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Inflation and Unemployment in the South African Democratic Era: Is There Any Trade-off?

By

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Declaration

I, the undersigned, hereby declare that this dissertation, save for supervisory guidance received, is the product of my work and effort. I have, to the best of my knowledge and belief, acknowledged all the resources of information in line with normal academic convections. I further certify that the dissertation is original and has not been submitted before at this or any other university for the award of any degree ay any other university purpose of obtaining a degree.

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Abstract

Achieving and maintaining price stability as well as the creation of sustainable employment are two of the most emphasized objectives of the South Africa Reserve Bank. South Africa has consistently suffered double-digit unemployment rates and unstable price levels, with a resultant stifling of economic growth rates. As a result of these continuous economic issues, South Africa's central bank policymakers have come under scrutiny regarding the adopted policy framework, which seems to be failing the economy with the growing unemployment rate and overall price level increments to prevail and triggering worsened standards of living for citizens. In an attempt to close the gap in the existing literature, this study examines the inflation-unemployment in democratic South Africa. This is achieved through examining the applicability of both the Phillips Curve and the New Keynesian Phillips Curve to determine whether these macroeconomic theories can be adopted in the fight against these economic issues facing South Africa. The Autoregressive Distributed Lag modelling technique is adopted by this study, where quarterly data spanning from 1994Q1 to 2019Q4 is analysed. Findings dismiss the existence of both the Phillips Curve and the New Keynesian Phillips Curve in South Africa. A recommendation to policymakers would be to focus less on inflation targeting, as it was discovered to have a small influence over the unemployment rate. Rather, given the finding that GDP was positively related to inflation, allowing inflation to move more freely could enable a stable economic growth that has the potential of reducing unemployment. This study further recommends that the SARB bank should for targeting output instead.

Dedication

To my daughter Mondewethu, you are my inspiration in everything I do, baby girl.

Contents

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Above all else, I thank God for seeing me through my academic journey thus far.

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I am forever indebted to the University of Zululand and the National Research Foundation for granting me the opportunity and means to pursue my postgraduate studies.

Ngiyabonga kakhulu. UNkulunkulu anibusise.

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List of Abbreviations and Acronyms

ADF	Augmented Dickey-Fuller Test
AIC	Akaike's Information Criteria
ARDL	Autoregressive Distributed Lag
CUSUM	Cumulative Sum Squares
CUSUMQ	Cumulative Recursive Sum of Squares
ECM	Error Correction Model
ECT	Error Correction Term
GEAR	Growth Employment and Redistribution
GTM	Gordon Triangular Model
JB	Jarque-Bera
NKPC	New Keynesian Phillips Curve
OLS	Ordinary Least Squares
PP	Phillips Perron
SADC	Southern African Development Community
SARB	South African Reserve Bank
StatsSA	Statistics South Africa
VAR	Vector Autoregressive
VECM	Vector Error Correction Model

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1. Introduction and background

Transitioning from an autocratic apartheid government to democracy in South Africa led to an era of economic redressing. The inherited economic and social legacies of apartheid which included high unemployment, income inequalities and excessive poverty levels affecting the black majority population, have contributed to South Africa's previous economic conditions. It is now more than two decades after the first democratic elections. However, unemployment levels remain high and keep rising, and were further impacted by the Covid-19 pandemic, which has crippled developing economies, including South Africa.

This study aims to provide new insights on the relationship between inflation and unemployment in South Africa and its implication on the economy's rates of growth post-1994, through a quarterly analysis from 1994 – 2019. 2020 is not included in the study due to abnormal circumstances. The study strives to ascertain whether monetary policy can be utilised to deal with continually rising unemployment issues.

Among its many goals, the main aim of the SARB is the achieving and maintaining good price stability and the achievement of sustainable economic growth. To achieve these mandatory and equally important goals, the SARB formulates and implements monetary policy, where the repurchase rate is used as the main monetary instrument (SARB, 2019).

Therefore, the Monetary Policy Committee (MPC) was formed right before the inflation targeting regime was adopted by the central bank. The MPC oversees and administers the monetary policy and is chaired by the Governor of the SARB. The main objective of the MPC is to monitor and manage the economy using monetary policy, which often involves the adjusting of reserve rates intending to decrease inflation rates and, therefore, aid in economic stimulation.

South Africa's monetary policies are implemented and aimed at achieving and maintaining sound price stability with the ultimate goal of achieving sustainable economic growth while transmitting the economy through different economic

channels. Monetary policy influences price stability through interest rate changes and the credit channel and influences unemployment through the spending-economic growth channel. Issues like low and stable inflation rates, combined with jobless economic growth, necessitates the need to understand the link between the two major issues of unemployment and price instability.

The inflation-unemployment relationship, commonly known as the “Phillips Curve” is regarded as one of the foundations of modern macroeconomics (Kabundi et al., 2019). According to Alfaris and Hussein (2017), this theory remains one of the core functions of macroeconomics that create an asymmetric relationship. One can, therefore, conclude that inflation and unemployment form a fundamental part of any economy.

Phillips (1958) first suggested that there exists a negative relationship between inflation and unemployment was first suggested by Phillips (1958). He opined that there exists a trade-off between wage inflation and unemployment in the long-run. He suggested that this trade-off could be exploited to create employment opportunities for the economy in question. Muhanna (2006) opined that the notion behind this theory is that there is a cost in lowering inflation, and that cost is higher unemployment. *Ceteris paribus*, the opposite is true for lowering unemployment, i.e., creating employment.

It is believed that a high rate of inflation and unemployment decreases the social welfare of individuals in any nation. This means that as much as possible, both inflation and unemployment should be kept at the lowest level in the economy (Bhattarai, 2016). Although the Phillips Curve theory has been met by wide criticism, it is regarded as a strong foundation of policy implementation. Karahan et al. (2012) opinioned that the Phillips Curve also provides a significant implication that concerns the economic policy's effectiveness.

Friedman’s (1968) opinions on the role monetary policy play concluded that the major goal of monetary policy is the achievement of sufficient employment creation, rapid economic growth, and the achievement and maintenance of price stability.

Sound macroeconomic policies are mandatory for the achievement of these goals mentioned above. According to Afzal and Awais (2012), this would determine a country’s maximum social welfare. Turnovsky (1993) identified expansionary monetary policies as one of the proposals governments can use to stimulate economic

growth. Khamfula (2014) opines that economic growth is largely dependent on the extensiveness and effectiveness of an economy's monetary policy.

As part of strengthening monetary policy in South Africa, the SARB adopted the inflation targeting regime in the year 2000. The idea behind inflation targeting is that it can be used as a cushion against unexpected price shocks. The targeted inflation was initially set at 3-5% but was re-adjusted to 3-6% recently (SARB, 2019). The SARB also adopted complementary policy features in line with inflation targeting that would ensure the success of this implementation. These include the following:

- Transparent inflation targets
- The high degree of accountability and transparency
- Discretion when setting Monetary Policy
- Periodic reassessments of policy based on updated and current forecasts

The SARB has been criticized for its overly strict monetary policy, especially the adoption of inflation targeting and its effects on South Africa's employment creation. Muhanna (2006) argues that the inflation-targeting framework, as one of its limitations, is the fact that it is based and relies heavily on forecasts. He further states that inaccurate forecasts can obscure the central bank's objectives and therefore impact its credibility.

One would ask if the SARB has been successful in its mandate to ensure price stability and create employment opportunities. According to Kumo (2012), it is quite evident that South Africa's economy is currently facing a huge issue of poverty, high general price level as well unemployment with the unemployment currently sitting at 27.6% while the inflation rate is at 4.4% according to StatsSA (2019). An overview of South Africa provided by the World Bank (2019) suggests that unemployment remains a key challenge in South Africa, particularly youth unemployment. Since high levels of inflation and unemployment negatively impact social welfare in a country, the priority should be to keep these two variables as low as possible (Bhattarai, 2016). Therefore, it is of paramount importance for a developing economy such as South Africa to thrive to achieve these twin goals to aid in effective and sustainable economic development.

Extensive research has been carried out on the inflation-unemployment relationship worldwide. Most recent studies on the South African economy have found that the Phillips Curve has flattened and no longer holds for South Africa (Fedderke and Schaling, 2005; Burger and Marinkov, 2006; Hodge, 2006; Leshoro and Kollamparambil, 2016 Phiri, 2016). Nell (2018) ascertains this by suggesting that the output gap coefficients found in these studies are either statistically insignificant or contain the wrong theoretical sign. Nell further states that there have been researchers though, who have attempted to revive the Phillips Curve for South Africa, such as Burger and Du Plessis (2013) and Fedderke and Liu (2016), who both focus on alternative proxies for the output gap, namely the M2 rate of growth and government expenditure.

Studies conducted in developing and less developed countries, such as Vermeulen (2015), Al-hosban (2015), Adebowale (2015), to mention a few, yielded different conclusions regarding the existence of the Phillips Curve in their respective economies. Studies (Govori, 2014; Muchdie, 2016; Shaari et al., 2018) conducted in developed economies showed contradicting findings based on their respective concentration. As will be observed in Section 2.3, it can be assumed that the dynamics between inflation and unemployment rates depend on the country's prevailing economic conditions, regardless of whether the economy in question is developed or not. However, Furuoka (2007) argues that very few studies examine the applicability of the Philips Curve in less developed nations. Empirical evidence from studies on less developed economies suggests that the Phillips Curve phenomenon hold in such economies (Furuoka, 2007; Touny, 2013; Hussein and Al-hosban, 2015; Adebowale, 2015).

In this study, the dynamics of the inflation-unemployment relationship are explored to find out if the Phillips and the New Keynesian Phillips Curves hold in the South African economy. This was achieved through examining the short- and long-run relationships between inflation and unemployment and between inflation, unemployment, and other factors. This study was carried out to advise policymakers, particularly the SARB, on possible policy frameworks that can be adapted to aid in employment creation and achievement of price stability and, therefore, overall economic growth stimulation.

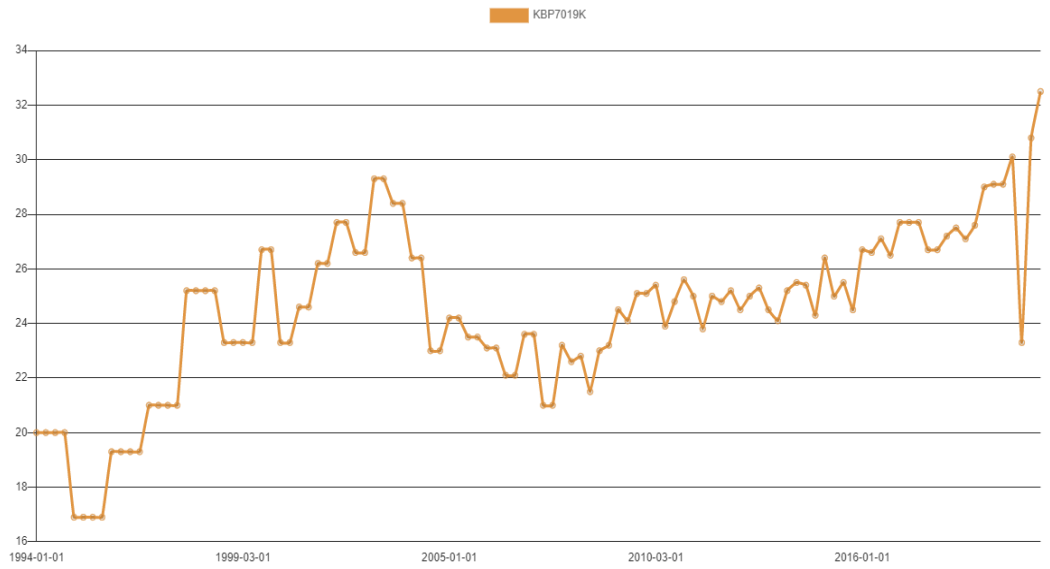
1.1.1. South Africa's unemployment

The unemployment topic in South Africa is a well-documented one as the economy is characterised by excessive levels of unemployment. In 1994, the economy's rate of unemployment was sitting at approximately 20% (SARB, 2019). It is apparent that since 1994, the overall annual unemployment rate has been increasing. According to StatsSA (2019), in the 4th quarter of 2019, the rate of unemployment was sitting at 29, 1%, a 5% increase over ten years from the 4th quarter of 2009. The leading contributor to this high unemployment rate is structural factors and the skills-mismatch in our labour force. South Africa's economic history hints at some reasons why unemployment rates are so high. This implies that employment-seeking individuals lack the necessary skills required for vacant jobs. Another contributor to high unemployment rates appears to be market rigidities, where firms and employees find do not find it easy to adjust to rapid economic fluctuations such as business cycle turning points. According to Pauw et al. (2006), South Africa is going through a technological transition that requires skilled labour and this, therefore, decreases the demand for unskilled labour.

A report issued by the International Labour Organisations states that South Africa is number 9 on the world's unemployment rankings (Anon, 2016). According to Schwab (2018), the projected unemployment rate for the next five years is believed to follow a similar path.

The trends of unemployment for the past 23 years are presented in Figure 1.1

Figure 1. 1 Official unemployment rate



Source: SARB

In the last 8 quarters, the economy's rate of unemployment rate rose to 29.1% in 2019Q4 from 27.1% in the last quarter of 2018. This rate has been recorded as the highest since the first quarter of 2017. According to Trading Economics (2019), the unemployment rate is usually expected to rise in the 1st quarter of the year as temporary staff hired to work over the busy festive season is laid off.

Employment decreased by 237 000 to 16.29 million from 16.53 million in the last quarter of 2018 (StatsSA, 2019; TradingEconomics, 2019). A job shedding of 126 000 was recorded in the formal sector, 68 000 in the informal sector, 142 000 in construction, 12 000 in agriculture, 20 000 in mining, 94 000 in finance and 50 000 in community and social services (StatsSA, 2019; TradingEconomics, 2019). A decrease of 176 000 from 22.67 million to 22.49 million was observed in the total labour force in the preceding quarter (2019Q3) (StatsSA, 2019; TradingEconomics, 2019). According to StatsSA (2021), the rate of unemployment increased from 30.8% in the 3rd quarter of 2020 to 32.5% in the 4th quarter of 2020. This was said to be the highest unemployment rate ever recorded since the start of the Quarterly Labour Force Survey in 2008.

1.1.2. South Africa's inflation

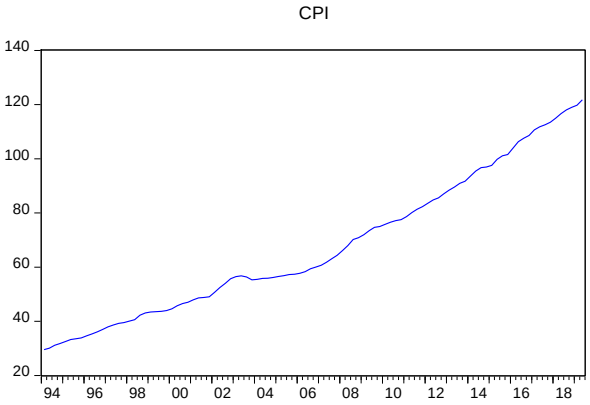
Inflation, commonly defined as "the constant increase in prices", can be described as a situation where the quantity supplied of money is way less than the demand in an

economy, resulting in a rapid increase of the general price levels. Inflation can largely impact the currency value which can decrease the purchasing power of consumers, and all this stifles economic growth.

Madito and Khumalo (2014) suggest that inflation plays a vital role in the South African economy as inflation is closely linked with the monetary growth supply. The economy's supply money is closely linked with M3 money stock variations. Expansionary monetary policies aim to boost economic growth by keeping interest rates low and thus encouraging economic participation through decreased borrowing costs (Mollentze, 2000), but with an upward impact on the rate of inflation.

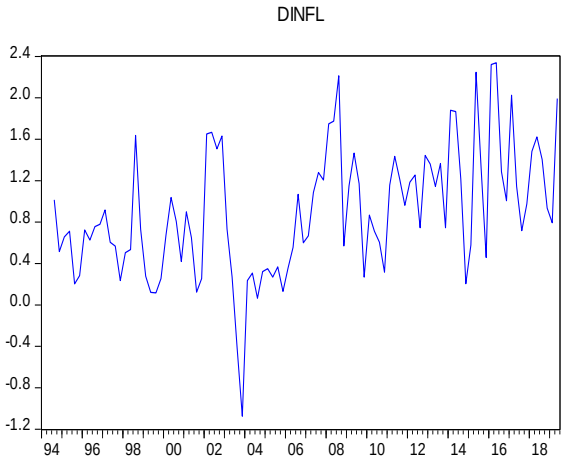
Inflation trends for the past 23 years are presented in Figure 1.2 and 1.3 below:

Figure 1. 2 Consumer Price Index



Source: E-views 10 (researcher's computations)

Figure 1. 3 Inflation rates



Source: E-views 10 (researcher's computations)

Figures 1.2 and 1.3 show an overview of South Africa's CPI and inflation, respectively, from 1994(Q1) to 2019(Q4). South Africa's rate of inflation is largely dependent on the economy's Consumer Price Index (CPI). It is quite clear that since 1994 the inflation rate has been fluctuating for the period under review, starting at roughly 8% in 1994. It is apparent that between the year 2004 and 2005 the inflation dropped to its lowest at roughly 0.6%. It is safe to assume that this dramatic drop in the inflation rate came due to the adoption of inflation-targeting in 2002. Between the year 2007 and 2009, inflation reached approximately 12%. We can also assume that this followed after the global financial crisis of recession. Since 2015 the inflation rates have stabilised. As of June 2018, the inflation rate was sitting at 4.6% from 4.4% in May. According to Statistics South Africa, 4.6% is the highest inflation rate since December 2017, which

resulted from increased fuel prices. The average South African inflation rate from 1968 to 2018 is 9.08%. The highest inflation rate to ever been recorded was in January 1986 at 20.70%, and the lowest ever inflation rate was recorded in 2004 at 0.20% (Anon, 2019). Based on this information and Figure 3 above, it is evident that South Africa's inflation rate, as the unemployment rate, has been unstable over the years, mainly due to economic fluctuations and instabilities.

1.2. Problem statement

In South Africa, the South African Reserve Bank has invested monetary resources and adopted various monetary policies in the fight against the issue of persisting unemployment, particularly youth unemployment. The Presidency and the National Treasury (2019) also emphasised the plan to continue fighting this worrying issue to stimulate the economy. This has been a rather difficult task as this issue continues to persist, hindering social and economic development simultaneously. According to the South African Reserve Bank, the main goal of its monetary policy implementation is the achievement and maintenance of price stability to contribute to the country's sustainable economic growth.

However, can it be concluded that monetary policy has been effective in ensuring sustainable economic growth rates and employment creation in South Africa?

Empirical evidence on the domestic economy suggests that prior research does not agree on the correct manner of conducting monetary policy. Reid and Du Rand (2013) ascertain this as they mention that there is still no clear understanding of monetary policy's effect on employment creation in South Africa.

According to Hodge (2002), studies before 1983 lacked accurate employment and unemployment statistics since the black population was not included in the labour force information, and this made these studies unreliable. Du Plessis (2013) and Fedderke and Liu (2016) suggest that employing other output gap proxies such as the government expenditure may provide possible results of the monetary policy for South Africa. Other researchers namely Fedderke and Schaling (2005); Burger and Marinkov (2006); Hodge (2006); Leshoro and Kollamparambil (2016); and Phiri (2017) suggest that South Africa's Phillips Curve has flattened over the years, indicating a weakening of the inverse relationship the between the rates of inflation and the rates of unemployment.

Existing empirical literature consulted sum up two contradicting approaches to how monetary policies can be implemented to benefit employment creation and price stability. Firstly, an argument that stems from the Phillips Curve is that there is an inverse relation between inflation and unemployment, a relationship that can be used in creating employment opportunities (Phillips, 1958). Secondly, the central bank argues that monetary policy's main goal is to achieve and maintain price and sound financial stability. This mandate has influenced most central banks, including the SARB, to opt for the targeting of inflation as the main monetary policy tool to achieve good price stability and employment creation (SARB,2018).

These arguments, however, do agree that there is some sort of correlation between inflation and unemployment, and this correlation has been the core motivation behind monetary policy for the past two decades. According to Phillips (1958), the main idea behind the essence of the relationship between price inflation and unemployment is that contractionary monetary policy measures can be implemented to allow for job creation in the long run. However, in practice, contractionary monetary policies keep inflation rates low, which may, in turn, stifle economic growth, increase unemployment and increase the cost of borrowing. Vermeulen (2017) agrees that it is a common phenomenon that an overly strict monetary policy such as inflation targeting stifles South Africa's economic growth. The researcher further states that central banks often face controversy using low inflation as a monetary policy method, resulting in higher unemployment.

The scope of the study will therefore differ from prior studies as follows: This study will examine the validity of the Phillips Curve in South Africa (or the invalidity thereof), whether this theory holds or does not in South Africa and if it does not hold, what are the reasons. This study will also suggest solid policy recommendations based on the conclusive results.

1.3. Study aim

This study aims to determine if a trade-off between inflation and unemployment in the South African democratic era exists or not.

- The main aim of this study is to examine whether the Phillips Curve and New Keynesian Phillips Curve hold in South Africa

- To examine if this relationship, if any, exists, can be exploited to the benefit of employment creation and the achievement of price stability.

1.3.1. Study objectives

I. To explore the causal correlation between South Africa's inflation and unemployment rates

II. To examine if a trade-off between inflation and unemployment rates in South Africa exists or not through estimating the traditional Phillips Curve and the New Keynesian Phillips Curve.

III. To identify the effects the 2007/09 global financial crisis had on these 'Phillips Curve' variables in South Africa.

IV. To suggest suitable policy recommendations that might be useful in achieving price stability and creating sound employment opportunities in South Africa.

1.4. Research hypotheses

To achieve the above aims of this research, the following hypotheses are tested:

- Hypothesis 1: There exists no significant causal relationship between inflation and unemployment in South Africa for 1994-2019.
- Hypothesis 2: There is no trade-off between inflation and unemployment in South Africa for 1994-2019.
- Hypothesis 3: The Global Financial Crisis did not have any effect on unemployment and inflation rates in South Africa.

1.5. The intended contribution of the study

Upon consultation of existing literature on the research topic, the researcher observed a limited study on the topic that includes other control variables, specifically the government expenditure and the output gap regarding the South African economy. Therefore, this study will contribute to existing knowledge by

1) Exploring the trends, nature and relationship between inflation and unemployment in specifically in the 'democratic years

2) Focusing on the causal relationship between South Africa's inflation and unemployment rates, also focusing on the 'democratic years

3) To introduce new control variables in the model estimation, such as oil and import prices, to account that South Africa is an open economy and, therefore, a huge part of the global economy.

4) To estimate a separate traditional Phillips Curve regression and the extended version of the Phillips Curve, i.e., New Keynesian Phillips Curve, which includes variables that account for global factors.

5) Moreover, lastly, to employ the Autoregressive Distributed Lag (ARDL) and Error Correction Model (ECM) techniques when estimating, a slightly different manoeuvre from most recent studies such as Furuoka (2007), Fedderke and Schaling (2005), and Govera (2017), all of which have explored the relationship between these two macroeconomic variables through employing various econometric techniques from the Generalized Autoregressive Conditionally Heteroscedastic (GARCH) to the Vector Error Correction Model (VECM) to the modelling techniques.

As mentioned, South Africa adopted the Inflation Targeting Framework. The results of this study will hopefully yield significant implications for South Africa concerning the Inflation Targeting Framework. Also, from the completed dissertation, the researcher aims to publish two short papers on the possible impacts and implications global factors had on the domestic inflation and unemployment rates post-1994.

1.6. Study organisation

This study contains five chapters. The introductory chapter, chapter one, is an overview of the entire study.

Following the introductory chapter is the literature overview chapter. Section 2.1. details the conceptual framework while Section 2.2. details the theoretical literature review by presenting the relevant theories that explore the relationship between inflation and unemployment and other possible variables that affect this relationship. This chapter also serves as the foundation of this study as the theoretical framework suggests the variables that ought to be used in a study such as this one. Section 2.3. covers the historical studies conducted under this topic, i.e., the empirical literature review. In this section, an extensive review of existing literature is conducted on both developed and developing economies and the domestic economy with the attempt of

grasping prior findings on the topic of various kinds of economies. This section also identifies gaps in the literature that this study might attempt to close.

Chapter three details the various statistical and econometric concepts and techniques this study employs in the modelling and analysis processes. This section contains two sub-categories with the first sub-category being a discussion of the relevant time series econometric techniques this study uses the ARDL modelling technique. The second sub-category covers the methodological estimation used which include the theoretical model/s and the discussion and motivation of the variables that will be employed in the theoretical model.

Chapter four consist of the empirical stages, results of the estimated analyses and results obtained from the estimation. The estimation processes begin with the preliminary estimations, including descriptive statistics, stationarity testing, and cointegration testing. The importance of these preliminary tests is that they determine the data's properties and provide a guideline of the estimation techniques that ought to be used in the estimation procedures. The ARDL method is used in examining the inflation-unemployment relationship. Post-estimation techniques, i.e., diagnostic tests, are carried out on the estimated models to confirm their validity. These include the Jarque-Bera, the Breusch-Pagan and the LM test, to name a few.

Chapter five details the empirical analysis findings in chapter four and concludes. Policy implications are drawn from the findings, and recommendations are thoroughly discussed.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

Here, the conceptual, theoretical, as well as empirical literature dedicated to investigating the inverse correlation between inflation and unemployment, are reviewed. These also lay the foundation of this study. The conceptual framework which provides an overview of the existing conceptual terms under this chosen topic is provided in section 2.1, followed by the theoretical framework in section 2.2. which provides a thorough background to the theoretical lens that guides this dissertation. The empirical literature in section 2.3 reviews the analysis of the current state of the subject matter of this study in both international economies and the domestic economy.

2.1. A conceptual framework for unemployment and inflation

2.1.1. Defining unemployment

The strict and expanded are the two most commonly used definitions of unemployment in South Africa. In the strict definition of unemployment, a person is only regarded as unemployed if they have been actively seeking employment/ looking into entrepreneurship and are open to starting a position immediately. The expanded definition of unemployment, on the other hand, considers discouraged job seekers, i.e., including people who have given up on searching for work. Notably, the strict definition that was declared has been regarded as the “official” definition of unemployment. Statistics South Africa (Stats SA) and the Department of Labour are the officially recognised providers of unemployment rates in South Africa with strict and expanded definitions of unemployment data.

2.1.2. Types of unemployment

Under these two above-mentioned distinct definitions of unemployment, four types of unemployment exist, namely: cyclical, frictional, and seasonal.

Demand-deficiency unemployment

Maynard (2007) defines demand-deficiency unemployment, also referred to as cyclical unemployment, as unemployment that occurs when the labour supply is adequately greater than the quantity of labour demanded in the labour market. This is mainly

caused by a decline in certain good/ services, which implies that production has to be decreased or, even in extreme cases, completely discontinued. Therefore, in such cases, wages become extremely low, and demand for labour is greatly decreased, creating what is known as ‘cyclical unemployment. It can be therefore concluded that this type of unemployment occurs when an economy is facing a recession period.

Frictional unemployment

Frictional unemployment occurs when individuals transition/move from one job to another. Therefore, frictional unemployment is characterised by the fact that its duration is relatively lower than other forms of unemployment. Malakwane (2012) suggests that frictional unemployment is mainly caused by insufficiency within the labour market. Baker (1999) further suggests that this lack of information can only be reduced if labour markets information is provided and through more improved and efficient recruitment systems.

Structural unemployment

According to Mohr (2015), this is the most complex type of unemployment since it is somewhat an “industry-specific” form of unemployment. Structural unemployment occurs when skills mismatches in an industry where individuals do not possess the necessary skills required by an industry/ sector. Structural unemployment can also be attributed to structural changes within the economy.

Seasonal unemployment

This type of unemployment occurs when individuals are unemployed during specific times/seasons of the year due to a decrease in labour demand. Some occupations only require workers only at certain periods in the year. Seasonal unemployment mainly occurs in the farming industry, as their demand for labour mostly increases during harvesting periods.

2.1.3. Defining inflation

Inflation, commonly described as “Public Enemy Number One”, refers to the sustained increase of the general price levels. Inflation can be observed by looking at the general price level over a specific period, i.e., considering the aggregate demand. Mohr (2015) defines inflation as a “continuous and considerable rise in prices in general”. It is important to note inflation as a process and not merely a condition since it is a continuous observation and general price behaviour. The essence behind inflation

being the “general price level” is attributed to the fact that it looks at the price of a predetermined “basket of goods and services”, which is adjusted over time in an economy.

The inflation level can be estimated by the CPI which is often adopted as its proxy. This indicator looks at the general price levels of the “basket of goods and services” afforded and bought by an average buyer. Inflation is expressed as a yearly rate and is calculated by looking at the percentage change of goods and services within the consumer basket from one period to another.

2.1.4. Types of inflation

Inflation can be distinguished by looking at the increment speed and by looking at its causes.

Creeping inflation

Creeping inflation can be described as inflation that gradually but continuously increases over time. The relatively small effect caused by creeping inflation eventually increases the cost of living in the long run. This kind of inflation is the most preferable since it can be regarded as the inflation that stabilises the economy, i.e., it does not have adverse effects unless wages do not positively respond to it. Therefore, it is of paramount importance that governments monitor creeping inflation and employ policies such as adopting minimum wages so that wages follow suit when prices increase.

Walking inflation

This kind of inflation arises from moderate price increments, resulting in an annual single-digit inflation rate of preferably between 3-7%. Walking inflation serves as a warning signal for governments to intervene before inflation progresses to ‘running/galloping’ inflation.

Galloping inflation

Galloping inflation occurs when prices rise rapidly within a short period at a rate between 10-20% per annum. These types of inflation can cripple any economy. Galloping inflation mainly affects the poor, i.e., lower-income citizens, as they have to bear ridiculously high living expenses. The only way to resolve such inflation is for governments to employ extremely restrictive monetary and fiscal policies.

Hyperinflation

This kind of inflation is the accelerating increase in prices by double or even triple digits. This kind of inflation completely wrecks the currency in question, and therefore the economy collapses. When hyperinflation occurs, prices rise uncontrollably up to a certain point where measuring them becomes almost impossible. As a result, the purchasing power of economic participants decreases drastically, and the currency consequently loses its value.

Stagflation

Stagflation, also known as recession inflation, occurs when there is slow economic growth within an economy coupled with low employment levels. Therefore, stagflation can also be described as a simultaneous increase in prices and stagnation of economic growth or a decline in GDP.

Therefore, one can conclude that the inflation causes are “demand-pull” and “cost-push” factors, as briefly discussed below:

i. Demand-pull inflation occurs as a result of an increase in demand conditions. These may increase the ability to purchase goods or increase the willingness of doing so
ii. Cost-push inflation stems from anything that reduces the supply situation. Some of these factors include the increase in production costs, the increase in government taxes and the decrease in the number of goods produced.

2.1.5. Defining inflation in South Africa

In South Africa, inflation is measured using the consumer price index (CPI), i.e., the average living costs or spending of an average South African. The consumer price index is calculated by totalling the costs of a predetermined “basket of goods” and services as used by an average South African. Thereafter, inflation rate is calculated by measuring the rise in the price of this “basket” over twelve (12) months.

2.2. Theories relating to inflation and unemployment

2.2.1 The original (traditional) Phillips Curve

The first-ever suggestion on a possible relationship between inflation and unemployment was first suggested by John Maynard Keynes in the “General Theory of Employment, Interest and Money” of 1936. Here, he suggested that unemployment rates can be stabilised through the use of “rising prices”. There exists, therefore, an inverse correlation between unemployment rates and prices.

In his study, “*The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957”*, Phillips (1958), scrutinized the correlation between the rate of changes in unemployment as well as the rate of changes in nominal wages in the UK for the period 1861-1957. Conclusive results came to a clear understanding of a long-run inverse relationship between these two variables. This resulted in him formulating a theory, commonly known as the Phillips Curve.

Fisher (1926) earlier observed a similar relationship in his study on the US economy for the period 1915-1925 to that discovered by Phillips (1958). The researcher went on to say that inflation, i.e.,’ changes in the general price level as it is known as’, is recognised as the main tool that can be exploited in the attempt of employment creation. Further studies such as that of Samuelson and Solow (1960) studied the inflation-unemployment relationship in the US economy for the period 1913-1957 and concluded that there is a trade-off between the variables in question.

Later studies that looked at the relationship between these Phillis Curve variables confirmed the original findings According to Furuoka (2007), the Philips Curve remains one of the major foundations of macroeconomics. Govera (2017) attests that most studies on the Philips Curve interrelation are mainly accredited to A.W Phillips’s theory.

Govera (2017) further suggests that the Philips Curve model made specific forecasts concerning the correlation between two variables within the Keynesian framework. This trade-off “policy” implied that monetary policy could be used to achieve the main objectives of macroeconomic policy, which are desirable inflation and unemployment rates. He further states that low unemployment levels coupled with high inflation levels could be either achieved through restrictive monetary policy through keeping inflation levels at the expense of high unemployment levels, ceteris paribus.

However, the 1970s US economy's events contradicted the Philips Curve theory as oil shocks lead to stagflation, whilst inflation rose dramatically, and unemployment increased, contradicting the Keynesian model's predictions. This resulted in many other economists such as Lucas and Sargent (1978) regarding the Keynesian model unreliable in articulating policies on the relation between process, unemployment and the growth rates (Govera, 2017).

2.2.2. A.W Phillips' critics

2.2.2.1 Milton Friedman's Deviation: The Monetarists perspective

In argument, Milton Friedman, a monetarist, suggested that there is misspecification in the Philips Curve theory. Friedman (1968) disputed that there is only a temporary relationship between prices and the unemployment levels in the short-run, since large excesses of labour supply will result from high wage rates in the labour markets, reversing the relationship between process and unemployment as presented by previous studies.

His theory is as follows:

$$\pi_t = \pi^e{}_t + \alpha(u_t - u^*{}_t) + e_t, \quad \alpha < 0, \qquad \dots (1.1)$$

Where π depicts inflation, π^e is the expected inflation, u depicts unemployment, u^* is natural unemployment, and e is the error term. This equation is now known as the "expectation-augmented Phillips Curve."

Friedman further states that employment is created by expansionary monetary policies when interest rates are lowered, increasing consumption and increasing labour productivity through technology changes due to lower interest rates, leading to higher output levels in the short-run. Friedman further suggests that an increase in prices, following the increased demand, decreases consumer purchasing power, resulting in further calls for wage increments. This, in turn, keeps unemployment levels at their natural rates since, in the long run, increases in prices are not proportionate to increases in wage rates. The conclusion is that the trade-off between inflation and unemployment is only a temporal one (Fuhrer, et al., 2009).

According to Whelan and Rudd (2005), this monetarist perspective is the most accepted critique of the Philips Curve by macroeconomists

2.2.2.2 Edmund S Phelps's Deviation

Phelps's (1967) theory, based on the Monetarist School of Thought, was more focused on economies with labour markets close to full employment. In his 1967 article, Phelps introduced a dynamic macroeconomic model that discovered independence between inflation and unemployment in the long run. This model was derived from the "optimal time-path of aggregate employment", and it assumes that inflation and unemployment are independent in the long-run. The model formulation was thus as follows:

$$\pi_t = \pi^e{}_t - \alpha u_t = \pi^e{}_{t-1} - \alpha u_t \quad \ldots(1.2)$$

$$\Delta\pi_t = \pi_t - \pi^e{}_{t-1} - \alpha u_t \quad \ldots(1.3)$$

Where,

π denotes the changes in the inflation rate,

u is the unemployment rate,

πe is the expected inflation which is formed adaptively (e = π_{t-1})

The above model implied that real wages conform to keep the demand and supply of labour at equilibrium, and those employees are responsive to real wages. He further states that workers predict inflation based on previous trends. Phelps concluded by stating that economies cannot trade inflation for high employment in the long run, confirming Friedman's monetarist insight.

2.2.3. Robert E Lucas Jnr's argument: Rational Expectations Theory

In his macroeconomic policy-making research, Lucas (1976) suggests perfect information amongst economic participants exists. He argues that it is pointless to forecast the monetary policy's effects on economic variables using historical data. The idea behind this critique of the Phillips Curve is that inflation policies do not create employment in the long-run as employees are able to adjust their inflation expectations. In his paper, he assumes that markets are perfect and approaching equilibrium. In his theory, he assumes that workers demand wages per the anticipated inflation since they are fully aware of the models' macroeconomic policymakers use of expansionary monetary policy to influence unemployment. Only unanticipated money supply changes could have an impact on output, employment and price level. According to Govera (2017), this results I n stagflation, a situation where the economy

in question is characterized by rising inflation, slow economic growth, and high unemployment levels. All this, therefore, contradicts the original Philips Curve phenomenon. In the 1970s Lucas's argument was widely criticized for assuming perfect information in markets, which saw King and Watson (1994) completely disregarding the relevance of Lucas's assumptions.

2.2.4. Sargent and Wallace monetary policy ineffectiveness proposition

Sargent and Wallace (1975), two neo-classical economists, argued that monetary policy cannot systematically manage the levels of output and employment, because forecasted expansionary monetary policy enables economic participants to appropriately alter expected wages and prices, in line with the rational expectations theory. The conclusion was that governments intervention through policy implementation (such as inflation targeting) is ineffective on real output and therefore on employment.

2.2.5. The Gordon Triangular Model (GTM)

In his working paper, Gordon (1990) developed the Gordon Triangular Model, in which he stated that inflation is determined by supply-push and demand-pull factors, combined with natural inflation (Built-in inflation). The model does not consider wages and employment levels as determinants of forecasted inflation. The model states that the actual inflation is related to real output changes and that inflation is mainly derived from the growth excess in real Gross National Product. Only a minimum of the inflation is a result of supply shocks, he concludes.

2.2.6. The New Keynesian Phillips Curve (NKPC)

Kiley (1997), as well as Taylor (1980) and Fischer (1997), argue that the New Keynesian Philips Curve framework is a structural model of inflation time dynamics. The major parameter is the time-lag that governs the marginal costs into inflation, and this time duration provides a measure of the degree of price stickiness in an economy. They concluded that the behaviour of inflation is better represented by price rigidity in the short-run. The NKPC theorem connects price immobility/stickiness with inflation and the behaviour of the overall economy, by relating inflation to the costs of production over time. The NKPC relates the expected inflation, the actual inflation as well as the output levels. This implies that when prices are resistant/sticky, firms use monetary policy as a guideline in the adjustment of prices.

The NKPC is theoretically more advanced than the original Philips Curve; thus, according to Du Plessis and Burger (2006), the NKPC became the "standard specification" in modelling unemployment and inflation behaviours.

Although the NKPC was widely accepted, some studies questioned its empirical evidence (Govera, 2017). According to a study by Ball (1991), a central bank's attempt to lower the inflation target would lead to disinflation, which, empirically, would result in a decrease in the employment rate and cause stunted growth. Fuhrer and Moore (1995) argue that existing empirical literature does not agree with the NKPC model theorem that price stickiness results in inflation stickiness. Mankiw (2001) questions the model's empirical validity. His main argument was that the model does not explain the effect of monetary policy on the inflation unemployment relationship.

In response to criticism against the NKPC, Dennis (2006) develops a conglomerate NKPC model, focusing on both information and price rigidity. The model assumes, in line with the new Keynesian Model, that only a proportion of firms can adjust their prices over a certain period while others cannot do so. The firms adjusting their prices are dependent on "menu costs", with higher menu costs implying that very few firms can adjust their prices during that period. Furthermore, he states that in conglomerate models, the combination of sticky prices and sticky information thrive when exposed to "empirical micro-data analysis".

2.2.7. The Sticky Information Phillips Curve (SIPC model)

This model was developed by Mankiw and Reis (2002) as an argument against the New Keynesian Philips Curve model. The SIPC, unlike the NKPC, is based on various macroeconomic nominal rigidity, i.e., elastic information instead of elastic prices. The model states that price inertia is motivated by information inelasticity rather than price inelasticity. In this model, the assumption is that there is imperfect information and the acquisition of information is very costly for firms, and that price updates are based on forecasted inflation.

2.2.8. The Post-Keynesian Theory

Palley (2007) suggests that the post-Keynesian theory originates from both the neo-classical and the neo-Keynesian models. The post-Keynesian theory with corresponding dynamic Philips Curve dis-equilibrium is formulated as follows:

$$\pi = f(u, \lambda\pi e) \qquad \ldots (1.4)$$

And

$$f1 < 0, f2 > 0, 0 < \lambda < 1, \pi = \pi e \qquad \ldots (1.5)$$

Here π represents the actual inflation rate, u represents the employment rate, λ denotes the coefficient of expected inflation, and πe denotes the expected inflation.

The assumption is that there is no natural rate of employment. Therefore, this implies a negatively sloping Philips Curve, which implies a permanent correlation between inflation and unemployment in the long run. The model implies that monetary policy affects inflation, unemployment, real wages, and overall growth rates (Palley, 2007). According to Bhaduri and Marglin (1990), the model assumes that both profits and wages determine growth.

2.2.9. The Neo-classical Theory

Palley (2007) argues that this theory is a widely accepted macroeconomic theory of monetary policy. This theory considers both money and inflation in its modelling. This theory corresponds with the idea of rational behaviour, i.e., people are rational when making economic decisions, and this theory, therefore, makes economic sense. This theory suggests that the main goals of consumers and firms are the maximisation of utility and profits, respectively, and this implies that consumers indirectly control market prices through demand.

The neo-classical Philips curve is given as follows:

$$\pi = f(u - u) + \pi e \qquad \ldots (1.6)$$

Where π denotes the actual inflation rate, u represents the unemployment rate, u* represents the natural unemployment rate and π is the expected inflation.

This model suggests that permanent expansionary monetary policies lead to a movement along the short-run Philips Curve, which results in a trade-off between the Philips Curve variables when inflation is increased, and unemployment is decreased. Therefore, in this model, savings determine investment, and there is equilibrium in the market where growth is at full employment.

Monetarists believe that only the supply of money determines the inflation rate and that the trade-off between the Philips Curve variables is only possible in the short-run.

The long run Philips Curve is vertical, dismissing the existence of a negative relationship between inflation and unemployment. This is a result of money neutrality in the long run. According to Gordon (1990), the assumption is that the unemployment rate does not determine inflation, whereas monetary policy does.

2.2.10. The Non-Accelerating Inflation Rate of Unemployment (NAIRU)

The NAIRU concept was first introduced by Lerner (1951) when he referred to the notion as the "low full-employment" condition, which can be attained by expanding aggregate demand instead of "high full-employment", which uses policies to encourage demand. This original research was further extended by Modigliani and Papademos (1975), where they referred to the theory as the Non-Inflationary Rate of Unemployment (NIRU).

According to Friedman (1958), the main idea behind this theory is that there has to be a certain portion of unemployment for every labour market associated with ''classical natural unemployment'' when wage rates are determined by policies such as the minimum wage.

According to Adam and Morrow (1999), the NAIRU can employ either one of its two broad modelling approaches, i.e., the expectations-augmented Phillips curve approach or the theoretical univariate framework approach, which considers several labour market variables as the empirical determinants of the NAIRU and where macroeconomic time series properties are adopted to identify the NAIRU respectively.

2.3. Empirical literature on the Unemployment and Inflation relationship

Prior researchers have empirically tested the various theories discussed above by using various econometric tools and methodologies, which have led to mixed conclusions. This section looks at past studies and their conclusions on developing nations as well as the domestic South African economies and is sectioned as follows:

Section 2.3.1 is a discussion on the topic from an international perspective; 2.3.2 is a review of prior studies on the topic concerning the South African economy and; the last section, section 2.4, reviews the implications of unemployment and inflation on South Africa's economic growth.

2.3.1. International perspective

In his paper, Govori (2014) tested the Philips Curve's existence in the United Kingdom using an econometric regression model with time-series data for 1956-2010. The researcher employed various econometric techniques, including the output gap, the Generalised Method of Moments, and the Hodrick-Prescot Filter, to estimate results. Conclusive empirical results from the tests employed indicate that the Philips Curve did not exist in the UK during the study's sample years.

Muchdie (2016) examined the Phillips Curve's existence in South Korean and Indonesian economies with data from 1980-2015, 1980-2015, and 1995-2015 respectively. The researcher employed the regression analysis on his tests. Empirical results indicated a negative correlation between these between the inflation rates and the unemployment rates in these economies mentioned above. This implied that these economies showed an insignificant existence of the Philips Curve in the long run since the regression coefficients took negative values in both the economies.

In their study, Shaari et al. (2018) used a panel data analysis to test the Philips curve's existence in 10 high-income earning countries with inflation and unemployment data from 1990-2014. Conclusive empirical results indicated the presence of the Philips Curve in the ten countries, both in the short and long runs which therefore implied the existence of the trade-off between inflation rates and unemployment rates in this panel of high-income earning countries.

Various researchers have investigated the relationship between inflation and unemployment rates in developing countries such as Nigeria, India, Malaysia, to name a few. Empirical evidence suggested different results regarding the inflation and unemployment dynamics.

Furuoka (2007) argued that very few studies examine the applicability of the Philips Curve in developing nations. In his study, his focus is on the Malaysian economy, where he empirically tests the relationship between inflation and unemployment. The study used the VECM analysis as a basis for the unit root test, the Johansen co-integration, and the Granger causality test to test the Philips curve's applicability in the Malaysian economy from 1973 through 2004. The results confirmed a causal relationship and a long run trade-off between inflation and unemployment in the long run.

In their attempt to examine the relationship between GDP growth and inflation in India, Prasanna and Gopakumar (2011) used the VECM as the base model, together with the co-integration and the error correction models with inflation and output growth data for the period 1972-2008. The conclusive results indicated a negative relationship between inflation and GDP growth, implying that inflation stunts economic growth in India in the long run.

Touny (2013)'s main objective of his study was to examine the existence of the Philips Curve hypothesis in the Egyptian economy for the period 1974-2011 and whether inflation policies reduce unemployment in the long run. He used the VECM analysis with inflation and unemployment data in his investigation. The results pointed to a positive relationship between inflation and the unemployment gap and the inflation rates in the long run.

In their attempt to test the existence of the Philips Curve in the Jordanian economy, Hussein and Al-hosban (2015) empirically assessed the relationship between unemployment and inflation rates with inflation and unemployment data from 1976 to 2013. They employed various econometric techniques, namely unit root testing, co-integration testing, the VECM, and the linear and non-linear OLS tests. The results concluded that there is a negative non-linear relationship between these two variables, which, therefore, confirmed the Philips curve's existence in the Jordanian economy for the period 1976-2013.

Adebowale (2015)'s main aim was to investigate the existence of the Philips Curve in the Nigerian economy for 1977-2013 by analysing the country's relationship between inflation and unemployment. This study employed the VECM and the Granger Causality test to analyse the inflation and unemployment data. The results from the causality test showed that unemployment is caused by inflation. Empirical results point to a trade-off between inflation and unemployment in Nigeria, aligning with the Philips Curve theory.

2.3.2. South African perspective

Upon consultation of literature, it was observed that a number of studies have been conducted on the relationship between the rates of inflation and the rates of unemployment in the domestic economy. Early studies on the existence of the Phillips Curve in the domestic economy include those of Krogh (1967), Hume (1971), and Truu

(1975), to name a few. Contradicting findings on the relationship between inflation and unemployment in the South African economy were observed and more apparent in the 1990s when the South African economy featured accelerating unemployment rates, stagflation, and repressive monetary and fiscal policies. According to Hodge (2002), studies before 1983 lacked accurate employment and unemployment statistics since the black population was not included in the labour force. Only in 1983, statistics for black unemployed people became available, and in 1991, racial classification ended.

Nell (2000) used South Africa's GEAR (Growth, Employment and Redistribution) programme as a base to his analysis of the extent to which single and double-digit inflation levels affect economic growth. The researcher considered GEAR as a foundation for firm monetary and fiscal policies. The methodology employed strays from previously used conventional time series in most studies as the researcher differentiated South Africa's inflationary encounters into four occurrences that allow for separate observances of the effect of inflation on South Africa's economy, both positive and negative. The researchers use a non-linear projection Philips Curve for 1971-1993 to analyse the relationship between inflation and unemployment. Quarterly data with the growth rate of real GDP, an intercept term, percentage change in terms of trade indicating supply shocks, consumer price inflation, rates of change in the M3 and the nominal interest rate were the variables used in his VAR estimation. The conclusion drawn from the results is that only single-digit inflation rates are beneficial to the economic growth of South Africa.

Hodge (2002) examines the gap between the contradicting results of the relationship between inflation and unemployment in South Africa, as presented by prior researchers. To close this gap, the researcher uses annual inflation, unemployment as well as economic growth rates for the period 1970-2000 in the following unit root OLS regression with the following specified model:

$$P_t = u + (U - U_n)_t + e_t \qquad \dots (1.7)$$

Where P_t depicts the inflation rate, U is the actual unemployment rate, Un is the natural unemployment rate and e_t is the error term.

Upon various estimations, the researcher discovered a significantly positive relationship between inflation and economic growth but an insignificant relationship

between inflation and unemployment. Therefore, it concluded the non-existence of the Phillips Curve hypothesis in South Africa, which implied that monetary policy could not be used as a tool for employment creation. According to the researcher, the reasons are that South Africa is characterised by structural unemployment and low aggregate demand.

Fedderke and Schaling (2005) employed the augmented Phillips Curve framework to analyse the interrelationship between the GDP deflator, the output gap, expected inflation and the real exchange rate. The researchers use annual data from 1960-1999 and the VECM to estimate the linkages amongst the variables. The results obtained pointed to an indirect mechanism by adjusting a unit of labour costs to the long run equilibrium.

Burger and Marinkov (2006) used the Gordon triangular model to estimate South Africa's Philips Curve with quarterly data ranging from 1976 and 2002. The researcher used the CPI and the output gap variables of the estimation. The paper uses the production function approach and the standard Hedrick-Prescott filter to analyse South Africa's output gap. Upon empirical results, researchers found that the Gordon triangular model does not hold for the South African economy. This came as a result of a lack of evidence of output levels effects on inflation, which implied that there is no trade-off between the two variables of the Philips Curve in South Africa

Vermeulen (2015) examined how the inflation rate affects the unemployment rate by looking at the direct effects inflation has on the output. Similar to the above-reviewed studies, this paper seeks to examine whether inflation could be manipulated to create employment opportunities or not in the South African economy. The researcher uses annual inflation and unemployment data and employs the Engle-Granger Error Correlation in the estimation processes. The results observed a positive co-integrating relationship between output and employment, while no evidence of the relationship between inflation and employment was discovered. Therefore, this paper dismisses the existence of the Phillips Curve hypothesis in South Africa.

Kabundi et al. (2016) estimated a time-varying Phillips Curve for South Africa with a slope, persistence of inflation, NAIRU, and targeted inflation. In their estimation, the researchers use quarterly unemployment data from 1994 (Q1) - 2014(Q2) and year-on-year CPI inflation rates, also both obtained from the SARB. The results from the

estimations concluded that South Africa's Phillips Curve has flattened since, after the Financial Crisis, the estimated inflation target of between 3.25% and 6.41% is slightly higher than the SARBs official targeted inflation band of 3-6%. Therefore, all these suggest that monetary policy has not been as effective as anticipated, which may be due to cost-push factors.

Leshoro and Kollamparambil's (2016) main objective is to test whether a stable Phillips Curve exists for South Africa and to explore the inflation dynamics of South Africa's economy. In their quest to find answers, the researchers employed a hybrid New Keynesian Phillips Curve Model as a theoretical framework. Various annual inflation, output gap and output gap data for the period 1980-2013 were employed using Fully-Modified Ordinary Least Squares (FMOLS) and various pre-estimation techniques. The empirical results obtained pointed to no existence of a stable Phillips Curve for South Africa. Therefore, the conclusion was that inflation targeting is not effective in the South African economy, but rather, the central bank should opt for growth targeting instead and consider fiscal policies.

Vermeulen (2017) revisited the gap in the existing literature around the correct manner of inflation targeting by directly examining the relationship between inflation and unemployment in South Africa. The study estimated the number of Philips Curves models for South Africa using employment, unemployment and inflation data by employing various econometric techniques, including the ARDL and EG approaches. The results pointed to the non-existence of the relationship between inflation and unemployment in South Africa for the given period, implying that the Phillips Curve is not real for South Africa.

Phiri (2017) re-evaluated the issue of persistence in the inflation processes in South Africa using monthly data collected from 2003 to 2016. The researcher further examined whether there has been a change in the persistence for the periods before and after the financial crisis (2001:1--2008:8) and (2008:1-2016:1). Empirical results concluded that inflation processes have been less persistent after the global financial crisis, indicating the SARB's success in controlling inflation during extreme shocks. However, the empirical results are interpreted with special caution being paid to South Africa's macroeconomy, so although the SARB may have been able to keep inflation below the upper band of targeted inflation of 3-6%, this was consequently

accompanied by lower economic growth rates, consistently high unemployment rates as well as relatively low-interest rates.

Govera (2017) examined the relationship between the Philips Curve variables, i.e., inflation and unemployment in South Africa. The researcher used the unemployment rate, the core CPI and the repo interest rate quarterly stats for the period 1994-2015 to examine the applicability of the Philips Curve in the South African economy. The researcher used the hybrid version of the New Keynesian Philips Curve and other econometrics techniques, including the Augmented Dickey-Fuller test and the Johansen co-integration technique methodologies to analyse South Africa's data. He also employed the VECM to examine the short-run relationship between the Philips Curve variables. The Granger causality test was used to examine the causality between the Philips Curve variables. Conclusive results based on models and tests ran confirmed a positive but peripheral relationship between inflation and unemployment in the long run.

Nell (2018) re-examined the role of structural change and nonlinearities in a Phillips Curve model for South Africa for the period's 1971Q1-1984Q4 and 1986Q1-2001Q2. The researcher adopts inflation, expected inflation and the output gap in an ARDL regression chosen by the Akaike Information (AIC) and the Schwarz Bayesian (SBC) selection criteria. The results suggest that the first period, i.e., 1971Q1-1984Q4, point to a non-trended inflation pattern. In the second period, i.e., 1986Q1-2001Q2, a decelerating inflation pattern is observed from a concave curve with an output gap. The conclusion was that the Philips Curve over the sample period 1971Q1-2001Q2 is structurally unstable due to the insignificant output gap as a variable. Results from the period 1971Q1-1984Q4 suggest evidence for a linear Phillips Curve with an output gap variable.

2.4. The implications of unemployment and inflation on South Africa's economic growth: An empirical literature review

The unemployment rate indicates a country's inability to utilise its labour force to its maximum. It can also be attributed to stunted growth since a country's GDP depends solely on its productivity level. That is why, therefore, achieving high employment levels and attaining sustainable and satisfactory economic growth levels should be a major concern and should be prioritised, especially in struggling and unstable

economies such as that of South Africa. This can be achieved by thorough knowledge of the relationship between an economy's labour force, its characteristics, and its implications on its economic growth.

Makaringre and Khobai (2018) examined the impact unemployment has on South Africa's economic growth for 1994-2016. The ARDL modelling technique was employed on quarterly data. The results obtained pointed to a negative long run relationship between the unemployment rate and the economic growth rate for the given period. Madito and Khumalo (2014) discovered similar results in their earlier study on the nexus between economic growth and unemployment in South Africa. However, their approach was different as they employed the VECM approach. They highlight that although South Africa's economic growth model is uniquely identified, the relationship between unemployment and economic growth often yields similar results, i.e., a long run negative relationship between these two variables.

A slightly different approach by Banda and Choga (2015) discovered that, when economic growth is an unemployment determinant, a positive long run relationship is present. Their study was on South Africa from 1994 to 2012, where unemployment was the endogenous variable, and economic growth (GDP) and labour productivity were the core exogenous variables. The VECM was the chosen methodology, and results indicated that a positive long run relationship exists between unemployment and economic growth. In contrast, the relationship between unemployment and labour productivity was discovered to be negative in the long run. Govender (2015) also conducted a study on post-1994 South Africa, where she uses OLS and data from 1994-2014 to examine whether the Okun's Law holds in the South African economy. The ECM was used to explore the relationship between economic growth, unemployment, and adjustment speed to equilibrium. The results showed signs of both short and long run trade-offs between economic growth and unemployment in South Africa. This study also concluded that Okun's Law holds in South Africa.

From the brief discussion above, we can conclude that although a certain percentage of unemployment will always exist in an economy, it should never be significantly above the natural rate of unemployment of that particular economy.

According to Akinboade et al. (2002), the relationship between economic growth and the country's inflation rate is critical for the formulation of sound monetary policies.

Munyeka (2014) bases his study on this statement when examining the relationship between inflation and economic growth in South Africa using quarterly data from 1993 to 2011. The study used a linear regression model. The results concluded a negative long run relationship between inflation and economic growth, which means inflation hinders South Africa's economic growth.

Bittencourt et al. (2015) examined the role inflation plays as a determinant of economic growth in SADC countries, including South Africa. The panel study was for the period between 1980 and 2009. The results suggested that inflation has been detrimental to the economic growth of the SADC region. This study also concluded that inflation in this region triggers the “Mundell-Tobin” effect, and this cripples economic activity and consequently hinders economic growth.

Phiri (2018) conducted a nonlinear regression analysis on the impact inflation has on South Africa’s economic growth by examining threshold effects between these two variables from 2001Q1 to 2016Q2. The results approved the targeted inflation bracket. However, the study advises that the upper level of the inflation target should be lowered to 5.3% since the threshold was 5.3% to create a sound financial environment. Hence it is concluded that inflation is one of the determinants of economic growth in South Africa.

Since it can be observed that in South Africa, inflation tends to stunt economic growth in the long run, high inflation rates should call for concern. As mentioned in section 1.1., the adoption of inflation targeting as a tool to ‘regulate’ inflation levels is still widely criticized; the suggestion is that this regime is abandoned to make room for economic growth.

2.5. Conclusion

This chapter detailed the review of literature on the subject of this dissertation. Section 2.1. details the conceptual framework employed by this study, where unemployment and inflation are thoroughly defined. Section 2.2. details the theories relating to inflation and unemployment, followed by section 2.3. which details the empirical literature on the correlation between inflation and unemployment. Under this section is Subsection 2.3.1. which provides for the relationship between these two variables in question from an international perspective. Sub-section 2.3.2. follows thereafter and explores the relationship in the South African economy.

An empirical analysis by several researchers with controversial, and opposing results, confirms the need to researched the topic and to conduct the research again with newer information and with a longer period after the Financial crisis of 2008.

All these further supported the need for this type of research on the economy such as that of South Africa as conflicting conclusions were reached under both the theoretical and the empirical modules.

The conceptual frameworks of this research are guided by the original Phillips Curve and the NKPC, with the original Phillips Curve being the theoretical framework in this study.

CHAPTER THREE

METHODOLOGY

3.0. Introduction

This section outlines the methods, econometric techniques that the researcher will follow during the data collection and regression analysis. This is a quantitative research study that will include estimating and running econometric regressions. Section 3.1. describes the nature of this research, while section 3.2. details the specified modelling this research uses. Section 3.3. further provides details on the nature of this research namely, the sampling, the sources of data and the data transformation procedures this research will follow. Section 3.4. through section 3.6 detail the estimation procedures this research follows and the last section, section 3.7. provides the limitations of this research.

3.1. Time series methods

This is a time-series study that means time-series observations will be observed, independent of time, unlike cross-sectional observations that depend upon points in time. What is most notable about time-series observations is that, according to Koop (2013), time-series observations estimate different values at different periods. According to Enders (2010), the following points can be noted from time-series data:

- Time series often portray clear trends
- Time series volatility are con constant over time
- High degrees of persistence can be observed from time-series shocks

Gujarati (2004) states that these properties of time series data may inflict a threat, such as generating spurious regressions when estimating statistical models. Therefore, this study will first examine the statistical properties of the data series employed before attempting to explore other estimation methods.

3.2. Model specifications

Based on literature review, one can conclude that inflation and unemployment have always been seen as a country's main determinants of economic development and

according to Zhang (2017), from the continuously growing literature on the Phillips Curve framework, one can also conclude that this theory provides an important basis for monetary policy. This is why this study will employ different versions of the Phillips Curve while using the original Phillips Curve as the main theoretical framework.

3.2.1. The general 'full form' of the Phillips Curve

This study specifies two general models for the Phillips Curve's main variables, i.e., the unemployment "slack" and the output gap. This is based on the Phillips Curve principle, which implies that these two variables are expected to hold different signs.

As mentioned in the theoretical literature section, A.W Phillips' study focused on the relationship between wage inflation and the unemployment rate (U_t), concluding that a trade-off exists between these two variables in the long run. The study by Friedman in 1968 extended Phillips' theory by adding the natural unemployment rate ($\hat{U}_t$) as another exogenous variable. Here the unemployment rate deviation ($U_t - \hat{U}_t$) is taken as the main exogenous variable.

According to Okun's Law, when this theory holds in a specific economy, the implication is that there exists a long run relationship between inflation and the output of that concerned economy. Therefore, the output lag deviation, derived from its "steady-state" ($y_t - \hat{y}_t$), will be used as the economic growth proxy. The two distinct model specifications for the unemployment 'slack' and the output gap are as follows:

1. Unemployment rate deviation

$$\mu_t = \beta_0 + \beta_1(U_t - \hat{U}_t) + \beta_2 E_t(\mu_{t+1}) + \beta_3(D_t{}^{crisis}) + \beta_4(\pi_t{}^{imp}) + \beta_5(Oilprice_t) + \varepsilon_t \quad \dots (3.1)$$

2. Output gap deviation

$$\mu_t = \beta_0 + \beta_1(y_t - \hat{y}_t) + \beta_2 E_t(\mu_{t+1}) + +\beta_3(D_t{}^{crisis}) + \beta_4(\pi_t{}^{imp}) + \beta_5(Oilprice_t) + \varepsilon_t \quad \dots (3.2)$$ where,

μ_t is the inflation rate.

β_0 is the constant.

$U_t - \hat{U}_t$ is the unemployment deviation where U_t and $\hat{U}_t$ depict the unemployment and the natural unemployment rates, respectively.

$y_t - \hat{y}_t$ is the output gap deviation. To enable percentage interpretation of real GDP (Y_t), the log of GDP (lY_t) is defined as y_t, leaving $\hat{y}_t$ as the prospective level of output.

$E_t(\mu_{t+1})$ depicts expected inflation,

D_t^{crisis} is the crisis 'dummy',

π_t^{imp} is the import price inflation,

$Oilprice_t$ depict oil prices and

β_1 to β_5 are the parameters of estimates.

Furthermore, the original Phillips Curve theory states that β_1 should be statistically significant with a negative coefficient in Equation 3.1.and should be statistically significant with a positive coefficient in Equation 3.2.

Justification of the selected variables is provided in Section 3.2.4.

3.2.2. The traditional Phillips Curve model

This study employs the traditional Phillips Curve model theorized by Phillips (1958) as an initial model. According to this theory, the inflation rate is a function of specific variables which include constant and excludes the natural rate of unemployment as an inflation determinant. Therefore, this model is specified as follows:

(a). The unemployment rates (U_t)

$$\pi_t = \beta_0 + \beta_1(U_t) + \varepsilon_t \quad \text{...(3.3)}$$

where,

π_t is the rate of inflation,

β_0 is the constant,

U_t is the unemployment rate,

ε_t is the error term.

NB: here β_1 is expected to be negative, as mentioned above.

(b). The output log (y_t)

$$\pi_t = \beta_0 + (Y_t) + \varepsilon_t \quad \ldots (3.4)$$

where,

π_t is the rate of inflation.

β_0 is the constant.

Y_t is the log of real GDP.

ε_t is the error term.

NB: here β_0 is expected to be positive, as mentioned above.

3.2.3. The New Keynesian Phillips Curve

Since the NKPC is regarded as the 'superior' Phillips Curve version, this study also estimates it. As explained in section 2.2.6 under theoretical review, the NKPC is an extension of the original Phillips Curve, which considers the natural rate of unemployment and output levels in estimation. This study also considers that the NKPC theory states that the inflation rate is better explained by price rigidity in the long run.

This study follows the hybrid version of the NKPC, which includes both the forward- and backwards-looking inflation components, to examine the behaviour of certain economic agents and their respective dynamics. This version of the NKPC considers expected inflation and lagged inflation in explaining the level of inflation in an economy and its dynamics (inflation inertia).

The most important characteristic of the NKPC is that it enables determining the extent of the impact of the individual behaviours of both the unemployment deviation and the output gap deviation.

The hybrid versions of the NKPC this study adopt are specified as follows:

(a). The unemployment rate deviation ($\boldsymbol{U_t - \hat{U}_t}$)

$$\pi_t = \beta_0 + \beta_1(U_t - \hat{U}_t) + \beta_2 E_t(\pi_{t+1}) + \beta_3 \pi_{t-1} + \varepsilon_t \qquad \ldots (3.5)$$

Here, the unemployment deviation is the principal inflation determinant. β_1 represents the original Phillips Curve, and its coefficient is expected to be statistically significant with a negative value.

(b). The output gap deviation ($y_t - \hat{y}_t$)

$$\pi_t = \beta_0 + \beta_1(y_t - \hat{y}_t) + \beta_2 E_t(\pi_{t+1}) + \beta_3 \pi_{t-1} + \varepsilon_t \quad \text{... (3.6)}$$

Here, the output gap deviation is the principal determinant of inflation and similarly, β_1 represents the original Phillips Curve where the coefficient is expected to be statistically significant with a positive value.

3.2.4. Justification of selected variables

Apart from the core variables of the Phillips Curve theory, i.e., inflation, unemployment rates and/or unemployment deviation, this study employs the output deviation, expected and lagged inflation rates, global financial crisis (dummy variable), import prices, as well as oil prices in the regression analysis. The use of these variables is motivated by existing empirical and theoretical literature as well as a personal contribution to literature based on theories, as briefly summarized below:

Output deviation

As previously mentioned in Section 3.2.1., this study uses the output lag deviation as an economic growth proxy in the estimation of the 'full form' Phillips Curve, i.e., the New Keynesian Phillips Curve. The motivation behind the adoption of this variable is motivated by Okun's Law theory, a theory that examines the relationship between the rates of unemployment and economic growth in a specific economy. This theory implies that, according to Wen and Chen (2012), when it holds in a specific economy, the assumption is that there exists a positive relationship between changes in employment and changes in output levels. This simply implies that based on the validity of this theory within a particular economy, it can be determined how much of GDP may be lost when the rate of unemployment exceeds the natural rate of unemployment.

Expected inflation

Expected inflation plays a vital role in determining the observed inflation rates. This may be attributed to the fact that both firms and households first consider the expected rate of inflation before taking major economic decisions (Bullard, 2016). The assumption is that, according to Bullard (2016), these decisions influence the rate of actual inflation. Since South Africa is assumed to be a forward-looking inflation economy, adopting expected inflation as one of the control variables in regression analysis is justified.

Global Financial Crisis, import and oil prices

South Africa is an open economy and is therefore prone to global economic conditions. Therefore, the Global Financial Crisis (GFC), import and oil prices are employed as proxies of the global economy.

3.2.5. Structural breaks

It is important to account for structural breaks when estimating econometric models as this enables possibly significant changes in the time-series data to be accounted for as well. De Gaetano (2018) points out that structural breaks may result in estimation failure as unaccounted-for structural breaks may induce instability in a model's parameters.

Therefore, for the structural breaks concern, this study employs the Chow test procedure to examine the effects of the global financial crisis spanning from December 2007 to June 2009. This structural break test separates the chosen period into two subsamples, where the parameter for each sample is estimated, and the F stat is used to examine the equality of the two subsamples.

3.2.5.1. Subsamples

The chosen study period for this study is 1994Q1 to 2019Q4. Using the Chow test, this period will be separated into two sub-samples at the structural breakpoints, and these will be re-estimated into the original Phillips Curve form, which excludes the financial crisis dummy variable as this variable will be accounted for in the Chow test.

3.3. Sampling, data sources and data transformation

Study sample

This study conducts a time series analysis of the South African economy for the period 1994Q1-2019Q4. The unemployment rate, unit labour costs, total government expenditure, import prices, and the nominal Gross Domestic Product (GDP) data were all sourced from the SARB, while the Consumer Price Index, exchange rate & interest rates were all sourced from the International Monetary Fund (IMF). The output gap, expected inflation, and the natural rate of unemployment computed using the HP filter.

The inflation rate, forward-looking inflation and backwards-looking inflation will be computed with CPI and GDP data using the following formulae:

$$infl = \frac{cpi - cpi(-1)}{cpi(-1)} \times 100 \qquad \dots (3.7)$$

$$backinfl = infl \times 1 \qquad \dots (3.8)$$

$$forwinfl = infl \times (-1) \qquad \dots (3.9)$$

$$GFC = dummy\ variable \qquad \dots (3.10)$$

This study uses the E-Views 10 statistical package in the data analysis processes.

It is important to conduct a pre-estimation inspection of data before executing any empirical econometric procedure. This will help to understand the core features of the data used. This section provides a preliminary analysis of the characteristics of the time series data this study uses.

Sources of sampled data

Table 3. 1 Sources and description of variables

Variable	Source	Frequency	Unit of measure	Code
Consumer price index	FRED	Quarterly	Index	ZAFCPIALLQINMEI
Unemployment rate	SARB	Quarterly	Percentage	KBP7019K
Oil Prices	FRED	Quarterly	USD	POILBREUSDQ
Real GDP	FRED	Quarterly	Percentage	ZAFGDPRQPSMEI
GDP Deflator	FRED	Quarterly	Index 2015=2010	ZAFGDPDEFQISMEI
Import prices	SARB	Quarterly	R Millions	KBP6014D

Global Financial Crisis	E-views (binary variable)	Quarterly	N/A	N/A

Source: Researcher's computations

The table above contains sources and description of the data used in this study. As can be seen, the data were obtained from 2 different i.e., SARB and FRED. Data were obtained from two different sources because data of some variables in use in this study is not available on the chosen frequency, and converting data from a certain frequency to another can result in the data losing its "quality", which may lead to unreliable estimations. To account for the effects the Global Financial Crisis had on our core variables, this study creates, using E-Views, a dummy/ binary variable, a proxy for the crisis, created based on the occurrence dates of the crisis.

Data transformation

Natural log transformation

This study conducts a natural log transformation to all variables not sourced as percentages to enable coefficients to be interpreted as percentage changes. Another benefit of such a transformation is that, according to Gujarati (2004), it can reduce the heteroskedasticity of the data series.

3.4. Overview of estimations

Pre-estimation tests are tests performed on the data before the actual estimations. These tests ensure that the data is suitable and meet all the econometrics estimation conditions. The first pre-estimation test this study conducted is the causality test which determines the causal direction between the variables in question. Thereafter, to determine the integration orders of the variables used in this study, the unit root testing procedure was conducted. It is through results obtained from this test that the ARDL estimation technique was chosen as the most suitable for this study. This is why, therefore, the ARDL Bounds testing approach was conducted as the most suitable test for cointegration. From the results obtained from the Bounds test, either the ARDL procedure or the ECM procedure was employed to examine the short-run dynamics of the variables within a model in question. Thereafter the long run dynamics were examined. Lastly, in ensuring that the estimated models are valid, model diagnostics

such as structural break tests, multicollinearity tests, autocorrelation tests, to name a few, were carried out on all estimated regressions.

3.5. Pre-estimation tests

3.5.1. Causality

Notably, a relationship between variables is not necessarily evidence of causality between those variables concerned. Therefore, it is of paramount importance that we perform a causality test to empirically prove the direction of influence, or the lack thereof, of the impact amongst variables.

Enders (2014) states that causality tests are performed to determine whether a particular variable's equation consists of another variable's lags or not, i.e., whether one variable can help strengthen another variable's forecast and, if so, to what extent.

3.5.1.1. Granger Causality test

This study's main aim is to test if there exists a negative correlation between inflation and unemployment in the specified period. As can be observed in the literature review section, there are contradicting opinions on the short and long-run relationships of inflation and unemployment. Therefore, to test for the long-run causal relationship between these variables, the Granger Causality approach as developed by Granger (1969) is employed. The idea behind this causality theory is that X causes Y if X's former values can be used to explain Y. If, upon estimating, the lagged x coefficients are significant, the implication is that the null hypothesis suggesting that x is not caused by y, is rejected. Granger (1969) suggested that x is caused by y if the lagged x values can be used to forecast y values and vice versa.

3.5.2. Unit root test

According to Nelson and Plosser (1982), macroeconomic variables in time series data often contain unit roots which may consequently deem estimated regressions invalid and spurious. This is why, therefore, it is important to determine integration "properties" of a time series data set before attempting to run/ estimate regressions.

Testing for unit root is conducted to determine the degree of stationarity in a data set as done in this study. To be deemed stationary and therefore valid, data sets are expected to possess the following characteristics:

- The data set mean is expected exhibit long-run consistency
- Variances are to be restricted and constant over time
- Theoretical autocorrelation should diminish as the width logs

It is vital for time series data sets to possess these characteristics to ensure validity of the estimated regressions. Notably, stationary time series data sets are able to absorb shocks within a regression, making it possible for means to remain fixed in the long term.

3.5.2.1. Augmented Dickey-Fuller (ADF)

In this study, the ADF is used as the principal stationarity test procedure. This procedure originates from Dickey and Fuller (1981). Sumera and Amjad (2016) numerically illustrate the ADF as follows:

$$\Delta X_t = \delta X_{t-1} + \sum_{j=1}^{q} \emptyset_j \, \Delta X_{t-j} + e_{1t} \qquad \dots (3.11)$$

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{j=1}^{q} \emptyset_j \, \Delta X_{t-j} + e_{2t} \qquad \dots (3.12)$$

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{j=1}^{q} \emptyset_j \Delta X_{t-j} + e_t \qquad \dots (3.13)$$

Where X_t is the time series under scrutiny, t is time, and εt is the error term. Time series ADF hypotheses are as follows:

- H0: δ = 0, implying the series in question is non-stationary, i.e., has unit root
- H1: δ < 0, implying that the series in question is stationary

In stationarity testing, a comparison between the estimated ADF t critical coefficients and estimated t stat coefficients of the are X_{t-1} is made. If the observed t stat exceeds the observed t critical, the null hypothesis is rejected, implying the data set in question is stationary, ceteris paribus, the opposite is true. All the variables employed by this study will undergo this procedure.

3.5.2.2. Phillips-Perron test (PP)

The PP technique is used as the confirmatory procedure following the ADF stationarity test analyses. The main difference between the PP and the ADF is that the PP pays no attention to serial correlation, whereas the ADF takes it into consideration and includes "parametric regression" when estimating. Phillips and Perron (1988) developed this time-series unit root testing approach to developing a simple test for unit root testing that test against the trend and stationary alternatives in a univariate time series. In the Phillips-Perron test for unit root testing, only the first-order autoregression is estimated with the constant and the 'transformed' Zt calculation is performed. Simultaneously, the adopted distribution theory is the critical values and asymptotic, which is based on Fuller (1976). The Phillips-Perron test takes the following form:

$$\Delta y_t = \mu + \alpha_{t-1} t + \sum_{i=1}^{n} \gamma_i \Delta \gamma_{t-1} + \varepsilon_t \qquad \dots (3.14)$$

Where t is the time series, μ = constant, Δ is the operator of differencing, and ε depicts the error term.

Suppose the Phillips-Perron results portray that the variables are stationary after the first difference I (1). In that case, this will mean we will have to adopt the Johansen test to test for co-integration of variables.

3.5.3. Cointegration analysis

3.5.3.1. ARDL bounds testing

In the Autoregressive Distributed Lag Model (ARDL), the dependent variables in time series models are often correlated with their time lags and independent variables. The bounds test is based on the assumption that the variables are integrated of order zero i.e., I (0) or integrated of order one i.e., I (1). Before the testing of co-integration, a test for the order of integration of each variable was conducted using the ADF and the PP tests. Although the ARDL bounds test approach is able to use variables integrated of order one or two, stationarity testing remains important and it ensures that variables integrated of order two or above are excluded from estimations as they may invalidate estimated regressions, deeming the results spurious.

Therefore, according to Ergun and Gosku (2013), the lags of dependent variables should also be considered in the modelled regression. In such a model, the dependent variable depends on both its lags and those of independent variables. The ARDL bounds testing approach as this method is, according to Pesaran and Shin (1999) and Pesaran et al. (2001), the most preferred methodology of testing cointegration. This approach is based on the Unrestrictive Vector Error Correlation Model, which enables better estimations of short and long-run relationships when compared to other traditional estimation methods. Pesaran et al. (2001) suggest that this cointegration technique can be used to test the long-run relationship between variables at levels without necessarily having to perform any pre-estimation tests. Although it is so, it is important to still perform a unit root test to avoid estimating with data stationery at 2nd difference or higher, to avoid spurious regressions.

One major advantage of using the ARDL test for cointegration is that it can be conducted using variables with different integration orders. i.e., it can be applied regardless of integration orders. Another benefit of choosing this method is because it allows for a sufficient number of lags to be taken into account when estimating regression equations, as Nkoro and Uko (2016) state. Other benefits of adopting this method for cointegration testing is that it has many advantages when compared to other older cointegration test procedures, which include the fact that it can be employed to test for a relationship between independent variables at any order, irrespective of the order of integration of concerning variables, but as long as they are not stationary at 2nd order. Another advantage of this method is that it makes it possible to derive an unrestricted error correction model (ECM) through performing a simple linear transformation. Another notable advantage of the ARDL bounds testing method is that existing empirical results show that this technique is superior compared to most cointegration techniques and provides consistent results for small-sized samples (Pesaran et al., 2001).

3.6. Estimation tests

Econometric modelling using various techniques allows researchers to explain econometric relationships and behaviours among variables. Therefore, this implies that the main goal of constructing economic models is to analyse and predict the economic behaviour of economic variables. It is important to note that the choice of the econometric modelling technique chosen for a particular study, such as this one,

is primarily based on the data and its characteristics discovered after performing the mandatory pre-estimation tests.

Therefore, to test for the hypotheses stipulated in section 1.4, this study will estimate equations *(3.1.)* and *(3.2.)* using the ARDL and VAR models, respectively.

3.6.2. Vector Error Correlation Model

If upon unit root testing, the variables are stationary at order one and if the Johansen procedure points to the existence of co-integration amongst the variables, this study will employ the Vector Error Correlation Model (VECM) to determine the short-run relationships between the regressed and regressor variables. Therefore, the VECM can be regarded as the VAR model with co-integration constraint since each VAR equation is an autoregressive distributive lag model. According to Vukeya (2015), the VECM is an exceptional VAR case that parents the Error Correlation Mechanism (ECM) term and that the VECM is the most used econometric method, simply because the ECM technique can adequately deal with spuriosity problems.

3.6.3. Autoregressive Distributed Lag Model

The ARDL Bound approach is adopted as the most suitable method of cointegration as guided by integration orders of the variables. as this method is, according to Pesaran and Shin (1999) and Pesaran et al. (2001), the most preferred methodology of testing cointegration. The ARDL approach is based on the Unrestrictive Vector Error Correlation Model, enabling better estimations of short and long-run relationships compared to other traditional estimation methods. One main benefit of using the ARDL test for cointegration is the fact that it can be conducted using variables with different orders of integration, i.e., can be applied regardless of integration orders. Another benefit of choosing this method is because it allows for a sufficient number of lags to be taken into account when estimating regression equations, as Nkoro and Uko (2016) state.

Following Ergun & Gosku (2013), an ARDL model taking the following general (p, q) linear regression form will be estimated:

$$Y_t = Y_{oi} + \Sigma^{p}{}_{i=1}\, \delta_i\, Y_{t-i} + \Sigma^{q}{}_{i-0}\beta^{\square}{}_{i}\, X_{t-i} + \varepsilon_{it} \qquad \dots (3.15)$$

Where $Y^{\square}_t$ are a vector, and the variables in $(X^{\square}_t)$' are expected to be integrated of I(0) or I(1); β and δ are coefficients; Y_{oi} is the constant; i = 1, … , k; p, q depict the most suitable lag lengths; ε_{it} is the error term

This model is classified as an ARDL model since both X and Y are the independent and dependent variables, respectively, lagged only once. It is notable that when the ARDL model, such as equation 19 above, is estimated, the length of the independent and dependent variables lags, i.e., p & q, is not automatically the same. Therefore, it is important to note that an appropriate and sufficient number of lags is of paramount importance in a vigorous ARDL model to obtain a valid statistical conclusion.

The ARDL estimation technique makes the exploration of econometric relationships between variables possible to understand and manoeuvre while also making it possible and easy to extract short-run model dynamics from long run relationship estimations.

3.7. Post-estimation tests

These are tests conducted after all the regressions have been estimated. Post-estimation tests

3.7.1. Diagnostic tests

To ensure statistical soundness and relevance of the estimated regressions, diagnostic inspections on the estimated models are carried out. This study applies a number of diagnostic tests to ascertain that the OLS assumptions are not violated. These tests are briefly outlined below:

Heteroskedasticity

One of the OLS assumptions states that for every observation $V(u_t) = \sigma^2$. This means the error term has a constant variance, which means heteroskedasticity over a specific sample period. Heteroskedasticity is a situation that occurs when the variability of a variable is not equal across the range of values of another variable that predicts it.

In heteroskedasticity, a scatter plot, i.e., the variability of dependent variables would depict a cone-like shade as it widens as the independent variable gains momentum. The violations of this OLS assumption result in misspecified and flawed t and f stats, which may imply that regression runs are insignificant, and the results are misleading.

Therefore, following recommendations provided by Gujarati and Porter (2009), to test for heteroskedasticity, this study employs the white test, which according to Ergun and Gosku (2013), is used to detect a linear form of heteroskedasticity as well as the Breusch-Pagan test which implies, according to Asteriou & Hall (2011), that a random variable series is heteroskedastic if the variances computed are also random.

Autocorrelation

According to Gujarati and Porter (2009), autocorrelation refers to the interdependence of observations within a series over time. Autocorrelation stems from the OLS assumption that states that covariances among disturbance terms equal to zero. The problem of autocorrelation arises when time series models are specified with insufficient lags or when significant explanatory variables have been omitted from the regression. The misspecification as a result of the excluded explanatory variables results in what is known as positive autocorrelation, rendering the regression spurious (Ergun & Gosku, 2013)

To test for autocorrelation, this study uses the graphical method as well as the Breusch-Godfrey LM-test, which was developed by Breusch and Godfrey (1978)

Suppose the below OLS model is estimated:

$$Y_t = \delta_1 + \delta_2 X_t + \delta_3 Z_t + u_t \quad \dots (3.16)$$

Now suppose the residuals equation is a follows':

$$u_t = \varphi_1 u_{t-1} + \cdots + \varphi_q u_{t-q} + \delta^*_1 + \delta^*_2 X_t + \delta^*_3 X_3 + \varepsilon_t \quad \dots (3.17)$$

Where H_0 (null hypotheses) is $\varphi_1 = \varphi_2 = \dots = \varphi_q + 0$ implies the absence of autocorrelation (Fstats tests that all φ are 0)

Normality test

Another OLS assumption is that error terms should be normally distributed. Satisfying the normality test of error terms enables the hypothesis testing to be statistically significant and also the generation of reliable confidence and prediction intervals.

This paper uses a graphical illustration to assess the normality of the error terms by plotting a "normality probability plot". For the residuals to be considered normally distributed, they are expected to follow a straight line on the scatter plot. To empirically test for normally, the Jarque-Bera test will be employed. According to Ergun and

Gosku (2013), the JB test for normality is expressed by 3rd and 4th moments of disturbances such as:

H_0 : Residuals are normally distributed

$$JB = (n - K)\left(\frac{s^2}{6} + \frac{(K-3)^2}{24}\right) \quad \ldots(3.18)$$

S is a measure of skewness

$$S = \frac{\mu_3}{\sigma^3} = \frac{\mu_3}{(\mu_2)^{3/2}} \quad \ldots(3.19)$$

K is a measure of Kurtosis

$$K = \frac{\mu_4}{\sigma^4} = \frac{\mu^4}{(\mu_2)^2} \quad \ldots(3.20)$$

So K and S will equal to 3 and 0 respectively when the variables are normally distributed.

Stability tests

Stability tests are carried out to ensure the validity specification of the regression's error correction. This paper uses the Recursive Estimate test to test for the correctness of this specification. According to Asteriou & Hall (2011), incorrectly specified models might result in higher R^2 which may therefore result in spurious regression and ultimately misleading regression results.

CUSUM Squares test is employed to examine the stability of the long run models. This test examines whether the models portray any structural breaks for the study period and confirm whether these models can be referred to for reliable behavioural predictions.

Test statistics (t stats)

According to Foley (2011), the t stat is used to test the hypothesis about means (μ) of unknown populations where σ is unknown. Studenmund (2006) suggested that t statistics test the coefficient hypothesis slope of an individual regression. This study used the t stats to calculate the slope coefficients between inflation, unemployment and independent variables, particularly the inflation rate. According to Gujarati & Porter

(2009), a decision about the null hypothesis can be made, whether to reject or accept, based on the t statistic value.

Correlation

Correlation is an econometric tool used to portray the strength of the relationship, if there are any, of the variable pairs. This study uses a correlation in explaining how unemployment and inflation variations are related to the independent explaining variables. A -1 coefficient of correlation implies that a perfect negative correlation between the variables concerned exists, and a coefficient of 1 is evidence of a positive correlation.

F Test

This component is used in testing the R^2 significance. For a model to be statistically significant, the F probability has to be < 0.05, rejecting the null hypothesis, which implies that there exists a non-linear correlation between the dependent and the independent variables, ceteris paribus, the opposite is true. The following is the F equation:

$$F = \frac{R^2}{k} \frac{1 - R^2}{n - k - 1} \qquad \ldots (3.21)$$

3.8. Limitations of the study

The suitable methodological modelling approach that the study used, the ARDL, cannot explore the relationship between variables with unit roots as this may result in spurious regressions (Oxera, 2010). Therefore, before attempting to estimate any regression, regardless of the chosen methodology, the appropriate pre-estimation tests such as cointegration tests are of paramount importance to avoid problems arising from the unit root problems.

3.9. Conclusion

Here, a detailed analysis of the data and statistical techniques used in exploring the data to achieve the study's specified aims and objectives. All the econometric procedures performed by this study in the following study are explained in this chapter.

The first section, Section 3.1. briefly details on time series methods and its suitable data characteristics. Section 3.2. provides for the model specifications used in this

study. Subsection 3.2.1. details the “full form” Phillips Curve and specifies the deviations used in this study, i.e., the unemployment rate deviation and the output gap deviation, while section 3.2.2. details the traditional Phillips Curve model. Section 3.2.3. provides for the NKPC model specifications. The following section, i.e., Section 3.2.4. provides for the justification of the variables employed by this study and Section 3.2.5. provides for the structural breaks affiliated with the Global Financial Crisis.

Section 3.3. details the study sample, its span, data sources as well as the data transformation techniques. Section 3.4. details the estimations overview, followed by Section 3.5. which details the pre-estimation procedures this study followed. Here causality techniques are detailed in Sub-section 3.5.1., followed by the stationarity tests techniques in Sub-section 3.5.2 and the cointegration test techniques in Sub-section 3.5.3. Sections 3.8. provides for the limitations of this study.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.0. Introduction

This chapter contains the data analysis and discussion of the study results. The chapter is divided into three sections. Section 1 examines the descriptive statistics and the pre-and post-diagnosis tests of the model used in this study. Section 2 presents and discusses the results of the long run equation estimated using the ARDL approach and the results of the estimated causality between inflation and unemployment. This section presents the results of the Error Correction Model for the selected ARDL model and a general discussion of the results. Section 4 is presented, containing the general description of the chapter.

4.1. Data Variability Measures

The behaviour of both the dependent and independent variables, that is, inflation (INF), oil price (LGOILPR), unemployment (LGUNEMP), expected inflation (LGEXINF), real gross domestic product (LGRGDP), unemployment deviation (LGUNEMPD), output deviation (LGOUTPD) and import price inflation (LGIMP)) including the mean, median, skewness, and standard deviation, among others, are illustrated in the summary of descriptive statistics Table 4.1.

Table 4. 1 Summary of descriptive statistics

	INF	LGUNEMP	LGUNEMPD	LGRGDP	LGOUTPD	LGOILPR	LGIMP	LGEXINF
Mean	1.9883	1.3822	-0.1519	0.3224	0.2049	1.6365	5.7995	1.9883
Median	1.9881	1.3909	-0.1144	0.4347	0.2739	1.7005	5.8468	1.9881
Maximum	2.0096	1.4669	0.5058	0.7835	0.6446	2.0872	6.0020	2.0096
Minimum	1.9728	1.2279	-2.0581	-1.3142	-2.6979	1.0449	5.4807	1.9728
Std. Dev.	0.0083	0.0540	0.4601	0.4131	0.3672	0.2998	0.1588	0.0083
Skewness	0.2244	-0.9582	-1.5634	-1.7516	-5.2840	-0.2252	-0.2728	0.2244
Kurtosis	2.5708	3.8217	7.0505	6.4062	41.5899	1.8156	1.5196	2.5708
Jarque-Bera	1.6548	1.8389	31.4632	23.4560	4.1594	2.9577	1.7868	1.6548
Probability	0.4372	0.0000	0.0276	0.0124	0.1489	0.3080	0.6045	0.4372
Observations	103	104	104	104	104	104	104	103

Source: Researcher's computations

Results in Table 4.1 indicate that INF had a mean value of 1.9883 and a median of 1.9881. The standard deviation of INF was 0.0083, which was lower than the mean, implying less variation in the data. The maximum value of INF was 2.0096 whilst the minimum was 1.9728, with kurtosis of 2.5708, which is the measure of the peakedness of the data. The measure of skewness for INF was 0.2244, meaning that the variable was skewed to the right and the right tail is long relative to the left tail. The Jarque-Bera p-value for the data was more than 0.05, implying that the variable is normally distributed.

As for UNEMP, the results show a mean value of 1.3822 and a median of 1.3909. The standard deviation of UNEMP was 0.0540, which in this case, lower than the mean, implying a low variation in the data. UNEMP, in its logged terms, had a maximum value of 1.4669 and the minimum was 1.2279. On skewness, FDI has a negative 0.9582, thereby confirming that its data was skewed to the left. The Jarque-Bera p-value is low 0.05, thereby implying that the variable was not normally distributed. UNEMPD has a mean value of -0.1519 and a median of -0.1144. The standard deviation was at 0.4601, which is far higher than the mean implying high data variation. From the table, UNEMPD had a maximum value of 0.5058 whilst the minimum was -2.0581. The kurtosis was 7.0505. The measure of skewness on UNEMPD was negative 1.5634, and this shows that its data was skewed to the left. The Jarque-Bera p-value for UNEMPD was lower than 0.05, which indicates that data were not normally distributed.

In terms of RGDP had a mean value of 0.3224 and the median value of 0.4347. The measure of the variation, that is, the standard deviation with the value of 0.4131, was far much higher than the mean. This implies that there is a high variation in the data. The maximum value for RGDP was 0.7835, whilst the minimum was -1.3142. The kurtosis was 6.4062. RGDP has a skewness of -1.7516, meaning that its data was slightly skewed to the left. Lastly, for RGDP, the Jarque-Bera p-value was lower than 0.05, which also goes to imply that the variable was not normally distributed. The mean values for OUTPD, OILPR, IMP, EXINF were 0.2049, 1.6365, 5.7995, and 1.9883, respectively. The measure for variation indicated that OUTPD had high variation as indicated by a standard deviation value of 0.3672, whilst OILPR, IMP, and EXINF standard deviations values were 0.2998, 0.1588, and 0.0083, respectively. Moreover,

the measure for skewness indicated that OUTPD, OILPR, and IMP are negatively skewed whilst EXINF was positively skewed. Lastly, the Jarque Bera probability values signify that these variables are normally distributed.

Since it can be observed that the variables in question portray a mixture in the data variation/ distribution, the assumptions of the Central Limits Theory are taken into consideration. This theory suggests that the bigger the sample size, the more normal data distribution becomes.

4.2. Stationarity test results

As mentioned in the previous chapter, the stationarity of data in the time series is of paramount importance in econometric modelling. Stationarity tests are conducted to determine the integration properties of the data in a time series. These tests make it possible to avoid spurious regressions, which may produce misleading results upon estimations.

To find out if the Phillips Curve (the trade-off between inflation and unemployment) holds in South Africa, all the variables used in this study were first examined for unit root through the use of basic line and symbol graphs (see Appendix A). The unit root status of all variable was determined by the Augmented Dickey-Fuller (ADF) test and confirmed by the Phillips Perron (PP) test. This was done to ensure that the variables were not integrated of order two, i.e., I (2), to avoid spurious results under the ARDL model. Table 4.3 below shows the results of the unit root test using the ADF test.

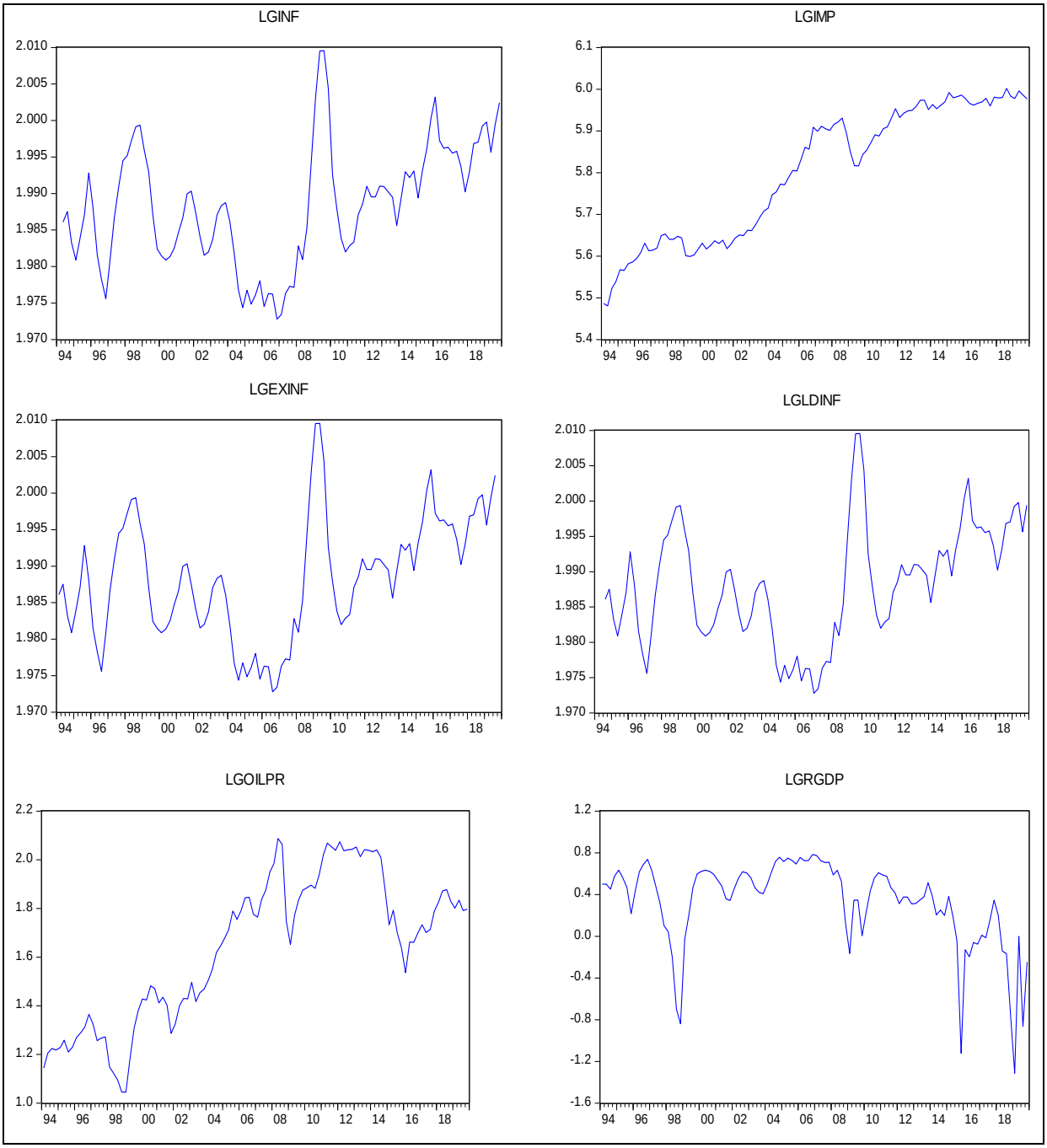
The graphic plots of variables at levels in Figure 4.1. gave an idea of the stationarity tests results obtained upon the stationary test. It can be observed that most of the variables chosen for this study are non-stationary at levels, implying that they have a unit root. This means that the only way to achieve stationarity for such variables is through differencing.

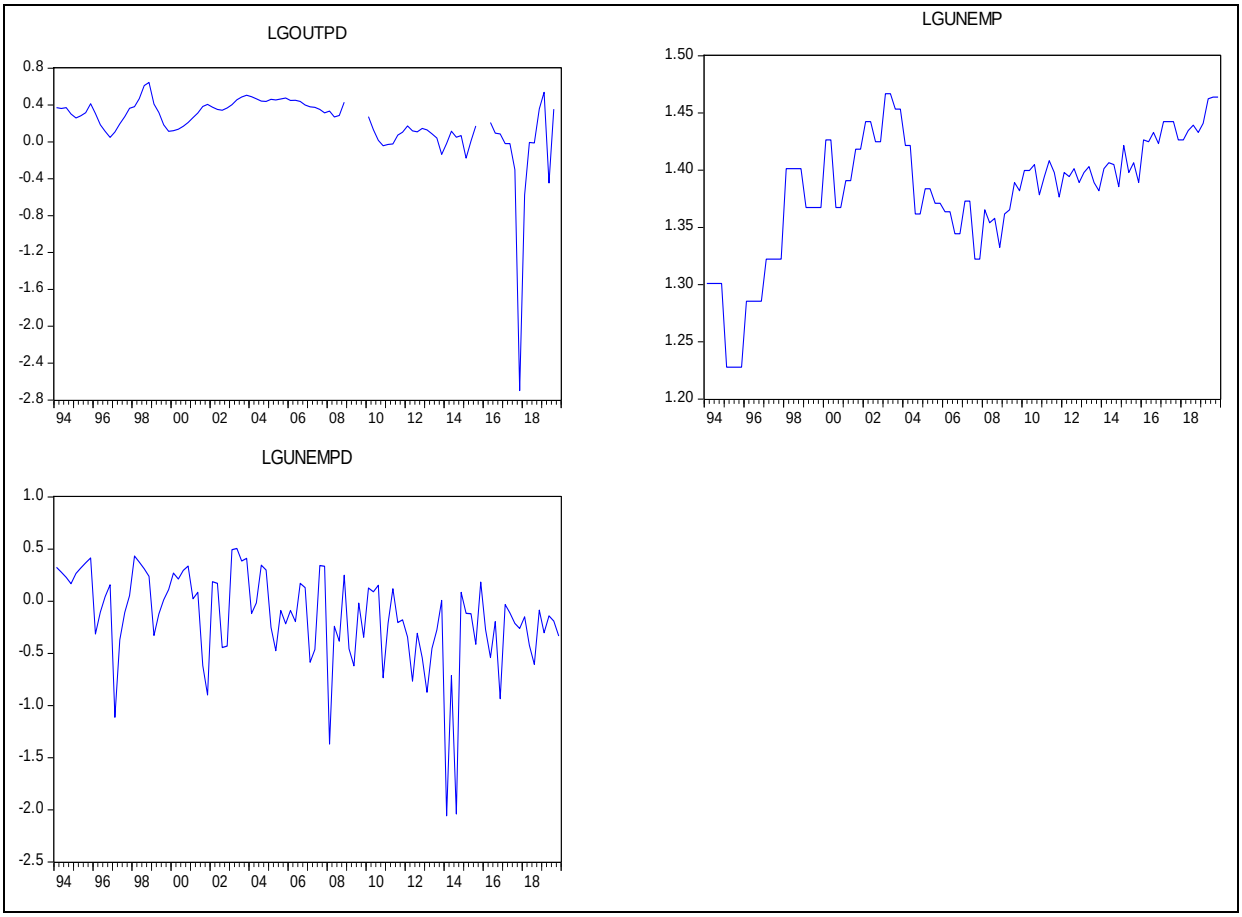
Therefore, this study used the ADF unit root testing procedure and the PP unit root testing procedure as the confirmation procedure. Both these testing procedures were conducted using the three-unit root components/equations in the following order:

1. Trend and intercept
2. Intercept
3. None

These unit root testing procedures are carried out to determine the significance of the restriction condition to identify the components of the unit root equation 3.13. in Section 3.5.2. These restriction conditions have to be appropriate enough for the variable in question, i.e., determine the stationarity level, which is the order of integration. That is why, therefore, all three-unit root components are included in the individual unit root equation.

Figure 4. 1 Graphical representation of data





Source: Researcher's computations

Graphical representation of all the variables at levels is presented in Figure 4.1. It can be observed that the unemployment deviation (LGUNEMD), real GDP (LGRGDP), the output deviation (LGOUTPD) are all stationary at levels. In contrast, all the other variables, namely, the inflation rates (INFL), the unemployment rates (LGUNEMP), oil prices (LGOILP), import prices (LGMP) and the expected inflation (LGEXPINF), all portray an upward trend.

Table 4. 2 Unit root test results

Variable	ADF statistic		Phillip-Perron		Order of Integration
	Level	1st difference	Level	1st difference	
INF	0.6804	-3.7811**	-2.7778	-5.5697**	I (1)

LGUNEMP	-2.7316	-11.1289**	-2.5535	-11.221**	I (1)
LGUNEMPD	-8.8143**	-10.3731	-8.8095**	-11.959	I (0)
LGRGDP	-3.5993**	-13.1791	-4.1074**	-15.5476	I (0)
LGOUTPD	-4.9426**	-5.7028	-6.3589**	-8.5565	I (0)
LGOILPR	1.3817	-7.9193**	-1.8092	-7.9193**	I (1)
LGIMP	-1.5097	-8.5706**	-1.759	-8.699**	I (1)
LGEXINF	1.6804	-3.7811	-2.7778	-5.5697**	I (1)

Source: Researcher's computations

**denotes the rejection of the null hypothesis of non-stationarity at a 5% significant level.

The ADF test tests the variables' non-stationarity null hypothesis against the alternative stationarity hypothesis. As can be observed from the second column of Table 4.3, when the regression is estimated at level, three of the variables (that is, LGUNEMPD, LGRGDP, LGOUTPD) are stationary where the values of the test statistic for all the other variables are less than the critical ADF value. All the other variables (INF, LGUNEMP, LGOILPR, LGIMP, LGEXINFL) become stationary after the first difference. Their respective test statistic values are greater than their respective ADF values in absolute terms at a 5% significance level. Therefore, the null hypothesis of non-stationarity can be rejected, accepting the alternative hypothesis of stationarity.

The results of the ADF test suggest that there is a mixed order of integration between the variables. When estimating, variables are used at their stationary level, which is often at the first difference. Non-stationary variables indicate the presence of a unit root which may offset estimated results. The same conclusion was reached from the Phillips-Perron test (see Table 4.3, column 4 and 5).

4.3. Diagnostic Test Results

Traditional Phillips Curve

To verify that the main model, i.e., the Traditional Phillips Curve, is suitable for the data under consideration, the pre-diagnostic tests, which includes the unit root and the

cointegration test, was performed. Thereafter, to validate the estimated model, post-diagnostic tests are performed, and the results are as follows:

Multicollinearity Test Results

To test for multicollinearity, the pairwise correlation matrix test is used. According to Gujarati (2004), correlation coefficients of 0.8 or above suggest that there exist high levels of multicollinearity between the independent variables in question, while only correlation coefficients below 0.8 are accepted in regression estimates. The table below contains the correlation matrix results

Table 4. 3 Pairwise Correlation Matrix Results

Variable	INF	LGUNEMP	LGUNEMPD	LGRGDP	LGOUTPD	LGOILPR	LGIMP	LGEXINF
INF	1.0000							
LGUNEMP	0.3830	1.0000						
LGUNEMPD	-0.1350	-0.1704	1.0000					
LGRGDP	-0.4690	-0.3693	0.0633	1.0000				
LGOUTPD	-0.1594	-0.1654	0.1778	-0.0073	1.0000			
LGOILPR	-0.0507	0.3103	-0.4129	0.0673	-0.2841	1.0000		
LGIMP	0.2498	0.4411	-0.4100	-0.2579	-0.3682	0.6920	1.0000	
LGEXINF	0.7070	0.3266	-0.1485	-0.4822	-0.2300	0.0292	0.3109	1.0000

Source: Researcher's computations

The results from the pairwise correlation matrix signify that multicollinearity does not exist among the exogenous variables. It can be observed from Table 4.3. that the pairwise correlation between all variables lies below 0.8, and as such, the researcher adopts the "do nothing" approach as suggested by Gujarati (2004) in such a situation.

Results of the ARDL Bounds Test for Cointegration

The initial step of the ARDL approach is to estimate the conditional VECM by ordinary least square to test for the presence of a long run relationship among the variables. This is done by conducting an F-test for the joint significance of the coefficients of lagged levels of the variables. If the F-statistics is above the Upper Bound, this denotes the rejection of the null hypothesis of no cointegration at a 1% or 5% level of significance. The results are shown in Table 4.4.

Table 4. 4 ARDL Bounds test results

Test Statistic	Value	K
F-statistic	9.1212	6

Critical Value Bounds

Significance	Bound ^{Lower}	Bound ^{Upper}
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84

Source: Researcher's computations

From Table 4.4, the calculated F-stat is 9.1212 which is greater than the upper critical bound of 5.73 at a 5% level of significance. This suggests that a long run association amongst the variables used in this study exists.

Structural break test

Structural breaks may result in serious changes in the time series data and result in misleading results if not considered. De Gaetano (2018) points out that structural breaks may result in estimation failure as unaccounted-for structural breaks may induce instability in the parameters of a model. The Chow breakpoint test holds the null hypothesis of no structural break. Therefore, structural break test results are presented in Table 4.5 below.

Table 4. 5 Chow Structural Break Results

Test	*Chi^2 statistic*	*Probability*
Chow	4.6739	0.3224

Source: Researcher's computations using E-views 10

Table 4.5. results indicate that we fail to reject the null hypothesis of no structural break at the specified dates; hence we conclude that the 2007-2008 global financial crisis had no significant effect on unemployment and inflation levels in South Africa within the Phillips Curve model.

Test for Heteroscedasticity

The Breusch-Pagan-Godfrey test was used to diagnose the model of any heteroscedastic error terms. The results of the test are shown in table 4.7.

Table 4. 6 Breusch-Pagan-Godfrey

F-statistic	2.0257	Prob. F (3,97)	0.1153
Obs * R-squared	5.9546	Prob. Chi-Square (3)	0.1138
Scaled explained SS	4.9098	Prob. Chi-Square (3)	0.1785

Source: Researcher's computations

From Table 4.6, since the probability value of the F-statistic is greater than 0.05, we do not reject the null hypothesis of homoscedasticity and conclude that the model is not heteroscedastic.

Test for Autocorrelation.

To examine for autocorrelation among the disturbance terms, the Breusch-Godfrey Serial Correlation LM test was used. The results are contained in Table 4.7.

Table 4. 7 Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.3014	Prob. F (2,95)	0.7405
Obs * R-squared	0.6369	Prob. Chi-Square (2)	0.7273

Source: Researcher's computations

Here, it can be observed that the p-value of the F-statistic is greater than 0.05, which means that the null hypothesis is accepted, concluding that there is no autocorrelation within the model.

Model Specification Test Results

The Ramsey RESET is used to check for specification errors within the model. A correctly specified model will generate an adequate picture of the relationship between inflation and unemployment. Results are contained in Table 4.8.

Table 4. 8 Ramsey RESET Test Results

	Value	Df	Probability
T-statistic	0.3690	96	0.7129

F-statistic	0.1362	(1, 96)	0.7129

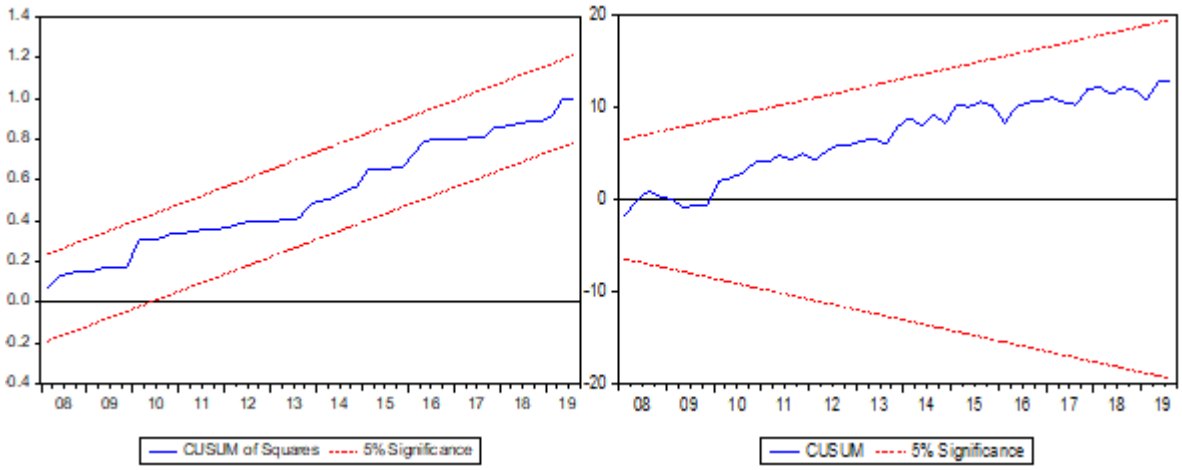
Source: Researcher's computations

The p-value of the RESET t stat is greater than the 5% level of significance and therefore the null hypothesis is accepted. This implies that the model is correctly specified.

Structural Stability test

To check the stability of the model, the study utilised the CUSUM and CUSUM of Squares Test. Given the results obtained in Figure 4.2 below,

Figure 4. 2 Structural Stability Test



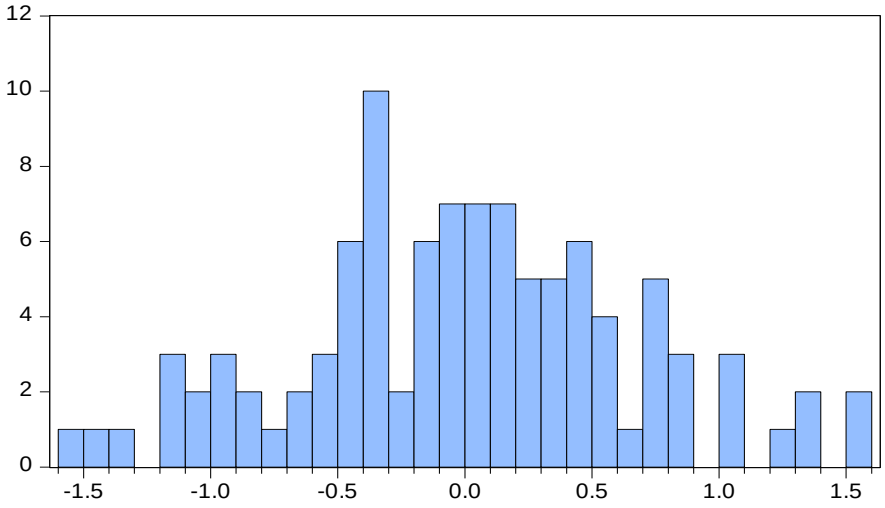
Source: *Researcher's computations*

The CUSUM and CUSUM of squares lie within the 5% boundary; hence the model is stable.

Normality Test Results

The study utilises the Jarque-Bera normality test to check for normality in the distribution of the residuals. A histogram is used to evaluate normality by exhibit the disturbance mean and associated levels of kurtosis and skewness, as illustrated in figure 4.3.

Figure 4. 3 Histogram- Normality Test



Series: Residuals	
Sample 1994Q4 2019Q4	
Observations 101	
Mean	3.15e-14
Median	0.000996
Maximum	1.558851
Minimum	-1.504091
Std. Dev.	0.659185
Skewness	0.041369
Kurtosis	2.787900
Jarque-Bera	0.218128
Probability	0.896673

Source: Researcher's computations

The Jarque-Bera stat of 0.2181 has a p-value of 0.8967, which is greater than 0.05, which implies that the disturbance term is normally distributed with a default minus 2 sample adjustment.

New Keynesian Phillips Curve Model

To confirm that the support model, i.e., the New Keynesian Phillips Curve model, is applied for the data under consideration, the pre-diagnostic tests and then the post-diagnostic test follow to validate whether the results are not spurious for analysis.

Structural break test

To test for the structural break(s) within the New Keynesian Phillips Curve, the Chow test was adopted, and the results are provided in Table 4.9 below.

Table 4. 9 Structural break test results

Test	*Chi^2 statistic*	*Probability*
Chow	6.2547	0.4315

Source: Researcher's computations

Table 4.9 results indicate that we fail to reject the null hypothesis of no structural break at the specified dates; hence we conclude that the 2007-2008 global financial crisis had no significant effect on unemployment and inflation levels in South Africa within the New Keynesian Phillips Curve model.

Test for Heteroscedasticity

Similar to the heteroscedasticity test procedure used in the traditional Phillips Curve, the Breusch-Pagan-Godfrey test was employed for the NKPC model. The results are presented in Table 4.10 below:

Table 4. 10 Heteroscedasticity test results

F-statistic	0.7973	Prob. F (4,98)	0.5297
Obs * R-squared	3.2464	Prob. Chi-Square (3)	0.5175
Scaled explained SS	8.2954	Prob. Chi-Square (3)	0.1852

Source: Researcher's computations

Here, it can be observed that the F-statistic probability value is greater than 0.05; therefore, this implies that the model does not suffer from heteroscedasticity as the alternative hypothesis of homoscedasticity is rejected.

Test for Autocorrelation

To test for the autocorrelation among the disturbance terms, the Breusch-Godfrey Serial Correlation LM test is used. The results are found in Table 4.11 below:

Table 4. 11 Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.3223	Prob. F (2,96)	0.7252
Obs * R-squared	0.6871	Prob. Chi-Square (2)	0.7093

Source: Researcher's computations

Here the F-statistic probability value is greater than 0.05, and this implies that this model does not suffer from autocorrelation as the null hypothesis is accepted.

Model specification test results

To check for specification errors in the model, the Ramsey RESET was employed. The results are presented in Table 4.12.

Table 4. 12 Ramsey RESET Test Results

	Value	Df	Probability
T-statistic	0.2516	97	0.7512
F-statistic	0.1275	(1, 97)	0.7384

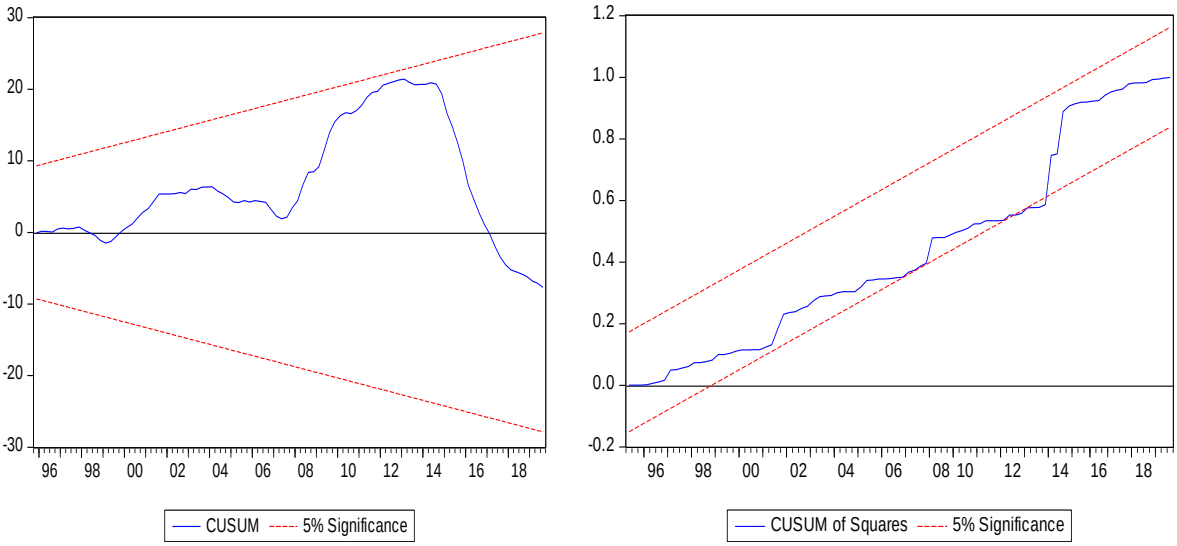
Source: Researcher's computations

Here, the null hypothesis is accepted, which implies that the model is correctly specified since the p-value of the RESET t stat is greater than the 5% significance level.

Structural stability test

To check the stability of the model, the study employed the CUSUM and CUSUM of Squares Test. Given the results obtained in Figure 4.4 below,

Figure 4. 4 Structural stability test



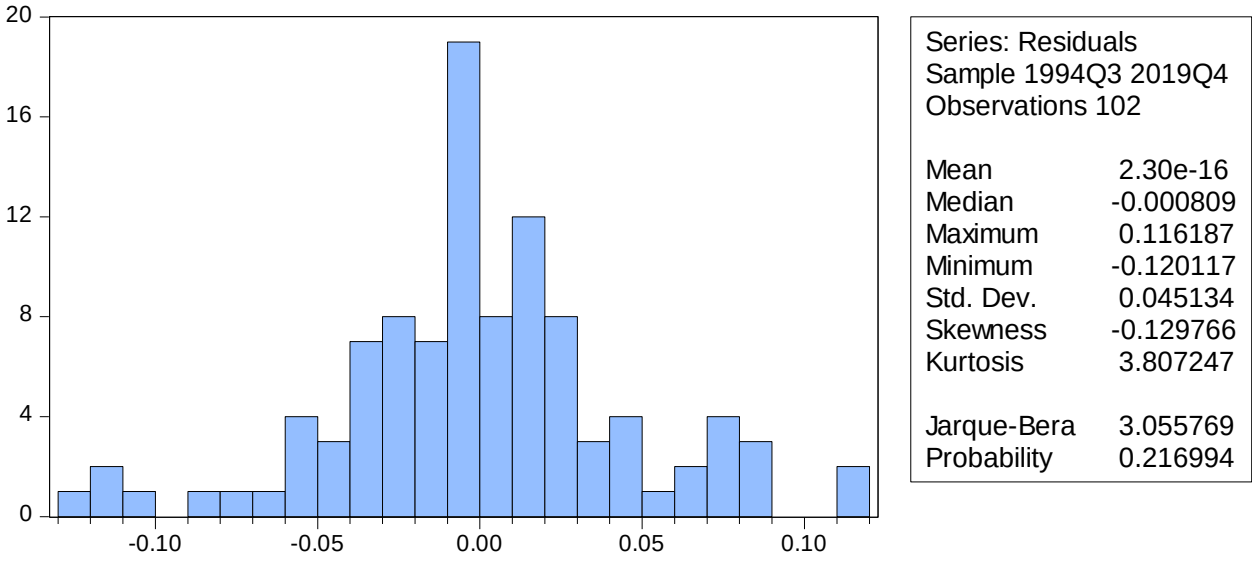
Source: Researcher's computations

The CUSUM and CUSUM of squares lie within the 5% boundary; hence the model is stable.

Normality Test Results

The study utilized the Jarque-Bera normality test to check for normality in the distribution of the residuals. The test uses a histogram to assess normality by showing the disturbance mean and associated levels of kurtosis and skewness, as shown in figure 4.5.

Figure 4. 5 Normality test results



Source: Researcher's computations

The Jarque-Bera statistic of 0.2181 has a probability value of 0.8967, which is higher than 0.05, implying that the disturbance term is normally distributed with a default minus 2 sample adjustment.

4.5. Estimated ARDL Regression Results

The results of the bounds test clearly show that there is a long run cointegration relationship among the variables; hence the estimation technique using ARDL (2.0) selected based on AIC for the optimal lag length. Additionally, the ARDL model can yield an Error Correction Term (ECT). The Error Correction Term captures the short-run dynamics of the system, and its coefficient measures the speed of adjustment to obtain equilibrium in the event of shocks to the system. The models were also examined for structural breaks using the Chow test, where no structural breaks were observed. The results obtained by normalizing on inflation (INF) are shown in Table 4.9. The coefficients indicate the long run elasticities, whilst the ECT coefficient signifies the speed of adjustment.

Table 4. 13 Estimated ARDL Regression Results

Cointegrating Form				
	Traditional Phillips Curve		New Keynesian Phillips Curve	
Variable	Unemployment rates	Output log gap	Unemployment rate deviation	Output deviation
ECT	-0.1432***	-0.2619***	-0.4888***	-0.6995***
Long Run Coefficients				
Constant	-85.9977***	-18.4759***	34.2444***	45.5705***
LGUNEMP	-8.2680			
LGRGDP		3.4265***		
LGUNEMPD			-0.0104*	
LGOUTPD				-0.0158***
LGEXINF			22.7142***	22.3062***
GFC			-0.0665***	0.0043
LGIMP			-0.1526***	-0.1785***
LGOILPR			0.0657***	0.0767***

Source: Researcher's computations

*** ** (*) denote the rejection of the null hypotheses at 1%, 5% (10%) level of significance*

The ECM (ECT) results are statistically significant at 1% level and have a negative sign as desirable for all the models. This is an indication of the joint significance of the long run coefficients. From Table 4.13, the estimated coefficient of the ECM is -0.1432, -0.2619, -0.4888, and -0.6995 for Unemployment rates, Output

log, Unemployment rate deviation and Output gap deviation models, respectively. This reflects a low speed of adjustment to equilibrium after a shock. This is approximately more than 14.32%, 26.19%, 48.88%, and 69.95% (for Unemployment rates, Output log, Unemployment rate deviation and Output gap deviation models, respectively) disequilibria from the previous year's shock converge back to the long run equilibrium in the current year.

4.5.1 Unemployment Rates

The results in Table 4.13 reveal that unemployment is negatively related to inflation in the long run since its coefficient is negative. However, the variable is statistically insignificant at a 5% level. This implies that for a unitary increase (decrease) in unemployment, inflation will also decrease (increase) by 8.27%% ceteris paribus. These findings invalidate the Phillips Curve concept that there is a trade-off between inflation and unemployment, given the insignificance of the variables. Nevertheless, it can be concluded that the Phillips Curve phenomenon does not hold within the South African economy in the given study period. These findings are in line with most recent studies on the empirical validity of the Phillips Curve, and these include Leshoro and Kollamparambil (2016), Phiri (2017), Vermeulen (2017), to name a few, which all dismisses the long run Phillips Curve existence in South Africa.

4.5.2. Output Log

The coefficient of real GDP is positive and statistically significant at a 1% level. Therefore, in the long run, a unitary increase (decrease) in South Africa's GDP will result in a 3.43% increase (decrease) in inflation, all things being equal. These findings agree with the Gordon Triangular theory, which suggests that observed inflation rates are determined by the level of real output an economy produces. Contradicting Burger and Marinkov (2006), this study concludes that South Africa's inflation rate is mainly derived from the growth excess in real GNP, as suggested by Gordon (1990). Additionally, a study by Kao & Wan (2017) reached the same conclusions that there is a positive relationship between GDP and inflation. This might be attributed to the reason that inflation can be seen as an incentive to invest, and it attracts foreign direct investments inflows. The findings concur with Khamis *et al*. (2015) and Khaled *et al*. (2019), who argued that inflation per se is not harmful to the growth of FDI inflows. Khaled *et al.* (2019) further point out that there is a threshold

beyond which inflation is harmful to foreign direct investment and economic growth. Moreover, when inflation is creeping, it is not harmful to investment and growth.

4.5.3. Unemployment Rate Deviation (NKPC)

The coefficient of unemployment deviation, which is -0.0104, carries a negative sign, and it is statistically significant at the 10% level. The implication is that a percentage increase (decrease) in unemployment deviation reduces (increase) inflation by approximately 0.01%. Thus, the results suggest that unemployment deviation does not enhance inflation in the long run, dismissing the New Keynesian Phillips Curve's existence in South Africa. Govera (2017) examines the relationship between the Philips Curve variables, i.e., inflation and unemployment in South Africa. The researcher used the hybrid version of the New Keynesian Philips Curve and reached similar conclusions with the findings of this study.

4.5.4. Output Gap Deviation

Output gap deviation is negatively related to inflation in the long run since its coefficient is negative. The variable is statistically significant at a 1% level. Results in Table 4.13 shows that for a unit increase in output gap deviation, inflation will also decrease by 0.02%. These results confirm that there is a trade-off between inflation and output gap deviation in South Africa. Hussein and Al-hosban (2015) empirically assessed the relationship between unemployment and the inflation rates with inflation and unemployment data from 1976 to 2013 and reached the same conclusions.

Overall, from the findings, it can be noted that the Traditional Phillips Curve does not hold water in the South African economy whilst the New Keynesian Phillips Curve theory holds in the South African economy.

Lastly, the study's findings under the unemployment rate deviation revealed that expected inflation and oil price have a positive relationship with inflation while imported price inflation and the global financial crisis negatively affected inflation. Nevertheless, in the case of output gap deviation, expected inflation, oil prices, and the global financial crisis positively impact inflation while imported price inflation negatively affects inflation. Studies by Vermeulen (2015) and Leshoro and Kollamparambil (2016) reached the same conclusions.

4.6. Results of the Granger Causality

The granger causality or the block exogeneity Wald test results are shown in Table 4.14 below.

Table 4. 14 Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
LGUNEMP does not Granger Cause LGINF	102	0.2409	0.6246
LGINF does not Granger Cause LGUNEMP		3.9645	0.0492
LGUNEMPD does not Granger Cause LGINF	102	0.3352	0.5640
LGINF does not Granger Cause LGUNEMPD		0.2534	0.6158
LGRGDP does not Granger Cause LGINF	102	0.9074	0.3431
LGINF does not Granger Cause LGRGDP		9.2841	0.0030
LGOUTPD does not Granger Cause LGINF	93	6.2946	0.0139
LGINF does not Granger Cause LGOUTPD		2.9862	0.0874
LGOILPR does not Granger Cause LGINF	102	1.59256	0.2099
LGINF does not Granger Cause LGOILPR		0.4188	0.5190
LGLDINF does not Granger Cause LGINF	101	36.4040	0.0000
LGINF does not Granger Cause LGLDINF		26.2158	0.0000
LGIMP does not Granger Cause LGINF	102	3.3929	0.0685
LGINF does not Granger Cause LGIMP		4.17935	0.0436
LGEXINF does not Granger Cause LGINF	101	24.9548	0.0000
LGINF does not Granger Cause LGEXINF		36.4040	0.0000

Source: Researcher's computations

From Table 4.14 results, it can be noted that there exists a unidirectional causality between unemployment and inflation, running from inflation to unemployment. This means that inflation granger causes unemployment, and unemployment does not granger cause inflation. It entails that in South Africa, the Phillips Curve does not hold since it explains that a bidirectional relationship exists between inflation and unemployment.

4.7. Discussion of Findings

4.7.1. Granger causality

The data analysis tested for causality between inflation and unemployment in South Africa between 1994 and 2019. A statistically significant unidirectional causality exists between unemployment and inflation from the granger causality findings, running from inflation to unemployment. This means that inflation granger causes unemployment, but unemployment does not granger cause inflation. It entails that in South Africa, the Phillips Curve does not hold since it explains that a bidirectional relationship exists between inflation and unemployment.

Unemployment as a cause of inflation

As noted in the results, the null hypothesis that long run unemployment does not cause long run inflation is not rejected. The results, therefore, reveal that unemployment is negatively related to inflation in the long run, albeit in a statistically insignificant way. Thus, it cannot be said that any increases in unemployment resulted in any decreases in inflation between 1994 and 2019. The above finding invalidates the Phillips curve's full applicability in South Africa between 1994 and 2019. Thus, the monetary policy aimed at job creation could not have had any significant effect on long run inflation, as suggested in the findings by Govera (2017).

Inflation as a cause of unemployment

The null hypothesis that long run inflation does not cause unemployment is, however, rejected. Therefore, this means inflation granger causes unemployment in the long run.

Implications of the causality results

While Phillip's curve may not hold in totality, the general relationship between inflation and unemployment as elucidated in the curve partially hold. Govera (2017) asserted that monetary and fiscal policies that targeted inflation (as an independent variable) could indeed have a positive impact on unemployment. Thus, a given level of inflation can increase jobs and decrease unemployment. Previous studies reviewed in the literature show some similar findings with the findings of this study. For instance, studies by Muchdie (2016) on the South Korean and Indonesian economies with data from 1980-2015, 1980-2015 and 1995-2015, respectively. Regression analysis showed negative relationships between inflation and unemployment in the long run,

similar to this study's findings. Like this study also, Muchdie (2016) could not confirm the applicability of the Phillip's Curve in these economies.

The findings by Shaari et al. (2018) on the applicability of the Philips Curve in 10 high-income earning countries between 1990-2014, however, run contrary to this study's findings. The researchers discovered that in these countries, monetary policies aimed at administering inflation could be of use in tackling unemployment as inflation rates were found to be negatively related to unemployment rates in the long run, i.e., there existed a trade-off. They also found bidirectional relationships where long run unemployment, in turn, had long run causality with inflation. The same final results were also obtained from a study by Furuoka (2007), who found that in Malaysia, economic data from 1973 to 2004 showed bidirectional Granger causality between long run inflation and long run unemployment, implying the applicability of Phillip's curve in that country. Other studies also found that Phillip's Curve did hold in some developing economies but came up with different relationships between inflation and unemployment. For instance, Egypt's findings showed a positive rather than a negative relationship between inflation and unemployment. Touny (2013) found that an increase in inflation increased unemployment when examining Egyptian data between 1974 to 2011.

The above differences between this study and other previous studies point to the uniqueness of economic dynamics between countries rather than to the invalidity of the Phillip's Curve as a theory. Additionally, the results could also have differed due to different focused periods by various researchers. Also, researchers applied different methodologies that could also have contributed to the differences in their findings on both the applicability and strength of the theory in different research settings.

4.7.2. Inflation and GDP

The findings made also showed that there was bidirectional causality between long run GDP and long run inflation. There was, however, a positive, unidirectional causality between the two running from long run inflation to long run GDP. This suggests that an increase in inflation may be a required remedy in facilitating GDP growth. The logic behind this is that moderate inflation can encourage increases in output as producers get incentivized to produce more by higher prices. However, this phenomenon, which most scholars see as a short-term adjustment, appears to hold in the long term for this

study. In the long-term, Mamo (2012) studied 13 sub-Saharan nations and between 1969 and 2009 and found a negative long-term relationship between inflation and GDP. Munyeka (2014) also found a negative relationship between GDP growth and inflation from a study of the South African economy using data from 1993 to 2011, which are inconsistent with results obtained from this study. Nonetheless, they support a cautious view that inflation targeting bands could be increased to facilitate economic growth.

4.7.3. Effects of the Global Financial Crisis

The cointegration equations show that the global financial crises variable cointegrated with inflation in the long run. The ADRL coefficient thereof was negative, indicating that the Global Financial Crises negatively affected long run inflation. Thus, a unitary change in the magnitude of the GFC variable accounted for a 0.06% change in long run inflation.

The findings show that the global financial crisis had a negative, albeit marginal, impact on inflation. Thus, an increase in the GFC (dummy variable) was correspondent with a decrease in inflation as the economy was experiencing a recession as a result of the crisis. The above findings concur with Kantor (2018), who suggests that the rise in inflation rates accompanying the GFC was generally a short-run phenomenon. As can be attested by the structural break results (see Table 4.6). In the long run, South Africa's inflation rate stabilized to single digits figure as early as 2009, a year after the onset of the crisis. Findings by Madubeko (2010) also confirm the view that the country recovered fairly quickly to financial crisis-induced inflation.

4.7.4. Inflation and the Output gap

The null hypothesis that output deviation does not granger cause long run inflation was rejected. On the other hand, the view that long run inflation does not granger cause long run output was not rejected.

This supports the assumption that inflation does not influence the output levels. However, noting that the effect of output is very small (a unitary increase in inflation will result in a 0.016% decrease in long run output deviation), there is a need for caution when applying this relationship in practice. The results also support the KNPC that projects a negative, unidirectional relationship between long run output deviation and long run inflation running from output deviation to inflation.

4.7.5. Inflation and oil prices as a supply shock

Estimation results dismiss the claim that oil prices as a supply shock, in the long run, had any statistically significant implications in the long run inflation rates, ceteris paribus; the opposite is true. Thus, there was neither unidirectional nor bidirectional statistical significance in the interaction of these two variables between 1994 and 2018.

Therefore, it can be concluded that oil prices did not play any causality role in the inflation rates, which contradicts observations and ultimately assumptions made in the 1970s that oil price changes constitute a major shock that destabilized the Phillip Curve-hypothesized relationship between inflation and unemployment (Govera, 2017).

4.7.6. Inflation and import prices

Long run imported inflation does not Granger cause long run inflation between 1994 and 2018 at a 0.05 level of significance. However, long run inflation impacts long run imported inflation at the same level of significance ($p<0.05$). The Granger causality findings are somewhat unexpected as imported inflation is expected to positively build into the total inflation. The ADRL long run coefficients also point at a negative relationship between inflation and imported inflation in the long run, with a unitary increase in imported inflation, resulting in a 1.5% decrease in long run inflation.

4.7.7. Inflation and exported inflation

There is bidirectional Granger causality between long run inflation and long run imported inflation. As a dependent variable, long run exported inflation has a negative sign suggesting that a fall in exported inflation will result in a rise in long run inflation. This also appears inconsistent with expectations but is not a phenomenon that is beyond explanation. Exports increases might be achieved through a lower exchange rate as this will translate to local goods becoming cheaper in foreign markets. Simultaneously, lower exchange rates would mean the prices of major imports like oil would rise, pushing inflationary pressures upwards. Nonetheless, with a unitary change in exported inflation projected to result in a 22.7% negative change in long run inflation, the results create doubt over such a relationship.

4.8. Chapter Summary

This chapter of the study outlined pre-estimation and post-estimation procedures carried out in this study. The results from the ARDL regression analysis indicated that the Phillips Curve does not hold water in South Africa (that is, the statistically insignificant relationship between inflation and unemployment). The bounds test validated the presence of a long run relationship between inflation, unemployment, oil prices, and gross domestic product. The granger causality test was in favour of a unidirectional causality between inflation and unemployment. Lastly, diagnostic tests were performed on both the main model (Phillips Curve) and the support model (New Keynesian Phillips Curve) to assess the models' validity and reliability. These include multicollinearity test, autocorrelation, heteroskedasticity, normality and stability test. The following chapter will present a summary of major findings, conclusion, and recommendations.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.0. Introduction

This last chapter concludes this research and gives brief policy recommendations based on the results obtained in Chapter 4. Section 5.1. details the summary of the entire research. Section 5.2 summarises this study's major findings, while Section 5.3 provides for the conclusion of this study's objectives. Sections 5.4 and 5.5 give recommendations drawn from this study and recommendations for future studies on this topic respectively. The last section, section 5.6 provides for the limitations of this study.

5.1. Summary

This study investigates the validity of the Philips Curve phenomenon with reference to the South African economy for the period 1994Q1 to 2019Q4. The motivation behind such a study is the possible use of inflation as a key tool in fighting the worsening unemployment issue the country is currently faced with.

The macroeconomic background of South Africa's economy is presented in Chapter 1, followed by a review of literature in Chapter 2, where the conceptual, theoretical as well as empirical literature surrounding the inflation-unemployment relationship was provided in sections 2.1, 2.2 and 2.3 respectively.

Some findings from the literature were in tandem with those made in the study while others differed significantly with the same findings. On the major question of whether the inflation-unemployment trade-off existed as per Phillip's Curve's theorisations, these studies findings were in line with several studies testing the empirical validity of the Phillips Curve. These include South African studies by Leshoro and Kollamparambil (2016), Phiri (2017) and Vermeulen (2017) who also dismissed its applicability in the country. However, on the relationship between inflation and unemployment but running from inflation (as an independent variable) to unemployment, many other studies confirm either a positive long-term correlation or causality. These studies include Govera (2017)'s done on the South African economy. Other studies from other economies that also confirmed similar relationships include studies by Muchdie (2016) on South Korean and Indonesian economies using data

from 1980-2015. On the relation between inflation and GDP, Mamo (2012) who studied 13 sub-Saharan nations between 1969 and 2009, and Munyeka (2014) who studied data from the South African economy between 1993 and 2011, both concluded on results that are inconsistent with those discovered by this study as theirs discovered that GDP is negatively related to inflation in the long-run and vice versa. The findings from the literature both international and South African were therefore wide-ranging confirming the need for this study.

This study had four research objectives. To recap, these were as follows:

- To explore the causal relationship between South Africa's inflation and unemployment rates post-1994.
- To examine if a trade-off between inflation and unemployment rates in South Africa exists or not through estimating the traditional Phillips Curve and the New Keynesian Phillips Curve.
- To identify the effects the 2007/09 global financial crisis had on these Phillips Curve variables in South Africa.
- To suggest sustainable and suitable policy recommendations that might be useful in achieving price stability and creating sound employment opportunities in South Africa.

5.2. Summary of major findings

In this study, the inflation-unemployment relationship was investigated in the South African economy to find out if the Phillips Curve and/or the New Keynesian Phillips Curve has existed in the period 1994Q1 – 2019Q4. This was done through the estimation of models guided by these two theories, using the ARDL and VECM techniques.

Results showed that there exists a unidirectional causality between South Africa's unemployment and inflation rates. This causal relationship runs from inflation to unemployment and therefore implies that unemployment is granger caused by inflation, while inflation is not caused by unemployment in South Africa for the study period. Estimation results showed that in the long-run, South Africa's unemployment and inflation are negatively related. These findings invalidate Phillips's concept as results discovered proved to be there was insignificance. Nevertheless, the conclusion

that the Phillips Curve phenomenon does not hold, i.e., no trade-off between inflation and unemployment rates exists within the South African economy in the given study period.

The Global Financial Crisis was discovered to have had a negative, marginal impact on inflation in the long-run as an increase in the GFC (dummy variable) was correspondent with a decrease in inflation as the global economy was going through a major recession as a result of the crisis.

Results on the relationship between inflation and GDP point to a positive relation between these variables in the long-run, with a unitary increase (decrease) in GDP expected to result in a 3.43% increase (decrease) in inflation, all things being equal. Employment deviation had a negative relationship with inflation, albeit only significant at the 10% level, which implies the New Keynesian Phillips Curve does not hold. The findings made also showed that there was no multidirectional causality between long-run GDP and long-run inflation. There was, however, a positive, unidirectional causality between the two variables running from long-run inflation to long-run GDP. The findings also show that the Crisis had a negative, albeit marginal, effect on inflation. Results from that data rule out the view that long-run oil prices as a supply shock had any statistically significant causality with long-run inflation. Long-run imported inflation does not Granger cause long-run inflation between 1994. There is bidirectional Granger causality between long-run inflation and long-run imported inflation. As a dependent variable, long-run exported inflation has a negative sign suggesting that a fall in exported inflation will result in a rise in long-run inflation, implying that there is a possibility that industries absorb increasing domestic costs to sustain their export contracts.

5.3. Conclusions on research objectives and hypotheses

The major conclusion of the study is summarised as follows:

5.3.1 To explore the causal relationship between the rate of inflation and the rate of unemployment in South Africa post-1994

The study found that between 1994 and 2019, there was no Granger causality running from unemployment to inflation, invalidating both the Phillips' Curves. However, there was negative causality running from inflation, meaning that increases in inflation resulted in marginal decreases in unemployment in this duration. The hypothesis that

inflation and unemployment are not causally related in South Africa for 1994-2019 was rejected based on the relationship running from long-run inflation to long-run unemployment.

5.3.2 To examine if a trade-off between inflation and unemployment rates in South Africa exists or not through estimating the traditional Phillips Curve and the New Keynesian Phillips Curve

The study's findings showed that the first relationship running from long-run unemployment to inflation did not hold under the Granger causality tests. Therefore, it emerged that wage inflation in South Africa could not be driven by unemployment, as asserted by the Phillips curve. Overall, it was discovered that the Traditional Phillips Curve does not hold in the South African economy whilst the New Keynesian Phillips Curve theory does, but is, however, insignificant.

5.3.3 To identify the effects the 2007/09 global financial crisis had on these 'Phillips Curve' variables in South Africa

The findings showed that the 2007/09 global financial crisis had a negative relationship with inflation. This relationship was also noted to be small, with a unitary change in the GFC variable accounted for a 0.06% change in long-run inflation. Thus, the null hypothesis that the Crisis had no effects not unemployment and inflation rates was rejected.

5.3.4 To suggest suitable policy recommendations that might be useful in achieving price stability and creating sound employment opportunities in South Africa

Based on findings, this study makes the following recommendations based on the findings from this empirical study:

Although it can be assumed that targeting inflation has somehow had a slight contribution to employment creation (as can be attested by the Granger causality test results (see Section 4.7.1)), monetary authorities should not focus all their attention on targeting inflation. Policies aimed strictly designed to fight the rising unemployment rate in the economy should be formulated and implanted.

Given the finding that GDP was positively related to inflation (see Section 4.7.2), inflation should be allowed to move more freely, and this could enable a stable

economic growth that has the potential of reducing unemployment, in the long-run. The study further recommends output targeting instead.

5.5. Conclusion

This chapter outlines the entire study where the findings are summarised with policy recommendations that policymakers may find useful in macroeconomic policy modelling. Here, suggestions regarding future research are provided. In light of this study's findings, it is noted that both inflation- and unemployment rates play vital roles in the rate of growth of the South African economy. Therefore, policy-makers are advised to revise and/ or enhance the current monetary policies that are in place since this study has 'rendered' them inefficient in achieving the core aims of the central bank of South Africa, i.e., namely, achieving sound financial prudence and creating sustainable employment.

5.6 Recommendations for further studies

The researcher recommends the following studies that will help to further identify and explain key relationships between variables investigated in this study:

- A study focusing on the roles of imported and exported inflation in employment creation and inflationary performance
- A study investigating relationships between various supply shock factors and the final effect of these relationships on unemployment, output and economic growth
- Studies that are examining the long-run relationships between money supply and unemployment over the same 1994 to 2019 period.

5.6 Study limitations

This study focused only on testing the "Phillips Curve and the New Keynesian Phillips Curve" hypotheses as possible tools that policymakers could use to achieve price stability and employment creation. This may have left out other key variables that could be useful in South Africa's unemployment and inflation rates and, ultimately, economic growth. This time-series study only focused on the South African economy period from 1994Q1 to 2019Q4, and therefore, consequently, results and conclusions obtained may not apply to other economies. However, this study is significant, as conclusions

drawn from the results are controversial and may generate new insight by Policymakers in South Africa.

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Appendices

APPENDIX A

Summary of empirical literature

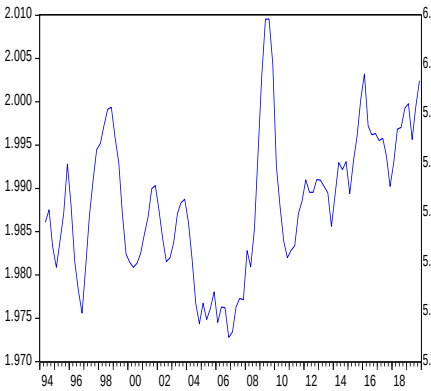
Author(s)	Countries and study period	Methodology	Empirical results
International perspectives			
Govori (2014)	United Kingdom 1956 - 2010	Generalised Method of Moments	Resulted indicates that the Philips Curve holds in the UK for the study period
Munchie (2016)	South Korea and Indonesia 1980 – 2015 1995 -2015		Results indicated a negative correlation between the inflation and unemployment rates; however these results were statistical insignificant
Shaari et al. (2018)	10 high-income earning countries 1990-2014	Panel VAR	Conclusive empirical results indicated the presence of the Philips Curve in the ten countries, both in the short and long runs which therefore implied the existence of the trade-off between inflation rates and unemployment rates in this panel of high-income earning countries.
Furuoka (2007)	Malaysa 1973 - 2004	VECM	The results confirmed a causal relationship and a long run trade-off between inflation and unemployment in the long run.
Prasanna and Gopakumar (2011)	India 1972 -2008	VECM	The conclusive results indicated a negative relationship between inflation and GDP growth, implying that inflation stunts economic growth in India in the long run.

Touny (2013)	Egypt 1974- 2011	VECM	The results pointed to a positive relationship between inflation and the unemployment gap and the inflation rates in the long run.
Hussein and Al-hosban (2015)	Jordanian 1976 - 2013	VECM	The results concluded that there is a negative non-linear relationship between inflation and unemployment which, therefore, confirmed the Philips curve's existence in the Jordanian economy for the study period
Adebowale (2015)	Nigeria 1977 – 2013	VECM	Empirical results point to a trade-off between inflation and unemployment in Nigeria, aligning with the Philips Curve theory.
South African perspective			
Nell (2000)	South Africa (1971 – 1993)	GEAR VAR	The Phillips Curve theory holds in South Africa, however, it is NOT significant.
Hodge (2002)	South Africa 1970 - 2000	OLS	Empirical results obtain dismisses the existence of the Phillips Curve in SA since no trade-off was noted between inflation and unemployment rates
Fedderke and Schaling (2005)	South Africa 1960 - 1999	VECM	The results obtained pointed to an indirect mechanism by adjusting a unit of labour costs to the long run equilibrium.
Burger and Marinkov (2006)	South Africa 1976 – 2002	Gordon Triangular Model	Phillips Curve phenomenon does not exist in SA.
Vermeulen (2015)	South Africa	Engle-Granger Error Correlation model	The results observed a positive co-integrating relationship between output and employment, while no evidence of the relationship between inflation and employment was

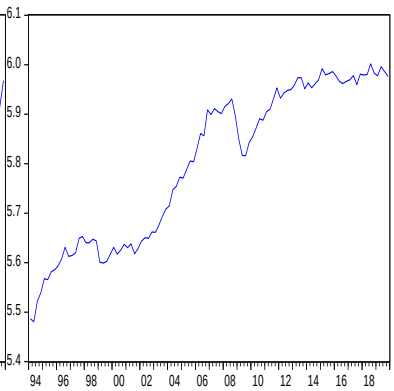
			discovered. Therefore, this paper dismisses the existence of the Phillips Curve hypothesis in South Africa
Kabundi et al.	South Africa 1994Q1 – 2014Q2	VAR VECM	The results from the estimations concluded that South Africa's Phillips Curve has flattened since, after the Financial Crisis
Leshoro and Kollamparambil (2016)	South Africa 1980 - 2013	Fully Modified Ordinary Least Squares (FMOLS)	The empirical results obtained pointed to no existence of a stable Phillips Curve for South Africa
Vermeulen (2017)		ARDL	The results pointed to the non-existence of the relationship between inflation and unemployment in South Africa for the given period, implying that the Phillips Curve is not real for South Africa.
Govera (2017)	South Africa 1994 - 2015	VECM	Conclusive results based on models and tests ran confirmed a positive but peripheral relationship between inflation and unemployment in the long run.
Nell (2018)	South Africa 1971Q1 – 1984Q4 1986Q1 – 2001Q2	ARDL	The conclusion was that the Philips Curve over the sample period 1971Q1-2001Q2 is structurally unstable due to the insignificant output gap as a variable. Results from the period 1971Q1-1984Q4 suggest evidence for a linear Phillips Curve with an output gap variable.

GRAPHICAL ANALYSIS

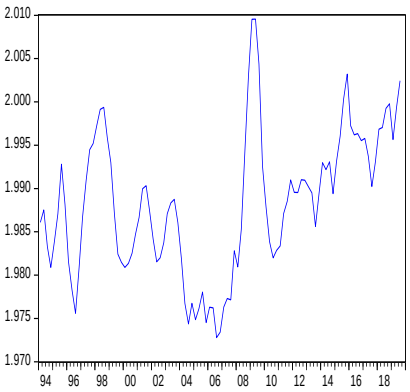
LGINF



LGIMP



LGEXINF



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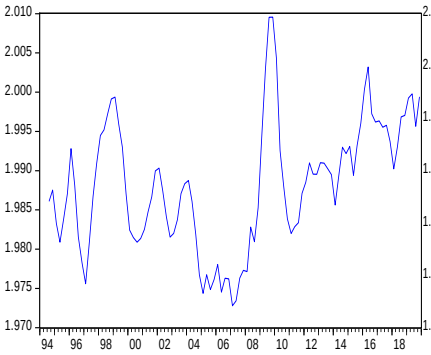
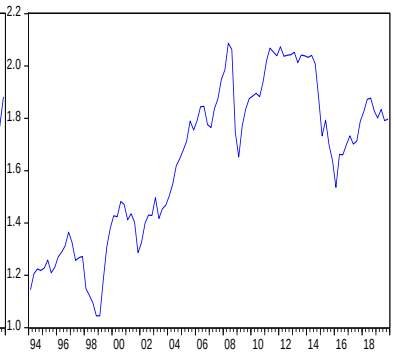
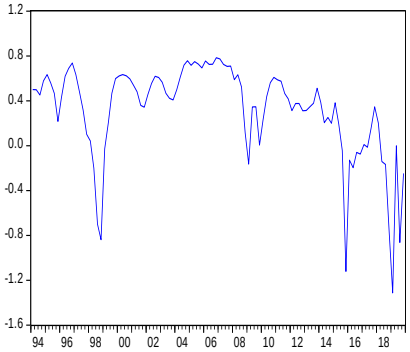
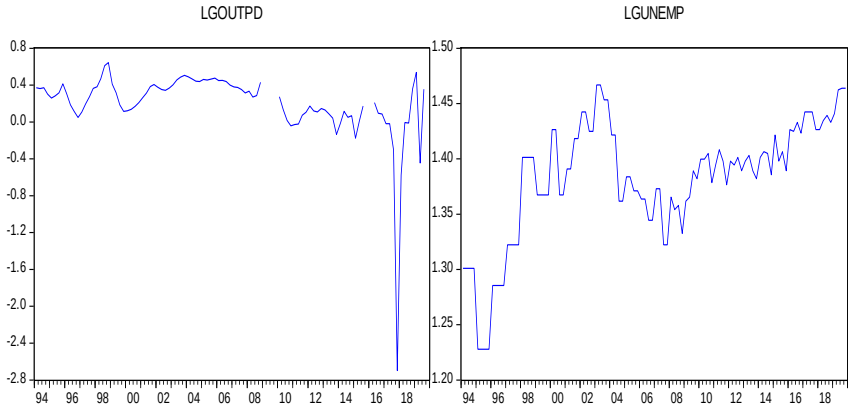


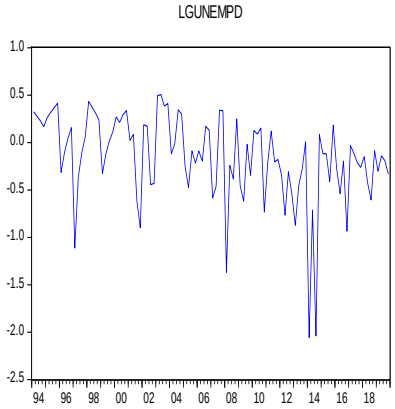
LGOILPR



LGRGDP







DESCRIPTIVE STATISTICS

	LGINF	LGUNEMP	LGUNEMPD	LGRGDP	LGOUTPD	LGOILPR	LGLDINF	LGIMP	LGEXINF
Mean	1.988260	1.382200	-0.151928	0.322364	0.204913	1.636519	1.988121	5.799529	1.988260
Median	1.988127	1.390935	-0.114400	0.434714	0.273882	1.700506	1.988019	5.846809	1.988127
Maximum	2.009560	1.466868	0.505760	0.783488	0.644645	2.087227	2.009560	6.001961	2.009560
Minimum	1.972785	1.227887	-2.058065	-1.314167	-2.697860	1.044932	1.972785	5.480674	1.972785
Std. Dev.	0.008262	0.054023	0.460140	0.413092	0.367208	0.299777	0.008181	0.158791	0.008262
Skewness	0.224383	-0.958165	-1.563400	-1.751587	-5.284040	-0.225241	0.232789	-0.272752	0.224383
Kurtosis	2.570829	3.821655	7.050548	6.406205	41.58989	1.815644	2.624986	1.519562	2.570829
Jarque-Bera	1.654773	18.83888	113.4632	103.4560	6470.159	6.957746	1.518947	10.78684	1.654773
Probability	0.437190	0.000081	0.000000	0.000000	0.000000	0.030842	0.467913	0.004546	0.437190
Sum	204.7908	143.7488	-15.80047	33.52583	19.87657	170.1980	202.7883	603.1510	204.7908
Sum Sq. Dev.	0.006962	0.300602	21.80805	17.57642	12.94479	9.256253	0.006759	2.597100	0.006962
Observations	103	104	104	104	97	104	102	104	103

MULTICOLLINEARITY TEST

	LGINF	LGUNEMP	LGUNEMPD	LGRGDP	LGOUTPD	LGOILPR	LGLDINF	LGIMP	LGEXINF
LGINF	1.000000	0.382979	-0.134958	-0.869035	-0.159382	-0.050668	0.895616	0.249771	0.907009
LGUNEMP	0.382979	1.000000	-0.170375	-0.369306	-0.165355	0.310335	0.403966	0.441100	0.326576
LGUNEMPD	-0.134958	-0.170375	1.000000	0.063324	0.177762	-0.412913	-0.066817	-0.409997	-0.148527
LGRGDP	-0.869035	-0.369306	0.063324	1.000000	-0.007331	0.067304	-0.773784	-0.257946	-0.782161
LGOUTPD	-0.159382	-0.165355	0.177762	-0.007331	1.000000	-0.284095	-0.222694	-0.368208	-0.230046
LGOILPR	-0.050668	0.310335	-0.412913	0.067304	-0.284095	1.000000	-0.072166	0.892019	0.029186
LGLDINF	0.895616	0.403966	-0.066817	-0.773784	-0.222694	-0.072166	1.000000	0.215696	0.724020
LGIMP	0.249771	0.441100	-0.409997	-0.257946	-0.368208	0.892019	0.215696	1.000000	0.310921
LGEXINF	0.907009	0.326576	-0.148527	-0.782161	-0.230046	0.029186	0.724020	0.310921	1.000000

APPENDIX B

UNIT ROOT TEST

LGINF

Null Hypothesis: LGINF has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.777762	0.2089
Test critical values:	1% level	-4.050509	
	5% level	-3.454471	
	10% level	-3.152909	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LGINF) has a unit root

Exogenous: None

Bandwidth: 31 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-5.569744	0.0000

Test critical values:	1% level	-2.588059
	5% level	-1.944039
	10% level	-1.614637

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LGINF has a unit root
Exogenous: None
Lag Length: 9 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.680366	0.8610
Test critical values:	1% level	-2.590065	
	5% level	-1.944324	
	10% level	-1.614464	

Null Hypothesis: D(LGINF) has a unit root
Exogenous: None
Lag Length: 8 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.781099	0.0002
Test critical values:	1% level	-2.590065	
	5% level	-1.944324	
	10% level	-1.614464	

LGUNEMP

Null Hypothesis: LGUNEMP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.553452	0.3024
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGUNEMP) has a unit root

Exogenous: None

Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-11.22060	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

Null Hypothesis: LGUNEMP has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.731631	0.2264
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGUNEMP) has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.12888	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

LGUNEMPD

Null Hypothesis: LGUNEMPD has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.809510	0.0000
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGUNEMPD) has a unit root

Exogenous: None

Bandwidth: 24 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-41.95868	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

Null Hypothesis: LGUNEMPD has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.814281	0.0000
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGUNEMPD) has a unit root

Exogenous: None

Lag Length: 2 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.37307	0.0000
Test critical values:	1% level	-2.588292	
	5% level	-1.944072	
	10% level	-1.614616	

LGRGDP

Null Hypothesis: LGRGDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.107442	0.0084
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGRGDP) has a unit root
Exogenous: None
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-15.54757	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

Null Hypothesis: LGRGDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.599323	0.0073
Test critical values:	1% level	-3.495021	
	5% level	-2.889753	
	10% level	-2.581890	

Null Hypothesis: D(LGRGDP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-13.17897	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

LGOUTPD

Null Hypothesis: LGOUTPD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.358853	0.0000
Test critical values:	1% level	-4.058619	
	5% level	-3.458326	
	10% level	-3.155161	

Null Hypothesis: D(LGOUTPD) has a unit root
Exogenous: None
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-20.55652	0.0000
Test critical values:	1% level	-2.590622	
	5% level	-1.944404	
	10% level	-1.614417	

Null Hypothesis: LGOUTPD has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.702751	0.0000
Test critical values:	1% level	-3.527045	
	5% level	-2.903566	
	10% level	-2.589227	

Null Hypothesis: D(LGOUTPD) has a unit root

Exogenous: None

Lag Length: 6 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.942611	0.0000
Test critical values:	1% level	-2.597025	
	5% level	-1.945324	
	10% level	-1.613876	

LGOILPR

Null Hypothesis: LGOILPR has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.809170	0.6933
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGOILPR) has a unit root

Exogenous: None

Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.919292	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

Null Hypothesis: LGOILPR has a unit root

Exogenous: None

Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.381655	0.7925
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

Null Hypothesis: D(LGOILPR) has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.919292	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

LGLDINF

Null Hypothesis: LGLDINF has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.824653	0.1921
Test critical values:	1% level	-4.051450	
	5% level	-3.454919	
	10% level	-3.153171	

Null Hypothesis: D(LGLDINF) has a unit root

Exogenous: None

Bandwidth: 31 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.589936	0.0000
Test critical values:	1% level	-2.588292	
	5% level	-1.944072	

	10% level	-1.614616

Null Hypothesis: LGLDINF has a unit root
Exogenous: None
Lag Length: 9 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.635852	0.8519
Test critical values:	1% level	-2.590340	
	5% level	-1.944364	
	10% level	-1.614441	

Null Hypothesis: D(LGLDINF) has a unit root
Exogenous: None
Lag Length: 8 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.783862	0.0002
Test critical values:	1% level	-2.590340	
	5% level	-1.944364	
	10% level	-1.614441	

LGIMP

Null Hypothesis: LGIMP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.758977	0.7174
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGIMP) has a unit root

Exogenous: None

Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.698966	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

Null Hypothesis: LGIMP has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.509720	0.8202
Test critical values:	1% level	-4.049586	
	5% level	-3.454032	
	10% level	-3.152652	

Null Hypothesis: D(LGIMP) has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.570604	0.0000
Test critical values:	1% level	-2.587831	
	5% level	-1.944006	
	10% level	-1.614656	

LGEXINF

Null Hypothesis: LGEXINF has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-2.777762	0.2089

Test critical values:	1% level	-4.050509
	5% level	-3.454471
	10% level	-3.152909

Null Hypothesis: D(LGEXINF) has a unit root
Exogenous: None
Bandwidth: 31 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.569744	0.0000
Test critical values:	1% level	-2.588059	
	5% level	-1.944039	
	10% level	-1.614637	

Null Hypothesis: LGEXINF has a unit root
Exogenous: None
Lag Length: 9 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.680366	0.8610
Test critical values:	1% level	-2.590065	
	5% level	-1.944324	
	10% level	-1.614464	

Null Hypothesis: D(LGEXINF) has a unit root
Exogenous: None
Lag Length: 8 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.781099	0.0002
Test critical values:	1% level	-2.590065	
	5% level	-1.944324	
	10% level	-1.614464	

APPENDIX C

HETEROSKEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey

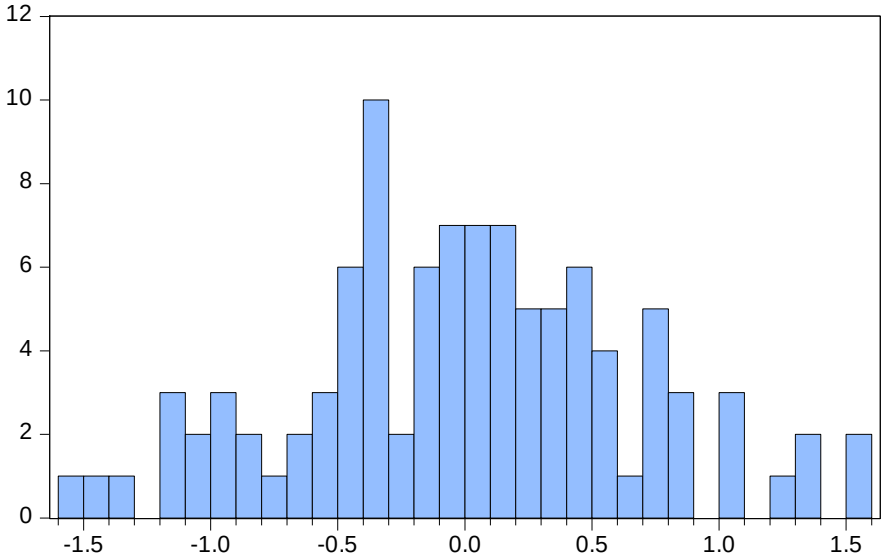
F-statistic	2.025685	Prob. F(3,97)	0.1153
Obs*R-squared	5.954599	Prob. Chi-Square(3)	0.1138
Scaled explained SS	4.909829	Prob. Chi-Square(3)	0.1785

AUTOCORRELATION TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.301429	Prob. F(2,95)	0.7405
Obs*R-squared	0.636892	Prob. Chi-Square(2)	0.7273

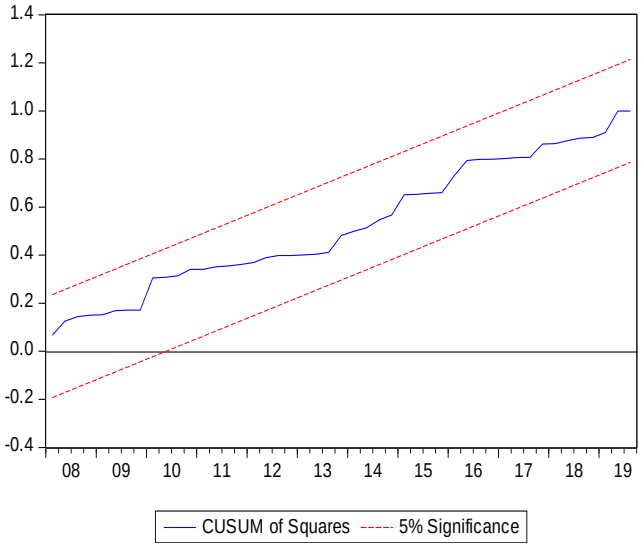
NORMALITY TEST

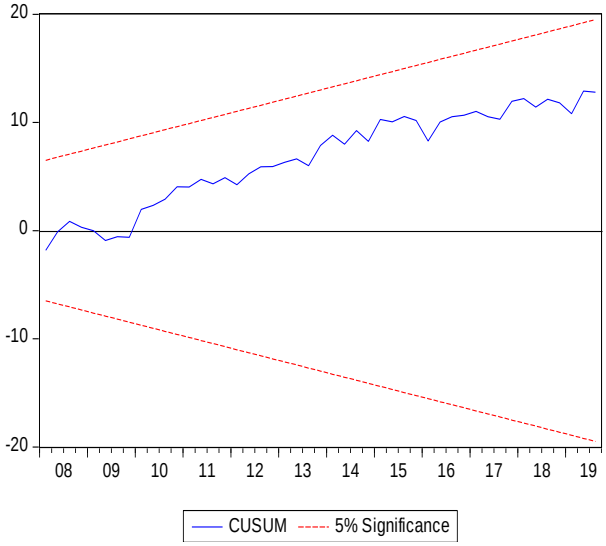


Series: Residuals
Sample 1994Q4 2019Q4
Observations 101

Mean	3.15e-14
Median	0.000996
Maximum	1.558851
Minimum	-1.504091
Std. Dev.	0.659185
Skewness	0.041369
Kurtosis	2.787900
Jarque-Bera	0.218128
Probability	0.896673

STABILITY TEST





STRUCTURAL BREAK TEST

Chow Breakpoint Test: 2008Q1

Null Hypothesis: No breaks at specified breakpoints

Varying regressors: All equation variables

Equation Sample: 1994Q3 2019Q3

F-statistic	1.195543	Prob. F(7,87)	0.3139
Log likelihood ratio	9.276183	Prob. Chi-Square(7)	0.2334
Wald Statistic	8.368803	Prob. Chi-Square(7)	0.3012

APPENDIX C

MODEL SPECIFICATION TEST

Ramsey RESET Test

Equation: UNTITLED

Specification: INFL INFL(-1) INFL(-2) LGUNEMP C

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.368990	96	0.7129
F-statistic	0.136154	(1, 96)	0.7129

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.061540	1	0.061540
Restricted SSR	43.45243	97	0.447963
Unrestricted SSR	43.39089	96	0.451988

GRANGER CAUSALITY TEST

Pairwise Granger Causality Tests

Date: 12/30/20 Time: 18:41

Sample: 1994Q1 2019Q4

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
LGUNEMP does not Granger Cause LGINF	102	0.24089	0.6246
LGINF does not Granger Cause LGUNEMP		3.96453	0.0492
LGUNEMPD does not Granger Cause LGINF	102	0.33516	0.5640
LGINF does not Granger Cause LGUNEMPD		0.25340	0.6158
LGRGDP does not Granger Cause LGINF	102	0.90744	0.3431
LGINF does not Granger Cause LGRGDP		9.28410	0.0030
LGOUTPD does not Granger Cause LGINF	93	6.29461	0.0139
LGINF does not Granger Cause LGOUTPD		2.98619	0.0874
LGOILPR does not Granger Cause LGINF	102	1.59256	0.2099
LGINF does not Granger Cause LGOILPR		0.41877	0.5190
LGLDINF does not Granger Cause LGINF	101	36.4040	3.E-08
LGINF does not Granger Cause LGLDINF		3.7E+22	0.0000
LGIMP does not Granger Cause LGINF	102	3.39293	0.0685

LGINF does not Granger Cause LGIMP		4.17935	0.0436
LGEXINF does not Granger Cause LGINF	101	3.7E+22	0.0000
LGINF does not Granger Cause LGEXINF		36.4040	3.E-08

APPENDIX DAUTOREGRESSIVE DISTRIBUTED LAG MODEL

MODEL 1

ARDL Cointegrating And Long Run Form

Dependent Variable: INFL

Selected Model: ARDL(2, 0, 3, 4, 0, 0)

Date: 12/30/20 Time: 20:05

Sample: 1994Q1 2019Q4

Included observations: 99

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INFL(-1))	0.561369	0.095109	5.902387	0.0000
D(LGUNEMPD)	-0.005060	0.002841	-1.781010	0.0785
D(LGEXINF)	0.388114	0.443911	0.874306	0.3844
D(LGEXINF(-1))	-24.538256	6.254770	-3.923127	0.0000
D(LGEXINF(-2))	35.423067	6.029288	5.875165	0.0000
D(GFC)	-0.004040	0.009427	-0.428597	0.6693
D(GFC(-1))	0.021411	0.011709	1.828598	0.0710
D(GFC(-2))	-0.028459	0.011865	-2.398633	0.0187
D(GFC(-3))	0.037882	0.009675	3.915508	0.0002
D(LGIMP)	-0.074604	0.023280	-3.204703	0.0019
D(LGOILPR)	0.032096	0.011581	2.771422	0.0069
CointEq(-1)	-0.488771	0.075850	-6.443920	0.0000

Cointeq = INFL - (-0.0104*LGUNEMPD -22.7142*LGEXINF -0.0665*GFC
-0.1526*LGIMP + 0.0657*LGOILPR + 34.2444)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGUNEMPD	-0.010353	0.006158	-1.681239	0.0964
LGEXINF	-22.714172	5.502108	-4.128267	0.0000

GFC	-0.066525	0.013490	-4.931528	0.0000
LGIMP	-0.152637	0.044577	-3.424097	0.0010
LGOILPR	0.065667	0.022697	2.893189	0.0049
C	34.244400	7.863527	4.354839	0.0000

MODEL 2

ARDL Cointegrating And Long Run Form

Dependent Variable: INFL

Selected Model: ARDL(1, 0, 1, 0, 0, 0)

Date: 12/30/20 Time: 20:03

Sample: 1994Q1 2019Q4

Included observations: 95

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGOUTPD)	-0.015823	0.003005	-5.264994	0.0000
D(LGEXINF)	-0.237742	0.382313	-0.621851	0.5357
D(GFC)	0.004275	0.004819	0.887103	0.3775
D(LGIMP)	-0.178424	0.018584	-9.600865	0.0000
D(LGOILPR)	0.076704	0.009211	8.327292	0.0000
CointEq(-1)	-0.699500	0.215069	-3.252444	0.0000

Cointeq = INFL - (-0.0158*LGOUTPD - 22.3062*LGEXINF + 0.0043*GFC
-0.1785*LGIMP + 0.0767*LGOILPR + 45.5705)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGOUTPD	-0.015831	0.003014	-5.252458	0.0000
LGEXINF	-22.306162	6.187690	-3.604925	0.0000
GFC	0.004277	0.004821	0.887163	0.3774
LGIMP	-0.178514	0.018556	-9.620160	0.0000
LGOILPR	0.076742	0.009199	8.342586	0.0000
C	45.570524	8.321338	5.476345	0.0000

MODEL 3 (MAIN MODEL)

ARDL Cointegrating And Long Run Form

Dependent Variable: INFL

Selected Model: ARDL(2, 0)
Date: 12/30/20 Time: 19:45
Sample: 1994Q1 2019Q4
Included observations: 101

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INFL(-1))	0.540824	0.088031	6.143563	0.0000
D(LGUNEMP)	-1.184197	1.372477	-0.862817	0.3904
CointEq(-1)	-0.143226	0.040494	-3.536988	0.0006

Cointeq = INFL - (-8.2680*LGUNEMP -85.9977)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGUNEMP	-8.268007	8.936829	-0.925161	0.3572
C	-85.997705	12.389199	-6.941345	0.0000

MODEL 4

ARDL Cointegrating And Long Run Form
Dependent Variable: INFL
Selected Model: ARDL(2, 1)
Date: 12/30/20 Time: 20:08
Sample: 1994Q1 2019Q4
Included observations: 101

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INFL(-1))	0.466326	0.075910	6.143119	0.0000
D(LGRGDP)	1.318426	0.222112	5.935850	0.0000
CointEq(-1)	-0.261878	0.053340	-4.909635	0.0000

Cointeq = INFL - (3.4265*LGRGDP -98.4759)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGRGDP	3.426527	0.584588	5.861436	0.0000
C	-18.475862	6.288945	-2.937831	0.0000

COINTEGRATION

ARDL Bounds Test

Date: 12/30/20 Time: 19:47

Sample: 1994Q4 2019Q4

Included observations: 101

Null Hypothesis: No long run relationships exist

Test Statistic	Value	k
F-statistic	9.121176	1

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84