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التضخم والبطالة في الحقبة الديمقراطية في جنوب إفريقيا: هل هناك أي مساومة؟

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Abstract:

South Africa has consistently suffered double-digit unemployment rates and unstable price levels, with a resultant stifling of economic growth rates. As a result, 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. To close the gap in the existing literature, this study examined the trade-off between inflation and unemployment rates in South Africa and its implication on the economy post-1994. The Autoregressive Distributed Lag modelling technique was adopted by this study, where quarterly data spanning from 1994Q1 to 2019Q4 was analysed. Findings dismiss the existence of both the Phillips Curve and the New Keynesian Phillips Curve in South Africa as the inflation and unemployment rates as no Granger causality running from unemployment to inflation was observed from 1994Q1 to 2019Q4, even though there was a negative causality running from inflation, meaning that during these years, increases in the inflation rate resulted in marginal decreases in the unemployment rate. A recommendation to policymakers would be to focus less on inflation targeting, as it was discovered to have a small influence on the unemployment rate. Rather, given the finding that GDP was positively related to inflation, allowing inflation to move more freely could enable stable economic growth that has the potential of reducing unemployment. This study further recommends that the SARB bank should go for targeting output instead.

Keywords: *inflation rate; New Keynesian Phillips Curve; Economic growth; unemployment; inflation targeting.*

الملخص:

عانت جنوب أفريقيا باستمرار من معدلات بطالة من رقمين ومستويات أسعار غير مستقرة، مما أدى إلى خنق معدلات النمو الاقتصادي. ونتيجة لذلك، خضع صناع السياسات في البنك المركزي في جنوب أفريقيا للتدقيق فيما يتعلق بإطار السياسة المعتمد، والذي يبدو أنه يخفق في الاقتصاد مع تزايد معدل البطالة وزيادة مستوى الأسعار الإجمالي، مما أدى إلى تدهور مستويات المعيشة للمواطنين. لسد الفجوة في الأدبيات الحالية، فحصت هذه الدراسة المفاضلة بين معدلات التضخم والبطالة في جنوب أفريقيا وتأثيرها على الاقتصاد بعد عام 1994. اعتمدت هذه الدراسة تقنية الانحدار التلقائي لنمذجة التأخر الموزع، حيث تم تحليل البيانات الفصلية الممتدة من الربع الأول من 1994 إلى الربع الرابع من 2019. وتستبعد النتائج وجود كل من منحنى فيليبس ومنحنى فيليبس الكينزي الجديد في جنوب أفريقيا نظرًا لمعدلات التضخم والبطالة ونظرًا لعدم وجود علاقة سببية تمتد من البطالة إلى التضخم من الربع الأول من 1994 إلى الربع الرابع من عام 2019 على الرغم من وجود علاقة سببية سلبية تنبع من التضخم، أي أنه خلال هذه السنوات أدى ارتفاع معدل التضخم إلى انخفاض هامشي في معدل البطالة. فكانت التوصية لصانعي السياسة هي التركيز بشكل أقل على استهداف التضخم، حيث تم اكتشاف أن لها تأثيرًا ضئيلًا على معدل البطالة. وبدلًا من ذلك، بالنظر إلى النتيجة التي تفيد بأن الناتج المحلي الإجمالي مرتبط بشكل إيجابي بالتضخم، فإن السماح للتضخم بالتحرك بحرية أكبر يمكن أن يؤدي إلى نمو اقتصادي مستقر لديه القدرة على الحد من البطالة. وتوصي هذه الدراسة كذلك بوجوب استهداف بنك احتياطي جنوب أفريقيا الإنتاج بدلاً من ذلك.

الكلمات المفتاحية: *معدل التضخم؛ منحنى فيليبس الكينزي الجديد؛ النمو الاقتصادي؛ البطالة؛ استهداف التضخم.*

1. Introduction

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.

According to the South African Reserve Bank (SARB), 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 government expenditure may provide possible results for 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 between the rates of inflation and the rates of unemployment.

Furthermore, empirical literature consulted sums 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 relationship between inflation and unemployment; a relationship 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 about using low inflation as a monetary policy method, resulting in higher unemployment.

The purpose of this study is 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, with the ultimate purpose of ascertaining whether monetary policy can be utilised to deal with continually rising unemployment issues and the cost of living. The study explored the causal correlation between South Africa's inflation and unemployment rates. It further examined if a trade-off between inflation and unemployment rates exists in the economy through estimating the traditional Phillips Curve and the New Keynesian Phillips Curve. Lastly, the effect of the 2007/08 global financial crisis on inflation and unemployment rates was tested.

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. The notion that suggests 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 assumption 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 with wide criticism, it is regarded as a strong foundation for policy implementation. Karahan et al. (2012) opined that the Phillips Curve also provides a significant implication that concerns the economic policy's effectiveness. It must be noted that

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

As part of strengthening monetary policy in South Africa, the SARB adopted the inflation targeting regime in the year 2000 to 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. However, 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 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 (2015), it is quite evident that South Africa's economy is currently facing a huge issue of poverty, high general price level as well as 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.

The rest of the paper is structured as follows: Section 2 discusses the conceptual, theoretical, and empirical literature. Section 3 describes the data and the methodology used in the study while the empirical results and discussion of findings are presented in Section 4. Conclusions and policy recommendations are provided in Section 5.

2. Literature Review

2.1. 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 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).

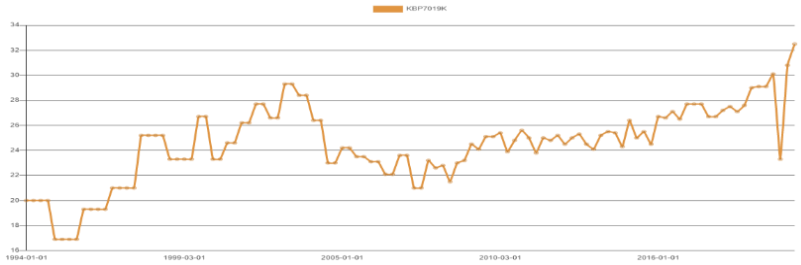

Figure (1): Official unemployment rate
Source: SARB

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.

2.2. 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 in 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 of 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 Figures (2) and (3) below:

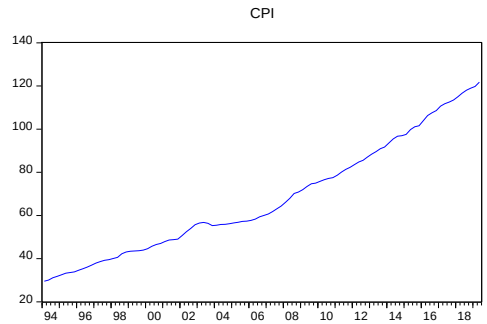

Figure (2): Consumer Price Index
Source: Researcher's computations

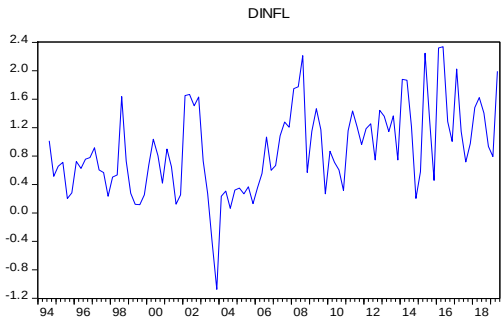

Figure (3): Inflation rates
Source: Researcher's computations

Figures (2) and (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. Between the years 2004 and 2005 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 years 2007 and 2009, inflation reached approximately 12%. We can also assume that this followed 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 of 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, like the unemployment rate, has been unstable over the years, mainly due to economic fluctuations and instabilities.

2.3. Theoretical Literature

The original Phillips Curve

The first-ever suggestion of 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 by "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 change in unemployment as well as the rate of change 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 Phillips Curve variables confirmed the original findings According to Furuoka (2007), the Phillips Curve remains one of the major foundations of macroeconomics. Govera (2017) attests that most studies on the Phillips Curve interrelation are mainly accredited to A.W Phillips's theory.

Govera (2017) further suggests that the Phillips 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 by keeping inflation levels at the expense of high unemployment levels, ceteris paribus.

However, the 1970s US economy's events contradicted the Phillips 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 as unreliable in articulating policies on the relationship between process, unemployment, and growth rates (Govera, 2017).

Phillips' critic

The New Keynesian Phillips Curve

Kiley (1997), as well as Taylor (1980) and Fischer (1997), argue that the New Keynesian Phillips Curve framework is a structural model of inflation time dynamics. The major parameter is the time lag that governs the marginal costs of 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 Phillips 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 the 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 thrives when exposed to "empirical micro-data analysis".

2.4. Empirical Literature

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), and 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 Phillips 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.

Inflation and unemployment in South Africa

Upon consultation of the literature, it was observed that several 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 did statistics for black unemployed people become available, and in 1991, racial classification ended.

Nell (2000) used South Africa's GEAR (Growth, Employment and Redistribution) programme as a base for 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 Phillips 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:

$$P_t = u + (U - U_n)_t + e_t \quad \ldots (1)$$

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 Phillips 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 Phillips Curve in South Africa.

Vermeulen (2015) examined how the inflation rate affects the unemployment rate by looking at the direct effects that 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. (2019) 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 Phillips 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 Phillips 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 Phillips Curve in the South African economy. The researcher used the hybrid version of the New Keynesian Phillips 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 Phillips Curve variables. The Granger causality test was used to examine the causality between the Phillips 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 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, points 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 Phillips 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.

3. Methodology

To close the observed gap in the literature and to achieve the aims and objectives of this research, this study employs the ARDL regressing approach in all its model estimations. 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. This approach was chosen as the ideal estimation technique since it is deemed as the most superior technique when compared to most cointegration techniques and is also able to provide consistent results for small-sized samples (Perasan et.al., 2001). This technique is mostly also preferable since it can incorporate variables of different integration orders and also because this method allows for a sufficient number of lags to be taken into account when estimating as Nkoro and Uko (2016) suggest. The ARDL methodology technique also makes it possible to derive an unrestricted error correction model (ECM)

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

$$Y\,t = Yoi + \Sigma pi{=}1\;\delta i\;Y\;t{-}i + \Sigma qi{-}0\beta'\acute{\imath}\;Xt{-}i + it \tag{2}$$

Where $Y't$ are a vector, and the variables in $(X't)$' are expected to be integrated of I(0) or I(1); β and δ are coefficients; Yoi is the constant; i = 1, …, k; p, q depict the most suitable lag lengths; it is the error term.

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.

Notably, this is a quantitative time series research study of the South African economy which uses quarterly data for the period 1994Q1 – 2019Q4. The unemployment rate, unit labour costs, total government expenditure, import prices, and the nominal Gross Domestic Product (GDP) data employed in this study 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 are 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 respectively:

$$infl = \frac{cpi - cpi(-1)}{cpi(-1)} \times 100 \tag{3}$$

$$backinfl = infl\ \times 1 \tag{4}$$

$$forwinfl = infl\ \times (-1) \tag{5}$$

As accounting for structural breaks in such a research study is important, it 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 (GFC) 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. It is for this reason therefore that the global financial crisis is taken as the dummy variable in such:

$$GFC = dummy\ variable \tag{6}$$

According to Okun's Law as pioneered by Okun (1962), when the Phillips Curve is prevalent in a specific economy, the implication is that there exists a long-run relationship between inflation and output in that economy in question. Based on this assumption, therefore, several versions of the Phillips Curve are estimated including the following "full-form" versions of the Phillips Curve estimated

- **Unemployment rate deviation**

$$\mu_t = \beta_0 + \beta_1\left(U_t - \hat{U}_t\right) + \beta_2 E_t(\mu_{t+1}) + \beta_3({D_t}^{crisis}) + \beta_4({\pi_t}^{imp}) + \beta_5(Oilprice_t) + \varepsilon_t \tag{7}$$

- **Output gap deviation**

$$\mu_t = \beta_0 + \beta_1(y_t - \hat{y}_t) + \beta_2 E_t(\mu_{t+1}) + +\beta_3({D_t}^{crisis}) + \beta_4({\pi_t}^{imp}) + \beta_5(Oilprice_t) + \varepsilon_t \tag{8}$$

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',
${\pi_t}^{imp}$ 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 7 and should be statistically significant with a positive coefficient in Equation 8.

In the estimations, the study employs the inflation rate as the core dependent variable (as can be noted in both equations 7 and 8) and the unemployment rate as the core independent variable, while oil prices, expected inflation, log real GDP, as well as the import prices are adopted as the supporting independent variables. The unemployment rate deviation is depicted by the difference between unemployment and the natural rate of

unemployment, whereas the output gap deviation is depicted by the difference between log GDP and the prospective level of output.

Within the general full-form version of the Phillips Curve, this study estimates two versions of the traditional Phillips Curve as stipulated in equations 9 and 10 below is estimated:

$$\pi_t = \beta_0 + \beta_1(U_t) + \varepsilon_t \quad (9)$$

where π_t is the rate of inflation, β_0 is the constant, U_t is the unemployment rate and ε_t depicts the error term. Here it is important to note that β_1 is expected to carry a negative sign as stated above.

The output log ($\boldsymbol{y_t}$) version of the traditional Phillips Curve is estimated as follows:

$$\pi_t = \beta_0 + (Y_t) + \varepsilon_t \quad (10)$$

where π_t is the rate of inflation, β_0 is the constant, Y_t is the log of real GDP and ε_t is the error term. Here, β_0 is expected to be positive.

3.1. 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**

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), and import and oil prices are employed as proxies of the global economy.

As discussed in the theoretical literature section above, the New Keynesian Phillips Curve (NKPC) is regarded as the superior version of the Phillips Curve and this study therefore also estimates this extension version. Unlike the traditional Phillips Curve, the NKPC considers both the natural rate of unemployment as well as the output levels when estimating. 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 hybrid versions of the NKPC this study adopt are specified as follows:

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

$$\pi_t = \beta_0 + \beta_1\left(U_t - \hat{U}_t\right) + \beta_2 E_t(\pi_{t+1}) + \beta_3\pi_{t-1} + \varepsilon_t \quad (11)$$

where 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 ($\boldsymbol{y_t - \hat{y}_t}$)

$$\pi_t = \beta_0 + \beta_1(y_t - \hat{y}_t) + \beta_2 E_t(\pi_{t+1}) + \beta_3\pi_{t-1} + \varepsilon_t \quad (12)$$

where 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.

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 in 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 the 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, and autocorrelation tests, to name a few, were carried out on all estimated regressions.

Since it can be observed from the literature review that there are contradicting opinions on the nature of both the long- and short-run relationships between inflation and unemployment, this study employs the Granger Causality test, as developed by Granger (1969), to examine the causal relationships between these two key variables. The idea behind this causality theory is that X causes Y if X's former values can be used to explain Y, and 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. Thereafter, to determine the integration orders of the variables used in this study, the unit root testing procedure was conducted. The Augmented Dickey-Fuller (ADF) test as proposed by Dickey and Fuller (1981) was employed as the principal stationarity test procedure and the Phillips-Perron (PP) as proposed by Phillips and Perron (1988) was used as the confirmatory procedure. Here, a comparison between the estimated ADF t critical coefficients and estimated t stat coefficients of the are coefficients X_{t-1} is made. Dickey and Fuller (1981) suggest that 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 underwent this procedure. It is through results obtained from this test that the ARDL estimation technique was chosen as the most suitable for this study. 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 the model in question. Thereafter the long run dynamics were examined.

Lastly, to ensure the statistical soundness and relevance of the estimated regressions, diagnostic inspections on the estimated models are carried out. This study applies several diagnostic tests to ascertain that the OLS assumptions are not violated. 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. To test for autocorrelation, this study uses the graphical method and the Breusch-Godfrey LM-test, which was developed by Breusch and Godfrey (1978). 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. 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. The 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.

4. Results and Discussion

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 1.0 below, 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 (1), columns 4 and 5).

Table (1): 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.

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 include the unit root and the cointegration test, were 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. Table 2 contains the correlation matrix results.

Table (2): 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 2 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

This study uses the ARDL bounds testing approach to test for cointegration among the variables. This is influenced by the fact that in an ARDL model, 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 or order 1.

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 (3).

Table (3): 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 (3), 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).

Table (4): Chow Structural Break results

Test	*Chi² statistic*	*Probability*
Chow	4.6739	0.3224

Source: Researcher's computations

Table (4) 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.

Diagnostic Tests

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 (5).

Table (5): Diagnostic Tests

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
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
Ramsey RESET Test			
	Value	Df	Probability
T-statistic	0.3690	96	0.7129
F-statistic	0.1362	(1, 96)	0.7129

Source: Researcher's computations

From Table (5), 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. To examine for autocorrelation among the disturbance terms, the Breusch-Godfrey Serial Correlation LM test was used. The results are contained in Table 8 panel B. 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.

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 8 panel C. 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. The results obtained and presented in Figure 1 in Appendix A.

The CUSUM and CUSUM of squares both 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 exhibiting the disturbance means and associated levels of kurtosis and skewness as illustrated in Figure 2 of Appendix A.

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 adjustments.

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 (6).

Table (6): Structural break test results

Test	*Chi² statistic*	*Probability*
Chow	6.2547	0.4315

Source: Researcher's computations

Table (6) 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.

Diagnostic Tests

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 (7).

Table (7): Heteroscedasticity test results

Breusch-Pagan-Godfrey			
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
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
Ramsey RESET Test			
	Value	Df	Probability
T-statistic	0.2516	97	0.7512
F-statistic	0.1275	(1, 97)	0.7384

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. To test for the autocorrelation among the disturbance terms, the Breusch-Godfrey Serial Correlation LM test is used. 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 (See Table 7 panel B).

To check for specification errors in the model, the Ramsey RESET was employed. The results are presented in Table 7 panel C. 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 and the result is presented in Figure 3 of Appendix A.

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 of Appendix A.

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 adjustments.

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) was 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 (8). The coefficients indicate the long run elasticities whilst the ECT coefficient signifies the speed of adjustment.

Table (8): Estimated ARDL Regression Results

Cointegrating Form				
	Traditional Phillips Curve		**New Keynesian Phillips Curve**	
Variable	Unemployment rates	Output log	Unemployment rate deviation	Output gap 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 a 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 11, 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.

In summary, the 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 that there was insignificance. Nevertheless, the conclusion is 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 because of the crisis.

Results on the relationship between inflation and GDP point to a positive relationship 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 that 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 did not have 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.

Discussion of findings

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.

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).

In the case of inflation and 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.

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 to 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 Phillips 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 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.

The findings also show 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 at 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 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 the results obtained from this study. Nonetheless, they support a cautious view that inflation targeting bands could be increased to facilitate economic growth.

Furthermore, the cointegration equations show that the global financial crisis 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 digit 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 from financial crisis-induced inflation.

On the inflation and 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 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.

However, the estimated 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. 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 ultimate 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).

In addition, the result revealed that 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.

Lastly, the result revealed that 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.

5. Conclusion and Policy Recommendations

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 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.

The study discovered 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 from 1994-2019 was rejected based on the relationship running from long-run inflation to long-run unemployment. Further 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 and is not 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. 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 on unemployment and inflation rates was rejected.

Though there were some contradicting results from this study; it was noted that both the inflation and the unemployment rates play vital roles in South Africa's economic growth and that these two macroeconomic variables should be monitored closely for the general well-being of the country's economy. It is advisable, also, that policymakers revise and/or enhance existing monetary policies, as conclusions reached by this study rendered these policies inefficient and ineffective in aiding the central bank reach its core objectives of achieving sound financial prudence and creating sustainable employment. It is further recommended that further studies focusing on the much more complex side of the inflation-unemployment relationship are carried out. Studies that explicitly focus on the roles played by both imported and exported inflation on employment creation and inflationary performance, as well as studies investigating the relationships between various supply shocks factors and the final effect of these relationships on unemployment, output and economic growth would shed further light on this dynamic inflation-unemployment relationship.

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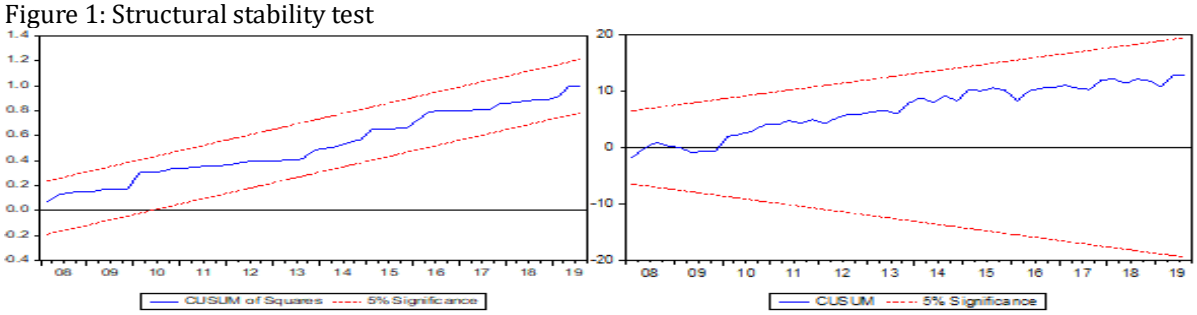
Appendices

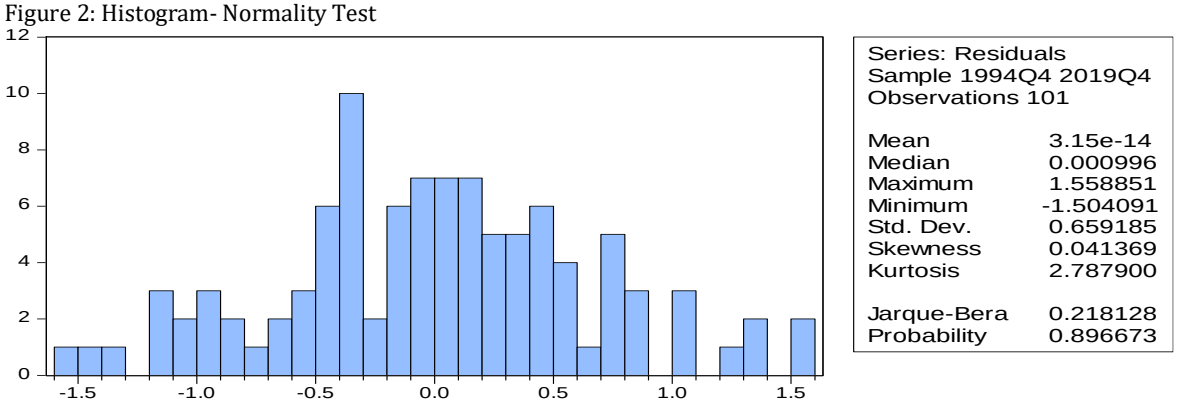
Appendix A

Figure 1: Structural stability test



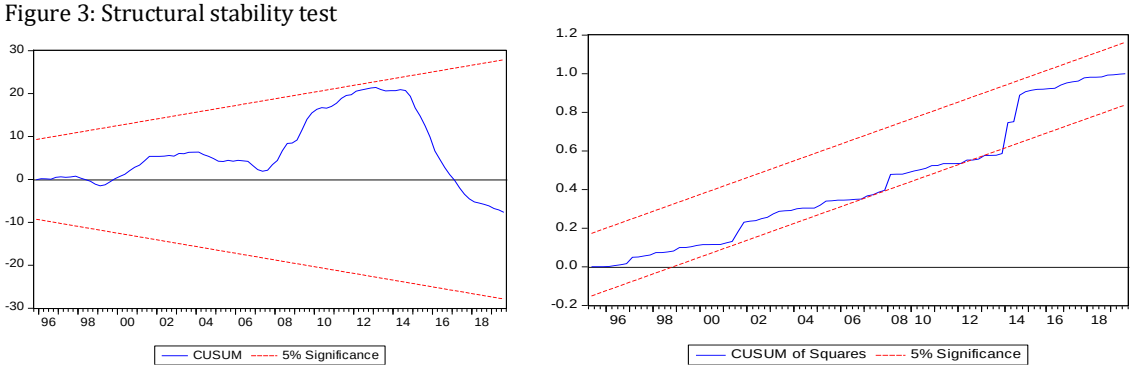
Source: Researcher's computations

Figure 2: Histogram- Normality Test



Source: Researcher's computations

Figure 3: Structural stability test



Source: Researcher's computations

Figure 4: Normality test