

**DETERMINANTS OF INFLATION IN SOUTH AFRICA:
AN EMPIRICAL INVESTIGATION**

by

OATLHOTSE P. MADITO

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SUPERVISOR: PROF. N.M. ODHIAMBO

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DECLARATION

Student Number: 55792219

I declare that "***DETERMINANTS OF INFLATION IN SOUTH AFRICA: AN EMPIRICAL INVESTIGATION***" is my own work and that all the sources that I have used or quoted from have been indicated and acknowledged by means of complete references.

A handwritten signature in black ink, appearing to read 'OP Madito', written over a horizontal line.

SIGNATURE

(Mr. OP Madito)

27 / 07 / 2017

DATE

ABSTRACT

This study investigated the determinants of inflation in South Africa using quarterly data from 1970Q1 to 2015Q4. The study was motivated by recent trends in domestic inflation that has frequently been at the upper end of the target range of between 3% and 6% and the need to guide inflation related policy since 2008. These recent trends raised concerns regarding the effectiveness of the current monetary policy approach in responding to internal and external factors that are significant in determining domestic inflation. Using Error Correction Model (ECM) modelling techniques, empirical results revealed that inflation expectations, labour costs, government expenditure and import prices are positive determinants, while GDP and exchange rates are negative determinants of inflation. To achieve the macroeconomic policy objective of a stable and low inflation rate for South Africa, more emphasis should be placed on anchoring inflation expectations, which was found to be highly significant in determining inflation.

KEYWORDS

Inflation, Determinants of inflation, Inflation expectations, Money supply, Government consumption expenditure, Exchange rate, Labour cost, Interest rates, Cointegration, Error Correction Model

DEDICATION

To my parents, my siblings, and my late brother **Thapelo Monchusi**, for all the time I spent away from home. I hope that the completion of this study will bring you comfort.

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Your invaluable support and guidance made it possible for this study to be completed.

Ke a leboga.

Notwithstanding the contribution of the aforementioned individuals and institutions, the responsibility for all the views and any shortcoming of this study, including errors and omissions, is entirely mine, and should not be attributed to any of the abovementioned individuals and institutions.

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ACRONYMS

Term	Description
ADF	Augmented Dickey Fuller
AR	Autoregressive
ARDL	Autoregressive Distributed Lag
ARMA	Auto-regressive Moving Average
CLRM	Classical Linear Regression Model
COSATU	Congress of South African Trade Unions
CPI	Consumer Price Index
CPIX	CPI excluding mortgage payments
DF	Dickey Fuller
DF-GLS	Dickey-Fuller Generalised Least Square
ECM	Error Correction Model/Mechanism
ECOWAS	Economic Community of West African States
EU	European Union
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GLS	Generalised Least Squares
GNI	Gross National Income
HPF	Hodrick-Prescott Filter
IFS	International Financial Statistics
INF	Inflation
IMF	International Monetary Fund
IT	Inflation Targeting

Term	Description
ITAC	International Trade Administration Commission of South Africa
LM	Lagrange Multiplier
LR	Likelihood Ratio
NEER	Nominal Effective Exchange Rate
OLS	Ordinary Least Squares
OPEC	Organization of the Petroleum Exporting Countries
PP	Phillips-Perron
PPP	Purchase Power Parity
SACU	Southern African Customs Union
SARB	South African Reserve Bank
SBC	Schwarz Bayesian Criterion
SIC	Schwarz Information Criterion
STATS SA	Statistics South Africa
UECM	Unrestricted Error Correction Model
UK	United Kingdom
USA	United States of America
VAR	Vector Autoregression
VECM	Vector Error Correction Model
ZAR	South African Rand

CHAPTER ONE: INTRODUCTION

1.1. Background to the Study

Inflation remains one of the most important challenges facing both developed and developing economies. Inflation is determined by various factors either internally whereby policy makers have some degree of control, or from external factors that policy makers have no direct control over. Inflation can be defined as a sustained increase in the average price level or alternatively, a continuous fall in the value of money (Mohr and Fourie, 2009). In South Africa Inflation is measured by the Consumer Price Index (CPI); and it is compiled and released by Statistics South Africa (Stats SA)¹.

Various economists and policy makers have different views on whether inflation occurs as a consequence of demand side factors (an increase in economic activities) or supply side factors arising from the increase in the cost of producing goods and services within the economy. Furthermore, Friedman (1963) wrote that “inflation is always and everywhere a monetary phenomenon”, suggesting growth in the quantity of money relative to output as the primary determinant of inflation.

South Africa faces a number of challenges with respect to persistent and escalating inflation rates which results in the deterioration of the purchasing power of the local currency. This impacts the Rand’s competitiveness against currencies from the country’s major trading partners. While the country is faced with other macroeconomic problems such as high unemployment and inequality, Marcus (2012), indicates that a high and volatile inflation rate increases uncertainty about future relative prices and also reduces the competitiveness of a country’s exports. There are various sources of inflation, as indicated by Mankiw (2012), that inflation can arise as a result of an increase in aggregate demand (demand pull inflation), a decrease in aggregate supply

¹ Other measures of inflation include *inter alia*, producer price index (PPI) and GDP deflator (Mohr and Fourie, 2008:478)

(cost push inflation), monetary factors (increase in money supply) or structural determinants (degree of independence of the monetary authorities).

Low inflation and price stability remains one of the most important objectives targeted by policy makers in the formulation and implementation of a monetary policy framework. The introduction of inflation targeting framework in 2000, signaled the beginning of a new phase in the development of anti-inflationary policies in the South African economy. As suggested by Mendonca (2007), inflation targeting is driven by economic transparency as it improves the conduct of the monetary policy. This change in monetary policy framework means that the maintenance of price stability became the main function of the South African Reserve Bank (SARB); and as outlined in the Constitution of the Republic of South Africa, Act 108 of 1996 and the Reserve Bank Act 90 of 1989, the mandate given to the reserve bank is “*the protection of the value of the Rand*” (Fourie and Burger, 2009). According to Fourie and Burger (2009) this could be interpreted to mean either the internal value (inflation) or the external value (exchange rate) of the domestic currency or both. However, since 2000 the SARB has interpreted its mission as signifying the internal value of the Rand (inflation) as its primary monetary policy objective. To date the SARB remains committed to inflation targeting to ensure long-run price stability in the domestic economy (De Waal and Van Eyden, 2012). The SARB, as a monetary authority, is required to achieve and maintain price stability in the interest of maintaining balanced and sustainable economic growth. Prior to the adoption of an inflation targeting framework, the central bank had adopted several different monetary policy systems which included amongst others exchange-rate targeting; discretionary monetary policy; monetary aggregate targeting and an eclectic approach (Mohr and Fourie, 2008).

Inflation in South Africa has been relatively high since the 1970s, however there was a period of unsteady growth during the early 1980s which contributed to a rise in the rate of inflation for almost two decades irrespective of numerous policies having been formulated by the Government to stabilise its existence. The 1970s were a period of structural change in inflation patterns from a period of low and stable inflation that was

just below 4% on average in the 1960s. South Africa struggled to maintain an inflation rate below 9% between 1971 and 1975 and the rates kept escalating particularly between 1976 and 1980 with an average inflation rate of approximately 12.1%. Although inflation was high at the time, the SARB did not adopt a consistently effective anti-inflationary policy stance (Fourie and Burger, 2009).

Moolman and Du Toit (2004) cited that monetary policy controls that were implemented during the 1960s and 1970s, signaled a need to abolish as many restrictions as possible and move towards a more market orientated policy approach in the 1980s. According to Van Zyl *et al.* (2009) the approach to monetary policy took a new turn during the 1970s particularly in the philosophy, style and methods of monetary policy formulation and implementation when world economies experienced a period of dual high inflation and unemployment.

Several countries started adopting monetary policy models that were aimed at countering the effect of inflation by introducing anti-inflationary policy measures to achieve monetary stability. Countries such as the United States of America (USA) and the United Kingdom (UK) tightened their monetary policies by constraining short-run nominal interest rates from rising above the average level. In light of the aforementioned, there is no doubt that inflation has been one of the most challenging macro-economic challenges faced by South Africa as evidenced by various anti-inflationary policies that have been implemented in the past to counter its negative effect in the economy. To date, inflation still remains one of the most difficult challenges faced by both developed and developing economies.

1.2. Statement of the problem

High and volatile inflation can be damaging not only to businesses and consumers but to the economy as a whole. The social and economic consequences of inflation are diverse and difficult to calculate accurately. Inflation causes instability and inefficiency in the economy as it slows down economic growth in the long-run as evidenced by a

decline in economic growth to 1.3% in 2015 (Stats SA, 2016). The costs of inflation to the economy is linked with higher inflation volatility because the more unstable the rate of inflation is, the lesser it is anticipated and the greater the risk of uncertainty. Nevertheless, inflation, whether anticipated or unanticipated, has numerous ramifications in the economy even at moderate rates and in order to determine it, there is a need to understand its determinants if we are to achieve stability in the state of the economy.

Since the adoption of an inflation targeting framework in 2000, the South African Reserve Bank (SARB) has been able to contain inflation within the specified range of 3% and 6%. However, there have been times in the past where the rate of inflation rose above the specified target range of 3% to 6% predominantly during its initiation stage, the global financial crisis and post-recession. On average, the rate of inflation has been approximately 6% since the commencement of inflation targeting in 2000. There has been much criticism by various macro-economists and leaders of trade unions regarding the current monetary policy approach, citing its inability to reduce the unemployment cost of fighting inflation (sacrifice ratio) as one of its major shortcomings (Vellery and Ellyne, 2011).

Despite the fact that inflation rates have been moderate since the introduction of inflation targeting system in 2000 as compared to the past economic trends when inflation was high but relatively stable, recent rates of inflation have been of great concern particularly since the inflation rates are frequently on the upper end of the targeted range of 3% to 6%. As a result, this raises concern with regards to the effectiveness of the current monetary policy approach on whether there is a shift in the determinants of inflation differing from those that were identified prior to a change in South Africa's monetary policy system in 2000. High inflation is associated with substantial inflation volatility causing uncertainty in price level expectations and thus making long-term economic decision more difficult, particularly to the unemployed citizens that are already part of a lower income group.

There have been numerous studies on the determinants of inflation in South Africa most of which were undertaken prior to 2000. This period symbolises a shift in the political and economic structure in South Africa and also the shift with regards to the operations of the South African Reserve Bank (see among others, Akinboade *et al.*, 2004; Vellery and Ellyne, 2011). Previous studies focused more on monetary and structural determinants of inflation, taking into account the impact of changes in monetary policy frameworks, economic sanctions and political turmoil of the previous Government. In 1986, a system of money supply target was introduced, and in 1989 that monetary system was enhanced in order to take a more consistent anti-inflationary policy stance. However, towards the 1990s the Reserve Bank noticed that money supply (M3) was growing at a rate of approximately 18% on average while inflation declined to a single digit number.

The evolution of the South African monetary policy since the 1970s signals the importance of examining the causes of inflation to align them with changing economic conditions; and as such, this study seeks to bridge the literature gap by identifying factors that influence inflation in South Africa different from factors that have been investigated in previous studies. This study also takes into account the impact of the inflation-targeting framework and its impact on the level of inflation in South Africa since its introduction. This study intends to investigate the determinants of inflation with the aim of evaluating the effectiveness of anti-inflationary policy and provide solutions based on the results obtained from the model that will support policy makers in achieving the desired long-run inflation target of between 3% and 6% in South Africa.

1.3. Objectives and hypothesis of the Study

1.3.1. Objectives of the Study

The overall objective of the study is to investigate the determinants of inflation in South Africa with the aim of identifying the factors (variables) that are more significant within

the model in order for them to be considered when formulating and implementing credible anti-inflationary policies.

The specific objectives of the study are to:

- Investigate various domestic and external factors that influence inflation in South Africa.
- Determine whether inflation in South Africa arises from cost-push or demand-pull inflation factors.
- Make policy recommendations based on empirical findings of the study.

1.3.2. Hypotheses of the study

The study hypothesises that:

1. Demand-pull factors that are positively associated with domestic inflation include government consumption expenditure, money supply and inflation expectations.
2. Cost-push factors with positive influence on inflation include import prices and labour costs, while exchange rates have a negative influence on inflation.
3. Macro-economic determinants of exchange rates and gross domestic product (GDP) are negatively associated with inflation in South Africa.
4. Changes in labour costs cause a corresponding positive change in the rate of inflation.
5. There is an existing positive relationship between money supply and inflation in South Africa.

1.4. Significance of the Study

Investigating the determinants of inflation is important as the findings will provide understanding with regards to the transmission of shocks and the inter-relationship between inflation and other economic factors that have an impact on inflation in South

Africa. Furthermore, the study determines the impact of both internal and external determinants of inflation, with the view that single factor analysis may be insufficient in providing solutions to the problem of inflation due to the fact that inflation comes from various sources and not only domestic factors. As a result, this study provides an assessment of inflation determinants in terms of the overall macro-economic system to allow for all significant and possible determinants of inflation to be taken into account, in order to make provision for a sounder basis for anti-inflationary policy.

The importance of identifying key determinants of inflation is crucial to the current inflation targeting framework in South Africa as it allows for prior identification of factors that drives inflation and as such provides policy makers with the necessary information required for the proper implementation of a monetary policy. Findings on whether inflation emanates from demand-pull, cost-push, monetary and structural factors will enable policy makers and economic agents to identify the type of inflation that is occurring and thereby determining correct measures that would remedy the rising effects of general prices in the economy. Finally, the study contributes to literature by identifying country specific factors that are significant within the model with the aim of contributing to the current inflation targeting framework (IT) in augmenting the existing anti-inflationary policies in South Africa. Policy recommendations will be made based on the empirical results obtained when analysing the relationship between inflation and its determinants.

1.5. Organisation of the Study

This study is structured into six chapters. Chapter two presents the dynamics of inflation in South Africa and an overview of the overall macroeconomic environment. Chapter three reviews theoretical and empirical literature on the determinants of inflation. Chapter four outlines the methodology and quantitative data to be employed in the study. Chapter five covers data analysis and the discussion of empirical results. Finally, Chapter six concludes the study, highlighting major findings, policy implications, limitations of the study as well as areas for further research on the subject.

CHAPTER TWO: THE DYNAMICS OF INFLATION IN SOUTH AFRICA

2.1. Introduction

This Chapter provides an overview of the evolution of inflation, inflation policies in South Africa and the underlying monetary and fiscal policy frameworks aimed at stabilising the rate of inflation since 1960. The importance of inflation policies will be discussed with more emphasis on the evolution of the South African monetary policy. Furthermore, this Chapter discusses inflation trends and its determinants in line with monetary policy regimes and other macro-economic policy frameworks implemented since 1960. This Chapter also provides an analysis of various determinants of inflation and their effects on the implementation of various monetary policy frameworks to capture the extent to which different policies reacted to developments in the determinants of inflation.

The remainder of the chapter is organised as follows. Section 2.2 discusses the measures of inflation; Section 2.3 gives an overview of inflation in South Africa. Section 2.4 reviews the trends of inflation and monetary policy during the period 1960-2015; Section 2.5 highlight the key determinants and trends of inflation in South Africa; Section 2.6 discusses the challenges of inflation in South Africa and finally, Section 2.7 concludes the Chapter.

2.2. The Measures of Inflation in South Africa

To measure inflation, a proxy has to be found for the general price level. There are various indirect measures for the general price level, none of which is ideal. In practice, however, CPI, or something similar, is generally used for this purpose (Mohr, 2008, p. 2). The CPI is one of the key macro-economic indicators produced by Statistics South Africa (Stats SA) which measures the rate of change in the price of consumer goods and is widely used to measure inflation in South Africa, the figures are published on a monthly basis since 1910 (Firer, 1999).

The introduction of inflation targeting in 2000 required the central bank to select appropriate price index to use as an indicator. The calculation of the selected price index required the exclusion of factors/variables that affect the conduct of monetary policy.

Inflation targeting led to the creation of another measure of CPI, namely the CPI for metropolitan and other urban areas excluding interest cost on mortgage bonds (CPIX). According to SARB (SARB, 2008, p. 1) 'On 21 October 2008 the Minister of Finance announced in his Medium Term Budget Policy Statement (MTBPS) that the targeted inflation measure would be changed from 25 February 2009 when the January 2009 CPI data was released. Following revisions to the methodology employed to compile the CPI, which would result, *inter alia*, in a change in the treatment of housing, the year-on-year increase in the consumer price index excluding mortgage interest cost (CPIX) for metropolitan and other urban areas would be replaced as the targeted measure with the headline CPI (CPI for all urban areas). The continuous inflation target range for headline CPI would remain at 3% to 6%'.

According to Fourie and Burger (2009) until 2008, the SARB excluded interest rates on mortgage bonds from the CPI calculation with the purpose of inflation targeting and the adjusted price index is referred to as CPIX. The CPIX is logical as the basis for setting inflation targets for the SARB; however, it does not serve as a standard measure for general price levels, since it excludes one of the most important prices (i.e. interest cost on mortgage bonds) that average consumers are faced with (Mohr, 2008).

The justification for using CPIX instead of CPI stems from the fact that central banks combat inflation by exerting upward pressure on interest rates with the expectation that it will slow down spending and as such, including interest rates on mortgage bonds in the price index will technically increase the level of inflation, causing monetary policy measures to appear inflationary while in fact it is deflationary.

As a basis for calculating (and setting) an inflation target for the SARB, the CPIX makes eminent sense (Fourie and Burger, 2009). However, the CPIX is *not* a basis for measuring the level of prices in general, since it excludes one of the most important prices the average consumer is faced with. Put differently, the CPIX does not measure the cost of living and the rate of increase in the CPIX therefore does not measure the rate of increase in the cost of living.

The SARB stopped using the CPIX in 2009 and since then, the CPI has been calculated differently with the inclusion of imputed rent². Since 2009 the SARB defined inflation targeting in terms of the overall CPI calculated for urban areas and as a result, nothing was excluded from the index used for inflation targeting.

2.3. An Overview of Inflation in South Africa

In South Africa, inflation is determined by various domestic factors such as goods and services that are produced locally, as well as external factors such as foreign prices (Wakeford, 2006). In an effort to achieve price stability in the country, SARB through the use of various monetary policy instruments, affects the rate of inflation through various channels such as interest rate channel, aggregate-demand channel and the expectations channel (Fourie and Burger, 2009 and Moore, 2008).

Over the years, various factors have influenced the level of inflation in South Africa. In the 1960s inflation remained relatively high and volatile when compared to inflation rates of South Africa's major trading partners such as China, the US and the UK. During the period from 1960 to 1970 inflation rate averaged at approximately 2.5% per annum. During that period, factors such as interest rates played a limited role in the monetary system that was highly influenced by liquid asset requirements (see Mohr and Fourie, 2008; Akinboade *et al.*, 2004).

² Imputed rent is an amount equal to the rent that you forgo by not renting your house to someone else, i.e. it includes the opportunity cost of not living in your own house (Fourie and Burger, 2009:362).

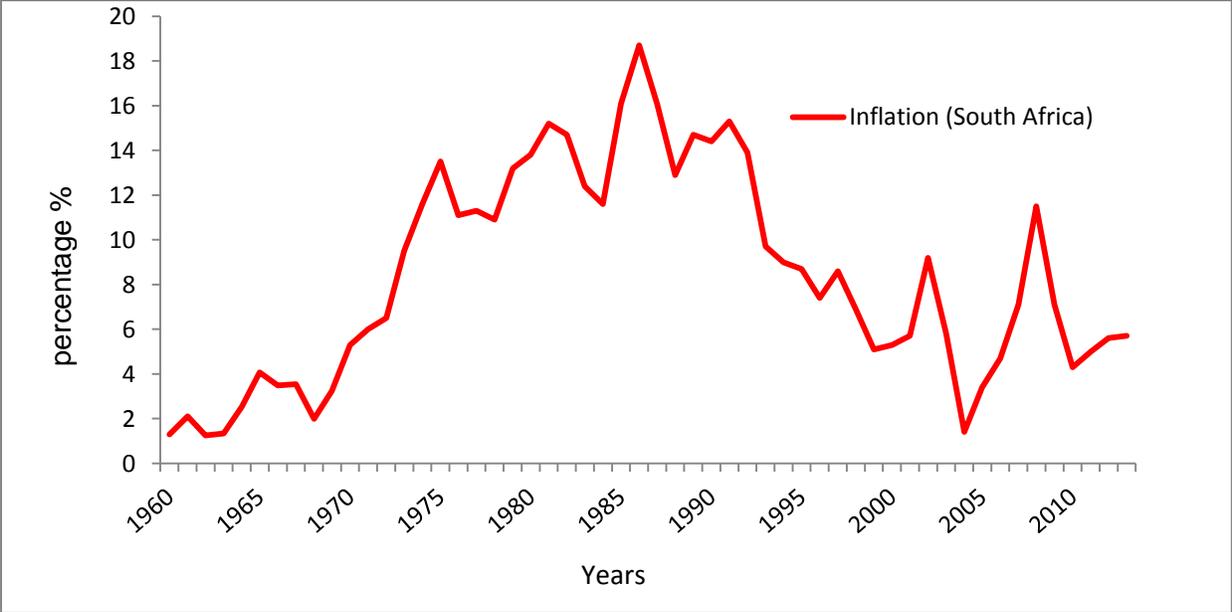
In the 1970s, oil price volatility had a major impact not only domestically but also internationally. Apart from that, domestic inflation has also suffered from increased production costs owing to economic sanctions that were imposed on South Africa in the mid-1980s. In the late 1980s and early 1990s, many of the sanctions were lifted and South Africa was re-integrated into the world economy. This resulted in a major increase in foreign transactions as South African firms were exposed to an increased demand for domestic products by international markets, prompting local firms to increase their production capacity: an action that led to an increase in inputs cost (mainly from imported intermediate products, i.e., raw materials and oil) and subsequently resulting in an increase in the general price levels (see van der Merwe, 1997; Moll, 1999).

Moreover the increase in production costs has more often been influenced by the volatility of the South African labour market which is characterised by frequent disputes that often take long periods to be resolved while hindering the domestic firms' competitiveness and ability to produce. The development in inflation expectations or the general public perception regarding the future rate of inflation also plays a critical role as the key component in macro-economics, owing to its impact on actual factors that determine inflation and also the sensitivity of the South African labour market to developments in inflation.

Expected inflation affects the overall economy specifically through wage setting mechanisms that result in numerous segments of the population, labour unions and business entities becoming involved in labour disputes that results in the loss of productivity by major sectors within the industry and this contributes towards the sluggish economic growth rate that has been witnessed over the past few years. Inflation expectations has emerged as one of the important factors that often leads to an increase in the general price level owing to its linkages to various macro-economic variables.

Volatility in the exchange rate (i.e. weaker Rand) has reduced the purchasing power of the South African Rand (ZAR) over the years allowing higher world prices to be directly and indirectly transmitted into the domestic prices. The level of instability in exchange rates between 2000 and 2010 had adverse effects on trade as it affected the price of imported final goods which resulted in an increased negative trade balance over the years. Among other factors, interest rates and money supply growth has also influenced the level of inflation particularly in the wake of monetary targeting regime during the 1980s where money supply growth (M3) peaked at 27.3% in 1988 whilst inflation recorded 18.7% in 1986. Figure 2.1 shows the trend of inflation in South Africa since 1960.

Figure 2.1: Inflation trend in South Africa (1960-2013)



Source: Stats SA (2015); World Bank (2015)

As illustrated in Figure 2.1, Inflation in South Africa has been increasing since the mid-1960s, however the 1980s experienced the worst rate of inflation since 1967 with an average of 14% per annum (p.a.) for the period 1981 to 1985 and an average of 15.3% per annum for the period covering 1986 to 1990. South Africa, as was the case with other western European countries, experienced inflation during the period between 1946 and 1960. However, in South Africa, the rate of inflation was relatively low, at an

average rate of 4% p.a. As indicated by Friedman (1963) that inflation is and will always be a monetary phenomenon, this statement serves as an indication that monetary policy cannot be left out when dealing with inflation since the monetary authorities have always been subject to the control of inflation and as such, the SARB and its policies have been very influential over the years in ensuring that a low rate of inflation is achieved and maintained.

Inflation started accelerating in the early 1970s starting in the first quarter of 1972. Within the period of three years, the inflation rate had more than doubled at 13.5% as compared to the last quarter of 1971. Inflation in South Africa rose significantly during the 1970s, recording an average of 8.7% between 1970 and 1975 per annum. As indicated by (Mohr, 2008) many countries in the world experienced rising inflation during the 1970s as a result of oil price shocks which are considered to be external to the economy particularly to non-oil producing countries such as South Africa and some of its major trading partners.

The price of imported goods and services is one the determinants of inflation in South Africa mainly due to the fact that a country cannot produce all its required goods and service by itself. In this case, some of the commodities that are not produced or manufactured domestically have to be sourced/imported from other countries. Imported inflation in this case results from an increase in the price of goods and services that are produced and sourced from foreign countries. Table 2.1 compares South Africa's inflation with that of its major trading partners from 1970 to 2013.

Table 2.1: Annual average inflation rate for South Africa and its major trading partners (1970-2013)

Period	RSA	USA	UK	CHINA*
1970 -1979	9.89%	7.10%	12.65%	-
1980 -1989	14.68%	5.55%	7.11%	12.70 %
1990 -1999	8.99%	3.00%	3.31%	7.75%
2000 -2013	5.88%	2.43%	2.26%	2.32%

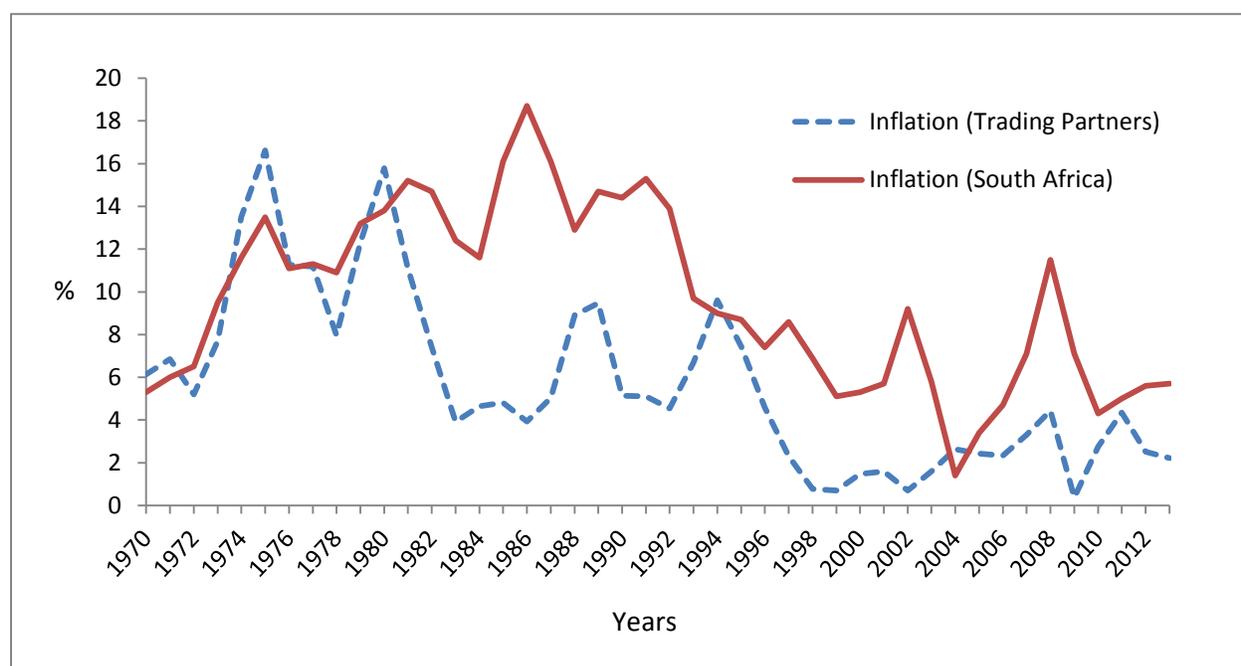
Source: IMF (2015); World Bank (2015); Stats SA (2015)

Table 2.1 shows the inflation rate between South Africa and USA in the 1970s averaged 9.89% and 7.10% per annum respectively. The difference between the two country's inflation rates at the time was relatively small at 2.79%. However, during the 1980s the average inflation rate in the USA declined from 7.10% in the 1970s to 5.55% while in South Africa inflation increased from 9.89% to 14.68% which is equivalent to an inflationary growth rate of approximately 48.4%. According to Ricci (2005) South Africa's major trading partners experienced a steady decline in inflation over the past two decades which was reflected by lower imported inflation in South Africa which resulted from an increasing openness of the economy in the early 1990s. According to De Waal and Van Eyden (2012, p. 2), South Africa's trade with the UK, USA, Japan and the Euro area has been decreasing in the last few decades.

Cawker and Whiteford (1993) found that high rates of inflation in the past have served to reduce South Africa's competitiveness in relation to its trading partners and competitors. Figure 2.2 shows the trends of inflation for South Africa and its trading partners.

* Note that the average annual inflation rate for China only include data from 1986-2013.

Figure 2.2: Inflation between South Africa and its main trading partners (1970-2013)



Source: IMF (2015); Stats SA (2015)

The 1980s was a period of high double digit inflation in South Africa as indicated by an average inflation rate of 14.68% which was attributed to ineffectual monetary policy during Gerhard de Kock's tenure as Governor of the Reserve Bank between 1981 and 1989 (Mohr and Fourie, 2008; Fourie and Burger, 2009). When compared to inflation figures of major trading partners³, South Africa experienced relatively high levels of inflation that was more than double when compared with those of the USA and UK for the period 1982 to 1987⁴.

As shown in Figure 2.2, on average, inflation in South Africa followed a similar pattern (upward trend) like that of its major trading partners for the period 1970 till the late 1980s in particular the USA and UK. The movement of inflation is roughly comparable,

³ Inflation for the trading partners was calculated as an average for USA, UK and China. However, it should be noted that inflation rates for China only include the period from 1986-2013.

⁴ Combined average rate of inflation for USA and UK between 1980 and 1989 was approximately 6.33% (see Table 2.1).

as it reflects some similarities in terms of the shocks, business cycle patterns and similar monetary policy approach adopted by most countries during that period. A declining trend in inflation since the 1970s is common to many countries. Although the countries followed a similar pattern, a combined average inflation rate for South Africa's trading partners peaked at higher rates until 1978, where they recorded an average rate of 7.96% while South Africa was marginally higher at 10.9%.

During the 1980s, the average inflation rate for South Africa's major trading partners declined significantly from 15.79% in 1980 to 3.9% in 1983, this decline recorded the lowest inflation rate since the period of high global inflation which was experienced in the 1970s particularly for the USA and UK. Since 1983, the average inflation for the major trading partners has been increasing steadily with the highest rate being 9.5% in 1984 and it has been relatively stable with a figure just below 5% for the past two decades. On the other hand, inflation in South Africa was relatively high in 1986, recording a historical rate of 18.7%, while the USA and UK recorded 13% and 18% respectively in 1980. The rate of inflation had been relatively high but stable, and the trend had been decreasing *albeit* at high rates when compared to countries such as the USA, UK and China.

Inflation was relatively stable in the 1990s with an average of 8.99% for the decade and it was close to China's level of inflation even though inflation in the UK and USA was far less than the prevailing inflation of the two developing countries. Inflation in South Africa remained relatively high between 1980 and 2000 even though there was a steady decline in the rate of inflation for its major trading partners. It is believed that the weaker monetary stance taken during that period was the main reason why inflation remained high while major trading partners were experiencing disinflation (Fourie and Burger, 2009). The robust monetary policy stance that was taken in the early 1990s has contributed towards a significant decline in the inflation differential between South Africa and its trading partners.

As indicated by Akinboade *et al.* (2004, p. 11), the inflation differential between South Africa and its main trading partners is fundamental to the authorities' rationale for further reducing the rate of price increases, as this will enhance the country's competitiveness on the global stage.

The introduction of inflation targeting saw South Africa's level of inflation declining to an average of 5.55% between 2000 and 2013. Although the financial crisis had a severe effect on domestic and global inflation between 2008 and 2009, South Africa's average level of inflation was competitive with that of its major trading partners remaining just below 6% for the period under review. Maintenance of price stability continues to be the primary function of the SARB under the current inflation targeting framework. Changes in monetary policy were brought about by changes in economic conditions influencing the direction of the economy.

Over the last few years South Africa has had to deal with the challenge of continued labour unrest which continues to affect the overall performance of the economy particularly within the main industrial sectors such as manufacturing, mining and agricultural sectors with the former being worst hit particularly given the severe labour protests that took place at the beginning of 2014 (SARB, 2014). Labour relations and persistent labour protests remain a major challenge in South Africa. In particular, changes in the structure of mining unionisation over the past few years having caused multiple, often violent disruptions, affecting the level of production (SARB, 2014). The effect of labour unrest contributed to a consecutive negative output growth in the first two quarters of 2014 *albeit* recording a positive growth of 0.6% in the third quarter of 2014 (SARB, 2014).

On the other hand, inflation rates continue to be driven primarily by exogenous factors and a negative output gap. However the current monetary policy stance strives to strike an appropriate balance between the risk of higher inflation and support for the domestic economic recovery. While the periods of inflation in South Africa tend to be triggered by foreign shocks, domestic shocks continue to play a significant role as well and often

intensifying the effects of the external factors. In recent years outbreaks in wage inflation, increased food prices and the current shortages in electricity supply the cost of which have been passed onto consumers, continues to exert inflationary pressure on the economy (SARB, 2014).

The impact of domestic factors continue to exert inflationary pressure as housing and utilities price inflation has remained relatively high and therefore sustaining consumer price inflation at the upper end of the target range. Recent movements in inflation were primarily driven by transport prices, which were affected by petrol price volatility. South Africa is losing out on opportunities to create more jobs mainly due to escalating labour costs and the increase in input prices resulting from both internal and external factors that directly influence domestic inflation emanating from both the production and consumption factors (SARB, 2014). The inflation trend in South Africa is discussed in accordance with the monetary policy regimes in Section 2.4.

2.4. Trends in inflation and monetary policy in South Africa

Inflation is the responsibility of the monetary authority, hence the SARB's main objective is to maintain price stability through ensuring that the level of inflation is kept to a minimum desired rate (Mohr and Fourie, 2008). The monetary policy framework in South Africa has undergone numerous changes in the country's history with varying degrees of success. According to Mohr *et al.* (2008) South Africa's monetary policy framework has gone through five monetary frameworks since the 1960s: a liquid asset-based system, a mixed system, a cost of cash reserves-based system with monetary targeting, a repurchase agreement (repo) system with monetary targeting and informal inflation targeting, and a repo system with formal inflation targeting.

Since the 1980s, South Africa went through three monetary policy frameworks (Aron and Muellbauer, 2000, 2001, 2004). Firstly it was the liquid asset ratio-based system with quantitative controls over interest rates and credit, followed by the pre-announced monetary supply targets/guidelines and finally the current inflation targeting framework.

The trend of inflation and the development in the determinants of inflation under different monetary policy frameworks since 1960 is discussed in the sections that follow. Section 2.4.1 discusses inflation and monetary policy conduct between 1960 and 1980, Section 2.4.2 highlights inflation and monetary policy between 1981 and 1985, Section 2.4.3 discusses inflation and monetary policy conduct between 1986 and 2000 and Section 2.4.3 discusses inflation and monetary policy between 2000 and 2014.

2.4.1. Inflation and monetary policy conduct between 1960 and 1980

Since the mid-1960s inflation has been a serious and continuous problem in South Africa. During that period, the monetary policy implemented a series of direct control measures which among others included credit ceilings, exchange controls and other direct consumer credit control measures that was aimed at countering the rising money supply and continuous inflationary pressure heading to the early 1980s (Akinboade *et al.*, 2004).

The main instrument utilised during this period was a liquid asset requirement which was used as a corrective instrument to achieve monetary policy objectives. At the time, interest rates played a minor role as a control instrument for the monetary authority and according to Chicheke (2008) the monetary policy performance was poor during this period as inflation remained relatively high and volatile.

The inquiry into the monetary system that was undertaken by the De Kock Commission (1985) for the monetary policy implemented between 1960s and the late 1970s laid the foundation for the monetary policy implementation during the 1980s (Smal and de Jager, 2001)

2.4.2. Inflation and monetary policy between 1981 and 1985

In an effort to contain persistent increases in money supply and the inflationary pressures experienced from the 1960s to 1980, the SARB implemented a series of direct controls such as exchange controls, a ceiling on advances, deposit rate controls

and some direct consumer credit controls (Moolman and Du Toit, 2004; MacKinnon, 1973). These monetary controls gave way in the 1980s to a need to eliminate financial regulations in domestic financial markets and a move towards a market oriented policy (Moolman and Du Toit, 2004; MacKinnon, 1973). As indicated by Mollentze (2000), South Africa's monetary policy was going through a period of transition from a predominantly direct to an increasingly market-related monetary dispensation.

In the early 1980s, the SARB adopted a strategy of liberalisation⁵ due to the ineffectiveness of the direct control system. The commission was established and tasked with the assignment to analyze the efficiency of the monetary policies following the financial repression period that was experienced in the early 1970s. The De Kock Commission (1985) recommended that the SARB should opt for a market orientated economy or an indirect control credit system that would lead to more efficient financial intermediations which was to be implemented by both the Government and the SARB.

However, Moll (1999) suggested that liberalisation was not meant solely just for financial markets. The abolition of interest rate control measures prompted the government to liberalise international capital markets which allowed domestic citizens some degree of freedom which enabled them to transfer capital in and out of the country. This process also eliminated restrictions on the domestic labour market in the early 1980s, whereby all factors of production had the autonomy to work either domestically or outside South Africa.

Under the cash reserves system, the discount rate influenced the cost of overnight collateralised lending and hence market interest rates. The supply of credit was influenced by open market operations and other policies acting on overall liquidity. By creating a persistent money market shortage and setting the discount rate at a relatively high level, the commercial bank rates were usually closely linked to the discount rate.

⁵Liberalisation is defined as elimination of financial regulations in domestic financial markets, such as credit ceiling, lending requirement or entry restrictions to reduce excess demand for credit (MacKinnon, 1973).

Monetary control was deemed to operate indirectly through the slowing of the demand, with an estimated lag for its ultimate effect on inflation of over 12 months (Aron and Muellbauer, 2006, p. 3).

2.4.3. Inflation and monetary policy conduct between 1986 and 2000

South Africa is one of the many countries that introduced money supply targeting as an anchor for monetary policy during the course of the 1980s (Stals, 1997b). Following the recommendations of the De Kock Commission (1985), South Africa introduced formal money supply target for a broad definition of money (M3) that was introduced in 1985. The adopted system allowed monetary authorities to place more emphasis on interest rate adjustments rather than direct credit extension restrictions that was followed prior to 1985.

As indicated by Aron and Muellbauer (2006, p. 5), monetary policy was aimed at controlling the growth rate in total money supply as an intermediate objective with the expectation that it will influence the amount of bank credit extension for the purpose of achieving the overall objective of protecting the value of the Rand both domestically and internationally. According to Akinboade *et al.* (2004), the monetary targets were applied in a flexible manner and its use was based on the assumption that there is a stable relationship between changes in money supply and inflation.

The target was set on a yearly basis using the moving average of three months in money supply (M3) growth for the period that covered the fourth quarter of the previous financial year to the fourth quarter of the current financial year. The objectives of setting the monetary targets were aimed at accommodating anticipated real GDP growth and containing inflation.

However, Aron and Muellbauer (2006, p. 5) suggest that the process that was followed to select the inflation target was not transparent as it was not mandatory for the SARB to give public explanations in circumstances where the monetary target was breached

as this is the practice in the current inflation targeting system that allows the monetary authorities to give public explanation as to why the target has been breached and what measures would be taken to ensure that inflation reverted back to the specified target. This practice indicates the differences between the two monetary policies in terms of transparency.

According to Smal and De Jager (2001, p. 3), the decision by the SARB to move away from formally targeting the money supply that was adopted in the mid-1980s in favor of an eclectic approach provided a broader range of economic indicators for the determination of its policy actions. According Smal and de Jager (2001:3), such a wide range of indicators as identified by Stals (1997a) consisted of:

- a. Changes in bank credit extension and the overall liquidity in the banking system.
- b. The level of the yield curve.
- c. Changes in official foreign reserves and in the exchange rate of the Rand.
- d. Actual and expected movements in the rate of inflation.

Van der Merwe (2004, p. 1) suggested that the reduction in inflation between 1992 and 1999 was achieved under the informal inflation targeting monetary policy framework and thereby prompted a change in the monetary policy. The formulation of an eclectic monetary policy approach which was implemented in the 1990s laid the foundation for formal inflation targeting framework policy which was adopted in 2000.

2.4.4. Inflation and monetary policy between 2000 and 2014

The introduction of inflation targeting in 2000 signaled the need for less central bank activity in the foreign exchange market. The scale of capital movements and shifts in a direction that accompanied a long period of international financial contagion in the late 1990s and into the 2000s, made currency intervention as a policy tool ineffective and unsustainable (SARB, 2014). Continuous depreciation of the exchange rate remains a concern about the attainment of the inflation target as the central bank is concerned

about the level and direction of the exchange rate due to the impact that it could have on the inflation rate. Recently one of the major causes of rising inflation has been attributed to the pass-through of Rand depreciation.

The currency has been on a steady downward trajectory since 2011, which accelerated in 2013 and early 2014 (SARB, 2014)⁶. Although there is no specific target for the exchange rate, no intervention is undertaken by the SARB in order to directly influence the level or direction of the exchange rate. Since the introduction of a formal inflation targeting framework, the repo rate has been the main instrument of monetary policy that seeks to influence inflation through various channels.

A change in the repo rate is expected to have direct effects on interest rates, equity prices, exchange rate, asset price and credit respectively through their various channels (Ludi *et al.*, 2006). Although inflation targeting focuses on a variety of targeted variables that influences inflation, Saxton (1997) states that price stability remains a viable policy goal. In particular:

- Price stabilising monetary policy retains a good deal of flexibility to achieve other policy goals and also works to stabilise economic activities.
- Inflation is not necessary to foster labour market adjustments and may work to remove existing wage flexibility. Price stability on the other hand, would likely work to promote such flexibility.
- An environment of price stability and low interest rates which does not constrain monetary policy; central banks can pursue stimulative policy via a variety of channels under stable prices. Price stability however, does minimize the need for such stimulative policy.
- The CPI remains a viable price index measure suitable for use as an inflation target. Despite some measurement bias, the CPI has many advantages which outweigh its disadvantages.

⁶ Monetary policy review, June 2014

Although the central bank uses various channels in conducting its operations under the current monetary policy framework, it uses interest rate (repo rate) as one of its main control instruments to ensure that it influences the lending rates by other financial institutions to be significantly higher than the inflation rate if the bank is to ensure that excessive credit growth and money supply growth is prevented. Changes in the repo rate affect the demand for and supply of goods and services which ultimately determines output fluctuations and inflationary pressures.

The SARB has stated that monetary policy requires patience as the process of combatting inflation requires a collective effort by all participants in the economy to prevent excessive money supply growth. For the central bank to successfully control the rate of inflation at the desired level, a collective effort, particularly by the private-sector banks to maintain interest rates at levels that are high enough to prevent excessive growth in credit extension.

The current inflation fighting strategy had some concerns with regards to its effectiveness in absorbing aggregate supply shocks which presents a greater challenge to inflation targeting countries as a negative supply shock such as a sharp increase in the oil price, increases prices while simultaneously resulting in decreasing output (Vellery and Ellyne, 2011). However, inflation targeting still remains one of the viable tools in ensuring that price stability is maintained in the economy. Although the central bank sets its repurchase rate (repo rate) at an appropriate level, the process of changing interest rates to influence money supply, credit and inflation takes time to work through due to time lags. In light of these challenges, the current monetary policy takes time to achieve the desired impact in the level of inflation and the economy in general (Vellery and Ellyne, 2011).

The conduct of monetary policy remains the most important tool in achieving the desired inflation outcomes. As observed in recent years, one of the major challenges affecting the inflation fighting policy emanates from the development in global economic

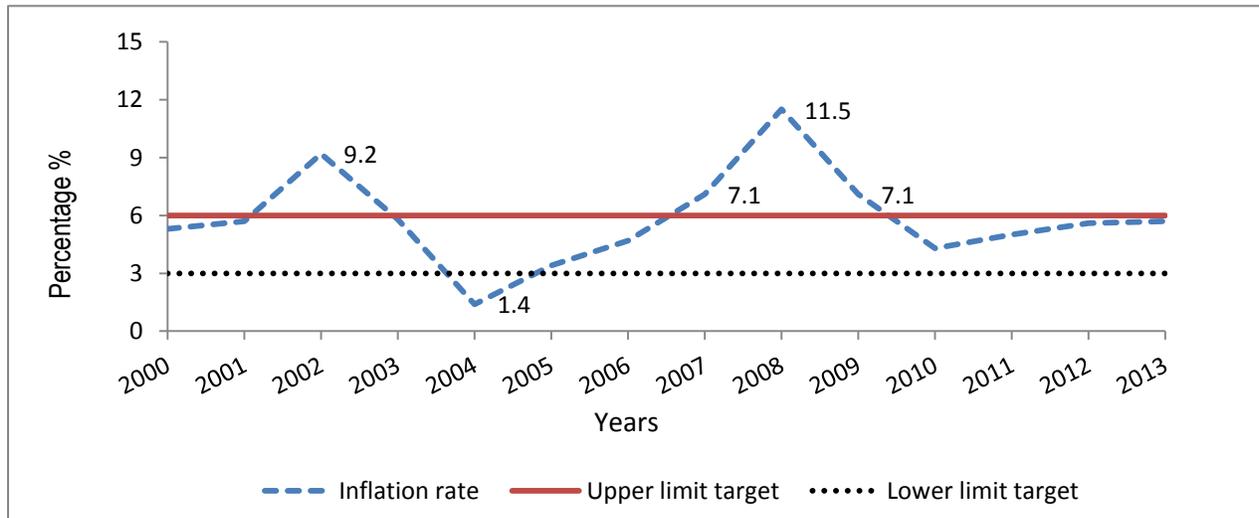
conditions particularly since the global financial crisis in 2008. Advanced economies such as the USA and Japan, responded with unexpected stimulus which among other factors included zero interest rates, unprecedented policy co-ordination and large-scale asset purchases (quantitative easing) and the process has moderated some of the adverse effects that resulted from the global financial crisis (Bernanke, 2012). Subsequent to the global financial crises in 2008, global risks have in recent years emanated from advanced economies through increasing the interest rate and tapering asset purchases particularly in the USA. In the current global economy where under-developed and developing countries are comprehensively dependent on the developments of other major developed economies in the world, it is important to note that although domestic factors continue to affect the rate of inflation in South Africa, global risks emanating from the monetary activities of advanced economies in countries such as the USA, UK and Japan, continue to play a fundamental role in shaping the conduct of monetary policy in South Africa.

2.4.5. Breaching the inflation target (2000-2013)⁷

The introduction of inflation targeting signaled the need for greater transparency and commitment to keeping inflation within the set target of between 3% and 6% by the SARB. One of the features of an inflation targeting framework is the greater degree of transparency it brings to monetary policy (SARB, 2014). However, Van der Merwe (1997) notes that the pursuance of price stability tended to be difficult and distorted due to the complex transmission mechanism of the monetary policy which is influenced by ever changing global conditions. Figure 2.3 shows the trends in the rate of inflation since the introduction of inflation targeting framework in 2000.

⁷ Factors that contributed to the breaching of inflation target are discussed in detail in Section 2.5.

Figure 2.3: Targeted inflation (2000-2013)



*CPIX for metropolitan and other urban areas until the end of 2008; CPI for all urban areas from 2009

Source: Stats SA (2015)

Figure 2.3 indicates that the average rate of inflation in South Africa breached the target on four occasions since the introduction of formal inflation targeting in 2000⁸. The first breach of the target was towards the last two quarters of 2002, while the average for the year reached the maximum of 9.2% and this presented a serious challenge to the credibility of inflation targeting particularly since it was expected that the set target for inflation to be maintained within the stipulated band would be achieved by 2002 (Casteleijn, 2001; Stats SA, 2015).

During the first breach of the target range, inflation was propagated by exogenous factors which were out of the control of the SARB. The main cause of inflation included a sharp increase in the cost of imported products, specifically a sharp rise in the price of crude oil and depreciation in the value of the Rand (Akinboade *et al.*, 2004; Kaseeram *et al.*, 2004).

⁸ The breaching of the target is based on the years in which the annual average inflation rate was recorded above 6%.

Domestically, food prices also had a major influence towards higher inflation levels that were experienced in 2002. Other causes of higher food prices were mainly attributed to adverse weather conditions which posed a serious threat to the country's food security. The longest standing inflation period in which inflation breached the target started in the second quarter of 2007 and lasted till the third quarter of 2009. On average inflation was recorded at 7.1% above the upper target range of 6% for the period 2007 to 2009 (see Figure 2.3). According to the SARB, besides the global financial crisis during that period, increases in food prices, electricity cost and petrol prices were main contributors to the high inflation levels experienced in 2007 and 2008 (SARB, 2008).

2.5. Trends in inflation and its determinants

There have been various causes of inflation over the years and such factors have had a direct influence on the trend of inflation and as well having an influence on the inflation outlook: as such, there is a need to closely monitor such variations and also provide an overview on the impact they had on the general price level and particularly on the conduct of monetary policy in South Africa.

Inflation occurs as a result of domestic and external factors which can be initiated from either the demand side or supply side of the market. Inflation results from amongst other factors, the depreciation of the exchange rate, growth in money supply, high fiscal stimulus in the form of increased tax accompanied by an increase in Government expenditure which widens the fiscal deficit, a fall in interest rate which stimulates the demand for credit and thereby stimulating demand for money and other goods and services in and outside the borders of the South Africa.

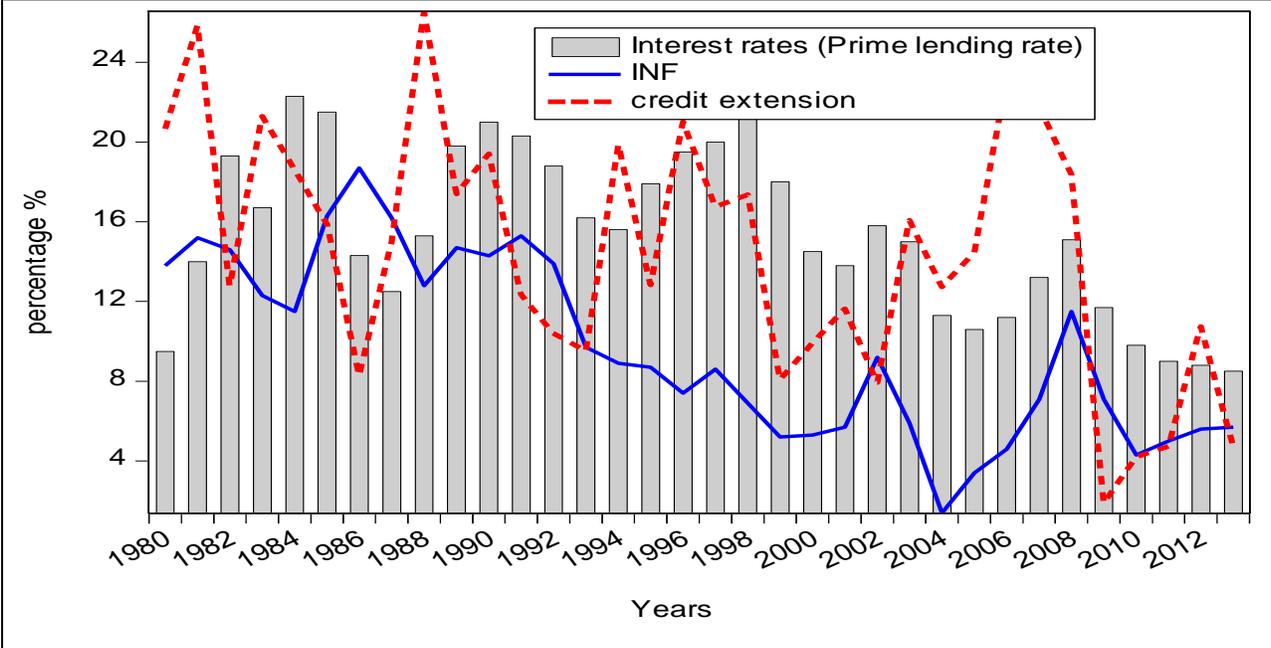
The impact of these underlying causes of inflation differs according to the prevailing economic condition and the appropriateness of the measures taken to fully address their influence on inflation. The factors influencing the rate of inflation has been subject to the conduct of monetary policy and other macro-economic policies aimed at fighting inflation over the years. This section provides historical observations of the relationship

between the actual inflation and some of its main determinants in accordance with the evolution of monetary policy over the years. Section 2.5.1 discuss inflation, interest rates and credit extension; Section 2.5.2 discuss inflation and money supply; Section 2.5.3 discusses inflation and exchange rate; Section 2.5.4 inflation and labour cost and Section 2.5.5 discusses inflation and global commodity prices

2.5.1. Inflation, interest rates and credit extension

In the 1980, the liquid asset ratio-based system brought into place quantitative control measures over credit extension and interest rates. However interest rates were used as an indirect monetary instrument, while liquid asset requirement was recognized as the main instrument to achieve monetary stability. A variety of instruments were also considered to stimulate economic growth while eradicating inflationary effects. In this system, interest rates were allowed to fluctuate with market conditions while monetary aggregates were used as immediate targets that are aimed at achieving the ultimate goal of price stability (Strydom, 2000). Figure 2.4 shows the trends in inflation, interest rates and credit extension for the period 1980 to 2013.

Figure 2.4: Inflation, interest rates and credit extension (1980-2013)



Source: SARB; Stats SA (2015)

As shown in Figure 2.4, the prime lending rate⁹ peaked towards the end of 1984 while the rate of inflation continued to increase *albeit* commercial banks placing restrictions on liquid assets as a minimum proportion of deposits. Such constraints were applied with an expectation that it would slow down credit extension which in turn would lead to a decline in the rate of inflation. There was an expectation that interest rate changes would have an effect on future inflation and not necessarily the current rate of inflation mainly due to time lags.

A change in prime lending rates is regarded as an indirect measure that is triggered by the central bank repo rate as an indication of a tighter monetary policy stance. However the trends in inflation seemed to have been moving in an opposite direction as shown by the steady increase in both interest rate and inflation between 1980 and into 1982. The decline in inflation in 1983 can be attributed to the lagged effects of interest rates that rose significantly from 9.5% to 19% during the period 1980 to 1983.

Monetary policy during the 1980s, placed more emphasis on the influence of credit extension and as such, by pursuing policy measures that allowed interest rates to be determined by the forces of demand and supply, the variations in interest rates was in accordance with the changing market conditions (Mollentze, 2000).

The lending rate served as a complementary measure to achieve monetary policy goals and most importantly its impact on the inflation. The effect of high and rising interest rates had an impact on the ability of commercial banks to provide credit and subsequently led to a decline in the rate of inflation. However, interest rates played a minor part as a remedial instrument under the monetary system that was adopted at the time, as the main policy instrument was liquid asset requirements, the policy that dominated in the early 80s (see Akinboade *et al.*, 2004; Moolman and Du Toit, 2004; Kaseeram *et al.*, 2004; Fourie and Burger, 2009).

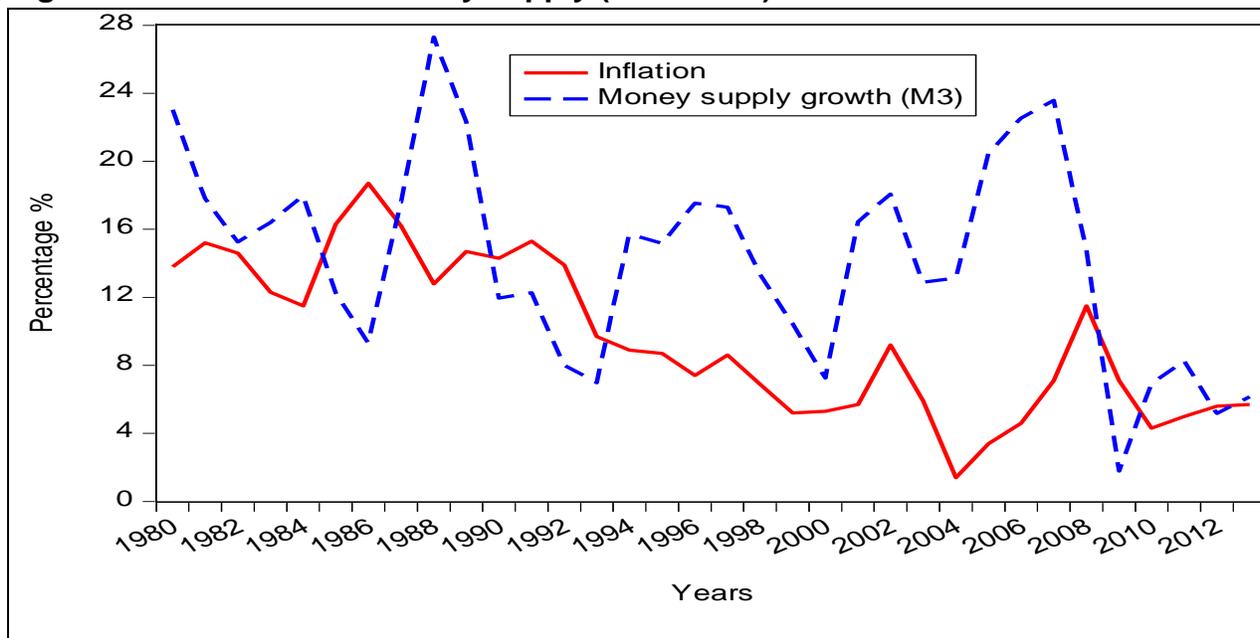
⁹ Prime lending rate is calculated as an average for the year i.e. $\frac{\sum(Value_{Jan} : Value_{dec})}{12}$

2.5.2. Inflation and money supply

Growth in money supply has in most cases been referred to as the cause of inflation and it is also regarded as a leading indicator for inflation. According to Svensson (2000), *albeit* high correlation between money growth and inflation in the long run, there is little or no empirical evidence that identifies growth in money supply as a leading indicator for inflation.

Money supply is identified as one of the determinants of inflation particularly by the proponents of the monetary targeting system. Stals (1999) pointed out that monetary targeting contributed significantly to a reduction in inflation from the double digit levels of between 12% and 20% from 1972 to 1992 to an average of below 10% from 1994 to 1999. Figure 2.5 shows the trends in the rate of inflation and money supply from 1980 to 2013.

Figure 2.5: Inflation and money supply (1980-2013)



Source: SARB; Stats SA (2015)

As shown in Figure 2.5, South Africa also experienced a significant decline in money supply from 27.3% in 1988 to approximately 7.0% in 1993. Subsequently, inflation also declined from 12.8% and 15% from in 1988 and 1991 respectively, to 9.3% in 1993. It is evident that monetary policy in the early 1980s was inflationary. This is based on the

behavior of some of the most important monetary policy aggregates and also because growth in aggregate demand has implications on the general price level mainly due to its reliance on the growth in the supply of money. Given that, it is also evident that the acceleration in inflation during that period had not been accidental. Over the past years high rates of inflation was directly linked with the growth in money supply in South Africa, as growth in money supply prevails, inflation also followed a similar trend although it's characterised by time lags.

According to Casteleijn (2001), time lags tend to differ from country to country due to differences in economic and financial market structures. Growth in money supply was roughly 15.3% in 1982 and it continued to grow to 18.0% in 1984. This growth in money supply was later followed by an increase in the price level from 11.5% in 1984 to 18.7% in 1986. According to the trend, there was a two year lag period before inflation responded to changes in money supply growth. This is evidenced by the behavior of money supply and inflation during the period 1982 to 1990 (see Figure 2.5). As indicated by Mboweni (2000, p. 67), monetary policy initiatives take time to make an impact on inflation because of the long lags (approximately 18 to 24 months).

The linkage between money supply growth and inflation indicates the role of money as one of the determinants of inflation in South Africa. However, Stals (1999) outlined that the usefulness of money supply targets as an indicator and a measure to stabilize the rate of inflation was affected by extensive financial liberalisation in the early 1980s through an increase in financial market activities and capital flows that led towards a more open economy in 1994. The latter statement is an indication that the determinants of inflation changes in line with the structural changes in the economy and as such, they should be carefully monitored owing to the fact that they affect the stability in the relationship between various macro-economic variables and inflation.

According to van der Merwe (1997), the growing integration of global financial markets, liberalisation of capital markets in South Africa, the elimination of strict exchange

controls and financial deepening in the form of the extension of banking services was significantly changed by the relationship between money supply (particularly M3) and the demand for goods and services.

The ongoing effects of liberalisation and the elimination of sanctions during the early 1990s were associated with an increase in real interest rates and a decline in inflation. During that period, the SARB was still pursuing a monetary targeting system as its main policy instrument. However, monetary targets were abandoned in the early 1990s and this was due to the monetary authorities' view that the relationship between inflation and growth in money supply was becoming unstable and unpredictable (Van der Merwe, 1997). Mohr (2008) observed that changes in monetary aggregates cannot be attributed to the decline in inflation in the mid-1990s as there was no noticeable decline in the rate of monetary aggregates.

In 1993, inflation rates decreased steadily from 9.7% to approximately 8.6% in 1997, whilst growth in monetary aggregate continued to increase from 7.0% to 17.3% during the same period. The expectation was that an increase in monetary aggregates would translate into an increase in the general price level. However, the trend from 1993 to 1997 clearly indicates that growth in monetary aggregates could not be attributed to inflation and as such, raised concerns with regards to the effectiveness of monetary targets achieving the ultimate goal of price stability. According to van der Merwe (2004, p. 1) 'the growth in money supply and bank credit extension in the 1990s was above the guidelines of the authorities for a considerable period. In these circumstances the public expected an increase in short-term interest rates. However, in analyzing the situation the authorities realized that the high growth in the monetary aggregates was mainly due to structural changes in the economy resulting to a large extent from the liberalization of the financial system.' This was seen as a signal to the monetary authorities that there was a need to introduce a new policy strategy that would align monetary policy conduct with new developments in the determinants of inflation.

De Wet (1994) suggested that access to international financial markets in 1994, remains one of the crucial structural aspect in the South African economy. As a result of structural changes in the economy due to liberalisation in the early 1990s, rapid growth in labour productivity suppressed an increase in nominal unit labour cost from 4.2% in 1992 to 12.8% in 1993 giving rise to steady real remuneration particularly to those people who received consistent work and payment (De Wet, 1994). Unlike most emerging market economies, South Africa has historically been an important player in international markets with a more open economy than many industrialised and developing countries.

Inflation declined to an average of 8.7% in 1995 compared to the 9.9% in the preceding year. From 1995, the inflation rate continued to decline up to 1999 *albeit* with a marginal increase of 1% between 1996 and 1997. However, it further declined significantly by 3.5% between 1997 and 1999 notwithstanding a sharp increase of 7.8% and 9.1% in the last two quarters of 1998.

The appreciation in the value of the Rand coupled with a corresponding hike in interest rates and the prospect of good rain for the season contributed to a reduction in food prices. This was identified as the one of the main reasons for a decline in the general price levels for the period 1995 to 1999. During that period, prime lending rates also increased from 17.9% to 21.8% in 1998. As indicated by Smal and de Jager (2001), the SARB's adoption of an eclectic monetary policy during the late 1990s was an indication that the inflation target did not necessarily have to be an officially announced target and this was the approach followed by the SARB as they indirectly pursued unannounced targets in order to achieve monetary policy goals.

2.5.3. Inflation and exchange rate

In the 1970s, a number of countries in the world experienced challenges as a result of the rising commodity prices. This was mainly attributed to a fixed exchange rate policy regime during that period as the SARB was required to maintain fixed exchange rates

with other foreign currencies (Gidlow, 1995). During that period, higher commodity prices were directly and indirectly transmitted to domestic prices. The effects of higher international prices are explained by the higher inflation rates that were experienced by South Africa's major trading partners. Although inflation was higher during that period, the inflation rate was relatively higher in South Africa when compared to its main trading partners¹⁰.

The strict or rather rigid exchange rate controls which were implemented in the periods prior to the adoption of inflation targeting led to frequent external/foreign shocks as they played a major role in influencing the internal value of an already weakening domestic currency. The impact of the weakening currency made it expensive for domestic consumers of international goods to import and it had an adverse effect on importers of input products that are not available domestically but used to further process products that were either re-exported or consumed locally. The weakening currency did not only have negative impact on input products, it also had a negative impact on the finished products that were not available domestically.

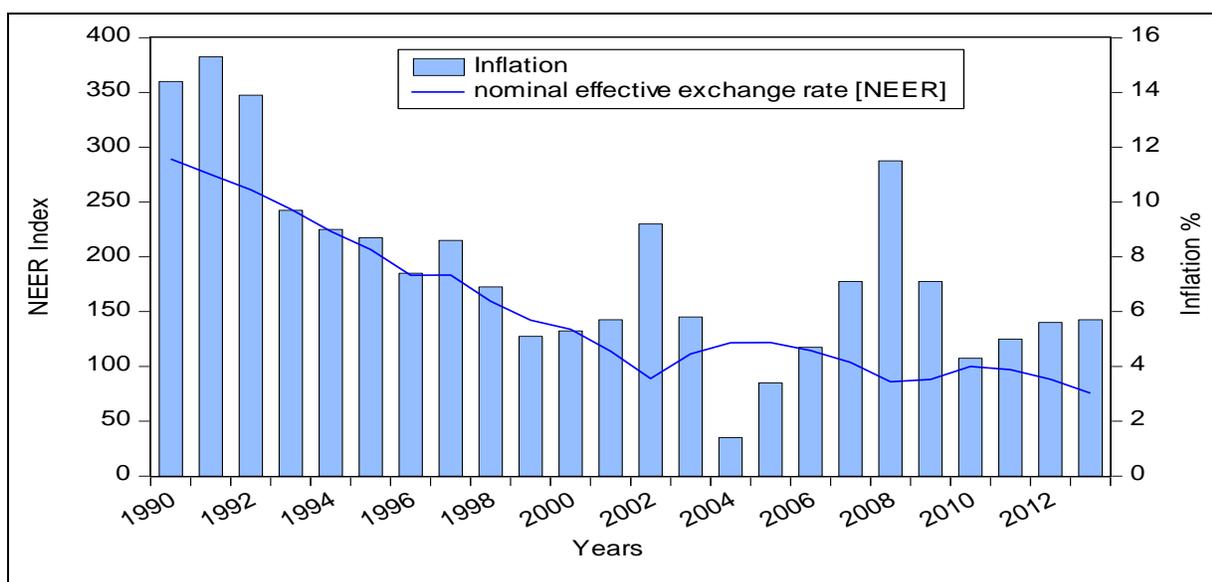
The effect of the falling exchange rate had a negative influence particularly on products such as oil, raw materials and some of the material that cannot be sourced domestically. Such an exchange rate crisis directly influenced inflation as it directly affected the domestic prices of goods and services.

Figure 2.6 depicts the movement between inflation and average nominal effective exchange rate of the Rand for the period from 1990 to 2013¹¹.

¹⁰ See Table 2.1 and Figure 2.2 for inflation comparison between South Africa and its major trading partners.

¹¹ Nominal effective exchange rate (NEER) is the weighted average exchange rate of the rand based on trade in and consumption of manufactured goods between South Africa and its most important trading partners (SARB, 2014).

Figure 2.6: Nominal effective exchange rate and inflation dynamics (1990-2013) ¹²



Source: SARB (2015)

The exchange rate is affected by various factors. Faure (2005, p. 239) identified interest rates as one of the most common factors that has a direct influence on the exchange rate. According to Faure (2005) the changes in interest rates has an influence on capital flows, capital that has a direct impact on the exchange rate. Akinboade *et al.* (2004, p. 2) indicates that the nature of the linkage among nominal exchange rate, import prices and domestic price are of crucial importance in a small open South African economy. The linkages amongst these variables relates to the extent of which the pass-through changes to the domestic price level. The importance of the linkages amongst the variables in the determination of inflation is further highlighted by Van der Merwe (1997) observations that a continuous increase in the volume of international capital flows and the impact of fluctuating interest rates began to reflect on the change in the external value of the rand (i.e. the exchange rate). According to Van der Merwe (1997), these variations in foreign capital flows and interest rates had the ultimate effect that longer time lags had become evident between the policy change and its desired impact on the real economy and inflation.

¹² Index: 2010 = 100 (weighted average exchange rate of the rand against foreign currencies)

As shown in Figure 2.6, depreciation in exchange rates during the 1990s, was followed by a decline in the rate of inflation and this could partly be explained by the rigid exchange rate policy at the time. Although the value of the domestic currency against the currency of the country's major trading partners depreciated over a 10 year period (1990-2000), the Rand was relatively stable when compared to the period from 2000 where the fluctuations were minimal even though the currency steadily continued to depreciate.

Following the sharp depreciation of the domestic currency in the late 1990s and towards the early stages of 2000, the majority of emerging economies including South Africa, shifted towards a flexible exchange rate policy which was part of the monetary policy of eclectic approach that emerged from the abolition of rigid exchange rates to give effect to the proposed or rather unofficial inflation targeting which led to the adoption of the formal inflation targeting framework in 2000. With the view to preventing the recurrence of a financial and currency crises, Edwards (2001) suggested that emerging countries should adopt either freely floating or super-fixed exchange rate regimes depending on the monetary policy approach in order for the policy to yield expected policy objectives.

Inflation and exchange rate exhibited similar trend between 1990 and 1999 as observed in Figure 2.6. As the rate of exchange rate weakened, inflation was on the downward trend during the same period. This is mainly attributed to the view that the inflation at the time was mainly explained by internal factors such as an increase in wages/salaries and some of the Government policies that advocated increased Government spending. Hodge (2009, p. 499-500) observed that South Africa's labour force had grown rapidly, especially during the second half of the 1990s and indication was that most of the fluctuation in the general price levels was mainly attributed to other internal factors with the exchange rate having a minimal impact during that period.

Meanwhile, the influence of external factors on domestic inflation started to emerge during the early 2000s. According to (Van der Merwe, 2004; Koller, 2005), inflation was

attributed to exogenous demand pull factors such as the decline in the value of the Rand, an increase in oil prices and administered prices.

Since then, much emphasis has been placed on the monitoring of exchange rate fluctuations since the introduction of the inflation targeting framework and this was confirmed when the SARB adopted a flexible exchange rate, which amongst other reasons, was adopted with the view of avoiding conflicts between monetary objectives and exchange rate policies (see Akinboade *et al*, 2004; Fourie and Burger, 2009). Van der Merwe (1997) further explained that, as opposed to periods where South Africa was to a great extent isolated from external foreign influences (at least up until the 1980s), the relationship between changes some of the economic variables such as exchange rates, interest rates, money supply and the inflation rate have now become far more complicated and unclear in the current liberalised economic conditions.

Subsequent to the introduction of inflation targeting, the value of the Rand displayed an increasing trend between 2002 and 2005, with the Rand gaining momentum against some of the major currencies of South Africa's main trading partners. The appreciation on the value of the Rand came in handy for the domestic economy as it was still recovering from major external supply shocks which resulted from an increase in oil prices and other imported commodities between 2002 and 2004. From 2006, the nominal effective exchange rate begun to decline and this had a major impact in the rate of inflation considering that the global economies were going into recession.

A decline in the value of the Rand concurred to an increase in inflation from 4.7% in 2006 to 11.5% in 2009. Although inflation was also influenced by other external factors, a simultaneous weakening of the Rand also intensified the effect of imported commodities prices.

It is evident in the world market that the most popular South African exchange rate is Rand to US Dollar rate and it is worth noting that between 2006 and 2009, the value of

the Rand when compared to the US Dollar depreciated on average from R6.77 to R8.44 in 2009. Other factors that perpetuated the depreciation of the value of the Rand was the global financial crisis between 2008 and 2009.

Post 2009, the volatility in the exchange rate was influenced by domestic factors which led to the depreciation of the currency beyond the financial crises. The nominal effective exchange rate peaked in 2010 after it slightly recovered from the 2008 financial shocks which demonstrated the effects of financial stress on real economic activity in the global economy.

With the nominal exchange rate having recovered markedly since 2008, there was, as a result, an increase in investor confidence around the world, the bilateral exchange rate of the rand against the US Dollar appreciated from R8.25 in 2008 to R7.25 in 2011 whilst inflation declined from 11.5% to 5% respectively during the same period.

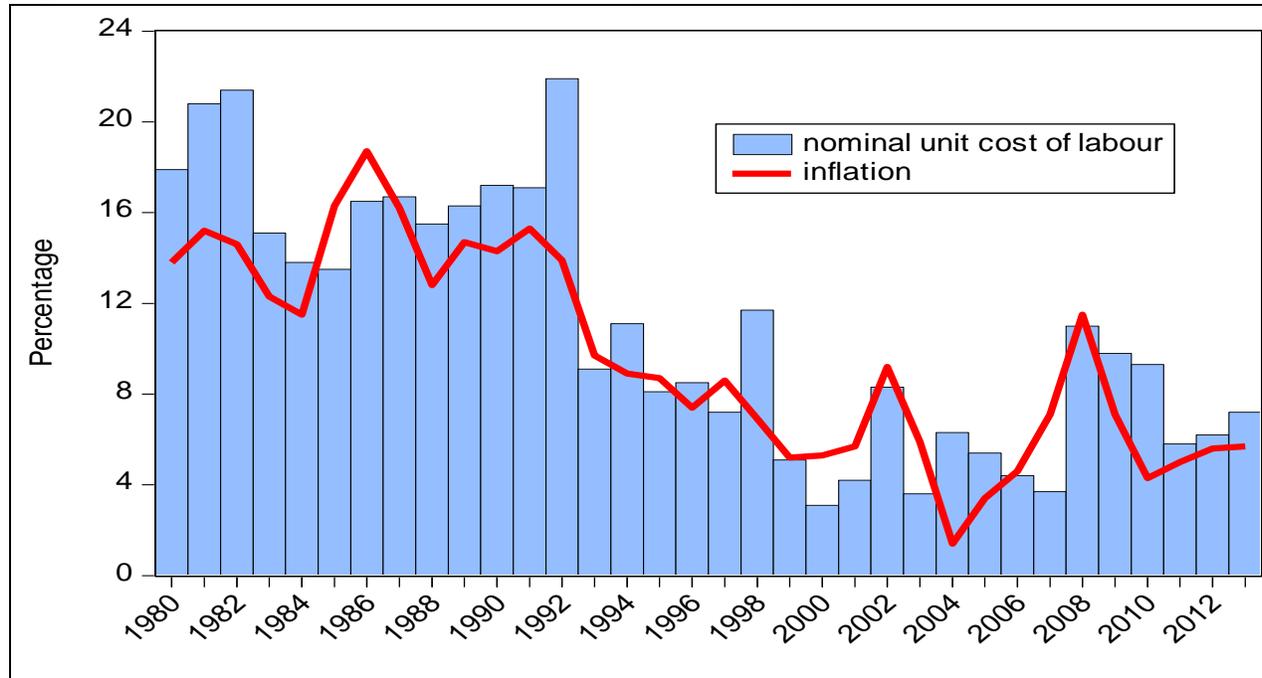
Although the SARB continued to maintain the average annual inflation rate within the target range for the last 3 years, inflation has been increasing steadily since 2010 while nominal effective exchange rates continue to depreciate. The continuous depreciation in the rate of exchange outlines South Africa's risk to external shocks mainly due to the continuous weakening of the Rand against the country's major trading partners and thereby leaving the prospect of high inflation uncertainty as a result of external factors such as higher import prices which poses a serious threat to the credibility of the SARB's ability to maintain inflation within the set target of between 3% and 6%.

2.5.4. Inflation and labour cost

A variety of domestic factors determine the level of inflation in the economy and this section deals with one of the many factors that has prevailed since the 1980s, particularly on the influence of labour activities in terms of cost and policy perspective. The influence of labour market activities on domestic prices often prevails as business's

respond to rising costs. Figure 2.7 illustrate the movement between inflation and nominal unit labour cost for the period from 1990 to 2013.

Figure 2.7: Unit labour cost and inflation (1990-2013)



Source: SARB (2015)

Labour laws in South Africa have been very influential particularly since the new Government came into power in 1994. Over the years, there has been a close correlation between inflation and the nominal unit cost of labour measured as wage inflation adjusted for productivity changes in the formal non-agricultural sector for the period 1980 and 2013 (see Figure 2.7).

Inflationary pressure from the labour market has been moving parallel with the rate of inflation over the years. As shown in Figure 2.7, unit costs of labour measured in terms of the year-on-year changes in wage inflation, adjusted for productivity changes in formal non-agricultural sector, shows that in 1980 unit labour cost was recorded at 17.9% while inflation was recorded at 13.8%. The average annual labour cost accelerated by approximately 4.1% more than the annual average rate in inflation recorded during the same year (see Figure 2.7). This is an indication that the effect of

high labour costs has contributed towards an increase in domestic inflation as the wages earned by households increased and as such, resulting in an increase in production cost for the local businesses.

On average, unit labour costs increased by 16.8% p.a. between 1980 and 1990, while inflation averaged 14.8% p.a. during the same period, which was approximately 2% less than the average growth on wage inflation. Although there was an average increase of approximately 0.12% on unit labour cost in the formal non-agricultural sectors, a sharp decline of 7.4% in 1980 was followed by a decline of 2.2% on the level of inflation between 1982 and 1984. The hike in inflation was followed by an increase in remuneration per worker, indicative of the role of expectations in the labour market and the inability of the market to absorb supply shocks experienced during the 1980s.

Unit labour costs peaked in 1992 subsequent to an increase in the general price level in 1984. Although the trend showed some signs of a declining inflation prior to 1984, a series of increases in unit labour cost was followed by a significant rise in the rate of inflation from 9.5% to 19% during the period 1984 to 1986. Between 1992 and 2000 there was a significant decline in unit labour cost and this is could partly be explained by the integration of the economy into the global world. Although unit labour cost peaked in the early 1990s, there was a significant decline in unit labour costs from 21.1% in 1992 to a record low of 3.1% in 2000.

During the same period, inflation rates also declined from the highest rate recorded for the period 1990 to 2000, declining from 15.3% in 1992 to 5.3% in 2000. Inflationary pressures arising from the labour market remained subdued during the 1990s with the trend showing a continued decline in both variables and these variations further indicated that nominal unit labour costs were an important domestic determinant of inflation in South Africa.

The variations in inflation and labour costs followed similar trends under the inflation targeting framework. Between 2001 and 2002, inflation rose significantly from 5.7% to 9.2% respectively. Variations in general price levels were mainly attributed to the weakening Rand and external shocks as a result of high oil prices. Domestically, labour costs and food prices also influenced these general price levels with remuneration per worker continuing to exert inflationary pressure on the economy as it grew by approximately 1.7% on average between 2000 and 2006.

Despite wage trends reflecting the upward drift in inflation expectations particularly in 2008 when wage inflation sharply increased from 3.7% in 2006 to 11% in 2008, this move led to an increase in the average inflation expectation from 5.6% to 9.4% respectively during the same period before it moderated to an average of approximately 6% towards the end of 2013.

Developments in the labour market, since 2008, remain broadly consistent with inflation targets, although it has been highly influenced by domestic factors such as protests particularly in the major labour intensive sectors such as mining and manufacturing. Since the beginning of 2009, wage inflation as measured by the unit cost of labour remained relatively steady as compared to the period between 2000 and 2006 where there were frequent variations in the labour market.

Since 2010, there has been a steady increase in both unit labour costs and inflation, with unit labour cost reaching 7.2% in 2013 while average annual inflation remained relatively steady inside the set inflation target parameters. Labour costs continue to rise thereby fueling inflation expectations which could increase the probability of an increase in inflationary pressure which may result in a tighter monetary policy stance beyond 2013. It was evident from the sluggish growth during the first three quarters of 2014 and the continued labour unrest as labour unions sought higher remuneration for their members, may have further lead to the rate of inflation breaching the targeted

parameters towards the last quarter of 2014, which according to the SARB projections, was expected to record an annual average of 6.1% for 2014 (SARB, 2014).

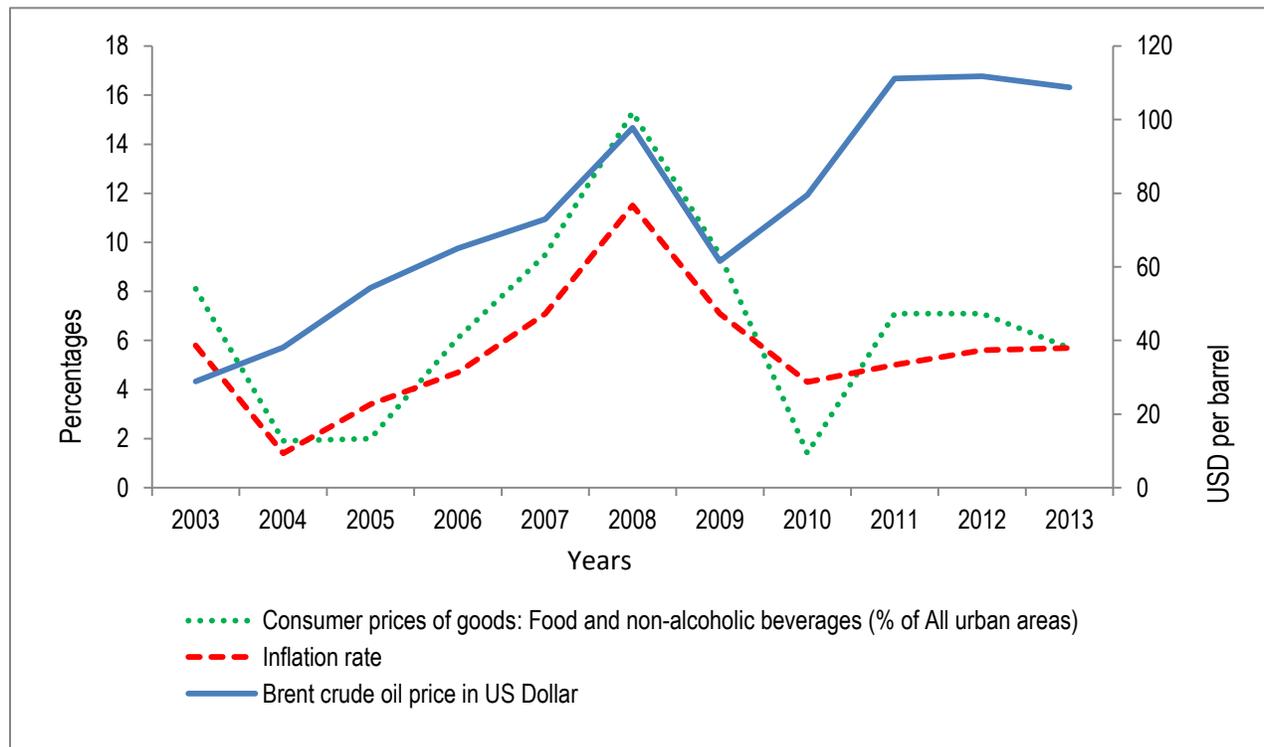
2.5.5. Inflation and global commodity prices

The rise in the rate of inflation could be attributed to the adverse supply shocks that were experienced by South Africa which included *inter alia* an increase in international oil prices, food prices and the massive depreciation in the value of the Rand against that of major trading partners towards the end of 2001. However, the response from inflation to interest rates showed positive signs which was attributed to the success of the inflation targeting framework, amongst others, the ability of central banks to anchor expectations of agents around its set targets is crucial to the credibility of the central bank (Demertzis and Viegi, 2008).

On average, inflation was above the projected parameters during 2002 and most notably it reached a peak of 12.5% in September 2000 and subsequently recording an average of 12.8% for the fourth quarter of 2002 before it started to decline in the first quarter of 2003. *Albeit* moving into the targeted area in the third quarter of 2003, an average rate for the year was still above the specified target range with a total annual average of 5.8%.

The current account deficit as a percentage of GDP rose from a very modest and manageable 1% in 2003 to a disturbing 5.8% in 2008. It further increased in the first quarter of 2009, and experienced a 3% fall in the second quarter of 2009. In 2000 inflation was attributed to exogenous factors such as the decline in the value of the Rand during the second half of 2001, due to an increase in oil and administered prices (Van der Merwe, 2004; Koller, 2005). As shown in Figure 2.8, oil prices continued to increase between 2003 and 2008 increasing from US\$28.89 Dollar per barrel to US\$97.77 Dollar per barrel. Among other factors, the volatility in the exchange rate had a significant impact on oil prices which then exerted pressure on the domestic inflation.

Figure 2.8: Food prices and oil prices (2003-2013)



Source: SARB (2015)

In 2004 inflation declined to a minimum of 1.4% resulting in the reduction in the repo rate from 8.5% in November 2003 to 7.5% in August 2004. *Albeit* a decline in the inflation rate and interest rates in 2004, the rate of inflation increased by approximately 2% to reach an average of 3.4% in 2005.

As shown in Figure 2.8, the increase in the rate of inflation in 2005 was in line with an increase in food and petrol prices which started to rise towards the third quarter of 2004. During this period, inflation in South Africa was as a result of demand side factors in the economy, with petrol prices being influenced indirectly by an increase in the Brent crude oil price which increased significantly from an average of US\$28.89 Dollar per barrel in 2003 to US\$38.1 Dollar per barrel in 2005.

Inflation in South Africa has been characterised by cost-push inflation particularly since the early 1990s. Food prices continued to increase strongly between 2005 and 2008 as

it recorded the highest inflation increase from a rate of 7.8% in March to 12.0% in September 2007, the highest rate of increase since 2003 (SARB, 2007, p. 2)¹³. Among other things, the global financial crisis contributed to the increase in the price of domestic services such as the cost of education, medical expenses and water rates have emerged as the major propagating factors that led to a record 11.5% increase in inflation since the inception of inflation targeting framework (SARB, 2007).

Inflation breached the upper limit of the target range (3% to 6%) by peaking at 11.5% during the global financial crisis in 2008. During that period South Africa recorded the highest annual double digit figure in the rate of inflation since 1992 and also the first of its kind since the adoption of the inflation targeting monetary framework. Although there was a decline in the levels of inflation in 2009, it still remained out of the targeted parameters until the first quarter of 2010 when it reached an average of 5.7% and an overall annual average of 4.3%. The SARB continued to contain the level of inflation at the specified rate of 3% to 6% between 2010 and 2012. Although it breached the target in the last quarter and first quarter of 2011 and 2012, respectively, the level of inflation has nonetheless remained relatively high but stable between 2011 and 2013. Beside stability in those three years, the first two quarters of 2014 has seen inflation breaching the target by reaching the maximum of 6.6% in May 2014.

Although food prices continued to exert pressure on domestic inflation, oil prices have been on a decline towards the end of 2014 as it declined from US\$112.31 in June 2014 to US\$79.49 in November 2014. However, its effects on domestic inflation is yet to be felt as prices of other commodities including food prices and a continuous weakening of the Rand offset the positive effects of cheaper oil prices in the domestic economy.

2.6. Inflation and its challenges in the South African economy

Over the years inflation has always been a problem and it continues to be challenging. As such, these challenges have prompted the implementation of several direct and

¹³ SARB monetary policy review (SARB, 2007)

indirect policy measures that are aimed not only at eradicating the negative effects of inflation but also at ensuring that there is a stable and sustainable financial position for the country.

Inflation trends in South Africa have tended to be triggered by foreign shocks. These shocks played a crucial role particularly with regards to factors that related to episodes of structural changes that South Africa has experienced over the years which often intensified the effects of external factors. One of these major challenges has also been as a result of the structural nature of inflation in South Africa which has given monetary authorities limited control over its main determinants and therefore making it difficult to achieve the monetary objective of stable and low inflation.

South Africa has been vulnerable to external shocks and this is as a result of a heavy dependence on international countries (globalisation). The openness of the economy towards the end of the 1980 also granted many foreign countries an opportunity to explore South African markets, giving limited opportunity for the emerging country (South Africa) to fully utilise the resources at its disposal.

One of the major challenges identified by Mohr and Fourie (2008) was the political change which introduced South Africa into the international economic arena. This has had far reaching effects, not only because it opened new possibilities for the South African economy but also because competition in the international economy was intense. The re-integration into the global economy intensified the degree of competition that domestic firms were previously subjected to.

In a country that is characterized by labour disputes such as South Africa, inflation expectations or the general public perception concerning the future rate of inflation plays a critical role as the key component in macroeconomic stability owing to its impact on the actual underlying forces of inflation and effectiveness of monetary policy. Expected inflation affects the overall economy specifically through wage setting

mechanisms that resulted in numerous segments of the population, labour unions and business entities being involved in labour disputes that often resulted in loss of productivity by major sectors within the industry and contributed towards the sluggish economic growth rate that was witnessed over the years.

Since the adoption of inflation targeting in 2000, the central bank has been able to contain inflation within the specified range of 3% and 6%, however, there have been times in the past where the rate of inflation rose above the specified target range predominantly during its initiation stage, the global financial crisis and post-recession.

On average, the rate of inflation has been approximately 6% since the commencement of inflation targeting in 2000 and there has been much criticism by various macro-economists and leaders of the trade unions regarding the current monetary policy approach. This criticism was aimed at the SARB for putting more emphasis on achieving its primary objective of price stability at the expense of high or rising unemployment rate. A study done on inflation targeting by Bergevin (2007) suggest that the inflation targeting framework lacked flexibility because it focuses on inflation rates at the expense of other monetary policy objectives in the sense that the pursuit to achieve low inflation is potentially costly in terms of the rate of employment, investment, and output level.

It is alleged that the central bank puts more emphasis on meeting its inflation targets and other macroeconomic variables are accorded less weight, given the latter claims, there were high expectations that inflation would be contained at the outlined targets, however, the SARB seems to have difficulties containing the rate of inflation within the stipulated target range and this problem appears to be persistent. Policy makers are faced with difficulties associated with anchoring inflation expectations in their attempt to maintain a lower level of unemployment relative to price stability due to the asymmetric and imperfect information and uncertainty concerning the economy (Vellery and Ellyne, 2011). Inflation expectations give rise to concerns not only for the government but for all economic participants. As inflation expectations set in, business entities respond by

increasing the prices of goods and services, trade unions respond by demanding higher wages to allow their members to adjust and maintain their real income in times of high and persistent inflation.

There are major economic and social consequences with inflation whether or not these are estimated or unforeseen, that are difficult to calculate accurately within the economy even at reasonable rates. In order to determine the reaction of monetary policy on inflation expectations, there is a need to understand its influence on different macro-economic variables and also the limitations of monetary policy actions pursued to attain stability within the state of the economy. Chatterjee (2002) suggested that due to a lack of understanding what is within the reach of a central bank in terms of controlling economic activity, makes it difficult for policymakers and other economic agents to make sensible choices regarding monetary policy.

It has emerged over the past few years that most developing countries have been striving to protect its domestic currency due to changing economic conditions which necessitate the transition of economic policy and such transformational changes resulted in changes in people's perceptions regarding the economic policy over time.

Given the prevailing economic condition in the late 1990s, South Africa had to direct its macro-economic policy measures into inflation. This was owing to the view that prices at the time were rising faster than the output growth and as such the SARB had to implement measures that would ensure that the effects of such slow growth accompanied by a growing demand on limited resources such as food prices, rising electricity costs, did not severely disadvantage the lower income individuals who are the most vulnerable to the effects of such inflationary outcomes.

Among other factors, fuel prices, which were directly affected by the continuous weakening of the exchange rate, also played a significant role in the move towards the formal adoption of inflation targeting. One of the decisions that led to the adoption of an

inflation targeting framework was in response to the difficulties that other inflation targeting countries faced in conducting monetary policy using exchange rate controls or monetary aggregate as an intermediate target (Batini *et al.*, 2006). This is relative to South Africa as the ineffectiveness of the previous monetary policy approach (monetary targeting) at the time required a more direct approach which would enable the monetary authority to have control over factors that directly influence domestic prices. However, according to Freedman and Laxton (2009) the other factors also included the desire to control inflation and to anchor inflation expectations through a simple observable target within which the SARB had to contain the rate of inflation.

The monetary policy under the inflation targeting framework came under great criticism and amongst the greatest opponents of the monetary system was the Congress of South African Trade Unions (COSATU) which has been on the forefront of the struggle against the current monetary policy mainly citing its biased approach to inflation at the expense of unemployment and unstable exchange rates (Vellery and Ellyne, 2011). According to Handa (2009, p. 316) 'it is argued that money is neutral in the long run, so that the central bank cannot change the level and path of full-employment output, nor should it attempt to do so since such an attempt will only produce inflation'.

This stems from the fact that the SARB use interest rates (repo rates) as one of the main control instruments associated with the current monetary policy. COSATU (2011) also argues that the efforts by the SARB to contain inflation have kept interest rates too high and such efforts had contributed to job losses during the 2008-2009 global recession. In support of their call for a review of the mandate of the SARB is Nobel laureate Joseph Stiglitz, who dismisses inflation targeting in general as a 'crude recipe based on little economic theory or empirical evidence' (Stiglitz, 2008; Vellery and Ellyne, 2011).

Studies over the decade have shown that in the short-run, the SARB's influence of monetary policy through interest rates to achieve other macro-economic goals such as

low unemployment and economic growth has in many instances been conflicting with price stability (Van Der Merwe, 2004; Mohr, 2008).

It is evident that the dynamics in the global financial markets towards 2007 and consequently the global financial crisis in 2008, contributed to the ongoing debate of which monetary policy should be undertaken. This has not only been the problem in South Africa but some of the countries that practice inflation targeting as their monetary policy, have also been under great scrutiny with a number of prominent economists suggesting that inflation targeting policy should be brought to the end as it does not yield the expected results particularly in the current global economy that is characterised by complex and changing global economic environment.

There has been a fair amount of criticism that the SARB focus solely on the rate of inflation targets and thereby making it the ultimate monetary authority goal. The effectiveness of the monetary system has been questioned and amongst others, there have been questions as to whether or not the current strategy of inflation targeting system has been effective in the reduction of the levels of inflation and to some extent the accuracy of the inflation forecast, has in most cases been labeled as being inaccurate and often a misleading indicator. According to opponents of the current monetary policy framework, there is a firm belief that the proxy for price stability (CPI) faces measurement bias (Saxton, 1997).

Despite a successful spell by the SARB in containing inflation within the targeted range for the larger part of the last decade, there are continuous allegations by the opponents of the inflation targeting framework that the central bank puts too much emphasis on meeting its inflation target and other macro-economic variables, particularly the levels of unemployment, are accorded less weight. On the other hand, proponents of the system argue that maintaining a positive but low rate of inflation is beneficial for the economy, particularly in the labour market where firms are afforded the flexibility to respond to small declines in productivity without having to reduce nominal wages, which creates

industrial unrest, from workers whose real wage would fall (Handa, 2009, p. 318). In light of high unemployment and underemployment problems in South Africa, Epstein (2008) suggests that there is a need to adopt an alternative framework for monetary policy.

2.7. Conclusion

This Chapter discussed the dynamics of inflation and its determinants in South Africa since 1960. Inflation has been a serious and continuous problem in South Africa leading to the implementation of various monetary policy frameworks. During the 1970s and 1980s, South Africa experienced double digit inflation mainly due to supply shocks originating from the rise in oil prices in the 1970s, growth in money supply and credit extension in the 1980s. Subsequent to that, money supply was given a relatively higher consideration in the conduct of monetary policy in the mid-1980s, as evidenced by the adoption of money supply targets/guidelines which were adopted in 1986. This was an indication that preventing excessive money supply growth in the economy was and is still a crucial element in combating inflation. Liberalisation also had an impact on the dynamics of inflation particularly leading to the structural changes that South Africa experienced both economically and politically due to the openness of the economy that was prevalent at the time.

South Africa has experienced three major increases in the level of inflation since 1980, with the first two commonly attributed to both monetary and structural causes and the most recent one being considered to have originated from supply side factors such as food and petrol prices. From 1998 to 2013 there were improvements to the general price levels mainly due to a greater degree of fiscal and monetary discipline which was enforced through the adoption of an informal inflation targeting system and then a formal inflation targeting system in 2000.

Wages are an important component in the determination of inflation, as they tend to raise output prices to the extent that these costs end up being passed on to consumers

and thereby increasing inflationary pressures due to its impact on inflation expectations. The effects of global factors such as quantitative easing, the weakening exchange rate and the current tapering/winding down of economic activities by a few of the advanced economies, continues to pose serious risks in the domestic economy particularly under the current monetary policy framework where interest rates plays a key role in the central bank's objective to achieve price stability. Implications emanating from these global risks will ultimately raise policy rates which will call for adjustment to the fiscal policy leading to a wider fiscal deficit which would in-turn translate into higher inflation rates.

Many economies across the world have recently started with the adoption of inflation targeting framework which rely on forecast models for output and inflation in the formulation of interest rate policies. There has been criticism that the current inflation fighting does not take into consideration the problem of unemployment. In the current monetary policy system, SARB sets its repurchase rate at an appropriate level aimed at changing interest rates to influence credit and money supply which takes time to work through before it ultimately influences inflation.

In conclusion, it is important to note that, like any other monetary policy that has been adopted and abandoned in the past, the current framework of inflation targeting has proven to be successful in the past decade. However, its success is increasingly becoming doubtful. The system is deemed to be ineffective in addressing unemployment challenges and also due to the monetary authority's failure to maintain the inflation rate within the targeted range of 3% to 6%. Furthermore, at times, the monetary authority has continued to struggle in containing inflation rate below 6% in recent years. Due to these reasons and other challenges facing the country's economy, it is argued that inflation targeting does not fit the current economic conditions and as such, it is becoming evident that there is a need to adopt an alternative monetary policy system with majority of the opponent calling for the adoption of employment targeting or a mixed policy (real targeting) which will strike a balance between inflation and unemployment among other policy recommendations.

CHAPTER THREE: THEORETICAL AND EMPIRICAL LITERATURE REVIEW

3.1. Introduction

This section reviews the previous works and studies based on the determinants of inflation in South Africa and abroad. The determinants of inflation remain an important macro-economic issue for policy makers. Inflation is one of the key macro-economic variables and is closely monitored by both policy makers and the society as they are directly and indirectly affected by its outcomes. Inflation is determined by various domestic and external factors. Although various studies have been conducted over the years, they have come to different but often similar conclusions.

The importance of identifying the causes of inflation in pursuit of an effective anti-inflationary policy that is aimed at achieving price stability is widely acknowledged both in theory and in practice. As such, this section considers theoretical and empirical literature on the determinants of inflation. The rest of this Chapter is organised as follows: Section 3.2 reviews the theoretical literature while Section 3.3 reviews the empirical studies that have been conducted on the determinants of inflation in South Africa and the rest of the world. Section 3.4 concludes the chapter.

3.2. Determinants of inflation: A theoretical framework

In explaining the concepts and theories of inflation, this study attempts to explore the available literature on the determinants of inflation with reference to the three central questions in the study of economics. In order to understand the determinants of inflation, it is very important to understand what is meant by inflation, how it is determined and why it matters (the cost, challenges and consequences).

Inflation is broadly defined as the sustained increase in the general or average price level. It is measured by different price indices. However in South Africa, CPI is

considered the most important index by Stats SA (Fourie and Burger, 2009). Inflation is determined by comparing the price, in two different periods, of a pre-determined basket of consumer goods and services (Fourie and Burger, 2009). For the purpose of this study, theory on the sources of inflation is explained according to several theoretical explanations. The sources of inflation are explained with reference to two broader schools of thoughts on economic theory and policy. These two main schools of thought can be found within mainstream economics, namely Keynesian and monetarist or the new classical school of thoughts. In an effort to explore other views regarding the causes of inflation, structural views and a transitory view of the purchasing power parity theory will also be explored to capture the extent to which structural factors influence inflation.

This study follows a distinctive approach in reviewing literature as compared to other previous studies which have in most cases been conducted based on individual theories. This is based on the fact that inflation emanates from various sources simultaneously, and not only from individual sources. It is for this reason that a combination of theories be explored in order to sufficiently capture the various determinants of inflation. The theoretical explanations of inflation and the proposed solution to its challenges are influenced by the different ideological and theoretical principles of economics which comprises of a combination of all the approaches mentioned above. Inflation is determined by various factors emanating from economic, social or political environment. These factors have been widely discussed in literature both domestically and globally. This section is divided in to three subsections. Section 3.2.1 reviews monetary/neo classical explanation on the determinants of inflation while Section 3.2.2 deals with Keynesian theory of inflation. Section 3.2.3 reviews structuralist theory of inflation.

3.2.1. Monetarist and neo-classical explanation of the determinants of inflation

In the famous words of Milton Friedman, 'inflation is always and everywhere a monetary phenomenon' (Friedman, 1963). The monetarist or rather new classical economists

suggest that an increase in money supply has always been identified as one of the major, if not a common, determinants of inflation. As indicated by Mankiw (2012, p. 348), this theory is often referred to as 'classical' because it was developed by some of the earliest economic thinkers. In explaining the classical theory of inflation, a distinction should be made with regards to the interpretation of how growth in money supply affects economic variables, particularly prices. Friedman (1968) and Mankiw (2012) discussed classical economist views of separating variables into two groups, namely nominal and real variables (the concept that is also known as classical dichotomy) and the proposition that money supply does not have any effect on real variables (also known as monetary neutrality).

Mankiw (2012) and Moenjak (2014) further suggested that, there was heavy reliance on the classical theory to explain the long run determinants of the price level and the inflation rate. According to Handa (2009), the heritage of the current monetary theory lies in two different sets of ideas, namely; the classical and the Keynesian. This heritage includes both the micro-economic and macro-economic aspects of monetary economics. Arnold (2008) further indicated that the classical economist position with monetary growth as a determinant of inflation was based on the theory of exchange rates and simple quantitative theory of money.

Moenjak (2014, pp. 77-78) identified key developments in the design and conduct of monetary policy, and amongst those, the quantity theory of money is identified and explained as follows: 'In the long run, monetary policy can only influence prices of goods and services in the economy and cannot influence quantity of output or level of economic activity directly. The effort by the central bank to stimulate the economy by printing money will only result in rising prices and inflation in the long run.'

While Mankiw (2012, p. 351) explains the quantity theory of money as follows: 'A theory asserting that the quantity of money available determines the price level and that the growth rate in the quantity of money available determines the inflation rate.' Expressed differently, Mankiw (2012) implies that the quantity of money that is available in an

economy determines its value, while growth in the quantity of money is the primary cause/determinant of inflation. Generally, quantity theory of money states that an increase in the quantity of money will lead to a proportional increase in the general price level. According to the classical view, money is only a medium of exchange that fuels the real economy without any real effect on its own (Fourie and Burger, 2009, p. 443). According to Handa (2009, p. 34), the monetary aspects of the traditional classical approach were encapsulated in the quantity theory for the determination of the price level and the loanable funds theory for the determination of the interest rate. The classical model of quantity theory of money can be written as follows:

$$MV=PY \dots\dots\dots (3.1)$$

Where, velocity of money in circulation (V) is assumed to move according to a predictable trend and total output (Y) to be stable at full employment level. The nominal money supply is denoted by M as the main determinant of inflation. According to the quantity theory of money, the long-run effect of money is only on the average price level and that price level cannot increase without an increase in money supply (Fourie and Burger, 2009).

The principle of monetary neutrality suggests that an increase in the rate of money growth raises the rate of inflation but does not affect any real variables (Mankiw, 2012, p. 359). Growth in nominal and real money supply affects the rate of inflation. According to Abel *et al.* (2008, p. 270), for countries with a higher rate of inflation, growth in nominal money supply is regarded as the most important factor in the inflationary process. Similarly, Weintraub (1960) and Akinboade *et al.* (2004) view the monetarist approach to inflation also suggests that as a direct result of monetary policy actions. The central bank's activities of contractionary and expansionary monetary policy is assumed to be the main cause of domestic inflation. These views outline the importance of understanding how interest rates operate as they link to the economy in the present

and the economy of the future through their effects on various economic factors (Mankiw, 2012).

For inflation targeting economies such as South Africa, interest rates, particularly the repo rate, plays a very important role in the determination of inflation. The central bank's move to reduce the repo rate prompts commercial banks to also follow a similar trend through the reduction of the prime lending rate. This monetary policy action results in an increase in money supply, which may exceed the aggregate demand for money and cause a surge in the rate of inflation. Furthermore, Mankiw (2012) takes into account the Fisher effect (the adjustment of the nominal interest rate to the inflation rate) as an important application of the principle of money neutrality which takes into consideration the effect of money on interest rates¹⁴. However, Mankiw (2012) also notes the limitation of the Fisher effect by claiming that it might be insignificant in the short run because inflation might not necessarily be anticipated.

According to the monetarist theory, taking into consideration the neutrality of money, in the long run, it is expected that a change in money growth should not affect the real interest rate. The Fisher effect suggests that for the real interest rate not to be affected, the nominal interest rate must adjust one-for-one to changes in the inflation rate (Mankiw, 2012). This implies that the long-run effects of an increase in the rate of money supply by the SARB will result in high inflation rate and nominal interest rate.

Chicheke (2008) states that in an effort to combat persistent periods of inflation or deflation, monetarists argue in favour of a fixed money supply rule. This view is supported by Atta *et al.* (1996) who also states that monetarist believes that an increase in cost will be reflected in nominal money supply, if monetary authorities increase the rate of growth in money supply to prevent a decline in output. The monetarist suggest that, over time, the SARB should conduct monetary policy in a manner that keeps the growth rate of the money supply fixed at a rate that is equivalent to the real growth rate

¹⁴ Also see Fisher (1930) argument on nominal interest rate and the expected rate of inflation

of the economy. Accordingly, the monetarists believe that monetary policy should be able to accommodate increases in real output without causing inflation or deflation (Chicheke, 2008).

South Africa is one of the many countries that continue to follow the inflation targeting framework, therefore the action of the central bank as indicated by Weintraub (1960) might not yield the desired result particularly given the current weakening of the Rand. This suggests that if not carefully monitored, the actions of the central bank, given the simultaneous challenges of rising inflation and the weakening in value of the domestic currency, this may result in the monetary policy not achieving its intended goal of price stability. The monetarist theory implies that the central bank's decision to loosen or not to tighten monetary policy to gauge growth in money supply might result in unintended consequences if some key factors affecting monetary policy direction are not fully considered and stabilised.

As postulated by monetarists, using the quantity theory of money equation, any monetary expansion in excess of what is necessary to facilitate the growing volume of transaction in a growing economy, will simply be reflected in increasing prices. The quantity theory equation, as indicated by Fourie and Burger (2009), can derive the following approximate rule:

$$\% \Delta P = \% \Delta M - \% \Delta Y - \% \Delta V \dots\dots\dots (3.2)$$

This implies that the rate of inflation is equivalent to percentage growth in nominal money stock, less percentage change in GDP growth and velocity. Thus, in pure monetary theory, inflation is mainly explained in isolation from any real economic variables which serve as an indication of monetarist or new classical theory acceptance of the classical dichotomy.

Another scenario of how monetary growth can influence inflation was also given by Laidler (1985). He considered an economy where demand for real money balances depends on the level of income and the expected rate of inflation to provide a dynamic model of inflation derived from the works of Cagan (1956) and Dutton (1971) in showing the existence of a positive relationship between monetary expansion and inflation rate.

3.2.2. Keynesian theory of inflation

Whilst monetarists hold that inflation is purely a monetary phenomenon that can only prevail as a result expansion in money supply at a rate that is faster than growth in output capacity, the Keynesian theory of inflation holds a different view of what constitutes inflation. According to Humphrey (1975), monetarists reject non-monetary explanations of inflation proposed by the Keynesian theory, which includes amongst others, shifts in government fiscal policies, cost-push factors, food and fuel shortages on the basis that inflation can only occur as a result of excessive growth in money supply.

In contrast, the Keynesian views on inflation can be described as the real theory of inflation and they recommend fiscal policy as an important tool in stabilizing the economy (Javed *et al.*, 2010). Whilst the monetarist takes into consideration the classical dichotomy, the Keynesian view makes a distinction between demand inflation and cost inflation. In addition, Fourie and Burger (2009) indicate that the price level and GDP are determined simultaneously and inseparably, writing off the possibility of a dichotomy between monetary and real processes. According to the Keynesian theory, the existence of unemployment in the economy in the short run would imply that growth in money supply will lead to an increase in aggregate demand, employment and output. However, they further suggest that in the long run the effect of money will be insignificant. Any growth in money supply higher than full employment level will result in continuous output growth and prices increase that is proportional to money supply growth (Javed *et al.*, 2010).

Another fundamental distinction between the monetarists and the Keynesians concerns the relationship between changes in the rate of monetary expansion and changes in the rate of inflation (Stein, 1981, p. 144). According to Stein (1981), Keynesians believe that for a change in the Okun's Gap to result in a change in the rate of inflation, changes in the rate of monetary expansion must first influence the unemployment rate. The Keynesian theory categorises the determinants of inflation according to demand-pull and cost-push factors. Section 3.2.3.1 discusses demand-pull inflation while Section 3.2.3.2 discusses cost-push inflation.

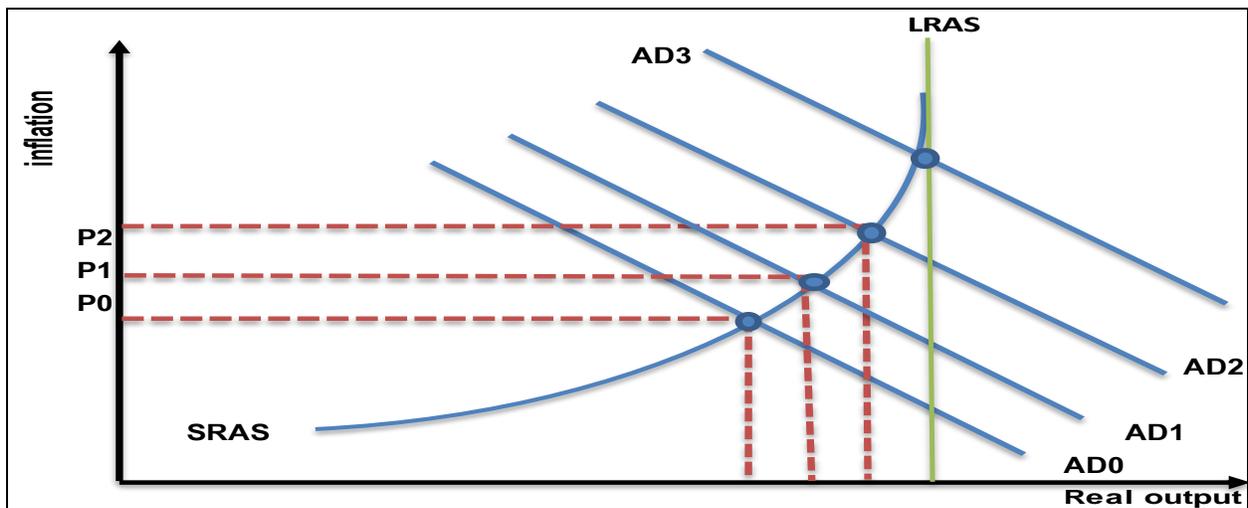
3.2.2.1. Demand-pull inflation

According to Mohr (2008), demand-pull inflation occurs when the aggregate demand for goods and services increase while the aggregate supply remains constant or unchanged. Demand-pull theory suggests that inflation occurs as a direct or indirect effect of both expansionary monetary and fiscal policy. According to the demand-pull theory, the excess demand pressure relative to the aggregate supply pulls up the prices of goods and services which results in an increase in the general price levels (Dhakal *et.al.*, 1994; Mohr and Fourie, 2008; Mohr, 2008). The following combination of factors has been identified as the sources of demand-pull inflation:

- Increased consumption spending by household and government.
- Increased export earning as a result of depreciation in the rate of exchange which enhance the competitiveness of the export market.
- Increase in investment spending resulting in lower interest rates.
- Improvement in business confidence.

Demand-pull inflation can be illustrated graphically, to demonstrate how an increase in aggregate demand and output can result in an upward pressure on the general price level as proposed by the Keynesian demand-pull theory. Demand-pull inflation is illustrated in Figure 3.1.

Figure 3.1: Demand-pull inflation



Source: Abel *et al.*, (2008); Mohr and Fourie (2008) and Authors own computation

As shown in Figure 3.1, demand pull inflation occurs when aggregate demand of goods and services increases. According to the Keynesian theory, as long as there is still excess capacity in the economy, an increase in the general price level will be accompanied by a simultaneous increase in income and production. At the point where full employment is reached, only prices will continue to increase shifting from AD2 to AD3 as shown in Figure 3.1.

According to the demand-pull theory, inflation occurs as a result of an increase in aggregate demand. Furthermore, demand pull theory suggest that changes in prices are assumed to be market clearing mechanism while excess demand in the goods and factor markets is considered to be the cause of inflation.

3.2.2.2. Cost-push inflation

The theory of economics classified the sources of inflation according to two broad categories, being supply factors mainly as a result of cost-push factors and demand factors arising mainly from excess demand which piles pressure on the general price level in the domestic economy (see Dhakal *et al.*, 1994; Mohr and Fourie, 2008).

Contrary to demand-pull theory, cost-push theory states that prices increase as a result of factor prices that accelerate more than factor productivity. Cost-push theory suggests that inflation occurs as a result of decrease in aggregate supply. Furthermore, the theory maintains that increases in wages push the prices of goods and services upwards (hence cost-push inflation), which is more often perpetuated by trade unions (i.e. COSATU in South Africa) or as a result of pricing policies emanating as a result of market power by monopolistic and oligopolistic firms in the economy. Alternatively, this process can also be explained by increases in wages and salaries or appreciation in the cost of raw materials that are used as inputs in the production process of firms. Increasing prices of imported raw materials (often referred to as imported inflation) and depreciation of the domestic currency also explains cost-push inflation (Humphrey, 1998).

One of the consequences of cost-push inflation is that high production cost often results in the reduction of the rate of employment as firms seek to offset higher production costs particularly in a labour intensive work environment. This often results in a decline in productivity which eventually leads to a decline in output. Thus, reducing inflation would imply cost in terms of temporarily lower output growth, which would however, be difficult to quantify owing to the sensitivity of the methodology employed (Hodge, 2002). Contrary to Keynesian views, monetarists claim that a restrictive fiscal policy without a reduction in the rate of monetary expansion cannot reduce the rate of inflation (Stein, 1981, p. 139). According to Whyte's (2011) observations, in developed countries, inflation is caused by changes in the cost of labour and labour-market rigidities, *albeit* not considered to be the main determinants of inflation in most developing countries.

3.2.3. Structuralist theory of inflation

Structuralists distinguish between basic (or structural) inflationary pressure and mechanisms that transmit or propagate such inflationary pressure in the economy (Akinboade *et al.*, 2004). The structuralist theory on inflation is based on the approach developed in Latin America by Prebisch (1961) and others. This theory is still widely

used primarily as a diagnostic and policy tool for inflation. The structuralist model developed by Cardoso (1981) is regarded as one of the best model of structural inflation (Akinboade *et al*, 2004), the model showed that increases in manufacturing costs did not only lead to higher prices, but also led to an inflationary process that tends to be self-perpetuating. Furthermore, the model also revealed that the structuralist interpretation allowed for a better understanding of the inflationary process in Latin America and provided an insight on the options available to the government in dealing with this inflationary process (Cardoso, 1981, p. 284).

One of the most important arguments by the structuralist school is that the roots of inflation can be found in bottlenecks of inelastic supply in the agricultural sector (Prebisch, 1961; Cardoso, 1981). Agenor and Montiel (1996, pp. 298-299) reiterates that this inelastic supply in the agricultural sector (i.e. inelastic supply foodstuff) is one of the key structural bottlenecks identified by structuralist theory, which include amongst others, the foreign exchange constraint, distorting government policies, the conflicts between capitalists and workers over income distribution and between profits and real wages¹⁵. Whilst, Mohr (2008) states that the most important aspect of this (structural) approach is that it focuses primarily on the fact that inflation is a process.

As a result of demand-pull and cost-push approaches not providing sufficient diagnoses to inflation process, their limitations in explaining the inflation phenomenon led to the emergence of an alternative approach, namely the structuralist approach. According to Nitzan (1990), the episodes of stagflation in the 1950s created a renewed interest in administered prices and revived the old controversy between demand-pull and cost-push theorists.

The structuralist approach retains the distinction between demand-pull and cost-push approach. However, they place it in a much broader context (Mohr and Fourie, 2008;

¹⁵ See Table 3.1 below which indicates various factors in the inflation process as identified by structuralist theory of inflation.

Mohr, 2008). Ackley (1959) argued that the distinction between demand and cost inflation did not provide sufficient support toward understanding the inflationary process in modern capitalism particularly during the period of stagflation in the 1950s. In an effort to provide a broader explanation on the causes of inflation, the structuralist approach identifies the underlying factors – which includes amongst others, a variety of non-economic dimension i.e. political, social and historical factors – in the determination of inflation (Fourie *et al.*, 2009). This is similar to Dagum's (1969) views on inflation. According to Dagum (1969, p. 1), inflation is a process originating from economic, political and social causes. Structuralists do not agree with the monetarist belief that inflation is purely a monetary phenomenon. According to the structuralist views, growth in money supply is indicative of the existence of upward pressure exerted on price by changes in structural and cost factors (Canavese, 1982).

Mohr's (2008) analysis on the three fundamental structural causes of inflation states that the underlying factors provide that the basis against which the inflation process occurs, defines the vulnerability of the economy to inflation. Similarly, Wachter (1979, p. 228) suggest that 'Structural problems are considered to be at the root of inflation, however, demand problems are clearly related to the propagation and persistence of the phenomenon.' This implies that although the underlying factors cannot provide a clear explanation of why the rate of inflation is what it is or the reason why it sometimes falls or accelerates, it still remains an important factor in the determination of inflation. Fourie and Burger (2009, p. 474) further suggests that underlying factors contribute to making an economy vulnerable to inflation as inflation is easily initiated, propagated and easily entrenched.

For the inflation process to continue, initiating factors trigger or aggravate a particular process of inflation as a result of certain increases in cost and/or other price increases. Such immediate increases are then referred to as initiating factors which can be categorized into demand-pull factors, cost-push factors and other related prices or cost increase. Although these factors are necessary to initiate the inflation process, they are not necessarily sufficient to generate inflation. This stage in the process is often referred

to as the first round effect of inflation by the SARB as it only facilitate the condition for triggering inflation but does not necessarily produce inflation in the economy.

For inflation to occur, it requires a combination of all three factors as identified under the structuralist theory (Dagum, 1969; Wachter, 1979; Fourie and Burger, 2009; Mohr and Fourie, 2008; Mohr, 2008). As indicated above, the final process in the process of inflation is referred to as propagating factors, which according to Fourie (2009), Mohr and Fourie (2008) and Mohr (2008) included a variety of factors which transmitted the initiating impulses through the economy over time, thus generating or sustaining a particular inflation process. In an effort to capture the inflationary process accurately, the SARB distinguish between the first round effects and second round effects with the latter being the most scrutinized as the pass through effect might generate inflationary pressure in the economy. Following the work of Mohr (2008), and as proposed by the structuralist, Table 3.1 displays the structural factors that induce inflation – categorised into three groups.

Table 3.1: Underlying, initiating and propagating factors

Underlying factors

Traditions, values and norms of society
Degree of conflict (or cohesion) between different groups in society
Political strength and bargaining power of trade unions
Degree of competition in the goods market
Degree of protection from international competition
Extent of administered pricing
Extent of formal and informal indexation
Size of the public sector
Degree of fiscal discipline
Degree of independence of the monetary authorities
Openness of the economy
International inflation environment
Exchange rate regime

Initiating factors

Demand-pull factors (e.g. exogenous increases in consumption, investment, government spending or exports)
Cost-push factors (e.g. exogenous increases in wages, profits or import prices)
Other price increases (e.g. as a result of natural disasters or increases in indirect taxes)

Propagating factors

Endogenous increases in the money supply
The various wage-price, price-price, price-wage and wage-wage interrelationships in the economy
Inflationary expectations
Interaction between domestic prices, the balance of payments and the exchange rate

Source: Mohr (2008, p. 6)

Structuralists use institutional framework and considers the basic components of the economic system with emphasis on long-run monetary and non-monetary factors (Donath and Dima, 2003). These factors explain how changes in structures and cost lead to inflation. Structuralist argues that, for instance, the degree of conflict between trade unions and employers through threats and strikes, in the demand for higher wages, exert pressure on employers and specifically the Governments (Mohr, 2008).

The outcome of these increases in wages results in demand that is higher than the increase in the rate of production, thus resulting into an increase in prices.

Donath and Dima (2003) further differentiate structural inflation into monetary structural inflation that is determined by systematic components of money supply and non-monetary structural inflation determined by non-monetary factors. The theoretical explanations of the structuralist model suggest that, inelastic supply bottlenecks in the economy are considered as some of the main influential factors of inflation (Prebisch, 1961), suggesting that supply side factors are considered to be the main determinants of inflation.

It should be noted that other schools of thought consider the rational expectations hypothesis proposed by economists such as Muth (1961) and Lucas (1972), as one of the key theories in explaining the nature and causes of inflation. Lucas (1976) postulates that inflationary effects of monetary or fiscal policies are nullified by economic participants. This is relevant to South Africa given the current monetary system (inflation targeting) undertaken by the monetary authority (SARB).

Factors such as the transparency and credibility in the conduct of monetary policy plays a substantial role in anchoring inflation expectations. Other theories that explain the inflation phenomenon include purchasing power parity which states that any commodity in a unified market has a single price (Akinboade *et al.*, 2004). According to this theory, changes in the domestic price are influenced by the volatility of the exchange rate as a result of inflation differentials between two countries. The following section reviews empirical literature with reference to the theoretical literature discussed above.

3.3. Determinants of inflation: Empirical evidence

Various empirical studies have been conducted on the determinants of inflation globally, and these studies have contributed to the broad debate on the factors that caused inflation over the years. Inflation is affected by various factors, depending on the

historical, political, social and most importantly the economic background of various underdeveloped, developing and developed countries globally. The empirical studies discussed are presented in three sections. Section 3.3.1 reviews empirical evidence from South Africa, Section 3.3.2 presents empirical literature from developing countries while Section 3.3.3 discusses empirical literature from developed countries.

3.3.1. Determinants of inflation: Empirical evidence from South Africa

Since 1970 there have been numerous attempts to investigate the causes of inflation in South Africa. Various researchers looked into the determinants of inflation and most notably Strydom (1976a) observed the impact of the sales duty, a tax system that was introduced in 1969. Although it increased Government revenue, this form of tax had adverse effect of the price level in the 1960s *albeit* its effect moderated in the 1970s. This tax was levied on the production stage rather than the distribution stage (Strydom, 1976a, p. 137). Furthermore, the study concluded that the most significant factors causing the accelerated inflation were linked to the successive devaluations of the Rand. Strydom's (1976a; 1976b) findings were supported by Strebel (1976) suggesting that accelerating inflation in the 1970s could be explained by the combined impact of built-in and imported price inflations, as sudden sharp rise in imported prices were partially explained by the devaluation of the currency.

Following Strydom's (1976a) study, comments were raised by Courtney (1976), Van Zyl (1976) and Shostak (1976) criticising the findings of the study on the effect of exchange rate devaluation on inflation, the empirical results regarding the price equation derived by Strydom (1976a) and that Strydom's conclusion that 'devaluation (in South Africa) cannot be defended on the evidence' should be rejected. In response to these critics, Strydom (1976b) and Strydom and Steenkamp (1976) maintained that inflation acceleration in the 1960s was explained by a combination of demand-pull factors and monetary expansion. These studies also suggested that in the 1970s, inflation was found to be primarily explained by cost push factors linked to successive devaluations of the exchange rate. In defense of the article he wrote earlier in 1976, Strydom (1976b)

indicated amongst other reasons that, Van Zyl's (1976) critics concentrated on the initial trade balance assumption and that he cannot claim validity of his analysis of inflation in South Africa.

De Kock (1980, p. 356) states that in the absence of a more market orientated monetary policy, 'the development in the business cycle could greatly increase the threat of bottleneck inflation, if not general demand inflation.' On the other hand, Dollery (1984) modeled market structure and inflation in South Africa and found that prices determined in concentrated markets of the manufacturing sector responded more slowly to increases in demand than competitively determined prices, thus having a dampening effect on inflation. His results were contrary to earlier contention provided in prior studies which suggested that market imperfections played an important role in the local inflationary process (Dollery, 1984, p. 356). The findings of Dollery (1984) were later confirmed by Fourie (1991) in his analysis on economic concentration and anti-inflationary demand policy in South Africa.

The De Kock Commission (1985) investigated the determinants of inflation and found amongst other factors that the tax increase, imported inflation and increase in wage and salaries in excess of productivity were insignificant in influencing the rate of inflation in South Africa. These findings were criticised by Mohr (1986) on the basis that the methodology and model applied in the study was not sufficiently robust to estimate the determinants of inflation. While Moore and Smit (1986) also criticized the Commission's findings, with evidence suggesting that wage prices had a significant influence on inflation in South Africa. These findings also correspond with Pretorius and Smal's (1994) view that the increase in labour cost was compelled by inflation expectations, which influence the rate of inflation. Mohr (1986) further argues that the biasness of the De Kock Commission towards monetarist views on the causes of inflation, might have led to the conclusion that salaries and wages, imported inflation and tax increase were insignificant in influencing Inflation in South Africa.

On the contrary, Mohr (2008, p. 10) observed that during the past decades or so, sharp increases in international oil prices and the increase in food prices as a result of domestic agricultural conditions have caused domestic prices to be more sensitive to international market trends. On the positive side, Mohr (2008) suggests that although the initiating factors continue to be experienced in the economy, the underlying factors have reduced the inflation bias in the economy, as the structural changes have minimized the incidence of cost push inflation in the form of increased domestic wages and price shocks. He further suggests that the second round effects or pass through have been favourable over the years as increases in wages and salaries have not necessarily translated to high prices and that inflation differentials does not necessarily result into currency depreciation.

De Waal and Van Eyden (2012) applied a vector error correction model (VECM) analysis to monetary inflation and inflation in South Africa and found that deviations from the purchasing power parity (PPP) explain inflation and the real effective exchange rates. On the contrary, Mohr (2008) suggest that although import prices can rise, inflation cannot be imported except under special circumstances, such as in West Germany during the 1950s and 1960s (Mohr, 2008, p. 4). However, Atta *et al.* (1999) and Gaomab (1998) does not share the same view as Mohr (2008), they indicated that inflation in Botswana and Namibia were influenced by South African prices through exports, suggesting that indeed imported inflation does exist. In the South African experience, Pretorius and Smal (1994) also had contradictory view to Mohr (2008), stating that the cost of imported goods also contributed to inflation.

Recent studies on the determinants of inflation in South Africa include amongst others, Kaseeram *et al.* (2004), who estimated the relationship between inflation and excess demand, labour costs, import prices, exchange rates and short-run interest rates for the period from 1978Q1 to 2000Q4 using the vector auto-regression (VAR) approach and VECM. The study focused primarily on the pass-through effects from currency devaluation to unit labour costs. The cointegrating vector results revealed that nominal exchange rates, nominal effective exchange rates and the import price index had a

significant influence on the price level (Kaseeram *et al.*, 2004, p. 100). In line with Pretorius and Smal (1994), the findings revealed that structural features such as inflexible labour policies, existing trade barriers and budget deficits amongst others, lead to inefficient markets, thus creating inertia and influencing the expectations mechanisms that perpetuate future inflation (Kaseeram *et al.*, 2004, p. 100).

Fedderke and Schaling (2000) used multivariate co-integration techniques to examine the cause of inflation in South Africa by analysing the link between unit labour cost, real exchange rate, output gap, inflation expectations and actual inflation prior to the introduction of inflation targeting framework in 2002. Using quarterly data for the period 1963Q4 to 1998Q2, the results confirmed the findings of earlier studies such as Kaseeram *et al.*, (2004) and Pretorius and Smal (1994), revealing that inflation was influenced by the marked up behavior of unit prices over labour cost. Their result was consistent with the cost push view on the inflationary process in South Africa.

Akinboade *et al.* (2004) provided a more comprehensive study on the determinants of inflation in South Africa. Motivated by the recent monetary policy shift towards inflation targeting, Akinboade *et al.* (2004) developed a model that examined the linkages between domestic inflation in South Africa, money and labour market and foreign exchange market conditions. Using a VAR and VECM techniques to determine the long run and short run relationship between inflation and its determinants for the period 1970Q1 to 2000Q2, evidence revealed that in the short run, increases in the nominal effective exchange rate of the rand reduce inflation. However in the long run, the analysis shows the existence of purchasing parity price relationship between South Africa and its major trading partners (Akinboade *et al.*, 2004).

The results further suggested growth in money supply has a significant influence on inflation both in the short run and long run, while real output growth in the long run may contribute to a decrease in domestic prices *albeit* not being significant in the short run (Akinboade *et al.*, 2004). Although Ziramba's (2008:226) findings, using the unrestricted

error correction models (UECM) for the period 1970 to 2005, suggests that money supply had an insignificant influence on inflation, Akinboade *et al.* (2004) shared the same view with Jonsson (1999, 2001) who found evidence of a stable relationship between domestic prices, money supply, nominal exchange rate and import prices.

Labour costs, partially driven by inflation expectations, have been suggested to be one of the key determinants in inflation particularly given the labour unrest observed over the years (Kaseeram *et al.*, 2004). The importance of inflation expectations is emphasized by Lucas (1976) theory of rational expectations, suggesting that inflationary effects of monetary or fiscal policies are nullified by economic participants. Evidence has shown in the past regarding the effect of labour cost in the economy, with Akinboade *et al.* (2004) also confirming the findings of (Kaseeram *et al.*, 2004; Fedderke and Schaling, 2000; Pretorius and Smal, 1994) that in the short run, a positive correlation exist between labour cost and domestic inflation, suggesting that there is a link between inflation and changes in labour cost. Akinboade *et al.* (2004, p. 43) concluded that inflation in South Africa is largely structural in nature, suggesting that it will be difficult to achieve the objective of reducing inflation as the monetary authority have limited over the main determinants of Inflation.

The studies reviewed suggest that inflation occurs due to a variety of factors that are in most cases country specific. Whilst majority of the studies particularly in Africa, suggest that monetary factors affect inflation, equally so, some studies have suggested based on empirical evidence, that the Keynesian demand-pull and cost-push factors and the structuralist factors have had their fair share in determining the rate of inflation on the continent. Additionally, government expenditure is also identified as one of the major factors causing inflation particularly in developing countries. This form of expenditure has to some degree, led to ineffective spending accompanied by inflationary consequences not only for developing countries but for developed countries equally. In South Africa, empirical evidence from Anoruo (2003) and Kaseeram *et al.* (2004) also suggest the influence of government expenditure as reflected by the observed budget deficit over the years. In the case of South Africa, it is noted that various studies came

to different and often related, but conflicting findings on the determinants of inflation over the years.

3.3.2. Determinants of inflation: Empirical evidence from developing countries

Recent economic data suggests that in 2012 Nigeria surpassed South Africa as the biggest economy in terms of GDP in the African continent (British Broadcast Corporation “BBC”, 2014). However, as much as inflation is a problem in South Africa, inflation continues to be a problem in the most developing countries. Like any other African countries, Nigeria has also experienced its fair share of inflation problems. Earlier studies such as Moser (1994) applied the error correction model (ECM) to determine the causes of inflation in Nigeria. The study found that both fiscal and monetary factors had a major influence on the impact of the depreciation of the Nigerian currency on inflation. According to Moser (1994), other factors that contributed to inflation in Nigeria included, amongst others, agro-climatic conditions particularly given the considerable role of food commodities in the composition of the CPI.

Huda (1987) examined the determinants of inflation in Botswana. Based on the results of the study, it was concluded that inflationary pressure arise as a result of South African prices and this was explained by the majority of imports that passes through South African borders and not only as part of the Southern African Customs Union (SACU) agreements but also because the economy of Botswana “relies mainly on exports for income generation and on imports for most of its consumer goods” (Huda, 1987:209). Although Huda (1987) was criticised for using traditional econometrics techniques, Masale (1993) and Atta *et al.* (1996) modified the econometric models and the results of both studies were found to be consistent with the finding of prior studies such as Huda (1887) and Ncube (1992) which applied traditional econometric techniques in examining the determinants of inflation in Botswana.

London (1989) and Canetti and Greene (1992) examined the impact of money supply and exchange rate on inflation for various African countries which included amongst others Nigeria, Ghana, Kenya, Tanzania, Uganda and Zambia. Amongst the twenty three countries that were sampled by London (1989), the vector auto-regression (VAR) analysis revealed that monetary dynamics and depreciation in exchange rates were dominant factors influencing inflation amongst the sampled countries. In the twenty countries sampled by Canetti and Greene (1992) using the pure monetarist model, the results revealed that between 1974 and 1985, exchange rate growth in money supply, real income and expected inflation played a significant role in the determinants of inflation for the selected African countries during that period.

Various studies such as Chhibber and Shafik (1990), Sowa and Kwakye (1993) and Dordunoo (1994) investigated the determinants of inflation in Ghana using various econometric techniques which included amongst other models, a long run model using the Johansen (1988) multivariate approach and error correction models. The collective findings of these various studies suggested that Ghanaian inflation is normally monetary in nature. In explaining the dynamics of inflation in Zambia, Adam (1995) developed a model in accordance with the fiscal reform and financial liberalization measures that took place between 1992 and 1993. The study concluded that tight fiscal policy stance ensured non-inflationary domestic deficit financing, which would not have prevailed in the absence of the early liberalisation.

Lim and Papi (1997) used an ECM model which included both long run and short run dynamics to examine the determinants of inflation in Turkey from 1970 to 1995. The study found that monetary factors (i.e. exchange rate, money supply) played a significant role in the process of inflation in Turkey, while the public sector deficit was also found to have had a significant direct influence in the rate of inflation. Kuijs (1998) also applied ECM approach to study the determinants of inflation in Nigeria using quarterly data for the period 1983 to 1996. Empirical results revealed that excess money supply has a significant impact on the price level, with the error correction term coefficient indicating that it would take more than two years for prices to fully adjusted to

a shock in excess money supply. Liu and Adedeji (2000) also studied the determinants of inflation in Iran using the ECM framework for the period from 1989Q1 to 1998Q4. The result of the study revealed that excess money supply generates an increase in the rate of inflation, while rise in real income reduces inflation in the long run.

In Namibia, Gaomab (1998) and Odada and Eita (2010) examined the causes of inflation and their studies found that one of the key features of inflation in the country was that it followed a similar pattern with South African prices. Gaomab (1998) found that South African prices were found to be significant in explaining the rate of inflation in Namibia, and as such, confirming evidence of the existence of imported inflation. Odada and Eita (2010) used various models to study the determinant of inflation from 1972 to 1998; the study concluded that the inflation episodes in Namibia were explained by monetary and structural factors. Atta *et al.* (1999) and Dlamini *et al.* (2001) examined the determinants of inflation in the SADC region for Botswana and Swaziland, respectively. Monetary variables such as nominal money supply, nominal interest rate and South African prices amongst other variables were used to examine the determinants of inflation for the respective countries. The Atta *et al.* (1999) study, focused primarily on the pass through of US exchange rate and South African prices, while Dlamini *et al.* (2001) concluded that real sector variables such GDP growth, had more influence on inflation than monetary variables. Monetary factors such as interest rates and money supply were found to be insignificant in explaining inflation in Swaziland.

Atta-Mensah and Bawumia (2003) used a vector error correction forecasting model, concluding that inflation in Ghana was purely a monetary phenomenon. Their findings were confirmed by Ocran (2007) who investigated the determinants of inflation in Ghana. The findings of the study also suggest that the Ghanaian inflation was as a result of monetary factors.

Abidemi and Maliq (2010) applied the error correction model (ECM) to determine the causes of inflation in Nigeria. The study found that both fiscal and monetary policies had a major influence on the impact of the depreciation of the Nigerian currency on inflation. This study confirmed earlier findings of Moser (1994) using ECM techniques that monetary factors and other factors that contributed to inflation in Nigeria included, amongst others, agro-climatic conditions particularly given the considerable role of food commodities in the composition of the CPI. Furthermore, Abidemi and Maliq's (2010) study, which mainly focused on monetary determinants, concluded that reducing inflation to lower levels would help reduce relative price uncertainty while improving resource allocation in the country.

Recent trends in inflation and its determinants have prompted the renewed interest in investigating inflation and its determinants since 2010. Adu and Marbuah (2011) investigated the determinants of inflation for the period 1960 to 2009 in Ghana using the autoregressive distributed lag (ARDL) approach to cointegration and ECM models. The results confirmed that there was significant evidence that nominal exchange rates, interest rates, real output, broad money supply and fiscal deficit influence the rate of inflation in Ghana. As one of the recommendations, Adu and Marbuah (2011, p. 266) suggests that there is a need to effectively anchor inflation expectations and promote transparency in the conduct of monetary policy.

In Nigeria, Bayo (2011) noted that inflation is one of the major macro-economic problems that confront the Nigerian economy and the attempts by the Government to control it using the traditional monetary and fiscal policies have not provided a long lasting solution. In his study, Bayo (2011) adopted an inflation function that combines the structuralist, monetarist and fiscal approaches. Using the ordinary least squares (OLS) method, the study found that the macro-economic uncertainties that are associated with the inflation rate in Nigeria were money supply, interest rates, exchange rates and fiscal deficits among other factors/causes.

A similar study was conducted by Awogbemi (2012), which also stated that monetary and fiscal policy measures are used as tools by the Nigerian Government for combating inflation and meeting various macro-economic objectives. The study also used the OLS model and the result of the study were in line with the findings of (Bayo, 2011), revealing the existence of a positive relationship between inflation and exchange rate (of US Dollar to Naira) and money supply growth rate. On the other hand, the study further revealed the existence of a negative relationship between inflation and gross domestic product (GDP) growth rate and ratio of Government expenditure to income.

Akinboade (2012) applied the VECM to examine the causes of inflation in Nigeria using quarterly data for the period 1986Q01 to 2008Q04. In line with the findings of Bayo (2011) and Awogbemi (2012), the results confirmed the existence of a significant long run negative effects of money supply and exchange rate on inflationary pressure, while changes in real output growth and foreign price had direct effects on inflationary pressure. According to the finding of Bayo (2011) and Awogbemi (2012), it is apparent that the Nigerian Government uses monetary and fiscal policies measures as tools for combating inflation and meeting various macro-economic objectives. However, after thorough evaluation on the effectiveness of these policies, both authors suggest that these traditional policies are not effective in combating inflation effectively due to negligence of the correlation that exists between Government expenditure, money supply and inflation.

Bayo (2011), Awogbemi (2012) and Moser (1994) further recommended that the structure of government expenditure should be well coordinated and that there should be high level of transparency in the fiscal operations. Developments and growth in the economy of African countries has been hampered by lack of transparency particularly in fiscal operation, the level of corruption by some Governments has often led to unnecessary and ineffective expenditure at the expense of the general public.

Adu and Marbuah (2011) investigated the determinants of inflation for the period 1960 to 2009 in Ghana using the ARDL cointegration approach and ECM model. The study found that the main macro-economic factors responsible for inflation in Ghana were real exchange rates and money supply. The findings of this study suggested that inflation in Ghana is of a monetary nature. In Iran, Sadeghi and Alivi (2013) modelled the impact of money supply (M2) on inflation and GDP using a VECM for the period from 1988Q1 to 2005Q4. The study found that in the long run, the excess creation of money led to an increase in the rate of inflation. Similar studies using the VECM framework on the subject have been undertaken by amongst others Khan and Schimmelpfenning (2006) in Pakistan and Yamak and Kucukkale (1998) in Turkey.

Although these studies suggested that various factors had contributed to inflation in their respective countries, it is worth noting that Government expenditure continues to be one of the crucial challenge facing African countries as noted by the studies of Awogbemi (2012) and Moser (1994) in Nigeria. Adu and Marbuah (2011:265) also emphasised that austere fiscal measures in Ghana are needed to contain the rate of inflation within reasonable growth range.

While, the above reviewed empirical studies have concentrated mainly on the two major economies in the Economic Community of West African States region (ECOWAS), it can be concluded that a combination of structural and monetary factors explain inflation in Ghana and Nigeria and the result of these studies have been consistent with prior studies on the determinants of inflation. Determinants of inflation have also been investigated in some other developing regions in the African continent.

In the Southern African Development Community (SADC), Taye (2013) used an ARDL estimation technique to examine the determinants of inflation in order to identifying the factors that have influenced its movements over time. This was as a result of high and unstable periods of inflation in Botswana for the last 20 years. The study found that both

domestic and international factors were influencing inflation in Botswana. Price expectations, money supply and South African prices were the major determinants.

3.3.3. Determinants of inflation: Empirical evidence from developed countries

Determinants of inflation have been widely discussed globally and various studies have been conducted using different approaches and models leading to different conclusions amongst different researchers. Developed countries whose empirical studies are presented in this subsection are categorised in terms of the country's Gross National Income (GNI) per capita as reported by the World Bank¹⁶. Analysis of empirical studies from developed countries presented in this Subsection allows for a comparison of various factors that have been found to influence inflation in both developing and developed countries.

Dhakai *et al.*, (1994) investigated the determinants of inflation in the United States using VAR modelling that includes major variables interacting with the price level in the macro-economy for the period from 1957Q1 to 1991Q4. The findings of the study revealed that changes in the money supply have a long-run direct causal impact on the price level and other non-monetary variables such as wages, budget deficit and the energy price had a significant impact on inflation.

Studies using the VECM framework on the subject have been undertaken by amongst others Engert and Hendry (1998) and Adam and Hendry (1999) in Canada and Hubrich and Vlaar (2000) in Germany. The findings of these studies have had mixed results, although some applied similar econometric techniques and used data falling within the same time period, the results were found to have contradictory findings, reiterating that factors influencing inflation are in most cases unique and vary according to country experiences. Boschi and Girardi (2005) applied a structural VECM model to analyse the

¹⁶ Economies are divided into four income groupings: low, lower-middle, upper-middle, and high, measured using gross national income (GNI) per capita, in U.S. Dollars, converted from local currency (World Bank, 2016), Available online at: http://data.worldbank.org/about/country-and-lending-groups#High_income

long run determinants and the short -run dynamic properties of the Euro Area inflation for the period from 1985Q1 to 2003Q2. The long run parameter estimates suggested that both supply and demand factors affected inflation, while income and fiscal policies were found to have significant impact on inflation than pure monetary variables.

Kandil and Morsy (2009) investigated the determinants of Inflation in the Gulf Cooperation Council (GCC) countries GCC and the study found that exchange rate depreciation reinforced the increase in import prices and the inflationary effect of external shocks. Khathlan (2011) used the Unrestricted Error Correction Model (UECM) based on ARDL model to examine money supply, world price level measured in terms of price index of the world and nominal effective exchange rate as the causes of inflation in Saudi Arabia between 1980 and 2009. The study found that in the long run, inflation was mainly influenced by external factors such as exchange rates, while in the short-run, supply bottlenecks and domestic factor such as money supply were more significant than the external factors.

Alexov*Å*i (2012) conducted a similar study as Kandil and Morsy (2009), however, focusing primarily on the determinants of inflation for new European Union (EU) members for the period 1996 to 2011. This study found that both cost push and demand pull factors affected inflation in the long-run, while short-run dynamics of inflation were explained by price expectations, labour cost and other exogenous shocks amongst other factors. Contrary to Boschi and Girardi (2005), Alexov*Å*i (2012) argues that there was no interdependence between inflation and Government deficit for new EU members between 1996 and 2011.

3.4. Conclusion

The Chapter has explored various theoretical and empirical approaches undertaken to explain and diagnose the causes of inflation. Amongst other theories, the monetarist approach which specifically focuses on the growth in monetary aggregate as the main determinants of inflation, analysis of which are explained on the basis of quantitate

theory of money. Other theories explored in this Chapter included the Keynesian theory which provided a distinction between demand-pull and cost-push inflation and the structuralist approach which defines inflation as a process that occur through a combination of underlying, initiating and propagating factors.

A review of empirical literature was done with the aim of establishing the determinants of inflation in South Africa, developing and developed economies. In South Africa, the studies conducted have had mixed results, although structural factors are believed to be the key determinants of inflation, monetary and Keynesian factors have been fundamental in influencing the level of inflation in the domestic economy.

Empirical evidence from developing and developed countries revealed that different factors explain the dynamics of inflation, and by applying various econometrics techniques, empirical evidence showed varied and often inconclusive results. Despite the inconclusiveness of the results, growth in money supply, labour cost, fiscal expenditure, exchange rate and import prices have been found to be the most common determinates of inflation in the reviewed studies.

CHAPTER FOUR: EMPIRICAL MODEL SPECIFICATION AND ESTIMATION TECHNIQUES

4.1. Introduction

This Chapter discusses the methodology adopted in this study as well as the theoretical and empirical model specifications. The Chapter is divided into five sections. Section 4.2 presents the empirical model employed in the study as well as justification of the variables included in the model. Section 4.3 provides the techniques used to estimate the model; while Section 4.4 discusses data sources and definitions of variables used in the study. Section 4.5 concludes the chapter.

4.2. Empirical Model Specification

The determinants of inflation in South Africa are reconsidered using the Error Correction Model (ECM) technique. Section 4.2.1 presents the general empirical model of the determinants of inflation while Section 4.2.2 provides justification of the variables included in the model.

4.2.1. The empirical model

The model hypothesise inflation (INF) as a function of inflation expectations (INF_{t-1}), exchange rate (EXR), Final government consumption expenditure (FGCE), real GDP (GDP), import prices (IM), nominal unit labour costs (LW) and money supply (M2) as the determinants of inflation for the period from 1970Q1 to 2015Q4. The adopted model partly draws from the study of Moser (1994) and Kuijs (1998) and incorporates elements of Greenidge and DaCosta (2009), Khathlan (2011) and Adu and Marbuah (2011) on the determinants of inflation. Given the time that some of these studies were conducted, and the structural and monetary developments that have taken place during the past twenty five years, a revisit of the topic using improved econometric techniques and recent data to get a renewed overview on the determinants of inflation in South Africa, cannot be over emphasised. The modified model is expressed as:

$$INF = f(INF_{t-1}, EXR, FGCE, GDP, IM, LW, M2) \dots\dots\dots (4.1)$$

The study estimates the following model:

$$\log INF_t = \alpha_0 + \beta_1 \log INF_{t-1} + \beta_2 \log EXR_t + \beta_3 \log FGCE_t + \beta_4 \log GDP_t + \beta_5 \log IM_t + \beta_6 \log LW_t + \beta_7 \log M2_t + \beta_8 DUM + \mu_t \dots\dots\dots (4.2)$$

Where:

- INF = Inflation
- INF_{t-1} = Inflation expectations
- EXR = Nominal effective exchange rate
- FGCE = Government consumption expenditure
- GDP = Real GDP/Economic growth
- IM = Import prices
- LW = Nominal unit labour input cost
- M2 = Money supply/money growth
- DUM00 = Dummy variable (introduction of Inflation targeting)
- α = Constant
- β = Respective coefficients
- t = Time/period
- μ_t = Error term

For the purpose of analysis, macroeconomic time series data is transformed into natural logarithm. Macroeconomic data, when not transformed, usually trends upwards and that often result in unit root tests identifying the series as non-stationary. According to Solnik (2000), when variables are in logarithms, the estimated coefficient can be interpreted as elasticities.

Studies have shown that in regression models involving time series data, it may happen that there is a structural change in the relationship between the regressand Y and the regressors (Gujarati, 2004, p. 273). Dummy variables are useful tools in econometrics as they represent variables that are more qualitative rather than quantitative in the system by splitting the sample into two distinct periods. The dummy variable was included in the model to account for possible structural break/outliers in the model that may occur as a result of various internal and external factors such as policy changes, etc. The dummy variable assumes the binary value of 0 and 1, where 0 represent the period before and 1 represents the specified period and/or subsequent period. *DUM00* (dummy for the introduction of inflation targeting framework in 2000) which assumes the value of 1 from 2000Q1 to 2015Q4 and 0 otherwise, has been included in the model to account for possible outliers.

4.2.2. Justification of the variables included in the model

4.2.2.1. Inflation and inflation expectations

Inflation, a dependent variable in the study, is generally defined as a sustained increase in the general or average price level. It is determined by comparing the price, in two different periods, of a pre-determined basket of consumer goods and services (Fourie and Burger, 2009; Mohr and Fourie, 2008). Thus, the actual inflation rate is calculated as follows:

$$INF = \frac{\pi_t - \pi_{t-1}}{\pi_{t-1}} \times 100 \quad \dots\dots\dots (4.3.1)$$

Where π_t is the current average price level and π_{t-1} is the average price level for the previous quarter. For the purpose of this study, inflation data are given as averages for the quarter and not as end-of-period data¹⁷. Considering that inflation expectations play an important role in the current monetary policy conduct in South Africa (see Kaseeram *et al.*, 2004; Mohr and Fourie, 2008; Fourie and Burger 2009), the study estimates the

¹⁷ The index is based on 2010=100

influence of inflation expectations in South Africa. While there are various models for inflation expectations, this study follows Moser (1994) model where the expected rate of inflation in period t is assumed to be based on adaptive expectations. According to the adaptive expectations theory, the current inflation rate is used as an indicator of the next period's inflation rate (Moser, 1994; Kaseeram *et al.*, 2004). Thus, the equation for expected inflation is expressed as follows:

$$E(\pi_t) = d_1(\Delta \log Inf_{t-1}) + (1 - d_1)\pi_{t-1} \dots\dots\dots (4.3.2)$$

Where $\Delta \log INF_{t-1}$ and π_{t-1} represents actual inflation and expected inflation respectively in period $t - 1$. For the purpose of this study, it is assumed that $d_1 = 1$, the inflation expectation equation can be specified in a reduced form model as follows:

$$E(\pi_t) = \Delta \log INF_{t-1} \dots\dots\dots (4.3.4)$$

According to SARB (1994, p. 36)¹⁸, the price formation process in South Africa are dependent on changes in labour costs, which are mainly driven by expectations. Based on the results of previous empirical studies, such as Moser, (1994), Ubide (1997), Kaseeram *et al.* (2004), Adu and Marbuah (2011), Alexov*Ã*i, (2012) and Taye (2013), the lagged inflation (a proxy for inflation expectations) is expected to have a positive influence on current inflation.

4.2.2.2. Exchange rate and inflation

Exchange rate is included in the model as an independent variable since evidence from previous empirical studies revealed that domestic prices are influenced by the volatility in the exchange rate. This is as a result of inflation differentials between two or more trading countries. Although the fluctuations of the exchange rate, in particular, a weaker

¹⁸ SARB quarterly bulletin, March 1994

exchange rate is beneficial for the country's export market, it has a negative influence on imported goods as it provides natural price increasing effect on the goods and services concerned. Developing countries, in particular those that import more than they export (net importers), often have to bear the burden of paying higher prices as compared to other countries whose exchange rate volatility is stable and currency depreciation does not necessarily translate to higher domestic prices. Exchange rate volatility has proved to be highly influential through its pass through effect or the so called second round effect on domestic prices. Existing empirical evidence suggests that almost every central bank does take exchange rate behavior into account when undertaking monetary policy, although Edwards (2006) argues that only few inflation targeting central banks openly recognize using the exchange rate as a separate term in their policy rules. Empirical literature in South Africa suggests that an appreciation of the rand or an increase in the real effective exchange rate results in a reduction in domestic inflation (see, among others, Moll, 1999; Wesso, 2000; Cheng and Tan, 2002; Akinboade *et al.*, 2004). In accordance with empirical literature, the exchange rate (as proxied by NEER index) is expected to have a negative effect on inflation in South Africa.

4.2.2.3. Government consumption expenditure and inflation

Government consumption expenditure as a determinant of inflation is well supported both in theory and empirical literature. The influence of government consumption expenditure on inflation is explained by the Keynesian demand-pull inflation theory. According to Romer (2001) government consumption expenditure depends on a number of factors such as real income, real interest rates and taxes. Khathlan (2011) suggests that high standards of living are associated with the increase in real income, which could lead to an increase in aggregate demand. Furthermore, the demand-pull theory suggest that excess demand pressure pulls up the prices of goods and services which result in an increase in the general price level (Dhakal *et.al.*, 1994; Mohr and Fourie, 2008). Government expenditure which is a component of total consumption expenditure continues to be one of the crucial challenge facing African countries as

noted by the studies of Awogbemi (2012) and Moser (1994) in Nigeria. Adu and Marbuah (2011, p. 265) also emphasised that austere fiscal measures are needed to contain the rate of inflation within reasonable growth range. Based on evidence from other empirical studies discussed, a positive relationship is expected between government consumption expenditure and the rate of domestic inflation.

4.2.2.4. Economic growth and inflation

Economic growth is defined as a sustained, recurring annual increase in the real GDP per capita or at least in real GDP over time (Fourie and Burger 2009, p. 497). Odhiambo (2013) found that there is a bi-directional causal relationship between inflation and economic growth in South Africa and in order to understand and explain how it determines or is determined by other macro-economic variables in the economy, there are three critical elements in its definition. Firstly, it is all about real GDP, not an increase in the nominal GDP caused purely by inflation. Second, it must be a sustained and recurring increase and thirdly, a decision should be made whether to consider aggregate GDP or per capita GDP (Fourie and Burger 2009, p. 497). According to Odhiambo (2012, p. 317), ‘the dynamic relationship between inflation and economic growth has recently been a subject of intense debate’ and it remains a controversial issue from both the theoretical and the empirical fronts. Various studies such as Barro (1996), Fischer (1993) and De Gregorio (1993) found that there is an existing negative relationship between GDP and inflation.

Real GDP growth rate was, therefore, employed and its simplest measure is computed as the quarterly average growth rate of real GDP. A negative coefficient of GDP growth is expected. According to Fourie and Burger (2009, p. 498) the formula for real GDP growth rate can be expressed mathematically as follows:

$$Y = \frac{Y_t - Y_{t-1}}{Y_{t-1}} \times 100 \dots\dots\dots (4.4)$$

Where:

Y_t = real GDP current quarter; and

Y_{t-1} = real GDP for the previous quarter.

4.2.2.5. Import prices and inflation

As a result of the current drought conditions that affected most agricultural commodities in Southern Africa for the 2015/2016 period, imports have risen and consequently have affected food prices negatively (ITAC, 2016). At the same time, the benefit as a result of the plunge in international commodity prices which in effect should lower the cost of imports, has in most instances been offset by the tariff measures, imposed to protect domestic manufactures/industries of similar products. In addition, the natural protection that is offered by the exchange rate effect, particularly on agricultural commodities that are trading at import parity prices and at the same time having a major contribution on food prices which forms an integral part in the country's consumer basket (ITAC, 2016). According to Monfort and Peña (2008), foreign food prices, in particular from Brazil, have had a big impact on the short-run dynamics of inflation in Paraguay. While there has been different views on the impact of import prices on inflation in South Africa by amongst others Mohr (2008, p. 4), who argues that although import prices can rise, inflation (a process) cannot be imported, except under special circumstances. Other empirical studies such as Pretorius and Smal (1994), Fedderke and Schaling (2000), Kaseeram *et al.* (2004), and Akinboade *et al.* (2004), found the existence of import prices pass-through to domestic inflation. In light of the foregoing, a positive relationship is expected between import prices and the rate of domestic inflation.

Being part of the global economic environment requires economic agents, particularly policy makers (i.e. central banks) to have a comprehensive understanding of the consequence of international developments on domestic economic factors such as

inflation. Import prices¹⁹ are included in the model, as a measure of the cost of goods and services bought by local residents from foreign country which could include either final products destined for final consumption or intermediate products that are further processed or manufactured into final consumable products. According to Peacock and Baumann (2008), import prices do help explain movements in inflation and the existing empirical evidence (i.e. in the UK) suggest that import prices have become more important in firms' marginal costs. Import prices are in most instances viewed as an exogenous factor in the determination of domestic inflation as it takes into account a variety of global economic factors which include amongst others foreign input cost, foreign policy measures, exchange rates, climate condition in foreign countries and other factors that affect the cost of production of imported commodities. It should however be noted that import prices are heavily affected by the rate of exchange and this would play an important role in the determination of inflation particularly given the deterioration in the value of the local currency since December 2015 and competition from low cost countries, making it difficult for domestic firms to raise their prices in the face of increased cost pressures.

4.2.2.6. Nominal unit labour cost and inflation

According to Paneva and Rudd (2015), many formal and informal descriptions of inflation dynamics assign an important explicit or implicit role to labour costs. The labour unit cost is included in the model to measure average cost of labour per unit of output produced. Economic theory suggests that if increases in labour costs exceed productivity gains, it results in an upward pressure on prices, thereby resulting in an increase in the general price level. South Africa is a unique country, and as it has been witnessed in the past, there have been many instances where labour related protests have resulted in cost raising effects on a variety of economic sectors, while the rate of productivity has declined over the same period. For instance, Bohlmann *et al.* (2014) studied the impact of 2014 platinum mining strike in South Africa and found that

¹⁹ For other views on the impact of import prices on inflation, see Mohr, P. 2008. On inflation. South African Journal of Economics, Vol. 76 (1): 1-15.

stopping the industry from working for a period of time would make its produce scarce and push its price up on world markets. Although several studies such as Brauer (1997) and Paneva and Rudd (2015) amongst others, have often reported a weaker link between inflation and labour unit cost in a variety of countries, locally, results from studies such as Kaseeram *et al.* (2004) and Akinboade *et al.* (2004) indicate that increases in nominal unit labour costs have played an important role in the inflation process in South Africa. In addition, other studies such as Mehra (2000); Lown and Rich (1997) and Emery and Chang (1996) have shown that labour unit costs also play a pivotal role in forecasting the rate of inflation, particularly since inflation expectations plays a crucial role in the current monetary policy framework in South Africa. Given the unique nature of labour policies in South Africa as compared to other countries in the world, a positive relationship between inflation and unit labour cost is expected to exist in South Africa.

4.2.2.7. Money supply and inflation

Economists widely agree that continued increases in the money supply leads to continued increases in aggregate demand, which generates continued inflation (Arnold, 2008, p. 287). Money supply, expressed in nominal terms²⁰, refers to coins and notes as well as demand deposit in circulation outside the monetary sector (M1). While M2, the variable used in the study, refers to M1 plus all other short-run and medium term deposit of domestic private sector with monetary institutions (Mohr and Fourie, 2008). Money supply is crucial in determining inflation not necessarily because of its direct impact on prices but because variation in money growth constitute most of the variations in growth in aggregate demand. According to Lissovolik (2003); Moenjak (2014) and Mankiw (2012), monetary policy can only influence prices of goods and services in the long run and any effort by the central bank to stimulate the economy by printing money will only result in rising prices and inflation in the long run. Thus in the

²⁰ The nominal quantity of money is the quantity expressed in units (i.e. Rand) while real money supply real quantity of money is the quantity expressed in terms of the volume of goods and services that the money will purchase (Friedman, 1971)

long run, growth in money supply is likely to grow at any rate, leading to persistent increase in the general price level. Although DeJager and Ehlers (1997) argue that growth in M3 is superior and a more stable indicator for future inflation rates than narrow money (i.e. M2) and it has a consistently negative relationship with interest rates. Doyle (1996) suggest that narrow money (i.e. M2) could be a fair leading indicator for inflation. Brown and Cronin (2007) also suggests that nominal money stock variables (M2) be used in order to keep the analysis focused on the relationship between the price indices. In light of the findings by Brown and Cronin (2007) and Doyle (1996), this study utilises M2 as a proxy for money supply and the coefficient is expected to be positive.

4.3. Estimation Techniques

The study employs an Error Correction Model (ECM) that was first used by Sargan and later popularised by Engle and Granger (Gujarati and Porter 2009, p. 764). The ECM approach incorporates both the long-run and short-run effects simultaneously and provides the speed of adjustment coefficient that measures the speed at which inflation revert to its long-run equilibrium position following a shock in the system. The ECM has evolved as a standard instrument in econometric analysis. This study followed a cointegration technique proposed by Johansen (1988) and Johansen and Juselius (1990). The Johansen-Juselius cointegration technique will be applied to examine if the variables are cointegrated. However, one of the limitations of the test is that, it relies on asymptotic properties, and is therefore sensitive to specification errors in limited samples. The ECM would be applied in order to capture short-run disequilibrium between inflation and its determinants. According to Brooks and Tsolacos (1999), an ECM technique has proven to be effective in capturing the short- and long-run relations between dependent and explanatory variables. The ECM approach incorporates both the long run and short run effect simultaneously and provides the speed of adjustment coefficient that will measure the speed at which inflation revert to its target range following a shock in the system.

The order of integration of a time series is of great importance in econometric analysis and several statistical tests have been developed to examine its existence (Lütkepohl and Krätzig, 2004, p. 13). Prior to applying the Johansen-Juselius cointegration technique, the first step is to determine if the variables are integrated of the same order. In determining the integration properties of the data, the study applies the Augmented Dickey-Fuller (ADF), Dickey-Fuller Generalised Least Square (DF-GLS) and Philips Perron (PP) unit root test to check for data stationarity. If a series is stationary without any differencing, it is integrated of order $I(0)$, while a series that is stationary at first differences is integrated of order $I(1)$. If a set of variables are truly cointegrated, then it would be possible to detect the implied restrictions in an otherwise unrestricted VAR (Greene, 2012, p. 965). Throughout this study, computations are done using Eviews 9 software package. This section is divided into four sections. Section 4.3.1 present unit root tests; Section 4.3.2 present the Johansen-Juselius Cointegration Test and finally, Section 4.3.3 discusses the ECM estimation techniques.

4.3.1. Unit root tests

Most macroeconomic time series data are characterised by non-stationarity, i.e. having unit roots. Dougherty (2007, p. 530) suggests that in time series analysis, we do not confide ourselves to the analysis of stationary time series. In fact most of the time series encountered are non-stationary. Stationarity of the data is fundamental in econometric modeling, as modeling non-stationary data using the OLS method can generate a spurious regression. Therefore, before proceeding with further analysis, the data must be tested for stationary (Noora *et al.*, 2007). As argued by Studenmund (2014, p. 405), if all the variables are found to be stationary, there is no need to worry about spurious regressions.

In examining the stationarity in the series ADF, DF-GLS and PP unit root tests will be applied to all the variables to detect if these variables are stationary. These tests will enable the researcher to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. Analysing

non-stationary variables result in the violation of the Classical Linear Regression Model (CLRM) assumptions, as it results in a spurious regression. Granger and Newbold (1974) argued that such results are characterized by a high R^2 and a low Durbin-Watson (dw) statistic. Furthermore, Verbeek (2000, p. 281) state that t -statistic and F -statistics appear to be significant, but the results derived have no economic sense. According to Enders (1995, p. 215) the results 'looks good' because the least-squares estimates are not consistent and the customary test of statistical inference do not hold. These tests are discussed in detail below, beginning with ADF test in Section 4.3.1.1, DF-GLS test is contained in Section 4. 3.1.2 and the PP test is presented in Section 4. 3.1.3.

4.3.1.1. Augmented Dickey-Fuller test (ADF)

Augmented Dickey-Fuller test (ADF) which was proposed by Said and Dickey (1984) include an extra lagged terms on the right-hand side of the Dickey-Fuller (DF) equation in order to eliminate autocorrelation. The ADF test is estimated by the following regression:

$$\Delta Y_t = \phi_1 + \phi_{2t} + \phi Y_{t-1} + \sum_{i=1}^M d_i \Delta Y_{t-i} + \mu_t \dots\dots\dots (4.5)$$

Where μ_t is the pure white noise error term (i.e.);

$$\Delta Y_{t-1} = Y_{t-1} - Y_{t-2} \dots\dots\dots (4.6)$$

$$\Delta Y_{t-2} = Y_{t-2} - Y_{t-3}, \text{ etc.} \dots\dots\dots (4.7)$$

White noise process refers to stationary process for which all autocorrelations are zero (Lütkepohl and Krätzig, 2004, p. 13). According to (Gujarati, 2004, p. 817) the number of lagged difference terms to include is often determined empirically, the idea being to include enough terms so that the error term is not serially correlated. By adding the

lagged difference terms of the regressand, the ADF test adjusts the DF test to deal with possible serial correlation in the error terms (Said and Dickey, 1984; Gujarati, 2004, p. 819). The null hypothesis of ADF test assumes that there exists a unit root in the time series (non-stationary time series), which is:

$H_0: \phi = 0$ (x_t - is non-stationary), against the alternative hypothesis

$H_1: \phi < 0$ (x_t - is stationary or no unit root)

The ADF test accommodates general Auto-regressive Moving Average (ARMA) (p, q) models with unknown orders. It follows the same asymptotic distribution as the DF statistic; therefore, the same critical values can be used. The ADF test assumes that the dynamics in the data have an ARMA structure, and tests the null hypothesis that a time series y_t is $I(1)$ against the alternative that it is $I(0)$.

4.3.1.2. Dickey-Fuller generalised least square (DF-GLS)

Dickey-Fuller Generalised Least Square (DF-GLS) proposed by Elliott *et al.* (1996), is a modified version of the Augmented Dickey Fuller test (ADF). According to Elliott *et al.* (1996), DF-GLS test for unit root has substantially improved power when an unknown mean or trend is present in the series and also works well in small samples. The DF-GLS test is similar to the ADF test, however, the DF-GLS apply generalized least squares (GLS) approach to detrend the series prior to estimation of the regression equation.

Since the DF-GLS is a modification of a standard ADF test, its equation involves substituting equation 4.5 with GLS trended time series. According to Elliott *et al.* (1996) the DF-GLS unit root test estimates the following equation:

$$\Delta y_t^d = \alpha y_{t-1}^d + \alpha_1 \Delta y_{t-1}^d + \dots + \alpha_p \Delta y_{t-i}^d + \varepsilon_t \dots \dots \dots (4.8)$$

The critical values and asymptotic power of the DF-GLS unit root test are those of the conventional Dickey Fuller (DF) t -statistics when there is no intercept Elliott *et al.* (1996, p. 824). The unit root test the null hypothesis that a series contains a unit against an alternative hypothesis that a series is stationary. Although the application of Dickey Fuller (DF) and Augmented Dickey-Fuller (ADF) unit root test has been standard practice in time series modeling, the DF-GLS possess a much better statistical properties.

4.3.1.3. Phillips-Perron test (PP)

According to Greene (2012, p. 957) the Phillips–Perron (1988) test is general but appears to have less than optimal small sample properties. PP test uses nonparametric statistical methods to deal with serial correlation in the error terms without adding lagged difference terms. Instead of the DF assumption of independence and homogeneity, the PP test allows for the disturbances to be weakly independent and heterogeneously distributed (Enders, 2004, p. 213). The PP unit root test allows for fairly mild assumptions concerning the distribution of errors (Asteriou and Hall, 2007). The autoregressive ($AR(1)$) process of the Phillips-Perron (PP) regression test is as follows:

$$\Delta y_{t-1} = \alpha^0 + \gamma y_{t-1} + e_t \dots\dots\dots (4.9)$$

The PP test makes a correction to the t -statistic of the coefficient γ from the $AR(1)$ regression to account for the serial correlation in e_t . The PP test, as it is the case with ADF test, can be performed with the inclusion of a constant, a constant and linear trend, or neither in the test regression (Asteriou and Hall, 2007, p. 299). Schwert (1989); Brooks (2002); and Aziakpono (2006) suggest that the ADF and PP tests, although the latter deal with serial correlation in the error terms without adding lagged difference terms, also have the tendency to over reject the null hypothesis of non-stationarity when it is true and under-reject it when it is false. These shortcomings in the tests have resulted in the two tests being criticized for their poor size and power properties. The PP

test will not be analysed in detail since its asymptotic distribution is the same as the ADF test statistic (Gujarati, 2004).

4.3.2. Johansen-Juselius cointegration test

Granger (1981) introduced the concept of cointegration, and it was further articulated by Engle and Granger (1987) (Hansen, 2012, p. 361). For this study, Johansen-Juselius cointegration is applied. Firstly, the unit root test as discussed in Section 4.3.1 is applied in order to ensure that the variables are stationary and integrated of the same order. The intention is to have stationary variables in order to avoid the problem of spurious regressions. The most desirable case is that when all the variables are integrated of the same order, we would then proceed with cointegration test. However, it is important to stress that it is not always the case, and that even in cases where the mix of $I(0)$ and $I(1)$ variables are present in the model, cointegrating relationships might exist. The inclusion of such variables, though, will massively affect the results and more consideration should be applied in such cases (Asteriou and Hall, 2007, p. 322).

In establishing the existence of cointegration relationships amongst variables, it is important to determine the optimal lag length between the dependent and explanatory variables in order to identify the appropriate lag length to apply. Asteriou and Hall (2007, p. 322) state that it is very important to find the appropriate lag length in order to have Gaussian error terms (i.e. standard normal error terms that do not suffer from non-normality, autocorrelation, heteroskedasticity, etc.). Adding additional lags will necessarily reduce the sum of squares of the estimated residuals. However, this could lead to loss of degrees of freedom because when estimating a model using lagged variables, some observations are lost in the process. The inclusion of additional coefficients could also reduce the forecasting performance of the fitted model (Enders, 2015, p. 69). On the other hand, including too few lags might also lead to specification errors (Gujarati and Porter, 2009, p. 785). In selecting the appropriate lag length, the study utilise Schwarz's Bayesian (1978) information criterion (SC) and Akaike (1974) information criterion (AIC). In general, the model that minimizes AIC and SBIC is

selected as the one with the optimal lag length and it should also pass all diagnostic checks (Asteriou and Hall, 2007).

One of the steps involved in estimating the Johansen-Juselius cointegration test is to determine the rank of Π or the number of cointegrating vectors. According to Asteriou and Hall (2007), there are two methods and corresponding statistics for determining the number of cointegrating relations and both involve estimation of the matrix Π , which imply a $k \times k$ matrix with rank r . The trace (λ_{trace}) and the maximum eigenvalue (λ_{me}) are specified as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^n \log(1 - \hat{\lambda}_i) ; \text{ And } \dots \dots \dots (4.10)$$

$$\lambda_{me} = (r, r + 1) = -T \log(1 - \hat{\lambda}_{r+1}) \dots \dots \dots (4.11)$$

Where r , is the number of cointegrating vectors under the null hypothesis, T is the number of usable observations and $\hat{\lambda}_i$ is the estimated value for the i th ordered eigenvalue from the (Π) matrix (Enders, 2004, p. 391 and Asteriou and Hall, 2007)

The maximum eigenvalue method tests the null hypothesis that rank (Π) is equals to r against the alternative hypothesis that the rank is $r + 1$. The test considers the largest eigenvalues in descending order and considers whether they are significantly different from zero. On the other hand, the trace statistic considers whether the trace is increased by adding more eigenvalues beyond the r th eigenvalue. The null hypothesis is that the number of cointegrating vectors is less than or equal to r (Asteriou and Hall, 2007). This implies that the number of cointegrating vectors is present if the trace statistic and maximum eigenvalues are less than their critical values (i.e. at 5% significance level). In some instances, there is a possibility that that the two cointegration tests (trace test and maximum eigenvalue in equation 4.10 and 4.11

respectively) may yield different results and in such instances, Alexander (2001) suggests that results obtained using the trace test should be preferred over the maximum eigenvalue results.

4.3.3. Error correction model (ECM) estimation

Having found that there is a long run co-integration relationship between inflation and its determinants, an error correction model (ECM) is applied in order to capture short-run disequilibrium between inflation and its determinants. The ECM approach incorporates both the long run and short run effect simultaneously and provide the speed of adjustment coefficient that will measure the speed at which inflation revert to its long-run equilibrium position following a shock in the system. Thus, error correction coefficient measures the speed at which deviation from long-run equilibrium are adjusted. The sign of error correction coefficient should be negative in order for the system to converge to equilibrium. While the equation for the ECM is fairly complex, the model itself is a logical extension of the cointegration concept (Studenmund, 2014). As soon as the number of cointegrating relationship has been determined, the residuals from the equilibrium regression can be used to estimate the error-correction model and analyse the effects of the variables as well as to see the adjustment coefficient, which is the coefficient of the lagged residual terms of the long-run relationship identified (Asteriou and Hall, 2007). In estimating the ECM, the OLS model is estimated. The study followed the general to specific approach which involves the inclusion of many variables and complex lag structures. The model will then be reduced to a parsimonious form following the general to specific approach to the preferred model specification. The characteristics and behavior of the general model and the parsimonious models will be examined and the model stability tests will also be performed.

In order to derive a model that is deemed appropriate for evaluating the determinants of inflation in South Africa, the model specification in equation 4.3 and 4.4 has been extended and modified to represent an ECM as follows:

$$\Delta \log INF_t = \alpha_0 + \beta_1 \Delta \log INF_{t-1} + \beta_2 \Delta \log EXR_t + \beta_3 \Delta \log FGCE_t + \beta_4 \Delta \log GDP_t + \beta_5 \Delta \log IM_t + \beta_6 \Delta \log LW_t + \beta_7 \Delta \log M2_t + \beta_8 DUM00 + \gamma ECM_{t-1} + \mu_t \dots \dots \dots (4.12)$$

Where, ECM_{t-1} is the lagged value of the error correction term, rate and Δ represents first-differences. The size of the coefficient γ indicate the speed of adjustment towards equilibrium and u_t is a well behaved error term. INF_{t-1} represent inflation expectation, EXR_t is real effective exchange rate, $FGCE_t$ is Government consumption expenditure, GDP_t is real GDP, IM_t represent import prices, LW_t is nominal unit labour cost, $M2_t$ is money supply and $DUM00$ is a dummy variable for monetary policy framework change in 2000.

4.3.4. Diagnostic tests

Once a model has been specified, a range of diagnostic tools are available for checking its adequacy and many of them are based on the model residuals (Lütkepohl and Krätzig, 2004, p. 40). The diagnostic checks are important to ensure that the ECM is correctly specified and reasonably fit for data. According to Takaendesa (2006), diagnostic checks test the stochastic properties of the model. For the purpose of this study, the following test would be performed: autocorrelation presented in section 4.3.4.1, heteroskedasticity is presented in section 4.3.4.2, and test for misspecification of the model is presented in section 4.3.4.3. Finally, normality test is discussed in Section 4.3.4.4.

4.3.4.1. Autocorrelation

It is important to check if the adopted model in equation 4.15 is reasonably fit for the data. In the diagnostic checking stage, the goodness of fit of the model is examined in order to look for outliers and evidence of periods in which the model does not fit the data well (Asteriou and Hall, 2007, p. 242; Gujarati, 2004, p. 846).

The third Gauss–Markov condition states that the value taken by the disturbance term in any observation be determined independently of its values in all other observations

(Studenmund, 2001). When the condition is not satisfied, the disturbance term is said to be autocorrelation, often called serial correlation (Dougherty, 2007). Autocorrelation normally occurs in regression analysis using time series data. Studenmund (2001, p. 318) identifies three major consequence of autocorrelation as follows:

- a. Pure serial correlation does not cause bias in the coefficient estimates.
- b. Serial correlation increases the variances of the $\hat{\beta}$ distributions²¹.
- c. Serial correlation causes OLS to underestimate the standard errors of the coefficients.

In testing for autocorrelation/serial correlation, the Lagrange Multiplier (LM) test sometimes known as the Breusch–Godfrey test is used. The Lagrange Multiplier (LM) test is a method used to test for serial correlation in the presence of a lagged dependent variable by analyzing how well the lagged residuals explain the residuals of the original equation (Studenmund, 2001, p. 420). The LM test tests the null hypothesis $H_0: \rho_1 = \rho_2 \dots = \rho_p = 0$ (no autocorrelation) against the alternative hypothesis $H_1: \rho \neq 0$, indicating the existence of autocorrelation.

4.3.4.2. Heteroskedasticity

Regression disturbances whose variances are not constant across observations are heteroskedastic. Heteroskedasticity arises in numerous applications, in both cross-section and time-series data (Greene, 2012, p. 268). Gujarati (2004, p. 299) states that the consequence of using the usual testing procedures despite the heteroskedasticity is that the conclusions drawn or the inferences made may be very misleading. In this study, the White's test is used to detect heteroskedasticity. Unlike other tests which are sensitive to the normality assumption, the general White's test does not rely on the normality assumption and is easy to implement (Gujarati, 2004, p. 413). Gujarati (2004, p. 414) further states that the White's test can be a test of (pure) heteroskedasticity or

²¹ This holds as long as the serial correlation is positive. In addition, if the regression includes a lagged dependent variable as an independent variable, then the problems worsen significantly (Studenmund, 2001:318).

specification error or both. The null hypothesis is that the error term has a constant variance (i.e. the observations of the error term are assumed to be drawn continually from identical distributions). The alternative would be for the variance of the distribution of the error term to change for each observation or range of observations (Studenmund, 2014, p. 102).

4.3.4.3. Regression specification error test

To ensure stability of the model in terms of the CLRM conditions, this study applied the Ramsey Reset test, which is a regression specification error test proposed by Ramsey (1969). The Ramsey Reset test is useful for testing a given model against general unspecified alternatives (Lütkepohl and Krätzig, 2004). According to Greene (2012, p. 137) the Ramsey reset test seeks to uncover nonlinearities in the functional form of the regression equation. The null hypothesis of no misspecification is rejected if the test p-values is smaller than 0.05.

4.3.4.4. Normality Test

The study applied the Jarque–Bera test of normality which is also based on the OLS residuals. The Jarque–Bera (JB) test first computes the skewness and kurtosis measures of the OLS residuals under the null hypothesis that the residuals are normally distributed (Gujarati, 2004, p. 148). In the case where the value of the JB statistic is very different from 0, the hypothesis that the residuals are normally distributed can be rejected. Alternatively, if the p-value is reasonably high (i.e. if the value of the JB statistic is close to zero) the null hypothesis of normality of residuals cannot be rejected (Studenmund, 2001; Gujarati, 2004; Asteriou and Hall, 2007).

4.4. Data source and description of variables

4.4.1. Data source

The study employs quarterly time series data for the period from 1970Q1 to 2015Q4. The data is sourced from the electronic database of the SARB (SARB, 2016), Stats SA (Stats SA), International Monetary Fund's (IMF, 2016) and the World Bank (World Bank,

2016). The variables included in the study consist of nominal effective exchange rate (EXR), Final Government consumption expenditure (FGCE), real GDP, import prices (IM), nominal unit labour cost (LW) and money supply (M2) as the determinants of inflation (INF).

4.4.2. Description of variables

The choice of the variables used in this study partially draws from the study of Jonsson (2001), Moser (1994), Kuijs (1998), Greenidge and DaCosta (2009), Khathlan (2011) and Adu and Marbuah (2011) on the determinants of inflation. The description of the variables used in this study is summarised as follows:

INF : Consumer Price Index (CPI) total for all urban areas (2010 = 100)

EXR : Nominal effective exchange rate (NEER) is the weighted average exchange rate of the rand based on trade in and consumption of manufactured goods between South Africa and its most important trading partners (2010 = 100).

FGCE : Final Government consumption expenditure seasonally adjusted (R millions).

GDP : Gross domestic product volumes (2010 = 100).

IM : Foreign trade - prices of imported goods and services into the country (R millions).

LW : Nominal unit labour cost index measuring change in labour cost per unit of output produced (2010 =100).

M2 : Real money supply (M2) in million Rands.

Dum00 : Dummy variable whose value is equal to 1 during the period 2000Q1 -2015Q4 and 0 otherwise, capturing the change in monetary policy framework from eclectic approach to inflation targeting in 2000.

4.5. Conclusion

This Chapter has discussed the methodology used in the study. The empirical models employed in the study, as well as the theories underpinning the model, were presented. The techniques used to estimate the model presented in the second section of this Chapter were also discussed. Discussed as well in this Chapter were data sources and definitions of variables used in the study.

CHAPTER FIVE: EMPIRICAL DATA ANALYSIS AND INTERPRETATION OF RESULTS

5.1. Introduction

This Chapter presents the empirical data analysis in accordance with the methodology or framework outlined in Chapter Four. The purpose of this Chapter is to examine the determinants of inflation in South Africa using the Error Correction Modelling (ECM) technique. This Chapter is divided into four sections. Section 5.2 presents the unit root test results, Section 5.3 Presents Johansen-Juselius cointegration test results while Section 5.4 presents ECM results. Section 5.5 concludes the Chapter.

5.2. Unit root test results

Prior to making any analysis on the determinants of inflation in South Africa, variables are first tested for stationarity using Dickey-Fuller generalised least square (DF-GLS), Augmented Dickey-Fuller (ADF) and Phillips- Perron (PP) unit root tests. The variables are tested mainly because one of the common problems in studying economic relationships is spurious regression. Since this study would explore co-integration analysis, the unit root tests would assist in determining the order of integration. The detailed results of the applied unit root tests are reported in Table 5.1.

Table 5.1: Unit root tests of all variables

Stationarity of all Variables				
Augmented Dickey-Fuller (ADF)				
Variable	Stationarity of all Variables in Levels		Stationarity of all variables in First Difference	
	Without Trend	With trend	Without Trend	With trend
LOG INF	-2.322	0.153	-2.834*	-7.718***
LOG EXR	-0.524	-2.589	-5.958***	-5.940***
LOG FGCE	-2.446	0.346	-5.302***	-12.913***
LOG GDP	-0.184	-1.487	-10.293***	-10.264***
LOG IM	-1.153	-3.018	-12.930***	-12.945***
LOG LW	-1.792	-0.916	-16.810***	-16.983***
LOG M2	-1.837	0.167	-8.915***	-9.166***
Dickey-Fuller generalised least square (DF-GLS)				
Variable	Stationarity of all Variables in Levels		Stationarity of all variables in First Difference	
	Without Trend	With Trend	Without Trend	With trend
LOG INF	0.147	-0.608	-2.155**	-2.667*
LOG EXR	1.651	-2.509	-5.691***	-5.785***
LOG FGCE	1.576	0.104	-1.783*	-4.302***
LOG GDP	2.724	-1.453	-3.666***	-5.491***
LOG IM	4.424	-2.574	-11.197***	-12.648***
LOG LW	2.144	-0.818	-3.498***	-4.632***
LOG M2	0.919	-0.369	-2.866***	-8.817***
Phillips-Perron (PP)				
Variable	Stationarity of all Variables in Levels		Stationarity of all variables in First Difference	
	Without Trend	With Trend	Without Trend	With trend
LOG INF	-2.546	0.682	-7.155***	-8.074***
LOG EXR	-0.401	-2.206	-11.700***	-11.668***
LOG FGCE	-1.249	-0.005	-15.124***	-16.378***
LOG GDP	-0.394	-1.666	-10.524***	-10.497***
LOG IM	-1.113	-3.409	-12.927***	-12.944***
LOG LW	-1.665	-1.001	-16.759***	-16.995***
LOG M2	-1.851	0.024	-9.573***	-9.613***

Note: *, ** and *** denotes stationarity at 10%, 5% and 1% significance levels respectively.

Overall, the stationarity results presented in Table 5.1 indicate that all variables are conclusively non-stationary in levels. However, after being differenced once, all variables became conclusively stationary. After establishing that all the variables are integrated of the same order $I(1)$, the procedure for testing for the possibility of cointegration among the variables is applied using the Johansen's cointegration approach to check if there is an existing long-run relationship between variables under study.

5.3. Cointegration test results

According to Lütkepohl and Krätzig (2004, p. 89), if the variables have a common stochastic trend, it is possible that there are linear combinations of them that are $I(0)$. In applying the Johansen-Juselius cointegration, it is important to determine the optimal lag length (k). In this instance, Akaike Information Criterion (AIC) and Schwarz information criterion (SC) tests were applied in order to guide the choice of the lag length.

The study proceeds to Johansen-Juselius cointegration analysis to check if there is an existing long run relationship between inflation and its determinants. The Johansen-Juselius cointegration tests the null hypothesis of no cointegration against the alternative that there is an existing cointegrating vector. The null hypothesis is rejected when the trace and max statistics is greater than the critical values. The results of the Johansen-Juselius cointegration test are presented in Table 5.2 for both the maximum eigenvalue statistic and the trace statistic respectively, allowing for unrestricted intercepts and no trends.

Table 5.2: Results of cointegration test

Panel A: Trace test				
H0: Rank=P	Hypothesized No. of CE(s)	Trace Statistic	0.05 Critical Value	Probability**
p=0	None *	135.97	125.62	0.010
P≤1	At most 1	89.09	95.75	0.132
P≤2	At most 2	57.83	69.82	0.308
P≤3	At most 3	39.29	47.86	0.249
P≤4	At most 4	23.73	29.80	0.212
P≤5	At most 5	12.30	15.49	0.143
P≤6	At most 6	1.35	3.84	0.244
Panel B: Maximum eigenvalue test				
H0: Rank=P	Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value	Probability**
p=0	None *	46.88	46.23	0.043
P≤1	At most 1	31.26	40.08	0.345
P≤2	At most 2	18.54	33.88	0.849
P≤3	At most 3	15.56	27.58	0.703
P≤4	At most 4	11.43	21.13	0.604
P≤5	At most 5	10.94	14.26	0.157
P≤6	At most 6	1.35	3.84	0.244

* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values

Based on the results presented in Table 5.2 Panel A, the null hypothesis of no cointegration was rejected based on the trace statistics of 135.97 which is greater than the critical value of 125.62. In other words, there is very strong evidence that the variables included in the systems are cointegrated. Thus the trace statistic tests strongly confirm the existence of one cointegrating equation.

Table 5.2 Panel B shows that the null hypothesis of no cointegration was rejected based on the maximum eigenvalue of 46.88 which is greater than the critical value of 46.23.

This result suggests that one cointegrating equation exist in the model. The result of the maximum eigenvalue statistic are in line with the results obtained from the trace test statistics which also indicated that one cointegrating equation exist in the system.

Based on the results presented in Table 5.2, the Johansen-Juselius cointegration test indicates the existence of a long-run relationship between inflation and its determinants. Having established that the variables are cointegrated, the study proceeds to estimate an error correction model.

5.4. Error correction model results

Subsequent to examining cointegration analysis, the evidence from the Johansen-Juselius procedure suggests the existence of cointegration amongst variables. Johansen-Juselius cointegration test revealed that inflation and its determinants are cointegrated and this formed a basis for estimating the ECM model. Using the general to specific modelling techniques to arrive at a parsimonious model, the ECM results are presented in Table 5.3.

Table 5.3: Error correction estimates

Dependent Variable: LogINF			
Variable	Coefficient	t-Statistic	Probability
$\Delta \text{LogINF}_{t-1}$	0.32***	4.80	0.000
ΔLogEXR_t	0.01	0.41	0.679
$\Delta \text{LogEXR}_{t-2}$	-0.02*	-1.83	0.070
$\Delta \text{LogFGCE}_t$	0.04*	1.88	0.062
ΔLogGDP_t	-0.31***	-3.84	0.000
ΔLogIM_t	0.03***	2.89	0.004
$\Delta \text{LogIM}_{t-1}$	0.03***	2.98	0.003
ΔLogLW_t	0.05***	2.74	0.007
$\Delta \text{LogLW}_{t-1}$	0.04**	2.00	0.047
ΔLogM2_t	0.03	1.06	0.289
<i>DUM00</i>	-0.01***	-4.27	0.000
ECM_{t-1}	-0.07**	-2.60	0.010
<i>c</i>	0.01***	5.72	0.000
R ²	0.56	F-statistic	17.50
Adjusted R ²	0.52	Prob (F-statistic)	0.00***
S.E. of regression	0.01	Durbin-Watson stat	2.00

Note: *, ** and *** denotes 10%, 5% and 1% significance levels respectively.

The results reported in Table 5.3 indicate that there is a positive and significant relationship between inflation and lagged inflation in South Africa. The lagged coefficient of inflation is positive and statistically significant at 1% significance level as expected, suggesting that a 1% increase in the previous quarter inflation results in 0.32% increase in current inflation. This result confirms the influence of inflationary expectations in the South African economy. This finding is in line with the findings of Kaseeram *et al.* (2004); Akinboade (2004); Adu and Marbuah (2011); and AlexovÃi (2012).

There is a negative relationship between inflation and exchange rate (as proxied by NEER index) in South Africa. The lagged coefficient of exchange rate is negative and statistically significant at 10% significance level. Since an increase in NEER, a proxy for exchange rate indicates an appreciation of the local currency against the weighted basket of currencies of its trading partners, this result implies that 1% depreciation/appreciation in the exchange rate for the previous quarters would result in a 0.02% increase/decrease in the current rate of inflation. This result is in accordance with *priori* expectations and consistent with findings of the studies conducted in South Africa that depreciation/appreciation of the rand results in an increase/decrease in the rate of domestic inflation (see amongst others Moser, 1994; Moll, 1999; Wesso, 2000; and Akinboade *et al.*, 2004). The negative lagged coefficient of exchange rate reported in Table 5.3 suggests that depreciation of the Rand may have adverse effects on domestic inflation.

The coefficient of government consumption expenditure is positive and statistically significant at 10% significance level. This result suggests that a 1% increase in the government consumption expenditure lead to an increase of 0.04% in domestic inflation. The sign of the coefficient is significant and positive, in line with *priori* expectations and also confirms the existence of demand-pull inflation in South Africa. This finding is similar to some empirical studies that found a positive relationship between government consumption expenditure and inflation (see, among others, Moser, 1994; Anoruo, 2003; Adu and Marbuah, 2011).

GDP has negative and significant influence on domestic inflation as expected. This implies that a 1% increase in the GDP result in a decrease of 0.31% in the rate of inflation. The coefficient of GDP is statistically significant at 1% significance level. This result supports empirical findings such as that of Barro (1996), Fischer (1993) and De Gregorio (1993) that found evidence of negative relationship between GDP and Inflation.

The relationship between imports prices and inflation is positive and statistically significant. This result is consistent with *priori* expectations that import price is positively associated with domestic inflation. The result suggests that a 1% increase in import prices results in a 0.03% increase in inflation. Similarly, the lagged coefficient of import price also suggest that a 1% increase in previous period import price result in an increase of 0.03% increase in current quarter's inflation. The coefficients of import prices are statistically significant at 1% significance level respectively. For an import dependent country such as South Africa, it is evident that external cost-push factors have had significant impact in determining domestic prices in South Africa. While Mohr (2008, p. 4) argues that although import prices can rise, inflation (a process) cannot be imported, except under special circumstances, empirical results obtained in this study is consistent with economic theory as postulated by structuralist cost push factors and the result is also in line with other empirical studies such as Lim and Papi (1997); Kaseeram *et al.* (2004); Monfort and Peña (2008); and Ziramba (2008) who also found the existence of positive import prices pass-through to domestic inflation in South Africa.

Unit labour cost is positively and significantly associated with inflation in South Africa. This result suggests that a 1% increase in unit labour cost lead to 0.05% increase in the rate of inflation. The lagged coefficient of unit labour cost is also positive and statistically significant, suggesting that a 1% increase in unit labour cost during the previous quarter's result in a 0.04% increase in domestic inflation for the current quarter. The coefficients of unit labour cost are also found to be statistically significant at 1% and 5% significance level respectively. These results are in line with economic theory and findings of other empirical studies such as Kaseeram *et al.* (2004) and Lim and Papi (1997) that increases in labour costs result in an increase in the rate of inflation. The result obtained further emphasize the role and impact of labour cost in the inflationary process between 1970 and 2015 and also reveal that cost-push factors are significant determinants of inflation in South Africa.

Money supply was found to be statistically insignificant in terms of its influence on the rate of inflation in South Africa. Although the coefficient is not statistically significant, the

sign of the coefficient is positive and consistent with *priori* expectation that a unit rise in the money supply in the economy would result in an upward movement in domestic inflation. The result is consistent with the monetarist quantity theory of money and empirical findings by Ziramba (2008) who found a positive relationship between inflation and money supply. This result further suggests that effort by the central bank to stimulate the economy by printing money would lead to a rise in the rate of inflation.

The dummy variable is negatively related to the domestic inflation and its coefficient is statistically significant at 1% significance level. The inclusion of the dummy also enhanced the stability of the model, capturing structural effects of the introduction of inflation targeting framework in 2000. The negative and highly significant coefficient implies that the current monetary policy framework had contributed to the reduction in inflation since its inception. This also suggests that although there have been mixed success in the past, the current monetary policy framework remains relevant and effective in keeping inflation within the desired range of 3% to 6%.

The error correction coefficient is negative and statistically significant as expected. This result also confirms the presence of a long-run level equilibrium relationship between inflation and its identified determinants. In terms of the overall stability of the model, diagnostic tests were performed to formally check the model assumptions and properties. The Breusch-Godfrey Serial Correlation LM test showed that the residuals in the model are not serial correlated, there is no heteroscedasticity in the error variance and the Jarque–Bera (JB) test revealed that the residuals are normality distributed. Ramsey Reset test confirmed that the error correction model has no specification error. Based on the diagnostic test results, it was therefore concluded that the estimated ECM model is correctly specified and the parameter estimates are valid and unbiased.

5.5. Conclusion

This Chapter has empirically examined the determinants of inflation in South Africa during the period from 1970Q1 to 2015Q4. Before undertaking the analysis, variables

were first tested for stationarity using Augmented Dickey-Fuller (ADF), Dickey-Fuller generalised least square (DF-GLS) and Phillips- Perron (PP) unit root tests and were found to be conclusively stationary after first difference. Information criteria tests were also applied in order to guide the choice of the lag length. The Johansen-Juselius cointegration test was applied and the results for both the maximum eigenvalue statistic and the trace statistic and both test revealed the existence long-run relationship between inflation and its determinants.

Using ECM modelling techniques to investigate the determinants of inflation in South Africa, it was found that inflation expectations, government consumption expenditure, import prices and labour costs are positively and significantly associated with domestic inflation. The study also found that the lagged exchange rate and GDP have a negative and significant influence on domestic inflation. The dummy variable representing the change in monetary policy framework in 2000 was found to be negatively and significantly associated with inflation, indicating the influence of structural factors in determining domestic inflation.

Money supply was found to be positively associated with inflation; however, its influence on inflation is statistically insignificant. Overall, the study results revealed that the main determinants that are significantly associated with inflation in South Africa include Inflation expectations, government consumption expenditure, GDP, import prices and labour cost, thus, confirming the hypothesis that inflation in South Africa is determined by both demand-pull and cost-push inflation factors.

The coefficient of the ECM term is negative and statistically significant as expected, confirming the presence of a long-run level equilibrium relationship between inflation and its determinants. Finally the overall stability tests indicate that estimated model is correctly specified and the parameter estimates are valid and unbiased.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

This study investigated the determinants of inflation in South Africa for the period from 1970Q1 to 2015Q4. This Chapter summarises the outline and the main findings of the study, draw conclusion and make recommendations based on the results obtained in the earlier Chapters. This Chapter is divided into four sections. Section 6.2 provides a brief summary of the study, while Section 6.3 presents a summary of empirical findings conclusions and recommendations of the study. In conclusion, limitations of the study and identified areas for further research are discussed in Section 6.4.

6.2. Summary of the study

The objective of this study was to investigate the determinants of inflation in South Africa. The study was motivated by the need to guide policy by identifying the factors (variables) that are significant within the model that could be considered when formulating and implementing credible anti-inflationary policies in South Africa.

In seeking to fulfill this broad objective, three specific objectives were pursued; and these are; (1) to investigate various domestic and external determinants of inflation in South Africa; (2) to determine whether inflation in South Africa arises from cost-push or demand-pull inflation factors; and (3) to make policy recommendations based on empirical findings of the study.

The study discussed inflation trends and its key determinants in line with monetary policy frameworks that have been implemented in South Africa since the 1960s, and other macro-economic policy frameworks implemented over the years. The theoretical and empirical underpinnings of determinants have been explored and it was found that numerous studies have investigated the determinants of inflation. Amongst other theories, the monetarist approach which specifically focuses on the growth in monetary aggregate as the main determinants of inflation, analysis of which are explained on the

basis of quantity theory of money. Other theories explored include the Keynesian theory which explained the determinants of inflation on the basis of demand-pull and cost-push inflation and the structuralist approach which indicated that inflation is a process that occurs through a combination of underlying, initiating and propagating factors.

A review of empirical literature revealed that in South Africa, the studies conducted have had mixed results, although structural factors are believed to be the key determinants of inflation, monetary and the Keynesian factors have also been fundamental in influencing the levels of inflation in the domestic economy. Empirical evidence from other developing and developed countries showed varied and often inconclusive results. However, despite the inconclusiveness of the results, inflation expectations, growth in money supply, labour cost, fiscal expenditure, exchange rate and import prices have been found to be the most common determinants of inflation in the reviewed studies.

Using an ECM modelling technique, the model hypothesised inflation as a function of inflation expectations, exchange rate, government consumption expenditure, real GDP, import prices, unit labour costs and money supply as the main determinants of inflation for the period from 1970Q1 to 2015Q4. The model included a dummy variable in order to account for the impact external factors and structural breaks in the model.

In order to empirically examine the determinants of inflation, a number of econometric techniques were employed in the study. Firstly, the results on the various unit root tests were presented, namely; Augmented Dickey-Fuller (ADF), Dickey-Fuller generalised least square (DF-GLS) and Phillips- Perron (PP) unit root tests. Subsequent to examining the unit root tests, all the variables in the study were found to be stationary after first difference (i.e. integrated of order 1). The study then proceeded to estimate the Johansen-Juselius cointegration test and the ECM technique to examine the long-run and short-run relationships between inflation and its determinants.

6.3. Summary of empirical findings, conclusions and policy implications

The overall empirical findings of the study revealed that domestic inflation is determined by both internal and external factors. The results from the study revealed that internal factors such as, inflation expectations, government consumption expenditure, GDP, unit labour cost and external factors such as import prices (foreign prices) and exchange rate were significant determinants of inflation in South Africa for the period from 1970Q1 to 2015Q4.

While cost-push factors were found to be dominant in determining domestic inflation in the model, demand-pull inflation factors were also found to be significant determinants of inflation in South Africa. The result of the study revealed that inflation expectations and government consumption expenditure have a positive and significant impact on domestic inflation. Although money supply was found to be insignificant in determining domestic inflation, the hypothesis that inflation is determined by demand-pull inflation factors in South Africa cannot be rejected.

Empirical results suggest that cost-push inflation factors have been significant determinants of inflation in South Africa. The results showed that import prices and unit labour cost were positively and significantly associated with inflation. On the other hand, exchange rate was also found to have a negative and significant influence on domestic inflation. The findings of this study lead to the conclusion that the hypothesis that inflation is determined by cost-push inflation factors in South Africa cannot be rejected. Thus, the general hypothesis that inflation is determined by both demand-pull inflation and cost-push factors in South Africa cannot be rejected. South Africa imports most of its commodities, and its output growth is reliant on imported intermediate input and capital goods. This degree of reliance on imported inputs (i.e. oil, grain commodities, machinery, etc.) makes South African producers' more susceptible to exchange rate fluctuations. The significant effect of import prices further explains the degree of influence by external determinants on domestic inflation. While it was envisaged that the re-integration of South Africa into the global economy in the early 1990s would bring

about increased competition through importation of lower priced foreign goods, which in turn, would restrain the impact of rising cost of production while simultaneously hindering domestic producers of goods and services to pass on high cost pressures to consumers. However, the benefit emanating from such process has been partially offset by development in the global factors that have had severe negative impact on emerging market economies such as South Africa and its main trading partners, particularly as a result of the excessive currency depreciation since the 2008 global financial crisis.

Exchange rate has a negative and significant relationship with domestic inflation. The negative impact of exchange rate on inflation suggest that the South African is more susceptible to exchange rate fluctuations particularly given the degree of reliance on imported foreign goods and services. Given that exchange rate is negatively associated with inflation, the hypothesis that macroeconomic determinant of exchange rate is negatively associated with inflation in South Africa cannot be rejected.

Money supply was found to be statistically insignificant in terms of its influence on the rate of inflation in South Africa. However, the sign of the coefficient was positive. Based on this result, the hypothesis that a positive relationship exist between inflation and money supply in South Africa cannot be rejected. The result obtained in the study suggest that cost-push and demand pull as well as structural factors have much broader and unintended consequence on domestic inflation than traditional monetary variables. However, given the challenges often experienced in maintaining the rate of inflation within the 3% to 6% target range, monetary authorities should be cognisant of the effect of increase in monetary base particularly given its positive association with domestic inflation.

GDP was found to have a negative and significant influence on domestic inflation. This implies that an increase in the GDP result in a decline in the general price level. Stable and low inflation is amongst the main macro-economic policy objectives in South Africa, and whilst the formulation and pursuit of this policy objective is not an easy task,

sustainable economic growth remains crucial in determining the level of domestic inflation. In order to achieve the objective of stable and low inflation there is a need to explore other sustainable growth stimulation policies since the results of this study suggests that potential growth prospects have significant policy implication on domestic inflation.

The dummy variable included in the model captures the impact of regime change in monetary policy from the eclectic approach to the current inflation targeting framework. The coefficient for the introduction of inflation targeting framework is negatively related to the rate inflation in South Africa and it is statistically significant. This suggests that the introduction of the new monetary policy framework in 2000 was successful in reducing the rate of inflation between 2000 and 2015. This result also shows that although the current monetary policy framework has had mixed success since its implementation, where inflation has moved above the 3% to 6% target, monetary authority have been able to maintain the rate of inflation within the set target, however the current framework appears not to respond efficiently to external shocks. Thus, it is recommended that inflation targeting as a monetary policy framework in South Africa be maintained. Although empirical studies found that targeting inflation comes at a cost of slow growth and high rate of unemployment (see Pollin and Zhu, 2006), it is also important to note the overall positive contribution of inflation targeting framework in South Africa since its implementation.

The error correction term coefficient was found to be negative and statistically as expected. This implies that any deviations in inflation adjust by approximately 7% quarterly to re-establish its long-run equilibrium path. This result confirmed the presence of a long run equilibrium relationship between inflation and it's identified determinants.

Based on the results of the study and taking into account the lesser degree of control that monetary authorities have in influencing labour costs, which is also significant in influencing inflation in South Africa, it is recommended that more emphasis be placed

on anchoring inflation expectations. This recommendation emanates from the fact that inflation expectations play an important role in influencing labour costs and subsequently the rate of inflation under the current monetary policy framework (see SARB, 1994; Kaseeram *et al.*, 2004). It is further recommended that a more comprehensive set of fiscal and industrial policy instruments (which include, among others, producer support through subsidisation and reduction of import tariffs on input material not available domestically) be considered. This consideration should be based on using non-monetary support mechanisms (such as increase in import duties to protect domestic industries) that do not result in an increase in government expenditure. Other cost-saving and industrial policy programmes (such as Special Economic Zones) that are designed to improve efficiencies and reduce the cost of production should also be prioritised.

This recommendation is based on the finding of the study that supply-side factors such as import prices, exchange rate and labour costs have been identified as significant determinants of inflation in South Africa. Given the current economic environment which appear to be significantly influenced by recent growing political instability, such policy intervention, would also assist in minimizing the impact of sources of instability emanating from external factors (i.e. external currency shocks, drought, higher foreign prices, etc.). These sources of instability affect an already limited ability of policy makers, particularly the monetary authority, in their effort to keep the rate of inflation within the desired target range of 3% to 6%.

Finally, it could be argued that the influence of external factors such as exchange rate and import prices which are significant within the model could perhaps be addressed by switching to an alternative monetary policy framework, such as exchange rate targeting. However, this alternative monetary policy would prove to be difficult to implement in an open economy such as South Africa, mainly due to its impact on capital inflow and outflow into the country (see Akinboade *et al.*, 2004). Adopting this monetary policy framework could have unintended consequences in maintaining a stable exchange rate and could also threaten the SARB mandate of achieving and maintaining price stability in South Africa. Other possible alternative monetary policy frameworks which were

adopted in the past would not do much in reducing the rate of inflation particularly given the structural nature of inflation in South Africa, hence the study recommends that the current inflation targeting framework be maintained while simultaneously being supplemented by other non-monetary policy measures, in order to achieve the macroeconomic policy objective of stable and low inflation in South Africa.

6.4. Limitations of the study and area of further research

Although great care and effort was taken to ensure that this study is analytically sound and defensible, it suffers from a few limitations, as is the case with other scientific research studies.

Firstly, in investigating the determinants of inflation in South Africa, the study endeavours to carefully select the most relevant variables that have been considered in theory and other empirical studies on the topic. However, as a result of time series data availability challenges, some macro-economic time series data, dating back to 1970Q1 was unavailable resulting in the use of proxy variables. Perhaps, future studies may benefit from the analysis that is based on longer-term time-series data. It would also be interesting to note if the results will be significantly different from those established in this study.

Secondly, while the study endeavored to look at many drivers or determinants of inflation possible, the study could not include all variables in the model. Future studies on the determinants of inflation may benefit from extending the analysis to include other fiscal policy variables that are not included in the study.

Finally, although these shortcomings might have affected the empirical findings, it is assumed that their impact was minimal and that they did not significantly alter the theoretical and empirical findings of this study.

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APPENDICES

Appendix A - Table 1A: Data used in the study

Period	INF	EXR	FGCE	GDP	IM	LW	M2	DUM00
1970Q1	2.17468	1380.45	1447	35.9561	2919	1.1	14027	0
1970Q2	2.20266	1376.11	1574	36.6898	3132	1.1	14837	0
1970Q3	2.22504	1367.99	1617	36.2662	3380	1.1	15136	0
1970Q4	2.24556	1368.03	1626	37.5422	3533	1.2	15419	0
1971Q1	2.26607	1379.62	1802	38.0983	3778	1.2	15227	0
1971Q2	2.32762	1374.52	1844	37.7877	3563	1.2	15622	0
1971Q3	2.36306	1344.24	1885	38.2799	3730	1.3	15870	0
1971Q4	2.39663	1293.14	1977	38.5551	3677	1.3	16359	0
1972Q1	2.41714	1194.16	1929	38.3278	3571	1.3	16274	0
1972Q2	2.45445	1192.23	2025	38.7288	3516	1.3	16725	0
1972Q3	2.51786	1129.29	1982	38.7527	3580	1.3	17524	0
1972Q4	2.56822	1154.09	1996	39.439	3893	1.3	18339	0
1973Q1	2.63909	1179.61	2070	39.9476	3980	1.4	18809	0
1973Q2	2.70064	1196.84	2158	39.77	4173	1.4	20395	0
1973Q3	2.75099	1186.55	2385	40.9202	4720	1.5	21317	0
1973Q4	2.82187	1232.22	2423	41.7084	5099	1.5	22033	0
1974Q1	2.88528	1297.87	2671	42.4877	5492	1.6	22969	0
1974Q2	2.97667	1240.76	2673	43.0717	6886	1.6	24231	0
1974Q3	3.10909	1248.81	2978	43.5595	7590	1.8	24882	0
1974Q4	3.21167	1211.02	3118	43.1483	7752	1.8	26601	0
1975Q1	3.28254	1182.71	3396	42.9756	8068	2	27768	0
1975Q2	3.3758	1183.24	3637	43.7164	7936	2	28931	0
1975Q3	3.4877	1168.09	3634	44.0664	8203	2.2	30094	0
1975Q4	3.5623	997.31	3845	44.4297	8753	2.1	31667	0
1976Q1	3.63691	1006.89	4036	45.0137	9271	2.2	32472	0
1976Q2	3.76746	1032.41	4380	44.1156	9070	2.2	34129	0
1976Q3	3.87937	1030.73	4531	45.1652	8567	2.5	34877	0
1976Q4	3.93532	1029.94	4341	44.8351	8828	2.4	35682	0
1977Q1	4.04722	1021.42	4577	44.7372	8729	2.5	35486	0
1977Q2	4.19643	1012.73	4653	44.7802	8067	2.5	37243	0
1977Q3	4.28968	995.56	4540	44.6074	8994	2.6	37780	0
1977Q4	4.38294	961.97	4682	44.8364	8782	2.6	38455	0
1978Q1	4.47619	915.85	5479	45.5737	8937	2.6	39687	0
1978Q2	4.5881	914.16	5370	46.4545	10286	2.7	41656	0
1978Q3	4.81191	870.28	5569	45.9547	10272	2.9	43120	0
1978Q4	4.92381	844.31	6030	46.373	10941	2.8	45034	0

1979Q1	5.03572	859.52	6135	47.1847	9918	2.8	44912	0
1979Q2	5.16627	884.34	6257	47.4895	11091	3	45878	0
1979Q3	5.48334	865.32	6933	47.844	13331	3.2	47548	0
1979Q4	5.61389	879.51	7371	48.8258	14204	3.1	50610	0
1980Q1	5.70715	894.91	7573	49.8289	13687	3.2	52200	0
1980Q2	5.89365	924.58	8134	50.7762	16782	3.5	54275	0
1980Q3	6.15477	938.83	8670	51.6455	18630	3.6	59183	0
1980Q4	6.45318	977.55	9147	51.7615	19525	3.7	63619	0
1981Q1	6.62104	1002.38	8920	52.4044	18561	3.9	67933	0
1981Q2	6.77024	993.75	10233	53.5489	21993	4.2	72404	0
1981Q3	7.12461	943.71	10762	54.3282	23173	4.3	75263	0
1981Q4	7.38572	881.61	11149	54.6672	24517	4.5	79492	0
1982Q1	7.57223	887.12	12445	54.1607	23477	4.6	80758	0
1982Q2	7.88929	839.72	12873	53.7088	23088	5	82387	0
1982Q3	8.1131	819.16	13116	53.6951	21574	5.2	85865	0
1982Q4	8.41151	847.79	13946	52.5599	20489	5.4	92076	0
1983Q1	8.63532	868.26	13878	51.7487	18906	5.6	96127	0
1983Q2	8.87778	882.26	14651	51.9636	18430	5.8	101362	0
1983Q3	9.10159	900.65	14874	52.5626	18745	5.8	107014	0
1983Q4	9.30675	857.34	15337	53.8958	23183	5.9	112513	0
1984Q1	9.51191	824.95	17004	54.8103	25139	6.2	117840	0
1984Q2	9.88493	803.01	18853	55.9489	24688	6.3	123227	0
1984Q3	10.1647	690.26	20112	55.0216	26865	6.6	131091	0
1984Q4	10.5004	619.18	20607	55.1067	27952	6.9	141807	0
1985Q1	10.948	585.11	20982	54.7784	27945	7	145727	0
1985Q2	11.4889	575.92	21418	54.3801	27026	7.3	149688	0
1985Q3	11.8246	476.4	24200	54.2365	28591	7.4	154579	0
1985Q4	12.3282	374.81	23400	54.8165	31626	7.6	160355	0
1986Q1	13.0556	434.4	25562	54.1634	31056	7.9	161717	0
1986Q2	13.4845	400.53	28315	54.5373	31737	8.4	163363	0
1986Q3	14.0814	345.32	27741	54.6601	37422	8.6	164536	0
1986Q4	14.6595	380.51	26534	54.8896	29865	8.9	169112	0
1987Q1	15.2191	385.7	31633	55.2888	33000	9.2	169041	0
1987Q2	15.7972	386.45	33076	55.4859	34570	9.6	176371	0
1987Q3	16.3195	384.34	32267	55.6884	36307	10	182470	0
1987Q4	16.879	374.05	35028	56.3721	38267	10.4	201719	0
1988Q1	17.2893	356.03	36531	57.2193	43711	10.6	217526	0
1988Q2	17.8115	331.94	36797	57.6256	47299	11.1	231267	0
1988Q3	18.3524	322.79	39063	58.4006	48354	11.2	247453	0
1988Q4	18.9679	313.35	41529	58.949	50208	11.5	270734	0
1989Q1	19.6393	314.65	45098	59.3141	52390	12.2	289758	0

1989Q2	20.4599	303.59	44869	59.5714	59178	12.6	301143	0
1989Q3	21.1687	297.38	46087	59.6193	53003	13.1	319852	0
1989Q4	21.8214	302.48	48214	59.2503	50729	13.6	348415	0
1990Q1	22.6048	301.76	51640	59.2978	53614	14	364817	0
1990Q2	23.3135	291.21	53039	59.2488	54473	15.1	369063	0
1990Q3	24.0595	284.37	56232	59.199	57089	15.3	369623	0
1990Q4	25.0107	279.59	61057	59.254	52328	15.7	389957	0
1991Q1	25.8687	278.84	59786	58.7827	56896	16.3	419468	0
1991Q2	26.8385	278.43	64341	58.65	57543	16.9	437974	0
1991Q3	27.8083	274.09	64264	58.6273	60642	17.6	449816	0
1991Q4	29.0393	268.96	67041	58.5264	56999	18.3	464920	0
1992Q1	29.9718	266.34	70525	58.1163	61380	19.6	473826	0
1992Q2	30.8671	264.52	71814	57.7598	61328	20.7	493003	0
1992Q3	31.7437	257.08	72118	57.0911	68075	21.3	507466	0
1992Q4	32.1726	257.12	76647	56.606	66829	21.7	516953	0
1993Q1	32.7881	255.29	81174	57.1075	70687	21.9	505459	0
1993Q2	34.1496	244.31	84721	57.7338	71383	22.1	504618	0
1993Q3	34.7278	236.57	88035	58.5649	78487	22.6	512230	0
1993Q4	35.2127	238.32	90878	58.9988	83119	23	532327	0
1994Q1	35.9587	238.95	94548	58.9147	86372	23.4	561335	0
1994Q2	36.5929	222.5	97379	59.5539	88848	25	588492	0
1994Q3	37.8984	214.95	99910	60.2237	102070	25.3	609981	0
1994Q4	38.6631	216.88	101151	61.2289	105698	25.6	638629	0
1995Q1	39.5397	212.19	101021	61.4501	115907	26	638762	0
1995Q2	40.4909	200.16	101413	61.7229	119658	25.8	680254	0
1995Q3	40.8266	206.59	102128	61.9894	123769	26.4	681389	0
1995Q4	41.1996	208.05	104078	62.234	125038	27.2	711692	0
1996Q1	42.1135	205.74	111318	63.1073	128657	27.4	765626	0
1996Q2	42.9528	182.63	120296	64.2893	139362	27.6	811539	0
1996Q3	43.9413	174.78	124404	65.0189	152776	28.4	842246	0
1996Q4	44.9671	169.55	129974	65.6355	152565	29.4	872042	0
1997Q1	46.1607	183.15	132973	65.8241	151521	29.5	912338	0
1997Q2	46.9814	187.44	133856	66.2267	153279	29.6	942493	0
1997Q3	47.7274	184.86	136642	66.3651	166605	30.3	980116	0
1997Q4	48.0631	178.44	139109	66.4653	171467	30.4	1041791	0
1998Q1	48.6972	179.21	140386	66.5493	168851	31.7	1076193	0
1998Q2	49.3873	171.46	143508	66.6434	169038	32.5	1108743	0
1998Q3	51.4203	141.92	145577	66.4973	199062	32.6	1147568	0
1998Q4	52.4274	146.28	146701	66.5616	190937	33.8	1160987	0
1999Q1	52.8191	141.4	149363	67.1737	174668	33.4	1160259	0
1999Q2	52.9869	143.32	152833	67.7083	176036	33.7	1200020	0

1999Q3	53.1361	142.98	156864	68.4477	187535	33.4	1248453	0
1999Q4	53.4532	141.25	161356	69.2004	201909	33.2	1313881	0
2000Q1	54.2925	141.05	166276	69.9788	216859	33.3	1321272	1
2000Q2	55.598	133.79	170214	70.6227	219041	34.5	1319581	1
2000Q3	56.6425	133.86	177487	71.3221	231233	33.8	1325471	1
2000Q4	57.202	126.66	182023	71.9289	251895	34.4	1386486	1
2001Q1	58.3211	120.98	185318	72.396	253694	34.6	1448679	1
2001Q2	59.1604	122.08	191006	72.7579	263409	35.2	1475230	1
2001Q3	59.3469	115.91	196401	72.9512	258128	35.2	1519592	1
2001Q4	59.6639	96.01	202847	73.5121	288773	36.7	1577242	1
2002Q1	61.6409	85.72	214940	74.466	333736	36.3	1719657	1
2002Q2	63.7298	90.62	225181	75.3677	337505	36.9	1754985	1
2002Q3	65.5203	86.58	236273	75.986	336998	52	1764353	1
2002Q4	67.2734	93.33	239242	76.4936	354309	51.4	1861645	1
2003Q1	68.2246	103.59	245835	77.2014	321442	51.5	1936886	1
2003Q2	68.6909	108.33	245184	77.5784	321251	52	2036196	1
2003Q3	68.5977	113.69	254567	77.9994	326350	52.8	2085697	1
2003Q4	67.777	120	265066	78.4494	331097	53.3	2165626	1
2004Q1	68.5231	115.15	271584	79.637	337180	54.5	2240173	1
2004Q2	69.1572	121.04	280304	80.7499	384038	55.4	2247938	1
2004Q3	69.4742	124.22	283798	82.0702	384309	55.6	2305913	1
2004Q4	69.9219	125.92	295854	82.9466	407181	60.1	2431619	1
2005Q1	70.4814	125.33	300102	83.7899	396481	57.9	2497927	1
2005Q2	71.358	119.84	309356	85.2936	432635	58.8	2612517	1
2005Q3	72.1786	120.27	323555	86.4566	462162	59.2	2742525	1
2005Q4	72.477	121.94	344175	87.0356	459606	61	2832683	1
2006Q1	73.1298	128.23	321102	88.3586	478654	61	2997887	1
2006Q2	74.2302	119.76	317581	89.8123	538906	70.7	3121339	1
2006Q3	75.9461	107.03	340180	91.0922	586215	71.7	3246366	1
2006Q4	76.4869	103.68	356801	92.5095	677329	73.8	3428646	1
2007Q1	77.4754	103.89	353554	93.9786	649210	71.8	3509047	1
2007Q2	79.4151	104.06	363226	94.7048	682565	74.1	3705917	1
2007Q3	81.2429	102.46	385502	95.8773	699411	75.1	3982479	1
2007Q4	82.9401	104.22	400866	97.2823	711946	77.1	4124324	1
2008Q1	86.1891	91.81	412823	97.9783	801581	79.5	4202938	1
2008Q2	88.5706	86.76	429412	99.0736	902988	82.3	4415435	1
2008Q3	91.3191	88.99	456153	99.5166	951668	84.1	4473940	1
2008Q4	92.0353	75.99	469684	99.0916	872999	86.6	4651877	1
2009Q1	93.426	76.98	475944	97.4911	760149	88.3	4726810	1
2009Q2	95.4298	88.2	474547	96.7973	645722	89.3	4717712	1
2009Q3	97.1691	92.46	505196	97.2272	648663	91.3	4638353	1

2009Q4	97.6228	94.07	536861	98.0621	704550	96.7	4676112	1
2010Q1	98.7192	96.42	544411	98.4302	727607	97.4	4713938	1
2010Q2	99.759	99.27	543934	99.0737	751318	99.4	4713328	1
2010Q3	100.534	100.76	555799	99.9851	772875	99.4	4769102	1
2010Q4	100.988	103.4	579505	100.838	757133	103.8	4936676	1
2011Q1	102.5	101.31	575865	101.626	820902	102.6	4979163	1
2011Q2	104.353	101.65	598863	102.116	860820	104.7	4969996	1
2011Q3	106.016	97.27	610749	102.825	908832	107.5	5085316	1
2011Q4	107.113	87.96	616789	103.476	995710	109.5	5296838	1
2012Q1	108.776	92.42	637267	104.093	974952	110.2	5352221	1
2012Q2	110.364	89.58	652234	104.896	1009422	111.1	5327721	1
2012Q3	111.423	88.64	666021	105.401	1017665	114.7	5455197	1
2012Q4	113.162	83.01	681391	106.054	1055621	115.4	5554966	1
2013Q1	114.493	80.9	701939	106.583	1108112	117	5631604	1
2013Q2	115.728	77.12	727748	107.981	1178581	130.8	5757187	1
2013Q3	118.38	73.39	744449	108.106	1231661	131.5	5949986	1
2013Q4	119.287	71.22	755758	109.686	1192710	132.5	6118546	1
2014Q1	121.783	66.73	772126	109.005	1276552	136.2	6223578	1
2014Q2	124.127	68.81	785865	109.323	1244932	135.7	6376249	1
2014Q3	125.753	68.13	791217	110.086	1257633	138.3	6499250	1
2014Q4	126.055	67.9	800614	111.374	1239039	140.4	6704068	1
2015Q1	126.811	68.06	797415	111.754	1261468	141.1	6715861	1
2015Q2	129.836	66.66	826285	110.919	1241524	146.9	6895063	1
2015Q3	131.689	62.97	837295	110.98	1279421	149.5	7128679	1
2015Q4	132.218	58.77	855286	111.363	1311559	152.9	7304886	1

*Original data prior to transforming into logarithms