseker, 2018).

The engine of long-run growth is driven by technological progress (Kwame, 2013). In explanation, each industry will contribute differently to the economy based on the technology it uses. Fluctuations in economic activity spawn technological changes, and the generation of increasing production further generates more new technology, which, in short, determines how much production output each industry can produce over time, as argued by Lawal, Nwanji, Asaleye, and Ahmed, (2016). The application of the CES production function, thus, analyses the channels of economic growth, considering employment in as much as “multiple structural mechanisms for job creation and destruction” (Lawal et al., 2016). Hence, the form of the production function is determined by the state of technology within different industries, whose size depends on the division of time. This means that a short-run production function is different from a production function derived from a longer period.

2.2.3 Technological Development

Technological development in economics refers to an increase in the efficiency of a product or process in an industry that increases output, with limited increases in input (Elias, 2018). Technological change leads to economic growth by helping industries improve production output with the same amount of input applied. An industry is a group of businesses that are related in terms of their main activity (Acemoglu, 2007). Notably, the manufacturing, health, entertainment, and telecommunication industries are the fastest-growing industries in the world according to Career Planet (2019). Across the world, the telecommunication sector is regarded as one of the largest growing industries, averaging an annual growth rate of 3% within the global economy by connecting many companies through communication inputs, sharing information and data, between industries, across the world (Beers, 2019). According to the vice-chairman and US telecommunications, media and entertainment leader from Deloitte, Kevin Westcott (2020): the telecommunication sector is expected to record a year-over-year growth rate of 89% from 2020 onwards. In 2020 the telecommunication sector will experience a worldwide rise in 5G network technology. This will cause the telecommunication sector revenue to increase by about $4.2 billion in 2020. By understanding the telecommunication sector as one of the largest growing industries to date, one acknowledges its place in stimulating global economic growth (Westcott, 2020). These technological improvements in the telecommunication sector led to improvements in other industries. For example, the business sector will acquire more proficient software tools that can then replace the need for human working capital through e-commerce.

These initiatives encourage industries to grow and empower young employers to create working opportunities that will further grow the economy. Similarly, information technology and communication advancements in the financial, retail and trade sector will reduce the cost of production, improve communication, enhance productivity, and provide quicker, more efficient business transactions due to newer, more sophisticated, e-commerce software and equipment (Wagner, 2019). A study by Bisseker (2018), showed that technological change slows down the economy in the short-term but speeds up the economy in the long-term. Advances in technology, specifically in the agricultural industry, could produce farm-friendly networks. [4]Technological development spawns the creation of infant industries, in addition to new employment opportunities in the long-run, but at the cost of losing many other small/intermediate jobs during that short-run structural change (Bhorat and Oosthuizen, 2008). Overall, technological development prompts communication channel enhancements, faster and more efficient production output, increased marketing channels, and, thus, creates new job opportunities in South Africa (Otekhilei and Zeleny, 2016).

[4] For instance, Davies (2019) pointed to the 5G rollout in that it will enable highly accurate GPS and weather forecasting, thus assisting farmers with harvesting; and sensors that measure soil moisture, temperature, and nutrients for more intelligent farming. Besides, autonomous tractors and drones operated via artificial intelligence, use less energy, recognise crops, calculate the amount of spray of pesticides or fertilisers for cultivation independently, and determine the requisite speed of operations while accounting for weather conditions and other elements (Davies, 2019). This technology has the effect of making the overall farming experience more self-sustainable and efficient while ensuring the natural resources are used more sparingly than before.

2.2.4 The value of 'ease of doing business'

Unemployment refers to people who are actively looking for work but cannot find work. The situation occurs when the supply of labour exceeds the demand for labourers i.e., "when the price of labour is too high for firms to afford" (Akanbi, 2015). Meyer (2017), and Mourre (2004), provide similar ideas behind why unemployment rises. They argued that high production costs are the most ascertainable reason for this phenomenon. When the cost of production is too high, it hampers the 'ease of doing businesses for firms. The following business constraint is referred to as the cost of labour and this conundrum affects the firm's ability to affordably hire more workers. However, removing the excess cost of labour would increase the 'ease of doing business' and encourage more employment opportunities, which, in return, lead to a lower unemployment rate (Bhorat and Oosthuizen, 2008). Government subsidies and the removal of unnecessary rules and regulations (red tape) will allow firms to retain more funds, which can then be invested elsewhere.

Many assistive avenues can be implemented to improve employment levels in the country. According to Boting and Standish (2019), an important recommendation is to help businesses to grow incomes and jobs through the 'ease of doing business principle. In economic terms, the 'ease of doing businesses refers to the removal of unnecessary rules and regulations set by government provincial officials. Theoretically, it is argued that reducing the production cost will improve the standards of living of ordinary people by reducing poverty and growing material well-being via job creation (Boting et al, 2019).

From an economic perspective, 'ease of doing business' in productivity costs will decrease the unemployment rate, while at the same time increase employment opportunities and promote long-term growth (Chappelow, 2019). With the government encouraging the development of informal and formal industrial growth, the cost of doing business has become a major hurdle for start-ups to overcome. Government recognize that employment growth is driven mainly by expansions in the working industries optimized by job creation. Today there is a growing realization that many regulations are either unnecessary or too onerous. The result has been a drive to ease the cost of doing business by relaxing restrictions on instruments in which employment rates are responsive.

The European Commission (2017) typically classified two types of 'ease of doing business' benefits as direct and indirect regulatory benefits.

The direct regulatory benefits.

- Improved well-being of people, Efficiency improvements (especially cost-saving), free access to important information, and output enhancements, service assortment, and quality.

The Indirect regulatory benefits.

- Macroeconomic benefits, '(such as GDP increases, enhanced productivity, improved employment rates, and improved job quality) and other 'non-monetizable benefits' (such as the protection of fundamental rights, and social cohesion)

The EU Commission (2017) argued that, unlike Okun's law, a one-to-one relationship between output and employment is onerous and does not make provision for 'ease of doing business' factors. For example, the leveraging of competitive advantages is part of fundamental governmental support for economic growth strategies. Such comparative advantages are promoted through export-oriented policy rather than import substitution which, according to the EU Commission (2017), is a proven avenue to economic success. Based on the guidelines governed by the International "Organisation for Economic Co-operation and Development" (OECD), developing countries growth strategies cannot be compared to developed country measures. An unfair depiction of each nation has designed models, uniquely developed to capsulise inputs specifically for economic growth and employment growth success within that country.

2.3 Review of past empirical studies

2.3.1: South African studies

Kumo (2012), measured the relationship between infrastructure investment and Economic growth in South Africa using the Granger Causality tests. The study was conducted between the period of 1960 to 2009. The methodology used in the study was a bivariate vector autoregressive (VAR) model that included structural changes in the economy. The Granger Causality test was further assessed "using the autoregressive distributed lag (ARDL) or bound test approach for cointegration". Findings from the ARDL result, showed a strong causality between economic infrastructure investment and GDP growth rate and vice versa. The results implied that infrastructure investment drives the long-run economic growth in South Africa. Naturally, the improved economic growth in return generates further economic infrastructure investment in the country. Furthermore, a stronger causality was found between economic infrastructure investment and employment in the public sector. This means that economic infrastructure investment reflects job creation in the public sector, specifically showing that jobs in maintenance, construction, and operational activities increase as more investment is provided by the government. In turn, the creation of jobs contributes to further infrastructure, indirectly, in the form of higher aggregate demand and economic growth. Economic growth is seen as one of many factors that drives job creation, but not in the private sector. The growth in private sector employment, conversely, remains one of the main drivers of economic growth, which in the long run does not always translate into job creation, thus reflecting the scenario of ‘jobless growth’ in the economy.

Leshoro (2013) studied the “relationship between economic growth and the level of employment” in South Africa, using quarterly data from 2000Q1 to 2012Q3. The methodology implemented in the investigation used econometric approaches like ‘Toda-Yamamoto (T-Y) causality test, rather than the conventional Granger (1969) causality test,’ which measures the direction of causation between employment and economic growth. The findings exhibited that an increase in real GDP will lead to an increase in employment in South Africa. Causality was, found significantly from GDP to employment. Leshoro (2013) concluded that economic growth leads to employment and the results obtained agree with the “Keynes General Theory of full employment”. Improvement in employment does not guarantee economic growth will improve, emphasizing that there is only a one-way causality between employment to real GDP Leshoro (2013). This supports the criticism of economic growth without employment in South Africa, also referred to as ‘jobless growth’. The hypothesis test thus, justifies Kumo (2012) findings that “the increase in economic growth is not because of increased employment.” Further results showed that causality from GDP to employment was significant. This supports Keynes’ theory on the effects of investment on aggregate demand and employment, in which investments into the South African economy leads to economic growth within the country

Meyer (2017) studied the long-run and short-run effects of economic growth on employment in South Africa. The findings showed that more than 27 per cent of unemployment in South Africa is associated with stagnated economic growth, “high levels of inflation, and high-interest rates”. The objective of the study was to analyse the status quo of the employment and gross domestic product growth relationship in South Africa. The study used “econometric time-series methods” to test the long and short-run relationship of employment and output, using quarterly data from 2002 to 2016. The methodology included a unit root test that measured the stationarity between the variable mixture. An ARDL bound test to measure the cointegration between the variables in question. The variables used for the employment and real GDP analysis were the “inflation rate and the repo rate”. The study concluded that, in the long-run, relationships among these variables are cointegrated, with the South African employment coefficient being 0.96. The study found ‘that the economic growth and repo rate cause changes in employment.’

The Mkhize (2019) study used time-series quarterly data from the 2000 to 2012. The author investigated the change in the “sectoral employment intensity of output growth, amongst eight established industries” in the South African economy. He concluded that employment intensity is determined by the short-run sectoral output growth, but total employment in both the informal and formal sectors, and GDP, are not co-integrated in the long run. The relationship, thus, remained unmoved in the long run. The methodology used in the study was the ARDL bound test to test the cointegration for all the variables in the short and long-run relationship with a different order of integration, which was confirmed through an Error Correction Model. The findings have proven that when industries reach their peaks, businesses in certain sectors of the economy will no longer be able to provide new employment or sustain a given level of employment, caused by an increase in the productivity growth rate. To stimulates further productivity growth rates, industries will have to accommodate new technological advances, driven by structural changes, which usually replaces low skilled workers. Therefore, the South African industries have changed over time with the implementation of new technology. However, the high levels of unemployment and poverty remained relatively the same while the economy expanded, leading to the economic phenomenon of jobless growth rates.

2.3.2: International studies

Moosa (2008), studied the relationship between economic growth and the unemployment rate in developing Arab countries (Tunisia, Morocco, Egypt, and Algeria) between the periods of 1980 and 2006. The study concluded, with statistical evidence, that the Arab countries’ unemployment and output growth were not correlated in a cyclical recovery, and it did not lead to a reduction of unemployment. The study used the gap, and the growth rate models, which were also used to estimate Okun's coefficient. The results showed that the unemployment-output relationship is unrelated in the four Arab countries. Sadiku, Ibraimi and Sadiku (2015) conducted a study analysing the 'relationship between GDP growth rate and the unemployment rate in Macedonia while applying Okun's Law'. The study consisted of quarterly data covering the period 2000-2012. For analysis of Okun's coefficient, four models were used in the investigation: the difference model, the dynamic model, ECM, and VAR estimation. Based on the empirical results, all four models did not indicate a robust "inverse relationship between the unemployment rate and economic growth". Moreover, the VAR methodology and Engel-Granger cointegration test, showed no causality between the unemployment-economic growth relationship, concluding that a change in the growth rate did not have a significant impact in the rate of unemployment and vice-versa.

The "employment intensity of sectoral output growth in Botswana" was researched by Ajilore and Yinusa (2011). Ajilore et al. (2011), identified key industries that are employment-intensive in Botswana's economy from the year 1990 to 2008. The findings were confirmed using both simple elasticities (an arithmetic method) and econometric procedures (the double-log linear specification, the Engle-Granger two-step approach, the "Augmented Dickey-Fuller test, and the Philips-Perron test" were all adopted. Findings confirmed Botswana's economic growth was driven, not only by employment or labour demand growth, but also by productivity improvements, accompanied by important structural changes, and applications of technology, specifically in the mining, agricultural and other labour-absorptive sectors of the economy. This, thus, suggested that growth performance in the long run does not always guarantee employment opportunities in the country, further confirming the existence of 'jobless growth.' Moreover, Otekhilei and Zeleny (2016) studied the relationship between self-service technologies in both advanced and developing economies (37 OECD member countries) and how they negatively impacted the lives of employers, in the long-term, throughout 1994 until 2014. Analysing how the adoption and usage of innovative technologies have continued to change the way of transacting between businesses and clients, have resulted in low skilled workers being jobless in the primary sector. These findings were supported by the Keynesian unemployment theory, developed by John Maynard Keynes (Keynes,1936). The theory states that an increase in aggregate demand, derived by high spending power, would lead to employers being encouraged to produce more goods and services to satisfy the subsequent high demand. Through the law, Otekhilei et. al (2016) verified that the unemployment rate is dependent on changes in output growth levels, which supports the Ajilore and Yinusa (2011) conclusion that the relationship between unemployment and growth levels does not remain constant over time, due to technological changes that lead to structural changes in key industries in the economy, then intervened upon by Government.

Agenor and Aynaoui (2016) analysed the policy derived from Okun's law and how these derived policies impacted the African countries studied. The study examined the important policy lessons encountered from using Okun’s law to measure economic growth and the development for all these African countries from the period between 1991 and 2015. The main objective was to measure unemployment against economic growth in some African countries and the variability of Okun's coefficient origin within these African countries. Okun's coefficient was then used to measure the intensity of growth and to verify if the output-employment relation is valid. The results confirmed that in some less developed African countries, the output-employment relation is weakly linked, therefore Okun’s law is invalid, (for example, in Botswana and Namibia) and the output-employment is strongly linked in more developed African countries, rendering Okuns law valid (with the examples here being Egypt and Tunisia.) The developed African countries have different economic structures and labour market configurations that work with the empirical regularity of Okun’s Law. Okun’s coefficient origin in African countries is based on their structural and environmental changes. The literature also confirmed that the impact of political stability, structural development, demographic factors, and domestic and foreign market competition, and the rule of law, are related to each other and these determinants influence the employment-output relationship in the short and long run.

Ssebulime and Muvawala (2019) conducted a study that estimated the Cost of Unemployment to Uganda’s Growth and Growth Trajectory using Okun’s Law. The investigation was based on time series data for the period 1980-2016. The study used an ‘auto-regressive distributed lag modelling approach,’ where the model proved that Uganda has lost approximately 6.7 trillion Ugandan Shillings, because of the current unemployment rate. Findings showed the unemployment rate has a real cost to Uganda’s economic growth rate, thus, confirming Okun’s law.

Pleic and Barry (2009), conducted a study on the “employment elasticities in Thailand, Brazil, Chile, and Argentina”. The annual growth rates data analysed for Chile was from 1980 to 2005, Argentina was 1989 to 2005, Thailand from 1981 to 2005, and Brazil from 1970 to 2005. The results by Pleic et al (2009) suggested that Chile's growth rate and employment elasticities were driven by the reduction of wage rate over the years, and two recessions, which tightened up the labour market through a forced structural change. The relationship between employment and output growth in Argentina was eventful (employment elasticity was altered by output change). Under the relaxation in the labour market regulations, employment levels have risen immensely in Argentina. Thailand, however, experienced fast economic growth rates and low unemployment rates for more than 20 years. Employment grew fast only because working-age population was also rising fast. Finally, Brazilian employment was high enough to signal a good quality of growth, that brought dramatic wage increases, rapid increases in the female participation rate, and a significant tightening up of the labour market. Over time, employment growth slowed down because of rising labour force participation, especially amongst women.

Mkhize (2019) is the most recent local study supporting the investigation of employment intensity in the various sectors using time-series methods of analysis. The study provided key insights concerning the relationship between "sectoral gross value-added and sectoral employment rate", investigating the change in "sectoral employment intensity of growth amongst eight industries in South Africa". However, the model used historical data from 2002 to 2016 which is insufficient to accurately represent the long-run relationship between employment and GVA. There is a four-year research gap in the employment growth intensity study conducted by Mkhize (2019), and many economic developments have transpired in South Africa since then. Hence, there is a need for a renewal of the study, employment growth intensity in South Africa. This research paper will, therefore, expand on the previous employment growth intensity studies. And attempt to update the study for the period between 1995 to 2019 while taking into consideration the transitional phase in which the South African government moved away from the apartheid regime, into the early stages of the democratic government, and most recently political instabilities and structural challenges. This will be done in addition to monitoring how changes in government policies have stimulated economic growth and employment, as well as simultaneously focusing on the effects of sector specific GVA on employment levels in three main sectors of industrial activities (primary, secondary, and tertiary). Additionally, this study will use different endogenous variables like the nominal wage rate and inflation rate (CPI) to represent further effects on the employment rate in the three sectors of activity, thereby providing more insight to a holistic overview of the employment levels in South Africa.

2.4 Conclusion

The literature review exposed the functionality of only using the production function and Okun's law as empirical measures. More specifically, discussing how implementing similar measures applied by other developed or developing countries cannot be directly applied to the employment and output growth relationship in South Africa. This is the case because, in certain periods of economic activity, developing countries (like South Africa) and, seldomly developed countries, both experience jobless growth. This furthers the notion that economic growth does not mean employment growth, thus indicating a contradiction in Okun's law: where the employment and output growth relationship corresponds to the same proportional growth. The empirical reviews confirmed that other macroeconomic variables influence employment growth. South African solutions for job creation are public works programmes, development on labour absorbing sectors, including entrepreneurship development with small businesses, "infrastructure investment, improved policies to motivate businesses to create more jobs by relaxing labour regulations" through 'ease of doing business,' the promotion of a partnership between small businesses and technology, and, finally, strengthening the education system. There is, thus, a research gap yet to be filled in the South African context. The findings hereon contextualise the importance this study has towards better utilising South Africa's employment growth intensity.

CHAPTER THREE: METHODS AND DATA

3.1 Introduction

Chapter three presents a framework of the research methodology and data employed in this research paper. The format of the paper is as follows: 3.2 explains the methodological framework and model specification employed to investigate the research question. 3.4 analytical and econometric framework of the study. Then, 3.4 represents the secondary data and data sources used in the study. Thereafter, 3.5 concludes this chapter.

3.2 Methods and model specification

To empirically model employment and growth rate, there first needs to be a functional relationship between the two variables. Like the work of Kapsos (2006), two methodologies (arithmetic and a modified point elasticity equation) are utilized for calculating employment elasticity. Here, an arithmetic model will be used to derive Okun's coefficient and measure the elasticity of employment. The arithmetic model divides the % change in labour to a percentage change in output growth for a specific period, as given below:

$$\varepsilon = \frac{\left[\frac{EMP_t - EMP_{t-1}}{EMP_t}\right]}{\left[\frac{GVA_t - GVA_{t-1}}{GVA_t}\right]} \qquad (3.1)$$

The ε represents the elasticity of employment rate between the period t and t-1, whereas the EMP and GVA represent the percentage change in employment and Gross Value Added, respectively. The above equation (3.1) represents the "arc-elasticity of employment computed between two different points in time", namely 0 and 1 (Herwartz & Walle, 2014). The results thereof will reveal whether elasticity is useful in determining if GVA for the primary, secondary, and tertiary sector affects each sectoral level of employment. However, merely using the arithmetic approach might not be sufficient. South Africa is a developing country with labour-intensive industries contributing more 'added-value compared to capital-intensive industries (Muqtada, 2003). Therefore, calculating the employment elasticities calculated for each year using this method leads to instability in the model (Islam, 2004). As a result, the simple arithmetic model was inappropriate for comparative purposes. Therefore, necessitating a second methodology: a point-elasticity equation that represents the double log-log regression model for the employment and GVA over a specific period. The double log multivariant equation is shown below:

$$LOGEMP = \beta_0 - \beta_1 LOGA_t + \beta_2 LOGB_t + \beta_3 LOGC_t + \varepsilon_t \quad (3.2)$$

In equation 3.2 the elasticity of employment concerning GDP in the country is given as $\beta_1+\beta_2$. The (*LOG*) symbol represents the "natural logarithm of the variable, and the regression coefficient refers to the employment elasticity concerning GDP or GVA" (a proxy for output.) (Pleic & Berry, 2019). The (*LOG*) symbol indicates deviations in the employment rate overtime, when the GVA is altered. Symbols A_t represent GVA of specific industry, B_t C_t represents explanatory variables, along with GVA that alter sector-specific employment numbers. These explanatory variables can be inflation rate, and interest rates, respectfully.

This is calculated by distinguishing equal sides of equation 3.2 to explain for ∂E / ∂E

$$\left(\frac{\partial E}{E}\right) = (\beta_1 + \beta_2)\left(\frac{\partial Y}{y}\right) \rightarrow \frac{\partial E}{E}\left(\frac{Y}{E}\right) = \beta_1 + \beta_2 \quad (3.3)$$

Moreover, Islam and Nazara (2006) showed that double log-log estimation offers another advantage. The second method requires regulating the "beta coefficients" with the independent variables (z) that could alter the dependent employment variable, such as GVA, nominal wage rate, inflation and interest rate as it is given by the common form in equation (3.2):

$$LOGEMP_i = f(LOGGVA_i, Z) \quad (3.4)$$

These variables may take the form of different degrees of industrialisation in the three sectors in the country and includes technological or other relevant policy change variables. Possibly, one could consider employment elasticity at the sectoral level (like primary, secondary, and tertiary industries), meaning employment in sector i, implied in the above equation (3.4), is affected by sectoral GVA_i and other related variables. The Z variable are acknowledged as integral variables that causes changes in employment in each sector, along with total GVA (Y). Deviations in employment is, thus, caused by changes in both Y_i and Y .

To counter the alteration, regression analysis approximates the functional correlation between employment and output for each sector. This is appropriate for time series analyses, especially when data on the employment rate and GVA are available (Ajilore et al, 2011). The regression analysis avoids the problem of finding normal base years and checks the robust nature of the employment elasticities between different industries over time. Therefore, the functional relationship is represented through a mathematical model, like the double-log log regression model that captures the employment elasticities in regression with the nominal wage rate, inflation, and the interest rate. Thus, the model will be specifically represented as follows:

$$LOGEMP = \beta_0 - \beta_1 LOGGVA_t + \beta_2 LOGWAGE_t + \beta_3 LOGCPI_t + \varepsilon_t \quad (3.5)$$

where:

EMP = Employment numbers in the primary, secondary, and tertiary sector
GVA_t = Gross Value Added in the primary, secondary, and tertiary sector (constant 2010 prices)
$Wage_t$ = Nominal wages, measured in Rands.
CPI = Consumer price index (measures inflation rate).
TIME (T_t) = Quarterly period variable from t = 1995 and t = 2019; ε_{it} = error term.

The main variables involved in the study are changes in the dependent employment rate (EMP) and the percentage change in the gross value added (GVA_{it}), which is the independent variable. The study will split the employment intensity among three industries, like the primary sector, the secondary sector, and, finally, the tertiary sector in South Africa. As observed in Table 3.1, the average data analysed is a combination of various economic sectors within the respective South African industries. All three industries selected will specify the elasticity of employment concerning value added in the given economic sector. The following measure will help determine whether specific sector-employment numbers increase in response to positive changes in GVA_{it} in the long-run equilibrium (employment-intensive) or remain unchanged, leading to jobless growth. Table 3.1 provides a brief description of the economically active industries functioning under every three main sectors.

Table 3. 1 Different economic sectors in the primary, secondary, and tertiary sector

Primary Sector	Secondary Sector	Tertiary Sector
Agriculture, forestry, and fishing	Manufacturing,	Whole and retail trade, catering, and accommodation
Mining and quarrying	Electricity, Gas & Water	Transport, storage, and communication
	Construction	Finance, insurance, real estate and business service, business services
		General government
		Community, social and personal services

Source: Author's compilation

Table 3. 2 Expected coefficient signs for the model specification:

Variables	Effect on Employment	Description
GVA_{it}	Positive (+)	The increase in the value-added from each sector would increase the country's total real GDP growth rate, which would increase the demand for labour by employers in various industries.
$Wage_{it}$	Negative (-)	An increase in nominal wage will increase the cost of production. Employers will hire fewer workers for labour.
CPI_{i}	Positive (+)	A long-run increase in the inflation rate would lead to a higher marginal revenue product of labour, causing demand for labour to increase.

Source: Author's compilation

3.2.1 Employment Growth Versus Productivity Growth

The elasticity produced from the equation (3.5) provides the intensity of employment results in response to the quantity of the GVA. If the value of elasticity is donated as 1, then every "1 percentage point of Gross Value Added is associated with a 1 percentage point increase in employment" (Kapsos, 2006). When analysing the elasticity of employment and productivity, it is evident that both an increase within the employment rate and productivity will improve economic growth, as argued by Islam (2004) and Kapsos (2006).

Table 3. 3 Different categories of employment elasticity[5]

GVA growth			
Term	**Category**	**Positive GVA growth (coefficient)**	**Negative GVA growth (coefficient)**
Employment Inelastic	$0<\varepsilon<1$	(+) employment growth	(-) employment growth
		(+) productivity growth	(-) productivity growth
Employment Elastic	$\varepsilon>1$	(+) employment growth	(-) employment growth
		(-) productivity growth	(+) productivity growth

Source: Author's compilation

Table 2.1 above gives the different categories of employment elasticity that need to be taken into consideration when formulating interpretations of the employment-growth intensity for each sector. Table 2.1 monitors sectors (primary, secondary, and tertiary) with GVA growth coefficients ranging between $0<\varepsilon<1$. A positive GVA growth increases both employment and productivity. However, the scenario is not ideal because it leads to employment inelasticity (jobless growth). This means that changes in GVA are not significant enough to explain employment numbers. If the elasticity moves beyond the $\varepsilon>1$ range then growth is 'employment intensive' and productivity declines, a scenario that is ideal because it leads to employment elasticity. Changes in GVA are, therefore, significant to explain employment numbers.

Table 2.1 also points out that in economies or industries with "negative" GVA growth, with a coefficient ranging between $0<\varepsilon<1$ implies that both employment and productivity will decrease. This is not ideal because it indicates employment inelasticity (jobless growth). Moreover, elasticities that move outside the $\varepsilon>1$ range, leads to job losses (a downswing in employment-intensive growth numbers) but improved productivity level, a scenario that also

[5] Table 3.3 relates to interpretations made when GVA output correlates with employment in either primary, secondary, and tertiary sector value added.

not ideal because it leads to an increase in the unemployment rate. Changes in GVA based on improved productivity, therefore, lead to technological advancements. Depending on the country's policy investment schemes in each sector, 'a country may be able to achieve a balanced contribution of both these elements towards output growth' (Mkhize, 2019). Thus, the relationship between employment growth and economic growth needs to be cautiously interpreted.

3.3 Analytical and Econometric Framework

The autoregression distributive lag modelling technique is used in the investigation. The ARDL model is an appropriate measure for long-run relationships. Thus, the ARDL model is applied to measure the relationship between GVA of each sector with unemployment rate of each sector in South Africa. According to Iheanacho (2017), the model provides numerous advantages to the study. These benefits include:

- The ARDL cointegration approach requires only a small sample size for analysis.
- The ARDL cointegration approach provides two critical values, the upper bound and lower value bound.
- The ARDL cointegration approach consist mixtures of different orders of integration.
- The ARDL cointegration approach provides estimates with statistics that are unbiased in the long run.
- The ARDL cointegration approach essentially helps assess the "short-run and long-run causality effect" among each variable on one another (Hye and Boubaker, 2011).

The double log-linear equation (3.5) is transformed into the ARDL model to approximate the short-run dynamic and long-run relationship, which is equated as:

$$\Delta InEMP_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta InW_{t-1} + \sum_{i=1}^{n} \alpha_{2i} \Delta Inr_{t-1} + \sum_{i=1}^{n} \alpha_{3i} \Delta In\pi_{t-1} + \sum_{i=1}^{n} \alpha_4 \Delta InGVA_{t-1} + \sum_{i=1}^{n} \alpha_5 \Delta InPG_{t-1} + \sum_{i=1}^{n} \alpha_6 \Delta InD_{t-1} + \beta_1 InW_{t-1} + \beta_2 Inr_{t-1} + \beta_3 In\pi_{t-1} + \beta_4 InGVA_{t-1} + \beta_5 InPG_{t-1} + \beta_6 InD_{t-1} + \varepsilon_t \quad (3.6)$$

From the above equation (3.6), the long-run relationship is symbolized by 'Δ' which represents the first-difference order of integration between the coefficient ($\alpha_1 - \alpha_5$). The coefficients of the short-run dynamics of the model are represented by the coefficient (β_1-β_5). The α_o is the stochastic component, which is the rate at which the average changes, (measured random fluctuations) in the series over time. ε_t is the error term and is an independent and identically distributed white noise process with a Normal Distribution of mean 0 and variance. However, before the estimation of the ARDL model, there are various steps to be conducted, discussed below.

3.3.1 Unit root test

Before performing the cointegration test in the time series analysis, the variables must be tested for stationarity. In this regard, a statistical test is conducted to verify whether a given time series is stationary and to avoid a spurious regression. There are several tests for stationarity that can be used to test the existence of unit-roots.[6] The ADF, PP and the KPSS test is widely used to perform the time series analysis (Prabhakaran, 2019), Therefore, the Augmented Dickey-Fuller and the Philips-Perron unit root tests are both applied. The approach tests the null hypothesis that "the series contains a unit root (stochastic trend/stationary) ($\Delta = 0$) against the alternative that the series contains no unit root" (non-stochastic trend/non-stationary) ($\Delta < 0$). According to Prabhakaran (2019), a unit root is a characteristic of a time series and is non-stationary. In Mkhize (2019), the preliminary step is to model the procedures appropriately to avoid a spurious regression which occurs when all variables are "integrated of order I(0), I(1) or I(2)". The variables integrated of order two cannot interpret the values of F statistics, therefore the outcome leads to spurious results, a result that needs to be avoided, according to Pesaran et al. (2001). As more regressors are added to the model, the chances of the series becoming stationary are rigorous. If the following levels of significance "1%, 5% and 10%" are less than the t-statistic then, the null hypothesis is rejected.

3.3.2 The bound cointegration test

The ARDL bound test occurs when the combination in which the variables of both orders, I(0) and I(1), is presented in the unit test. An I(0) order of integration will allow the researcher to

[6] Other popular unit root tests for time series analysis include the Philips-peron, Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests, the ADF-GLS test (or DF-GLS test), and Zivot–Andrews test.

conduct a simple ordinary least square estimation (3.4) for each South African sector, but a mixture of I(1) and I(0) will force the researcher to conduct an cointegration test via a ARDL model to estimate the reality of a long-run relationship (Fofana, 2001). The ARDL bound test would be the most appropriate test to represent the long and short-run relationship between the variables. According to Herwartz (2014), the ARDL bounds test is based on the joint F-statistic whose 'asymptotic distribution' is associated with two critical values, the lower bound (variables are integrated of order zero, no cointegration) and the upper bound (variables are integrated of order one, cointegration exists). The first step in the ARDL bound approach is to derive the hypotheses which are the null H_0 and states that all variables are integrated of order 0 (stationary), thus, arguing that the mean, variance, and covariance does not change in the short run and variables out change remain constant. A deviation will only occur when the variables are stationary in levels but if variables are stationary in first, second difference or any other difference and not in 'levels,' then the result would mean that stationarity exists between the mean, variance and covariance whilst showing a deviation.

To correct the deviation of the variable who are not in stationarity in levels over a specific period. The Error correction term needs to be estimated through the Error correction model, for the model to tell the individual how fast or how slow these variables adjust to the long-run value, in consideration of short-run dynamics. The alternative $H_{1:}$ states that all variables are integrated of order 1 (non-stationary). Step two is computing the F-statistic and lagged levels, to determine the appropriate lag length. Using the F-test, step three is determining the critical F-statistics, which will be compared to the computed F-statistics in step four. A decision will then be made based on the level of cointegration. For instance, the null hypothesis is rejected when the computed F-statistic is greater than the "upper critical bound" or 'not rejected' if the computed F-statistic falls below the "lower critical bound" (also known as the Dickey-Fuller test statistic.) Based on results within the cointegration test, if there is a long-run relationship then the alternative hypothesis would be selected. The null hypothesis of stationarity and the alternative hypothesis of non-stationarity are presented below as:

Null Hypothesis	**Alternative Hypothesis**
$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_5 = 0$	$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$

Therefore, the ARDL bound test authenticates the information through the Error Correctional Model, and that is why the bound test has two hypothesis tests.

3.2.3 Error Correctional Model (ECM) on ARDL form

Once the presence of cointegration has been confirmed by the ARDL bound test, the Error Correction Model (ECM) can then be used to determine the speed of the adjustment. For instance, how fast or slow the cointegrated variables adjust to the long-run value while considering short-run dynamics (Moosa, 2008; Porter, 2010). The ECM model is derived from the ARDL model, whereby the ECM includes "both the short run and the long-run" measures and measures deviations when all variables are in order of I(1) and I(0) combined. The error correction model (ECM) is specified as follows:

$$\Delta InEMP_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta In\mathrm{W}_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta Inr_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta In\pi_{t-1} + \sum_{i=1}^{n} \beta_4 \Delta InGVA_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta InPG_{t-1} + \sum_{i=1}^{n} \beta_6 \Delta InD_{t-1} + \gamma ECM_{t-1} + \varepsilon_t \quad (3.7)$$

The ECM_{t-1} represents the Error Correction Term, a residual value derived from the ARDL bound cointegration approach. (γ_1) is the error coefficient, also referred to as the long-run coefficient, and a parameter that indicates the adjustment speed that is required to "restore the long-run equilibrium relationship and/or the rate at which the cointegration model corrects the previous disequilibrium between different periods". According to Sheefeni (2017), the long-run coefficient should carry a 'negative sign and statistically significant.' Moving forward, the ε_t is the identically distributed white noise error term and parameters from (β_1-β_5), known as short-run coefficients. When the ECM_{t-1} coefficient is statistically significant and negative then theoretically, any short-run movements between employment (dependant variable) and GDP, wage, interest rates, and inflation (explanatory variables) will converge back to the natural long-run equilibrium.

3.3.4 Stability and Diagnostic test

The diagnostic and the stability tests are essential for determining the 'goodness of fit' of the cointegration model. The tests evaluate how good a sample data distribution fits with a population with a normal distribution. In other words, this diagnostic test shows if the sample data represents the data that is expected to be found in the actual population or if it is, perhaps, skewed. The stability test seeks to assess the validity of a model (Beck, Demirgüç-Kunt, and Levine, 2000). Furthermore, the diagnostic tests inspect the cointegrated model for 'serial autocorrelation, functional form, non-normality and heteroscedasticity.' Beck et al. (2000) suggested that by employing both the "cumulative sum of recursive residuals (CUSUM)" and the “cumulative sum of recursive residuals squares (CUSUMSQ),” the stability test is conducted. The CUSUM and CUSUMSQ statistics are “updated recursively and plotted against the breakpoints,” as mentioned by Muqtada, (2003). Therefore, the CUSUM statistic and the CUSUMSQ statistic is plotted within the critical statistic where the level of significance would be ‘1%, 5% and/or 10%’ respectively. This implies that in the given regression the null hypothesis for all coefficients is stable and not rejected.

3.4 Data

The association between the unemployment rate and economic growth in the South African context requires secondary time series data collected from the 1995Q1 to 2019Q4. The time-series data is based on variables like nominal wage rate (Rands), inflation rate measured using Consumer Price Index (CPI), gross domestic product per sector, long-term interest rate, and economic crisis (recession). The data for these variables will be obtained from the Economics Trader, South African Statistics, South African Reserve Bank and Quantec. The inflation rate, interest rates, unemployment rate, and the nominal wage rate each consist of negative values, and therefore will be converted into natural logarithms representing the same unit of measure (in percentages). This is a convenient means to reduce outliers and transform each variable into an asymmetrical (normalized) dataset for easy interpretation. While the output growth rate (GVA per sector) and population growth rate will be unchanged because the variables are already measured in percentage rates, the choice of the period stated is limited because information for interest rate, inflation rate and wage rate were only fully readily available in 1999 four years later, after South Africa came out of Apartheid.

3.5 Conclusion

Chapter three discussed the methodology and data to be employed in this research study. The chapter presented the model that will be implemented as per estimating or quantifying the intensity of employment in South Africa among three different economic sectors.

CHAPTER FOUR: EMPIRICAL FINDINGS

4.1 Introduction

Chapter four presents the empirical results of the study based on the model specified in chapter three. This chapter explores how the methodological approach was undertaken. The structure of the chapter is as follows: 4.2.1 for the primary sector, 4.2.2 for the secondary sector, 4.2.3 for the tertiary sector, and 4.2.4 for 'all sectors.' Each section represents the respective sector's empirical results, the unit root test, the lag length, the long run ARDL estimates, the short-run ARDL estimates and the diagnostic test. Finally, section 4.3 completes the chapter.

4.2 Empirical findings

The following section consists of the empirical results of the primary sector in 4.2.1, the secondary sector in 4.2.2, the tertiary sector in 4.2.3 and 'all sectors' in 4.2.4.

4.2.1 Empirical results for the primary sector

4.2.1.1 Unit Root Test

For the primary sectors, the presence of a unit root in the time series variables was determined using the ADF and PP test.

Table 4. 1 Unit root test: ADF & PP in levels and first differences

Variable	Model Specification	Augmented Dickey Fuller test	Phillips-Perron test	Augmented Dickey Fuller test	Phillips-Perron test	Order of Integration
		Levels	Levels	First Difference	First Difference	
LOGEMP	Constant	-1.602	-1.292	-2.896**	-4.224***	I(1)
	Constant and Trend	-2.6780	-1.896	-2.879	-4.207***	I(1)
LOGGVA	Constant	-2.390	-2.897**	-2.791*	-4.651***	I(0)

	Constant and Trend	-3.048	-2.918	-2.796	-4.652***	I(1)
LOGWAGE	Constant	-2.664*	-1.734	-4.790**	-4.882***	I(0)
	Constant and Trend	-2.969	-1.975	-4.799**	-4.891***	I(1)
LOGCPI	Constant	-3.229**	-2.488	-4.978**	-4.993**	I(0)
	Constant and Trend	-3.396*	-2.620	-4.956**	-4.971**	I(0)

Source: Author's computations
*Note: *, ** and *** means the rejection of the null hypothesis of non-stationarity at 10%, 5% and 1% respectively.*

As observed in table 4.1 above, the order of integration of the variables is I(0) and I(1). The number of people employed (LOGEMP) and (LOGCPI) are variables that maintain the same order of integration under different model specifications. Respectively, the order of integration for LOGEMP and LOGCPI are I(1) and I(0) for "constant only" and "constant with the trend". Gross value added (LOGGVA) and wage rate (LOGWAGE) are integrated of mixture I(0) and I(0) when the model specification uses both the constant and trend. Therefore, there is a "mixture of order I(0) and I(1)", which warrants an estimation of the ARDL.

4.2.1.2 Lag length

Table 4. 2 VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	72.52	NA	0.01	-1.53	-1.43	-1.49
1	245.39	326.31	0.00	-5.40	-5.26	-5.35
2	273.73	52.85	0.00	-6.02	-5.85	-5.95
3	274.82	2.00	0.00	-6.02	-5.82	-5.94
4	276.87	3.73	0.00	-6.04	-5.82	-5.95
5	281.01	7.44	0.00	-6.11	-5.86	-6.01
6	288.16	**12.69***	**0.00***	**-6.25***	**-5.97***	**-6.14***
7	288.50	0.59	0.00	-6.24	-5.93	-6.11
8	288.90	0.69	0.00	-6.22	-5.89	-6.08

Source: Author's computations

According to the VAR 'Lag order selection criteria', the appropriate lag length of the VAR is 6 but is restricted to lag 1 to prevent an overlap. The lag length is used to test short-run dynamics using the ARDL short-run model estimation. Because there is no cointegration between GVA and employment in the primary sector, only short run employment intensities are determined. A VAR model is estimated to determine the appropriate lag length, as indicated in table 4.2.

4.2.1.3 Long-run ARDL estimates

The following section presents the ARDL bound test of cointegration among the variables investigated in the primary sector.

Table 4. 3 Bounds test for cointegration

F-Bounds Test	**Value**	**Level of Significance**	**Lower Critical Value**	**Upper Critical Value**
			I(0)	**I(1)**
F-statistic	2.46	10%	2.72	3.77
K	3	5%	3.23	4.35
Asymptotic: n=1000		1%	4.29	5.61
T-Bounds Test	**Value**	**Level of Significance**	**Lower Critical Value**	**Upper Critical Value**
			I(0)	**I(1)**
T-Statistic	-1.73	10%	-2.57	-3.46
		5%	-2.86	-3.78
		1%	-3.43	-4.37

Source: Author's computations

Table 4.3 represents the cointegration results for the primary sector. F-statistic value of the ARDL bound test is below the upper bound I(1) and lower bound I(0) critical values. The result implies no relationship between employment and GVA in the primary sector for long-run, thus, no cointegration and the null hypothesis is accepted. Hence, an error correction model on the ARDL form cannot be estimated to determine the speed of adjustment.

4.2.1.4 Short-run ARDL estimates

Table 4. 4 Short-run estimated coefficients

Variable	Coefficient	std error	t-Statistic	Prob.
D(LOGEMP(-1))	0.743	0.081	9.206	0
D(LOGGVA(-1))	-0.033	0.178	-0.186	0.853
D(LOGWAGE(-1))	-0.004	0.012	-0.389	0.698
D(LOGCPI(-1))	0.011	0.011	1.039	0.302
C	-0.001	0.001	-0.587	0.559
Robustness Indicators				
R^2		0.528		
Adjusted R^2		0.507		
F-Statistic		25.172		0.000
D.W Statistic		1.786		

Source: Author's computations

The short-run elasticities are denoted by 'D,' which resembles the short-run equation shown in table 4.4. The results showed the fluctuated trends in employment and productivity between 1995 and 2019 within the primary sector. In theory, a 1-percentage point of additional GVA growth will see total employment grow by the GVA's coefficient amount during 1995-2019, indicating a one-to-one relationship. Although, it was observed in table 4.4 there is a negative relationship between total employment and growth in the primary sector for the short run. The coefficient value of GVA is -0.033 and is used to explain the level of elasticity. The value of the coefficient falls in-between the category of inelasticity $0 < \varepsilon < 1$. In the short run, there is positive employment growth and positive productivity growth. Yet, the relationship between total employment and GVA growth is non-responsive, meaning employment does not respond to changes in output growth in the primary sector. Therefore, confirming the notion of jobless growth. The following result partially conforms to the empirical findings interpreted in the study by Moosa (2008) for developing Arab countries like Tunisia, Morocco, Egypt, and Algeria. The results go against the classic theory of employment and output, which assumes over the period that the long-run period full employment exists. However, there is no run relationship present in the primary sector.

4.2.1.5 Diagnostic test

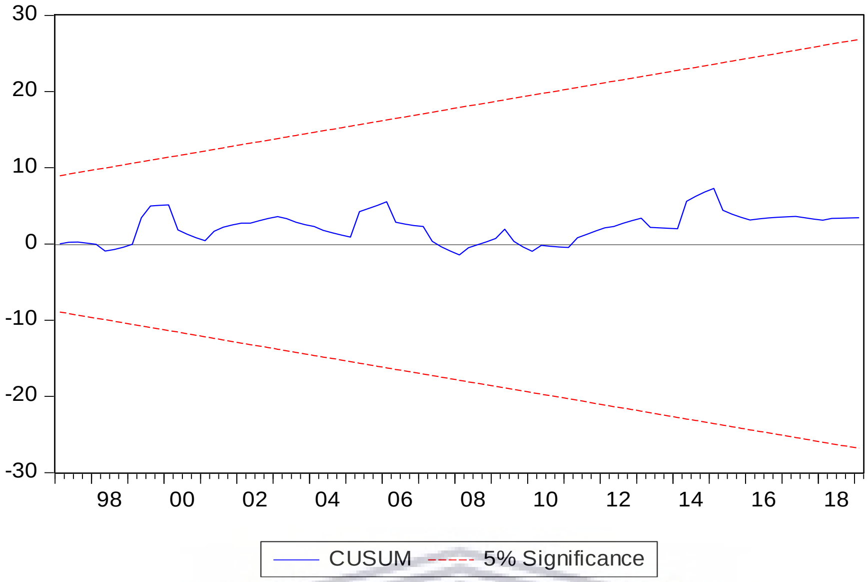
Table 4. 5 Residual diagnostic and stability test

Breusch-Godfrey Serial Correlation LM Test (Results)			
F-statistic	1.998	Prob. F(1,89)	0.161
Heteroskedasticity Test: White (Results)			
F-statistic	0.782	Prob. F(14,80)	0.685
Obs*R^2	11.434	Prob. Chi-Square(14)	0.652
Ramsey RESET Test (Results)			
	Value	df	Probability
F-statistic	0.589	(1,89)	0.445

Source: Author's computations

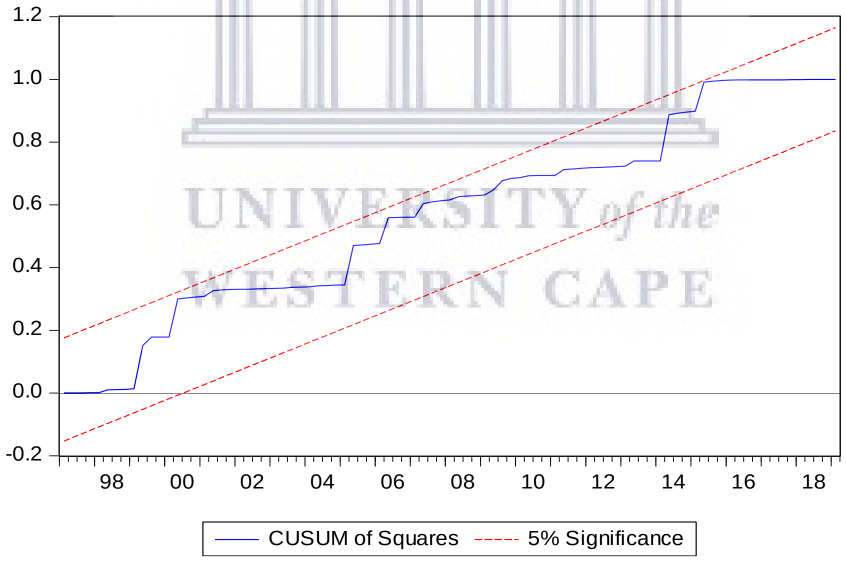
Table 4.5 represents diagnostic and stability tests on the ARDL short-run model. The results obtained will determine the model's robustness for forecasting and policy measures. Table 4.5 above shows that the ARDL short-run model used is not suffering from serial correlation. The 'Breusch-Godfrey Serial Correlation LM' tested for autocorrelation between the variables. The results confirmed no correlation among the variables, which is verified by the Prob. F-value of 0.161 which is greater than the 5% level of significance. The White Test was utilised to test for heteroscedasticity, the results confirmed no heteroscedasticity. The Ramsey RESET test was undertaken to test for the model misspecification and/or omitted variables, and the results confirmed that the ARDL model does not suffer from misspecification and omitted variables. The results indicate that the estimated regression model is specified correctly.

Figure 4. 1 Cumulative sum (CUSUM)



Source: Author's computations

Figure 4. 2 Cumulative sum of squares (CUSUMSQ)



Source: Author's computations

The Cumulative Sum and Cumulative Sum of Square constancy tests were undertaken to test the stability of the parameters used in the model. The results confirmed that the parameters are stable and do not change suddenly (Makeleni, 2019). Figures 4.1 and 4.2 show that the CUSUM and CUSUMSQ lines lay within the 5% level of significance; the lines did not break the 5% level of significance lines from 1995 to 2019.

4.2.2 Empirical results for the secondary sector

4.2.2.1 Unit root test

.

Table 4. 6 Unit root test: ADF & PP in levels and first differences

Variable	Model Specification	Augmented Dickey Fuller test	Phillips-Perron test	Augmented Dickey Fuller test	Phillips-Perron test	Order of Integration
		Levels	Levels	First Difference	First Difference	
LOGEMP	Constant	-2.341	-1.244	-2.731*	-2.949**	I(1)
	Constant and Trend	0.036**	0.536	-2.718	0.155	I(0)
LOGGVA	Constant	-1.465	-1.470	-3.138**	-3.430**	I(1)
	Constant and Trend	0.881	0.984	-3.328*	0.033**	I(1)
LOGWAGE	Constant	-1.299	-1.985	-3.791***	-5.107***	I(1)
	Constant and Trend	0.885	0.520	-4.053**	0.000***	I(1)
LOGCPI	Constant	-3.229**	-2.488	-4.978***	-4.993***	I(1)
	Constant and Trend	0.058*	0.273	-4.956***	0.0001***	I(0)

Source: Author's computations
*Note: *, ** and *** means the rejection of the null hypothesis of non-stationarity at 10%, 5% and 1% respectively.*

As observed in table 4.6 above, the order of integration of the variables is I(0) and I(1). The gross value added (LOGGVA) and wage rate (LOGWAGE) variables maintain the same order of integration I(1) under different model specifications. The order of integration of LOGEMP and LOGCPI are integrated of mixture I(1) and I(0) when the model specification uses both the "constant only" and "constant with trend". Therefore, there is a order I(1) and I(0) mix integration which allows an estimation of the ARDL model.

4.2.2.2 Lag length

Table 4. 7 VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	167.67	NA	0.00	-3.69	-3.57	-3.63
1	331.22	308.73	3.84	-7.33	-7.19	-7.27
2	359.20	**52.17***	**2.09***	**-7.93***	**-7.77***	**-7.87***
3	359.24	0.08	2.14	-7.92	-7.72	-7.84
4	359.24	0.00	2.19	-7.89	-7.67	-7.80
5	359.42	0.33	2.23	-7.87	-7.62	-7.77
6	360.51	1.94	2.22	-7.88	-7.60	-7.76
7	360.59	0.13	2.27	-7.86	-7.55	-7.73
8	360.59	0.00	2.32	-7.83	-7.50	-7.70

Source: Author's computations

The VAR Lag Order Selection Criteria is estimated to determine the appropriate lag length, and according to table 4.7 above the appropriate lag length of the VAR is 2.

4.2.2.3 Long-run ARDL estimates

Table 4. 8 Bounds test for cointegration

F-Bounds Test	Value	Level of Significance	Lower Critical Value	Upper Critical Value
			I(0)	I(1)
F-statistic	4.23	10%	2.72	3.77
K	3	5%	3.23	4.35
Asymptotic: n=1000		1%	4.29	5.61
T-Bounds Test	**Value**	**Level of Significance**	**Lower Critical Value**	**Upper Critical Value**
			I(0)	**I(1)**
T-Statistic	-3.12	10%	-2.57	-3.46
		5%	-2.86	-3.78
		1%	-3.43	-4.37

Source: Author's computations

According to table 4.8, at a 10% level of significance, the F-statistic is greater than both the lower bound I(0) and upper bound I(1) critical values. The null hypothesis of no cointegration is rejected, suggesting there is cointegration among the variables, and an error correction model on the ARDL form can be estimated. The bounds test indicates that employment and GVA are co-integrated in both the short and long-run dynamics (Davidson and MacKinnon, 1993).

Table 4. 9 long-run estimated coefficients

Variable	Coefficient	std error	t-Statistic	Prob.
C	0.281	0.113	2.493	0.015
LOGGVA	0.373	0.095	3.910	0.000
LOGWAGE	0.130	0.072	1.792	0.077
LOGCPI	0.184	0.085	2.163	0.033

Source: Author's computations

In table 4.9, the findings show a positive relationship between total employment and growth in the secondary sector. Like in the primary sector, the GVA growth coefficient is positive. This resembles positive employment growth and positive production growth in the secondary sector for the long run. However, the GVA growth coefficient of 0.373 is less than 1 in terms of elasticity, thus falling into the category of inelasticity. This suggests that employment is not responsive to changes in growth as represented by GVA, therefore, supporting the notion of 'jobless growth'. Also, the probability value of GVA is 0.000 which is less than 5%. Therefore, GVA is statistically significant to explain the total employment rate. The results confirm the following empirical findings by Mkhize (2019), capital intensive inputs are increasing, and labour-intensive inputs are decreasing in the secondary sector, especially within the manufacturing sector in South Africa, whereby GVA increases while employment rates remain the same. This is linked to a rise in capital resources, like improvements in manufacturing utilities. The findings were supported by the Keynesian unemployment theory by John Maynard Keynes (Keynes,1936). In this, growth in capital intensive industries experienced various sector-specific job losses in the secondary sector, due to a lack of expenditures within an economy, which decreased aggregate demand. Partially, this is due to sophisticated improvements in the manufacturing productivity in which labour market skill inputs were not readily available. Employment levels in the manufacturing industry, thus, declined to 1.1 million in 2011 from 1.6 million in 1995 (SARB 2012).

The job losses occurred during the second and third quarters of 2008 were partly due to the global financial crises (SARB 2012). The South African government intervened and provided support to both relatively "labour-intensive and value-adding manufacturing firms that had been adversely affected by the global financial crisis". Following the affirmation of the growth strategies, the sectoral value-added growth alone did lead towards substantial employment growth. This informs the notion that targeted industry labour market initiatives are needed for stimulating employment growth. These growth initiatives must consider labour market constraints, like the joint bargaining impact of trade unions and different skill/education levels when addressing employment problems. The secondary sector is, therefore, capital-intensive, an increase in employment rate relies on the expansion of capital-intensive inputs (Ajilore and Yinusa 2011).

4.2.2.4 Short-run ARDL estimates

Table 4. 10 Short-run estimated coefficients

Variable	Coefficient	std error	t-Statistic	Prob.
C	0.281	0.067	4.174	0.000
D(LOGEMP(-1))	0.676	0.063	10.650	0.000
D(LOGGVA)	0.595	0.103	5.761	0.000
D(LOGGVA(-1))	-0.449	0.115	-3.949	0.000
D(LOGWAGE)	-0.012	0.005	-2.418	0.017
D(LOGWAGE(-1))	0.009	0.005	1.523	0.131
CointEq(-1)*	-0.031	0.008	-4.187	0.000
Robustness Indicators				
R^2		0.833		
Adjusted R^2		0.822		
F-Statistic		73.182		0.000
D.W Statistic		1.9142		

Source: Author's computations

In table 4.10 (the above results are shown), the error correction term passed the three basic criteria. The probability of the ECM term is below the 5% level of significance, which makes the ECM term statistically significant. The ECM term indicates long run convergence, and the model is non-explosive. Multiplied by 100, the speed of adjustments of the ECM equals 3.05% which indicates a low average speed of adjustment. According to the R-square, the model has a good-fit with a value of 83.30% and the F-statistic value is statistically significant. The Durbin-Watson statistic confirmed no correlation between the variables concerned.

4.2.2.5 Diagnostic test

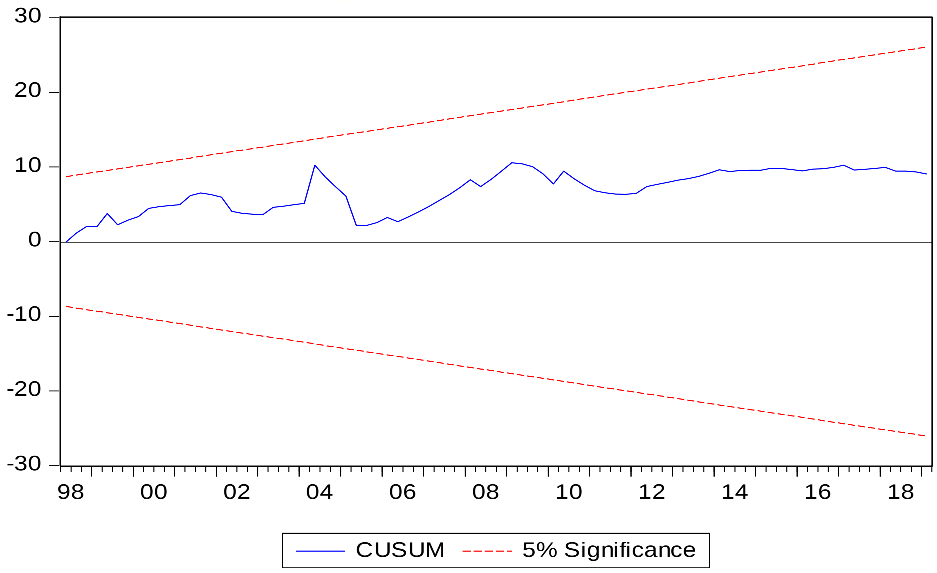
Table 4. 11 Residual and stability diagnostic test

Breusch-Godfrey Serial Correlation LM Test (Results)			
F-statistic	0.083	Prob. F(2,83)	0.921
Heteroskedasticity Test: White (Results)			
F-statistic	1.055	Prob. F(35,59)	0.419
Obs*R^2	36.578	Prob. Chi-Square(35)	0.395
Ramsey RESET Test (Results)			
	Value	df	Probability
F-statistic	0.101	(1, 84)	0.751

Source: Author's computations

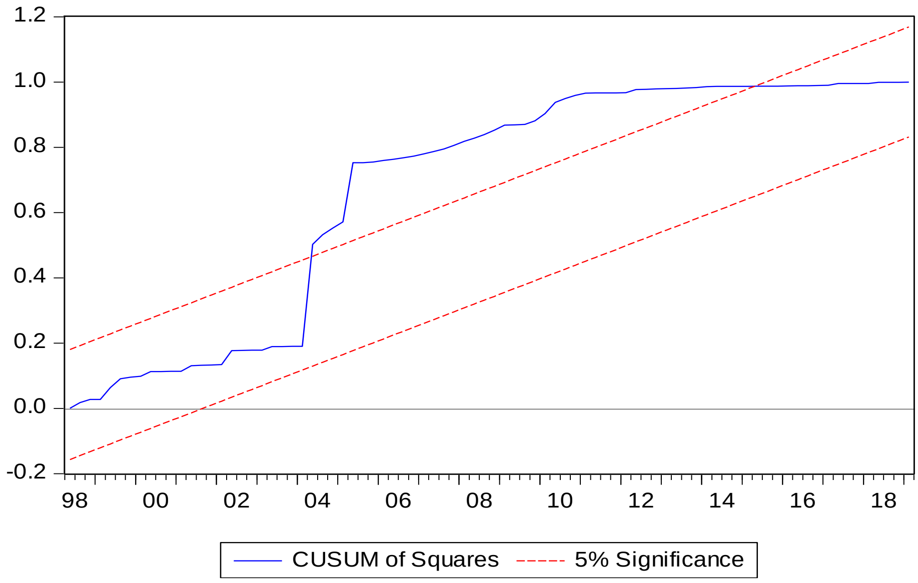
Table 4.11 represents diagnostic and stability tests on the ARDL model for the secondary sector, the ARDL model is thus, not suffering from serial correlation. The "Breusch-Godfrey Serial Correlation LM" test with a Prob. F-statistic value of 0.920, is greater than the 5% level of significance. The White Test was utilised to test for heteroscedasticity, the results confirmed that the model has no heteroscedasticity. The Ramsey RESET test was undertaken to test for the model misspecification and/or omitted variables, and the results confirm that the model does not suffer from misspecification and omitted variables.

Figure 4. 3 Cumulative sum (CUSUM)



Source: Author's computations

Figure 4. 4 Cumulative sum of square (CUSUMSQ)



Source: Author's computations

The **Cumulative Sum** and **Cumulative Sum of Square** constancy test were undertaken to test the stability of the parameters used in the model. Although, Figures 4.3 and 4.4 show that the CUSUM and CUSUMSQ lines lay within the 5% level of significance; the lines did break the 5% level of significance lines from 2005 to 2009 and then diverge back inside the 5% confidence interval indicating instability in the short run. However, the line recovered and moved back into the 5% significance, thus establishing its long-run equilibrium. The instability was caused by changes in the economic structure, whereby the economy was growing more strongly than in 20 previous years, during which time the employment rate was growing exceptionally high. Also, during 2008-2009 the South African economy slowed down due to the global financial crises that started with the housing crisis in the United States, and which caused a massive crash in the global stock market (StatsSA, 2010).

4.2.3 Empirical results for the tertiary sector

4.2.3.1 Unit root test

Table 4. 12 Unit root test for ADF & PP in levels and first differences

Variable	**Model Specification**	**Augmented Dickey Fuller test**	**Phillips-Perron test**	**Augmented Dickey Fuller test**	**Phillips-Perron test**	**Order of Integration**
		Levels	**Levels**	**First Difference**	**First Difference**	
LOGEMP	Constant	-0.943	-0.805	-3.376**	-3.698***	I(1)
	Constant and Trend	-2.544	-1.566	-3.394*	-3.716**	I(1)
LOGGVA	Constant	-1.235	-1.726	-1.79	-1.855***	I(1)
	Constant and Trend	-1.271	0.266	-2.065	-2.144***	I(1)
LOGWAGE	Constant	0.902	-0.066	-1.663	-4.554***	I(1)
	Constant and Trend	-0.193	-0.917*	-2.064	-4.593***	I(0)
LOGCPI	Constant	-3.229**	-2.488	-4.978***	-4.993***	I(0)
	Constant and Trend	-3.396*	-2.620	-4.956***	-4.971***	I(0)

Source: Author's computations
*Note: *, ** and *** means the rejection of the null hypothesis of non-stationarity at 10%, 5% and 1% respectively.*

As detected in table 4.12, under various model specifications all variables, except for consumer price index (LOGCPI), maintain the same order of integration of I(1). The variable, LOGCPI order of integration is of I(0) for both the "constant only" and "constant and trend" model specification, while LOGWAGE has both I(1) and I(0) order of integration. The tertiary sector has no variable integrated of order I(2), thus the tertiary sector's order of integration is mixed which supports the estimation of the ARDL model.

4.2.3.2 Lag length

Table 4. 13 VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	238.50	NA	0.00	-5.27	-5.15	-5.22
1	322.67	158.87	4.65	-7.14	-6.10	-7.08
2	364.53	78.08	1.86	-8.06	**-7.89***	**-7.99***
3	364.55	0.04	1.90	-8.03	-7.84	-7.96
4	364.65	0.19	1.94	-8.01	-7.79	-7.92
5	365.55	1.62	1.94	-8.01	-7.76	-7.91
6	368.98	**6.08***	**1.84***	**-8.07***	-7.79	-7.95
7	368.10	0.03	1.88	-8.05	-7.74	-7.92
8	369.13	0.24	1.92	-8.02	-7.69	-7.89

Source: Author's computations

According to the VAR Lag Order Selection Criteria in Table 4.13 above, the fitting lag length of the VAR is 6. The lag length of 6 that can be used to test long-run dynamics in the ARDL model.

4.2.3.3 Long-run ARDL estimates

According to the ARDL bound test, there is cointegration between GVA and total employment in the tertiary sector. Like the secondary sector, an error correction model can be estimated. Table 4.14 below, represents the ARDL bound test of cointegration results required to test the employment-growth rate relation in the long-run.

Table 4. 14 Bounds test for cointegration

F-Bounds Test	Value	Level of Significance	Lower Critical Value	Upper Critical Value
			I(0)	I(1)
F-statistic	3.112137	10%	2.72	3.77
K	3	5%	3.23	4.35
Asymptotic: n=1000		1%	4.29	5.61
T-Bounds Test	**Value**	**Level of Significance**	**Lower Critical Value**	**Upper Critical Value**
			I(0)	**I(1)**
T-Statistic	-3.262390	10%	-2.57	-3.46
		5%	-2.86	-3.78
		1%	-3.43	-4.37

Source: Author's computations

The results of the bound test demonstrate that the F-statistic is greater than the lower bound I(0) critical value at a 10% level of significance. Although smaller than the upper bound I(1) critical value, the F-statistic falls between the two bound levels. The null hypothesis of no cointegration could, thus, be rejected or not rejected. In other words, the calculated F-values fall within an indecisive region. However, practitioners argued that, since the value is not extremely below both bounds, it implies that there is weak cointegration and the researcher can then use the discretion to decide on the position. Hence, in this case, the null hypothesis is rejected, which further implies for the tertiary sector that employment-GVA growth relation is correlated in the long-run. Therefore, an error correction model is necessary to determine the speed of adjustment, considering both short and long dynamics.

Table 4. 15 Long-run Estimated Coefficients

Variable	Coefficient	Std Error	T-Statistic	Prob.
C	0.462	0.156	2.966	0.004
LOGGVA	0.792	0.023	34.186	0.000
LOGWAGE	-0.005	0.027	-0.195	0.846
LOGCPI	-0.014	0.015	-0.904	0.368

Source: Author's computations

According to table 4.15, there is a positive correlation between the GVA and the employment rate. The GVA growth coefficient is positive and larger than the GVA growth coefficients in the previous sectors. This resembles a long-run positive employment growth and positive production growth in the tertiary sector. However, the GVA growth coefficient, 0.792, is less than 1 in terms of elasticity, thus falling into the category of inelasticity. This suggests that employment is not responsive to changes in growth as represented by GVA. The GVA's coefficient in the tertiary sector amounts to 0.792 which is less than 1 elasticity category. The coefficient, thus, falls in the category of inelasticity. Although, the probability value is 0.000 which is less than a 5% level of significance, indicating that the gross value does significantly contribute to employment. However, the positive and significant coefficient of GVA is not great enough to influence a positive change to the employment rate. Therefore, employment is less responsive to changes in sectoral output in the tertiary sector. The employment coefficient in GVA (0.791588) is important to the tertiary sector's output in employment generation. Like the empirical finding by Pattanaik and Nayak (2011), Ajilore and Yinusa (2011), and Meyer (2017), collectively, which identified key industries in the tertiary sector that are employment intensive. All three findings show a similar result, suggesting that growth performance, in the long run, does not always guarantee employment opportunities in the country confirming the scenario of 'jobless growth.' A lack of employment opportunities in other industries (primary and secondary) causes a sectoral shift in economic structure across all sectors, leading to an increase in economic performance. The probability value of GVA is 0.0000, less than 5%, which is statistically significant to explain the total employment rate. GVA's coefficient is used to explain the level of elasticity, multiplied by 100, and the rate of change is equal to 79.16%, which is less than 1 (100). Thus, a 1% point of growth in the value-added in the tertiary sector will cause total employment to increase by 79.16% (while holding every other variable unchanged), which is not high enough for employment to be intensive to growth. The percentage points fall within the category of employment inelasticity, which indicates 'jobless growth'. The results, thus, confirm that GVA growth is not large enough to implement a positive change in employment intensity in South Africa.

The role of the tertiary sector on the entire economy cannot be considered independently. The performance of each representative industries in the tertiary sector is co-dependent with the growth of other industries in all sectors (primary and secondary). According to Altman (2006), the interdependent linkage that exists between the primary, secondary and the tertiary sector are bi-directional. The secondary sector contribution to the tertiary sector is, thus, significant where the manufacturing industry produces essential utility inputs needed to improve infrastructure and business efficiency in the tertiary sector. The movements from the manufacturing industry to services could either stimulate higher demand in services (improvements in the standard of living) or from services to manufacturing could stimulate higher demand for manufacturing (improvements consumer good productivity). The combined effect between the different industries within the primary, secondary, and tertiary sector drives economic growth (Altman 2006).

The coefficient inflation rate is negatively correlated to the employment rate. This signifies high unemployment rate expansions at the expense of low inflation in the tertiary sector. However, marking economic problems associated with weaknesses in the economy due to lack of investment spending in the tertiary sector added with stagnant economic progress depresses wages and heightens interest rates. Thus, inflation rate and tertiary employment has a negative relationship.

4.2.3.4 Short-run ARDL estimates

Table 4. 16 Short-run estimated coefficients

Variable	Coefficient	Std Error	T-Statistic	Prob.
C	0.462	0.129	3.578	0.000
D(LOGEMP(-1))	0.802	0.071	11.371	0.000
D(LOGGVA)	0.925	0.295	3.131	0.002
D(LOGGVA(-1))	-0.867	0.313	-2.772	0.007
CointEq(-1)*	-0.095	0.027	-3.589	0.001
Robustness Indicators				
R^2		0.721		
Adjusted R^2		0.709		
F-Statistic		58.118		0.000
D.W Statistic		1.989		

Source: Author's computations

Within the tertiary sector, the results for the error correction term passed all three basic criteria. The probability of the ECM term is below the 5% level of significance, which makes the ECM term statistically significant. The ECM term (-0.095) indicates a long-run convergence and that the model is non-explosive. According to the R-square, the model has a good-fit with a value of 72.03%. The F-statistic is statistically significant, and the Durbin-Watson statistic indicated no correlation between the concerned variables. Moreover, observed in table 4.16, the value-added coefficient affects positively towards employment. Multiplied by 100, the speed of adjustments of the ECM for the tertiary sector equals 9.15%, which is greater than the speed of adjustment 3.05% of the secondary sector. The tertiary sector is growing faster than the primary and secondary sector. The value-added ratio affects positively the total number of employees and is highly statistically significant, which explains the significant proportion of the variation in employment in comparison to gross value-added. If the value-added ratio increases by one per cent, the total number of employments is expected to increase by 92.45%, ceteris paribus.

4.2.3.5 Diagnostic test

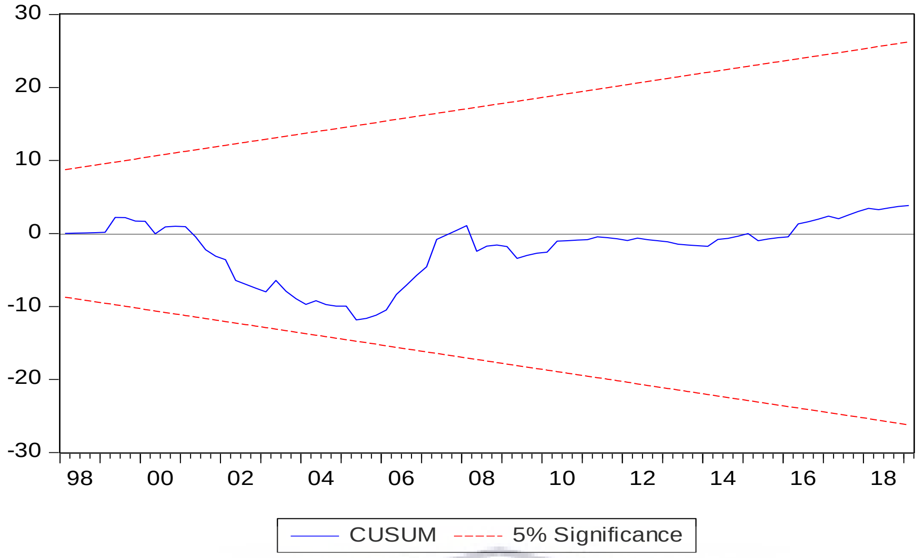
Table 4. 17 Residual and stability diagnostic test

Breusch-Godfrey Serial Correlation LM Test (Results)			
F-statistic	0.349	Prob. F(2,85)	0.706
Heteroskedasticity Test: White (Results)			
F-statistic	1.356	Prob. F(16,78)	0.186
Obs*R^2	20.679	Prob. Chi-Square(16)	0.191
Ramsey RESET Test (Results)			
	Value	df	Probability
F-statistic	2.118	(1, 86)	0.149

Source: Author's computations

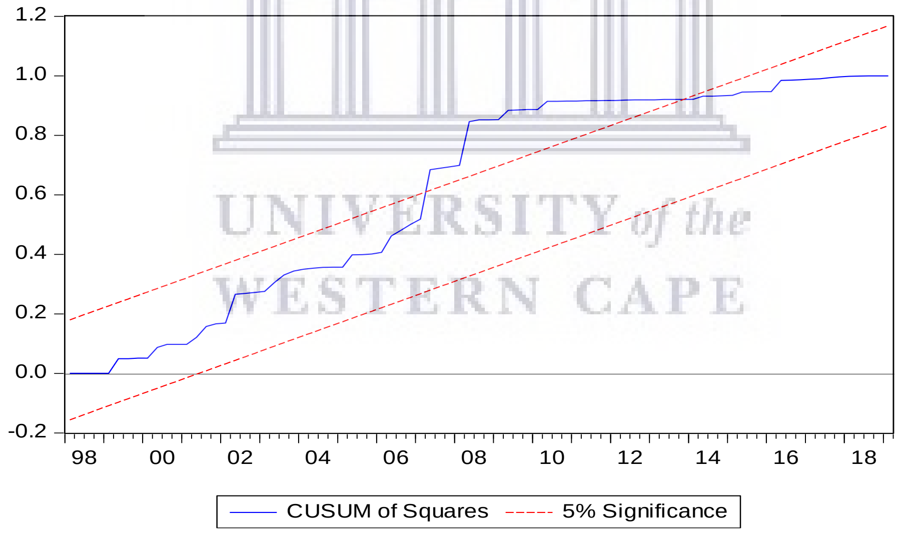
Table 4.17 represents diagnostic and stability tests on the ARDL model for the tertiary sector. According to the residual and stability diagnostic, the ARDL model is not suffering from serial correlation. The "Breusch-Godfrey Serial Correlation LM" test verified the P-value of 0.7063 is greater than the 5% level of significance. Similarly, the White Test was utilised to test for heteroscedasticity, and the results confirmed that the model has no heteroscedasticity. The Ramsey RESET test was undertaken to test for the model misspecification and/or omitted variables, and the results confirm that the model does not suffer from misspecification and omitted variables.

Figure 4. 5 Cumulative sum (CUSUM)



Source: Author's computations

Figure 4. 6 Cumulative Sum of Square (CUSUMSQ)



Source: Author's computations

The Cumulative Sum and Cumulative Sum of Square constancy test were undertaken to test the stability of the parameters used in the model. Although, Figures 4.5 and 4.6 show that the CUSUM and CUSUMSQ lines lay within the 5% level of significance; a similar occurrence as in the secondary sector and being that the linkage between sectors in the tertiary sector is bidirectional with the secondary sector: the CUSUM and CUSUMSQ lines break outside the 5% level of significance lines in a similar period as in the secondary sector. However, in this case, the breakage occurred during the 2008 to 2013 interval and diverges back inside the 5% confidence interval indicating instability in the short run. The lines do recover, moving back into the 5% significance boundary establishing long-run equilibrium. The instability represented in the model lines was caused by external market factors like contractions in the South African economy driven by the effects of the 2008/2009 global recession.

4.2.4 Empirical results for "all sectors"

4.2.4.1 Unit root test

Table 4. 18 Unit root test: ADF & PP in levels and first differences

Variable	**Model Specification**	**Augmented Dickey Fuller test**	**Phillips-Perron test**	**Augmented Dickey Fuller test**	**Phillips-Perron test**	**Order of Integration**
		Levels	**Levels**	**First Difference**	**First Difference**	
LOGEMP	Constant	-0.437	0.185	-3.457**	-3.710***	I(1)
	Constant and Trend	-3.140	-2.418	-3.448	-3.745	I(1)
LOGGVA	Constant	-1.269	-1.596	-2.424	-2.617*	I(1)
	Constant and Trend	-1.067	0.022	-2.655	-2.866*	I(1)
LOGWAGE	Constant	-0.672	-0.854	-2.983**	-4.724***	I(1)
	Constant and Trend	-1.148	-1.291	-3.271*	-4.759***	I(1)
LOGCPI	Constant	-3.229**	-2.488	-4.978***	-4.993***	I(0)
	Constant and Trend	-3.396*	-2.620	-4.956***	-4.971***	I(0)

Source: Author's computations
*Note: *, ** and *** means the rejection of the null hypothesis of non-stationarity at 10%, 5% and 1% respectively.*

As observed in table 4.18 above, the unit root test for all South African sectors reveals all variables, except for consumer price index (LOGCPI), which maintains the same order of integration of I(1) under different model specifications. While the LOGCPI order of integration is of I(0) for both the model specification like “constant only” and “constant with the trend”, there is no variable integrated of order two and, therefore, there is a order of I(1) and I(0), thus an estimation of the ARDL can be conducted.

4.2.4.2 Lag length

Table 4. 19 VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	192.20	NA	0.00	-4.23	-4.12	-4.18
1	336.15	271.73	3.43	-7.44	-7.30	-7.38
2	370.40	63.83	1.63	-8.19	-7.98	-8.12
3	370.53	0.26	1.66	-8.17	-7.97	-8.09
4	371.15	1.13	1.67	-8.16	-7.94	-8.07
5	372.80	2.97	1.65	-8.17	-7.92	-8.07
6	377.36	**8.09***	**1.52***	**-8.26***	**-8.02***	**-8.14***
7	377.43	0.12	1.56	-8.23	-7.93	-8.11
8	377.58	0.27	1.59	-8.22	-7.88	-8.08

Source: Author’s computations

According to the VAR ‘Lag Order Selection Criteria’ in Table 4.19 above, the appropriate lag length of the VAR is 6. The lag length of 6 is used to test long-run dynamics in the ARDL.

4.2.4.3 Long-run ARDL estimates

According to table 4.20 below, the ARDL bound test of cointegration results demonstrates that the F-statistic value is greater than lower bound I(0) at 5% and 10% level of significance. Although smaller than the upper bound I(1) critical value, the F-statistic still falls between the bound levels of cointegration. Thus, the “null hypothesis of no cointegration is rejected”, which indicates variables will eventually return to their natural level of equilibrium in the long run. An ECM is estimated to determine the speed of adjustment of long-run equilibrium.

Table 4. 20 Bounds test for cointegration

F-Bounds Test	Value	Level of Significance	Lower Critical Value	Upper Critical Value
			I(0)	I(1)
F-statistic	3.48	10%	2.72	3.77
K	3	5%	3.23	4.35
Asymptotic: n=1000		1%	4.29	5.61
T-Bounds Test	**Value**	**Level of Significance**	**Lower Critical Value**	**Upper Critical Value**
			I(0)	**I(1)**
T-Statistic	-2.93	10%	-2.57	-3.46
		5%	-2.86	-3.78
		1%	-3.43	-4.37

Source: Author's computations

According to the ARDL bound test, there is cointegration between total gross value-added and total employment for the combined industries. The combined sector variable is dubbed as 'all sectors' and consists of information based on the primary, secondary, and tertiary sectors. For 'all sectors', an error correction model can be estimated. Table 4.21 represents the long-run estimated coefficient (dependent variable: Employment Value) for all South African industries.

Table 4. 21 long-run estimated coefficients

Variable	Coefficient	Std Error	T-Statistic	Prob.
C	0.227	0.094	2.414	0.018
LOGGVA	0.856	0.079	10.824	0.000
LOGWAGE	-0.038	0.029	-1.311	0.194
LOGCPI	-0.082	0.027	-2.984	0.003
LOGINT	0.181	0.056	3.238	0.002

Source: Author's computations

Table 4.21 measures trends in total employment and total value-added between 1995 and 2019 in the economy. Observing the South African market industry holistically, with all the sectors included, there is a robust and positive relationship between total employment and total GVA, indicating employment and productivity growth are both positive. The coefficient of the GVA for all sectors combined is 0.856 which, just like the individual sectors, is less than '1' elasticity category. Hence, the total GVA for ‘all sectors’ falls in the category of inelasticity, meaning that employment is non-responsive to GVA changes in ‘all sectors’. Although, the probability value of GVA is less than the 5% level of significance, thus indicating that GVA significantly contributes to employment. The contribution is still not efficient enough to implement a positive increase in total employment in the long run, which goes against Okun’s law that theorises that if growth increases, so should the level of employment, thus reducing unemployment.

This is like empirical findings by Kapsos (2006) and Acemoglu, (2007) which indicated that a 3% in economic growth rate is vital to influence the reduction of the unemployment rate by a 1% per cent point and essentially increase the employment rate. To reduce the unemployment rate or in this case, increase employment, the real GDP growth must equal or grow more than the potential rate of output (more than 1 elasticity) especially in a developing country like South Africa. Thus, the GVA is less than the 3% required rate established by developed countries which verify jobless growth across all sectors in South Africa. This confirms the Ancharaz (2010) empirical findings that developing countries in Africa experienced rapid growth without significant job creation, because that growth was not influential enough to create jobs, thus demonstrating the flaws of utilizing the standard form of Okun’s law for developing countries. The standard version of Okun’s law is only applicable to developed countries with large GDP growth rates, hence the law is modified to include macroeconomic factors like the wages rate, inflation rate, interest rates, and/or a general decline in economic activity in South Africa to analyse the other factors that could influence the employment rate in South Africa.

The wage rate and CPI have a negative and insignificant relationship between employment and sectoral output. Another variable that was not previously added within the previous investigated models is long term interest rates. The long-term interest of 18.06% is low, which reflects positively on employment, whereby consumers are encouraged to spend more and save less, for producers in the market industry to spend and invest more in capital-intensive goods due to a reduced cost of borrowing (Gavin, 2013). The increased demand for consumption and investment then leads to a higher demand for labour. The employment elasticity coefficient of GVA 0.86 explains total output about employment generation. In terms of elasticity categories, this value falls under the inelasticity because it is less than 1. This suggests that unemployment is non-responsive or less responsive to changes in growth, implying jobless growth. However, the probability value of GVA is 0.0000, less than 5%, which is statistically significant to explain the total employment rate. The GVA's coefficient (elasticity) is equal to 0.856% which is less than 1 ($\varepsilon < 1$). Thus, a 1% point of growth in 'all sector' value-added, will cause the total employment to increase by 85.6% (while holding every other variable unchanged), which resembles a low intensity of employment to growth. These results, thus, re-confirm jobless growth in South Africa across all sectors.

4.2.4.4 Short-run ARDL estimates

Table 4. 22 Short-run estimated coefficients

Variable	Coefficient	Std Error	T-Statistic	Prob.
C	**0.220**	**0.048**	**4.717**	**0.000**
D(LOGEMP(-1))	0.694	0.060	11.533	0.000
D(LOGWAGE)	0.040	0.006	6.860	0.000
D(LOGWAGE(-1))	-0.025	0.007	-3.769	0.000
D(LOGCPI)	-0.012	0.003	-3.907	0.000
D(LOGCPI(-1))	0.007	0.003	2.120	0.037
D(LOGINT)	0.116	0.022	5.252	0.000
D(LOGINT(-1))	-0.084	0.023	-3.610	0.001
CointEq(-1)*	-0.060	0.013	-4.610	0.000
Robustness Indicators				
R^2		0.869		
Adjusted R^2		0.857		
F-Statistic		71.250		0.000
D.W Statistic		2.068		

Source: Author's computations

Table 4.22 above, shows short-run estimated coefficients (dependent variable: Employment Value) and the error correction term for 'all sectors.' The probability of the ECM term is below the 5% level of significance, which makes the ECM term statistically significant. Once more the ECM term is negative and indicates convergence in the long run, meaning the ARDL model is non-explosive. According to the R-square, the model has a good-fit with a value of 86.89% and the F-statistic value is statistically significant. The Durbin-Watson statistic indicated no autocorrelation. Moreover, as observed in table 4.22, the value-added coefficient affects positively total employment, like the long-run relationship, and when multiplied by 100 the speed of adjustments of the ECM for the 'all sectors' equals 6%. The ECM term confirms long-run convergence between the employment and the explanatory variables for all industries.

4.2.4.5 Diagnostic test

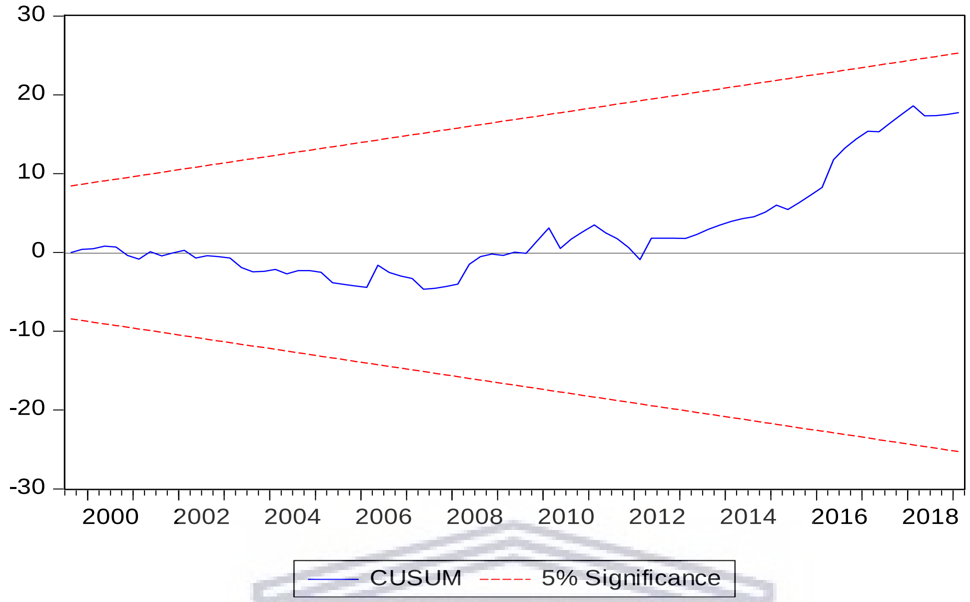
Table 4. 23 Residual and stability diagnostic test

Breusch-Godfrey Serial Correlation LM Test (Results)			
F-statistic	0.198	Prob. F(2,80)	0.820
Heteroskedasticity Test: White (Results)			
F-statistic	18.269	Prob. F(63,31)	0.000
Obs*R^2	92.508	Prob. Chi-Square(63)	0.010
Ramsey RESET Test (Results)			
	Value	df	Probability
F-statistic	5.136	(1, 81)	0.026

Source: Author's computations

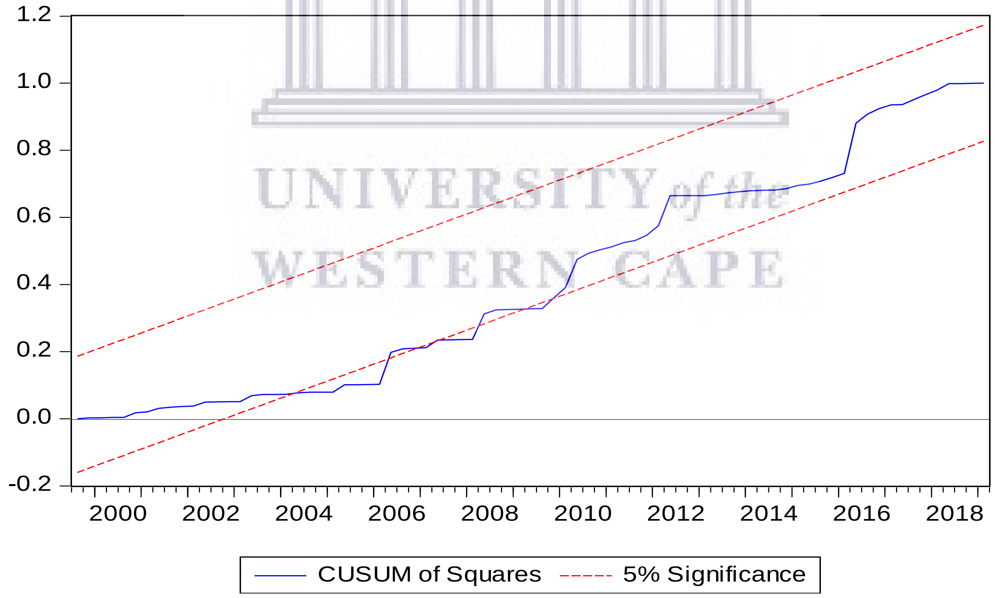
Table 4.23 represents the diagnostic and stability tests on the ARDL model for all industries in the South African economy. The Prob. F(2,80) value of 0.8203 is greater than the 5% level of significance. The result of the residual and stability diagnostic show that the ARDL model is not suffering from serial correlation, confirmed by the "Breusch-Godfrey Serial Correlation LM" test. Similarly, the White Test was utilised to test for heteroscedasticity, and the results confirmed that the ARDL model has no heteroscedasticity. The Ramsey RESET test was undertaken to test for the model misspecification and/or omitted variables, and the ARDL model does not suffer from misspecification and omitted variables. Just like the primary sector, the regression model is estimated correctly.

Figure 4. 7 Cumulative sum (CUSUM)



Source: Author's computations

Figure 4. 8 Cumulative sum of square (CUSUMSQ)



Source: Author's computations

The Cumulative Sum and Cumulative Sum of Square constancy test were undertaken to test the stability of the parameters used in the model. Although, Figures 4.7 and 4.8 show that the CUSUM and CUSUMSQ lines lay within the 5% level of significance; a similar occurrence as in the secondary, and tertiary sector; the combined CUSUM and CUSUMSQ for all (South African) industries' lines break outside the 5% level of significance lines. However, in this case, the breakage occurred during the 2004 to 2013 interval and diverges back inside the 5% confidence interval indicating instability in the long run. Nonetheless, the line recovered and moved back into the 5% significance establishing its long-run equilibrium. Much like the explanation used in the tertiary sector, the instability was caused by changes in the economic structure, whereby the economy was growing more strongly than in 20 previous years, and during that time employment rate was growing exceptionally high. Also, during 2008-2009, the South African economy slowed down due to the global financial crises that started with the housing crisis in the United States, and which caused a massive crash in the global stock market (StatsSA, 2010).

4.3 Conclusion

Chapter four discussed the collected empirical findings used to explain the study. The section explained the various tables and figures used to explain the empirical findings. The Unit root test was derived to explain the level of significance among the estimated variables. In summary, all sectors – primary, secondary, and tertiary sectors have a unit root, the t-value is significant enough to explain the rate of employment. Therefore, an ARDL model is an appropriate measure to interpret the level of employment intensity and establish whether there is a long run cointegration among employment and GVA. The ARDL model test shows that, in all sectors in South Africa, there is jobless growth in the long run. This was proven by employing the ECM regression analyst. The diagnostic and stability test proved that the ARDL model is stable. In all cases, the ARDL model was not suffering from misspecification or omitted variables. The estimated regression model is, thus, well-specified and corresponds to economic theory and the assumptions underlying the modelling measures.

CHAPTER FIVE: CONCLUSION AND POLICY RECOMMENDATION

5.1 Introduction

Chapter Five recapitulates all the research collected and analysed in chapter four and outlines the limitations of the study. The empirical findings implicated in the study will be summed up in Section 5.2, based on the combined employment and growth information collected for all South African industries between the period 1995 and 2019. Thereafter, section 5.3 gives policy recommendations and the limitations of the study. Lastly, section 5.3 concludes the whole study.

5.2 General conclusion

The purpose of this research was to explore employment growth intensity in South Africa. This study is uniquely important to establish whether these effects are impactful in the long run. The following study focuses on the employment-growth relation within three types of South African sectors, namely: the primary, secondary, and tertiary sector. Another focus area was the investigation of the employment-growth relation for all industries, recognised as the fourth module entity in the study. Years after the apartheid regime were removed from government, South Africa experienced increased economic growth, with the rate of employment growing steadily low. Okun's law hypothesized a one for one relationship between employment and economic growth. For instance, recent empirical results showed no relationship between employment and economic growth in the long run for South Africa's primary sector. The secondary and tertiary sector has a weak long-run relationship between employment and growth. In all circumstances, all industries' GVA did not amount to 1 (100%) or more employment elasticity categories to implement positive changes in the employment numbers between the period of 1995-2019. The same results are evident for the combined statistical measure of 'all industries' in South Africa, which confirms that Okun's law cannot be applied for developing countries like South Africa, and that modification has to apprehended to include other macroeconomic factors to influence changes in the level of employment. The ARDL method has been utilized as it produces coherent estimations of the long-term relationship that are asymptotically normal regardless of whether the underlying repressors are I (0) or I (1). Hence, the ARDL Long Run Form and Bounds Test were estimated to determine cointegration in the long run among total employment and value-added. Included in the correlation analyst are nominal wage rate and the inflation rate. The study made use of secondary time-series quarterly data and employed times-series techniques of analysis such as unit root tests, ARDL bound test to cointegration and error correction model estimation. The bound test to cointegration revealed a long-run relationship result among the variables. There are minimal South African studies that have used the ARDL model to examine the relationship between employment and economic growth in South Africa. Therefore, to update the study on the employment-growth relation, the following study examined the intensity of employment rate to the GVA proxy, to investigate whether a change in GVA translates into a change in employment.

The co-integration results showed that employment levels and GVA in the primary sector are not co-integrated, variables in question stagnated in the long run. Although the secondary and tertiary industries are co-integrated in the long run, the level of intensity of growth is not strong enough to influence a positive change in the employment rate, as the GVA coefficient was below the level of elasticity ($\varepsilon < 1$). Subsequently, analysing the combined aspect of all industries' modules of investigation (primary, secondary, and tertiary) showed a long run co-integration. However, the level of intensity failed to equal or succeed the 100% threshold to effect a positive change in total employment. The effect indicates jobless growth for the period 1995 to 2019 in South African. This reiterates the notion that technological advancements have caused South Africa to become more capital-reliant, which caused structural adjustments that weakened the employment-growth relationship. Observed from the growth performance in the primary sector, findings indicate that the connection between employment and growth is driven more by labour output than employment. This validates the rising capital-intensive inputs that has been experienced in all industries replacing lower skilled workers and, thus, no improvements in the level of total employment. Hence, sector growth (GVA) unaccompanied by other economic factors cannot promise substantial employment growth, but synchronized sector initiatives in the labour market will improve employment growth. Also, uni-directional relationship was not found between employment and real GDP in South Africa, as the researcher failed to reject the null hypotheses that "there is no long-run relationship between employment and economic growth" at all significant levels. However, we rejected the null hypothesis that "there is no relationship between employment and economic growth." The outcomes support the censure of growth without employment in South Africa, denoted as 'jobless growth.'

The results of the residual and stability diagnostic show, in all three sectors the ARDL model is not suffering from serial correlation. The ARDL model level of significance is confirmed by the “Breusch-Godfrey Serial Correlation LM” test. The White Test confirmed the ARDL model has no heteroscedasticity, meaning the residuals are equally spread out within the boundary of measured values. Thus, confirming the reliability of the hypothesis test and confidence interval. The Ramsey RESET test confirmed that the model does not suffer from misspecification and omitted variables. In conclusion, value-added in the primary and secondary sectors does not influence changes in the primary and secondary employment numbers (thus, employment growth is inelastic). Also, in the tertiary sector and all sectors combined, the value-added were not employment-intensive to growth (thus, employment growth is inelastic). Therefore, an increase in economic growth does not guarantee a one for one increase in employment, confirming that Okun's law is not always applicable to the South African economy. Other economic and environmental factors need to be considered in the modelled equation to accommodate factors that influence employment levels (Kumo, 2012).

5.3 Recommendations and limitations

The study successfully delivered the research questions as expected. The results of the study have strategic inferences that can help improve the employment rate of South Africa. However, the scope of this study was limited, as such, there are more questions about how the study arrives at its conclusions which were not addressed. Breaking down the individual industries to focus on each respective sectors within the primary sectors (i.e mining and agriculture industry), secondary sector (i.e manufacturing and construction industries) and tertiary sector (i.e transport and financial business industries) are recommended to understand which sector, under its respective industry, is more employment growth intensive. This can be an area for future research that has been successfully adapted amongst other African countries like Eqypt and Morocco (Agenor, and Aynaoui, 2015).

Policy recommendations should scale-up public employment programmes and infrastructure projects; geared specifically to tackle youth unemployment The Active Labour Market Policies (ALMPs) are programmes geared toward temporarily mitigating unemployment in South Africa (Red Tape Reduction Unit, 2017). The underlining objective of ALMPs is to assist people of working age to get into the labour market. ALMPs can be geared to reduce structural imbalances in the labour market and improve the overall functionality of the labour market.

Government should develop policies that develop workers with essential skills to work accordingly in capital-intensive industries, to ensure workers perform and adapt to new structural changes in the economy (Akanbi, 2015). This will eliminate the possibility of structural unemployment. This can be achieved by building stronger partnerships between training institutions and companies to help subsidise and facilitate short courses for the youth. This will ensure that education systems produce labourers with skills and qualifications that are aligned with the job demands in the labour market. Government should invest in entrepreneurial programme and workshops that compel the same standard of student mentoring programmes in all schools and universities to empower students to become successful entrepreneurs (Red Tape Reduction Unit, 2017). The initiative will help the Government close the gap in employment economic involvement.

Other policy recommendations that been successfully implemented in sub-Saharan African country like Namibia, include reducing the demand-side unemployment, a reduction in taxes, increased employment wage/salary levels across all essential industries. On the supply-side, unemployment includes employment grants and reduction of the influence of trade unions. In South Africa, the tertiary sector is the most functional sector that could provide valuable jobs opportunities that could improve the level of employment. Therefore, investment spending in the tertiary sector is pivotal. Implementing smart technology will help bridge the gap and facilitate the current knowledge and skills to ease the transitory unemployment problem.

REFERENCES

Adenuga, I., Babalola, S., & Saka, J. (2013). The Validity of Okun's Law in Nigeria: A Difference Model Approach. Asian Economic and Financial Review, 3(12), 1598-1608.

Acemoglu, D. (2007). Advanced Economic Growth: Lecture 19: Structural Change. Massachusetts Institute of Technology, online at https://economics.mit.edu/files/1953

Agenor, PR., & El Aynaoui, K. (2003). Labour market policies and unemployment in Morocco : a quantitative analysis. The World Bank, Policy Research Working Paper Series 3091.

Agenor, PR., & El Aynaoui, K. (2015). MOROCCO: Growth strategy for 2025 in an evolving international environment. OCP Policy Center, online at http://www.ocppc.ma/sites/default/files/OCPPC-Book-Version-en_0.pdf.

Agenor, PR., & El Aynaoui, K. (2016). Policy Lessons from Okun's Law for African Countries. OCP Policy Center, online at https://www.imf.org/external/np/seminars/eng/2016/GlobalLaborMarkets/pdf/Aynaoui_Session1_paper.pdf

Ajilore, T., & Yinusa, O. (2011). An Analysis of Employment Intensity of Sectoral Output Growth in Botswana. Indian Development Review, 9(1), 115-141.

Akanbi, O. (2015). Impact of Macroeconomic Variables on Nigerian Unemployment using the Vector Autoregressive Approach. International Journal of Research in Humanities and Social Studies, 2(2), 65-76.

Andrew Moore, A. (2014). South Africa's economy: key sectors. *Brand South Africa reporter,* online at https://www.brandsouthafrica.com/investments-immigration/economynews/south-africa-economy-key-sectors.

Andersen, B., and M. Corley. (2003). The Theoretical, Conceptual and Empirical Impact of the Service Economy: A Critical Review. WIDER Discussion Paper No. 2003/22, Washington DC.

Banister, J. 2004. "Manufacturing employment and compensation in China", Beijing: Beijing Javelin Investment Consulting Company, online at http://www.bls.gov/fls/chinareport.pdf

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2000). A new database on financial development and structure. World Bank Economic Review 14, 597-605.

BBQ online. (2019). Digitalisation and the rising rate of unemployment in the banking sector. The banking sector and retrenchments, online at http://www.bbqonline.co.za/articles/digitalisation-and-the-rising-rate-of-unemployment-in-the-banking-sector-29202.html

Baylor University. (2019). What is the Role of Technology in Business? Online MBA Program, online at https://onlinemasters.baylor.edu/articles/what-is-the-role-of-technology-in-business.aspx

Beaudry, P., and F. Collard. 2002. Why has the Employment-Productivity Tradeoff among Industrialized Countries been so Strong? NBER Working Paper No. 8754, National Bureau of Economic Research, Cambridge, Massachusetts.

Bhattacharya, D., and M. Rahman. 1999. Female Employment under Export-Propelled

Industrialization: Prospects for Internalizing Global Opportunities in the Apparel Sector in Bangladesh. Occasional Paper, United Nations Research Institute for Social Development, Geneva.

Bruno, S. F., A. M. Falzoni, and R. Helg. 2001. Measuring the Effect of Globalization on Labour Demand Elasticity: An Empirical Application to OECD Countries. FLOWENLA Discussion Paper 2, Hamburg.

Bernstein, A. (2001) Why is South Africa failing to get the growth and jobs we need?. Op-ed, online at https://www.cde.org.za/why-is-south-africa-failing-to-get-the-growth-and-jobs-we-need/

Boting, A., Standish, B. (2019). Promoting the Ease of Doing Business: An Initial Assessment

Stratecon, applied economic research. www.straton.co.za.

Bhorat, H., and M. J. Oosthuizen. 2008. Employment Shifts and the 'Jobless Growth' Debate. In Human Resources Development Review 2008: education, employment and skills in South Africa, edited by A. Kraak and K. Press, 50–68. Cape Town: HSRC Press.

Bisseker, C (2018). SA's population is booming, and the economy is struggling to keep up. Financialmail, online at https://www.businesslive.co.za/fm/features/2018-09-27-sas-population-is-booming-and-the-economy-is-struggling-to-keep-up/.

Career planet. (2019). The fastest growing industries in South Africa. Career Planet, Welcome to a World of opportunities, online at https://careerplanet.co.za/the-fastest-growing-industries-in-south-africa/.

Chappelow, J. (2019). Real Gross Domestic Product (GDP). Investopedia, online at https://www.investopedia.com/terms/r/realgdp.asp

Christiaans, T. (2011) Semi-Endogenous Growth When Population is Decreasing, Economics Bulletin 31 (3), pp. 2667–2673.

Clark, C. 1940. The Conditions of Economic Progress. London: Macmillan.

Döpke, J. 2001. The "Employment Intensity" of Growth in Europe. Kiel Working Paper No. 1021, Kiel Institute of World Economics, Germany.

Dumitrescu, B.A., Dedu, V., Enciu. (2009). The correlation between unemployment and real GDP growth: A study case on Romania. Annals of Faculty of Economics, 2(1), 317322.

Davidson, R., and J. G. MacKinnon. 1993. Estimation and Inference in Econometrics. New York: Oxford University Press.

Dopke, J. 2001. The Employment Intensity of Growth in Europe (Kiel Working Paper,No. 1021). Germany: Kiel Institute of World Economics.

Davis, M. (2019). Inflation and Economic Recovery. Investopedia, online at https://www.investopedia.com/financial-edge/0212/inflation-and-economic-recovery.aspx.

Iheanacho, E. (2017). ARDL Approach to Trade Liberalisation and Economic Growth in the Developing Country: Evidence from Nigeria. An International Multi-Disciplinary Journal, Ethiopia. African Research Review. AFRREV VOL. 11 (2), SERIAL NO. 46, April 2017: 138-159. Published by Department of Economics Abia State

University, Uturu Abia State, Nigeria, online at ISSN 1994-9057 (Print) ISSN 2070-0083 (Online) DOI:http://dx.doi.org/10.4314/afrrev.v11i2.11
Elster, J., (1983), Explaining Technical Change (Studies in Rationality and Social Change, Cambridge University Press.
Elder, S., and D. Schmidt. 2004. Global Employment Trends for Women, 2004. Employment Strategy Paper 2004/8, International Labour Organization, Geneva.
Elias, J. (2018). Technology Reporter, Silicon Valley Business Journal. Tesla says it helped create more than 50,000 jobs in California in 2017, online at https://www.bizjournals.com/sanjose/news/2018/05/16/tesla-economic-impact-california-bay-area-jobs.html.
European Commission, 2017 a. Better Regulation Guidelines Impact Assessment, online at https://ec.europa.eu/info/sites/info/files/better-regulation-guidelines-impact-assessment.pdf.
Fofana, N. F. 2001. "Employment and Economic Growth in the Cote d'Ivore: An Analysis of Structural Determinants." African Development Review 13 (1): 98–113, online at https://doi.org/10.1111/1467-8268.00032.
Fuhrmann, R. (2019). Okun's Law: Economic Growth and Unemployment. Investopedia, Economics Macroeconomics, online at https://www.investopedia.com/articles/economics/12/okuns-law.asp
Fuhrmann, R.C. (2013). Okun's law: Economic growth and unemployment, online at www.investopedia.com/articles/economics/12/okun-law.asp
Ghazali,M., & Mouelhi, R. (2018). The Employment Intensity of Growth:Evidence from Tunisia. Journal of Economic Development 85 (43): 3, University of Tunis, Tunisia University of Manouba, Tunisia.
Heckman, J. J. (2003). China's Investment in Human Capital. Economic Development and Cultural Change 51 (4): 795–804, online at https://doi.org/10.1086/378050.
Herwartz, H & Walle, M., Y. (2014). Openness and the finance-growth nexus. Journal of Banking, 48, 235-247
Hye, Q. M. A. & Boubaker, H. B. H. (2011). Exports, imports and economic growth: An empirical analysis of Tunisia, The IUP Journal of Monetary Economics 9(1) 6–21.
Investopedia. (2019). The 5 Industries Driving the U.S Economy, online at https://www.investopedia.com/articles/investing/042915/5-industries-driving-us-economy.asp.
Johnson, V., & Blanchard, O. (2014). Macroeconomics - Global And Southern African Perspectives (Paperback). Publisher: Pearson Education South Africa. Year: 2014. University: UNISA
Kapsos, S. (2006). The Employment Intensity of Growth: Trends and Macroeconomic Determinants. Labor Markets in Asia, 2006. Labor Markets in Asia pp 143-201. Palgrave Macmillan, London.
Kapsos, S. 2005. "Employment Intensity of Growth: Trends and Macroeconomic Determinants." Employment Strategy Paper 2005/12. Geneva: International Labour Organisation.
Karim, El A., & Aomar, I. (2016). Policy Lessons from Okun's Law for African Countries, online at

https://www.imf.org/external/np/seminars/eng/2016/GlobalLaborMarkets/pdf/Aynaoui_Session1_paper.pdf
Kwame, P. (2013). Trade liberalisation and growth: The Ghanaian experience.Journal of Economics and Sustainable Development, 4(5): 125-135.
Khemraj, T., J. Madrick, and W. Semmler. (2006). Okun's Law and Jobless Growth. Schwartz Centre for Economic Policy Analysis. Policy Note 3.
Kumo, W. L. (2012). Infrastructure Investment and Economic Growth in South Africa: A Granger Causality Analysis. African Development Bank, Working Paper Series N° 160, Tunis, Tunisia.
Ssebulime, K. Muvawala, J. (2019). Estimating the Cost of Unemployment to Uganda's Growth and Growth Trajectory 1980-2016: 'an auto-regressive distributed lag modelling approach' International Journal of Econometrics and Financial Management. 2019, 7 (1): 27-36.
Lawal, A. I., Nwanji, T. I., Asaleye, A., & Ahmed, V. (2016). Economic growth, financial development and trade openness in Nigeria: An application of the ARDL bound testing approach. Cogent Economics and Finance, 4, 1–15.
Leshoro, T.L. (2013). Does Economic Growth Lead Employment in South Africa? University of South Africa (UNISA), South Africa. Journal of Economics and Behavioral Studies 5, (6): 336-345, June 2013 (ISSN: 2220-6140).
Loots, E. 1998. "Job Creation and Economic Growth." Paper presented at the Biennial Conference of the Economic Society of South Africa. Potchefstroom: South African, online at https://doi.org/10.1111/j.1813-6982.1998.tb01256.x.
Mahadea.D., & Simson, R. (2010). The Challenge of "Low employment economic growth" in South Africa: 1994 -2008. School of Economics and Finance, University of KwaZulu-Natal.
McKinsey Global Institute. (2015). South Africa's big five: Bold priorities for inclusive growth. Johannesburg.
Meyer, B., & Tasci, M. (2012). An unstable Okun's Law, not the best rule of thumb. Economic Commentary, (8), 1-5.
Meyer, D.F. (2014). Job Creation, a Mission Impossible? The South African Case. Mediterranean Journal of Social Sciences. 5(16), 65-75.
Meyer, D.F. (2017). An Analysis of the short and long-run effects of Economic Growth on Employment in South Africa. International Journal of Economics and Finance Studies. 9 (1): 2017 ISSN: 1309-8055 (Online), North-West University, South Africa.
Mourre, G. (2004). "Did the pattern of aggregate employment growth change in the Euro area in the late 1990s?". European Central Bank Working Paper Series, 2004, No. 358.
Muqtada, M. (2003). "Macroeconomic stability, growth and employment: Issues and considerations beyond the Washington Consensus". Employment Paper 48. Geneva, ILO.KwaZulu-Natal.
Moosa, I., (2008). "Economic growth and unemployment in Arab countries: Is Okun's law Valid?" Proceedings of the International Conference on the Unemployment Crisis in the Arab Countries. Mar. 17-18, Cairo- Egypt, pp: 1-19.
Mkhize, I.M (2019). The Sectoral Employment Intensity of Growth in South Africa.

Southern African Business Review. University of South Africa. Published by Unisa Press. https://upjournals.co.za/index.php/SABR.

OECD (2020), The impact of the COVID-19 pandemic onjobs and incomes in G20 economies, OECD Policy Responses to Coronavirus (COVID-19), OECD Publishing, Paris, https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_756331.pdf

Okun, A. (1962). “Potential Output: Its Measurement and Significance.” In Proceeding of the Business and Economic Statistics Section of the American Statistics Society, 98–104. USA: American Statistical Association.

Otekhilei, C.A., Zeleny, M.(2016). Self Service Technologies: A cause of unemployment. International Journal of Entrepreneurial Knowledge Issue 1/2016, (460). DOI: 10.1515/ijek-2016-0005.

Pleic, M., and Berry, A. (2019). Employment & Economic Growth Employment Elasticities in Thailand, Brazil, Chile & Argentina. Employment & Economic Growth: A review of employment elasticities. Published at, Human Sciences Research Council (HSRC): centre for poverty employment and growth.

Prabhakaran, S. (2019). Augmented Dickey Fuller Test (ADF Test) – Must Read Guide. Retrieved: https://www.machinelearningplus.com/time-series/augmented-dickey-fuller-test/

Romer, P. M. (1993). The origins of endogenous growth American. Economic Association.

Rodrik, D. (2007). Harvard University One Economics, Many Recipes: Globalization, Institutions and Economic Growth.

Red Tape Reduction Unit, 2017. Report outlining the key findings and potential improvement measures following a service review of the National Public Transport Regulator, Cape Town: Western Cape Government.

Statistical South Africa (2019). Quarterly Labour Force Survey – QLFS Q4:2018. Issued by Statistics South Africa. http://www.statssa.gov.za/?p=11882.

SARB. (2014). The South Africa Reserve Bank Quarterly Bulletin (data sets). Pretoria:

Islam, I. and Nazara, S. 2000. “Estimating employment elasticity for the Indonesian economy”. ILO Technical Note, Jakarta.

Islam, R. 2004. “The nexus of economic growth, employment and poverty reduction: an empirical analysis”. Recovery and Reconstruction Department, Geneva, ILO. SARB.

Sadiku, M. Ibraimi, A. Sadiku, L. (2015). Econometric Estimation of the Relationship between Unemployment Rate and Economic Growth of FYR of Macedonia. Department of Accountancy and Finance, Eastern Macedonia and Thrace Institute of Technology, Kavala, Greece. Published by Elsevier B.V. DOI: 10.1016/S2212-5671(15)00009-X.

Yu, D. and Swanepoel, C. (2021). Granular understanding of joblessness in South Africa can help pinpoint policies. Issued by The Conversation. https://theconversation.com/granular-understanding-of-joblessness-in-south-africa-can-help-pinpoint-policies-156138

Wagner, H. (2019). What Is Jobless Growth? Economics, Macroeconomics. Issued by Investopedia. https://www.investopedia.com/articles/economics/10/jobless-growth-economy.asp

Zhang, J., Jiang, C. and Wang, P. (2014). Total factor productivity and China's miraculous growth:An empirical analysis. Available at SSRN, online at http://ssrn.com/abstract=2456009 [18. Aug. 2015].