

# **The determinants of inflation in South Africa: 1997-2011**

**Name : Tlamelo Phramencia Phetlhu**

This dissertation is submitted in partial fulfilment of the requirement for the degree  
Master of Business Administration at North West University, Mafikeng Campus

**Supervisor : Dr Mike Sekwila**

**October 2012**

|                         |
|-------------------------|
| <b>LIBRARY</b>          |
| <b>MAFIKENG CAMPIJS</b> |
| CALL NO.:               |
| 2021 -02- 1 1           |

## **Abstract**

This study targeted the a cause-effect relationship pertaining to the CPI inflation in South Africa and the core variables causing it. The result is a set of scenarios of effects on CPI inflation due to the core variables, the corresponding transitional probability matrices and the resulting Markov's chains for forecasting CPI inflation. The core variables have been identified using the findings of an in-depth literature review. The core variables are: total government expenditures, total private expenditures, exchange rate (USD to ZAR) and taxation. A five year sample has been taken from RBSA and OECD sources. First of all, a Pearson's correlation testing has been conducted to estimate the approximate transitional probabilities. Thereafter, four scenarios were defined to arrive at the final Markov's chains. Based on the findings, the current scenario of CPI inflation in South Africa has been discussed, compared with the past, and a method of forecasting CPI inflation using the Markov's chains is proposed. In addition, a discussion of how the Markov's chains can be modified by moving the five year (or larger sample) ahead has been presented. In the future, it is proposed that a benchmark be created by conducting a similar analysis on the comparable countries such that a better view of national performance of South Africa can be gauged.

## **Acknowledgements**

Firstly, I would like to dedicate this research to my mother Keneilwe Gladys Phetlhu, and my sisters for the support over the of couple years. Secondly, Thanks to all the people who have helped and inspired me during my research.

A special thanks go to my supervisor, Dr Mike Sekwila, for his guidance during my research. His perpetual energy and enthusiasm motivated all his advisees, including me. In addition, he was always accessible and willing to help his students with their research. As a result, research life become smooth and rewarding for me.

Last but not least, thanks be to God for my life through all tests in the past years. You have made my life more bountiful. May your name be exalted, honoured, and glorified.

## **Declaration of Authenticity**

I declare that all material presented in my research is my own work and I've acknowledged whatever has been adapted from other sources. I understand that if at any time it is shown that I have significantly misrepresented any material presented to University of North West, any action could be taken against me.

[.....]

Tlamelo Phetlhu

Date:

[.....]

Dr Mike Sekwila

Date:

## Table of Contents

|                                          |                         |
|------------------------------------------|-------------------------|
| List of Figures:                         | <u>9</u> <del>10</del>  |
| List of Tables:                          | <u>11</u> <del>11</del> |
| Chapter 1: Introduction                  | <u>11</u> <del>12</del> |
| 1.1 INTRODUCTION                         | <u>11</u> <del>12</del> |
| 1.2 BACKGROUND                           | <u>11</u> <del>12</del> |
| 1.2.1.GOVERNMENT SPENDING                | <u>12</u> <del>13</del> |
| 1.2.2 PROBLEMS ASSOCIATED WITH INFLATION | <u>13</u> <del>14</del> |
| 1.3 PROBLEM STATEMENT                    | <u>15</u> <del>16</del> |
| 1.4 PURPOSE                              | <u>16</u> <del>17</del> |
| 1.5 RESEARCH AIM                         | <u>16</u> <del>17</del> |
| 1.6 OBJECTIVES                           | <u>16</u> <del>17</del> |
| 1.7 RESEARCH QUESTIONS                   | <u>17</u> <del>17</del> |
| 1.7.1 PRIMARY RESEARCH QUESTION          | <u>17</u> <del>18</del> |
| 1.7.2 SECONDARY RESEARCH QUESTION        | <u>17</u> <del>18</del> |
| 1.8 INTENDED OUTCOMES                    | <u>17</u> <del>18</del> |
| 1.9 SIGNIFICANCE OF THE STUDY            | <u>18</u> <del>19</del> |
| 1.10 RESEARCH METHODOLOGY                | <u>19</u> <del>20</del> |
| 1.10.1 DATA COLLECTION                   | <u>20</u> <del>20</del> |
| 1.10.2 MARKOV CHAIN                      | <u>20</u> <del>21</del> |
| 1.11 STUDY LAYOUT                        | <u>21</u> <del>21</del> |
| 1.12 SUMMARY OF CHAPTER 1                | <u>21</u> <del>22</del> |

|                                                                                    |                                       |
|------------------------------------------------------------------------------------|---------------------------------------|
| Chapter 2: Literature Review                                                       | <u>2223</u>                           |
| 2.1 INTRODUCTION TO INFLATION AND ITS ENABLERS                                     | <u>2223</u>                           |
| 2.2 THE IMPACT OF INFLATION ON NATIONAL ECONOMIC GROWTH                            | <u>2425</u>                           |
| 2.3 A REVIEW OF MACRO-ECONOMIC VARIABLES AND POLICIES THAT AFFECT PRICES AND WAGES | <u>2627</u>                           |
| 2.3.1 INTEREST RATES                                                               | <u>2627</u>                           |
| 2.3.2 EXCHANGE RATES                                                               | <u>2930</u>                           |
| 2.3.3 TAXATION                                                                     | <u>3132</u>                           |
| 2.3.4 GOVERNMENT SPENDING                                                          | <u>3334</u>                           |
| 2.3.5 CENTRAL BANK MONETARY POLICIES                                               | <u>3637</u>                           |
| 2.3.6 EMPLOYMENT                                                                   | <u>4041</u>                           |
| 2.4 CRITICAL DISCUSSION: RESEARCHER'S OWN VIEWS ON POLICIES TO CONTROL INFLATION   | <u>4244</u>                           |
| 2.5 INFLATION IN SOUTH AFRICA                                                      | <u>4546</u>                           |
| 2.6 SUMMARY OF CHAPTER 2                                                           | <u>4950</u>                           |
| Chapter 3: Research Methodology                                                    | <u>5152</u>                           |
| 3.1 INTRODUCTION TO THE RESEARCH                                                   | <u>ERROR! BOOKMARK NOT DEFINED.52</u> |
| 3.1.1 CONTEXT                                                                      | <u>5152</u>                           |
| 3.2 RESEARCH PHILOSOPHY AND STRATEGIES                                             | <u>5253</u>                           |
| 3.2.1 A REVIEW OF RESEARCH PHILOSOPHIES AND STRATEGIES                             | <u>5253</u>                           |
| 3.2.2 PHILOSOPHY AND STRATEGY CHOSEN FOR THIS RESEARCH                             | <u>5354</u>                           |
| 3.3 RESEARCH METHODOLOGY                                                           | <u>5455</u>                           |
| 3.3.1 QUALITATIVE VERSUS QUANTITATIVE METHODOLOGY                                  | <u>5455</u>                           |

|                                                                                 |                      |
|---------------------------------------------------------------------------------|----------------------|
| <b>3.3.2 CHOICE OF METHODOLOGY IN THIS RESEARCH</b>                             | <b><u>5556</u></b>   |
| <b>3.4 SUMMARY OF CHAPTER 3</b>                                                 | <b><u>5657</u></b>   |
| <b>Chapter 4: Research methods, data collection and description of the tool</b> | <b><u>5758</u></b>   |
| <b>4.1 RESEARCH METHODS</b>                                                     | <b><u>5758</u></b>   |
| <b>4.1.1 A REVIEW OF RESEARCH METHODS</b>                                       | <b><u>5758</u></b>   |
| <b>4.1.2 CHOICE OF METHODS FOR THIS RESEARCH</b>                                | <b><u>5960</u></b>   |
| <b>4.2 SAMPLING, DATA COLLECTION AND ANALYSIS</b>                               | <b><u>6061</u></b>   |
| <b>4.2.1 REVIEW OF SAMPLING, DATA COLLECTION AND ANALYSIS METHODS</b>           | <b><u>6061</u></b>   |
| <b>4.2.2 A REVIEW OF MARKOV CHAIN ANALYSIS</b>                                  | <b><u>6263</u></b>   |
| <b>4.2.3 APPROACH FOLLOWED IN THIS RESEARCH</b>                                 | <b><u>6566</u></b>   |
| <b>4.3 ETHICAL CONSIDERATIONS</b>                                               | <b><u>6768</u></b>   |
| <b>4.4 SUMMARY OF CHAPTER 4</b>                                                 | <b><u>6768</u></b>   |
| <b>Chapter 5: Data organisation and analysis</b>                                | <b><u>6869</u></b>   |
| <b>5.1 TABULATION AND STATISTICAL ANALYSIS OF DATA</b>                          | <b><u>6869</u></b>   |
| <b>5.2 MARKOV'S CHAIN ANALYSIS</b>                                              | <b><u>8081</u></b>   |
| <b>5.3 DISCUSSIONS</b>                                                          | <b><u>8687</u></b>   |
| <b>5.4 SUMMARY OF CHAPTER 5</b>                                                 | <b><u>9192</u></b>   |
| <b>Chapter 6: Conclusions and Recommendations</b>                               | <b><u>9293</u></b>   |
| <b>6.1 CONCLUSIONS</b>                                                          | <b><u>9293</u></b>   |
| <b>6.2 RECOMMENDATIONS</b>                                                      | <b><u>9899</u></b>   |
| <b>6.3 SUGGESTIONS FOR FUTURE STUDIES</b>                                       | <b><u>99100</u></b>  |
| <b>6.4 SUMMARY OF CHAPTER 6</b>                                                 | <b><u>100100</u></b> |

7. References

100404

Appendix A

111444

## List of Tables:

|                                                                                                                                                              |             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Table 1: Differences between qualitative and quantitative methodologies.....                                                                                 | <u>5455</u> |
| Table 2: Historical data of private and government total expenditures, exchange rate<br>and CPI inflation rate.....                                          | <u>6869</u> |
| Table 3: Correlation analysis between the variables stated in Table 2 (private and<br>government expenditures and exchange rate) and CPI inflation rate..... | <u>7071</u> |

## List of Figures:

|                                                                                                                                                                                                                      |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Figure 1: Regression coefficients on regression lines plotting between growth rate of excess money and inflation with excess money growth being less than 10% and less than 20% (Dwyer and Fisher, 2009:1224) .....  | <u>3738</u> |
| Figure 2: Regression coefficients on regression lines plotting between growth rate of excess money and inflation with excess money growth being less than 50% and less than 100% (Dwyer and Fisher, 2009:1225) ..... | <u>3839</u> |
| Figure 3: Monetary transmission mechanism in South Africa (Smal and de Jager, 2001:5)                                                                                                                                | <u>4749</u> |
| Figure 4: Mathematical modeling chart (Joubert and Steyn, 2003:92).....                                                                                                                                              | <u>5960</u> |
| Figure 5: Time series plotting of the four variables: private and government spending, exchange rate and CPI inflation .....                                                                                         | <u>7374</u> |
| Figure 6: Time series plotting of exchange rate and CPI inflation.....                                                                                                                                               | <u>7475</u> |
| Figure 7: Direct Tax slabs of past five years in South Africa<br>( <a href="http://www.taxconsulting.co.za/tax-guide-2007.php">http://www.taxconsulting.co.za/tax-guide-2007.php</a> ).....                          | <u>7576</u> |
| Figure 8: Markov's chain for scenario A.....                                                                                                                                                                         | <u>8182</u> |
| Figure 9: Markov's chain for scenario B.....                                                                                                                                                                         | <u>8384</u> |
| Figure 9: Markov's chain for scenario C .....                                                                                                                                                                        | <u>8485</u> |
| Figure 11: Markov's chain for scenario D .....                                                                                                                                                                       | <u>8586</u> |

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 INTRODUCTION**

Inflation is defined as an upward movement of the general price level of most of the essential goods and services needed by the natives of an economy to sustain their well-being (Harriott, 2000:6).

Inflation is a very critical variable that affects the socio-economic lifestyles and overall well-being of the people of a nation (Salmanpour and Bahloli, 2011:1226). It is a complex variable and is highly unpredictable due to uncertainties in the factors that cause inflation (Salmanpour and Bahloli, 2011:1226). In general, inflation is viewed as a hindrance to the overall economic growth of a nation given that it affects the purchasing power of people and entities (Salmanpour and Bahloli, 2011:1227).

Inflation can have either a positive or a negative effect on the economy including loss of stability in the real value of money and other monetary items over time, with positive effects including mitigation of economic recessions and debt relief by reducing the real level of debt.

### **1.2 BACKGROUND**

More often, the South African economy experiences a short-term disturbance in inflation caused by the exchange rate, investment, government spending and tax. As a result, inflation becomes a major concern in South Africa. The focus of this study is to find

ways, means and solutions for predicting the probability of inflation, together with variables causing it, whether they would increase or decrease.

Songezo Zibi (City Press, 2011) reported that the National Treasury had deemed it fit to put out a draft discussion document to pave the way for the government to pass legislation making it difficult for people to withdraw their pension benefits when changing jobs. The intended legislation is further aimed at assisting with and focussing on the curbing of inflation as far as the subjects are concerned.

For the purpose of enhancing the economy, there is also a need to introduce tax legislation that will support saving, in the sense that the interest earned on savings must be tax free. In a way, this will assist the community and the country in dealing with a high rate of inflation in South Africa. It is also imperative for the proposed legislation to allow contributors to have access to their benefits.

### **1.2.1. Government Spending**

High and stable GDP is associated with economic prosperity and enhanced economic growth. High GDP may lead to higher income for consumers and could facilitate investment by firms and government. High GDP may lead to economic instability and increased cost to the economy. Lower inflation may facilitate economic stability and investment planning by firms, leading to higher rates of economic growth. Unemployment reflects an underutilised resource, but labour market concerns are now switching towards productivity. The balance of payments reflects a country's trading position with the rest of the world. Just like individuals, an economy has to be concerned about running up a long-term deficit. It is important to recognize that a

government may not be capable of targeting all macro-economic variables. For example, higher GDP may lead to higher inflation (Begg & Ward, 2004).

According to Begg & Ward (2004), conflicts exist because of a misalignment of interests. Without government control, firms can pollute the environment freely. The cost of pollution is, instead, carried by society. By making the firm bear the responsibility and cost of pollution, the firm's and society's interests are aligned. The way to achieve this is to tax the firm if it pollutes, and perhaps even provide it with subsidies if it tries to operate pollution-free. More generally, solutions to misalignment of interests are the use of financial incentives to change the behaviour of one of the parties.

Sorensen & Whitta-Jacobsen (2005) explain that the co-movements in different economic variables over the business cycle may be measured by their coefficients of correlation with GDP. Private investment, consumption and imports, all have a strong positive correlation with GDP. Employment also displays a clear positive correlation with GDP, but it is a lagging variable, being more strongly correlated with the GDP of the two previous quarters than with current GDP. Labour productivity tends to vary positively with GDP, and so does inflation in most countries, although the latter correlation is not very strong. The nominal short-term interest rate tends to go up in the two quarters, following a rise in GDP, reflecting a tightening of monetary policy.

### **1.2.2 Problems associated with inflation**

Uncertainty about future inflation has two costs: firstly it makes planning more complex, raising the real resources society uses to make plans and do business. Secondly,

people dislike risks. When people make nominal contracts, uncertainty about inflation means uncertainty about the eventual real value of the nominal bargains currently made. This is true cost of inflation, if a lower average level of inflation also reduces uncertainty about inflation. This may be a reason to aim for a low inflation rate. The institutions that commit the government to low inflation may also reduce the scope for uncertainty about inflation. If so, lower average inflation has a real benefit because it also diminishes uncertainty (Begg *et al.*, 2005).

According to Lapin (1976), the main distinguishing feature of a Markov process is that it is concerned with the probabilities for being in various states at any given time and moving from one state to another. A further characteristic of a Markov process is that in the long-run, the probability of being in a particular state will be constant over time and will hold, regardless of the state probability that applied in the beginning .

A key property of a Markov process is that it has no memory in the usual sense; yielding some useful mathematical properties. A Markov process serves as a convenient model for many important business applications, especially in marketing and includes some inventory and queuing situations and various operations. Inflation is a very critical variable that affects the socio-economic lifestyles and overall well-being of the people of a nation (Salmanpour and Bahloli, 2011:1226). It is a complex variable which is highly unpredictable due to uncertainties in the factors that cause inflation (Salmanpour and Bahloli, 2011:1226). In general, inflation is viewed as a hindrance to the overall economic growth of a nation, given that it affects the purchasing power of people and

entities (Salmanpour and Bahloli, 2011:1227). Hence, when inflation is low in an economy, the central bank tries to maintain it as long as possible and when inflation rises, the central bank faces uncertainty about which monetary policy will bring it down to acceptable levels (Salmanpour and Bahloli, 2011:1227).

### **1.3 PROBLEM STATEMENT**

South Africa is experiencing a sudden increase in inflation caused by the exchange rate, investment spending, government spending and tax. High inflation is a major concern to South Africa. The focus of the study is to establish what the probability is that inflation, together with variables causing it, will increase or decrease using a Markov chain and available historical data.

The biggest immediate threat to South Africa's continued economic growth is the capacity constraint that has increased because of the country's strong economic performance. A weak demand contains inflation pressure and inflation expectations should be more forward-looking. Inflation in South Africa remains persistently high, although pressures can be contained by weak demand and a relatively strong rand in order to reduce volatility of inflation expectations and to make the rand more sustainable. Progress has to be made to attain the inflation target and significant improvements have to be made to the previous government's policy by making the Reserve Bank more accountable for its actions and to increase the transparency and predictability of monetary policy.

When dealing with this subject, it is important to look at the close relationship between fluctuations and output fluctuations and a clear tendency for stock price movements to lead in output.

## **1.4 PURPOSE**

The purpose of this dissertation is to make an academic presentation on the causes of high inflation in South Africa, as well as the recommendations to reduce it without compromising on growth and development. This dissertation is expected to add value to the existing empirical knowledge on inflation in South Africa.

## **1.5 RESEARCH AIM**

The aim of this study is to establish the probability that inflation, together with variables causing it, will increase or decrease in South Africa and the strategies beneficial to the nation to optimise outputs and reduce inflation.

## **1.6 OBJECTIVES**

The study seeks to achieve the following objectives:

- (a) To investigate the projected path of inflation rate using available historical data.
- (b) To identify the relevant variables causing inflation in South Africa., and
- (c) To recommend appropriate strategies to optimise output and reduce inflation so that growth and prosperity keep improving while inflation is contained or reduced.

## **1.7 RESEARCH questions**

The following are the primary and secondary research questions of this study.

### **1.7.1 Primary research question**

The primary research question is stated as below:

What is the probability that inflation, together with variables causing it, will increase or decrease in South Africa?

### **1.7.2 Secondary research question**

The secondary research questions are stated below:

- (a) Why is South Africa experiencing a sudden increase in inflation?
- (b) Why is managing GDP, inflation, unemployment and the balance of payment important?
- (c) How are the various macro-economic variables affecting inflation and output in South Africa?

## **1.8 INTENDED OUTCOMES**

The researcher firstly wants to establish a correlation between the four chosen variables and inflation in South Africa, using linear regression analysis to evolve the Pearson coefficients. The Pearson coefficients vary from 0 to  $-1$  for a negative correlation and 0 to  $+1$  for a positive correlation. Based on the values of the Pearson coefficients derived

from the data set (monthly values taken from Reserve Bank website), the Markov transition matrix is formed and the Markov chain is completed. The Markov chain does not incorporate historical data and hence the resulting Pearson coefficients have been treated as indicators of present state correlations to apply in the Markov chain, and the future (expected) correlations are computed. This method has its own limitation because the Pearson coefficient values between the causal variables (exchange rate, investment spending, government spending and taxes) and the output variable (inflation), in the data set, are treated as present values in the Markov chain. However, the technique used, is expected to prove or disprove the hypotheses with a reasonable level of validity and reliability, given that one of the most trusted data sources of South Africa (on the Reserve Bank website) has been used.

## **1.9 SIGNIFICANCE OF THE STUDY**

The research is expected to ensure an empirical generalisation about the causal factors of inflation in South Africa. The generalisation may be useful for existing research aspirants interested in this subject matter as an academic reference. The researcher wants to disseminate the resulting knowledge through conference participation and journal papers. To achieve this, the researcher will try to prepare the study results for publication in a journal dedicated to South African affairs. The researcher is also keen to participate in conferences and is looking forward for an opportunity to present the knowledge gained. In this way, it is expected that the dissertation will ensure a sound academic contribution in South Africa pertaining to the nation's macro-economic affairs.

On the personal front, it is expected that the efforts applied in finishing this report will enable the researcher to acquire skills of proving hypotheses employing advanced statistical techniques. The researcher expects to use these skills for conducting management, finance and economics related studies in future and to make useful contributions to the analysts and decision-making think tanks that may be the end-users of such reports.

## **1.10 RESEARCH METHODOLOGY**

Quantitative research is a form of conclusive research involving large representative samples and fairly structured data collection procedures, and a primary role of quantitative research is to test hypotheses (Struwig and Stead 2001:4). According to Denzin & Lincoln (in Welman *et al.*, 2005) quantitative research methods do not involve the investigation of processes but emphasise the measurement and analysis of causal relationships between variables within a value-free context. A hypothesis is a proposition or statement regarding the relationship between two or more variables (phenomena) and a hypothesis can be tested. As a result of dealing with numbers, the quantitative researcher uses a process of analysis that is based on complex structured methods to confirm or disprove hypotheses. Quantitative researchers try to keep the research process as stable as possible. They also control the investigation and structure of the research situation in order to identify and isolate variables. Specific measurement instruments are used to collect data (Welman *et al.*, 2005:9).

### **1.10.1 Data Collection**

Analysis of data depends on the type of study and type of data used. Since the study involves the Markov chain, to find the future state of the inflation rate using the present values of the inflation rate, secondary data is used in the analysis. The time series plots for both original and transformed data were used and calculations were also be done.

### **1.10.2 Markov's Chain**

The Markov chain is named after Andrey Markov and is a random process where all information about the future is contained in the present state. One does not need to examine the past to determine the future to be more exact. The process has Markov properties, meaning that future states depend only on the present state and are independent of past states. The main distinguishing feature of a Markov process is that it is concerned with the probabilities of being in various states at any given time, and moving from one state to another. A further characteristic of a Markov process is that the long term probability of being in particular states will be constant over time and will hold regardless of the state's probability that applied in the beginning (Lapin, 2002).

A key property of the Markov process is that it has no memory in the usual sense, yielding some useful mathematical properties. The Markov process serves as a convenient model for many important business applications, especially in marketing, some inventory and queuing situations, and various operations (Lapin, 2002).

## **1.11 STUDY LAYOUT**

In the first Chapter the literature on the subject of inflation and other related topics were reviewed. Chapter two reflects the research methodology to be used in this research. Chapter three also reflects the collection of data, primarily on providing help with the tools and techniques used in the process data collection. The discussion of the results from the model is in Chapter four. Chapter five constitute the, outline the conclusion and recommendation of the study.

## **1.12 SUMMARY OF CHAPTER 1**

In this study the data will be collected from the South African Reserve Bank and be analysed, using a technique called Markov analysis. Graphs will also illustrate the investigation of the exchange rate, investment spending, government spending and tax, to establish whether they have effects of inflation. The steady-state revealed that exchange rate, investment spending, government spending and tax do not affect inflation.

## **CHAPTER 2:**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION TO INFLATION AND ITS ENABLERS**

Inflation is defined as an upward movement of the general price level of most of the essential goods and services needed by the natives of an economy to sustain their well-being (Harriott, 2000:6). Inflation is measured by the change in Consumer Price Index (CPI) that incorporates the prices of most of the essential commodities in an economy (Harriott, 2000:7). The noticeable effect of inflation on people is the reduction of demand for certain commodities because people can purchase lesser products with the same amount of money (Harriott, 2000:8).

Inflation is a very critical variable that affects the socio-economic lifestyles and overall well-being of the people of a nation (Salmanpour and Bahloli, 2011:1226). It is a complex variable and is highly unpredictable due to uncertainties of the factors that encourage inflation (Salmanpour and Bahloli, 2011:1226). In general, inflation is viewed as a hindrance to the overall economic growth of a nation, given that it affects the purchasing power of people and entities (Salmanpour and Bahloli, 2011:1227). Hence, when inflation is low in an economy, the central bank tries to maintain it as long as possible and when it inflates, the central bank faces an uncertainty about which monetary policy will bring it down to acceptable levels (Salmanpour and Bahloli, 2011:1227). Some experts have noted that targeting inflation may cause financial

recession if there are errors in adopting the right monetary policy (Salmanpour and Bahloli, 2011:1228). This may be the effect of high rate of change of inflation if it is high in the country and is being actively targeted by the central bank and the government (Salmanpour and Bahloli, 2011:1225).

A report by HM Treasury (n. d.) stated the following factors that enable inflation in an economy:

- (a) The projections of future price changes
- (b) The demand pressures
- (c) The macro-economic variables and policies that directly or indirectly affect prices and wages

These are dependent variables that are affected by a number of independent variables. The forward looking models for price changes itself cause inflation and they can cause change in demand pressures as well. For example, if there is an expectation of increase in prices of essential commodities (like, food, oil, household consumables, etc.) by a forecasting model published by the government, people tend to purchase more than their daily needs, thus causing inflation in the markets. Demand may change due to the creation of an "output gap" with respect to the current demand, by either reduction of output or increase in demand. For example, reduction in unemployment or increase in general wages tends to increase demand in the marketplace. Hence, all the factors that cause increase in employment and wages tend to increase demand and hence the inflation if an "output gap" is evident (HM Treasury, n. d.).

Comparing the contents presented by Salmanpour and Bahloli (2011:1226-1227) and H.M. Treasury (n. d.), inflation in an economy may be caused by an overall social uplifting of people by the virtue of increase in employment and wages. Does this mean that inflation is positively related to economic growth of a country? This aspect is discussed in the next Section.

## **2.2 THE IMPACT OF INFLATION ON NATIONAL ECONOMIC GROWTH**

Gylfason and Herbertsson (2001:405-410) argued that the relationship between inflation and economic growth cannot be empirically generalised because it depends upon the underlying macro-economic factors that have caused the inflation. They reviewed many reports that have concluded that the reduction in per-capita growth of an economy is much lesser than the increase in inflation from 5 to 50% per year (ranging from – 0.14% to – 4.5%, depending upon the period of a study and the economies included in a study). However, there is some threshold beyond which the per capita growth of a country reduces significantly. Gylfason and Herbertsson (2001:407) marked the threshold at 110%. A general analysis by Gylfason and Herbertsson (2001:424) supports the view of central bankers that inflation has a systematic and lasting long-term effect on economic growth and hence, its stability is essential to ensure sustained economic growth.

However, Guerrero (2006:72-77) presented a detailed analysis to prove that countries that have faced hyperinflation and a slump in economic growth should look at other

factors that might have caused such a scenario. Poor economic condition may be due to many other factors, like – poor governmental policies, inadequate industrial productivity and performance, high corruption and high unemployment. Inflation may be just an outcome of such a scenario. Guerrero (2006:77) sampled the hyperinflation periods of a number of countries that were facing numerous problems that affected their growth. Guerrero (2006:77-78) demonstrated that the inflation levels reduced considerably in these countries once the economic uncertainty was over. Hence, it should be noted that both inflation and economic growth are complex secondary variables that may or may not be related to each other through a one-way causal relationship. Does this mean that inflation targeting is an effective method to produce good results pertaining to economic growth in a country? Mollick, Cabral and Carneiro (2011:537) partially agree with this, stating that “inflation targeting has resulted in positive outcomes when dynamic models have been employed but have resulted in not-so-positive outcomes when static models have been employed”. As explained by Mollick, Cabral and Carneiro (2011:543-546), static modelling of inflation targeting comprises announcing a numerical target that the government and central bank try to achieve by closely monitoring and throttling certain underlying indices. The indices vary by country. For example, emerging economies monitor the population growth index as one of the indices, whereas economies that are highly active in global markets monitor the globalisation index as one of the indices. On the contrary, as explained by Mollick, Cabral and Carneiro (2011:546-549), a number of proxy variables are also monitored that cause dynamic effects on the indices. For example, if an economy is monitoring globalisation index, they may consider certain proxy variables, like – assets related

globalisation, equity related globalisation and trade openness. Inflation targeting in such economies is highly complex but yields better per capita growth results than static modelling, as concluded by Mollick, Cabral and Carneiro (2011:547-548).

In the next Section, the researcher has reviewed the variables that affect prices of commodities and services in an economy, and hence impact inflation.

## **2.3 A REVIEW OF MACRO-ECONOMIC VARIABLES AND POLICIES THAT AFFECT PRICES AND WAGES**

In Section 1.1, the researcher reviewed the article by HM Treasury, which revealed that there can be three factors that enable inflation in an economy – future price projections, demand pressures and the macro-economic variables and policies that affect prices and wages. In this Section, the researcher has conducted a focussed review of the third factor stated as “macro-economic variables and policies that affect prices and wages”.

### **2.3.1 Interest rates**

The relationship between interest rates and expected inflation rate is most popularly known by the Fisher equation, as stated below:

Nominal interest rate := Real interest rate X Expected inflation rate(Ireland, 1996:23)

The nominal interest rate in this equation is defined as the return on investment on a nominal bond in a given period. The real interest rate in this equation is defined as the

return on investment on a real bond in the same period. In Fisher equation, the nominal bond is similar to a US treasury bond. A real bond in the Fisher equation is similar to investing in the cost of one unit of a commodity product at the beginning of the period and getting “N” units of the commodity product at the end of the period at the maturity value of the bond (N may be a fraction or a whole number)(Ireland, 1996:23-24) Crowder and Hoffman (1996:115-116) tested the Fisher equation after tax-adjusting it and found that long-term relationship between nominal and real interest rates holds better than short-term relationships because the shocks in real interest rates are effectively absorbed by the nominal interest rates. Hence, inflation predictions are more accurate when a long-term relationship between nominal and real interest rates are considered.

Modern research studies, however, have empirically proved that both short-term and long-term interest rates affect inflation in an economy. Tillmann (2008:2725-2726) explained the concept of cost channel that directly affects the supply side and hence contributes to the dynamics of inflation (Tillmann, 2008:2725). The concept of cost channel is linked with holding of working capital for bearing the costs of production (Tillmann, 2008:2726). The key agent that plays a role in this dynamics is the financial intermediary (a lending institution) (Tillmann, 2008:2725). Supposing that the companies borrow their working capitals from financial intermediaries, a short-term increase of interest directly inflates the cost of working capital holding by the companies (Tillmann, 2008:2726). This may result in the supply side productivity declining (Tillmann, 2008:2726), and hence causing an “output gap” (a term coined by HM

Treasury n. d. reviewed in Section 1.1). Hence, governing of interest rates can be used by central banks as a tool to govern the supply side outputs by changing their marginal costs and hence the inflation (Tillmann, 2008:2727). This process is called “policy-controlled interest rates” to drive the retail lending rates, whereby the latter is always higher as a result of the lending policies of the financial intermediaries (Tillmann, 2008:2727). The discussion by Tillmann (2008:2724-2727) revealed that even short-term interest rates can also contribute effectively to inflation dynamics. Sometimes, the short-term impact on interest rates can be adverse due to the sudden rise in the prices of most essential commodities. Wu and Ni (2011:4158-4160) believe that sudden shocks in oil prices have shaken even the most stable economies of the world (like the great depression in US) because the monetary policy is tightened by the congress as a response to such adverse oil price shocks. The most natural outcome is the rise of interest rates and the fall of industrial output, thus causing steep increases in inflation (Wu and Ni, 2011:4159). Historically, turbulent oil prices have caused significant impacts on consumer price indices, economic activities, and the average inflation rises even if oil prices subside temporarily during a period (Wu and Ni, 2011:4159-4160).

Reynard (2007:1441) presented weaknesses in monetary policy modelling when including short-term interests and real economic activities. They argued that the monetary developments and price movements are related in such a way that outputs of monetary policies lags real monetary developments in an economy (output gaps) (Reynard, 2007:1464). In fact, price increases are not always mathematically linked with quantity adjustments in the outputs (Reynard, 2007:1464). Sometimes, prices keep on

increasing due to market sentiments even if the output gaps show a reducing trend (Reynard, 2007:1464). The price increase stops only when the output gaps are completely gone and a surplus output is visible in the market (Reynard, 2007:1465). This phenomenon is very difficult to incorporate in inflation projection models if only aggregate monetary demands are included in the models (Reynard, 2007:1465). Reynard (2007:1466) recommended that inflation targeting should not be based on the data of aggregate monetary demand, rather should be wisely based on a number of indicators and models. In such models, governing short-term interest rates may not produce the desired results in the economy. The central banks will have to wait for prolonged periods to witness any tangible effects on inflation, and monitor a number of indicators and models.

### **2.3.2 Exchange rates**

Impact of exchange rates on inflation is higher in dollarized economies than the economies where majority of debt is issued in local currency (Carranza, Galdon-Sanchez and Gomez-Biscarri, 2009:98). The balance sheets in such economies are maintained in US Dollars and hence there is a negative effect on net worth of the companies whenever the value of US Dollar depreciates (Carranza, Galdon-Sanchez and Gomez-Biscarri, 2009:99). The impacts can be on revenues and profitability, as well if the depreciation of US Dollar is with respect to the currencies of countries with which these companies have trading relationships (Carranza, Galdon-Sanchez and Gomez-Biscarri, 2009:99).

Given that there is an indirect impact on the capital budgeting of companies, the output gaps may occur, thus causing a finite impact on inflation (Carranza, Galdon-Sanchez and Gomez-Biscarri, 2009:102). The impact of exchange-rate fluctuations are, however, small on inflation having substantial local production (Garcia, Restrepo and Roger, 2011:1590). But it is always beneficial to incorporate exchange rate fluctuations in inflation targeting, because it is advantageous for handling risk premium shocks and thus avoiding any adverse effect on output performance and inflation (Garcia, Restrepo and Roger, 2011:1591). In general, inflation targeting process takes into account exchange-rate risks in a standard framework (Garcia, Restrepo and Roger, 2011:1591). Exchange rate shocks affect the importers and exporters differently (Aizenman, Hutchison and Noy, 2011:717-719). If a country is facing higher costs in importing US Dollars, the commodity exporters earn better revenues but the commodity importers have to pay higher prices in local currency (Aizenman, Hutchison and Noy, 2011:717). This scenario increases local inflation of imported commodities especially when they are essential and are largely imported as in the case of emerging economies with limited indigenous production (Garcia, Restrepo and Roger, 2011:1591). If the country faces such inflation in most essential commodities (example, oil, food, ) then there can be a widespread cascading effect on overall inflation of the economy (Aizenman, Hutchison and Noy, 2011:718). Arize, Malindretos and Nippani (2004:240-241) carried out an analysis of exchange rate variability and inflation of 82 countries and found that small countries face the significant impact of inflation due to nominal exchange rate fluctuations.

Inflation targeters work upon those control variables that are related to the internal effects of the economy, because external variables largely remain out of control (Aizenman, Hutchison and Noy, 2011:719). For example, many inflation targeters throttle the international currency reserves to control the exchange rates and their impact on inflation (Aizenman, Hutchison and Noy, 2011:719). The most vulnerable to exchange rate shocks are the emerging economies that hardly have any indigenous variables to control (Aizenman, Hutchison and Noy, 2011:718). However, as proved by Alfaro (2005:231), more open economies suffer lesser fluctuations in real interest rates and hence suffer lesser impacts on the inflation. Alfaro (2005:229) also found that the fixed exchange-rate regimes are shielded from exchange rate shocks and their impact on inflation, whereas transparent economies enjoy better results in containing inflation against exchange rate fluctuations over a longer term (they do get affected in shorter runs). To conclude, whether caused by internal or external factors or whether inflation can be lowered or not against exchange rate fluctuations, central bank policy makers should keep a close eye on the variation in real exchange rates because it is a good indicator of future inflation rates in the economy (Aizenman, Hutchison and Noy, 2011:719).

### **2.3.3 Taxation**

In any economy, investors calculate their investments and savings after deducting the taxations. Hence, the Fisher equation needs to be modified to include after tax effects. Assuming that the interest payments in an economy are tax deductible and interest

receipts are taxable, Darby (cited by Gandolfi, 1982:797) has modified the Fisher equation as follows:

After tax real rate of interest =  $(1 - \text{tax rate}) \times \text{nominal rate of interest} - \text{expected rate of inflation}$  (Darby's equation cited by Gandolfi, 1982:797). In fact, the following rearranged presentation of this equation is called Darby's effect:

Nominal rate of interest =  $\text{After tax real rate of interest} + \text{expected rate of inflation} / (1 - \text{tax rate})$  (Gandolfi, 1982:797)

Differentiating this equation with respect to expected rate of inflation, we get:

Change in nominal rate of interest with respect to change in expected rate of inflation =  $1 / (1 - \text{tax rate})$  (Gandolfi, 1982:797)

The taxation in this equation can be a corporate tax on companies or income tax on individuals (Gandolfi, 1982:798). Hence, when taxation is considered, the nominal rate of interest increases by a multiple of expectations in inflation increase (Gandolfi, 1982:798).

Governments levy taxes under their budgetary constraints (Poterba and Rotemberg, 1990:1). Higher taxes can cause higher rate of change of nominal interest rate with respect to inflationary expectations as explained by Darby's effect above. The

government needs consider the inefficiencies caused by the two effects, whether empirically related or not (Poterba and Rotemberg, 1990:2). High inflation can cause economic slowdown and high taxes may reduce investment decisions, savings and labour supplies (Poterba and Rotemberg, 1990:2). If there are higher revenue pressures on the government amidst large scale spending, the government will tend to increase tax rates and will also tend to increase lending interest rates (Poterba and Rotemberg, 1990:3). In this way, the inflation will increase, but by virtue of a consolidated government policy and not just by one of the variables (Poterba and Rotemberg, 1990:3). However, there is a drop in social security of an income tax payer if the government policy makers do not adjust the tax rates for inflation (Immervoll, 2000:13). The low income groups suffer a lot because of the dual impact of increased taxation and inflation (Immervoll, 2000:13). There may be an increase in the price of every essential commodity if direct taxes are levied without adjusting for inflation (Immervoll, 2000:14). The bottom line is that in the end consumers suffer a larger inflation than what is targeted by the government (Immervoll, 2000:14;Koreshkova,2003:2)

#### **2.3.4 Government spending**

Government spending is an important and one of the largest components of the GDP (calculated using the expenditure approach) of a nation (Campillo and Miron, 1997:341). However, it was found that public debt to GDP ratio has a correlation with inflation (Campillo and Miron, 1997:341). The level of government debt indirectly affects inflation because it causes a distorting effect on the national output (Campillo and Miron, 1997:341). However, if the government cares for social welfare (Campillo and Miron,

1997:339) and invests in technologies and infrastructure (Campillo and Miron, 1997:349), it helps in reducing inflation. Hence, the research by Campillo and Miron (1997) discovered that debt to GDP ratio is inversely related to inflation in highly developed nations (p. 344) and directly related to inflation in less developed nations (p. 345).

Inflation is also positively related to a fiscal deficit imbalance, as discovered by Budina and van Wijnbergen (2000:3). By definition, fiscal deficit encompasses all deficits by the government of a nation and not just the deficits due to interest paid on public debts (Budina and van Wijnbergen, 2000:7). However, prolonged fiscal deficit and its imbalance with the monetary policies result in a continuously mounting public debt, which is not good for a nation (Budina and van Wijnbergen, 2000:30). Prolonged fiscal deficit indicates that a government is running at a loss because the total expenditures made by the government exceed the total revenues earned by the government (Budina and van Wijnbergen, 2000:8). It needs to be analysed by a government year-on-year as the percentage of GDP in a given quarter (Budina and van Wijnbergen, 2000:6). In macroeconomics, it is already well established that prolonged and persistent fiscal deficits force the government of a nation to finance it through the creation of money (Catao and Terrones, 2005:531). This phenomenon is called seigniorage and is widely established as an inflation enabler (Catao and Terrones, 2005:531). It is represented by the following formula:

$S = \text{Rate of change of money with respect to Residual Money Balance} \times \text{Residual Money Balance} / \text{Commodity Price Level}$

(Serban, 2002:8)

The commodity price level is dependent upon consumer price index at time "t", which is represented as:

$\text{Consumer price index at time "t"} = \text{Budget deficit at time "t"} / \text{Money balance at the end of time "t"}$  (Serban, 2002:7)

If we divide the numerator and denominator by GDP at time "t", the result is:

$\text{Consumer price index at time "t"} = \text{Ratio of Budget deficit at time "t" to GDP at time "t"} / \text{ratio of Money balance at the end of time "t" to GDP at time "t"}$  (Serban, 2002:7)

This gives an equation relating the inflation level with the size of budget deficit (Serban, 2002:9).

However, Catao and Terrones (2005:549-550) proved that the causal relationship between fiscal deficit and inflation is not always linear. They demonstrated that the linearity increases over sufficiently longer timelines of continued fiscal deficit, and is more persistent in developing countries having high inflation rates (Catao and Terrones, 2005:550). This means that developed countries possess non-linear causal relationship between fiscal deficit and inflation (p. 552). This correlates well with the discussion by Campillo and Miron (1997:339, 349), that governments can reduce the impact of fiscal deficit on inflation by spending in infrastructure development, technology and innovations that cause economic growth in the nation, rather than employing faulty monetary policies. In this context, Talvi and Vegh (2005:156-159) described that the

influence of fiscal deficit on inflation will be minimal if the government expenditures and output are positively correlated. Moreover, they also stated that “fiscal and monetary policy of the country should be stable throughout the assessment period unless some significant deviations in output are evident” (p. 158). To judge this fact empirically, the next sub-section is dedicated to a review of influence of central bank monetary policies on inflation.

### **2.3.5 Central bank monetary policies**

Monetary policies matter in a country because they cause adaptive expectations among the people, confidence (or non-confidence) in the local currency, tendency to spend or save, resulting in variations in spending patterns in the society, and hence an increase or decrease of inflation (Bernasconi and Kirchkamp, 2000:315-316). Brumm (2006:189) described that central bank independence as having a strong negative correlation with inflation in developing nations, whereas Cukierman, Miller and Neyapti (2002:237) found that such a powerful negative correlation emerged only after the liberalisation in developing countries gained significant momentum after the banking reforms. In many developing nations, the central bank has been given independent authority to target inflation (reduction) through appropriate monetary policies, while in developed countries inflation targeting has been persistent since the 1990s (Brimmer, 2002:93). As per studies made by Brimmer (2002:94-97), inflation targeting by central banks had returned positive results in developed as well as developing nations. A recent study by Lin and Ye (2009:118) on thirteen developing countries also revealed that inflation targeting by central banks has returned excellent results in reducing inflation as well as

reducing inflation variability. Their study was mostly in countries that adopted a policy of central bank independence and their monetary policies of inflation targeting in or after 2004.

The central bank monetary policies are linked with money growth in a nation with an understanding that excess money growth has a direct correlation with inflation (Dwyer and Fisher, 2009:1223). The following Figures (1 and 2) show the correlation coefficient (Pearson coefficient) on the regression lines plotted between growth rate of excess money and inflation.

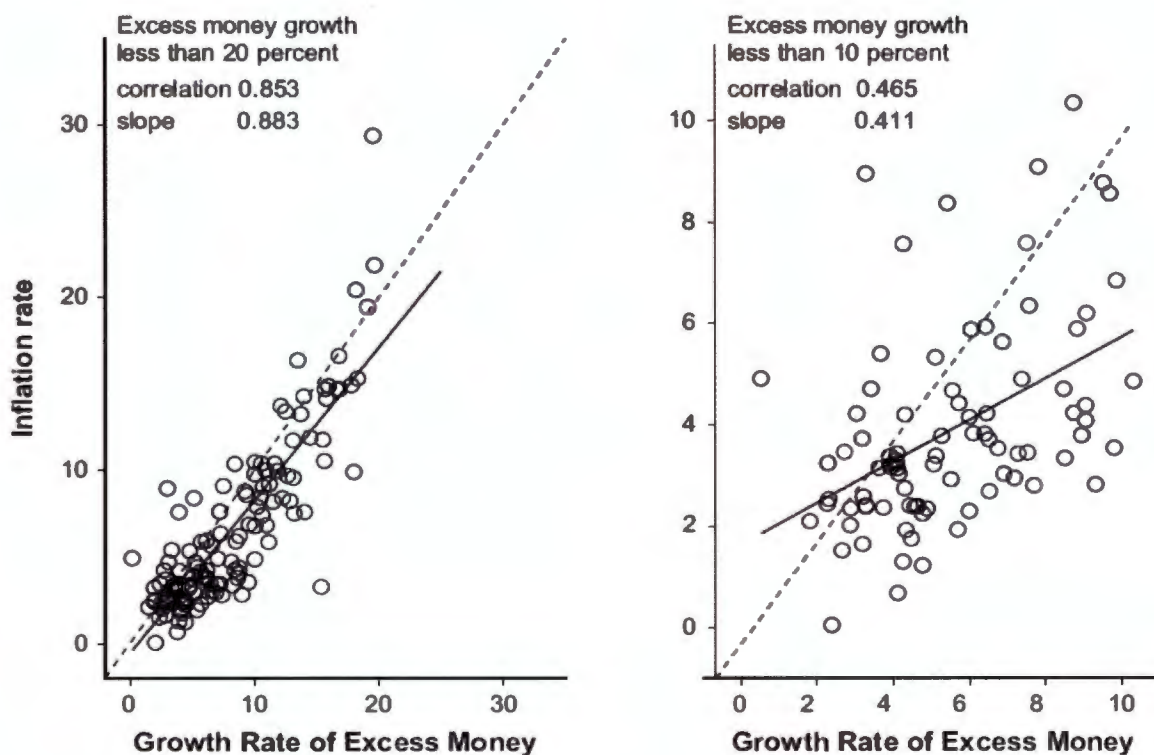


Figure 1: Regression coefficients on regression lines plotting between growth rate of excess money and inflation with excess money growth being less than 10% and less than 20% (Dwyer and Fisher, 2009:1224)

In all the four plots, the solid line is the regression line and the dotted line is a line starting from the origin with a slope of 1.0. The regression correlation is insignificant (0.465) in the plot of excess money growth less than 10%. In this plot, the data points are highly scattered and the slope of the regression line is significantly different from the slope of the dotted line. The regression coefficient has improved (0.853) when the plot is created with excess money growth less than 20%. The data points tend to align with the regression line that has a slope closer to the dotted line. (Dwyer and Fisher, 2009:1224)

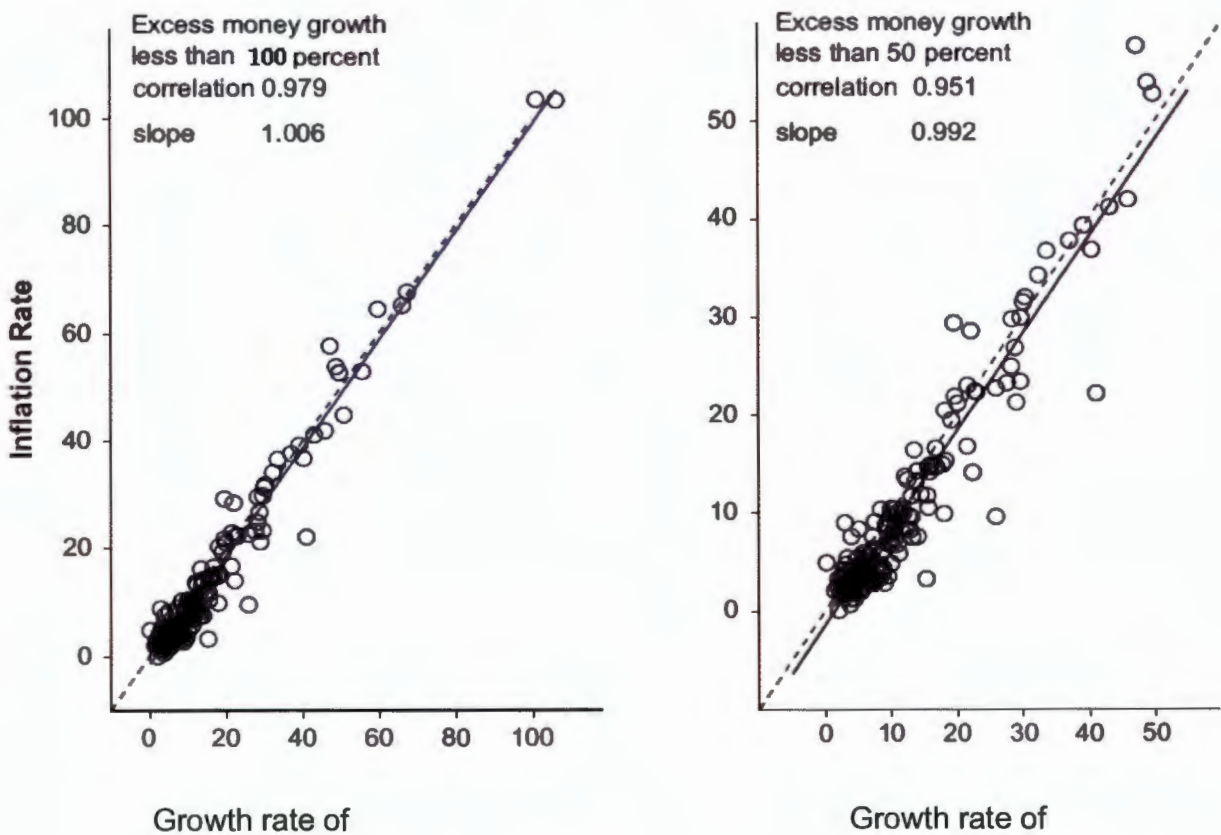


Figure 2: Regression coefficients on regression lines plotting between growth rate of excess money and inflation with excess money growth being less than 50% and less than 100% (Dwyer and Fisher, 2009:1225)

When the regression line plotting is carried out with excess money growth less than 50%, the data points are densely populated along the regression line, barring a few scattered data points drifted away from the line. The regression line is only slightly away from the dotted line. The correlation coefficient has increased to 0.951 in this case. Finally, when the regression line plotting is carried out with excess money growth less than 100%, the data points are densely populated and closely aligned with the regression line that is now almost along the dotted line (Dwyer and Fisher, 2009:1225).

The above analysis shows that the monetary policy of a central bank is positively correlated with inflation if it results in moderate to high excess money growth in the society. Hence, the central bank should tune the monetary policy in such a way that the excess money in the market should be curbed as much as possible, without causing hindrances in achieving the growth targets. This interpretation of the above data is supported by the research by Mollick, Cabral and Carneiro (2011:537). Their research revealed that inflation targeting in under-developed countries results in longer lags in increasing the per capita income output, and shorter lags in fully developed industrialised economies (Mollick, Cabral and Carneiro, 2011:549). Hence, inflation targeting is a good strategy keeping the growth targets in mind (Mollick, Cabral and Carneiro, 2011:548). For example, a developing country cannot afford to curb the

determinants of its growth, like financial globalisation and trade liberalisation (Mollick, Cabral and Carneiro, 2011:537). As further reiterated by Baltensperger, Fischer and Jordan (2007:88), a central bank cannot play the sole role of inflation targeter. It should have a sophisticated toolkit of monetary policies to fuel growth as well as curb inflation (Baltensperger, Fischer and Jordan, 2007:104). In this context, Hung (2003:45-48) advised that central banks should target institutional support liberalisation and inflation targeting in parallel, keeping the growth targets in consideration. Liberal institutional support can release excess money in the markets thus increasing the demand (Hung, 2003:46). If the output does not increase proportionately, there is a high chance that inflation can increase (Hung, 2003:48). However, it should also be noted that growth can generate higher employment and influence increase in wages. This phenomenon can also cause excess money in the markets causing a direct correlation with inflation. This phenomenon may not be in the control of the central banks and is reviewed in the next sub-section.

### **2.3.6 Employment**

Inflation has an indirect relationship with employment, as revealed by (Huang et al, 2010:229). They further revealed that persistent inflation is associated with uncertainty and hence it has a distortive effect on investment projects and corresponding resource allocation (p. 230-231). For example, the public-private partnership scenario in the country may be distorted (p. 231). These effects slow down growth of businesses and hence result in a reduction of employment rate in the country (Huang et al, 2010:229). They sampled a large longitudinal data set from 71 countries, tested for threshold

effects in linear regression results and found that an increase of inflation beyond 8% of GDP causes significant negative effects on productivity and growth (p. 234). Reduction of employment rates is an outcome of negative productivity and growth (Huang et al., 2010:229). However, when a central bank's monetary policies result in the reduction of inflation, this phenomenon reverses and the industry witnesses growth as well as an increased rate of employment (Gali et al., 2001:1239). Increased growth results in increased incentives/bonuses of employees that may result in excess money in the market (Gali et al., 2001:1239). This may result in increase of inflation if a certain threshold is crossed (like, the 10% threshold shown by Dwyer and Fisher, 2009:1224). Hence, employment rate, growth rate, resource allocation and capacity utilisation are cyclical indicators that are linked with inflation through the traditional Phillips curve (Gali et al., 2001:1240). However, it should also be noted that increase in wages may not always result in higher purchasing power and hence inflation (Gali et al., 2001:1263). The increase in wages may also be delinked with development and growth (example: due to high pressures by the labour unions) (Gali., 2001:1263). Such a phenomenon may result in employment stagnation influencing a reduction of rate of employment and hence low inflationary pressures (Gali et al., 2001:1264). This effect was evident in Europe in 1980s that caused a severe recession (Gali et al., 2001:1266).

As per discussion in previous sub-section, central banks can maintain a balance between inflation targeting and meeting growth (and hence employment) targets. However, Surico (2007:306) revealed that central banks normally take the route of the political mandate of the nation. If the mandate is to increase employment, they prefer to

ease the monetary controls by invoking growth friendly policies (Surico, 2007:306). Such a mandate may cause inflationary pressures but if the political mandate allows to ignore it for the time being, they will prefer to do the same (Surico, 2007:306). On the other hand, if the political mandate is to reduce inflationary pressures on the society, the central banks will attempt to tighten the monetary controls (Surico, 2007:307). The economic scenario of the nation, and the political mandate to solve the problems, drives the decision-making by the central banks (Surico, 2007:307). Overall, as revealed by Tillmann (2008:2727), the output of a country should increase along with employment (or wage) growth such that the increase in supply is able to cater to the increase in demand due to excess disburseable money in the society.

Having studied the empirical theories that presented the factors that cause inflation, the researcher, in the next Section, presents a critical discussion on how inflation can be controlled. Thereafter, the researcher reviews the empirical literature on inflation dynamics of South Africa in Section 1.5.

## **2.4 CRITICAL DISCUSSION: RESEARCHER'S OWN VIEWS ON POLICIES TO CONTROL INFLATION**

Inflation is a general increase in consumer price index comprising the most essential commodities purchased by the citizens. It is expressed as a percentage of the GDP of the country. Fundamentally, inflation rises or falls due to a gap in supply and demand. If the output of a country is insufficient to meet the demand, the prices of essential commodities may go up. The prices also go up when the government tries to bridge the

gap through expensive means (like importing essential commodities). The logistics and supply chain costs incurred by the government in importing goods may be higher than local production and hence the prices are raised. The attempts by the government in reducing the fiscal deficit and in reducing the balance of payments may push the prices upwards. The steps that a government may take are: increase taxes to pay debt, stimulate economic growth to generate taxes to pay debt and print more local currency notes to pay debt. The first option will be highly undesirable for the citizens of a country and the third option may result in high inflation because the problem of low output is not solved by simply printing additional currency notes. Hence, the second option makes more sense, because increased output to meet demand makes a country self sufficient. The government can achieve a dual purpose by stimulating growth: reduce supplies from external sources and reduce fiscal deficit. For stimulation of growth, if the government creates a mandate of trade liberalisation with institutional support, businesses may flourish and result in higher outputs and employment. More growth may result in increased wages resulting in excess money left with the citizens, that may increase the demand, and hence the prices of essential commodities. The central bank may plan and execute the money supply/control policies to meet growth and employment targets.

Hence, there are two facets resulting in higher inflation in a country: solving a deficit crisis or meeting ambitious growth targets. The key attribute that results in inflation is a reduction of output below the level of current demand. In both the facets, increasing output to meet demand should be the primary focus of a government. The monetary

policies of the central bank should be balanced to take care of growth, as well as reduction in inflation. The government should promote many policies to ensure that best results can be achieved from the central bank's monetary policy. For example, if the central bank has liberalised institutional support for small and medium scale enterprises (SMEs), the government should create an environment in which the SME businesses flourish. Special schemes should be launched for entrepreneurship development, export promotions and foreign direct investments (FDIs). The government should focus on each sector that contributes to the output of most essential commodities of the nation. However, output may not increase indefinitely at the pace of growth in demand. Hence, the government should also implement policies to curtail the demand. For example, if the citizens get excess money due to increase in wages and bonus payments, the government should offer certain tax saving investment schemes in which, the citizens can invest and avail dual benefits: tax saving and growth of money. With such schemes around, the citizens may be compelled to save money for future rather than spend all of them and fuel demand. This will also be good for the well-being of the citizens in the longer run.

The expenditures made by the government should ensure growth and output optimisation results. Growth of businesses will lead to higher taxes that government can use to pay the debts. On the other hand, output optimisation will lead to the control of inflation in spite of increased demand due to the growth of businesses. Globalisation schemes (like liberalisation of foreign direct investments and opening the markets for multinational players) will lead to better accumulation of key fully convertible currencies

thus strengthening the local currency in the global markets. If there is persistent inflation and inadequate growth of outputs, then the government may be spending money in the wrong schemes.

There may be problems related to corruption or industrial cartels that may be pushing the prices upwards. For example, if there is a high demand for homes, there is the chance that cement and iron manufacturers may form a cartel and push the prices upwards while the regulatory authorities do not notice it because they are supporting such cartels. The government policies should strictly prohibit formation of cartels and should operate effective monitoring and control mechanisms.

## **2.5 INFLATION IN SOUTH AFRICA**

Inflation in South Africa has not been researched adequately in the recent past. It has, however, appeared in group data treatments of many countries by scholars and the International Monetary Fund reports. It is currently a topic of interest due to its persistently rising trend in the recent past. As learnt from the literature review in this chapter, persistently rising inflation and rising fiscal deficit indicates that the growth and output targets are not met. Hence, it is important to study the underlying causes of inflation in South Africa and the policies that can help in reducing inflation.

In South Africa, the Reserve Bank has been made autonomous after positive results of inflation targeting in the 1990s (van der Merwe, 2004:1). South African Reserve Bank follows a formal and transparent inflation targeting strategy (van der Merwe, 2004:2).

The inflation targeting in South Africa encompasses the following five basic elements executed and controlled by the central bank:

- (a) Medium term inflation targets (numerical) are announced to the public.
- (b) The monetary policy enforces an institutional commitment to price stability as the primary goal be achieved by the banking and financial institutions, whereby all other goals are treated as sub-ordinates of this primary goal.
- (c) The policy instruments are chosen to encompass underlying variables including exchange rate, monetary aggregates, industrial growth, GDP, balance of payments, interest rates and other such variables that affect inflation in medium term.
- (d) Monetary strategy and policies along with aims, objectives, plans and decisions are communicated to the public transparently.
- (e) Central bank is made independent and accountable to achieve the inflation targets.

(van der Merwe, 2004:2-3)

Three types of consumer price indices are measured in South Africa: headline consumer price index, core consumer price index and overall index. The headline consumer price index includes prices of all the items that reflect the domestic cost of living in the nation and covers the most essential commodities (but does not include mortgage bonds). Core inflation excludes all such items that are affected by exogenous shocks not in the control of the central bank. In South Africa, the core inflation does not include mortgage bonds, certain food products and certain indirect taxes. It, however,

includes oil prices. The overall index includes all items of headline and core indices plus the exclusions in them. These indices are published with versions covering metropolitan, urban and rural areas. The most significant index is the overall price index covering the entire nation (van der Merwe, 2004:4-9).

The following Figure presents the monetary transmission system of South Africa (Smal and de Jager, 2001:5).

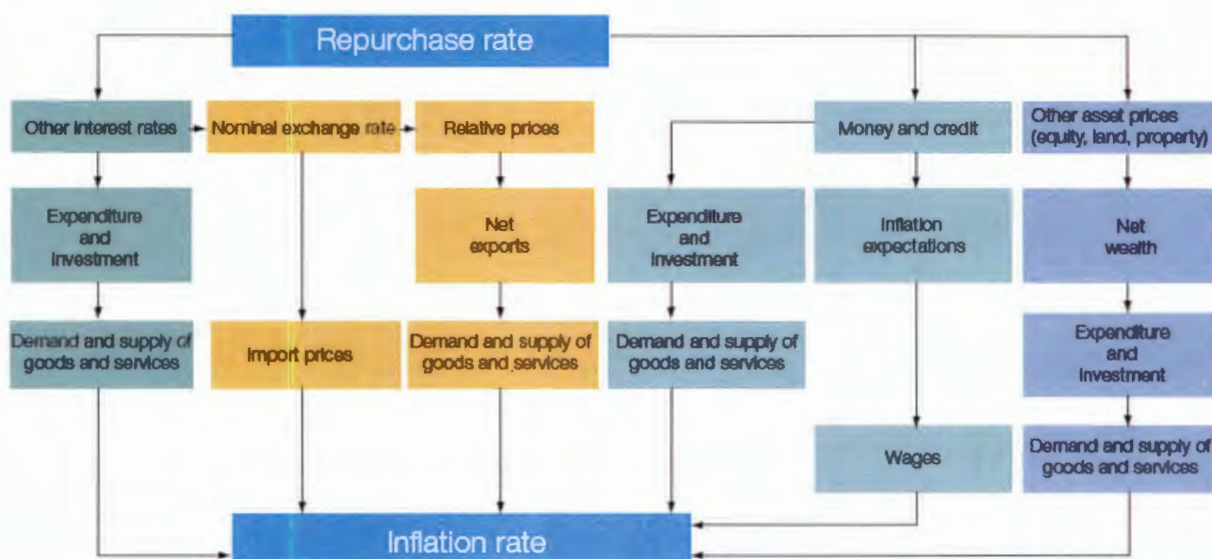


Figure 3: Monetary transmission mechanism in South Africa (Smal and de Jager, 2001:5)

The South African Reserve Bank controls the change in repurchase (repo) rate through a series of economic events throughout the country. The events are presented in the Figure 3 above. The repo rate directly influences decisions on investments and spending, asset prices, money and credits, exchange rates and interest rates. Changes in repo rate affect both demand and supply of essential commodities. The domestic

inflationary pressure is the result of pressure on supply by the demand. Other factors that influence inflationary pressures in South Africa are: the creation of new markets for goods and services, pressures originating from the labour markets and exchange rate fluctuations (also referred to as imported inflation). Money and credits, other asset prices (equity, land and property) and interest rates are three primary throttles used by the central bank in South Africa (Smal and de Jager, 2001:5-6).

Aron and Muellbauer (2001:26) described that South African economy as being dependent upon its minerals (mining), and the local stock market is less liquid and important to raise capitals. Hence, the terms of trade in South Africa are different. The high interest rates and lack of liberal money policies were the key growth limiters and high inflation during 1990s (Aron and Muellbauer, 2001:27). As per their analysis, the South African growth is fuelled by international capital flows and trade liberalisation (Aron and Muellbauer, 2001:28). In a recent research by Aron and Muellbauer (2012:456), they found that inflation forecasting in South Africa has been very challenging given that sectoral inflationary pressures in South Africa are highly volatile due to volatility in food prices and exchange rates. Moreover, the responses to monetary changes (expansions/contractions) vary significantly in different regions of South Africa (Fielding and Shields, 2006:965). Hence, a single indicator may not represent the inflationary pressures across the entire South Africa (Fielding and Shields, 2006:978). It is also observed that monetary policy changes result in persistent and significant changes in relative prices of various provinces of South Africa (Fielding and Shields, 2006:979). In addition, Naraidoo and Paya (2012:446) discovered that there

are nonlinearities in the short-term impacts of monetary policy rules on inflation that can be reduced by lengthening the forecasting horizon. They recommended semi-parametric modelling for forecasting interest rates (Naraidoo and Paya, 2012:454). Gupta and Kabundi (2011:1076) also supported long range time series forecasting of nominal interest rate, inflation and per capita growth rate in South Africa employing large factor models.

These recent efforts on forecasting macro-economic variables in South Africa have returned commendable results. However, this researcher believes that more empirical results are needed by testing additional models. In this study, the Markov chain has been tested by using Pearson coefficients of linear regression of four causal variables correlated with inflation as the elements of Markov transition matrix.

## **2.6 SUMMARY OF CHAPTER 2**

Inflation, output and growth are related to underlying microeconomic variables in a very complex manner. The complexity and the relationship itself vary by country, and the type of country (rich, poor, developed and developing). The literature reviewed in this Chapter has presented many perspectives of such relationships. However, not much emphasis has been given by academicians on the specific case study of South Africa, especially in the recent past when high development and growth rates have resulted in persistently increasing inflation. Some recent studies by scholars have returned useful models and their results. However, it is important that more models should be tested such that better empirical generalisations can be evolved. The next Chapter comprises

a review of research philosophies and methodologies and the researcher's choices made for conducting this study.

## **CHAPTER 3:**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION TO THE RESEARCH**

In this Chapter, the researcher has introduced the research details, the research philosophy and its related research methodology. Based on these fundamentals, the researcher has created a research design in Chapter 1 incorporating the conclusions in this Chapter and additional reviews carried out in Chapter 4.

##### **3.1.1 Context**

Inflation in South Africa has been increasing considerably, as per the published Reserve Bank data. In this research, an organised study of inflation in South Africa and the variables causing it is conducted. Based on the learning from the literature, the following underlying variables have been chosen in this study:

- (a) Exchange rate
- (b) Investment spending
- (c) Government spending
- (d) Taxes

The empirical support of correlation between these variables and inflation is reviewed in Chapter 1. The correlations have been reviewed in the empirical literature by taking data from many Western and European countries. However, there is insufficient empirical support for the causes of inflation in South Africa. Hence, the researcher has

studied the correlations between these variables and inflation in South Africa to evaluate how they are related. As reviewed in Chapter 1, the key attribute to contain inflation is a rise in output to ensure that the rise in demand can be fulfilled. Hence, the researcher has also studied a correlation of government and investment spending with the GDP to determine the chances that inflation will not increase as a result of growth. Based on the findings and a comparison with the literature, the researcher has presented recommendations on how inflation can be reduced in South Africa without compromising on growth and development.

## **3.2 RESEARCH PHILOSOPHY AND STRATEGIES**

### **3.2.1 A review of research philosophies and strategies**

Research philosophy is linked with the motivation and purpose of the research (Bryman and Bell, 2007:12). If the motivation is to generate new theories, the philosophy followed is interpretivism and if the motivation is to prove theories (hypotheses), the philosophy followed is positivism (Bryman and Bell, 2007:13). Saunders, Lewis and Thornhill (2011:113) stated that "Positivism is a way of working in the traditions followed by natural scientists" and "interpretivism is a way to distinguish between intrinsic understanding of social actors" (p. 114). Both positivism and interpretivism belong to the framework of epistemology that evolves the knowledge that is acceptable to the interested parties in a particular field of study (Saunders, Lewis and Thornhill, 2011:112). Hence, the underlying methodologies to make a study credible are branches of epistemology (Saunders, Lewis and Thornhill, 2011:112). Epistemology demands that each researcher should describe and justify the research methodologies and the

linked techniques and instruments that have been employed to arrive at the results (Saunders, Lewis and Thornhill, 2011:120). The other two philosophies under epistemology are: pragmatism and realism. Pragmatism is a philosophy in which, a researcher tests different positions (Saunders, Lewis and Thornhill, 2011:109), and realism is the philosophy that raises a question about existence of objects of phenomena independent of our knowledge about their existence (Saunders, Lewis and Thornhill, 2011:114). In addition to epistemology, there is another framework called ontology that deals with studies on social structures (Bryman and Bell, 2007:20). It has two philosophies: objectivism and social constructivism (Bryman and Bell, 2007:21). Given that this is not a research on social structures, a discussion on these philosophies has been skipped.

Positivists employ scientific methods to deduce knowledge from data and information by discovering correlations between independent and dependent variables, whereas interpreters employ hermeneutics (an art of human interpretation skills) to induct knowledge from data and information (Bryman and Bell, 2007:15). Hence, positivisms employ deductive strategy and interpreters employ inductive strategy of study.

### **3.2.2 Philosophy and strategy chosen for this research**

This study is based on statistical and probability models that are widely used in natural science research. Moreover, the researcher has worked on correlations between independent and dependent variables chosen in this research using deductive strategy and has evolved a forecasting model. Hence, the researcher has chosen positivism

philosophy. This philosophy and strategy is suitable for this study because the research is based on numerical data archives administered and maintained by the central bank of South Africa. An interpretive philosophy for inducting knowledge from such large data sets and evolving visible trends may not be feasible. There may be some experts that have developed advanced skills to extract information from such data sets maintained by central bank of a nation. But such skills are developed after an extensive experience in macroeconomics analytics and working on various models. The researcher is a student and hence lacks such an experience. Hence, the positivism philosophy with deductive strategy is more feasible for the researcher to conduct this study.

### 3.3 RESEARCH METHODOLOGY

A research methodology is an umbrella classification for grouping various underlying research methods (Bryman and Bell, 2007:24). It is of two types: qualitative and quantitative (Bryman and Bell, 2007:24), with differences as described in the following sub-section.

#### 3.3.1 Qualitative versus quantitative methodology

Bryman and Bell (2007:25) tabulated the following differences between qualitative and quantitative methodologies:

Table 1: Differences: between qualitative and quantitative methodologies

| Qualitative | Quantitative |
|-------------|--------------|
|             |              |

|                                                    |                                                |
|----------------------------------------------------|------------------------------------------------|
| Based on interpretivism in epistemology            | Based on positivism in epistemology            |
| Based on social constructivism in ontology         | Based on objectivism in ontology               |
| Accepts texts, graphics and videos as inputs       | Accepts only numerical inputs                  |
| Applies methods of organised human interpretations | Applies mathematical and statistical modelling |
| Employs inductive strategy                         | Employs deductive strategy                     |
| Used to build new theories                         | Used to prove/reject theories                  |

Based on the above table, the researcher's choice is mentioned in the next sub-section.

### **3.3.2 Choice of methodology in this research**

Based on the differentiation in Table 1, it is revealed that quantitative methodology is the natural choice for this study. This is because positivism and deductive strategy, chosen by the researcher, are presented as characteristics of quantitative research as indicated by Bryman and Bell (2007:25). In fact, Bryman and Bell (2007:26) argued that it is not always true that positivism cannot be adopted by qualitative researchers. However, as stated by them, "it is a question of epistemological compliance, and traditionally the interested parties in most fields of study are more comfortable with quantitative methodology for proving hypotheses (positivistic approach)". Hence, quantitative methodology is the natural choice of the researcher for conducting this study.

### **3.4 SUMMARY OF CHAPTER 3**

In this Chapter, the researcher has presented her intent to choose positivism philosophy, deductive strategy and quantitative methodology after some literature was reviewed. In the next Chapter, the researcher has built upon these fundamental choices to evolve a complete research design for this study.

## **CHAPTER 4:**

### **RESEARCH METHODS, DATA COLLECTION AND DESCRIPTION OF THE TOOL**

#### **4.1.Introduction**

In this Chapter, the researcher has reviewed the research methods, data collection and instruments used under the umbrella of quantitative methodology to determine the choices for this study.

#### **4.2 RESEARCH METHODS**

##### **4.2.1 A review of research methods**

In this sub-section, the researcher has reviewed only quantitative methods because it has been shortlisted in the previous Chapter. Bryman (2004:78) identified two approaches for conducting a quantitative research: statistical modelling and mathematical modelling. In statistical modelling, the concepts are carefully mapped with their indicators and measures of the chosen indicators (Bryman, 2004:82). The sampling is carried out in such a way that sufficient data about the indicators is collected from the population (Bryman, 2004:82). Two most common methods of collecting quantitative data are: experimentation (includes field experiments and simulations in laboratory environment) and surveys (Bryman, 2004:121). The researcher should conduct the sampling very carefully to ensure that accurate results about the indicators and the underlying concepts can be obtained to ensure validity of results (Bryman,

2004:83). The data is then organised, tabulated/charted and applied in statistical analysis models. Some of the key statistical data analysis methods (described in Section 3.2.1) are the following: (Saunders, Lewis and Thornhill, 2011:450-466)

- (a) Significance testing
- (b) Association testing (chi-square)
- (c) Differential testing (Kolmogorov-Smirnov, independent groups t-test, paired t-test, one-way analysis of variance)
- (d) Strength of correlation between pairs of variables (Pearson product moment correlation coefficient test, Spearman's rank correlation test, Kendall's correlation coefficient)
- (e) Cause-and - effect relationship between variables (linear regression analysis)
- (f) Trend analysis (descriptive statistics) and forecasting (time series forecasting and Markov chain).

The other method for quantitative research is mathematical modelling (Joubert and Steyn, 2003:91). In this method, the researcher denotes the variables of the phenomena as mathematical symbols, applies mathematical theories and formulae to create theorems, applies mathematical theorems, solves them, tests in simulation or laboratory environment and verifies the results (Joubert and Steyn, 2003:93). The workflow of mathematical modelling is presented in Figure 4 below (Joubert and Steyn, 2003:92). It is preferred by scientists testing a natural phenomenon in an experimental research environment (Joubert and Steyn, 2003:94). It is also highly preferred in

operations research and operational management sciences (Joubert and Steyn, 2003:91).

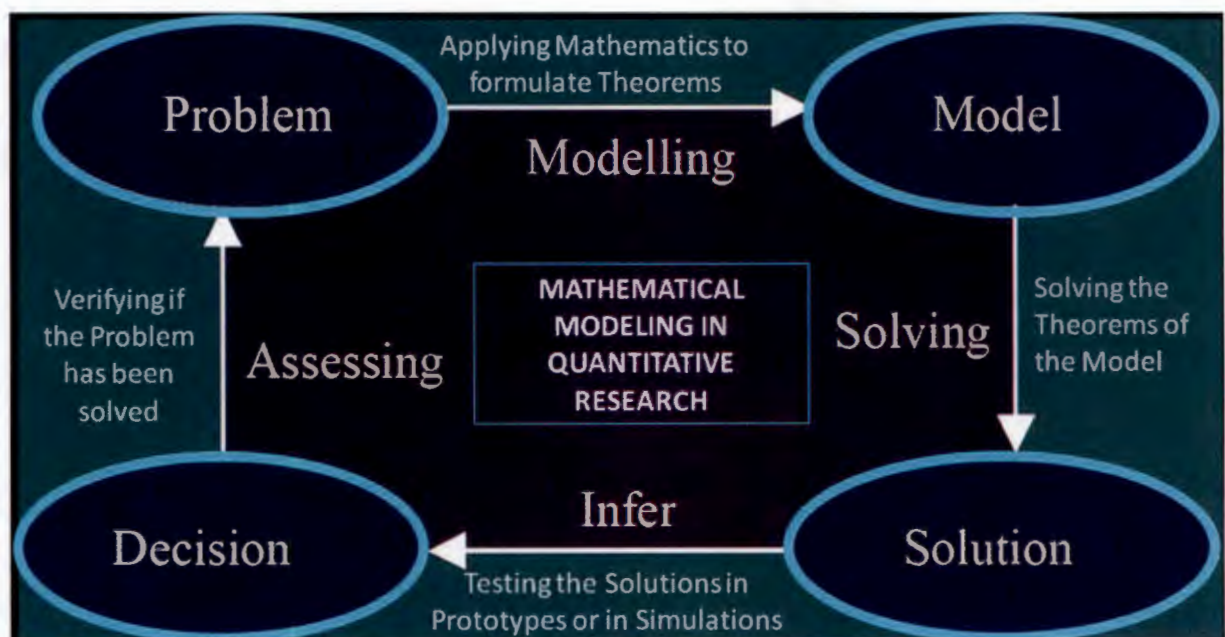


Figure 4: Mathematical modelling chart (Joubert and Steyn, 2003:92)

#### 4.2.2 Choice of methods for this research

The researcher has chosen statistical modelling in this study. The study is on inflation in South Africa and its underlying macro-economic variables. The data is collected from the website of Reserve Bank of South Africa. Given that this study is based on the archives of a government administered database, an experimental approach with mathematical modelling cannot be used in this research. Hence, the researcher's choice is statistical modelling. The study comprises three secondary research questions stated in subsection 2.1.5.2. The first two questions have been addressed with the help of an in-depth literature review. The third question has been addressed by conducting a

quantitative analysis of data collected from the Reserve Bank of South Africa for proving the hypotheses stated in subsection 2.1.6. The analysis comprises two steps:

- (a) A linear correlation analysis (Pearson coefficient) between the variables stated in the hypotheses points.
- (b) A Markov chain analysis to present a method of predicting inflation based on the transitional probabilities of the variables affecting inflation.

The linear correlation analysis is sufficient to accept or reject the hypotheses. However, it is not sufficient to make a prediction of how inflation is expected to vary in future. The correlation outcomes do not form a direct input to Markov chain, because the only input to it is the present state and the estimated transitional probabilities. However, the correlation coefficient values have given an idea on the probability values to be assumed to create the Markov transition matrix. The two methods are discussed in the next Section.

## **4.3 SAMPLING, DATA COLLECTION AND ANALYSIS**

In this Section, the sampling method, the data collection procedure and analysis procedure chosen for this research have been reviewed and discussed. The choice for this research is presented after carrying out a brief review of the literature, detailing the possible techniques in quantitative research.

### **4.3.1 Review of sampling, data collection and analysis methods**

Collis and Hussey (2009:147-152) explained the following sampling methods in quantitative research:

- (a) A simple random sampling is executed when each member of the population has an equal probability of getting chosen in the sample.
- (b) A restricted sampling is executed when each member of the population has a unique probability of getting chosen in the sample.
- (c) A systematic sampling is executed following a fixed pattern when each member of the population belongs to an organised pattern or array.
- (d) A stratified random sampling is executed when multiple members of the population possess identical attributes and hence can be grouped in strata.
- (e) Cluster sampling is executed when heterogeneous members of a population can be clustered together to achieve a common purpose.
- (f) Area sampling is executed when members of the sample can be chosen from different geographical areas of the population.
- (g) Double sampling is executed when a large scale data set (already existing) needs to be organised and reduced in the form of a sample of secondary data such that it can be analysed.

Based on the above analysis, it is evident that the sampling method used in this sample is double sampling. A sample data of five years (Table 2) has been collected after analysing the existing data of about 40 years in the OECD and RBSA websites, an existing data of 25 years in Liberta.co.za, and a data set of 10 years existing the exchange rates.co.uk. The data is collected from secondary sources and hence this study is technically a secondary research.

The data analysis is carried out in two steps. The first step is carried out employing Pearson correlation and a basic analysis of time series plotting. Pearson correlation is a coefficient represented by the following formula, which represents the linearity of correlation between two variables (University of West England, 2007):

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

Here, 'x' and 'y' are the values of the variables and 'n' is the sample size. The value of 'r' varies from – 1 to + 1. A negative correlation is indicated by a value from – 1 and zero and a positive correlation is indicated by a value between zero and +1. A value below 0.5 is viewed as low correlation, a value of 0.5 to 0.8 is viewed as moderate correlation and a value above 0.8 is viewed as significant correlation. (University of West England, 2007)

In this study, the correlations between the independent variables (government and private spending, exchange rates and direct tax rates) and inflation have been analysed. In addition, an interpretive analysis of the time series plotting of the data in the sample has been carried out to understand the correlations more deeply. The correlation coefficients have been used as inputs to the Markov transitional matrices. The rationale for following this strategy is discussed in the next sub-section.

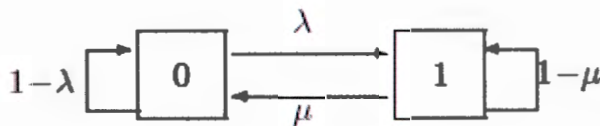
#### **4.2.2 A review of Markov chain analysis**

A Markov chain may be viewed as a sequence of random variables that have Markov properties, stated as the following:

If the value of a variable at a time (t) is known, then the past values of the random process may not influence the future conditional probabilities of the variable. Hence, a Markov chain has no memory. However, Markov chain works for a finite state space represented by a matrix of transition probabilities presented as:

$$A = \begin{pmatrix} p_{00} & p_{01} & \cdots & p_{0S} \\ p_{10} & p_{11} & \cdots & p_{1S} \\ p_{20} & p_{21} & \cdots & p_{2S} \\ \vdots & \vdots & \vdots & \vdots \\ p_{S0} & p_{S1} & \cdots & p_{SS} \end{pmatrix}$$

For example, with reference to the following Markov chain:



The matrix of transition probabilities is the following:

$$A = \begin{pmatrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{pmatrix} = \begin{pmatrix} 1-\lambda & \lambda \\ \mu & 1-\mu \end{pmatrix}$$

(Henkel, Martin and Nardari, 2008:4-10; Oxy.edu, 2005:5-9)

In the matrix of transitional probabilities, the sum of a row is equal to 1 and the matrix is always of a M X M type (square matrix). The transitional probabilities can be calculated after conducting a set of experiments and observing the transitions. It is represented by the total number of times a transition has reached a state (say, j) divided by the number of trials. If experiments are not feasible, then the transitions need to be taken from historical records (if available). (Oxy.edu, 2005:9)

However, this simple formulation cannot be applicable if the transitions are dependent on some other variable or variables. In this case, the transition probabilities can be obtained by correlating the transitions of the other variables (assumed as independent variables) with the transitions of the studied variable (assumed as dependent variable) (Walsh, 2004:4). If the data set is very large, then a statistical correlation analysis may be needed (like, autocorrelation, cross-correlation and Pearson correlation) (Walsh, 2004:5-8). As discussed by Henkel, Martin and Nardari (2008: 2-5), there may be a number of overlapping series of discrete data values in a sample having a finite correlation. Hence, on a finite time horizon having inter-related variables, the probability of the next state of a data value of a variable in a sample depends upon its correlation with the other variables on the horizon (Henkel, Martin and Nardari, 2008:14-15). In such a case, the matrix of transitional probabilities is said to have a stochastic property as indicated by the following equations (Coolen, 2009:16):

$$\forall (i, j) \in S^2 : p_{ij} \in [0, 1]$$

$$\sum_i p_{ki} = 1$$

$$\sum_i p_i(n+1) = \sum_i p_i(n)$$

Hence, the transitional probabilities can assume a value between 0 and 1 and the sum of all transitional probabilities is unity. Moreover, the sum of transitional probabilities at state 'n' is equal to the sum of transitional probabilities at state 'n + 1', which is equal to unity. This implies that if the probability of an increase in variable 'A' due to increase in variable 'B' is 'p', then the probability of an increase in variable 'A' due to reduction in

variable 'B' is  $1 - p$ . However, there is a third event possible that 'A' might increase without any change in variable 'B'. Hence, if the probability of increase in 'A' due to an increase in 'B' is ascertained as 'p', then  $(1 - p)$  can be split into two probabilities: a probability of increase in 'A' due to reduction in 'B', and a probability of increase in 'A' without any change in 'B'. A similar decision should be taken if the probability of increase in 'A' due to a reduction in 'B' is ascertained (say, p'). In this case, the probability  $(1 - p')$  can be split into two probabilities. This process may be viewed as normalising a probability when the Markov matrix exhibits a stochastic property. (Coolen, 2009:16-17)

#### **4.3.3 Approach followed in this research**

In this research, there are five variables overlapped on the same time horizon: private expenditure, government expenditure, exchange rate, tax rate, and CPI (consumer price index) inflation (increase in general price level). The variations of these variables have been captured over a five year horizon (2007 to 2011; quarterly data) from RBSA and OECD databases. The CPI inflation is analysed as the studied (observed) variable and other variables have been analysed as independent variables. The variations in CPI inflation due to tax rate has been interpreted manually because the tax rate has not changed in South Africa during this period albeit the taxable slabs have been adjusted.

In the first step, the 2-tailed Pearson correlation is calculated between the independent variables (private expenditure, government expenditure, exchange rate) and CPI inflation rate. The variables have been analysed further by plotting them on a time

series. The Pearson correlation coefficient has been taken as the transitional probability based on the outcomes of the following two studies:

- (a) Ratto and Stokke (2012:9) used the Pearson test to estimate transition probabilities over a fixed time horizon. To test its validity, they divided the time horizon into four sub-periods and compared the transition matrices of the sub-periods (dividing number of positive transitions with the total number of transitions) with the full period matrix (comprising Pearson coefficient values). The differences between transition probabilities were minor, at 95% confidence level. Hence, with a reasonable accuracy, the Pearson correlation coefficient values can be included as transitional probabilities in the Markov matrix.
- (b) Fallahi and Rodríguez (2007:20) argued that the Pearson correlation coefficient is a measure of the probability of two variables remaining within a common regime. For example, Pearson correlation of 0.8 implies that two variables on a time horizon will remain in the same regime 80% of the time. It may be viewed in another way that, both variables have a high probability of varying in the same direction 80% of the time. Hence, 0.8 can also be assumed to be the transition probability, with a reasonable level of accuracy.

However, the researcher observed two characteristics of both the case studies:

- (a) They are based on a sample taken at a significantly long time horizon.
- (b) The transitions of the variables are stochastic.

Hence, in this study we follow the process by Ratto and Stokke (2012) and Fallahi and Rodriguez (2007). The sample has been taken with a reasonably long time horizon (five years), and it is assumed that all the variables exhibit stochastic transitions.

#### **4.4 ETHICAL CONSIDERATIONS**

As per Collis and Hussey (2009:45), a researcher should conduct the study in such a way that no deception or harm is caused to anyone in any form. In this study, there is no chance of deception or harm because the study has been carried out using secondary data collected from highly reliable sources. There is no primary research conducted, and hence no respondents are interviewed or surveyed in this study. Moreover, the analysis is general in nature for academic theory building on economic variables and is not expected to cause any harm to an individual, community or an organisation.

#### **4.5 SUMMARY OF CHAPTER 4**

In this Chapter, the researcher has studied the quantitative research methods and chosen the approach of this study. The data is collected on a time horizon of 5 years, from 2007 to 2011, on a quarterly basis. The approach chosen in this study comprises two steps: a Pearson correlation analysis between the economic variables (stated in hypotheses) and CPI inflation, and a Markov chain analysis of the CPI inflation. In the next Chapter, the primary data has been tabulated and the approach has been applied to generate the results for interpretations.

## **CHAPTER 5:**

### **DATA ORGANISATION AND ANALYSIS**

#### **5.1 INTRODUCTION**

In this Chapter, the data collected from Reserve Bank of South Africa (RBSA) pertaining to the variables stated in the hypotheses are presented and analysed. In the next Section, the data is tabulated and the results of a correlation analysis, and a Markov chain analysis are presented.

#### **5.2 TABULATION AND STATISTICAL ANALYSIS OF DATA**

The following Table presents quarterly data from Q1 2007 to Q4 2011 pertaining to private and government total expenditures, exchange rates, and CPI inflation rate. The data sources are the following:

- RBSA (expenditures – current)
- OECD (expenditures – archives)
- Liberta.co.za (CPI inflation history)
- Exchange rates.co.uk (historical exchange rates)

Table 2: Historical data of private and government total expenditures, exchange rate and CPI inflation rate

|         | Private total<br>expenditure (R<br>Billions) | Government<br>total<br>expenditure (R<br>Billions) | Exchange rate<br>(USD to SA<br>Rand) on the<br>last day of the<br>quarter | CPI Inflation<br>rate on the last<br>date of each<br>quarter (%) |
|---------|----------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------|
| Q4 2011 | 461.16                                       | 170.75                                             | 8.0763                                                                    | 6.1                                                              |
| Q3 2011 | 453.35                                       | 169.25                                             | 8.0975                                                                    | 5.7                                                              |
| Q2 2011 | 437.56                                       | 162.96                                             | 6.7717                                                                    | 5.0                                                              |
| Q1 2011 | 428.20                                       | 153.60                                             | 6.7801                                                                    | 4.1                                                              |
| Q4 2010 | 418.15                                       | 150.62                                             | 6.6026                                                                    | 3.5                                                              |
| Q3 2010 | 407.66                                       | 149.72                                             | 6.9711                                                                    | 3.2                                                              |
| Q2 2010 | 396.32                                       | 142.70                                             | 7.6755                                                                    | 4.2                                                              |
| Q1 2010 | 388.04                                       | 141.38                                             | 7.2855                                                                    | 5.1                                                              |
| Q4 2009 | 383.89                                       | 139.65                                             | 7.4100                                                                    | 6.3                                                              |
| Q3 2009 | 375.06                                       | 137.75                                             | 7.5222                                                                    | 6.1                                                              |
| Q2 2009 | 367.46                                       | 124.87                                             | 7.7005                                                                    | 6.9                                                              |
| Q1 2009 | 360.48                                       | 118.86                                             | 9.4402                                                                    | 8.5                                                              |
| Q4 2008 | 357.89                                       | 120.99                                             | 9.5160                                                                    | 9.5                                                              |
| Q3 2008 | 357.95                                       | 110.97                                             | 8.2732                                                                    | 13.1                                                             |
| Q2 2008 | 354.04                                       | 104.61                                             | 7.8950                                                                    | 12.2                                                             |
| Q1 2008 | 344.24                                       | 106.39                                             | 7.9803                                                                    | 10.6                                                             |
| Q4 2007 | 336.73                                       | 104.45                                             | 6.8062                                                                    | 9.0                                                              |

|         | Private total<br>expenditure (R<br>Billions) | Government<br>total<br>expenditure (R<br>Billions) | Exchange rate<br>(USD to SA<br>Rand) on the<br>last day of the<br>quarter | CPI Inflation<br>rate on the last<br>date of each<br>quarter (%) |
|---------|----------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------|
| Q3 2007 | 332.12                                       | 96.61                                              | 6.8900                                                                    | 7.2                                                              |
| Q2 2007 | 321.71                                       | 95.53                                              | 7.0798                                                                    | 7.1                                                              |
| Q1 2007 | 310.36                                       | 94.62                                              | 7.2230                                                                    | 6.1                                                              |

In the following table (Table 3), the Pearson correlation between the variables stated in 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> columns and CPI inflation has been obtained from SPSS. As a ballpark figure, the correlation coefficient values above 0.5 are accepted as moderate and the values above 0.8 are accepted as significant. As noticed in Table 3 below, CPI inflation has a moderate negative correlation with total private expenditure ( - 0.543), a moderate negative correlation with total government expenditure ( - 0.635), and a moderate positive correlation with exchange rate from USD to ZAR ( + 0.526). However, the government and private expenditure are significantly positively correlated ( + 0.978), while the exchange rate is almost not correlated with government and private expenditures.

Table 3: Correlation analysis between the variables stated in Table 2 (private and government expenditures and exchange rate) and CPI inflation rate

| Correlations                                                 |                        |                        |                      |                  |                       |
|--------------------------------------------------------------|------------------------|------------------------|----------------------|------------------|-----------------------|
|                                                              |                        | Private<br>Expenditure | Govt.<br>Expenditure | Exchange<br>Rate | Inflation<br>Rate CPI |
| Private<br>Expenditure                                       | Pearson<br>Correlation | 1                      | .978**               | -.089            | -.543*                |
|                                                              | Sig. (2-tailed)        |                        | .000                 | .710             | .013                  |
|                                                              | N                      | 20                     | 20                   | 20               | 20                    |
| Govt.<br>Expenditure                                         | Pearson<br>Correlation | .978**                 | 1                    | -.097            | -.635**               |
|                                                              | Sig. (2-tailed)        | .000                   |                      | .684             | .003                  |
|                                                              | N                      | 20                     | 20                   | 20               | 20                    |
| Exchange Rate                                                | Pearson<br>Correlation | -.089                  | -.097                | 1                | .526*                 |
|                                                              | Sig. (2-tailed)        | .710                   | .684                 |                  | .017                  |
|                                                              | N                      | 20                     | 20                   | 20               | 20                    |
| Inflation Rate<br>CPI                                        | Pearson<br>Correlation | -.543*                 | -.635**              | .526*            | 1                     |
|                                                              | Sig. (2-tailed)        | .013                   | .003                 | .017             |                       |
|                                                              | N                      | 20                     | 20                   | 20               | 20                    |
| **. Correlation is significant at the 0.01 level (2-tailed). |                        |                        |                      |                  |                       |
| *. Correlation is significant at the 0.05 level (2-tailed).  |                        |                        |                      |                  |                       |

These correlations may be investigated further by looking into their time series charts (created on SPSS). The following Figure presents how the four variables have varied in five years from 2007 to 2011 on a quarterly basis. For better clarity, the time series plotting of exchange rate and CPI inflation is presented in a separate plot in Figure 6. It is very interesting to observe that the government and private spending follow an yearly incremental pattern with the values almost connected. The inflation variations follow a reducing pattern and quite consistently follow the government and private spending in the opposite direction, without a lag. Hence, it appears that the effects of government and private spending on inflation are visible within the same quarter.

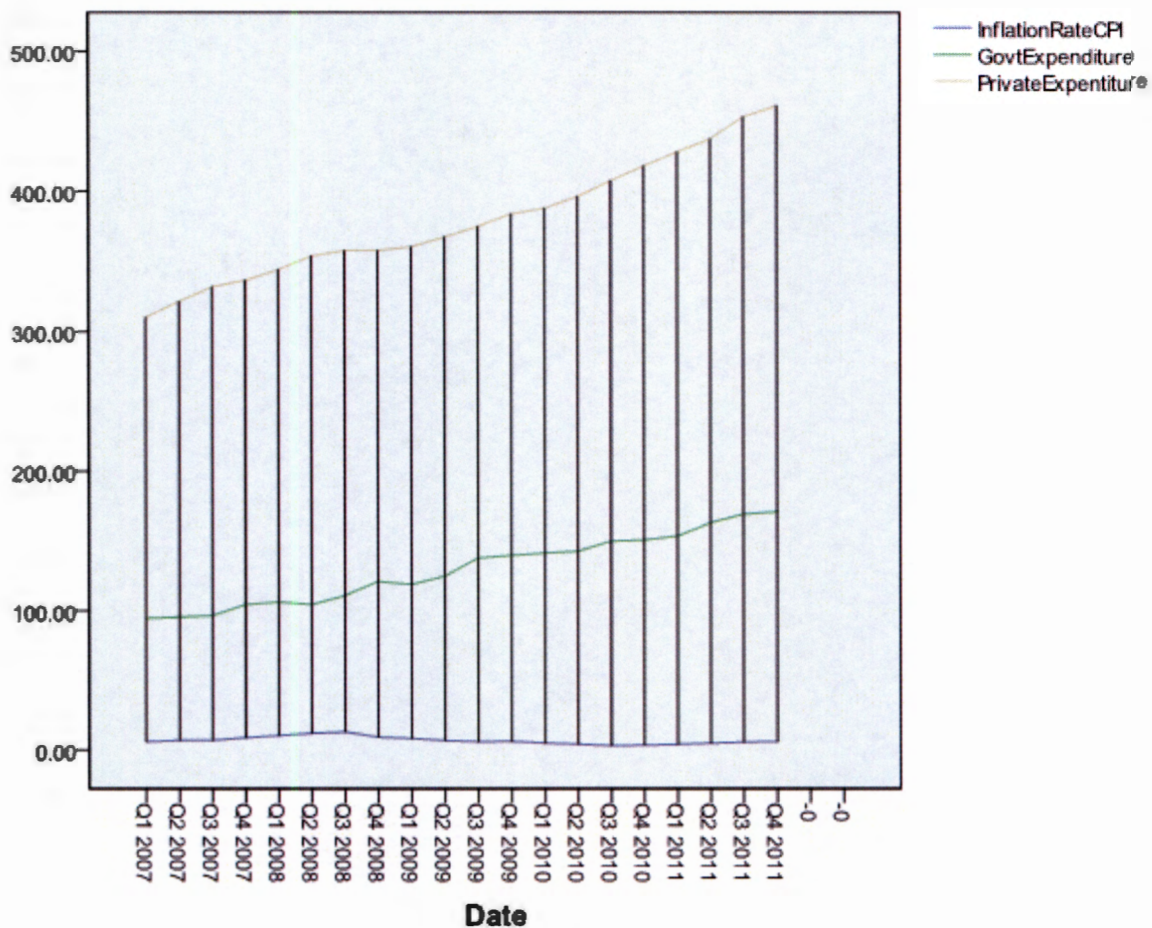


Figure 5: Time series plotting of the four variables: private and government spending, exchange rate and CPI inflation

The exchange rates and CPI inflation follow reasonably similar patterns, with the crests and troughs well connected to some points. Hence, it may reasonably be concluded that the effects of exchange rates on CPI inflation is almost like government and private spending, although in the same direction. Moreover, unlike the government and private spending, both exchange rate and CPI inflation vary in a cyclic pattern.

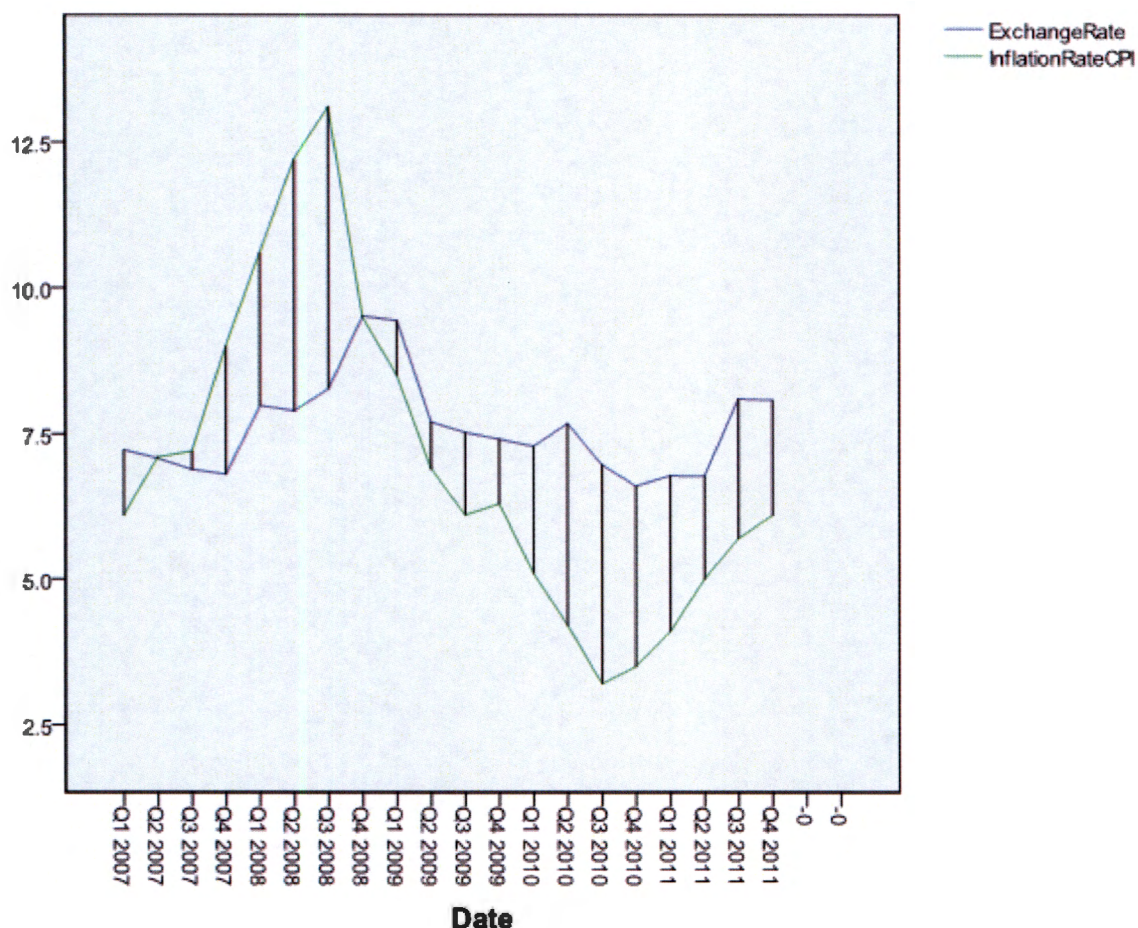


Figure 6: Time series plotting of exchange rate and CPI inflation

Tentatively, the variations in CPI inflation as per the correlation values reflect within the same quarter (of the entire model and not just one variable). However, the individual correlation pairs will be needed to assume the transition probabilities in the Markov chain.

To estimate the variation of CPI inflation with direct tax rates, an interpretive method has been employed. This is because the tax rates prevail in multiple slabs and hence

entering them in SPSS will be cumbersome and prone to errors. The tax slabs of the five years are analysed as following:

| Tax Guide 2007                                       |           |                                             | Tax Guide 2008                                       |           |                                             |
|------------------------------------------------------|-----------|---------------------------------------------|------------------------------------------------------|-----------|---------------------------------------------|
| 2007 Tax Rates for 01 March 2007 to 28 February 2008 |           |                                             | 2008 Tax Rates for 01 March 2008 to 28 February 2009 |           |                                             |
| South African Individual Taxpayers                   |           |                                             | South African Individual Taxpayers                   |           |                                             |
| Income exceeding ...                                 | But Below | Tax                                         | Income exceeding ...                                 | But Below | Tax                                         |
| R 0                                                  | R 112,500 | 18%                                         | R 0                                                  | R 122,000 | 18%                                         |
| R 112,501                                            | R 180,000 | R 20,250 + 25% of the amount above 112,500  | R 122,001                                            | R 195,000 | R 21,800 + 25% of the amount above 122,000  |
| R 180,001                                            | R 250,000 | R 37,125 + 30% of the amount above 180,000  | R 195,001                                            | R 270,000 | R 40,210 + 30% of the amount above 195,000  |
| R 250,001                                            | R 350,000 | R 58,125 + 35% of the amount above 250,000  | R 270,001                                            | R 380,000 | R 62,710 + 35% of the amount above 270,000  |
| R 350,001                                            | R 450,000 | R 93,125 + 38% of the amount above 350,000  | R 380,001                                            | R 490,000 | R 101,210 + 38% of the amount above 380,000 |
| R 450,000 and above                                  |           | R 131,125 + 40% of the amount above 450,000 | R 490,001 and above                                  |           | R 143,010 + 40% of the amount above 490,000 |

| Tax Guide 2009                                       |           |                                             | Tax Guide 2010                                       |           |                                             |
|------------------------------------------------------|-----------|---------------------------------------------|------------------------------------------------------|-----------|---------------------------------------------|
| 2009 Tax Rates for 01 March 2009 to 28 February 2010 |           |                                             | 2010 Tax Rates for 01 March 2010 to 28 February 2011 |           |                                             |
| South African Individual Taxpayers                   |           |                                             | South African Individual Taxpayers                   |           |                                             |
| Income exceeding ...                                 | But Below | Tax                                         | Income exceeding ...                                 | But Below | Tax                                         |
| R 0                                                  | R 132,000 | 18%                                         | R 0                                                  | R 148,000 | 18%                                         |
| R 132,001                                            | R 210,000 | R 23,760 + 25% of the amount above 132,000  | R 148,001                                            | R 221,000 | R 25,200 + 25% of the amount above 148,000  |
| R 210,001                                            | R 290,000 | R 43,260 + 30% of the amount above 210,000  | R 221,001                                            | R 305,000 | R 45,450 + 30% of the amount above 221,000  |
| R 290,001                                            | R 410,000 | R 67,260 + 35% of the amount above 290,000  | R 305,001                                            | R 431,000 | R 70,850 + 35% of the amount above 305,000  |
| R 410,001                                            | R 490,000 | R 109,260 + 38% of the amount above 410,000 | R 431,001                                            | R 552,000 | R 114,750 + 38% of the amount above 431,000 |
| R 490,001 and above                                  |           | R 152,060 + 40% of the amount above 490,000 | R 552,001 and above                                  |           | R 160,730 + 40% of the amount above 552,000 |

| Tax Guide 2011                                       |           |                                             |
|------------------------------------------------------|-----------|---------------------------------------------|
| 2011 Tax Rates for 01 March 2011 to 29 February 2012 |           |                                             |
| South African Individual Taxpayers                   |           |                                             |
| Income exceeding ...                                 | But Below | Tax                                         |
| R 0                                                  | R 150,000 | 18%                                         |
| R 150,001                                            | R 235,000 | R 27,000 + 25% of the amount above 150,000  |
| R 235,001                                            | R 325,000 | R 48,250 + 30% of the amount above 235,000  |
| R 325,001                                            | R 455,000 | R 75,250 + 35% of the amount above 325,000  |
| R 455,001                                            | R 580,000 | R 120,750 + 38% of the amount above 455,000 |
| R 580,001 and above                                  |           | R 168,250 + 40% of the amount above 580,000 |

Figure 7: Direct Tax slabs of past five years in South Africa

(<http://www.taxconsulting.co.za/tax-guide-2007.php>)

It may be observed that the tax rates have remained the same, but the slabs have been increased gradually. Hence, effectively it may be interpreted that the net taxes paid by individuals have been reduced in South Africa in the past five years. The inflation rates at the end of second quarter in each year in the sample (assuming that the effects are visible two quarters after the taxes are paid) are the following:

Q2 2007: 7.1

Q2 2008: 12.2

Q2 2009: 6.9

Q2 2010: 4.2

Q2 2011: 5.0

While the tax slabs have been increasing gradually, the inflation is following a cyclic pattern in this sample. Hence, it appears that direct tax rates and inflation are poorly correlated. Keeping this in view, variations in direct tax rates have not been taken as an input to the Markov chain analysis.

The above observations may be used to estimate the transition probabilities and their values in Markov chain. It may be noted that this is the sole purpose of carrying out the above observations, because the Markov chain is a memory less framework and does not take into account the historical values. The transitional probabilities are approximately assumed as following:

- (a) CPI inflation variation (approximately at the beginning of next quarter) with respect to increase in government spending:
  - a. No variation: 0.1 – it is assumed that there may be small probability that CPI inflation may remain the same.
  - b. CPI inflation will reduce: 0.63 – a closest value of the correlation coefficient has been taken as an assumption.

- c. CPI inflation will increase: 0.27 – the remaining probability has been assumed to be of an increase in CPI inflation.

The probability values of points b and c will swap if government spending reduces.

(b) CPI inflation variation (approximately at the beginning of next quarter) with respect to increase in private spending:

- a. No variation: 0.1 – it is assumed that there may be small probability that CPI inflation may remain the same.
- b. CPI inflation will reduce: 0.54 – a closest value of the correlation coefficient has been taken as an assumption.
- c. CPI inflation will increase: 0.36 – the remaining probability has been assumed to be of an increase in CPI inflation.

The probability values of points b and c will swap if private spending reduces.

(c) CPI inflation variation (approximately at the beginning of next quarter) with respect to increase in exchange rates (USD to ZAR):

- a. No variation: 0.1 – it is assumed that there may be small probability that CPI inflation may remain the same.
- b. CPI inflation will increase: 0.53 – a closest value of the correlation coefficient has been taken as an assumption.
- c. CPI inflation will reduce: 0.37 – the remaining probability has been assumed to be of a reduction in CPI inflation.

The probability values of points b and c will swap if exchange rate reduces.

Theorem: If there are three probabilities of the same event due to three different stochastic variables in their respective samples (say,  $N_A$  ,  $N_B$  ,  $N_C$ ), they can be combined as following:

$$P(E) = P(A) [ 1 - (N_B + N_C) / (N_A + N_B + N_C) ] + P(B) [ 1 - (N_A + N_C) / (N_A + N_B + N_C) ] + P(C) [ 1 - (N_A + N_B) / (N_A + N_B + N_C) ]$$

Proof:

It is assumed that the three stochastic varying variables are part of three different samples causing the same event E. However, If the samples could be combined, then

$$P(E) = (A + B + C) / (N_A + N_B + N_C) \\ = A / (N_A + N_B + N_C) + B / (N_A + N_B + N_C) + C / (N_A + N_B + N_C)$$

Where, A, B and C = no. of times the event occurs in samples  $N_A$  ,  $N_B$  and  $N_C$  , respectively.

We can rewrite the equation as:

$$P(E) = (A / N_A) X [ 1 - (N_B + N_C) / (N_A + N_B + N_C) ] + (B / N_B) X [ 1 - (N_A + N_C) / (N_A + N_B + N_C) ] + (C / N_C) X [ 1 - (N_A + N_B) / (N_A + N_B + N_C) ] \\ = P(A) [ 1 - (N_B + N_C) / (N_A + N_B + N_C) ] + P(B) [ 1 - (N_A + N_C) / (N_A + N_B + N_C) ] + P(C) [ 1 - (N_A + N_B) / (N_A + N_B + N_C) ]$$

(concept taken from: Meyer and Nagpal, 2002)

In this study, sample is  $N=20$ , for the three independent stochastic variables (government spending, private spending and exchange rate). Hence,

$$P(E) = P(A) (1 - 40/60) + P(B) (1 - 40/60) + P(C) (1 - 40/60)$$

$$= [P(A) + P(B) + P(C)] \times (1 - 40/60) = [P(A) + P(B) + P(C)] \times 1 / 3$$

Hence, in this study, the three probabilities of inflation caused by three events can be combined by simple averaging. With this approach, there can be three scenarios:

[A] If the government spending and private spending increase, and exchange rate also increases (it may be recalled that government spending and private spending have a high Pearson correlation coefficient of 0.987 and exchange rate has almost no correlation with either of them and hence can vary independent of them), the following will be achieved:

- (a) CPI inflation remaining same: 0.1
- (b) CPI inflation will increase: 0.39
- (c) CPI inflation will reduce: 0.51

[B] If the government spending and private spending reduce, and the exchange rate also reduces, the following will be achieved:

- (a) CPI inflation remaining same: 0.1
- (b) CPI inflation will increase: 0.51
- (c) CPI inflation will reduce: 0.39

[C] If the government spending and private spending increase, and the exchange rate reduces, the following will be achieved:

- (a) CPI inflation remaining same: 0.1
- (b) CPI inflation will increase: 0.33
- (c) CPI inflation will reduce: 0.57

[D] If the government spending and private spending reduce, and the exchange rate increases, the following will be achieved:

- (a) CPI inflation remaining same: 0.1
- (b) CPI inflation will increase: 0.57
- (c) CPI inflation will reduce: 0.33

### 5.3 MARKOV CHAIN ANALYSIS

Let us suppose that the chain comprises three states: State1, State 2 and State3. The analysis of Markov chain for scenarios A, B, C and D stated in previous Section, is presented as following.

The Markov transition matrix is given by the following:

|      |     |     |
|------|-----|-----|
| P11. | P12 | P13 |
| P21. | P22 | P23 |
| P31. | P32 | P33 |

Here,

P11 = Transitional probability of Inflation remaining at state 1

P12 = Transitional probability of inflation transitioning from state 1 to state 2

P13 = Transitional probability of inflation transitioning from state 1 to state 3

P21 = Transitional probability of inflation transitioning from state 2 to state 1

P22 = Transitional probability of inflation remaining at state 2

P23 = Transitional probability of inflation transitioning from state 2 to state 3

$P_{31}$  = Transitional probability of inflation transitioning from state 3 to state 1

$P_{32}$  = Transitional probability of inflation transitioning from state 3 to state 2

$P_{33}$  = Transitional probability of inflation remaining at state 3

Scenario [A]: Let state 1 be the current state, state 2 is the state of increased inflation and state 3 is the state of reduced inflation. When government and private expenditures increase and exchange rate also increases, the following will be the three state Markov chain:

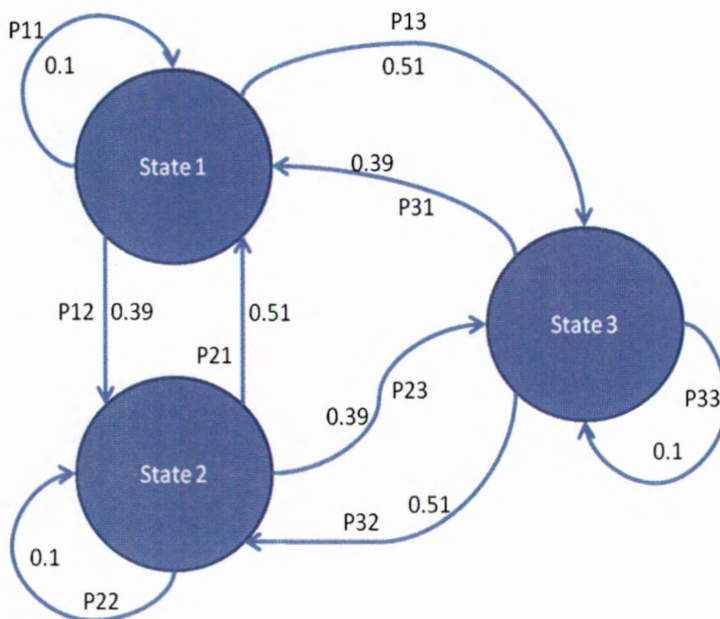


Figure 8: Markov's chain for scenario A

The transitional probability matrix for scenario A will be

≡

|      |      |      |
|------|------|------|
| 0.10 | 0.39 | 0.51 |
| 0.51 | 0.10 | 0.39 |
| 0.39 | 0.51 | 0.10 |

It may be noticed that the sums of probabilities of each row is 1 to cater to the property of Markov's transitional probability matrix. Also, the matrix is in M X M form. The transition probabilities for transition from state 1 to state 2, and state 1 to state 3, has been entered in the matrix as per the calculations in previous Section. However, transitions from state 2 to state 3, and state 3 to state 2 are hidden Markov transitions and hence, their transition probabilities can be estimated by following the rule of a stochastic Markov transition matrix stated in Section 3.2.2 (the sum of probabilities in any row equals 1).

This three state Markov chain gives a number of clues by analysing the probability values. For example, it shows that if Markov's transition matrix needs to be satisfied, then there is a hidden transition from state 2 (higher inflation than state 1) to state 3 (lower inflation than state 1), which will occur at a lower probability at 0.39 (obtained with the help of Markov's transition matrix). On the other hand, the vice versa (state 3 to state 2) is expected to occur at a high probability (0.51)

Keeping the same philosophy, the Markov chain and the corresponding transition matrix of the other three scenarios are shown as following:

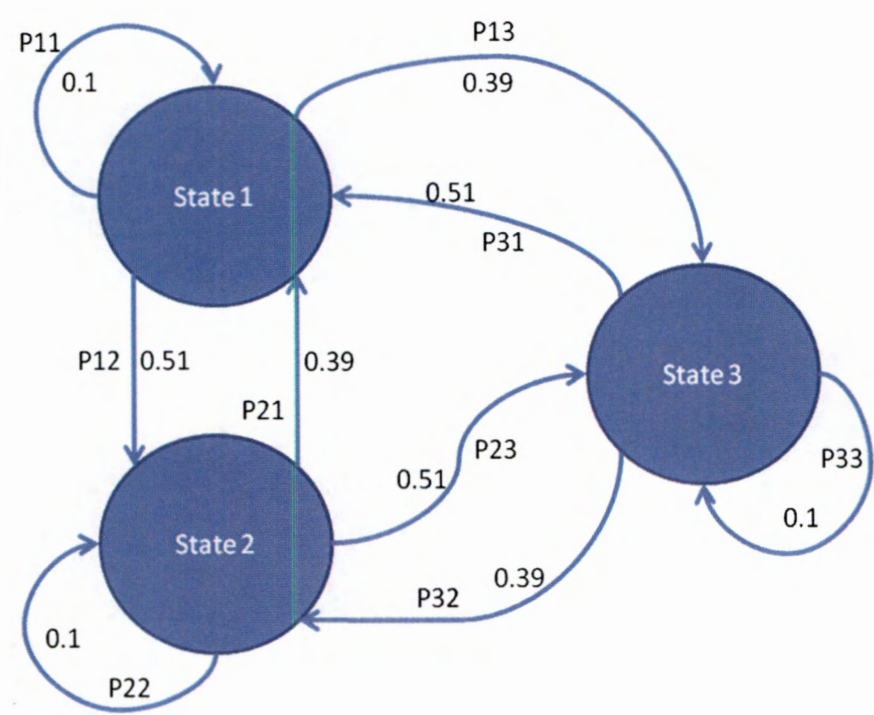


Figure 9: Markov’s chain for scenario B

The transitional probability matrix for scenario B will be

≡

$$\begin{bmatrix} 0.10 & 0.51 & 0.39 \\ 0.39 & 0.10 & 0.51 \\ 0.51 & 0.39 & 0.10 \end{bmatrix}$$

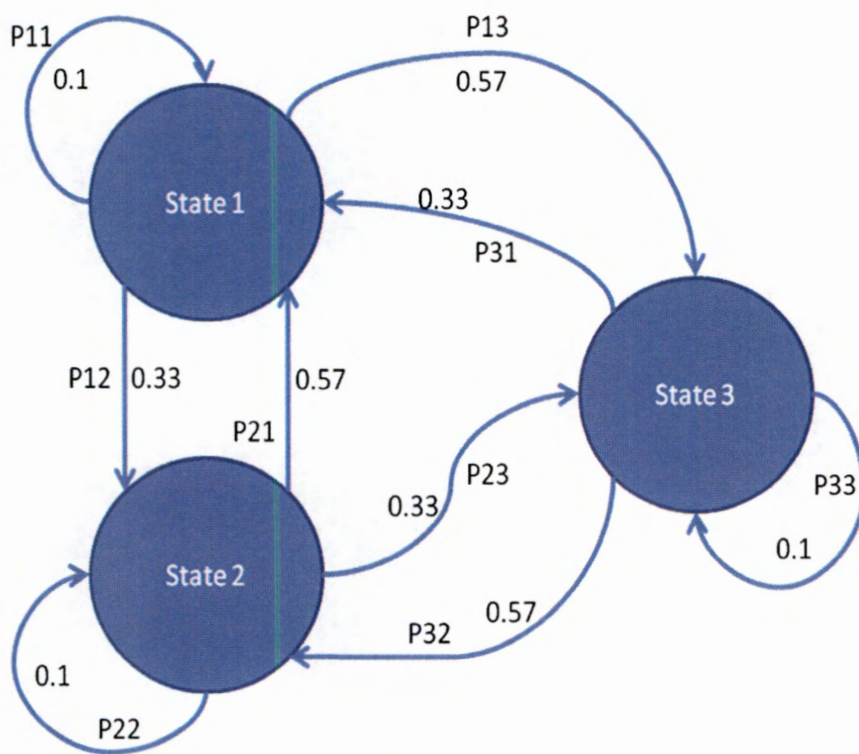


Figure 10: Markov's chain for scenario C

The transitional probability matrix for scenario C will be

≡

|      |      |      |
|------|------|------|
| 0.10 | 0.33 | 0.57 |
| 0.57 | 0.10 | 0.33 |
| 0.33 | 0.57 | 0.10 |

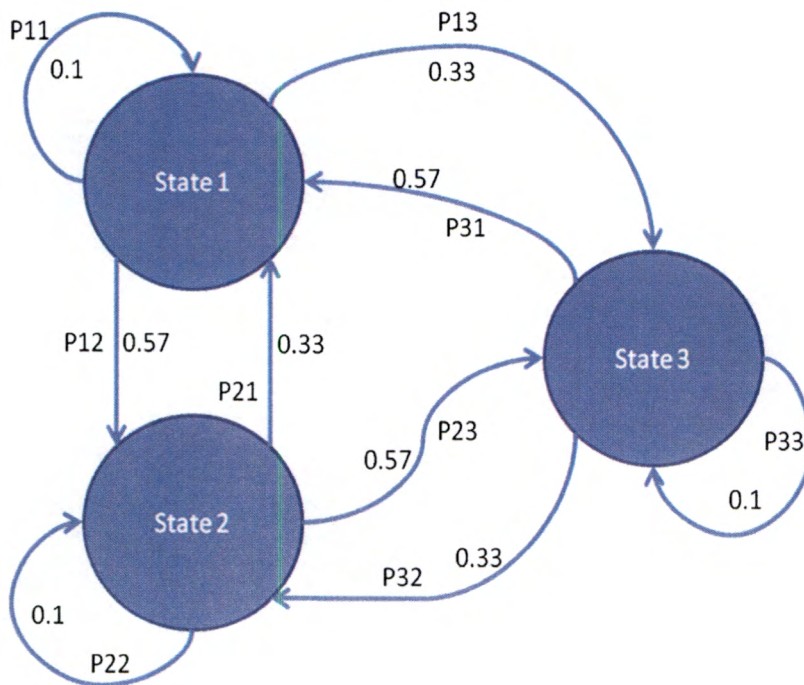


Figure 11: Markov's chain for scenario D

The transitional probability matrix for scenario D will be

≡

|      |      |      |
|------|------|------|
| 0.10 | 0.57 | 0.33 |
| 0.33 | 0.10 | 0.57 |
| 0.57 | 0.33 | 0.10 |

## 5.4 DISCUSSIONS

In the Markov chains, it can be observed that the transitions are inversely proportional to the government and private spending, and directly proportional to exchange rates. However, from Table 3, it can be observed that government and private expenditures are highly correlated (Pearson coefficient at 0.978). Hence, it may be concluded that both of them will vary proportionately and may almost certainly push inflation downwards. The exceptions may occur due to change in exchange rate (USD to ZAR). Hence, the probability of reduction of inflation due to government and private spending may happen if there is an increase in exchange rates. This is the reflection from the four scenarios of Markov's chain presented in previous Section.

It should be observed that the transitions from state 1 to state 2, state 1 to state 3, state 2 to state 1, and state 3 to state 1 have been included in the transition probability matrix using the probabilities calculated in the four scenarios (A, B, C and D). However, the transitions from state 2 to state 3, and from state 3 to state 2, in the four scenarios are

hidden and has been evolved due to the stochastic property of Markov's transition matrix. This is the unique feature of Markov's matrix. It can evolve the hidden state transitions not apparent from the transitional probability calculations.

The Markov chain analysis of stochastic variables having a high correlation with each other in a sample taken on a common time horizon can be carried out using correlation analysis. The Pearson correlation between two variables can be taken as a transitional probability with a reasonable level of accuracy (up to 95 percentile). Hence, in this study the Pearson correlation coefficient has been taken as the estimated probability value (say,  $P$ ) for a transition. The probability value for the opposite transition can be taken as  $(1 - P)$ . However, the researcher has split this probability  $(1 - P)$  into two parts to include a "no transition" scenario, which can very much happen in case of the variable studied in this research (i.e., CPI inflation not varying at all, in spite of variations in the independent variables). This approach has been used in this study in all the four scenarios.

Based on the current state of inflation, one can analyse the probability of the next state by investigating the scenario (change in government and private expenditures, and the change in exchange rate). The Markov chain is dynamic and hence the probabilities assumed based on correlation analysis, may change as the sample window is expanded or moved ahead. This is because the Pearson correlation values between the independent variables and CPI inflation might change. Hence, the Markov chains may

have to be prepared again with slight variations of transition probabilities in each preparation cycle.

Before concluding the dissertation, it is essential to analyse which hypotheses have been accepted. Based on the Pearson correlation analysis and mapping with the literature review, the following hypotheses have been accepted:

- (a) The hypothesis no.  $H_{A0}$  stating that exchange rate affects inflation in South Africa is accepted with a moderate confidence level. The Pearson test returned a direct correlation between CPI inflation and exchange rate with a moderate value of 0.526. Compared with the literature review, this finding matches with the findings by Carranza, Galdon-Sanchez and Gomez-Biscarri (2009), Garcia, Restrepo and Roger (2011), Aizenman, Hutchison and Noy (2011), Arize, Malindretos and Nippani (2004) and Alfaro (2005). However, their discussion revealed two key facts about this correlation. The first fact is that the correlation between exchange rate and CPI inflation is significant in highly Dollarized economies. The second fact is that the correlation is significant in economies significantly dependent upon imports. The Pearson correlation test reveals that both the facts are applicable in South Africa, albeit at moderate levels. Hence, South Africa is better placed in terms of local sustainability and openness of its economy. To improve further, the government should focus on better output growths and reduce the dependency on imports. Moreover, the local markets should be developed to a large extent such that the economical dependency on imports for the growth of

the nation can be reduced. Both these factors require significant local expenditures by government and private companies to create local opportunities and employment.

- (b) The hypothesis no.  $H_{B0}$  stating that investment spending affects inflation in South Africa is accepted with moderate confidence level. The Pearson test returned an inverse correlation between CPI inflation and investment spending with a moderate value of  $-0.543$ . This result is in line with the findings in the literature review. Huang, Lin, Kim and Yeh (2010) stated that private expenditures result in improved output and hence reduced inflation. However, Galiet al., (2001) stated that government should create an environment for private spending through investment-friendly monetary policies and institutional support. Given that central government follows the political mandate of a nation (Surico, 2007), fuelling private expenditure is the accountability of government. In South Africa, private players have contributed significantly but the moderate inverse correlation indicates that it is not sufficient to generate the desired output and reduce reliance on importing of essential commodities. An influence of exchange rates on inflation can be reduced if the local production is sufficient to meet the demand, and on the other hand the demand is sufficient to reduce the economic dependence of the nation on exports. In other words, the dollarization effects in South Africa need to be reduced.

(c) The hypothesis no.  $H_{C0}$  stating that government spending affects inflation in South Africa is accepted with a moderate confidence level. The Pearson test returned an inverse correlation between CPI inflation and government spending with a moderate value of  $-0.635$ . The effects of government expenditure are almost the same as the effects of private expenditure. It is important not only to increase output but also to encourage private expenditure. A very good sign in South Africa is that government and private expenditures are significantly correlated (Pearson coefficient is  $0.978$ ). This indicates a consistent contribution by government and private players in economic development of South Africa. However, the inflation is only moderately reduced due to government spending because the contribution to output is still not optimum and the effects of exchange rate fluctuation on CPI inflation are prevalent.

(d) The hypothesis no.  $H_{D1}$  stating that taxation does not affect inflation in South Africa is accepted. A Pearson test was not possible because the direct tax rates have not changed in South Africa in the sampled period, rather the taxable slabs have been increased gradually. However, it is observed that the inflation has varied stochastically in the sampled five years although the direct taxable slabs have been increased gradually by the government. Hence, it is evident that there is very low correlation between direct tax variations and CPI inflation variations. This reveals that the government's support to direct tax payers in the form of reduced burden has not influenced inflation.

The above findings indicate that inflation in South Africa is moderately influenced by changes external to the nation (dollarization effects) that is preventing the nation in deriving full benefits from the local expenditures made by private parties and government. This finding is analysed in detail in the next Chapter because the first research question is an inquisition of the factors causing high inflation in South Africa.

Based on the above findings, the research questions have been answered in the next Chapter. In addition, a discussion has been presented on justification of how the objectives have been met and to what extent.

## **5.5 SUMMARY OF CHAPTER 5**

In this Chapter, the five year data collected comprising quarterly values is tabulated and the Pearson correlation analysis has been conducted. Based on the analysis, the transitional probabilities for constructing Markov chains have been estimated and the chains prepared for four scenarios. The revelations about hidden transitions in Markov chains, by complying with the stochastic matrix rules have been highlighted. In addition, a discussion on the accepted hypotheses is presented along with an analysis of its interpretations indicating what is applicable in South Africa, and what changes are needed. In the next Chapter, the findings have been concluded in the context of South Africa.

## **CHAPTER 6:**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **6.1 INTRODUCTION**

In this Chapter, the conclusions are presented based on an analysis of how the research questions have been addressed, in line with the research design formulated at the beginning of this study.

#### **6.2 CONCLUSIONS**

The primary aim of this study was to establish the probability that inflation in South Africa, together with the variables causing it, would increase or decrease. The primary aim has been fulfilled by collecting data of five years pertaining to CPI inflation and the variables causing it, conducting a Pearson correlation test, constructing Markov transitional matrices for four identified scenarios, and constructing the corresponding Markov chains. In addition, the study targeted the determination of strategies good enough to produce optimum outputs in South Africa and be able to reduce inflation.

In Chapter 3, an organised study of inflation and the macro-economic variables causing it was studied by reviewing a large number of relevant literature. The studies by Harriott (2000), Salmanpour and Bahloli (2011), HM Treasury (n. d.), Guerrero (2006), Mollick, Cabral and Carneiro (2011), Ireland (1996), Tillmann (2008) and Crowder and Hoffman (1996) emphasised the primary reason for inflation as a gap in the national output that

applies significant pressure on the supplies to meet the demand. The output is influenced by the cost of inputs (materials and labour). Hence, the macro-economic variables that influence the output affect inflation directly are the ones causing variations of inflation. Scholars like Reynard (2007), Bernasconi and Kirchkamp (2000), Brumm (2006), Cukierman, Miller and Neyapti (2002), Brimmer (2002), and Tillmann (2008) identified the monetary policy of the government as the key macro-economic factor affecting inflation. Wu and Ni (2011) identified oil price shocks as one of the greatest factor influencing the output. Dwyer and Fisher (2009) identified 20% or more excess money in the market as highly correlated with inflation.

There are other factors identified as well, such as: institutional support (availability of loans), trade liberalisation, and globalisation (Baltensperger, Fischer and Jordan, 2007; Hung, 2003; Mollick, Cabral and Carneiro, 2011). However, these do not lie at the core of the gamut of macro-economic variables affecting inflation. It is important that the government of a country establishes growth targets to reduce the output gap. Hence, all the independent macro-economic variables influencing output gap need to be considered. In this study, the following macro-economic variables have been chosen as a result of an extensive literature review on the macro-economic variables affecting inflation, and a separate study of the state of inflation and the variables affecting it in South Africa:

- (a) Government expenditures
- (b) Private expenditures
- (c) Exchange rates

#### (d) Taxation

All other variables in some form are dependent upon these variables. For example:

- Output growth is dependent upon government and private expenditures.
- Increase in employment is dependent upon the output growth caused by government and private expenditures.
- Increase in wages is dependent upon increase in employment and output growth.
- Balance of payments is a result of inadequate output growth such that essential commodities are imported from external sources.
- Increase in supply costs depend upon high reliance on external sources and increase of exchange rates.
- Surplus money in market is dependent upon taxation policies.

There are many such factors that are directly or indirectly related to these fundamental variables. A quantitative study of the influence of above variables on the consumer price index inflation (the primary indicator of inflation in South Africa) has been conducted in this study using two sophisticated instruments: Pearson's correlation tests and Markov's chain analysis (includes formulation of Markov's matrix of transitional probabilities).

Fundamentally, the outcomes of this study are the following:

- (a) An in-depth literature review
- (b) A Table of data pertaining to fundamental macro-economic variables and inflation figures of five years – 2007 to 2011.

- (c) A time series analysis
- (d) A Pearson's correlation test
- (e) A list of four scenarios of change in inflation in South Africa
- (f) Markov's matrices of transitional probabilities pertaining to the four scenarios
- (g) Markov's chains in the four scenarios

The following is a description of the outcome of the study outcomes with respect to the research questions:

- (a) Why is South Africa experiencing a sudden increase in inflation?

Outcomes: The findings to this question have been discussed in Section 5.3. The analysis in Section 5.3 revealed that South Africa is moderately affected by both internal expenditures (government and private) and external factors (dollarization of South African economy). However, a very good sign in South Africa is that government and private expenditures are highly correlated (0.978). In this sample, the beginning quarter (Q1 2007) and the ending quarter (Q4 2011) have witnessed a CPI inflation rate of 6.1. This may reveal that inflation has not changed in this sample. However, 6.1% cannot be treated as the benchmark because South Africa has witnessed inflation rates of the order of 3.2% (Q3 2010), 3.5% (Q4 2010) and 4.1% (Q1 2011). The CPI inflation has been at its peak at 9.0, 10.6, 12.2, 13.1 and 9.5 (in the period Q4 2007 to Q4 2008) after which, the inflation subsided for a few quarters. However, it is increasing again. Given the study of the correlation test of the chosen macro-economic variables, it is evident that government expenditure hardly increased during the period of peak inflation albeit the private expenditure

gradually increased at a slower pace. The USD to ZAR exchange rate increased significantly during this period (with the peak value at 9.5160). A combined effect of the high impact of dollarization during this period (recall that this was the peak of the economic crisis) and slowed pace of government and private expenditures caused a steep rise in CPI inflation. The exchange rate has again increased significantly (it was 8.0763 in Q4 2011 and is 8.3451 on September 20<sup>th</sup> 2012). The latest recorded rate of CPI inflation is 5.0% (end of Q2 2012; source: Liberta.co.za). This is a good sign because the trend of Q4 2007 to Q4 2008 is not getting repeated. This means that the government and private expenditures have improved output to such an extent that the effect of dollarization has reduced on South Africa. By the end of Q2 2012, the total government expenditure is R 696.213 billion and the total private expenditure is 1882.204 billion (Source: RBSA). These values in Q1 2012 are R 683 billion and R 1844.643 billion (Source: RBSA). All the three factors (government expenditure, private expenditure and exchange rate) have increased and hence, as per the Markov chain analysis in this dissertation, it is scenario A. Therefore, there should be a probability of 0.51 that inflation will reduce and a probability of 0.39 that the inflation will increase. As correctly predicted by our Markov chain, the inflation has reduced from Q1 2012 (6.1%: source: Liberta.co.za) to Q2 2012 (5%: source: Liberta.co.za). This has happened due to significant private and government expenditures reducing the impact of external factors (reflected in the exchange rate rise). The nation has significant local potential that needs to be tapped and made independent of external disturbances.

(b) Why is managing GDP, inflation, unemployment and the balance of payment important?

Findings: This question has been addressed in the Section 1.7.2 and is further clarified here, taking into account the findings of Pearson's correlation test and construction of Markov's chain. GDP is a measure of output of a nation. Our study showed that both private and government expenditures, which contribute significantly to output, are highly correlated in South Africa. Hence, both are collective indicators of output optimisation. However, if output is optimised but inflation still grows, there are external factors affecting South African economy (dollarization), or else the expenditures are not returning desired results. If the desired returns are not achieved, and there is high level of dollarization, the unemployment cannot be reduced, the balance of payment will increase and the taxation may be increased to reduce fiscal deficit. The good sign in South Africa is that inflation is moderately correlated in the reverse direction to government and private expenditures (in the sample collected from 2007 to 2011). Hence, there is scope for improvement. The national efficiency will be indicated if inflation is significantly inversely correlated with government and private expenditures. This will nullify the effects of dollarization on the South African economy. Increased desired output will definitely reduce unemployment, and balance of payment.

(c) How are the various macro-economic variables affecting inflation and output in South Africa?

Findings: As a result of Pearson's test, the following facts are evident in the sample of five years collected from RBSA and OECD pertaining to the chosen macro-economic variables of South Africa:

- CPI inflation is inversely proportional to government expenditure, and the correlation is moderate ( $-0.635$ ).
- CPI inflation is inversely proportional to private expenditure, and the correlation is moderate ( $-0.543$ ).
- CPI inflation is directly proportional to exchange rates, and the correlation is moderate ( $+0.526$ ).

An interpretation of the gradually increasing taxable slabs for direct taxing in South Africa and the CPI inflation values indicate that the latter is poorly correlated with direct taxing. Keeping in view these correlations, four scenarios have been created in Section 5.1 that may influence the CPI inflation. These scenarios have been used to construct the transitional probability matrices and the Markov chains, as presented in Section 5.2.

### **6.3 RECOMMENDATIONS**

In this study, it is recommended that the Pearson correlation (and other forms of correlation tests) should be conducted on a moving five year sample (like, the new window at the end of 2012 should be 2008 to 2012). All correlations should be revalidated, the transitional probability matrices should be reconstructed keeping in mind the four scenarios analysed, and the Markov chains should be reconstructed. The reconstructed transitional probability matrices and the new Markov chain can then be

used for a quarterly forecast of CPI inflation. In this study, the researcher has taken into account one-way of studying correlations. However, there can be more sophisticated methods to evaluate correlations more accurately. For example, the effects of multiple correlation coefficients can be combined to finalise a net value. This process may be useful in making a more accurate estimation of transitional probabilities. Moreover, the moving sample window may be increased from five years to seven years or ten years to determine more accurate estimation of correlations.

#### **6.4 SUGGESTIONS FOR FUTURE STUDIES**

Essentially, it is suggested that this study should be repeated every year by moving the sample window gradually by six months to one year. This will be a useful method to continuously monitor the national efficiency and the reduction of the dollarization of the South African economy. However, this study has missed one key aspect – a benchmark. A benchmark can be created by conducting this analysis for all countries having economic structures comparable to that of South Africa. An immediate idea that comes to mind is that the South African economy may be compared with the other nations in the BRICS group (Brazil, Russia, India and China). By repeating this analysis for these nations, a benchmark may be created, such that the performance of the South African economy can be compared with the benchmark. The future researchers may like to study how such a benchmark can be created. The researcher of this study is also keen to contribute in this direction in her future academic studies.

## 6.5 SUMMARY OF CHAPTER 6

In this Chapter, the conclusion has been presented and the research questions have been addressed. The results of a literature review, Pearson's correlation testing and Markov's chain analysis have been used to present the findings against the research questions. In addition, the recommendations from this study and the suggestions for future studies have been made.

## References

- Aizenman, J., Hutchison, M. and Noy, I. (2011). "Inflation Targeting and Real Exchange Rates in Emerging Markets". *World Development*, Vol. 39 (5): p. 712–724. Elsevier.
1. Alfaro, L. (2005). "Inflation, openness, and exchange-rate regimes: The quest for short-term commitment". *Journal of Development Economics*, Vol. 77: p. 229–249. Elsevier.
  2. Arize, A. C., Malindretos, J. and Nippani, S. (2004). "Variations in exchange rates and inflation in 82 countries: an empirical investigation". *North American Journal of Economics and Finance*, Vol. 15: p. 227–247. Elsevier.
  3. Aron, J. and Muelbauer, J. (2012). "Improving forecasting in an emerging economy, South Africa: Changing trends, long run restrictions and

- disaggregation". *International Journal of Forecasting*, Vol. 28: p. 456–476. Elsevier.
4. Aron, J. and Muellbauer, J. (2001). "Interest rate effects on output: evidence from a GDP forecasting model for South Africa". Centre for the Study of African Economies, Department of Economics, University of Oxford, p. 3-43.
  5. Baltensperger, E., Fischer, A. M. and Jordan, T. J. (2007). "Strong goal independence and inflation targets". *European Journal of Political Economy*, Vol. 23: p. 88–105. Elsevier.
  6. Bernasconi, M. and Kirchkamp, O. (2000). "Why do monetary policies matter? An experimental study of saving and inflation in an overlapping generations model" *Journal of Monetary Economics*, Vol. 46: p. 315-343. Elsevier.
  7. Brimmer, A. F. (2002). "Central banks and inflation targeting in perspective". *North American Journal of Economics and Finance*, Vol. 13: p. 93–97. Elsevier.
  8. Brumm, H. J. (2006). "The effect of central bank independence on inflation in developing countries". *Economics Letters*, Vol. 90: p. 189–193. Elsevier.
  9. Bryman, A. and Bell, E. (2007). "Business Research Methods". Second Edition. OUP, London.

10. Bryman, A. (2004). "Social Research Methods". Second Edition. London: Oxford University Press.
11. Budina, N. and van Wijnbergen, S. (2000). "Fiscal Deficits, Monetary Reform, and Inflation Stabilization in Romania". Policy Research Working Paper WPS-2298, Macroeconomics and Growth, The World Bank Research Group, p. 3-32.
12. Campillo, M. and Miron, J. A. (1997). "Why does inflation differ across countries?". p. 335-362. Book Chapter: *Reducing Inflation: Motivation and Strategy*. Romer, C. D. and Romer, D. H. (Eds). University of Chicago Press.
13. Carranza, L., Galdon-Sanchez, J. E. and Gomez-Biscarri, J. (2009). "Exchange rate and inflation dynamics in dollarized economies". *Journal of Development Economics*, Vol. 89: p. 98–108. Elsevier.
14. Catao, L. A. V. and Terrones, M. E. (2005). "Fiscal deficits and inflation". *Journal of Monetary Economics*, Vol. 52: p. 529–554. Elsevier.
15. Collis, J. and Hussey, R. (2009). "Business Research: A Practical Guide for Under Graduate and Post Graduate Students". Third Edition. US: Palgrave McMillan

16. Coolen, A. C. C. (2009). "Markov Chains: Compact Lecture Notes and Exercises". Department of Mathematics, King's College London, p. 2-40.
17. Crowder, W. J. and Hoffman, D. L. (1996). "The Long-Run Relationship between Nominal Interest Rates and Inflation: The Fisher Equation Revisited". *Journal of Money, Credit and Banking*, Vol. 28 (1): p. 102-118. Ohio State University Press. JSTOR.
18. Cukierman, A., Miller, G. P. and Neyapti, B. (2002). "Central bank reform, liberalization and inflation in transition economies-an international perspective". *Journal of Monetary Economics*, Vol. 49: p. 237–264. Elsevier.
19. David Begg, Stanley Fischer and Rudiger Dornbusch (2005), economics 8th edition by publisher: mcgraw-hill higher education.
20. Dwyer, G. P. and Fisher, M. (2009). "Inflation and monetary regimes". *Journal of International Money and Finance*, Vol. 28: p. 1221–1241. Elsevier.
21. Fallahi, F. and Rodríguez, G. (2007). "Using Markov-Switching Models to Identify the Link between Unemployment and Criminality". Department of Economics, Faculty of Social Sciences, University of Ottawa, p. 2-53.

22. Fielding, D. and Shields, K. (2006). "Regional asymmetries in monetary transmission: The case of South Africa". *Journal of Policy Modelling*, Vol. 28: p. 965–979. Elsevier.
23. Gali, J., Gertler, M. and Lopez-Salido, J. D. (2001). "European inflation dynamics". *European Economic Review*, Vol. 45: p. 1237-1270. Elsevier.
24. Gandolfi, A. E. (1982). "Inflation, Taxation, and Interest Rates". *The Journal of Finance*, Vol. 37 (3): p. 797-807. American Finance Association. JSTOR.
25. Garcia, C. J., Restrepo, J. E. and Roger, S. (2011). "How much should inflation targeters care about the exchange rate?". *Journal of International Money and Finance*, Vol. 30: p. 1590–1617. Elsevier.
26. Guerrero, F. (2006). "Does inflation cause poor long-term growth performance?". *Japan and the World Economy*, Vol. 18: p. 72–89. Elsevier.
27. Gupta, R. and Kabundi, A. (2011). "A large factor model for forecasting macroeconomic variables in South Africa". *International Journal of Forecasting*, Vol. 27: p. 1076–1088. Elsevier.
28. Gylfason, T. and Herbertsson, T. T. (2001). "Does inflation matter for growth?". *Japan and the World Economy*, Vol. 13: p. 405-428. Elsevier.

29. Harriott, K. (2000). "Essential facts about inflation". Research & Economic Programming Division, Bank of Jamaica, p. 3-20.
30. Henkel, S. J., Martin, and Nardari, F. (2008). "Time-varying Short-Horizon Predictability". Published thesis, Carnegie Mellon University, p. 1-49.
31. Huang, H., Lin, S., Kim, D. and Yeh, C. (2010). "Inflation and the finance–growth nexus". *Economic Modelling*, Vol. 27: p. 229-236. Elsevier.
32. Immervoll, H. (2000). "The Impact of Inflation on Income Tax and Social Insurance Contributions in Europe". Department of Applied Economics, University of Cambridge, p. 1-30.
33. "Influences on inflation". HM Treasury article. n. d.  
<http://archive.treasury.gov.uk/pub/html/top/top6/inf.html> [Accessed: March 22, 2012]
34. Ireland, P. N. (1996). "Long-Term Interest Rates and Inflation: A Fisherian Approach". *Federal Reserve Bank of Richmond Economic Quarterly*, Vol. 82 (1): p. 21-36.

35. Joubert, J. W. and Steyn, D. (2003). "Operationalising Operations Research". *World Transactions on Engineering and Technology Education*. Vol. 21 (11): p. 91-114.
36. Lawrence L lapin (1976), 10<sup>th</sup> Edition Quantitative Method for Business Decisions
37. Lin, S. and Ye, H. (2009). "Does inflation targeting make a difference in developing countries?". *Journal of Development Economics*, Vol. 89: p. 118–123. Elsevier.
38. "Markov Chain Models". P. 2-20.  
URL: <<http://faculty.oxy.edu/angela/prior%20to%200708/392/CH5-MarkovChains.pdf>> [Retrieved on: 28 August 2012]
39. Meyer, A. and Nagpal, R. (2002). "Introduction to Probability". Course Notes 10, Mathematics for Computer Science, Massachusetts Institute of Technology: p. 1-45. URL: <<http://www.cs.brown.edu/courses/csci1510/reference/probability.pdf>> [Retrieved on 30 August 2012]
40. Mollick, A. V., Cabral, R. and Carneiro, F. G. (2011). "Does inflation targeting matter for output growth? Evidence from industrial and emerging economies". *Journal of Policy Modelling*, Vol. 33: p. 537–551. Elsevier.

41. Naraidoo, R. and Paya, I. (2012). "Forecasting monetary policy rules in South Africa". *International Journal of Forecasting*, Vol. 28: p. 446–455. Elsevier.
42. "Pearson Correlation Coefficient  $r$ ". University of West England, 2007, URL: <http://hsc.uwe.ac.uk/dataanalysis/quantinfasspear.asp> [Retrieved on 28 September 2012]
43. Poterba, J. M. and Rotemberg, J. J. (1990). "Inflation and Taxation with Optimizing Governments". *Journal of Money, Credit and Banking*, Vol. 22 (1): p. 1-18. Ohio State University Press. JSTOR.
44. Rattso, J. and Stokke, H. E. (2012). "Regional convergence of income and education: Investigation of distribution dynamics". Department of Economics, Norwegian University of Science and Technology, p. 2-23.
45. Reynard, S. (2007). "Maintaining low inflation: Money, interest rates, and policy stance". *Journal of Monetary Economics*, Vol. 54: p. 1441–1471. Elsevier.
46. Salmanpour, A. and Bahloli, P. (2011). "Inflation, Inflation Uncertainty and Factors Affecting Inflation in Iran". *World Applied Sciences Journal*, Vol. 14 (8): p. 1225-1239.

47. Saunders, M.N.K., Lewis, P., and Thornhill, A. (2011). "Research Methods for Business Students". Fifth edition. Prentice Hall, London.
48. Sekaran, U. (2010). "Research methods for business: A skill building approach". Fourth Edition, NY: Wiley.
49. Serban, M. (2002). "Budget Deficit and Inflation". Published PH D thesis, Academy of Economic Studies. p. 4-28. Proquest Information and Learning. ABI Informs.
50. Smal, M. M. and de Jager, S. (2001). "The monetary transmission mechanism in South Africa. Occasional Paper No. 16, South African Reserve Bank, p. 1-19.
51. Songezo Zibi, City Press, (14 August 2011), An economic "CODESA" must have real value.
52. Struwig, F.W. and Stead, G.B. (2001), *Planning, designing and reporting research*. CapeTown: Masker Miller Longman
53. Surico, P. (2007). "The Fed's monetary policy rule and U.S. inflation: The case of asymmetric preferences". *Journal of Economic Dynamics and Control*, Vol. 31: p. 305–324. Elsevier.

54. Talvi, E. and Vegh, C. A. (2005). "Tax base variability and pro-cyclical fiscal policy in developing countries". *Journal of Development Economics*, Vol. 78: p. 156–190. Elsevier.
55. Tillmann, P. (2008). "Do interest rates drive inflation dynamics? An analysis of the cost channel of monetary transmission". *Journal of Economic Dynamics and Control*, Vol. 32: p. 2723–2744. Elsevier.
56. Van der Merwe, E. J. (2004). "Inflation targeting in South Africa". Occasional Paper No 19, South African Reserve Bank, p. 1-19.
57. Walsh, B. (2004). "Markov Chain Monte Carlo and Gibbs Sampling". Lecture Notes for EEB 581, version 26. URL: [web.mit.edu/~wingated/www/introductions/mcmc-gibbs-intro.pdf](http://web.mit.edu/~wingated/www/introductions/mcmc-gibbs-intro.pdf). [Retrieved on 28 August 2012].
58. Welman, C., Kruger, F. and Mitchell, B. (2005), *Research Methodology*, (3<sup>rd</sup> Ed), Cape Town: Oxford University Press Southern Africa.
59. Wu, M. and Ni, Y. (2011). "The effects of oil prices on inflation, interest rates and money". *Energy*, Vol. 36: p. 4158-4164. Elsevier.

Pages 110

## Appendix A

|    |         | Private total<br>expenditure (R<br>Billions) | Government<br>total<br>expenditure<br>(R Billions) | Exchange<br>rate (USD to<br>SA Rand) on<br>the last day<br>of the quarter | CPI Inflation<br>rate on the last<br>date of each<br>quarter (%) |
|----|---------|----------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------|
| 1  | Q1 2007 | 310.36                                       | 94.62                                              | 7.223                                                                     | 6.1                                                              |
| 2  | Q2 2007 | 321.71                                       | 95.53                                              | 7.0798                                                                    | 7.1                                                              |
| 3  | Q3 2007 | 332.12                                       | 96.61                                              | 6.89                                                                      | 7.2                                                              |
| 4  | Q4 2007 | 336.73                                       | 104.45                                             | 6.8062                                                                    | 9                                                                |
| 5  | Q1 2008 | 344.24                                       | 106.39                                             | 7.9803                                                                    | 10.6                                                             |
| 6  | Q2 2008 | 354.04                                       | 104.61                                             | 7.895                                                                     | 12.2                                                             |
| 7  | Q3 2008 | 357.95                                       | 110.97                                             | 8.2732                                                                    | 13.1                                                             |
| 8  | Q4 2008 | 357.89                                       | 120.99                                             | 9.516                                                                     | 9.5                                                              |
| 9  | Q1 2009 | 360.48                                       | 118.86                                             | 9.4402                                                                    | 8.5                                                              |
| 10 | Q2 2009 | 367.46                                       | 124.87                                             | 7.7005                                                                    | 6.9                                                              |
| 11 | Q3 2009 | 375.06                                       | 137.75                                             | 7.5222                                                                    | 6.1                                                              |
| 12 | Q4 2009 | 383.89                                       | 139.65                                             | 7.41                                                                      | 6.3                                                              |
| 13 | Q1 2010 | 388.04                                       | 141.38                                             | 7.2855                                                                    | 5.1                                                              |
| 14 | Q2 2010 | 396.32                                       | 142.7                                              | 7.6755                                                                    | 4.2                                                              |
| 15 | Q3 2010 | 407.66                                       | 149.72                                             | 6.9711                                                                    | 3.2                                                              |
| 16 | Q4 2010 | 418.15                                       | 150.62                                             | 6.6026                                                                    | 3.5                                                              |
| 17 | Q1 2011 | 428.2                                        | 153.6                                              | 6.7801                                                                    | 4.1                                                              |
| 18 | Q2 2011 | 437.56                                       | 162.96                                             | 6.7717                                                                    | 5                                                                |
| 19 | Q3 2011 | 453.35                                       | 169.25                                             | 8.0975                                                                    | 5.7                                                              |
| 20 | Q4 2011 | 461.16                                       | 170.75                                             | 8.0763                                                                    | 6.1                                                              |

| Tax Guide 2007                                       |           |                                             | Tax Guide 2008                                       |           |                                             |
|------------------------------------------------------|-----------|---------------------------------------------|------------------------------------------------------|-----------|---------------------------------------------|
| 2007 Tax Rates for 01 March 2007 to 28 February 2008 |           |                                             | 2008 Tax Rates for 01 March 2008 to 28 February 2009 |           |                                             |
| South African Individual Taxpayers                   |           |                                             | South African Individual Taxpayers                   |           |                                             |
| Income exceeding ...                                 | But Below | Tax                                         | Income exceeding ...                                 | But Below | Tax                                         |
| R 0                                                  | R 112,500 | 18%                                         | R 0                                                  | R 122,000 | 18%                                         |
| R 112,501                                            | R 180,000 | R 20,250 + 25% of the amount above 112,500  | R 122,001                                            | R 195,000 | R 21,960 + 25% of the amount above 122,000  |
| R 180,001                                            | R 250,000 | R 37,125 + 30% of the amount above 180,000  | R 195,001                                            | R 270,000 | R 40,210 + 30% of the amount above 195,000  |
| R 250,001                                            | R 350,000 | R 58,125 + 35% of the amount above 250,000  | R 270,001                                            | R 380,000 | R 62,710 + 35% of the amount above 270,000  |
| R 350,001                                            | R 450,000 | R 83,125 + 38% of the amount above 350,000  | R 380,001                                            | R 490,000 | R 101,210 + 38% of the amount above 380,000 |
| R 450,000 and above                                  |           | R 131,125 + 40% of the amount above 450,000 | R 490,001 and above                                  |           | R 143,010 + 40% of the amount above 490,000 |
| Tax Guide 2009                                       |           |                                             | Tax Guide 2010                                       |           |                                             |
| 2009 Tax Rates for 01 March 2009 to 28 February 2010 |           |                                             | 2009 Tax Rates for 01 March 2010 to 28 February 2011 |           |                                             |
| South African Individual Taxpayers                   |           |                                             | South African Individual Taxpayers                   |           |                                             |
| Income exceeding ...                                 | But Below | Tax                                         | Income exceeding ...                                 | But Below | Tax                                         |
| R 0                                                  | R 132,000 | 18%                                         | R 0                                                  | R 140,000 | 18%                                         |
| R 132,001                                            | R 210,000 | R 23,760 + 25% of the amount above 132,000  | R 140,001                                            | R 221,000 | R 25,200 + 25% of the amount above 140,000  |
| R 210,001                                            | R 290,000 | R 43,260 + 30% of the amount above 210,000  | R 221,001                                            | R 305,000 | R 45,450 + 30% of the amount above 221,000  |
| R 290,001                                            | R 410,000 | R 67,260 + 35% of the amount above 290,000  | R 305,001                                            | R 431,000 | R 70,650 + 35% of the amount above 305,000  |
| R 410,001                                            | R 480,000 | R 109,260 + 38% of the amount above 410,000 | R 431,001                                            | R 552,000 | R 114,750 + 38% of the amount above 431,000 |
| R 480,001 and above                                  |           | R 152,960 + 40% of the amount above 480,000 | R 552,001 and above                                  |           | R 160,730 + 40% of the amount above 552,000 |

| Tax Guide 2011                                       |           |                                             |
|------------------------------------------------------|-----------|---------------------------------------------|
| 2011 Tax Rates for 01 March 2011 to 29 February 2012 |           |                                             |
| South African Individual Taxpayers                   |           |                                             |
| Income exceeding ...                                 | But Below | Tax                                         |
| R 0                                                  | R 150,000 | 18%                                         |
| R 150,001                                            | R 235,000 | R 27,000 + 25% of the amount above 150,000  |
| R 235,001                                            | R 325,000 | R 48,250 + 30% of the amount above 235,000  |
| R 325,001                                            | R 455,000 | R 75,250 + 35% of the amount above 325,000  |
| R 455,001                                            | R 580,000 | R 120,750 + 38% of the amount above 455,000 |
| R 580,001 and above                                  |           | R 168,250 + 40% of the amount above 580,000 |

End of Document