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Appropriateness of inflation targeting in South Africa

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

ABSTRACT

The appropriateness of inflation targeting in South Africa is examined. South Africa has adopted flexible inflation targeting, wherein considerations for other macroeconomic variables are prioritized. There is evidence of growing concern regarding South Africa's monetary policy framework., emerging primarily from the trade union movement and the communist party. The concerns are borne out of the developmental challenges that are still facing South Africa, ranging from high unemployment, high levels of poverty and inequality, and low economic growth.

In attempt to understand these concerns, the following key economic variables GDP, Manufacturing Data, Exchange Rate, and Repo Rate were investigated using both Eviews and Stat tool. To eliminate the impact of the recent global recession, the data that has been analyzed is up to 2008. The research compares two periods, namely; the pre inflation targeting period (1990 – 1999) and post inflation targeting period (2000 – 2008).

The study has found that despite unemployment, inequality and economic growth having being sluggish over the years, these factors are not as a result of inflation targeting. Evidence indicates that inflation has been reduced and stabilized since the adoption of inflation targeting. This research argues that this methodology is important for South Africa's economic development, as evident by increased output. This research concludes that the implementation of inflation targeting is appropriate for South Africa.

KEYWORDS: Inflation, Inflation Targeting, Price Stability, Phillips Curve, Transmission Mechanism, Exchange Rate.

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DECLARATION

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

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Jeoffrey G Mashele Date

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CHAPTER 1 INTRODUCTION TO RESEARCH PROBLEM

1.1 Introduction

Inflation targeting is one of the key monetary frameworks that many central banks, South Africa included, have adopted in conducting monetary policy. In the early 1990s, long term price stability has been regarded as the central goal for monetary policy, hence inflation targeting. According to Comert and Epstein (2011), the South African Reserve Bank has implemented inflation targeting (IT) implicitly and explicitly for more than fifteen years. However the formal inflation targeting was only adopted in 2000 as will be explained in the sections below.

1.2 Historical perspective of monetary policy practises in South Africa

The South African Reserve Bank (SARB) established in 1921, has conducted monetary policy from its inception under different regimes. The SARB's approach to monetary policy from inception was to apply credit and interest rate policies aimed at bringing about the necessary conditions for an eventual return to the gold standard. The restoration of the gold standard was one of the primary objectives of the South African Reserve Bank (SARB, 2011). The gold standard was abolished in 1932. The SARB adopted a new monetary policy, namely to link the value of the domestic currency to that of the pound sterling, which implied that the Union of South Africa had to join the Sterling Area.

In March 1933, parliament passed the Currency and Exchanges Act, No 9 of 1933, which linked the value of the domestic currency to that of UK pound sterling. According to Rossouw (2006:8) quoting De Kock (1954:212), "South Africa's domestic economic conditions and international economic relations at the time showed that "the abandonment of the gold standard and the depreciation of the South African pound to the level of sterling were decidedly beneficial to the Union." During the Second World War, the domestic monetary policy was supplemented by extensive system of direct control measures to curb inflationary pressures during the war.

After the Second World War, South Africa became part of the international exchange rate system under the Bretton Woods agreement, which meant that the external value of the currency and exchange rate stability remained the primary focus of monetary policy (SARB, 2011). After the Bretton Woods system disintegrated in 1971, South Africa adopted a policy to peg the rand to sterling. However, when the sterling was devalued, South Africa moved to link the currency to the US dollar. In 1979, following the De Kock Commission's recommendation, SARB decided to introduce a system of managed floating which aimed amongst other things, to pursue more consistent and effective contra-cyclical or growth policies because of adjustments to the exchange value of the rand (Van der Merwe, 1999).

Appropriateness of inflation targeting in South Africa: Chapter one

In 1984, the socio-political events in South Africa hampered the country's participation in exchange rate markets. In 1986, SARB announced the adoption of specific growth targets for a money supply aggregate as the country's monetary framework which continued until in the early 1990s. However the integration of South Africa with the rest of world and the introduction of number of reforms undertaken led to the money supply to become a less reliable indicator of underlying inflation.

According to Smal and Jager (2001), SARB moved away from the formally targeting the money supply and began using a broader range of economic indicators for the determination for its policy actions called eclectic approach. These indicators included:

- Changes in bank credit extension
- The overall liquidity in the banking system
- The level of the yield curve
- Changes in the official foreign reserves and in the exchange rate of the rand; and
- Actual and expected movements in the inflation rate of inflation.

In 2000, the South African authorities decided to move away from the informal targeting and adopted the formal targeting of inflation (Rossouw and Padayachee, 2011). The assertion about an informal inflation targeting is also supported by Casteleijn (1999) who said that the South African Reserve Bank tentatively assumed a goal of maintaining inflation at a level that would be more or less in line with the average rate of

inflation in the economies of South Africa's major trading partners and international competitors. At the time the international inflation environment translated into an inflation rate of between 1 and 5 per cent per annum.

The evolution of monetary policy in South Africa since 1921 clearly illustrates that the monetary policy framework is somehow shaped by the circumstances of the time. Since the inception of the South African Reserve Bank, its goal has been modified accordingly. In 2005, SARB changed its primary goal from the achievement and maintenance of financial stability to achievement and maintenance of price stability in the interest of balanced and sustainable economic growth (SARB, 2010).

Van der Merwe (2004:1) stated that "economists generally agree that monetary policy should be primarily concerned with the pursuit of price stability. However, they still differ on how this objective can be achieved most effectively." A further complication was raised by Issing (2004:169) who asked the following questions: "What is the ultimate objective of monetary policy, and what is the appropriate framework for conducting monetary policy?" Similar questions are being asked in South Africa.

As indicated above, South Africa adopted inflation targeting in 2000 as its means for conducting monetary policy framework. The government sets the inflation target based on the consumer price index for all metropolitan areas, excluding interest rates on

mortgage bonds. The target range of 3 – 6% has remained in place for a very long time now; there has been an adjustment from achieving an average rate of 3 – 6 % per annum to achieving a continuous rate of 3 – 6 % per annum; the SARB uses the repo rate as its main instrument to control inflation.

Inflation targeting has a number of benefits. According to Svensson (1999) inflation targeting improves the output-inflation trade-off.

In South Africa, inflation targeting was adopted for the following reasons (Van der Merwe, 1999: 16)

- Intermediate objectives fall away with inflation targeting and policy becomes more transparent. Policy changes depend on expected developments in inflation.
- Inflation targeting improves the co-ordination between monetary policy and other economic policies provided that the target is consistent with other objectives. This better co-ordination in an inflation-targeting framework, compared with other monetary policy frameworks, can be achieved by the structured decision-making process of this framework.
- Inflation targeting serves to discipline monetary policy and increase the central bank's accountability. Clear targets are set which the central bank has to meet. If the actual inflation rate deviates from these targets, the central bank has to explain what went wrong. This disciplines the central bank and leads to a better understanding on the part of the public why monetary policy decisions are made.

- The application of inflation targeting affects inflationary expectations, which should facilitate a reduction in inflation. If inflation targets are perceived to be credible, they form the basis for future price and wage setting. Inflation targets, in theory, should therefore influence the increase in the operational cost of enterprises as well as their price setting.

Despite the benefits that have been alluded above with regards to inflation targeting, questions still remain about its appropriateness in the South African context. According to Epstein (2008), the policy of inflation targeting in South Africa has achieved some gains, but has done little to reduce unemployment and generate more economic equality. Furthermore, Epstein and Yeldah (2008) quoting Heintz (2006) said that employment creation had dropped off the direct agenda of central banks just as the problem of global unemployment, underemployment and poverty are taking centre stage. Price stability on its own will not suffice to maintain true macroeconomic stability, because it will not secure financial stability and employment growth.

Comert and Epstein (2011) in their paper for the celebration of the 90 years of the South Africa Reserve Bank raised a concern that if the central bank focuses primarily or solely on keeping commodity inflation at a low, stable rate, whether it will short change or make worse other important policy goals, such as unemployment, financial stability or stable asset prices? Mishkin (2007) stated that despite a sizeable number of countries that have adopted inflation targeting as its nominal anchor, this trend has triggered an

intensifying debate over whether inflation targeting makes a difference. Opinions diverge widely over whether central banks are better off after they adopted inflation (forecast) targeting as an explicit and exclusive anchor for conducting monetary policy.

For almost a decade now since South Africa adopted formal inflation targeting as its monetary framework, and in the aftermath of the recent global recession, it is opportune to assess the design and implementation of inflation targeting, the conduct of monetary policy, and country's performance.

1.3 Rationale for the study

South Africa is currently battling to deal with developmental challenges that ranges from high levels of unemployment, low economic growth and high levels of inequality. Almost a decade since the adoption of inflation targeting, South Africa's unemployment rate remain high at 28,2 % as at the end of the second quarter 2011 (StatsSA, 2011). Between 2000 and 2010, the South African economic growth has averaged around 3,2% per annum.

The Congress of South African Unions (COSATU) and its allies, reacting after the Finance Minister's budget speech in 2010, expressed concerns that South African Reserve Bank's mandate should be changed so that its Monetary Policy Committee (MPC) has to take cognisance of broader national priorities, particularly economic

growth and job creation, rather than focusing on the narrow concern of inflation targeting (COSATU, 2011).

The primacy of their argument is that inflation targeting ignores the real side of the economy which is growth and employment. Arguments around the relationship between inflation and unemployment have been in existence for quite a long time. In the 1950s and 1960s, this was investigated and led into the development of Phillips curve, which explores the relationship between inflation and unemployment (Phillips, 1957).

Monetary policy is part of the broader economic policies. Svensson (2002) argued that the ultimate objective of economic policy is to guarantee and enhance the citizen's welfare. This ultimate objective is further disaggregated into separate goals; which are price stability, high economic growth, equitable distribution of wealth and income and full and stable employment. It therefore came as no surprise that monetary policy is expected to contribute towards reducing unemployment and increasing economic growth.

The recent global financial crisis has exerted pressure on a number of central banks, especially with regards to the relevance of inflation targeting. According to Comert and Epstein (2011), in response to these impacts and to insure against further detrimental effects, argued that monetary policy worldwide has changed significantly since 2008. The Governor of SARB, Gill Marcus, in the Bank's *Annual Report 2010/11* stated that

the bank has been given a mandate to take a leading role in maintaining financial stability (SARB, 2011). This brings into question whether this assertion mean that inflation targeting as a monetary framework is not appropriate to deal with the real side of the economy.

Issing (2004) argues that inflation is costly and a low inflation environment is a necessary precondition for long term growth and efficient allocation of resources. According to Bernanke and Mishkin (1997), inflation targeting as the primary goal of monetary policy is clearly considered for medium to long term horizons, with an understanding that monetary policy in the short term will affect the real economy such as output and employment. However, it is considered that no central bank should use monetary policy for short-run stabilisation (Svensson, 2003).

1.3 Research Problem

This research seeks to assess the appropriateness of inflation targeting with respect to South Africa. The research will focus on the following problem statement:

- To determine the impact of monetary policy to both output and inflation via transmission mechanism;
- To examine the relationship between inflation variability and output variability since the introduction of inflation targeting; and

- To determine if inflation targeting serve as an anchor to inflation expectations.

CHAPTER 2 THEORY AND LITERATURE REVIEW

2.1 Introduction

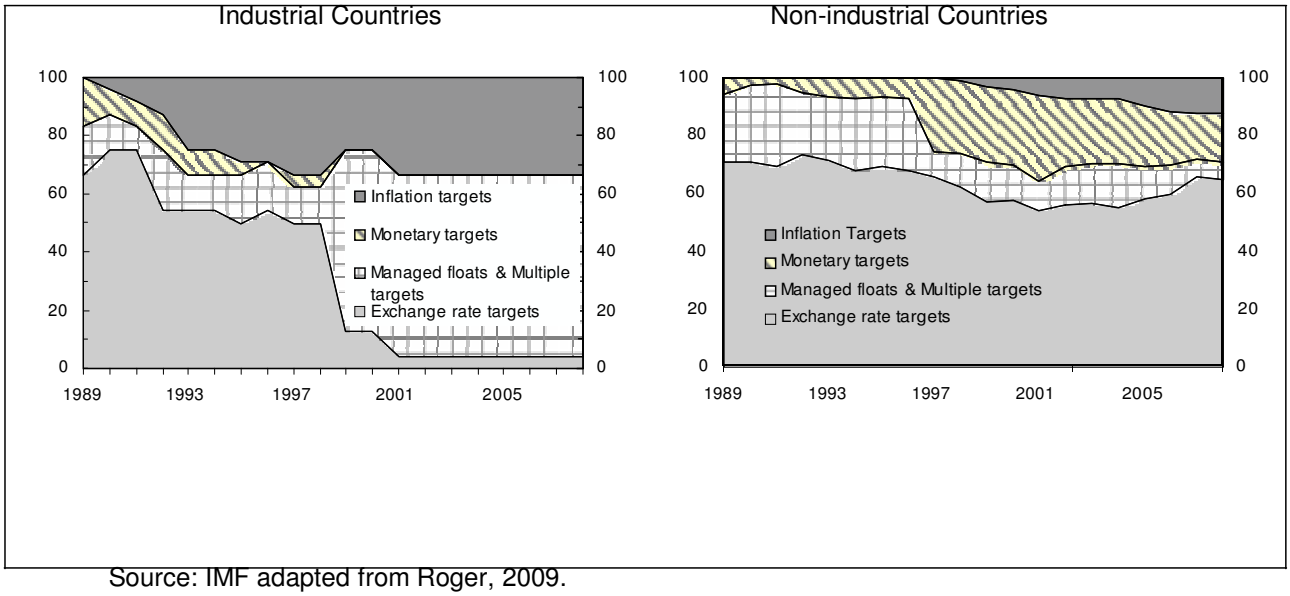
Since New Zealand adopted inflation targeting in 1990, a number of countries have explicitly adopted an inflation target as their monetary framework. According to Roger (2009), 29 countries have adopted 'inflation targeting' as their monetary policy framework, this includes 14 high income countries and 15 lower income emerging market and developing countries. The term 'inflation targeting' was understood to mean a monetary policy strategy that made the achievement of a designated low rate of inflation the sole objectives of monetary policy (McCallum, 2007).

2.2 Debate on inflation targeting

The emergence of inflation targeting since the 1990s has been seen as an exciting development in the approach of central banks towards monetary policy. Countries adopted this framework in response to the difficulties they had encountered in conducting their monetary policy using either an exchange rate peg or monetary aggregate as the main intermediate target. According to Freedman and Laxton (2009a), unfavourable experiences with other nominal anchors (such as exchange rate and monetary targeting) as well as the desire to lower the rate of inflation and to anchor inflation expectations through a simple observable target were the most common reasons underlying the countries' switch to inflation targeting.

According to Roger (2009) exchange rate pegs of various kinds accounted for about two thirds of monetary policy in industrial countries in 1989 (see figure 2.1 below). In Europe, the ERM crisis in 1992 served as a spur to the adoption of inflation targeting. In the emerging market economies, the shift toward inflation targeting has been a more gradual process, and within Latin America, the 1998 financial crisis spurred adoption of inflation targeting. At least until the global financial crisis erupted, inflation targeting was expected to continue to spread among both emerging markets and developing economies.

Figure 2-1: Evolution of Monetary Policy Regimes, 1989-2008



Source: IMF adapted from Roger, 2009.

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The debate about the appropriateness of inflation targeting especially within the emerging markets has existed since the inception of this policy framework. Mishkin (2000) argued that although inflation targeting is not a panacea and may not be appropriate for many emerging-market countries it can be highly useful monetary policy framework in a number of them. However, Roger and Stone (2005) in support of inflation targeting concluded that inflation targeting is associated with an improvement in overall economic performance.

Aron and Muellbauer (2007) claimed that the implementation of inflation targeting in South Africa for instance, has helped reduce inflation and promoted healthy macroeconomic performance. The then governor of the SA Reserve Bank, Mr T T Mboweni in his address at the biennial Congress of the Economic Society of South Africa, Pretoria (1999) advocated a move away from the "eclectic" or informal inflation-targeting monetary policy framework to formal inflation targeting. His argument was based on the fact that the eclectic framework had created uncertainties about the Reserve Bank's decisions and actions which were perceived as being in conflict with the stated guidelines for the growth in money supply and bank credit extension. He argued that adopting inflation targeting will minimize the social and economic cost of achieving price stability.

However, Mishkin (2007) quoting Bernanke *et al* (1999) stated that the fall in inflation levels and volatility, interest rates, and output volatility is part of a worldwide trend in the 1990s, and inflation targeters have not done better in terms of these variables or in

terms of exchange rate pass-through than non-targeting countries such as Germany or the United States. Ball and Sheridan (2005) argued that inflation targeting does not make any difference, since the reflection of apparent success is nothing but simply a reflection of mean reversion; that is, inflation will fall fastest to those countries that start with high inflation rate.

Stiglitz (1999) argued strongly against inflation targeting as monetary policy framework. He stated that the world's central bankers are a close-knit club, given to fads and fashions. In the early 1980s, they fell under the spell of monetarism, a simplistic economic theory promoted by Milton Friedman. However, after monetarism was discredited (at great cost to those countries that succumbed to it), the quest began for a new mantra; and that answer came in the form of "inflation targeting," which says that whenever price growth exceeds a target level, interest rates should be raised (Stiglitz,1999). Kahn (2009) quoting Stiglitz (2008) suggested that in trying to contain inflation, the "cure would be worse than the disease" (Kahn, 2009)

Epstein (2007) argued that after several decades of experience with this inflation-focused market-based approach, the policy record has been rather disappointing for many countries. In a number of countries, inflation has come down, but it is questionable to what extent the drop in inflation is due to changes in domestic monetary policy. He further argued that employment creation and economic growth are not an automatic by-product of stabilization focused central bank policy.

Comert and Epstein (2011) quoting Stiglitz (2008) said "many people treat inflation as if it were something that is costly in its own right, inflation only matters as it affects the two variables we do care about, output and its distribution." Accordingly this talks about output, income distribution and unemployment trends.

2.3 Does inflation targeting matter?

Inflation targeting begins with the premise that the main goal of monetary policy in any country must be to attain and preserve a low and stable rate of inflation (Restrepo *et al*, 2009). What is inflation? Rossouw (2007:10), quoting Murali (2004) stated that the word inflation owes its origin to the Latin word *inflare*, which literally means "to blow into", from *flare* "to blow". Inflation describes a process of continuously rising prices commonly measured as the percentage rate of increase in a price index (SARB, 2010: 15).

The need to have a low and stable inflation is based on understanding that inflation is bad. Low inflation is described to mean that continuous increase in the general price level, that is, in the prices of all goods and services are at such a low level that it no longer influences the decision-making of consumers and producers. The SARB identifies the following as negatives of inflation on social and economic effects (SARB, 2010):

- Firstly, inflation has important implications for the redistribution of income and wealth. To the extent that inflation is unexpected, savers and people on fixed income will tend to suffer most, while borrowers will benefit. However the implication on the redistribution on income can be hedged away but this is only available for the wealthy.
- Secondly, inflation distorts the tax system, as most tax systems do not allow for inflation. When income rises with inflation, it pushes income earners into a higher tax bracket thereby resulting into a disproportional increase in tax payments.
- Thirdly, inflation results in an increased uncertainty which results in more difficult economic decision-making. High inflation is usually accompanied by greater price variability. The confusing price signals make the price system less efficient, and the result is lower levels of investment and growth.

However, in contrast, Epstein (2007) quoting Polin and Zhu (2006) stated that taking into account the non-linear relationship between inflation and economic growth, there is a positive relationship between inflation and economic growth, especially when the cause of inflation is due to demand expansion. Furthermore, it was found that for developing countries, an inflation rate of just below 15% is not harmful for economic growth. As such there is an argument about the rationale to try bringing inflation to a single digit.

What is inflation targeting? Since there is a vast amount of literature on inflation targeting, the first challenge is to decide on a proper definition. Van der Merwe (2004)

quoting Mishkin (2001:1), defined inflation targeting as a monetary policy framework that encompasses five elements:

- the public announcement of medium-term numerical targets for inflation;
- an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated;
- an information inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments;
- increased transparency of the monetary policy strategy through communication with the public and markets about the plans, objectives, and decisions of the monetary authorities; and
- Increased accountability of the central bank for attaining its inflation objective.

From Mishkin's definition, it is clear that inflation targeting is more than the public announcement. Inflation targeting enhances policy transparency, accountability and predictability (Aron and Muellbauer, 2007). According to Issing (2004), the broadest definition of inflation targeting is simply a monetary policy framework that accords overriding importance to the maintenance of price stability, typically defined as a low and stable rate of consumer price inflation.

However, due to some weaknesses identified with the broad definition, Issing (2004) narrowed down the definition of inflation targeting to be a monetary policy framework

based on the adoption of a monetary policy rule, in which forecasts of future inflation play a central role in this, either in the form of the so-called instrument rules or target rules. An instrument rule expresses the monetary policy instrument, usually a short-term nominal interest rate as a simple and linear function of deviation of key macroeconomic variables, generally inflation and the output gap. In the target rule, the appropriate setting for the monetary policy instruments is defined implicitly as the solution to an optimisation problem facing the central bank (Issing, 2004).

2.4 Preconditions for inflation targeting

Inflation targeting should be supported by the right institutions. In establishing institutional arrangements to support inflation targeting, distinctions is drawn between goal, target, and instrument autonomy. Goal autonomy refers to the independent authority of the central bank to define the ultimate objectives of monetary policy; in particular, whether price stability should be the primary goal. Even if the central bank lacks this authority, it may have target autonomy, allowing it to specify the level and details of an inflation target that would be consistent with the broadly set goal of price stability. Finally, the central bank must have operational autonomy, giving it independent authority to use or set its monetary policy instruments to achieve its inflation target (Heenan *et al*; 2006).

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The following are some of the examples on the autonomy of the central bank from different countries (adapted from Heenan *et al*)

Table 2-1: Central Bank Autonomy

Country	Goal Autonomy	Target Autonomy		Instrument Autonomy	
	Legislated	Target	Government	Credit to	Gov't Participation in Policymaking 4/
Australia	Multiple goals	G+CB	Yes	Yes	Voting member
Brazil	Inflation target	G	No	No	No
Canada	Multiple goals	G+CB	Yes	Yes, limited	Non-voting
Chile	Price + financial stability	CB	Yes	Yes	Non-voting[5]
Colombia	Price stability	CB	Yes	No	Voting member
Czech	Price stability	G+CB	No	No	Non-voting
Hungary	Price stability	G+CB	No	No	Non-voting
Iceland	Price stability	G+CB	No	No	No
Indonesia	Currency stability	G+CB	No	No	No
Israel	Price stability	G	No	No	No
Korea	Price stability	G+CB	No	Yes	Non-voting
Mexico	Price stability	CB	No	Yes	Non-voting
New Zealand	Price stability	G+CB	Yes	Yes	No
Norway	Low, stable inflation	G	Yes	No	No
Peru	Monetary stability	CB	No	No	Voting member
Philippines	Price stability	G+CB	No	Yes, limited	Voting member
Poland	Price stability	CB	No	No	Non-voting
Romania	Price stability	G+CB	No	No	No
Slovakia	Price stability	CB	No	No	No
South Africa	Currency stability	G+CB	Yes	Yes	No
Sweden	Price stability	CB	No	No	Non-voting
Thailand	Monetary stability	CB	No	Yes	No
Turkey	Price Stability	G+CB	No	No	Non-voting
United	Price stability	G	Yes	No	Non-voting

Notes and Sources:

1/ G = Government; CB = Central Bank.

2/ Roger and Stone (2005), Table 3.

3/ Tuladhar (2005), Table 6.

4/ Tuladhar (2005), Table 3.

5/ Finance Minister may delay implementation of decisions for two weeks.

Table 2.1 above is not exhaustive as it has not taken into considerations recent developments. For instance, Poland is now part of EURO zone and Serbia and Ghana have since adopted inflation targeting as well.

Masson *et al* (1997) identified the following as prerequisites for a country that intends to adopt inflation targeting as their monetary policy:

- The central bank should be permitted to conduct monetary policy with a degree of independence. The monetary authorities should be able to freely use any instruments of monetary policy towards the attainment of nominal objective. There should be no fiscal dominance, that is monetary policy should not be dictated by fiscal policy.
- The absence of any firm commitment by the authorities to target the level or path of any other variables such as wages or nominal exchange rate.

Accordingly Masson *et al* (2007) believes that a country that satisfies these two requirements is geared towards adopting the inflation targeting. Mboweni (1999) echoed the same sentiments, he stated that despite government and authorities working jointly to set the target, the central bank should be free to use any instruments towards the attainment of the stated objective. Furthermore, for the instrument used by the monetary

authority to have an impact, require an effective money, capital and foreign exchange markets. Therefore there is a need for well-developed financial markets to exist within a country. The financial markets have to react quickly to the monetary instrument for the monetary policy to be effective in impacting inflation. He further highlighted the importance of close co-operation between monetary policy and other policies.

The co-operation of monetary policy and other policies in particular fiscal policy is supported by Peter *et al* (2006) who argued that if fiscal policy is on an unsustainable path, or based on assumptions or objectives inconsistent with the inflation objectives, then the credibility or feasibility of inflation targeting may be compromised. This suggests that the credibility of the adoption of inflation targeting depends less on whether the central bank or government specifies the goal but on whether there is a clear and public commitment by both to take the actions necessary to achieve the goal of price stability.

Lacker (2007) has argued that monetary policy should be forward looking. Therefore for the monetary instrument to have an impact, it is also important for the country to develop inflation forecasting capacity, and have the necessary software and informational technology.

2.5 Inflation target design

The underscoring of inflation targeting is the design of the target and the index that should be targeted. Mboweni (1999) stated that despite no consensus on how inflation should be measured, the index should include a range of products whose price changes represent a change in the cost of living and are accepted by the public. Accordingly all countries that adopted inflation targeting, use the headline consumer price index (CPI).

Heenan *et al* (2006) stated the following as a requirement for a well designed inflation target:

- Anchor inflationary expectations - it should be relevant to a broad range of economic agents, signal a medium-term commitment by the central bank to low inflation, and be easy to understand by the general public.
- Provide a benchmark for central bank accountability - it should not be easily manipulated by the central bank, should be based on an index that is available on a timely and frequent basis, and should not be subject to significant revision.
- Be consistent with the central bank's objectives - its design should reflect the central bank's goal to maintain price stability while avoiding excessive short-run output volatility.

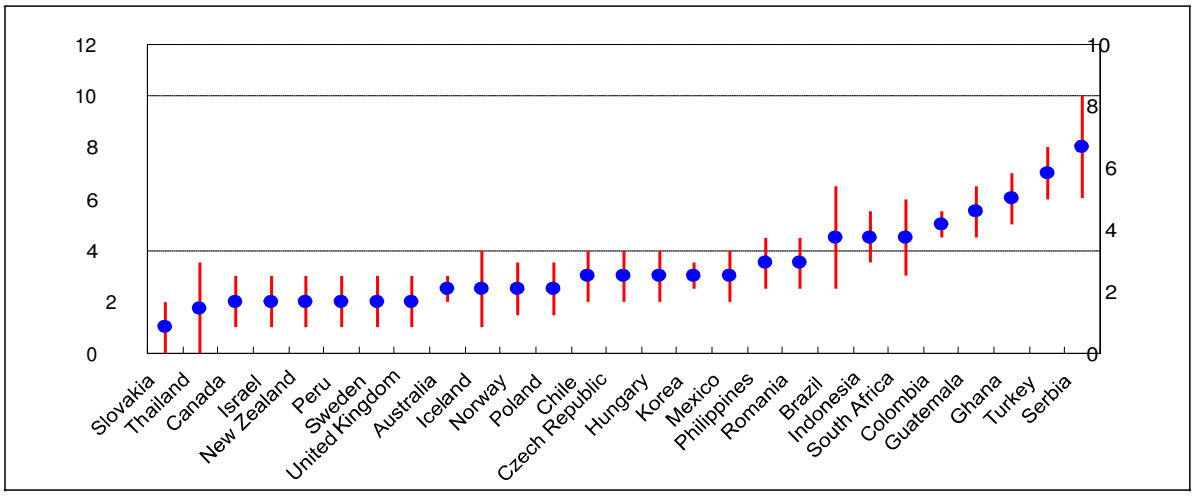
There has been a debate with regards to the target rate for inflation. Mboweni (1999) stated that it is a matter of choice between a point range or a target band. This choice reflects a trade-off, a narrower band may be interpreted as indicating a stronger commitment to the inflation target, but frequent breaches could undermine credibility. A fixed point target is much more difficult to hit than a band. A single point provides the

best focus for inflation expectations and avoids the disadvantage of a band which tends to concentrate expectations towards its upper boundary. A band, however, leaves some discretion to the central bank and can provide more flexibility in the case of unforeseen price shocks.

Heenan *et al* (2006) argued that the target rate of inflation should be such that it is not harmful to economic growth. The threshold level of inflation which inflation is not harmful for growth prospects vary between one and eight percent. However as stated above, this is in contrast to Epstein's views that an inflation of just below 15 percent is not harmful for economic growth for developing countries.

However as evidenced in the diagram below (adapted from Rogers), countries that have adopted inflation targeting are using different target rate of inflation, ranging from point target, midpoint or a band.

Figure 2-2: Inflation Target Levels and Bands in 2008

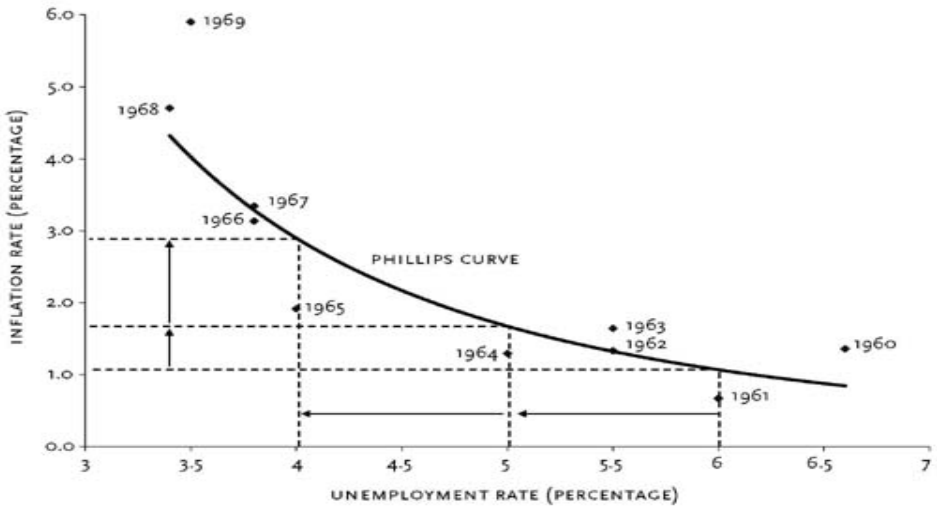


Source: Rogers, 2003

2.6 Employment, economic growth and inflation

The question around the appropriateness of inflation targeting pertains to its relationship to employment, economic growth and inflation. Van der Merwe (2004) noted that commentators of monetary policy argue that inflation targeting leads to an overemphasis on monetary stability at the cost of growth and development, and reduces flexibility in dealing with exogenous shocks to the economy. However other views described the above as a fundamental macroeconomic problem, the relationship between inflation and unemployment has been around as long as macroeconomics has been in existence. The relationship between the two variables is summarized in what is called the Phillip's Curve. It was named after an economist called A.W Phillips who in 1957, documented an inverse relationship between inflation and unemployment after collating one hundred years of data for the United Kingdom (Lacker, 2007).

Figure 2-3: Phillips curve



Source: Hoover, 2002

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The Phillips curve has played a significant role in the evolution of monetary policy as it has been interpreted to capture the relationship between inflation and unemployment or even GDP growth; however the relationship has varied over time. According to Lacker (2007), the Phillips curve linking unemployment to price inflation was first sat down in 1960 by Paul Samuelson and Robert Solow for U.S data. Figure 2.3 shows a typical Phillips curve fitted to data for the United States from 1961 to 1969. The Phillips curve was interpreted as describing a set of choices available to society, for example when the data available indicates that price stability tended to coexist on average with 5% unemployment, therefore society will have to live with higher inflation to enjoy the unemployment lower than 5%.

However, further studies emerged that factored the role of expectation in the relationship between inflation and unemployment (Friedman, 1968). Phelps and Edmund (1969) as quoted by Lacker (2007) developed the expectation-augmented Phillips curve which stated that a change in inflation and by implication monetary policy does not have a persistent long term effect on real economic activity. Over the medium to long run, unemployment and economic growth tended to return to rates that were determined by productivity growth, population dynamics, and other characteristics of the markets for goods and labour (Lacker, 2007).

Hoover (2002) put it that Friedman's and Phelps's analyses provide a distinction between the "short-run" and "long-run" Phillips curves. So long as the average rate of

inflation remains fairly constant, as it did in the 1960s, inflation and unemployment will be inversely related. But if the average rate of inflation changes, as it will when policymakers persistently try to push unemployment below the natural rate, after a period of adjustment, unemployment will return to the natural rate. Therefore from figure 2.3, the long run curve is a vertical line above the natural rate of employment. To this end monetary policy are regarded as having a transitory effect on unemployment.

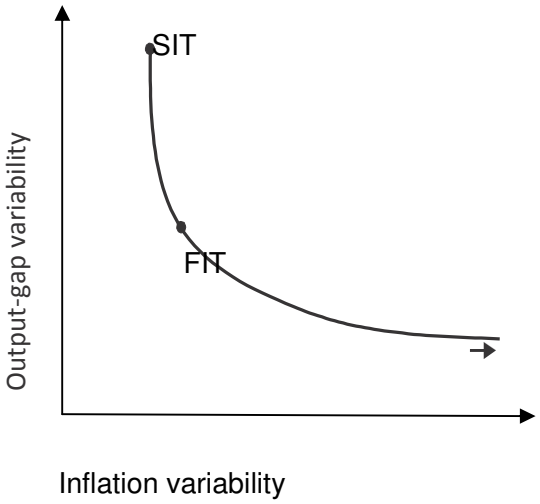
According to Colander (2010), a distinction is made between the short run and long run Phillips curve with varying results in answering the question, with the view that there is no long run trade-off between unemployment and inflation; however there is a short term trade-off. The role of expectation in the relationship between inflation and unemployment is explained in detail in the next section below.

According to Van der Merwe (2004:11), " the fact that there is not a long-run trade-off between inflation on the one hand and economic growth and employment on the other hand, makes the benefits of an accommodating monetary policy stance largely transitory while the costs of the policy measures are permanent." Mishkin and Bernanke (1997) argued that in understanding the relationship between inflation and the other economic variables, it is important to distinguish between strict inflation targeting and flexible targeting. Issing (2004:176) differentiated between the two as follows; "Strict inflation targeting is defined as the inflation framework that is characterised by the adoption of loss function that focuses on the deviations of forecast inflation from a target

level; whereas flexible inflation targeting on the other hand is an inflation framework that is characterised by the adoption of the loss function that focuses on both deviations of inflation and output from their targets."

Svensson (2003) illustrated this distinction between strict inflation and flexible inflation targeting through a simple graph below:

Figure 2-4: The Trade-off between inflation variability and output-gap variability



Source: Svensson, 2003

Svensson (2003: 269) stated that "the intersection of the axes corresponds to zero variability of inflation and the output gap, that is, inflation always equal to the inflation target and the out- put gap always equal to zero. However because of the complex

transmission mechanism of monetary policy, unpredictable shocks, imprecise control and inevitable uncertainty, zero variability is a completely infeasible outcome. Instead, the curve shows the most efficient and feasible combinations of inflation and output-gap variability that monetary policy can achieve."

The SIT in the graph represents the strict inflation targeting, where all efforts are made towards stabilizing inflation without considering the consequences of output variability. The point FIT in the graph is the flexible inflation targeting wherein the central banks put in some weight on the output variability.

2.7 Inflation expectation and its role

Inflation expectations play a key role in determining the relationship between inflation and the real economic activity. Expectations about future policy play a key role in the manner in which people make decisions today. Lacker (2007) stated that when people are certain about the policymakers' objectives or strategy they adjust their inflation expectations accordingly. Inflations targeting is regarded as an indication or a signal of the direction of monetary policy which is primarily forward-looking. Gurkaynak *et al* (2007) has placed expectation as a key driver towards low and stable inflation. Expectation plays a key role in the inflationary process, when expectations of inflation

are high; people tend to raise their wages and prices, therefore causing inflation, the opposite are also true.

Mboweni (1999) stated that transparency introduces predictability, and helps to ensure that expectations are consistent with the objective of price stability, thus lowering the cost of achieving the inflation target. According to Colander (2010), the way individuals form their expectations can be classified under the three broad classifications, that is, rational expectations, adaptive expectation and extrapolative expectation. Under rational expectations, people's expectation is based on their assessment of how the economy is likely to behave, including their knowledge of the process driving policymakers' choices. Adaptive expectations meant that households and firms based their expectations of future inflation on the observations of recent past inflation. Extrapolative expectation, individuals form their expectation based on the trend.

According to Gürkaynak *et al* (2007), inflation targeting is geared towards ensuring proper communication with the public to the extent that future inflation is anchored by inflation targeting. This view was supported by Orphanides and Williams (2007) who stated that a well-anchored expectation enables inflation targeting central banks to achieve greater stability of output and employment in the short run, while ensuring price stability in the long run. Aron and Muellbauer (2007) stated that anchoring agents' inflationary expectations around a credible target facilitates a more moderate approach to shocks by the central bank, as agents will discount short-term volatility; this tends to

lower uncertainty to the economy. They went further to suggest that if economic agents believe that the central bank will achieve its inflation target, the inflation expectation is anchored around inflation target, price and wage setting will be far less responsive to the temporary fluctuation in inflation, creating stability.

Heenan, Peter and Roger (2006) alluded to the three elements that are critical to successful implementation of inflation targeting as a monetary framework. First and foremost is the announcement of an explicit quantitative inflation target and the acknowledgment that low, stable inflation is the primary objective and responsibility of the central bank. Secondly is the clear communication of the central bank's policy strategy and the rationale for its decisions, which enhances the predictability of the central bank's actions and its accountability to the public. Furthermore this should be reinforced by the importance of consistency and credibility of the central banks. Thirdly is a forward-looking policy orientation, characterised by the vigilant monitoring of inflation expectations at both short-term and longer-term horizons. Together, these elements provide a focal point for inflation, facilitate the formation of the public's inflation expectations, and provide guidance on actions that may be needed to foster price stability.

Estrella (2005: 722) stated that, "the slope of the yield curve is empirically a significant predictor of inflation and real economic activity. Specifically, the spread between long-term and short-term government bond rates appears frequently in the literature as a

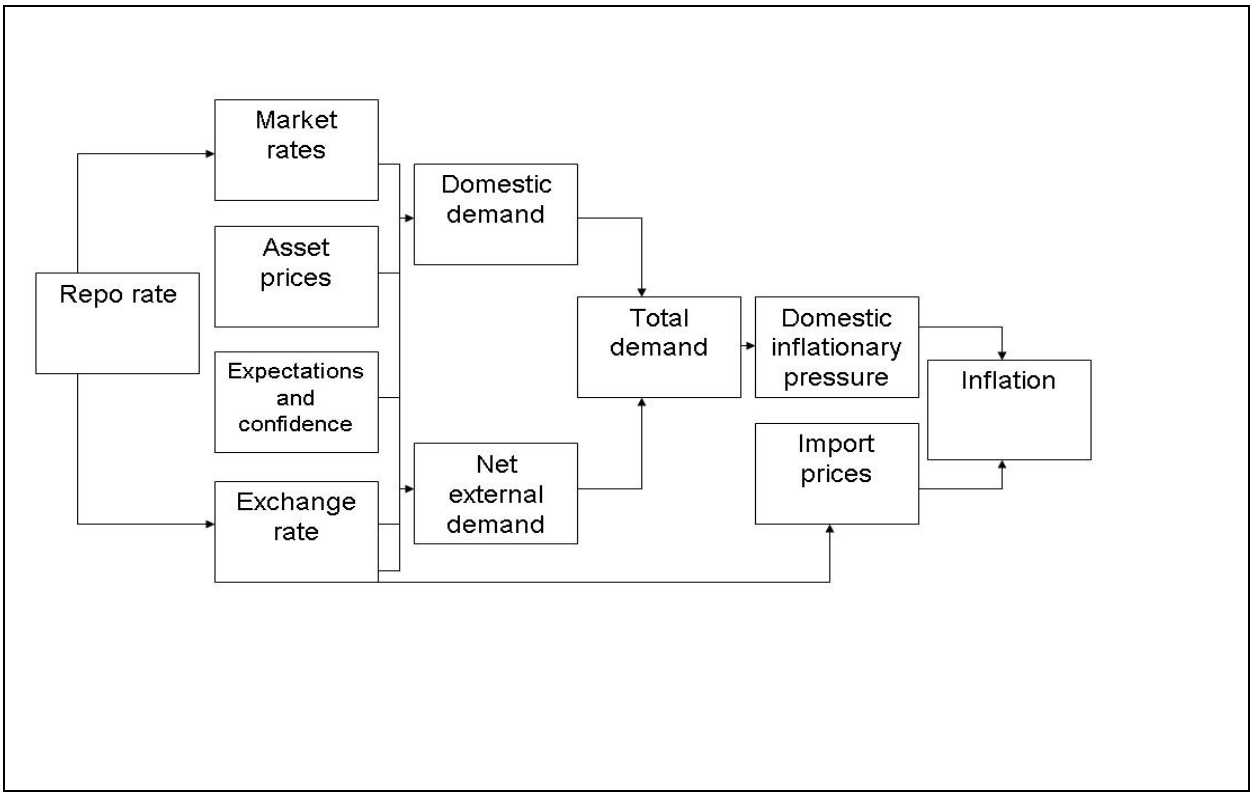
significant regressor in equations that predict inflation, particularly with long horizons and in equations that predict various measures of future economic activity, such as real GDP growth, industrial production growth and recession indices".

2.8 Transmission mechanism

According to Bordon and Weber (2011), the monetary transmission mechanism describes the effect of monetary policy on real economic activity and the rate of inflation. Inflation targeting is prone to suffer from external dominance, namely high sensitivity of inflation shocks to the exchange rate that will make it difficult for the central bank to achieve its inflation target. Therefore, the choice between strict and flexible inflation targeting is crucial, especially when the monetary policy transmission mechanism is a major factor. However it is important to note that the effectiveness of monetary policy transmission is highly dependent on the financial system's level of development. With a well functioning financial system, changes in the policy rate have a substantial influence on aggregate demand and thus on the price level (Bhattacharya, Patnaik and Shah, 2011). Norris and Floerkemeir (2006) as quoted by Bhattacharya, Patnaik and Shah (2011) have found that the operations of monetary transmission channels varies systematically across countries due to differences in the extent of financial intermediation, the size, concentration, and health of the banking system; the development of capital markets; and structural economic conditions. The figure below

provides a schematic illustration of the main transmission channels of monetary policy decisions.

Figure 2-5: Stylised representation for transmission mechanism



Source: SARB

Monetary policy works largely via its influence on aggregate demand in the economy to influence the real economy. The main instrument is the repurchase rate (repo) which has a direct effect on other variables in the economy such as other interest rates, the exchange rate, money and credit, other assets prices and decisions on spending and

investment. In the long run monetary policy determines the movements in the general price level in terms of how much the purchasing power of money has changed over time. There are several links in the chain of causation running from monetary policy changes to their ultimate effects on the economy.

An official interest rate affects the market interest rates (mortgage rate, and bank deposit rates) at varying degrees, Furthermore, the market value of securities such as bonds and equities get affected as well, the price of bonds are inversely related to the long term interest rate; the official rate also makes a policy statement which signal a particular expectation in the market. According to Bhattacharya, Patnaik and Shah (2011), the interest rate channel of monetary policy requires transmission of shocks to short term policy to the long term yield curve. A change in the official interest rate also affects the exchange rate, other things being equal a rise in the official rate will lead to an immediate appreciation of the domestic currency in foreign exchange markets, and vice versa. The exchange rate appreciation follows from the fact that higher domestic interest rate relative to interest rates on equivalent foreign currency assets; make the domestic currency attractive to international investors (Bank of England, 2004).

The above changes also affect the spending, saving and investment behaviour of individuals and firms in the economy. For example when official interest rates rise, everything being equal this should lead to higher savings, and less spending, also this will lead to a domestic exchange rate appreciating which makes foreign goods less

expensive relative goods produced at home. Therefore everything being equal, a change in the official rate will affect the demand for goods and services produced in here at home (Bank of England, 2004).

All the changes in individual and firms' behaviour added up across the whole economy, equals aggregate spending. The total domestic expenditure in the economy is equal by definition, to the sum of private consumption expenditure, government consumption expenditure and investment spending.

Equation 1: Aggregate expenditure (closed economy)

$$AE = C_0 + I_0 + G_0 \quad \text{..... (1)}$$

(Close economy) where C_0 is for both private and individual consumption; and I_0 is for autonomous investment and G_0 is for autonomous government spending.

However, an open economy will also have an added component of $(X_0 - M_0)$ where X_0 stands for export and M_0 stands for import to make the equation to be affected by the exchange rate. Smal and de Jager (2001) stated that when real interest rates fall, deposits denominated in rand become less attractive than deposits denominated in foreign currencies, and the rand depreciates. The depreciation of the rand will cause

foreign goods to be more expensive than domestic goods, therefore causing a rise in net export which results into an increase in output.

Equation 2: Aggregate expenditure (open economy)

$$AE = C_0 + I_0 + G_0 + (X_0 - M_0) \quad \text{..... (2)}$$

According to the BIS (2007) when prices of imported goods are quoted in foreign currency and are sold to consumers for local currency, the exchange rate plays a crucial role in the consumer prices. However this works where there is a complete exchange rate pass-through.

Transmission mechanism brings the importance of exchange rate in the fore. The exchange rate plays an important role in the transmission mechanism for monetary policy, as one of the two main channels through which central bank actions affect aggregate demand and subsequently inflation. Freedman and Inci Ötker-Robe (2010) suggested that when the central bank considers actions needed for monetary policy they should take into account developments of exchange rate, since they influence inflation both directly through their effect on traded goods process and indirectly through their effect on aggregate demand.

However according to the BIS (2007) the impact of the exchange rate in the pass through is high only if the exchange rate is used as an anchor of inflationary expectations. Any changes in the exchange rate are quickly incorporated into expectations, and thus influence the prices of both tradable and non tradable goods and services. However, in an inflation targeting regime with a floating exchange rate, the inflation expectations is anchored by the central bank's inflation target, therefore the exchange rate developments have limited influence on both output and CPI.

CHAPTER 3 RESEARCHQUESTIONS/PROPOSITIONS/HYPOTHESES

3.1 Introduction

Inflation targeting as a monetary policy framework was adopted just over a decade ago in South Africa, however debate about its usefulness or appropriateness is still very much alive. This research will attempt to provide some of the answers as they pertains to the research questions below which have been unpacked to address the question of appropriateness.

3.2 Hypotheses

The main hypothesis is that inflation targeting in South Africa is an appropriate monetary tool. The alternative is that the inflation targeting as the monetary framework is not appropriate for South Africa. Appropriateness is a broad term, however in this study the focus will be on addressing the real economic activity of employment and output. To determine the above hypothesis, the following issues will be investigated:

1. The impact of monetary policy to the economy through transmission mechanism
2. The analysis of the relationship between output variability and inflation variability.
3. Low and stable inflation is related to inflation targeting as an anchor of inflation

CHAPTER 4 RESEARCH METHODOLOGY AND DESIGN

4.1 Introduction

The objective of the study is to determine the appropriateness of inflation targeting, by investigating the relationship of certain key economic variables since the adoption of inflation targeting in South Africa. These variables will also be examined before inflation targeting was adopted. In line with Blumberg *et al* (2008), in order to decide whether this study qualifies to be either a qualitative or quantitative research, the following questions were considered:

- What is the research problem?
- What are we attempting to conduct, an explorative, descriptive, causal or predictive study
- What is the objective?
- What the information do we still need to obtain and what is already available?

After a careful assessment of the above questions, the study will be quantitative where it attempts to explore causal relationships among different economic variables to be able to answer the question: is inflation targeting appropriate for South Africa?

4.2 Scope and Unit of Analysis

The scope of this study is the appropriateness of inflation targeting with respect to South Africa. South Africa adopted inflation targeting framework in 2000, which is just over a decade ago. The unit of analysis is the key macroeconomic variables that are affected by monetary policy framework.

4.3 Research Design

A research design attempts to provide a blueprint for the realisation of the research objectives (Blumberg *et al*, 2008). As explained above the study is based on establishing causal relationships, therefore the research design has taken this into consideration. The following are the sub hypothesis to be investigated:

- **Null Hypothesis 1: The policy rate within an inflation targeting has a zero effect on output.**

The hypothesis seeks to analyse the impact of monetary policy within an inflation targeting regime to output. In order to assess the null hypothesis, the study uses a vector auto regression (VAR). The variables to be considered are Consumer Price index (CPI), the nominal exchange rate, repo rate and manufacturing index as a proxy

for output. South Africa is regarded as an emerging market which is an open economy; therefore domestic variables are endogenous to the system are affected by exogenous world variables but not the other way around.

The structure of the model is

$$\Delta y_t = \mu + \alpha\beta y_{t-p} + A_1 \Delta y_{y-1} + \cdots\cdots\cdots\cdots + A_{p-1}\Delta y_{t-p+1} + \delta X_t + u_t$$

Where y_t denotes a vector of endogenous variables that includes the exchange rate, the interest rate, output and the price index. The vector of exogenous variables X_t includes the US interest rate and the US producer price index. However for this study the exogenous variables were set to zero since the study intends to look investigate the impact of monetary policy to both output and prices.

Despite inflation targeting being adopted in 2000, the impact of policy decisions has a time horizon of two to three years, therefore the post inflation period to be tested will be from 2002. The model will be run on two sample periods: the first one covering the period 1990–1999 (Pre inflation targeting) and the second, 2002–2008 (Post Inflation targeting). The idea is to compare the behaviour of both output and inflation responses in these two time periods.

- **Null hypothesis 2: Implementation of inflation targeting disregards the output variability at the expense of inflation variability.**

The hypothesis seek to ascertain if the central bank has selected the best instruments over the years to contain both inflation and output in such a manner that it minimises the loss function. The central bank is able to achieve the optimal compromise between inflation stabilisation and output-gap stabilisation, while maintaining long run price stability by adopting flexible inflation targeting (Svensson, 1999). Inflation targeting should not be concerned with only attaining low inflation at the expense of other objectives of monetary policy, that is, promote economic growth. Svensson (1999) stated that inflation targeting is a targeting rule, with a relatively explicit loss function to be minimised. The loss function is concerned with the stability of the real economy, for instance output variability is also included. Therefore in determining the relationship between inflation targeting and output, a loss function equation as developed by Svensson (2003) will be used. The quadratic loss function is of the form:

Equation 3: Loss Function

$$L_t = (\pi_t - \pi^*)^2 + \beta(\gamma_t - \gamma_t^*)^2 \quad \text{.....(3)}$$

Where π_t and γ_t denote inflation and output in period *t*, respectively, π^* is the inflation target (or the midpoint of the target range), $\gamma_t *$ is the potential output, $\gamma_t - \gamma_t^*$ is the output gap and $\beta \geq 0$ is the relative weight on stabilizing the output gap. Inflation and output are the target variable, the variable that enters the loss function, whereas $\gamma_t *$

and π^* are the target levels. The effect of monetary policy always has a lag effect on both inflation and output; hence the central bank has to be forward looking and considers its actions on the future inflation and output gap.

According to Svensson (2003), the loss function should be explicitly determined by the central bank where a central bank has adopted flexible inflation targeting. This relates to determining the parameter $\beta > 0$; however in South Africa the loss function is not determined explicitly. However the time that it takes to achieve the inflation rate is used as an indication for whether the central bank is concerned with inflation target or it is concerned with both inflation variability and output variability. A relatively short policy horizon implies a commitment to achieving the target inflation rate fairly quickly following a shock, but with greater variability of output and financial variables. A relatively long horizon results in less volatility in output and financial market variables, but in inflation away from its target for a longer period of time following a shock. In both cases, however, the actions taken by the central bank must aim at bringing the rate of inflation back to its target over the specified time period (Kahn, 2009).

- **Null Hypothesis 3: In the inflation targeting regime, a far ahead forward inflation compensation is relatively insensitive to incoming economic news.**

Gurkaynak *et al* (2007) stated that the reason many central banks adopted the formal inflation target framework was based on the belief that an explicit and clearly communicated numerical objective for the level of inflation over a special period would help anchor long term inflation expectations. Rossouw (2007) stated that despite the fact that central banks have no control over inflation expectations; however it can influence it over time by means of consistent monetary policy.

Two approaches will be explored in the study. The first approach will be to examine the new survey of inflation expectations from the Bureau of Economic Research (BER). Accordingly the survey asks households, trade unions, businesses and financial analysts what their expectations are of average CPIX and of average CPI inflation in the forthcoming calendar year and for the year thereafter. Participants are asked for their expectations for the current and following calendar years, and thus the expectations horizon shortens for each consecutive quarterly survey in the year.

Notwithstanding the existence and the importance of other economic agents (for example. consumers in consumption decision, trade unions in wage negotiations or producers in pricing decisions) who are concerned about inflation, the second approach

uses the information from the bond market to assess if indeed inflation targeting anchors long term inflation expectations. A comparison between behaviour of long term nominal and indexed bond yields will be used.

Gurkaynak *et al* (2007) defines forward inflation as the difference between forward rates on nominal and inflation–indexed bonds. This provides the high-frequency measure of the compensation that investors require to cover the expected level of inflation and the risks associated with inflation. The daily frequency of bond yield, together with the frequent release of important macroeconomics statistics and monetary policy announcements will be used. A regression equation on the following variable will be used: capacity utilization, CPI, core CPI, unemployment figures, real GDP, retail sales, wholesale trade and monetary policy (repo rate).

Another way of gauging inflation expectations is by looking at the spread between index-linked bonds and other domestic bonds of a similar maturity structure. However, interpretation of these trends in terms of credibility can be problematic. The yield differential is a function of the expected inflation rate over the horizon, but also of inflation risk. With the maturity period constantly decreasing, such risk obviously will fall, reducing the spread. Further, a high demand for a small issue of bonds will affect the perceived liquidity of the bond and drive down the yield.

In order to aid with the interpretation of the econometric results, two standard reference macroeconomic models are utilized.

$$\pi_t = \mu_\pi E_t \pi_{t+1} + (1 - \mu_\pi) A_\pi(L)\pi_t + \gamma y_t + \varepsilon_t^\pi$$

And

$$y_t = \mu_y E_t y_{t+1} + (1 - \mu_y) A_y(L) y_t - \beta(i_t - E_t \pi_{t+1}) + \varepsilon_t^y$$

Where π denotes the inflation rate, y the output gap, and i the short term nominal interest rate, and ε^π and ε^y are independent and identically distributed (i.i.d) shocks.

4.4 Population and sampling

The study is based on key economic variables drawn from the I-Net bridge and South African Reserve Bank (SARB). These variables will be examined since the adoption of inflation targeting by South Africa from 2000 until 2008. Due to the recent global recession, information from 2009 to date is excluded. A judgemental sampling will be used in this study in line with Blumberg *et al* (2008). In conducting a comparison between the period before inflation and after inflation targeting, the economic variables to be analysed before inflation targeting will be done from 1990 until 1999. The reason

for using the judgemental sampling is to ensure that the data between the two periods is very comparable.

4.5 Data collection and analysis

The research approach for this project is quantitative; therefore all the data that will be used are secondary in nature, different databases will be used to source the data. The data will be sourced from the I-Net Bridge, South African Reserve Bank database and Statistics South Africa. The data that will be required for this project are daily frequency of the bond rate, CPI, core CPI, unemployment figures, actual and potential output figures, interest rate, retail sales, capacity utilization, wholesale figures, exchange rate and GDP figures.

4.6 Limitation of the research

Inflation targeting is suppose to work within an open and transparent environment, however unlike in other jurisdictions, in South Africa, the central bank (SARB) does not release the minutes of its meetings that led to a particular policy direction. Therefore this research is limited to the information that is in the public domain as far as the implications of inflation targeting are concerned.

CHAPTER 5 RESULTS

5.1 Introduction

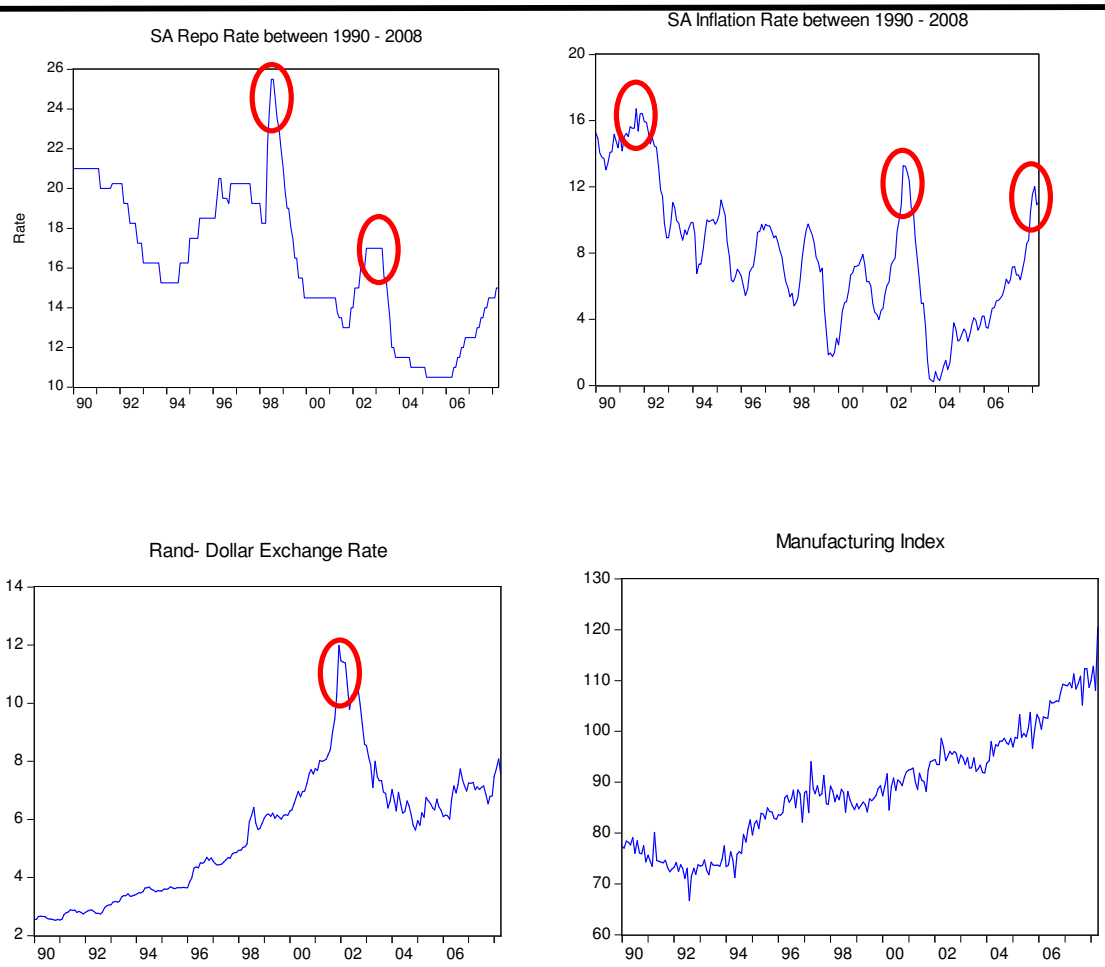
This chapter presents the concise results based on the data analyzed. The data that has been used in this study is clustered around the following hypotheses:

- **Hypothesis 1: The policy rate within an inflation targeting has a zero effect on output.**
- **Hypothesis 2: To determine the relationship between the variability of inflation and output variability**
- **Hypothesis 3: In an inflation targeting regime, a far ahead forward inflation compensation is relatively insensitive to incoming economic news**

Starting with hypothesis 1, the following data series were investigated:

The data series chosen is the Consumer Price index (CPI), the nominal exchange rate measured by the rand per dollar rate. The analysis of monetary policy transmission requires a careful choice of the interest rate. The interest rate should be able to capture the true nature of the monetary policy stance. Therefore the repo rate is used to capture the policy interest rate. The manufacturing index is used as a proxy for output. All the domestic variables have been seasonally adjusted with an exception of the exchange rate and interest rate.

Figure 5-1: Exchange rate, prices, output and interest rate



Source: Author's own calculation

The figure 5.1 shows key variables for testing hypothesis 1. A seasonally adjustment for certain variables has been applied using the X12 ARIMA program of the U.S Census Bureau (for more details see the attached appendix 1). The output series as represented by the manufacturing index shows an upward trend from 2003 until the Great Recession of 2008, where it begun to slide downward. The inflation rate has

been trending downwards though highly variable since 1990; however it went up in the early 2000 before returning to low levels early 2004. During the 2008 world economic recession, inflation rose much quicker to higher levels. Therefore in order to take into account structural breaks in the data, the Great recession of 2008 is excluded from the data that is being analysed. The data to be analysed is from month 1 in 2000 till 2008 month 12. The red circles in the figure above represent the spikes that occurred over the years.

5.2 Diagnostic analysis

The time series data should first be analysed to take into considerations certain characteristics that might impact the running of the model.

5.2.1 Stationarity and Unit Root Test

The stationarity of a series strongly influences its behaviour and its properties. For example a persistence of shocks will be infinite for non-stationary series. If the variables in the model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will not be valid. Applying the Dickey Fuller test statistics to test the null hypothesis of unit root for each of the series, the following results were obtained:

Appropriateness of inflation targeting South Africa: Chapter five

a). Time Series: CPI (seasonally adjusted)

Null Hypothesis: LOG_CPI has a unit root

Exogenous: Constant

Lag Length: 12 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.903734	0.3295
Test critical values:	1% level	-3.497029	
	5% level	-2.890623	
	10% level	-2.582353	

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

The null hypothesis of a unit root for the CPI seasonally adjusted is not rejected.

b) Time Series: Production index seasonally adjusted (Proxy for output)

Null Hypothesis: LOG_GDP has a unit root

Exogenous: Constant

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.935339	0.7732
Test critical values:	1% level	-3.497029	
	5% level	-2.890623	
	10% level	-2.582353	

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

The null hypothesis for the presence of a unit root for the production index is not rejected.

c) Time Series: Rand/ Dollar exchange rate (ZARUSD)

Null Hypothesis: LOG_EX has a unit root

Exogenous: Constant

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

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.638427	0.4593
Test critical values:	1% level	-3.497029	
	5% level	-2.890623	
	10% level	-2.582353	

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

The null hypothesis for a unit root for rand- dollar exchange rate is not rejected.

d) Time series: South African repo rate

Null Hypothesis: LOG_REPO has a unit root

Exogenous: Constant

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

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-0.991816	0.7539

Test critical values:	1% level	-3.497029
	5% level	-2.890623
	10% level	-2.582353

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

The null hypothesis for the presence of unit root is not rejected.

Therefore all the time series contains a unit root based on the ADF test conducted. In a situation where there is a presence of a unit root, the next step would be to conduct a first-differencing of all variables to deal with non-stationarity issues. However, for auto regression model there has been a contestation about this assertion. Enders (2004) quoting Sims and Stocks (1990) argued against differencing stated that the data for vector auto regression (VAR) should not be detrended as this throws away information concerning the co-movements in the data and that if enough of the variables are cointegrated, an analysis in levels is still correct because the ordinary least squares (OLS) estimator of the reduced-from VAR efficiently estimates the cointegrating relationship.

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5.3 Estimation of vector auto regression (VAR)

The VAR testing was used due to the fact that the monetary transmission mechanism is a short-run phenomenon and it also allows impulse responses evaluation over the short to medium term.

Table 5-1: Auto regression estimates

Included observations: 100

Standard errors in ( ) & t-statistics in [ ]

	LOG_CPI	LOG_EX	LOG_GDP	LOG_REPO
LOG_CPI(-1)	0.927181	0.003428	0.004098	0.010321
	(0.05120)	(0.00889)	(0.00473)	(0.00651)
	[18.1106]	[0.38568]	[0.86578]	[1.58509]
LOG_EX(-1)	0.251717	0.946006	0.012632	0.073771
	(0.21074)	(0.03659)	(0.01948)	(0.02680)
	[1.19442]	[25.8576]	[0.64840]	[2.75240]
LOG_GDP(-1)	0.507512	-0.044407	0.918916	0.107583
	(0.55871)	(0.09699)	(0.05165)	(0.07106)
	[0.90837]	[-0.45784]	[17.7915]	[1.51405]
LOG_REPO(-1)	-0.095331	-0.006169	-0.031462	0.942105
	(0.21342)	(0.03705)	(0.01973)	(0.02714)
	[-0.44669]	[-0.16651]	[-1.59472]	[34.7099]

C	-2.490919	0.322343	0.414546	-0.524717
	(2.87733)	(0.49951)	(0.26599)	(0.36594)
	[-0.86570]	[0.64532]	[1.55849]	[-1.43389]

Source: Author's calculation

5.4 Determination of the appropriateness of the estimate VAR

Different tests were conducted to assess the appropriateness of the VAR estimates. The lag of the VAR estimation was selected using the Akaike (AIC) and Schwartz (SC) information criteria. The VAR estimation was also tested for the presence of serial correlation through the Autocorrelation LM test and it was found not to be present (Appendix 2). In order to determine the stability of the VAR (stationarity), an AR Roots table was conducted which showed that all roots have a modulus less than one and lie inside the unit circle (appendix 3).

5.5 Summary of statistics

Table 5-2: Summary of results for the VAR estimates

Summary of results for the VAR estimates

	LOG_CPI	LOG_EX	LOG_GDP	LOG_REPO
R-squared	0.898394	0.923641	0.899738	0.975076
Adj. R-squared	0.889462	0.916928	0.890924	0.972885
Sum sq. resids	7.228226	0.223605	0.052373	0.121048
S.E. equation	0.281835	0.049570	0.023990	0.036472
F-statistic	100.5770	137.5929	102.0780	445.0203
Log likelihood	-10.53503	163.2583	235.8327	193.9432
Akaike AIC	0.390701	-3.085166	-4.536653	-3.698863
Schwarz SC	0.625166	-2.850700	-4.302188	-3.464398
Mean dependent	1.491075	2.000326	4.584754	2.267285
S.D. dependent	0.847693	0.171986	0.072639	0.221491

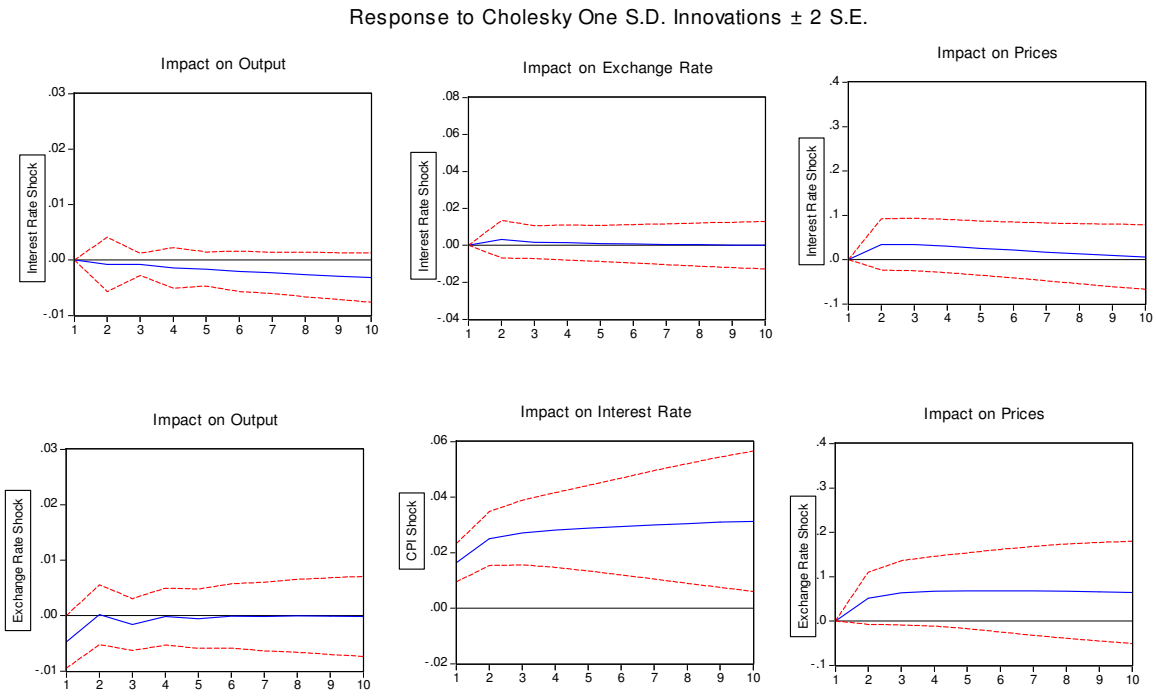
Determinant resid covariance (dof adj.)	1.10E-10
Determinant resid covariance	7.52E-11
Log likelihood	597.9974
Akaike information criterion	-11.23995
Schwarz criterion	-10.30209

Source: Author's own calculation

5.6 Impulse responses

The figure below presents impulse response functions indicating the impact of policy related variables on both output and prices.

Figure 5-2: Impulse response



Source: Author's own calculation

5.7 Variance decomposition

The Variance decomposition provides more information about the relative importance of each random innovation in affecting the variables in the VAR. The table below show the variance decomposition for a period of up to six months.

Table 5-3: Variance decomposition

Variance Decomposition of CPI:

Period	S.E.	CPI	EX	GDP	REPO
1	0.281835	100.0000	0.000000	0.000000	0.000000
2	0.428948	97.64949	1.411767	0.305943	0.632805
3	0.527374	96.13126	2.371690	0.666008	0.831044
4	0.597424	94.95895	3.101501	1.032483	0.907065
5	0.649876	93.94808	3.707452	1.419460	0.925011
6	0.690592	93.01622	4.250044	1.818366	0.915375

Variance Decomposition of EX:

Period	S.E.	CPI	EX	GDP	REPO
1	0.049570	3.971264	96.02874	0.000000	0.000000
2	0.070023	3.358939	94.97680	1.442162	0.222101
3	0.084591	3.504809	95.28060	1.023302	0.191291
4	0.095668	4.026149	94.94586	0.855206	0.172786
5	0.104970	4.695782	94.43615	0.715239	0.152824

6	0.112769	5.440995	93.78450	0.637143	0.137361

Variance Decomposition of GDP:

Period	S.E.	CPI	EX	GDP	REPO
1	0.023990	0.223029	3.856674	95.92030	0.000000
2	0.026472	0.303023	3.172113	96.43353	0.091334
3	0.031693	0.281241	2.469662	97.12122	0.127875
4	0.034449	0.285508	2.092751	97.34386	0.277878
5	0.037562	0.270535	1.782541	97.52244	0.424482
6	0.039933	0.256867	1.577506	97.52739	0.638240

Variance Decomposition of REPO:

Period	S.E.	CPI	EX	GDP	REPO
1	0.036472	20.24585	0.124946	0.000164	79.62904
2	0.052030	33.17579	0.120451	0.110459	66.59330
3	0.065583	38.07927	1.006898	0.731819	60.18201
4	0.077306	40.65869	2.370302	1.508956	55.46205
5	0.088016	42.08484	4.021843	2.445346	51.44797
6	0.098069	42.90751	5.862069	3.422116	47.80831

Source: Author's own calculation

5.8 Granger causality tests

The table below presents the results of the multivariate and bivariate block Granger causality tests which tests whether an endogenous variable can be treated as exogenous variable.

Table 5-4: Multivariate and bi-variate block granger causality test

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 2000M01 2008M04

Included observations: 100

Dependent variable: CPI

Excluded	Chi-sq	Df	Prob.
EX	4.742223	4	0.3148
GDP	0.891651	4	0.9258
REPO	17.50714	4	0.0015
All	24.74816	12	0.0161

Dependent variable: GDP

Excluded	Chi-sq	Df	Prob.

CPI	3.392987	4	0.4943
EX	7.899229	4	0.0953
REPO	0.904446	4	0.9239
All	14.84756	12	0.2499

Source: Author's own calculation

5.9 Hypothesis 2: To determine the relationship between the variability of inflation and output variability

The Second hypothesis considers the impact that inflation targeting has had on output as a macroeconomic indicator and inflation as well. The following data series were evaluated: Output, inflation rate, target inflation rate and potential output to ascertain if central bankers have become "inflation *nutters*" who eschews other economic objectives.

The investigation is done based on the loss function developed by Svensson(2003):

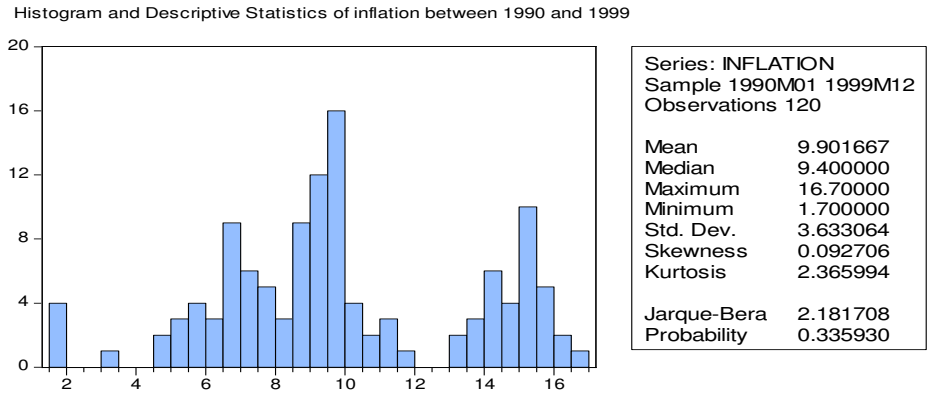
$$L_t = (\pi_t - \pi^*)^2 + \beta(\gamma_t - \gamma_t^*)^2$$

To ascertain the variability of both the output and inflation between 1990 and 2008, both the mean and the standard deviations of the data series are assessed.

Appropriateness of inflation targeting South Africa: Chapter five

5.10 Inflation variability

Figure 5-3: Histogram and the descriptive statistics of Inflation between 1990 and 1999

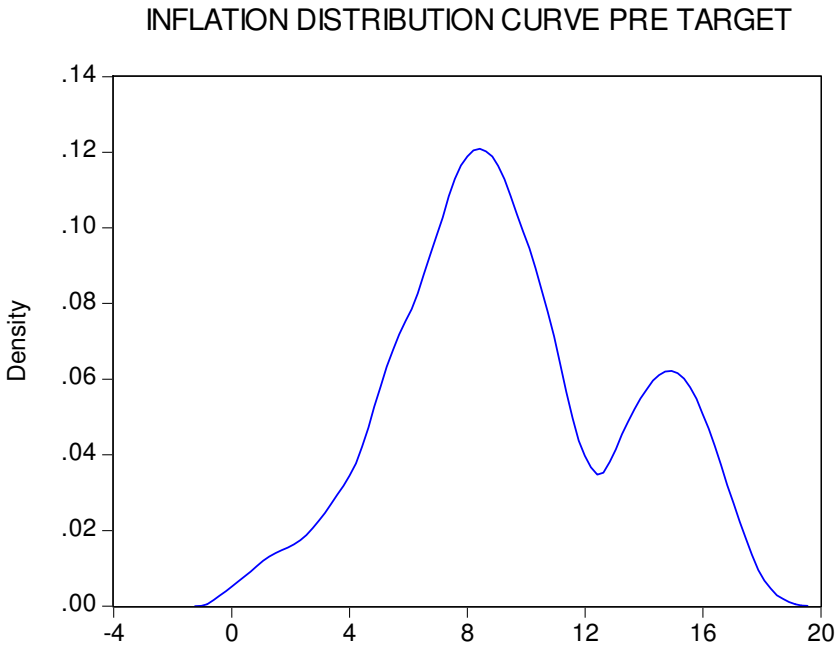


Source: I net bridge

Inflation during the pre-inflation targeting regime, moved from a minimum of 1,7 per cent to a maximum value of 16,7 per cent with a standard deviation of 3,63 and a mean of 9,9. The mean value is high during the pre inflation targeting period.

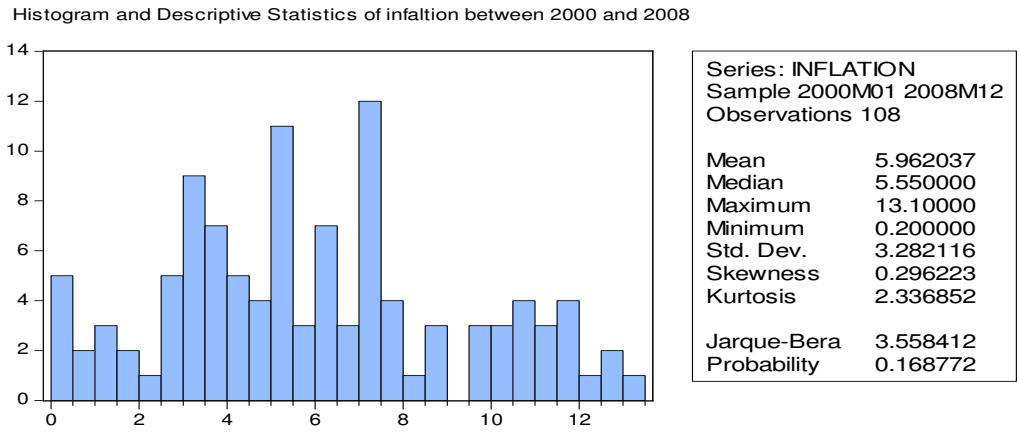
The figure below shows a graphic representation of inflation distribution curve which is unstable which indicates high levels of inflation variability which is in support of the above assessment about the movement of inflation rate.

Figure 5-4: Inflation distribution curve pre target



Source: I net bridge

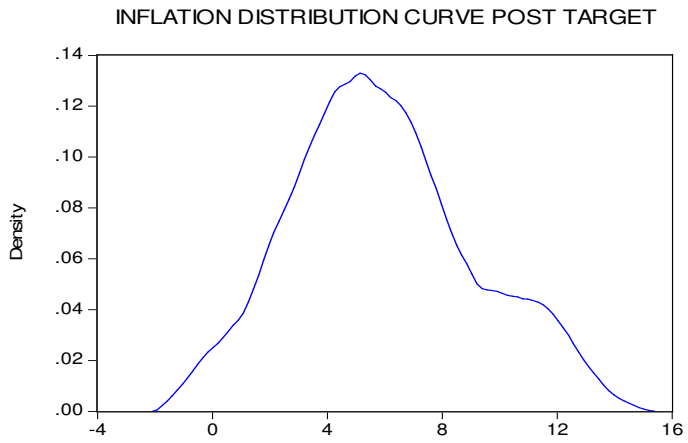
Figure 5-5: Histogram and the descriptive statistics of Inflation between 2000 and 2008



Source: I net bridge

Inflation post target has a minimum value of 0,2 per cent and the maximum value of 13,1 per cent and a standard deviation of 3,282 with a mean value of 5,96.

Figure 5-6: Inflation distribution curve post-inflation



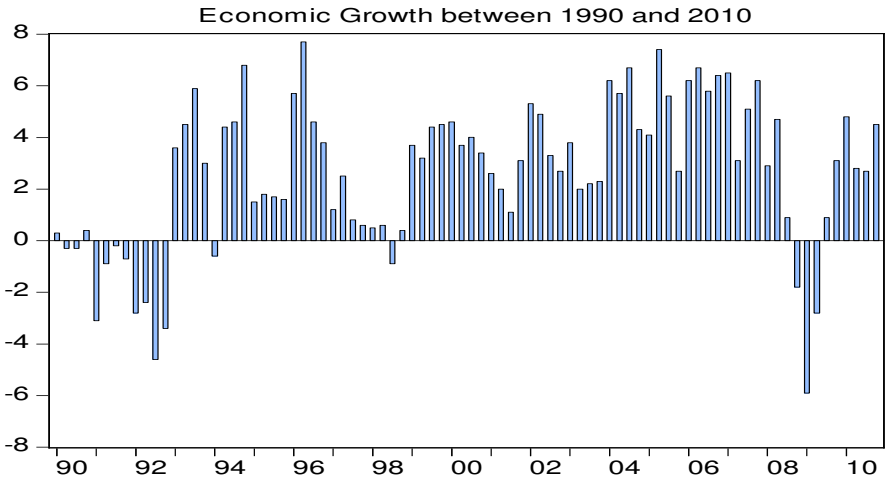
Source: I net bridge

5.11 Output variability

To account for the structural changes, the information on the output is divided into two periods which are the pre-targeting period and targeting period (pre crisis). The investigation in terms of the GDP growth rate is focused on the descriptive statistics before and after inflation targeting before the crisis. To arrive at the output gap by subtracting potential output from actual output, the potential output was calculated using the Hodrick-Prescott filter method.

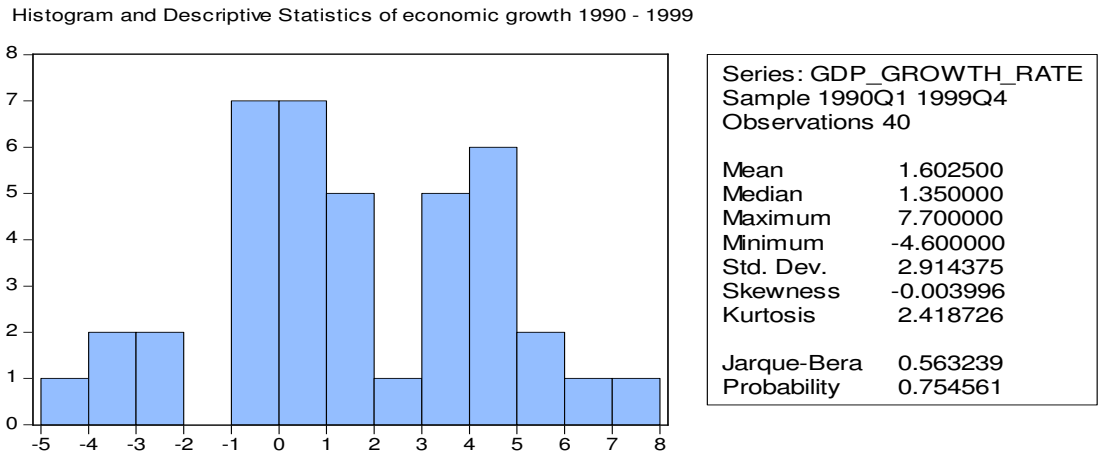
Appropriateness of inflation targeting South Africa: Chapter five

Figure 5-7: South Africa's economic growth rate 1990 - 2010



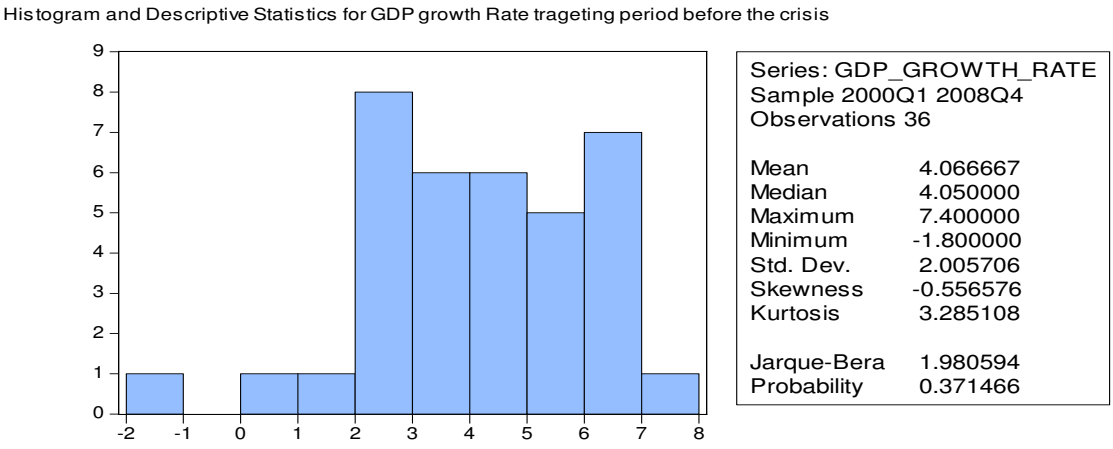
Source: SARB

Figure 5-8: Histogram and descriptive statistics of GDP growth rate pre-inflation targeting



Source: SARB

Figure 5-9: Histogram and Descriptive Statistics for GDP growth Rate during the targeting period before the crisis



Source: SARB

5.12 The mean difference of GDP before and after Inflation targeting

Mean of the GDP before inflation targeting is represented by μ_0 and the mean of the GDP after inflation targeting is represented by μ_1 .

$\mathbf{H_0 : \mu_0 \geq \mu_1}$

$\mathbf{H_1 : \mu_0 - \mu_1 < 0}$

The null hypothesis states that there is no difference on the GDP before and GDP after inflation targeting, which means the implementation of inflation targeting is immaterial to GDP. The alternative states that the mean difference of GDP before and after inflation targeting is non zero. To capture the expectations that inflation targeting has helped boast GDP such that the GDP before targeting is less than GDP post inflation targeting, their difference is set to be less than a zero.

Table 5-5: Summary results for the mean of GDP pre and post targeting

StatTools Report

Analysis:	Hypothesis Test
Performed By:	18577318
Date:	Wednesday, August 31, 2011
Updating:	Live

Hypothesis Test (One-Sample)	GDPPRE Data Set #1	GDPPOST Data Set #1
Sample Size	40	45
Sample Mean	484783.80	1536772.38
Sample Std Dev	157817.84	530262.18
Hypothesized Mean	0	0
Alternative Hypothesis	<> 0	<> 0
Standard Error of Mean	24953.19	79046.82
Degrees of Freedom	39	44
t-Test Statistic	19.4277	19.4413
p-Value	< 0.0001	< 0.0001
Null Hypoth. at 10% Significance	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject
Hypothesized Std Dev	1	1
Alternative Hypothesis	<> 1	<> 1

Ratio of Std Devs	157817.8372	530262.1811
Degrees of Freedom	39	44
Chi-square Test Statistic	971352319436.4000	12371831152798.6000
p-Value	< 0.0001	< 0.0001
Null Hypoth. at 10% Significance	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject

Source: SARB

The table below tests if there is a difference between of the GDP mean before targeting and post targeting.

Table 5-6: Summary statistics of the GDP mean before targeting and GDP mean after targeting

Descriptive Statistics Section

Variable	**Count**	**Mean**	**Standard Deviation**	**Standard Error**	**95.0% LCL of Mean**	**95.0% UCL of Mean**
GDPPRE	40	484783.8	157817.8	24953.19	434311.2	535256.4
GDPPOST	34	1296012	349359.8	59914.72	1174114	1417909

Note: T-alpha (GDPPRE) = 2.0227, T-alpha (GDPPOST) = 2.0345

Confidence-Limits of Difference Section

Variance Assumption	**DF**	**Mean Difference**	**Standard Deviation**	**Standard Error**	**95.0% LCL Difference**	**95.0% UCL**

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Equal	**72**	**-811227.8**	**263498.8**	**61464.61**	**-933755.2**	**-**
688700.3						
Unequal	44.31	-811227.8	383352	64903.28	-942005.6	-
680449.8						

Equal-Variance T-Test Section

Alternative Hypothesis	**T-Value (Alpha=.010)**	**Prob Level**	**Reject H0 at .050**	**Power (Alpha=.050)**	**Power**
Difference <> 0	-13.1983	0.00	Yes	1.0	1.000000
Difference < 0	**-13.1983**	**0.00**	**Yes**	**1.000000**	1.0000
Difference > 0	-13.1983	1.000000	No	0.000000	0.000000

Difference: (GDPPRE)-(GDPPOST)

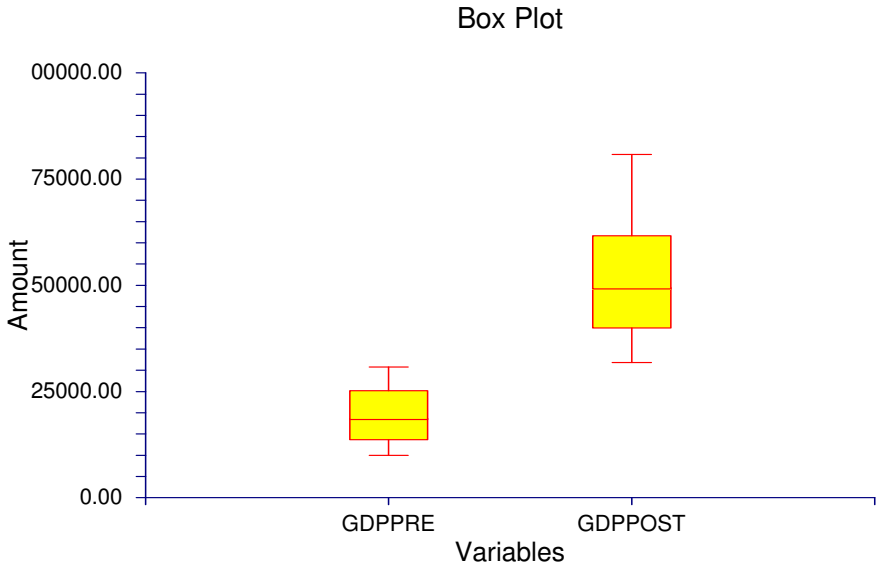
Aspin-Welch Unequal-Variance Test Section

Alternative Hypothesis	**T-Value (Alpha=.010)**	**Prob Level**	**Reject H0 at .050**	**Power (Alpha=.050)**	**Power**
Difference <> 0	-12.4990	0.000000	Yes	1.000000	1.000000
Difference < 0	**-12.4990**	**0.000000**	**Yes**	**1.000000**	1.00000
Difference > 0	-12.4990	1.000000	No	0.0000000.000000	

Difference: (GDPPRE)-(GDPPOST)

Source: SARB

Figure 5-10: Box Plot for GDP Pre inflation and GDP Post inflation



Source: SARB

5.13 Hypothesis 2: In the inflation targeting regime, far ahead forward inflation compensation is relatively insensitive to incoming economic news

Inflation targeting as an anchor of inflation is examined in two ways. Firstly, it is examined from the inflation expectation survey conducted by Bureau of Economic Research (BER). Secondly it is assessed by means of the Ordinary Least Square (OLS) method using the three month treasury bill yield, five year bond yields and the twelve months jibar rate.

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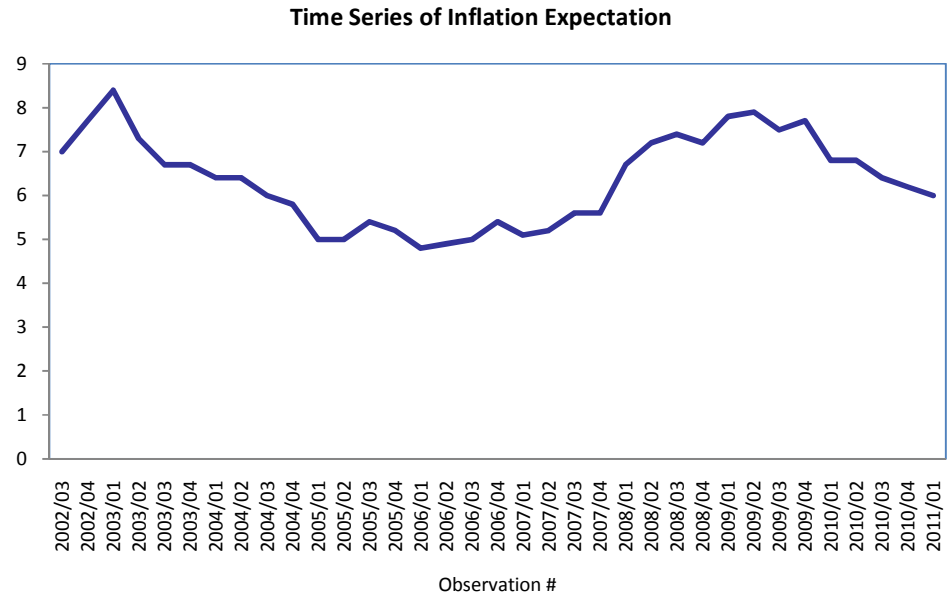
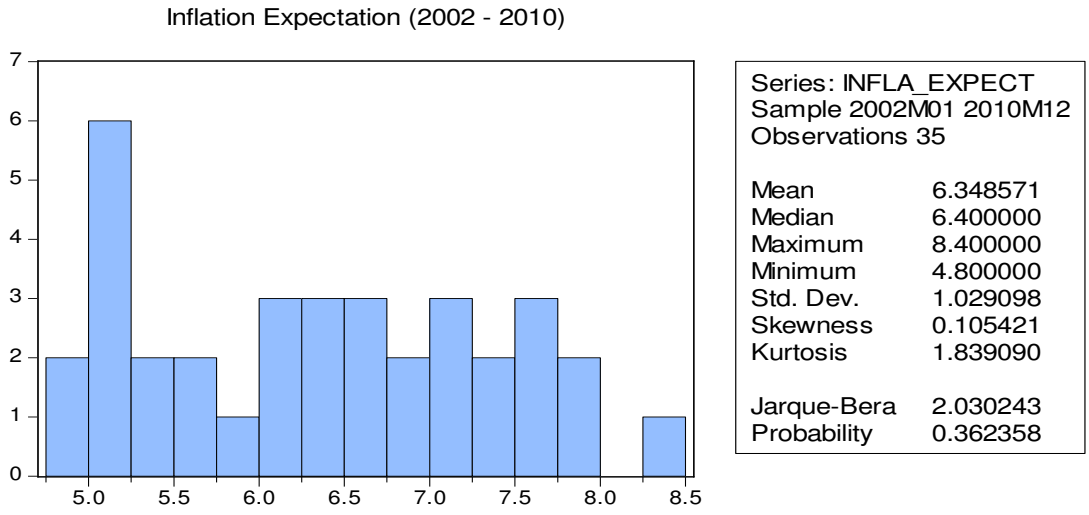
Figure 5-11: Inflation expectations between 2002 and 2011



Source: SARB

Figure 5-12: Histogram and summary of statistics on inflation expectations



Source: SARB

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As indicated in chapter 4, BER has been conducting surveys on the inflation expectations from different role players. Their results are on the current expectation (CPI0), inflation expectation in a year's time (CPI1) and inflation expectation in two year's time (CPI2). A statistical analysis has been conducted to determine their mean from the third quarter 2000 until fourth quarter 2010.

Table 5-7: Summary of statistics on inflation expectations

StatTools Report

Analysis:	One Variable Summary
Performed By:	18577318
Date:	Thursday, September 01, 2011
Updating:	Live

One Variable Summary	CPI0 Data Set #1	CPI1 Data Set #1	CPI2 Data Set #1
Mean	6.018	5.843	5.745
Variance	6.635	4.249	3.723
Std. Dev.	2.576	2.061	1.930
Skewness	-0.4740	-1.3652	-1.6975
Kurtosis	3.3647	5.5192	6.4874
Median	6.200	6.100	5.900
Mean Abs. Dev.	1.967	1.444	1.333
Mode	0.000	6.100	0.000
Minimum	0.000	0.000	0.000
Maximum	11.000	8.700	8.500
Range	11.000	8.700	8.500
Count	44	44	44

Sum	264.800	257.100	252.800
1.00%	0.000	0.000	0.000
2.50%	0.000	0.000	0.000
5.00%	0.000	0.000	0.000
10.00%	3.300	3.900	4.100
20.00%	4.100	4.600	4.700
80.00%	8.200	7.500	7.300
90.00%	9.200	8.300	7.700
95.00%	9.500	8.500	7.800
97.50%	10.600	8.600	8.100
99.00%	11.000	8.700	8.500

Source: SARB

5.14 The behaviour of interest yields to domestic macroeconomic news

The slope of the yield curve has been used as a guide to assist in the prediction of both output and inflation. The figure below provides a graphic representation of the yield curve for the 10 year South African bond.

Figure 5-13: SA Government 10 Year Bond Yield

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The interest yields examined are the three months treasury bill rates, twelve month jibar rates months and a five year bond which are dependent variables with inflation rate (EINF), Retail Trade (RTCURS); Manufacturing Production Index (MANUSA); Capacity Utilization (CPUTLE), unemployment rate (SAEMP) and Repo rate (SAREP1).

Table 5-8: Regression analysis for three months treasury bill

StatTools Report

Analysis: Regression

Performed By: 18577318

Date: Thursday, September 01, 2011

Updating: Static

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.9874	0.9750	0.9710	0.313743341

ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	6	142.2965638	23.71609397	240.9318	< 0.0001
Unexplained	37	3.642090709	0.098434884		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Confidence Interval 95% Lower	Confidence Interval 95% Upper
Constant	-0.923849992	1.522430366	-0.6068	0.5477	-4.008586925	2.160886941
EINF	0.028724994	0.038493623	0.7462	0.4602	-0.049270495	0.106720482
RTCURS	6.95721E-06	5.95747E-06	1.1678	0.2504	-5.11377E-06	1.90282E-05

MANUSA	-0.000899342	0.019690979	-0.0457	0.9638	-0.040797054	0.038998371
CPUTLE	0.021784436	0.033824406	0.6440	0.5235	-0.04675032	0.090319192
SAEMP	0.00420969	0.011593497	0.3631	0.7186	-0.019280966	0.027700346
SAREP1	0.800352276	0.05311309	15.0688	< 0.0001	0.692734933	0.907969618

Source: SARB

The table below shows the regression analysis of the five year bond yield in relations to the macroeconomic data.

Table 5-9: Regression analysis for the five bond yield

StatTools Report

Analysis: Regression

Performed By: 18577318

Date: Tuesday, October 04, 2011

Updating: Static

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.9073	0.8232	0.7945	0.881034879

ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	6	133.7362657	22.28937762	28.7152	< 0.0001
Unexplained	37	28.72023092	0.776222457		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Confidence Interval 95% Lower	Confidence Interval 95% Upper
Constant	20.2752168	4.275195924	4.7425	< 0.0001	11.61284704	28.93758656
EINF	-0.20995614	0.108095439	-1.9423	0.0597	-0.42897831	0.009066017
RTCURS	-6.94598E-05	1.67294E-05	-4.1520	0.0002	-0.000103357	-3.55628E-05
MANUSA	0.140003249	0.055295003	2.5319	0.0157	0.027964931	0.252041567
CPUTLE	-0.331640136	0.094983629	-3.4916	0.0013	-0.524095249	-0.139185022
SAEMP	0.006413243	0.03255615	0.1970	0.8449	-0.059551783	0.072378269
SAREP1	0.592139799	0.149148933	3.9701	0.0003	0.289935355	0.894344242

Source: SARB

Table 5-10: Regression analysis for the twelve months jibar rate

StatTools Report

Analysis: Regression
Performed By: 18577318
Date: Tuesday, October 04, 2011
Updating: Static

Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.9520	0.9062	0.8910	0.69145438

ANOVA	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value

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Table

Explained	6	170.9687861	28.49479768	59.5989	< 0.0001
Unexplained	37	17.69003893	0.47810916		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	**Confidence Interval 95%**	
					Lower	**Upper**
Constant	-2.892226434	3.355262114	-0.8620	0.3942	-9.69063324	3.906180372
EINF	-0.019129823	0.084835534	-0.2255	0.8228	-0.191022943	0.152763297
RTCURS	-1.34487E-05	1.31296E-05	-1.0243	0.3123	-4.00517E-05	1.31544E-05
MANUSA	0.130666213	0.043396661	3.0110	0.0047	0.042736225	0.218596201
CPUTLE	-0.104357871	0.074545115	-1.3999	0.1699	-0.255400621	0.046684879
SAEMP	0.008546643	0.025550739	0.3345	0.7399	-0.043224072	0.060317359
SAREP1	0.903564794	0.117055165	7.7191	< 0.0001	0.666388501	1.140741087

Source: SARB

CHAPTER 6 DISCUSSION OF RESULTS

6.1 Introduction

Chapter five of this study documented the statistical findings of the following hypotheses:

- Hypothesis 1: The policy rate within an inflation targeting has a zero effect on output and prices.
- Hypothesis 2: To determine the relationship between the variability of inflation and output variability
- Hypothesis 3: In an inflation targeting regime, a far ahead forward inflation compensation is relatively insensitive to incoming economic news

In this chapter, the results from chapter five are discussed in detailed by providing insight in relation to the literature review in chapter two and the research question posed in chapter one.

6.2 Hypothesis 1: The policy rate within inflation targeting has a zero effect on output and prices.

An investigation of transmission mechanism in South Africa was done to assess if the monetary policy has an impact on output and prices. There are six channels of monetary policy transmission: (1) interest rate channel; (2) bank lending channel; (3)

balance sheet; (4) asset price channel; (5) exchange rate channel; and (6) expectation channel. The analysis considered two specific channels, namely the exchange rate and interest rate channels. The first thing was to conduct the unit root test to check for stationarity. Accordingly the following time series (GDP, Price Index and Repo Rate) were found to be non stationary (the null of a unit root was not rejected). Due to the presence of a unit root in the above time series, differencing of the series was conducted where all the series were found to be statationary. However in order to avoid losing the depth of the data series, VAR estimation was conducted on data at their level.

According to both appendix 2 and 3, the estimation of VAR was found to be stable wherein all the series were found to be stationary. Furthermore the residuals were found not to be serially correlated.

Table 5.1 shows the result of the VAR estimation for both output and prices as follows:

$$CPI = -2.693 + 1.017CPI(-1) - 0.1265\ CPI(-2) + \ 1.172EX\ (-1) - \ 1.027EX(-2) + \ 1.007GDP\ (-1) - \ 0.47\ GDP(-2) + \ 1.04\ REPO(-1) - \ 0.998REPO\ (-2)$$

$$GDP = 0.167 + 0.001\ CPI(-1) + 0.000\ CPI(-2) + \ 0.049\ EX\ (-1) - \ 0.035\ EX(-2) + \ 0.473\ GDP\ (-1) + 0.495\ GDP(-2) - 0.024\ REPO(-1) + \ 0.001\ REPO\ (-2)$$

The expected sign of the long run elasticity of domestic prices with respect to exchange rate is positive. This is clearly in line with literature review which highlighted that as exchange rate depreciates, imported goods become more expensive as consumers switch from demanding more expensive imported goods to demanding more of the goods produced domestically. This is in turn leads to the prices of domestic goods to increase.

The expected sign of the long run elasticity of output with respect to the exchange rate is positive, as the exchange rate increase, output tends to increase as well. As will be explained in details below, when exchange rate depreciates, demand increases and thus raises the production of goods in important-competing industries. The signs of the long-run elasticities of the domestic price index and output with respect to the interest rate are expected to be negative, since contractionary monetary policy reduces economic activity putting downward pressure on prices.

Accordingly the long run elasticities depicts the static relationship among the variables, for example if the exchange rate is hit by a shock amounting to one percentage point at period t, the long run elasticity of prices indicates the change in the price index at period *t + 1*. However in order to understand the dynamic effect of shocks to different variables, we analyse impulse responses below.

6.3 Summary of statistics

Table 5.2 shows the summary statistics of the VAR estimates. Accordingly the R square of all the variables are more than 86% which is a measure of goodness of fit or the measure of prediction power in the dependent variable of the regression equation. Also to mitigate the problem associated with the R square, we also investigated the adjusted R square which also are more than 86 % for all equations. Both the consumer price and output equation have an adjusted R square of more than 86% which show that the dependent variables are explained by the regression equation.

6.4 Impulse Response

Figure 5.2 presents impulse response functions with regards to the impact of policy variables on output and prices. The impulse responses indicate how a unit to the causal variable, say, the interest rate at period *t,* affects the response variable, say, the domestic price index, in each subsequent period $t + s$, $s = 1, 2, 3$ ....

One standard deviation shock of exchange rate is associated with an immediate increase in output; however it stabilizes over the medium term. The exchange rate is

represented by rand per dollar, therefore an increase in the exchange rate represents depreciation and a decrease in the exchange rate represents an appreciation. Furthermore the analysis is based on nominal effective exchange rate (NEER). South Africa is an open economy with a flexible exchange rate, therefore it is in line with the literature theory that when the exchange rate depreciates this will result in domestic goods and services being cheaper than foreign goods and services. The cheaper domestic goods and services spur an interest on local products relative to the foreign products, therefore the net export increases.

Figure 5.2 also shows that one standard deviation shock of exchange rate is associated with an increase in prices. This is also in line with economic theory; an increase in a demand for goods and services induces the price to rise. Therefore an increase in the demand of local goods and services due to the depreciation of the exchange rate results into an increase in prices. A one standard deviation shock to the interest rate is associated with a drop in output, but it leads to a price increase immediately. However, over a period of time, the price is anchored down. This supports the interest rate channel whereby changes in the repo rate leads to a change in interest rate which alters the spending pattern and investment of firms and individuals. When the repo rate increases, banks automatically increase the interest rate which influences an immediate reaction or respond of consumption and investment in an opposite direction. The demand pressures are fed through to the changes in the output gap and inflation. Repo rate as a monetary policy tool is forward looking; therefore the downward price

anchoring over a period in figure 5.2 is in line with the notion of forward looking approach.

As explained before, South Africa is a small open economy, and it has adopted a flexible exchange rate. Therefore in line with academic theory, in the advent of flexible exchange rates, more attention has been paid to how monetary policy affects exchange rates, which in turn affect net exports and aggregate output (exchange rate channel). Expansionary monetary policy affects exchange rates because when it leads to a fall in domestic interest rates, deposits denominated in domestic currency become less attractive relative to deposits denominated in foreign currencies. As a result, the value of domestic deposits relative to other currency deposits falls, and the exchange rate depreciates (denoted by ↑). A lower value of the domestic currency results in the price of domestic goods being cheaper than foreign goods which in turn cause a rise in net exports (NX ↑) and hence in aggregate spending (Y ↑) (Mishkin, 2001).

A schematic representation for the monetary transmission mechanism that operates through the exchange rate channel is as follows:

$$\mathrm{M} \uparrow => E \uparrow => NX \uparrow => Y \uparrow$$

Looking at the results from figure 5.2, accordingly an interest rate shock provides a positive shift in the exchange rate. This is however dependent on the banking system within a specific country. In South Africa, when the central bank announces a shift on

the repo rate this is immediately followed by the banks making an announcement with regards to an adjustment in the overdraft the interest rate.

According to Svensson (2003), a reduction of the short term interest rate results in the depreciation of the nominal exchange rate (which is an increase in nominal exchange rate), which also leads to a rise in the real exchange rate, as prices are sticky going down. The rise in the real exchange rate implies that the domestic price of imported and exported final goods increases (when the foreign-currency prices of both imported and exported final goods are sticky). Because these goods are included in the Consumer Price Index (CPI), this means that CPI inflation increases, depending on these goods' share in the CPI. This is the so-called direct exchange rate channel to CPI inflation.

Accordingly when the short term real interest rates as referred above fall, this tends to stimulate consumption and investment within an economy which results in both aggregate demand increasing. This is the so-called real-interest rate channel to aggregate demand.

6.5 Variance decomposition

The variance decomposition determines the share of fluctuations in output and prices that are caused by different shocks at a horizon of six months. The calculation of this is presented in table 5.3, wherein the first column is the period; the second column is the forecast error of the variables for each forecast horizon. The rest of the columns are showing the variance shock due to each variable. The innovation to exchange rate account for the largest movement in prices comparing with the rest of the variables at 4,2% fluctuations. The repo rate seems to have less direct impact or shock on prices as it only accounts for less than 1 percentage point of price fluctuations, this might be explained by the fact that a repo rate has an indirect influence towards the prices. Also the time lag that required for monetary policy to affects prices.

In period one, the innovations to prices account for about 4% of the fluctuations of the exchange rate which is the largest (comparing with the rest), it is then followed by the GDP and repo rate respectively. The reasons for this is due to the fact that rand is a heavily traded currency, and it also sensitive to other macroeconomic indicators. As the figures for inflation are released, this information is interpreted by the market to indicate the likely direction of the interest rate, which leads into both traders and dealers taking positions on the currency. The exchange rate reacts much quickly to information that enters the market.

An innovation to exchange rate accounts to about 4 percentage points of fluctuations to the output. This is supported by the literature review which indicates that exchange rates in an open economy will have an impact on output via the import and export side. According to the BIS (2007), when prices of imported goods are quoted in foreign currency and are sold to consumers for local currency at the going market exchange rate, any change in the exchange rate will be automatically transmitted to the consumer prices of the importing country, implying a complete exchange rate pass-through.

6.6 Hypothesis 2: To determine the relationship between the variability of inflation and output variability

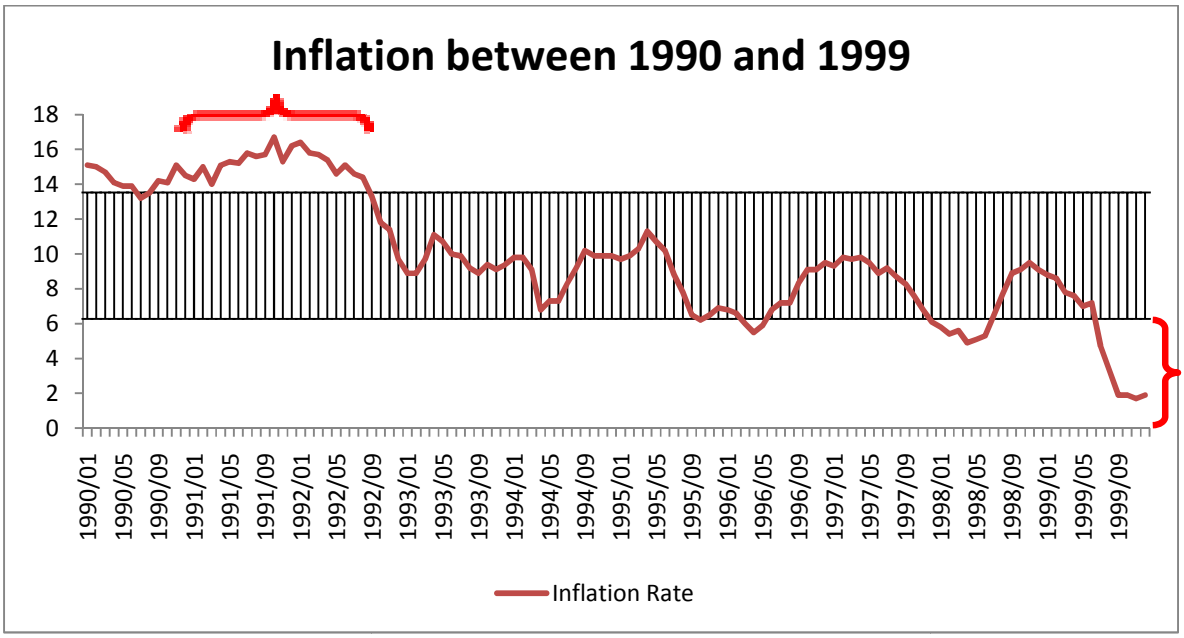
Amongst the criticism against the countries that have adopted inflation targeting as their key monetary framework has been the fact that the narrow focus on inflation may blind bankers to other worthwhile economic objectives such as dealing with output and employment. According to De Carvalho (2010) quoting Stiglitz (2008) stated that central banks that focus on inflation targeting tend to lose sight to macroeconomic issues due to their narrow focus on just inflation. Kahn and de Jager (2011) phrased the issue about output and inflation by asking a question of whether or not inflation targeting places too much weight on the inflation objectives at the expense of other possible objectives of monetary policy.

The trade-off between inflation variability and output variability is best captured by the loss function as developed by Svensson (2002). From chapter five, the descriptive and the summary statistics were run. The first statistics descriptive is for inflation. In figure 5.2, the statistics descriptive for inflation before inflation targeting are presented. The histogram indicates a lot of movement between 1990 and 1999 which shows that inflation before the targeting period was not stable. The shape of the histogram deviates from significantly from the normal distribution.

During this period, inflation rate averaged 9,9 per cent (mean), the median (this is number that appear a lot more within the sample period) is 9,4 per cent. Inflation ranges from a minimum of 1,7 per cent with a maximum of 16,7 per cent. The standard deviation (a measure of how spread out the numbers are) of inflation rate during this period is at 3,6. The spread out of the numbers is huge which shows high variability of inflation during this period.

The figure below illustrates the movement of inflation rate over a period, with the shaded area depicting the one standard deviation from the mean.

Figure 6-1: Inflation rate between 1990 and 1999



Source: SARB

The figure above shows that despite high levels of variability during this period, the inflation rate retained its downward bias most of the time. This is line with Rossouw and

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Padayachee (2011), quoting Dr C.L. Stals immediately after being appointed Governor, who said "…. *the main emphasis of monetary policy has ….. [Now] ... been switched to the curtailment of inflation …..[i]n the circumstances it can no longer be regarded as appropriate to continue to accommodate price increases through large increases in Bank credit and in the monetary policy …..[as] ..[t]hrough a disciplined monetary and fiscal policy approach …. it will be possible to reduce the rate of inflation in South Africa over the next few years" (Stals, 1989:10)*

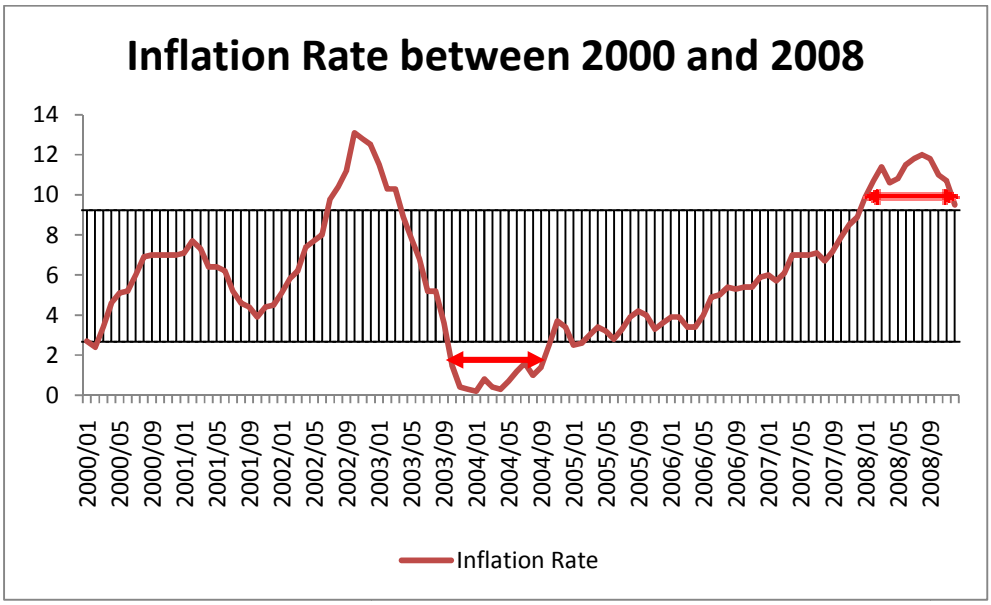
Inflation variability was profound during the early 1990s, despite the statement made by the Governor in 1989 as inflation increased from 1989 to late 1992 and early 1993. The SARB did not have an anchor for inflation. The absence of an anchor contributed to a lack of credibility. This is supported by Rossouw and Padaychee (2011), who argued that the lack of credibility contributed to three years of stagflation in South Africa (from 1989 to 1992), characterised by negative economic growth and double-digit inflation.

Now focusing attention on the period of inflation targeting minus the period after the financial depression (2000 – 2008), inflation rate has a mean value of 5,9 per cent, has a minimum value of 0,2 per cent and a maximum value of 13,1 per cent. The histogram does provide a graphical representation that follows normal distribution. The standard deviation is around 3,2 in this period. During the targeting period, inflation rate has decreased from an average rate of 9,6 per cent to an average rate of 5,6 per cent. The standard deviation decreased to 3,2. Both the average (mean) inflation and inflation

variability decreased during the inflation targeting period. Therefore, inflation targeting has been found to be consistent with the quadratic loss function.

The statistical information from figure 5.2 is supported by the figure below which shows inflation being anchored most of the time around 5.6 and one standard deviation.

Figure 6-2: Inflation rate between 2000 and 2008



Source: SARB

6.7 Output variability

Output variability was considered in two time periods, namely pre-inflation targeting and post-inflation targeting without the crisis period. In figure 5.8 (growth rate before inflation

targeting), the histogram displays normal distribution characteristics. The mean value of the growth rate is at 1,6 per cent, with a standard deviation of 2,9. However in figure 5.9 (growth rate after inflation targeting), the mean value of the growth rate is 4,0 with a standard deviation of 2,0. The standard deviation of output growth between the two time periods show a decline in variability as the standard deviation declined from 2,9 to 2,0. The mean growth rate in between the two time period show an increase from an average of 1,6 per cent to an average of 4,0 per cent.

Table 5.5 provides a summary statistics for the mean of GDP (constant value) before and after inflation targeting. The mean of GDP in between the two periods was to ascertain if inflation targeting has brought any difference in the GDP (calculated at a constant value) performance. The null hypothesis stated that the mean of GDP before and after inflation targeting are equal, therefore their difference is equal to zero. From Table 5.5 the hypothesized mean of zero for both GDP before and after inflation targeting is rejected. The *p*–value for a one tailed test is less than 0.0001 which provides enough evidence to reject the null hypothesis at the 1 % significance level (as well as at 5% and 10% levels). Therefore since both the before and after targeting GDP are not zero, the mean difference is examined.

Table 5.6 provides a summary statistics of the GDP mean difference before and after inflation targeting. Applying both the Equal-Variance T-Test and Aspin-Welch unequal variance test, the null hypothesis of equal means at 0,05 is rejected in favour of the

alternative hypothesis. Accordingly the difference mean is at -811227,8 with a standard error of 614464,6. The difference equation is (GDPpre – GDPpost), therefore a negative figure shows that GDP after inflation targeting has performed better.

The results are in line with the findings of Svensson (2003) who argued in respect of the trade-off between inflation and output that in the long term, monetary policy can only control nominal variables such as inflation and exchange rate. However in the short to medium term, these have a direct impact on the growth rate of real variables such as GDP. Accordingly monetary policy that leads to high and or variable inflation is harmful to the real economy and to the economic growth, by making market mechanism work less well and by creating unnecessary uncertainty.

Furthermore, high and variable inflation impairs the capacity of the market mechanisms to achieve efficient resource allocation, and the ensuring uncertainty makes it more difficult, consumer and servers to make the right decisions. Therefore inflation targeting reducing the variability of inflation, this then enables efficient resource allocation which also tends to bodes well for economic growth.

6.7 The null hypothesis 3: In the inflation targeting regime, far ahead forward inflation compensation is relatively insensitive to incoming economic news

Examining the graph based on the information gathered from the Bureau of Economic Research (BER), it is clear from figure 5.11 that inflation expectation from a wide range

of stakeholders that comprise the trade unions, businesses and households and financial analysts expected inflation to be low and stable. This observation was clear even during the time of recession; this is a clear statement of confidence and credibility to the monetary authority. The observation confirms the findings by Rossouw (2007) who stated that despite the central bank not having control over inflation expectations it can influence this through consistent monetary policy actions.

Table 5.7 provides a summary statistics results of inflation expectation of different time periods. The CPI0 represent an inflation expectation from the current period, CPI1 is an inflation expectation in a year's time and CPI2 is an inflation expectation in two year's time. The mean inflation expectation are 6, 01; 5, 84 and 5, 74 for CPI0; CPI1 and CPI2 respectively. In the near term, the mean inflation expectation is higher, and starts to slow as the term period is extended. This supports what Lacker (2007) stated that when people are certain about the policymakers' objectives or strategy they adjust their inflation expectations accordingly. Mboweni (1999) added that transparency introduces predictability and helps to ensure that expectations are consistent with the objective of price stability, thus lowering the cost of achieving the inflation target.

The variability of inflation expectation from the current period is at 2,56; and in a year's time is at 2,06 and in two years' time is at 1,93. This also confirms that inflation targeting not only does anchors inflation expectation down but also stabilizes it. The standard

deviation of inflation expectation for the current period is at 2,56 which decreases to 1,93 over a two year inflation expectation.

Figure 5.13 shows that the South African 10 year bond yield between 2000 and 2011 declined from around 15,4 per cent to the current yield of 7,69 per cent. In the twelve months period between October 2010 and October 2011 it declined by 17 basis points. The yield is an indications of what investors expect in return to loan funds to governments, which reflects their inflation expectations and the likelihood that the debt will be repaid. Using the yield as a proxy of inflation expectations, inflation was expected to be contained at lower levels.

Though the slope of the yield curve was not calculated, it can be inferred from the yield curve that slope has been minimized over a period, which can be used to gauge that inflation and output variability will be minimized. There has been debate with regards to predictive power of the slope of the yield curve to both inflation and output; however the work done by Mehl (2006) has found that South Africa's slope of the yield curve indeed has a predictive power to both inflation and output.

6.8 Results of interest yields to domestic macroeconomic releases

The SARB uses the repo rate as the monetary tool to control inflation. Therefore the Treasury bill rate, the five year bond rate and the 12 month jibar rate were therefore regressed against a set of macroeconomic data and the monetary policy announcements to determine if the rates take inflation compensation into consideration. Table 5.8 provides a summary results of the three month treasury bill regression on the following macroeconomic data and monetary policy announcement through the repo rate: with inflation rate (EINF), Retail Trade (RTCURS); Manufacturing Production Index (MANUSA); Capacity Utilization (CPUTLE), unemployment rate (SAEMP) and Repo rate (SAREP1).

The three month Treasury bill rate exhibits a highly significant response to the monetary policy announcements with a *p*–value of 0.0001. All the other macroeconomic data were found to statistically insignificant. The non-response to the rest of the macroeconomic clearly illustrates that inflation expectations in the long run are anchored. The release of this data does not affect investors.

Table 5.8 provides the summary results for the regression analysis for the five year bond. The five year SA bond rates are statistically significant to all the macroeconomic data and the monetary policy announcements. The results compares favourably with

Taylor rule equation as explained by Gurkaynak *et al* (2008). An upward increase in inflation, output and capacity utilisation leads to an increase in short-term interest rates. The rates responded strongly to the monetary policy instrument (repo rate) as opposed to the inflation rate directly. The five year bond rates have a *p*-value of 0.0003 and it has *p*-value of 0.0597 on inflation rate. The fact that the five year bond rates do not respond strongly to the inflation rate directly supports the hypothesis that inflation expectation is anchored during the inflation targeting period.

Table 5.9 provides the summary statistics results for the twelve month jibar rate on both the macroeconomic data and the repo rate. The twelve month rates respond statistically significant to only manufacturing data and the monetary policy instrument (repo rate). However, it maintains the same sign as observed with the five year bond rates, which is in line with the Taylor rule. The rates here are highly sensitive to the repo rate with a *p*-value of less than 0.0001. According to Gurkaynak *et al* (2007), if the long term inflation expectations are firmly anchored, one would expect to see little or no response of the rates to the macroeconomic data. Therefore it is clear that a credible inflation-targeting framework significantly helps to anchor the private sector's perception of the distribution of future long-run inflation outcomes and these filters in their investment decisions.

6.9 Summary of results

The research objective was to assess the appropriateness of inflation targeting with respect to South Africa. The research focused on the three broad themes which are:

- The impact of monetary policy to both inflation and output through the transmission mechanism;
- The assessment of the trade-off between inflation variability and output variability since adopting inflation targeting; and
- The assessment of inflation targeting as an anchor of inflation expectation

In the study a vector auto regression (VAR) has been used and it has found that transmission mechanism is efficient in South Africa. Furthermore using VAR, it was established that monetary policy has an impact on both inflation and output. However, the impact of monetary policy is not a direct one; it moves through the various channels, the most notable one is through the exchange rate channel. The transmission mechanism has also proved that the impact of monetary policy decisions only happens with a time lag (one quarter to about six quarters). Therefore the null hypothesis that monetary policy rate within the inflation targeting has a zero effect on output is rejected.

During the course of inflation targeting era, the central bank has been able to strike a balance between inflation variability and output variability. From the results in this paper, it is clear that the loss function as articulated by Svensson (2003) has always been minimized. There is no evidence that suggest that inflation targeting was implemented in manner that undermined output. The inflation rate before the targeting period was characterised by high variability, however during the targeting period the variability of inflation rate has been low. Also on comparing the performance of output between the two periods (pre and post inflation targeting), output has performed much better during

the inflation targeting period. Notwithstanding the provision of the explanation clause and the letter sent by the Minister of Finance to SARB in 2010, the results show also that central bank is not an inflation *nutter*. Therefore the null hypothesis that the implementation of inflation targeting disregards the output variability at the expense of inflation variability is rejected for South Africa.

Lastly the study has also found that inflation targeting has helped to anchor inflation expectations. The information drawn from the Bureau of Economic Research's surveys for the current year, in a year's time and in two years' time, shows inflation expectations to have been anchored downward and stable. Furthermore the yields on the long-term bond (ten year bond) have shown to be biased downwards and stable since the implementation of inflation targeting. As stated in this paper, a yield is an indication of what an investor expects to be compensated taking into account inflation expectations. Also in support of the null hypothesis that inflation targeting serves as an anchor, the forward rates in terms of three months treasury bill, five year bond and the twelve months jibar have proved to be somehow less sensitive to economic news.

CHAPTER 7 CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Inflation targeting as a monetary policy framework can indeed have undesirable consequences if it is not well managed. Therefore it should not be perceived as a panacea; it has its own challenges as much as it has benefits. It is therefore important to highlight the difference between strict inflation targeting and flexible inflation targeting. The strict inflation targeting emphasises a need to subject everything to the inflation target as opposed to flexible inflation targeting where, depending on other shocks, the target can be missed. In this regard strict inflation targeting becomes inappropriate as it undermines other shocks which cannot be controlled by the monetary policy. In the strict inflation targeting, the central bank is not concerned about the trade-off between inflation and output variability.

On the other hand, flexible inflation targeting pays attention to both inflation variability and output variability. The trade-off between inflation variability and output variability is best captured by the loss function. The loss function emphasises that despite the rate of inflation being the primary objective of the monetary policy, this should not mean that the central bank should be indifferent to developments in other economic variables, the most important of which is the output gap. The response of the central bank to a shock

to the economy depends on such matters as the country's preference for inflation stability relative to output stability, the type of shock to which the central bank is reacting (demand or supply), whether the economy is already at its target rate of inflation or still in the process of disinflating, and finally, the credibility of the central bank. Based on the findings of the study, the SARB is not indifferent to output variability. The SARB, like most of the central banks, has not adopted an explicit loss function. However, it can be argued that the SARB endeavours to minimise the loss function on its conduct of monetary policy. The time lag it takes to achieve inflation target is an indication of whether the central bank is indifferent to output variability or not. As indicated in the study, the short time horizon to achieve the target is an indication of being a stricter inflation targeter as opposed to a longer time horizon. In the study it was found that monetary policy has had a minimum impact on inflation and output in the short time horizon. A full impact of monetary policy has an 18 to 24 months time lag which supports the view that output variability matters.

Furthermore to ensure that the central bank is not an inflation *nutter*, a provision to miss the target was granted through an explanation clause. This also emphasise the point that other macroeconomic variables matter in the implementation of the inflation targeting. In 2010 the Minister of Finance issued a letter to the Governor of the SARB reemphasising the need for the central bank to take into consideration other macroeconomic variables when applying its monetary discretion.

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South Africa has an advanced financial structure which bodes well for transmission mechanism. For monetary policy to have a desired impact on both inflation and output within the inflation targeting framework, the transmission mechanism should work efficiently. The study has found that indeed transmission mechanism through the exchange rate has an impact on both inflation and output over a period. In this study, due to a limited time period, the results can easily be misinterpreted to give an impression that the impact of transmission is minimal. Therefore it should be well understood that the full impact of monetary policy takes between 18 and 24 months as discussed above.

Inflation targeting anchors inflation expectations which in turn has a bearing in the manner in which different agents within the economy behaves. The study has found evidence in support of inflation targeting as an anchor of inflation expectation. Since the introduction of inflation targeting, inflation expectations were stabilised over a period of time. There are benefits in anchoring inflation expectations, when future inflations are anchored, price shocks do not lead to second round effect of inflation, hence inflation targeting helps with stabilizing inflation.

The argument that the poor do not benefit from inflation targeting is not true, especially considering that as inflation rises, the poor do not have any means of protection against inflation on their income. Therefore it is also important for them to have a low and stable inflation environment. Besides the poor, investors also do benefit from an inflation

targeting regime. A well anchored inflation reduces the volatility of bonds yields, and also it lengthens the duration of the yield curve which provides confidence to the investors. The other benefits from a longer yield curve are market-determined interest rate that makes the transmission mechanism of monetary policy more effective. As the nature of monetary policy is forward looking; therefore the information in the market determined longer term interest rates from the yield curve becomes useful to inform monetary decisions.

7.2 Recommendations

The current moderate policy in the implementation of the inflation targeting should be maintained, where the primary goal is to achieve price stability but should be cognisant of other crucial elements of the economy that affects society in general, for example stabilising the business cycle and aspects of financial stability. Stabilising the business cycle contribute to stabilising output movements around the potential output. In practice and in most situations, this means taking a somewhat more gradual and more moderate approach to monetary policy, aiming to achieve the inflation target at a somewhat longer horizon than would be technically feasible (perhaps three to four quarters). It also means accepting that inflation will, in the short term, deviate, sometimes quite a bit, from the inflation target. The SARB should be more flexible towards the attainment of the inflation target.

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Despite inflation targeting having being successfully implemented in South Africa, the recent Great Recession in the world raised a fundamental question of whether it is not now appropriate for central banks to also keep an eye on asset price or on financial stability issues, over and above focusing only on inflation. However it should be noted that the central bank should be able to assess the appropriate level of assets prices. An increase in asset price is a symptom of overheating economy, which may also find its way back into consumer price inflation. A rapid increase in assets prices has negative repercussions for the economy as a whole, especially when the gains in asset prices do not seem solidly supported by earnings prospects.

The central bank should consider financial stability issues. Before 2005, the goal of the central bank was to achieve and maintain financial stability before being changed to achievement and maintenance of price stability. The financial stability should therefore be a secondary goal of the central bank. In most situations the neglect of financial stability responsibility has been due to a lack of a proper tool as opposed to when the central bank deals with price stability, wherein the policy interest rate is recognised as a tool. The BIS (2010) suggested a *Tinbergen* principle, which says that there should at least as many instruments as objectives to dealing with financial stability issues.

South Africa has adopted a flexible exchange rate system; this means that the movement of the exchange rate is determined by the market. However, there have been questions whether the central bank should intervene in the exchange rate or not.

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In this paper, it has been shown that the exchange rate channel of transmission mechanism is effective. This therefore suggests that exchange rate matters as far as both output and inflation are concerned. The central bank must take into account developments in the foreign exchange rate when deciding upon the monetary policy actions required within an economy. This is now possible since the move from bi-monthly meetings to monthly meetings to respond to development of exchange rate timeously.

The gradual approach in accumulating reserves when exchange rate favours South Africa should be encouraged.

7.3 Future research

Inflation targeting as monetary framework was found to be appropriate for South Africa. However there remains a question with regards to what is an appropriate target. In South Africa the target is set by the Minister of Finance with no explanation of the rationale behind the choice of the specific target. In particular, the relationship between inflation and output growth has been found to be nonlinear, with a threshold level of inflation above which inflation exerts a negative effect on growth, but below which it has no effect on growth. For example, Khan and Senhadji (2000) has found the threshold to be 1-3 per cent for industrial countries and 7-11 per cent for developing countries, with a very wide confidence interval for the latter (1 to 20 per cent confidence interval at a 90% confidence region). Epstein (2007) stated that for developing countries, an inflation of just below 15 per cent is not harmful for economic growth. Despite South Africa's inflation target set between 3 and 6 per cent, the remaining question is, what is the appropriate target level that the country can adhere to without impacting on economic growth?

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APPENDICES

Appendix 1: X 12 ARIMA program of the U.S Census Bureau

```
This method modifies the X-11 variant of Census Method II
          by J. Shiskin A.H. Young and J.C. Musgrave of February, 1967.
         and the X-11-ARIMA program based on the methodological research
          developed by Estela Bee Dagum, Chief of the Seasonal Adjustment
           and Time Series Staff of Statistics Canada, September, 1979.

      Primary Programmers: Brian Monsell, Mark Otto


     Series Title- PRODINDEX
     Series Name- PRODINDEX
     08/13/11    15:00:14.90

        -Period covered-  1st month,2002 to 12th month,2010
        -Type of run - multiplicative seasonal adjustment

        -Sigma limits for graduating extreme values are 1.5 and 2.5 .
        -3x3 moving average used in section 1 of each iteration,
         3x5 moving average in section 2 of iterations B and C,
         moving average for final seasonal factors chosen by Global MSR.
        -Spectral plots generated for selected series
        -Spectral plots generated for series starting in 2003.Jan

 FILE SAVE REQUESTS (* indicates file exists and will be overwritten)
  C:\Users\18577318\AppData\ev_temp\EVX12TMP.d11  final seasonally adjusted data
  C:\Users\18577318\AppData\ev_temp\EVX12TMP.out  program output file
  C:\Users\18577318\AppData\ev_temp\EVX12TMP.err  program error file
```

PRODINDEX PAGE 1, SERIES PRODINDEX

Contents of spc file C:\Users\18577318\AppData\ev_temp\EVX12TMP.spc

```
Line #
------
     1: series{
     2:      title = "PRODINDEX"
     3:      start = 2002.1
     4:      name = "PRODINDEX"
     5:      file = "C:\Users\18577318\AppData\ev_temp\EVX12TMP.DAT"
     6: }
     7:
     8: x11{
     9:      sigmalim = (1.5,2.5)
    10:      print = ( +ftestd8 +residualseasf +x11diag +qstat +specsa +specirr)
    11:      save = ( D11)
    12:      savelog = (q,q2,fb1,fd8,msf)
    13: }
    14:
```

PRODINDEX PAGE 2, SERIES PRODINDEX

A 1 Time series data (for the span analyzed)
From 2002.Jan to 2010.Dec
Observations 108

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec	TOTAL
2002	83. 97.	92. 98.	96. 99.	93. 106.	98. 106.	95. 82.	1144.
2003	84. 97.	93. 94.	96. 96.	89. 103.	94. 102.	93. 81.	1121.
2004	83. 100.	92. 100.	101. 102.	89. 108.	99. 108.	98. 87.	1165.
2005	85. 101.	96. 103.	102. 108.	96. 107.	100. 111.	100. 91.	1200.
2006	90. 107.	97. 109.	106. 110.	95. 117.	104. 119.	107. 97.	1258.
2007	95. 111.	105. 114.	114. 109.	101. 124.	113. 124.	109. 97.	1316.
2008	96. 115.	109. 115.	112. 114.	112. 121.	114. 114.	115. 88.	1325.
2009	84. 99.	92. 97.	99. 101.	87. 109.	94. 109.	95. 91.	1154.
2010	86. 106.	94. 102.	105. 102.	95. 112.	102. 114.	104. 91.	1211.
AVGE	87. 104.	96. 103.	103. 105.	95. 112.	102. 112.	102. 89.	

Table Total- 10893.80 Mean- 100.87 Std. Dev.- 9.68
Min - 80.70 Max - 124.20

PRODINDEX PAGE 3, SERIES PRODINDEX

C 17 Final weights for irregular component
From 2002.Jan to 2010.Dec
Observations 108
Lower sigma limit 1.50
Upper sigma limit 2.50

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec	S.D.
2002	100.0	100.0	100.0	0.0	100.0	100.0	
	100.0	100.0	100.0	100.0	100.0	43.5	1.0
2003	100.0	100.0	100.0	100.0	100.0	100.0	
	90.0	100.0	100.0	100.0	100.0	100.0	1.0
2004	100.0	100.0	0.0	100.0	100.0	100.0	
	100.0	100.0	100.0	100.0	100.0	100.0	1.0
2005	100.0	100.0	100.0	0.0	100.0	100.0	
	100.0	100.0	0.0	0.0	100.0	59.9	1.1
2006	100.0	100.0	100.0	100.0	100.0	100.0	
	100.0	100.0	100.0	97.8	100.0	100.0	1.1
2007	100.0	100.0	100.0	100.0	0.0	100.0	
	100.0	100.0	0.0	100.0	100.0	64.3	1.1
2008	100.0	100.0	0.0	0.0	100.0	100.0	
	100.0	100.0	100.0	100.0	100.0	100.0	1.1
2009	100.0	100.0	100.0	100.0	100.0	100.0	
	100.0	100.0	100.0	100.0	100.0	14.2	1.1
2010	100.0	0.0	100.0	100.0	100.0	100.0	
	100.0	100.0	100.0	100.0	100.0	100.0	1.1

PRODINDEX PAGE 4, SERIES PRODINDEX

D 8 Final unmodified SI ratios
From 2002.Jan to 2010.Dec
Observations 108

	Jan Jul	Feb Aug	Mar Sep	Apr Oct	May Nov	Jun Dec	AVGE
2002	88.2	97.2	101.3	97.6	103.1	99.8	
	101.5	102.3	103.8	111.0	110.9	85.7	100.2
2003	88.3	97.6	101.7	94.6	100.4	100.3	
	103.9	101.4	103.9	111.7	109.6	86.7	100.0
2004	88.2	96.9	105.9	92.7	102.1	100.5	
	102.5	102.5	104.4	110.4	109.7	88.7	100.4
2005	86.7	97.0	103.0	97.3	101.2	100.7	
	101.2	103.2	106.9	105.9	109.2	89.9	100.2
2006	88.2	94.8	103.6	92.4	100.4	102.0	
	102.3	103.2	103.6	109.7	110.6	89.3	100.0
2007	87.2	95.7	103.6	92.2	103.8	100.0	
	101.7	104.3	98.9	112.2	111.8	86.4	99.8
2008	85.5	96.0	98.5	98.1	100.3	101.4	
	102.5	103.6	105.0	113.9	110.4	87.1	100.2
2009	84.9	95.0	103.5	92.1	99.9	100.9	
	104.9	101.9	105.2	112.5	110.1	90.6	100.1
2010	85.4	92.4	102.7	92.3	99.6	102.3	
	105.4	101.8	102.4	111.7	112.8	89.6	99.9
AVGE	87.0	95.8	102.7	94.4	101.2	100.9	
	102.9	102.7	103.8	111.0	110.6	88.2	

Table Total- 10809.89 Mean- 100.09 Std. Dev.- 7.42
Min - 84.93 Max - 113.93

PRODINDEX PAGE 5, SERIES PRODINDEX

D 8.A F-tests for seasonality

Test for the presence of seasonality assuming stability.

	Sum of Squares	Dgrs.of Freedom	Mean Square	F-Value
Between months	5661.0033	11	514.63666	170.845**
Residual	289.1806	96	3.01230	
Total	5950.1838	107		

**Seasonality present at the 0.1 per cent level.

Nonparametric Test for the Presence of Seasonality Assuming Stability

Kruskal-Wallis Statistic	Degrees of Freedom	Probability Level
96.8170	11	0.000%

Seasonality present at the one percent level.

Moving Seasonality Test

	Sum of Squares	Dgrs.of Freedom	Mean Square	F-value
Between Years	26.0016	8	3.250204	1.268
Error	225.6280	88	2.563954	

No evidence of moving seasonality at the five percent level.

COMBINED TEST FOR THE PRESENCE OF IDENTIFIABLE SEASONALITY

IDENTIFIABLE SEASONALITY PRESENT

Appendix 2: Autocorrelation LM Test

VAR Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 11/07/11 Time: 17:13
Sample: 2000M01 2008M04
Included observations: 100

Lags	LM-Stat	Prob
1	48.69760	0.0000
2	51.89103	0.0000
3	17.34451	0.3636
4	10.06565	0.8632

Probs from chi-square with 16 df.

Appendix 3: VAR stability Check AR Roots

Roots of Characteristic Polynomial
Endogenous variables: LOG_CPI LOG_EX LOG_GDP LOG_REPO
Exogenous variables: C
Lag specification: 1 2
Date: 11/07/11 Time: 17:09

Root	Modulus
0.971577	0.971577
0.960657 - 0.063172i	0.962732
0.960657 + 0.063172i	0.962732
0.869480	0.869480
-0.535731	0.535731
-0.167158	0.167158
0.146509 - 0.052963i	0.155788
0.146509 + 0.052963i	0.155788

No root lies outside the unit circle.
VAR satisfies the stability condition.