AN ECONOMETRICS ANALYSIS OF THE DETERMINANTS OF INFLATION IN NAMIBIA

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE OF THE UNIVERSITY OF NAMIBIA

BY

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MARCH, 2007

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Abstract

This paper employ various econometric techniques to analyze the determinants of inflation in Namibia, focusing particularly on the relationships that exist between the Namibian price, as the dependant variable, and the real Gross Domestics Product, Broad money supply, interest rate, and South African Price index as well as the United States price index, being the explanatory variables and probable determinants of inflation rate in Namibia.. Inflation equations that were estimated used quarterly data from 1993 to 2003 for Namibia, South Africa and United States, and it was found that in the short run, domestic prices are influenced by the level of economic growth and foreign prices, in particular South Africa. This conclusion is broadly in line with results from Goamab (1996) and Odada etal (2000).

Acknowledgement

This study would not have been possible without the support of many people. I gratefully acknowledge Dr. Omu Kakujaha-Matundu for his dedicated supervision through out this thesis, Dr. Devi Bedari for the useful comments provided in the construction of econometric models used in the quantitative analysis of the study. I also thank my colleagues who despite their hectic schedules selflessly offered guidance and support, Mr. Postrick Mushendami, Mr. Rudolf Humavindu and last but not least, Mr. Leonard Kamwi. Finally, I thank my wife, children and numerous friends who endured this long process with me, always offering support and love.

Declaration

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Acronyms

ADF	:	Augmented Dickey Fuller
BON	:	Bank of Namibia
CBS	:	Central Bureau of Statistics
CPI	:	Consumer Price Index
CPIX	:	CPI excluding interest rate on mortgage bonds
CRDF	:	Cointegrating Regression Dickey-Fuller
D-W	:	Durbin-Watson
ECM	:	Error-Correction Model
E-G	:	Engle-Granger
GDP	:	Gross Domestic Price
HIES	:	Household Income and Expenditure Survey
ICPI	:	Interim Consumer Price Index
M2	:	Broad Money supply
NEPRU	:	Namibia Economic Research Unit
NID	:	Normally Independently Distributed
NPC	:	National Planning Commission
ODC	:	Other Depository Corporation
OLS	:	Ordinary Least Squares
PAM	:	Partial Adjustment Model
PP	:	Phillips-Peron
RSA	:	Republic of South Africa
SBDW	:	Sargan-Barghava Durbin Watson
UN	:	United Nations
UNTAG	:	United Nations Transitional Assistant Group
USA	:	United States of America

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CHAPTER 1

1.1   Introduction

The paper aims at studying the determinants of inflation in Namibia during the period 1993-2003, a period during which the country experienced erratic inflation rates attributed mostly to prevailing macroeconomic conditions. Inflation has been one of the principal macroeconomic challenges facing many developing countries including Namibia.   Inflation, which is a sustained increase in general price level in an area over a certain period of time (Samuelson and Nordhaus 1995) is measured in Namibia by using the Consumer Price Index (CPI) compiled by the Central Bureau of Statistics (CBS) of the National Planning Commission Secretariat (NPC).

Due to its being one of the enemies of an economy, it is important to understand its behavior. Modeling exercise based on econometrics attempts to identify those factors that create and propagate inflation in an economy. The models employed in this study help us to recognize whether inflation is fully determined by domestic factors or to a larger extent by factors outside domestic control. To control inflation in an economy, policy makers should fully comprehend the factors that determine the inflation process in the economy if it is determined by domestic factors.

In a nutshell, this paper sets out to analyze and estimate the coefficients of the inflation model of Namibia. The Inflation function of Namibia comprises of several factors which

determine its path and these are; Real GDP, Broad Money Supply, nominal interest rate, nominal Exchange rate and the foreign prices. The ultimate goal of this paper is on establishing which variables are more significant within the model so that they can be used for anti-inflationary policies. The analysis is based on quarterly *time-series* data of these variables covering the period 1993-2003. The paper utilizes econometrics techniques such as unit root testing also known as Stationarity Test, Cointegration and Error Correction Model (ECM) in analyzing statistical characteristics of these variables.

In Namibia in the early 1990s, the inflation rate was relatively high, around 17 percent per year, even though prices begun to fall down towards mid-90s. According to various Bank of Namibia (BON) Annual Reports, inflation was the highest in 1992, due to a cyclical drought that led to a severe shortage of cereal crops in Namibia and South Africa. However it began to show a downward trend by 1994. The lowest inflation rate in the 1990s was experienced in 1998, which was 6.2 percent. A combination of efforts from the government of Namibia and monetary authorities in South Africa were cited as contributing factors. By the turn of the century, Namibia was already experiencing a single digit rate, downward trend of inflation so much that in 2005, it stood at 2.2 percent.

1.2 Statement of the Problem

Inflation, as a general rise in the price level in an area over a certain period of time has serious distortionary effects to the economy, thus becomes a worrying phenomenon.

Higher inflation rates than the rest of the world, for instance will make domestic goods and services become relatively more expensive, when this happens, Namibia will loose competitiveness. Being a country that is heavily depended on external trade, a loss in competitiveness would harm the economy seriously.

Highly variable inflation rate similar to the one experience in the early 1990s, 1992 in particular has the tendency to distort price mechanism because people find it difficult to distinguish price movements associated with changes in the demand and supply for particular goods and services from general increases in the price level, resulting in an inefficient allocation of resources. Constantly changing prices leads to uncertainty in future prices, and uncertainty about future prices makes it difficult for individual and firms to plan correctly. Unpredictable price movements cause expectations, which can further fuel inflation; thus, wage-spiral or labor unrest may occur as workers seek wage rises to maintain real income. Recent evidence of wage –spiral and labor unrest were observed in the fishing, mining and textile industry during the period of the study. This is worrisome because these industries are the mainstay of our economy, and a disruption in their activities negatively affects the economy at large.

Experience has also shown that the mostly affected groups of people in the economy are those on fixed incomes since they stand to lose out e.g. pensioners, this income group receives annual increases on their income but prices of goods and services rise monthly. High rates of inflation leads to a lower and sometimes negative, real deposit rates of

interest which in turn discourages savings and consequently slows down the savings-investment growth process, as alluded to by Odada etal (2002) Historical trends in savings and investment given by Ipunbu and Kadhikwa (1999) supports this statement, it shows evidences of declining Gross National Savings (GNS).

1.3   Research Objectives

The objective of this study includes the following:

- to examine the relevant variables influencing inflation in Namibia, using both theoretical and empirical analytical frameworks;
- to determine which explanatory variables are significant determinants of Namibian inflation and which may be useful for anti-inflation policies;
- to present and discuss economic policy implications and draw some conclusions

1.4   Significance of the study

This study sets itself apart from generic social science researches that have been done before because; it combines the tools of econometrics, mathematics and statistics to analyze an economic phenomenon: inflation. The key feature of this study is that it amalgamates economic theory with mathematical and statistical economics. Chapter three of this paper is thus dedicated to the discussion of theories of inflation.

A major significance of this study lies in its ability to provide empirical content to the qualitative hypothesis advanced for this study; that is; the study will provide numerical estimates of all coefficients of explanatory variables which are included in the model.

This study shall, at the end of the period avail its findings to be tested, the study will test the suitability and measurability of all variable included in the model. That is, this study will conduct an empirical verification of the theories that are involved. The core of this analysis is price stability or low inflation rate. Price stability represents one of the main economic challenges for the economic policy and the responsibility of achieving and maintaining it has been entrusted to the central banks and in Namibia the task rests with the BON. Price stability has such high priority within economic policy because as part of the financial framework for a country's economic activity it ensures stable and predictable conditions which in turn have a positive impact on economic activity and the employment rate Bernarke (2006). To perform this task, Central Banks relies on economic analyses, such as this study, to make informed monetary policy decisions. Principally, these analyses focus on assessing price and economic activity developments and the factor assumed to propagate them.

This study will contribute immensely to the overall goal of our macroeconomic policy, in particular price stabilization policy. It will provide a range of econometric analytical tools towards a better understanding of inflation path in Namibia. The study will assist in highlighting the significance of different economic variables in the determination

process of inflation in Namibia. The study will also statistically enrich and add to the already existing economic statistics wealth in the area of price stability for future. This study is vital in that it will further assist in recognizing the most significant variables in the model which can be taken into consideration in formulation of anti-inflationary policies.

1.5   Methodology

This study follows two approaches, the first being a qualitative approach where the description and overview of inflation is discussed. The second approach has employed quantitative technique to estimate the coefficients of the determinants of inflation in Namibia. The study is based on quarterly data from 1993 to 2003. To a certain extent, this study benefits from the work done by other researchers including Goamab (1998), Odada etal (2000) and as a result there are some resemblances in methodologies. As already indicated in the introductory remarks, it includes explanatory variables such as real GDP, nominal money supply, nominal interest rate and exchange rate and foreign prices. Since regressing one non-stationary variable on another can lead to spurious regression results, Granger and Newbold (1974), Unit Root Test also known as stationarity test is performed on all variables estimated to avoid it. The data used in this study will also be tested for cointegration and if found to exist, the ECM, an alternative regression technique is used, to estimate the short-run equation. See (Pindyck and Rubinfeld, 1991)

1.6   Limitation of the Study

The main aim of the study is to examine variables of the inflation model of Namibia and to ascertain statistical quality of the parameters in the model. In general, they were found to be satisfactory, but there remain some limitations. The first limitation of this study concerns the choice of variables. The choice of the relevant variable is not a straight forward one, given the nature of the Namibian economy. The economy is small and import dependent. As the results, external factors that the country does not have direct control over easily enter the economy and influence macroeconomic conditions. Therefore, the chosen variables might not be the only variables in the economy capable of influencing domestic prices.

The second limitation concerns the period of the study. The study consists of only 44 observations. The reason is that no suitable data was available prior to independence in 1991 and this lack of data for a sufficient period poses serious estimation challenges.

The third limitation concern the statistical quality of the data, this led to some coefficients in the equations not to be stable and sometimes poses wrong signs.

Furthermore, while examining the determinants of inflation rate, we did not explore the underlying political and institutional features of Namibia which could also lead to high

inflation rates or provide an atmosphere conducive to achieving price stability.[1] This is mainly because their quantitative effect or impact are too less and difficult to measure and analyze.

1.7   Organization of the Study

The study is organized in five chapters. Chapter 1 introduces the research problem, the objectives and significance of the study and the methodology employed in the analysis. Chapter 2 provides an overview of CPI and inflation, while chapter 3 focuses on the literature review and also reviews the empirical evidence presented in the study. Chapter 4 deals with the modeling and quantitative component of this analysis, Conclusions drawn from this study and the policy recommendations are covered in Chapter 5.

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[1] Examples of these institutional features are central bank independence, openness to trade and the economy's size and development.

CHAPTER 2 OVERVIEW OF INFLATION IN NAMIBIA

2.1   Introduction

This chapter essentially provides a historical overview of the CPI and inflation, the general description and methodology used in compiling them. The CPI is one of the key macroeconomic indicators used by the CBS in the National Planning Commission Secretariat under the Office of the President of the Republic of Namibia. The CBS mainly uses the CPI as an indicator of the change in consumer price that are experienced by a target population. The present CPI target population includes all Namibian private households living in urban or rural areas. The NPC calculates the index as a weighted arithmetic averages of the items indices, with the weights estimated on the basis of results from the HIES 1993-94, and is published on the base December 2001 (NPC 2005). A brief description of the HIES is given in section 2.3

According to the CBS, prices used in the CPI computation by the NPC relate to a sample of 259 goods and services and are collected in 8 localities; special procedures are applied to ensure that the prices collected in consecutive months correspond to goods and services of an unchanging or equivalent quantity and quality. The baskets and weights are updated to take into account changes that take place in the purchasing patterns of the population. The present CPI uses the 1993-94 basket of consumer goods and services.

2.2 Calculating the CPI

The NPC calculates the index in two steps. In the first step, the item indices are calculated by comparing prices in each period. In the subsequent steps, higher-level indices are calculated by aggregating the item indices. The item indices are calculated as un-weighted geometric averages of price ratios. The higher-level indices are calculated as weighted averages of the item indices by using chained laspeyres index number formulae. According to Mendenhall etal (1996) laspeyres index number is a weighted composite index in which the weights are assigned the values that they assumed for the base year.

2.3 Household Income and Expenditure Survey 1993-94

A key element in the construction process of CPI in Namibia is the HIES 1993-94. One of the main objectives of this survey was to provide household expenditure data for the construction of a national Consumer Price Index for Namibia. The survey was carried out in the 12-month period from November 1993 to October 1994 and covered a sample of 4,752 household (which represented about 2% of total household in 1990). For deriving the CPI weights, the expenditure records of 4379 households were used. For the purpose of selecting the sample household, the sampling frame based on the 1991 Population Census was used (NPC 2005).

Selection of the sample was a two stage-state design, with PSU selected with probability proportional to size in the first stage, and household selected with equal probability in

the second stage. The reference period for each sampled household was a calendar month and the diary method was used for the daily recording of household transaction of income and expenditure with the assistance by the enumerators. For the purpose of the index, household cash expenditure was used for the calculation of the item weights.

The estimated value of the consumption from own production and transfer in kind was not taken into account. According to the results of the 1993-94 HIES survey, the expenditure on food, transport and housing accounted for 65 % of the total household expenditure.

The household expenditure on food was the highest, representing almost 30% of the total expenditure. This was followed by expenditure on housing (20%). The spending on the remaining group (clothing and footwear, education, health, etc) was 35%.

2.4   Weights determination

According to various NPC manual books, the weight assigned to each item included in the index basket reflects its relative importance in the total household consumption expenditure and is derived from the consumption pattern of the reference population by dividing the expenditure on the item with the total household expenditure and expressed in percentages. The weights used in the new CPI series are derived from the expenditure data reported in the 1993-94 HIES and are replacing the 1983-84 weights that were in use during the previous 13 years. The 1993-94 basket differs from the 1983-84 basket

not only because of changes in spending patterns but also because of the population to which it relates. Every five years the results from this survey are used to identify the goods and services bought by a typical consumer or household and which should be included in the basket of goods and services to monitor price changes. Furthermore, the results are used to determine the weights of the products/groups (indicator products) in the basket. Fig 2.1 shows indicator products used in these exercises. These are products and services which are selected in the basket that is used to compile the CPI (NPC 2005).

Figure 2.1 Indicator Products Weights Source: NEPRU, 1998
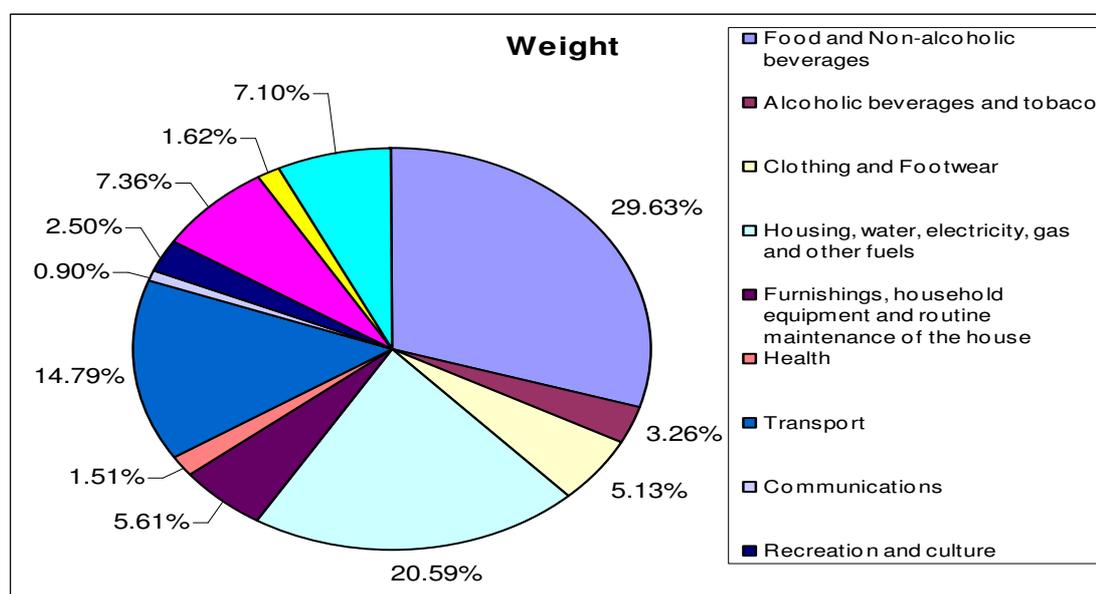
Figure 2.1 shows indicator products used in this exercise and weights of different categories of indicator products and services which have been used in the compilation of

the CPI basket. As mentioned already, the weights reflected in the figure represent the relevant importance of the indictor product. A summary of the items selected and their weights is given in Table 2.1

Table 2.1 Summary of CPI weights

Item	Weight
Food and Non-alcoholic beverages	29.63%
Alcoholic beverages and tobacco	3.26%
Clothing and Footwear	5.13%
Housing, water, electricity, gas and other fuels	20.59%
Furnishings, household equipment and routine maintenance of the house	5.61%
Health	1.51%
Transport	14.79%
Communications	0.90%
Recreation and culture	2.50%
Education	7.36%
Hotel, cafes and restaurants	1.62%
Miscellaneous goods and services	7.10%
Total	**100.00%**

It is very clear from the previous discussions that techniques and methodologies used in compiling the CPI has gone a number of phases. The aim of the next subsection is to look at the trends in inflation together with specific changes and modification to the CPI methodologies, then we shall also look at the reasons and rational for these changes.

2.5   Trends in Namibian Inflation

The last section provided a general background and description as well as the old methodologies used by the CBS to compile the CPI. This section begins by looking at some documented changes and modifications to the CPI. Finally, we will explore the evolution of inflation during the 1990s period.

2.5.1   Interim CPI

Since 1993, the CBS published monthly index known as the Interim Consumer Price Index for the city of Windhoek (ICPI). The ICPI that has been in use was introduced in January 1993 until January 2005 to replace the RSA based index that had been running since 1975. The old index's main shortfall was that it was constructed as the sub-national index of RSA. The 1993 ICPI was initially intended to be an interim measure awaiting the introduction of a national index which would be based on the result of the 1993/94 nation-wide household income and expenditure survey. Its coverage was limited to the city of Windhoek and was calculated by comparing the prices of goods and services observed in the reference month with the price observed in December 1992.

The ICPI was based on expenditure of 800 households covered in the 1985 HIES. The basket contained only 183 items whose prices were collected in approximately 90 outlets. In total, around 590 price quotations were processed each month. Over time, with the changes in the consumption patterns of the population, the ICPI basket of goods and services became obsolete. Calculation in this index ceased in January 2005.

2.5.2 Current Revision

The new CPI with a national coverage was published in January 2005 with December 2001 being the new base year period. Weights used in the current CPI index are based on estimates of the total household consumption in 1993-94. The rebasing exercise provided an opportunity to review the methods and procedures used to calculate the CPI with the primary purpose of making the CPI a more reliable, representative and accurate indicator of consumer price movements at national levels.

Revision of the baskets and updating of the weights were required to reflect the changes in the consumption patterns but also to produce an index that is representative for a whole country. Therefore the basket for the ICPI was replaced in January 2005 by a new consumer Price Index basket based on the results of the household Income and Expenditure Survey implemented in 1993-94.

The new basket of goods and services is a better representative of the consumption pattern of all private households living in urban and rural areas as compared to the old one. Several changes were introduced that led to significant improvements in the CPI estimates. One of the major changes was the extension of the CPI households' coverage. Previously, it covered only the households living in the city of Windhoek. Now, it is expanded to cover all households, making the CPI a more comprehensive national measure of consumer price movement. Apart from weights, adjustments were also made to the price collection, which is now expanded to cover the whole country.

Apart from Windhoek, 7 other localities are now included in the price collection for the first time. In addition, the item coverage widened and the number of prices collected increased from less than 600 to more than 7000. Other changes include adoption of the latest version of the standard international classification COICOP. Compared with the previous CPI classification, the current classification is simpler and better structured for analyzing price movement. The previous main group "Transport and communication" was split into two groups. "Transport" and "Communication", these changes were made in recognition of the increased importance of both transport and communication in total expenditures. Two other groups, namely "Education" and "Hotels, cafes and restaurants", were introduced to make the classification consistent with COICOP. Finally, several less obvious changes were implemented with this CPI. These include the use of geometric means at the first-stage aggregation of colleted price data and introduction of chained laspeyres index formula for the calculation of sub-group and

group indices. The aim of these changes was obviously to improve the quality of the CPI estimates.

2.5.3   Evolution of Inflation During the period 1993-2003

An illustration of how inflation evolved during the 1993-2003 period is given in fig 2.2

Figure 2.2 Movement of inflation during the 1993-2003 period
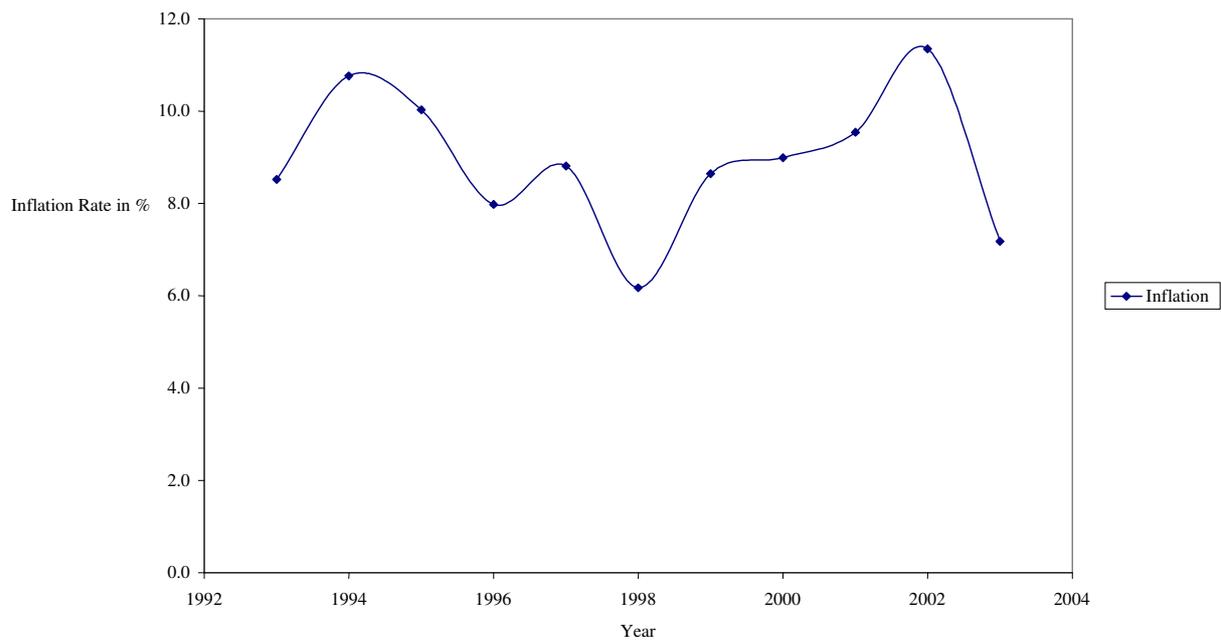
Source: Author's Database, 2007

Figure 2.2 shows how inflation evolved during the period 1993-2003. According to BON Annual reports, by 1990, there were still no overall consumer price index which

covered all major areas of the country was developed in Namibia. However, the CPI of the capital city, Windhoek which has been in use since 1972 was taken as a proxy for the overall CPI of Namibia and based on this proxy, inflation, as measured by changes in the CPI for the city of Windhoek, declined from 12.1% in 1990 to 11.8% in 1991, but this trend was enormously reversed in 1992. This was due to the experienced cyclical drought of 1992, which resulted in a shortage of food supply through out the country. A combination of factors during 1990 to 1991, led to a decrease in inflation rate in the country. One of them was the departure of the UNTAG team that had been in Namibia as a UN unit prior to independence dampened the domestic demand.

This was coupled with an increased stability of the rand against other currencies from mid-September 1989 (Goamab, 1996). According to this CPI, inflation was exceptionally high in 1992, averaging an annual rate of 17.9 percent as compared with the annual average rate of 11.8 percent in 1991. The BON's research department at the time maintained that the main reasons for the sharp increase in 1992 were among others; a substantial decline in the production of cereal crops both in the country and in RSA, which by that time was the main food supplier to Namibia. A 12 percent rise in petroleum products of 1992 further aggravated the situation. A substantial rise of 22 percent in money supply further fueled domestic inflation.

The influence of South African prices on the price levels in Namibia played a major role in 1994. This meant that a large percentage of the Windhoek item consumer price

inflation was essentially imported from RSA. Food prices was the major driving force behind Namibia's inflation rate since it accounted for about 28 percent of the total weight of the consumer basket. The average annual inflation rate of 1994 was 10.8; this upward trend was mainly due to increases prices of major items in the consumer basket, notably items such as food, housing, fuel and power. The increase in the inflation of these items was mainly due to a 13 percent additional sales duty on luxury goods which had been introduced the previous year, 1993, even though its effect was felt only in 1994.

Decreased consumer inflation in South Africa helped in bringing down inflation rate in Namibia to 10.1 in 1995. In 1995 external factors in the form of a spill-over effect played a role in reducing inflation rate in the country. Consumer prices in RSA declined to an average of 8.7 percent in 1995 compared to 9.9 percent for 1994.

By 1995, inflation rate exhibited a declining trend and it was expected to continue through to 1996. South Africa experienced deflationary fundamentals which were characterized by the appreciating South African Rand, relevant high interest rates and the prospects of good rain season.

As was expected, 1996 saw a slower increase in the main price indices. This was attributed mainly to a slower growth in nominal labor cost per unit production. In April 1996, the bank rates were raised to curb inflationary pressures. This act restrained an excess expansion of the monetary aggregate and high level of aggregate demand.

In 1998, efforts of the domestic government and RSA monetary authorities to control inflation finally paid off. The average annual inflation for the year 1998 was 6.2 percent. This was the lowest since independence. Consistent tight monetary policies applied by the central banks of Namibia and RSA were cited as the main reason behind this achievement.

The average annual inflation rate in 1999 rose 8.6 percent. Favorable macroeconomic conditions that prevailed during that year held it constant at the same rate. Imported inflation however rose due to an increase in international oil price which spilled over to Namibia. As a result, the next period saw an increase in consumer inflation; however the effect of the stable currency and falling interest rate was large enough to offset the increase and kept it constant. A swell in the price of the sub-index of food led to an upward turn in consumer inflation in 2001. Although unchanged since 2000, the 9.3 percent inflation rate was higher than the 8.6 percent rate observed in 1999. A close analysis of the 2001 inflation rate revealed that the upward trend in inflation originated from increases in the price of domestically produced goods. As a result, domestic inflation overtook imported inflation. Goamab (1998) also noted this phenomenon as one of the key causes of inflation in Namibia.

The other factors which were suspected to have been key players in this turn of event was the value added tax and the fuel price increase that took place during the year.

Food price continued to play a dominant role in determining overall inflation even in 2002. The average annual inflation rate for 2002 was one of the highest after following the 1992's 17.9 percent inflation rate.

The BON suggested a number of reasons to explain this trend. Upon closer examination, it was established that imported inflation was higher than domestic inflation. This was attributed to the weak external value of the Namibian dollar coupled with rising price of crude oil. Inflation rate dropped down to a single digit in 2003. The decline in one of the largest component in the consumer basket (i.e. food) led to this decline. The average annual inflation rate for 2003 went down to 7.3 percent. The decline in the annual inflation rate during 2003 reflected the tight monetary stance that prevailed that year. A stronger exchange rate also supported the slowdown.

A further low inflation rate of 4.2 percent was observed in 2004. According to the BON researchers, this relatively low inflation rate was due to a set of macroeconomic forces which prevailed during the course of that year. This included a stronger exchange rate, which also contributed to the slowdown in the price of imported goods as well as global deflationary pressures. 2005 witnessed the lowest inflation rate since independence, much lower than the 2004's 2.4 percent. The average annual inflation rate for 2005 was 2.2 percent. This was mainly due to a decline in prices of major components of the consumer basket.

2.5.4 Summary

The tremendous task of collecting the CPI in Namibia is carried out by the CBS; the previous chapter described the methodology of compiling it. The chapter also introduced the HIES 1993-94, and its significant role in the construction of CPI as a measure of inflation. The HIES 1993-94, helped to provide the household expenditure data for the construction of the CPI for Namibia. Indicator products and their weights that are used for the CPI construction are presented in Figure 1.1

The section further showed how inflation rates of Namibia and South Africa followed a similar trend for the past decade; however there have been some periods where either South Africa or Namibia inflation rate remained above the other, several reasons have also been advanced to explain this phenomenon. The technical differences between the two countries involved in computing the CPI, (i.e. Consumer basket and weights was the most suggested of all the reasons) was cited as one of the reasons behind those differences. This has necessitated the need to embark on some revisions in the computation techniques, hence the introduction of the ICPI in 2005.

According to the BON sources, the most probable factor that has been responsible for influencing inflation is foreign prices, South African prices in particular. This paper will examine all probable variables in the inflation model, to ascertain their significance and magnitude in influencing inflation. In general, the inflation trend has been declining for the past ten years; such that, the annual inflation rate for 2005 was 2.2 percent.

The evolution of inflation during the period under study was mainly attributed to a combination of macroeconomic condition that prevailed in both South Africa and Namibia.

CHAPTER 3 LITERATURE REVIEW

3.1   Introduction

Inflation has been the most hotly debated macroeconomic issue during the past two decades and numerous theories have been advanced to explain this phenomenon. Many have turned to economic theory for answers, but unfortunately, even economic theory does not offer an exact remedy to the problem of inflation. The main reason why economic theory can not offer them an exact remedy is because many economists still holds different and sometimes conflicting view on what could be the possible causes of inflation. It is for this reason that when one turns to a discussion of the causes of inflation, one usually finds that the literature contains two major competing propositions which attempt to explain the phenomenon. First there is a monetarist model which sees inflation as essentially a monetary phenomenon the control of which requires as a necessary and sufficient condition control of the money supply in such a way that it grows consistent with the growth of demand for money at stable prices. Second, a structuralist model which looks at the structural set up of an economy and the supply side.

3.2   Theories of Inflation

3.2.1   Monetarists Model

Monetarist uses Friedman (1969)'s proposition, to argue that excess supply of money in an economy leads to domestic inflation. This school of thought, completely rule out the

possibility that inflation could also be a result of changes in demand for, and cost of producing, goods and services in an economy. For them, changes in demand is only capable of producing only one-round shifts in prices, and this shift can only be transformed into sustained inflation if monetary growth rate is increased in order to accommodate the changes and their effects on prices. They simply argue that changes in demand are not capable of resulting into sustained price increases in the absence of monetary accommodation by monetary authorities such as central banks.

Monetarist believes that increase in cost will be reflected in nominal money supply if monetary authorities increase the rate of growth in money supply to prevent a decline in output (Atta et al 1996).

Money supply growth can be transformed into inflation directly or indirectly. The direct process occurs when the increases in money supply directly ends up into the hands of economic agents such as consumers, producers and suppliers of factors of production, who will then spend it on goods and services. This sort of expenditure has the ability to exert too much pressure on aggregate demand. These upward pressures then lead to inflation. The indirect process occurs when economic agents decides not to spend directly on goods and services, and choose to instead deposit their new money into their bank accounts at commercial banks and other financial institutions. In this instance, inflation will occur because the money that have been deposited into various bank accounts by these economic agents provides a basis for further increase in money supply; these institutions will now have the capacities extend more credits to economic

agents than before. In their view therefore, the only remedy for inflation is a reduction in growth in money supply, on the assumption that money supply is exogenously determined by monetary authorities.

Perhaps, the most illustrated scenario of how monetary growth can influence inflation was given by Laidler (1985). Laidler provided a dynamic model of inflation to show that there exists a positive relationship between monetary expansion and inflation rate. His model is derived from the work of Cagan (1956), but the discrete-time formulation which he used follows Dutton (1971). This model begins by considering an economy in which the demand for real money balances depends on the level of real income (or permanent income) and the expected rate of inflation, the latter being given by an error-learning process. Fix the level of real income at exogenously given full-employment level and specify the demand-for-money function so that the log of real-money balances at time t, Mt-Pt depends upon the log of (constant) real balances over Y and the level of the expected rate of inflation that ruled the end period t-1, Δp^e_{t-1} thus:

$$M_t - P_t = w + kY - \alpha\Delta P^e_{t-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(I)}$$

Note that the first difference in the log of the price level, ΔPt, is equal to the proportional change in the price level that takes place between period t and defines the expected rate of inflation as:

$$\Delta P^e_t = h\Delta P_t + (1-h)\Delta P^e_{t-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(II)}$$

Substituting equation (II) into (I), performing the Koyk transformation, and rearranging the results yield:

$$P_t = hw + hkY + M_t - (1-h)M_t{-}1 + (1 - h + \alpha h)P_{t-1} - \alpha hP_{t-2} \dots\dots\dots\dots\dots\dots\dots\dots(III)$$

and because the rate of change of real income assumed equals to zero, the first difference of equation (III) gives:

$$\Delta P_t = \Delta M_t - (1- h)\Delta M_{t-1} + (1-h + \Delta h)\Delta P_{t-1} - \alpha h\Delta P_{t-2} \dots\dots\dots\dots\dots\dots\dots (IV)$$

for a constant rate of change in the nominal money supply, the rate of inflation in long-run equilibrium, when ΔP_t equals ΔP_{t-1} and ΔP_{t-2} reduces to:

$$\Delta P = \Delta M \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (V)$$

In the long-run equilibrium the rate of inflation is equal to the rate of monetary expansion.

Basically, what equation (V) tells us is that the impact effect in period t of an increase in the rate of monetary expansion is to increase the inflation rate by the same amount. In the next period, the coefficient of ΔP and ΔM becomes relevant. They push in opposite direction but, because the latter is larger in absolute value, the inflation rate continues to rise in the next period, thus over-shooting its long-run equilibrium value. Perhaps the most important implication of the model is that it shows the inflation rate to be equal to the rate of monetary expansion only in the long-run equilibrium. This failure to equality between the inflation rate and the monetary expansion rate in the real world in no sense negates a monetary explanation of inflation.

3.2.2 Structuralist Model

Structuralist attempts to discredit the monetarist's opinion that inflation is a purely monetary phenomenon, according to them, inflation is not a result of money supply growth but changes in structural set ups, and cost which leads to changes in relative prices in the real-world situation in which money prices especially wages, tend to be inflexible downward, which is capable of leading to inflation. For them, growth in money supply is an indication of the existence of upward pressure exerted on price by structural and cost changes (Canavese, 1982).

Odada et al expressed the basic Structuralist model as follows:

$$P_t = d_0 + d_1C_1 + d_2D_t + u_4$$

Where p_t is the rate of inflation in period t; C_t is the rate of change in an appropriate index of costs of production in period t; D_t is the is the rate of change in aggregate demand for goods and services and; u_t is a random error term. D_i (I = 0, 1, 2) are the parameters of the model. In this model, P_t is expected to vary positively with C_t and D_t. Odada et al's expression of the structural model is driven from Canavese (1982)'s proposition, which says; structural inflation arises from three inter-related phenomena: Changes in economic structural causes changes in relative prices; some money price (especially wages) are inflexible downward or rigid downward; an induced growth in money supply occurs to accommodate the resulting increase in the price level.

Structuralist uses institutional framework to explain how changes in structures and cost leads to inflation. They argue that if for instance, trade unions agitate for higher wages by putting pressure on their employers especially governments through the threats of strikes. This demands may be greater than the increase in production that follows from the increase in wages, this may lead to increase in prices.

Alternatively, the rise in wages is viewed as an increase in the cost of production by the producers, and it is passed on to consumers in the form of higher prices of goods and services.

The other frequently mentioned structural characteristic which is missing in Odada et al's model is the relative inelasticity of the supply of food in various countries. It is agued that there is a tendency for food supply to lag behind the demand generated by the expansion of income in the non-agricultural sector, which is concomitant of economic development and that this cause food prices to rise. The other structural aspect that this school of thought advances in their debate is the exchange rate. Exchange rate policy is an important instrument for achieving broad objects of general economic policy namely; growth, internal balance, external balance and price stability.

Structuralist believes that foreign price pass-through effects are a significant cause of domestic inflation, especially for import-dependent countries. Structuralist argues that the causes of inflation must be sought in certain structural characteristics of economies, and that elimination of inflation, requires that policies be directed towards removing the various structural bottlenecks which are said initiate and perpetuate inflation.

3.3   Theoretical Model of Inflation Determination

Namibia is a small, open and heavily import dependent economy and the problem of inflation has been of central concern to the monetary authorities over the past two decades. Given the economic set up of this country, it is clear and more apparent that of all the theories we discussed above, neither of them is capable of accounting for inflation alone in Namibia. It is for this reason that it was found fit for this study to employ a simple theoretical model that we adapted from Ubide (1997); this model was selected because it has been successfully used to study inflation processes of many countries in the world, which have similar economic feature like Namibia. For example, Ubide (1997) used it to study determinants of Inflation in Mozambique, Laryea and Sumaila (2001) used it to study inflation in Tanzania.

The model starts by Assuming that the overall price level is a weighted average of the price of tradable goods P^T and of nontradable goods P^{NT}, this is expressed as:

$$logP_t = \alpha\ (logP^T_t) + (1\text{-}\ \alpha)\ (logP^{NT})..\ (1)$$

Where $0\langle\alpha\langle1$

The price of tradable goods is determined in the world market and depends on foreign price P^f and on the exchange rate (e), assuming that purchasing parity holds

$$logP^T = log^e_t + logP^f_t...\ (2)$$

Hence depreciation (appreciation) of the exchange rate or an increase (decrease) in foreign prices will increase (decrease) domestic prices.

It is assumed further that the price of nontradable goods is set in the domestic money market, where demand for nontradables is assumed for simplicity, to move in tandem with overall demand in the economy. This implies that, the price of nontradable goods is determined by the money market equilibrium condition, i.e. real money supply (M^s/P) equals real money demand (m^d):

$$logP^{NT} = \beta \ (logM^s_t - logm^d_t)...\ (3)$$

Here, β is a scale factor representing the relationship between economy-wide demand and the demand for nontradable goods. The demand for real money balances is also assumed to depend on real income and inflationary expectations.

Typically, the money demand function should also include interest rate as an opportunity cost variable. However, due to the underdeveloped nature of financial markets in developing countries such as Namibia, the relevant substitution effect being captured is between goods and money, and among different financial securities. Thus the expected rate of inflation can be used as a proxy to capture the opportunity cost of holding money

$$M^d_t = f \ (Y_t \ , E \ (\pi_t))..\ (4)$$

Hence economic theory predicts a positive relationship between money demand and real income, and an inverse relationship between money demand and the expected rate of inflation, as summarized in equation (4).

Expected inflation can be modeled in several ways. Following Ubide (1997), the following general formula is employed:

$$E(\pi_t) = d(L(\pi_t)) + (1-d)\Delta logP_{t-1} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

Where $L(\pi)$ represent a distributed lag learning process for the agents of the country. If all the weights in $L(\pi)$ are equal then, an adaptive expectations will prevail. On the other hand if weights decrease with time, then a learning process evolves. For simplicity, we assume that $d = 0$. After doing all the relevant substitutions and rearranging, the price level can be expressed generally as follows:

$$P_t = f(M_t, Y_t, P_{t-1}, E_t, P^f_t) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (6)$$

Log-linearizing equation *(6)*, we can write the long run inflation equation as:

$$logP_t = \alpha_0 + \alpha_1 logM_t + \alpha_2 logY_t + \alpha_3 \Delta logP_{t-1} + \alpha_4 logE_t + \alpha_5 log\ P^f_t +$$

$$u_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (7)$$

Where u_t is an error term which is assumed to be normally distributed and of mean zero. Theory predicts that the partial derivative of price with respect to money stock and exchange rate be positive. This is because, if it is assumed that the velocity of money is

constant and that the economy is operating at full capacity, then according to the quantity theory of money[2], any increases in the money supply will result in an increase in the price level, which if sustained, would be inflationary.

To explain why the partial derivative with respect to the exchange rate is positive, we observe that exchange rate developments can contribute to consumer price inflation either directly through their impact on the cost of imported goods. On the other hand, inflation is predicted to be a decreasing function of output, since an increase in output eases the demand pressure in the economy.

Based on equation (7), it is expect that an increase in money supply, expected inflation, the exchange rate and foreign price will push up prices, while an increase in real income will lead to a fall in the growth of price.

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[2] Fisher's equation: $MV=PQ$

3.4   Empirical cases

This section looks at the empirical work that was done in the area of inflation in Namibia and its neighboring countries as well as other studies in various developing countries especially the sub-Saharan region. The aim is to establish evidence of the existence of this phenomenon in these countries. The literature review which was conducted for this study has revealed to us that there is indeed a considerable body of empirical work on inflation in the Sub-Saharan economies than in Namibia. These studies have attempted to examine the phenomenon by through various approach and many of these further attempted to estimate the causes of inflation from structural and monetarist perspective.
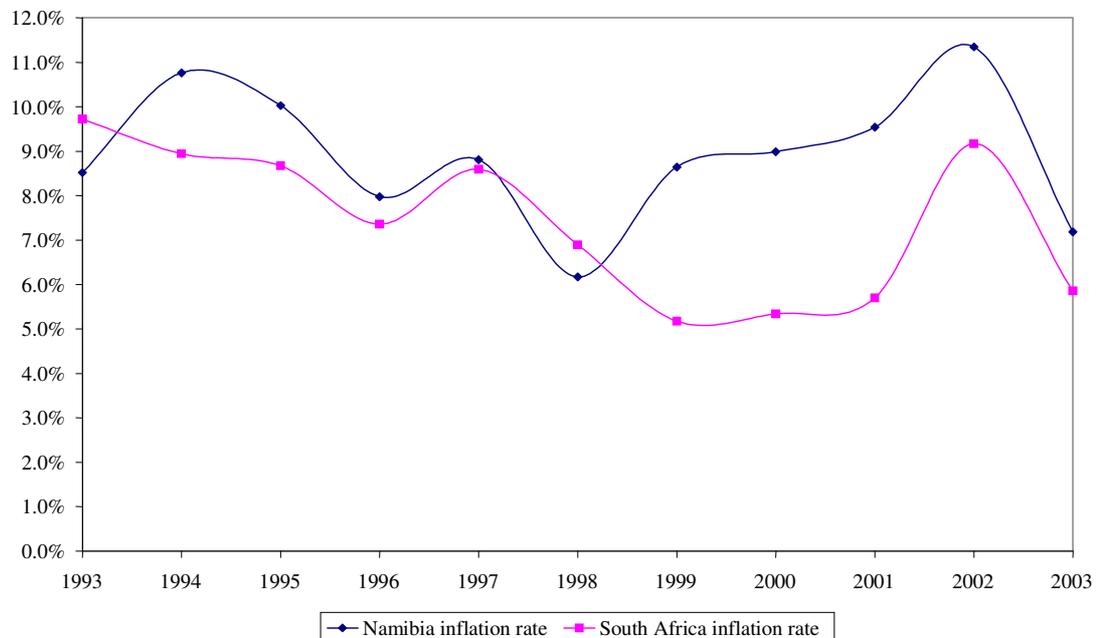
3.4.1   The case of Namibia and South Africa

In the context of Namibia, very limited amount of research on inflation is observed. Goamab (1998) observed that one of the key features of inflation in Namibia is that Namibia and South Africa's inflation rates follow a similar pattern. This is due to the fact that Namibia imports about 80% of goods and services from that country and as a result developments in price in that country influence Namibian price too.

Fig 3.1 shows Namibia and South Africa's inflation rate from 1993 to 2003. This figure shows that Namibia and South Africa's inflation trends has been closely moving in the same direction, even though from 1993 to 1997, Namibian inflation rate was higher than the South African one, they converged in 1997. Between 1997 and 1998, the South

African inflation rate has been above the Namibian inflation, but went down again and continued to move closely and in the same direction but below Namibian inflation rate. This kind of trend, suggested to us that there could be a possibility of a pass-through of South African prices to Namibia's domestic prices.

Figure 3.1 Trends in Namibia and South Africa's inflation rates: 1993-2003

A historical overview of inflation in Namibia that Goamab (1998) advanced provided some explanations on these trends from 1973. He cited the use of different commodity basket in calculating CPI in Namibia and South Africa; oil price increases; cyclical drought; currency depreciation; taxation of imports; and increases in domestic demand.

Odada etal (2000) also established possible causes of inflation in Namibia in 2000 by analyzing annual data from 1972 to 1998. He used various models to estimate the coefficients of these variables. He identified a number of monetary and structural factors as significant source of inflation. Domestic costs were also regarded as a source of inflation in Namibia. It is expected in developing countries, even in developed countries that inflation and money supply will have a positive relationship. This expectation was confirmed by Odada et al, who found that a one percent increase in money supply will increase the general consumer price level in Namibia by 0.1 percent. A similar observation was made almost three years earlier by Goamab (1998), when he concluded that a one percent increase in broad nominal money supply lead to 0.1 percent in the price level.

Odada et al (2000) again made another observation; the role of GDP in influencing inflation. He concluded that a one percent increase in GDP will lead to a 0.1 percent decrease in general price level. The most interesting feature of both studies concerns the influence of foreign price on domestic prices, both studies tend to agree that there is a strong influence of foreign prices on Namibian prices. According to Goamab (1998) close to 70 percent of the increase in the domestic price is caused by increases in the South African Price levels. Affirming this observation was Odada etal (2000), who found that a one percent increase in South African price level will lead to more than 50 percent increase in the domestic price levels.

Compared to other countries, which might have similar economic setups, where inflation is purely a monetary phenomenon, observations from previous studies make us believe that inflation in Namibia is not a purely monetary phenomenon, but it is also caused by monetary as well as structural and cost factors.

3.4.2   Other Sub-Saharan Countries

The first evidence of the empirical work in SSA is Ubide (1997) who studied the determinants of inflation in Mozambique and developed a detailed econometric model which included both monetary and structural factors of inflation. According to Ubide, Mozambique's inflation was consistently high until 1995, and then plunged in 1996 to 147 percent from 70 percent in 1994. He suggested in his paper that Mozambique's inflation pattern is a combination of a fundamental trend set by economic policies, seasonal behavior that followed closely that of agriculture and a collection of irregular event that corresponded mainly to agroclimatic conditions. His empirical results showed that that the marked tightening of monetary policy in 1996 was the ultimate reason for the control of inflation in 1996, and hence seems to correspond to a change in the fundamental trend of inflation that may have long lasting effects.

Laryea and Sumaila (2001) also examined inflation process in Tanzania, and made fundamental proposition regarding the country's inflation. Tanzania's inflation rate which averaged about 30 percent in the early 1990s dropped to about 13 percent at the

end of 1998. Using an ECM, Laryea and Sumaila estimated an inflation equation for Tanzania based on quarterly data, for the period 1992: to 1998:4. The result from the econometric regression analysis shows that inflation in Tanzania, either in the short run or the long run, is influenced more by monetary factor and to a lesser extent by volatility in output or depreciation of the exchange rate.

To these results, they suggested and recommended that to control inflation in Tanzania; the government should pursue tight monetary and fiscal policies. In the long run, the government should pursue policies to increase food production to ease some of the supply constraints. Another country in the SADC in which a study on inflation was conducted is Zimbabwe. Chhiber et al (1998) showed in that inflation in Zimbabwe was influenced by nominal money growth, foreign prices, exchange rate, unit labor cost and real income. They arrived at this conclusion after studying inflation from both structural and monetarist perspective.

In Ghana, chhiber and Safik (1990) used 1965-88 annual data to study inflation in that country; their result showed that Ghanaian inflation is monetary and structurally influenced. These conclusions were confirmed by Sowa and Kwakye (1991). The two studies agreed that money supply is the key determinants of inflation in the Ghanaian economy, and variables such as the official nominal exchange rate and the real wages were found to be insignificant (the study found however, highly significant unofficial exchange rates).

Other studies done in the Sub-Saharan countries were Elbadawi's (1990) research in Uganda, which revealed that rapid monetary expansion and depreciation of the parallel exchange rate were principal determinants of inflation during the 1988-89 period. Results of one of the early studies in the neighboring Botswana (Huda, 1987; Leith, 1991 and Ncube, 1992) concentrated mainly on price and nominal exchange rate and foreign price relationship. Results from these studies however were not received well by the research community. Even with the fact that they found South African price to be the most significant factor that influenced prices in Botswana, suggesting that inflation in Botswana was essentially imported, it used traditional econometric approaches. Studies by Masale (1993) and Atta et al (1996) rescued the situation by modifying and adding to the techniques to come up with reliable conclusions in line with the new econometric practices, which turned out to be almost similar to the ones derived before using traditional econometric techniques.

Combing all the studies done this far, empirical results suggest that in Africa, the primary determinants of inflation are growth in monetary stock, expected inflation, nominal interest rate and exchange rate, real income and foreign prices. This literature review has helped us establish the evidence of the existence of inflation both in Namibia and the surrounding SSA countries. The next chapter brings us to the quantitative component of this study, where we shall apply econometric techniques to analyze variables that are supposed to be the driving forces behind inflation rate in Namibia.

CHAPTER 4 MODELING INFLATION IN NAMIBIA

4.1   Introduction

The previous chapter begun by discussing the ongoing debate on the possible theoretical causes of inflation, and this chapter hereby brings in essential concepts of econometrics which are used in estimations of relationships suggested by economic theories.

In consistency with the primary objective of this paper, our main intention for analyzing time-series is essentially to be able to describe, explain, predict data and use it to control economic situations i.e. anti-inflationary policies. This chapter comprises the empirical estimations of inflation in Namibia. We will begin by specifying our model, and then define the data that we have used by providing the sources and all transformation made in derivation of certain variables, and also briefly describe the data trends for the period under study.

The model is estimated with quarterly data from 1993 to 2003. (*See Table 4.1 for a description of data source).* We have chosen this sample period because we believe that it will provide us with a long-term view, the rational for quarterly as opposed to annual frequency, is because it captures short-term inflation dynamics. A similar choice was made by Lim and Papi (1997) when they were analyzing inflation dynamics of Turkey.

4.2 Model Specification

Based on our theoretical discussions in chapter 3 we have specified the long run equation as follows:

$$lnP_t = \beta_0 + \beta_1 lnY_t + \beta_2 lnM_t + \beta_3 lnR_t + \beta_4 lnE_t + \beta_5 lnSP_t + \beta_6 lnUSP_t + V_t \ldots\ldots\ldots\ldots\ldots 8$$

$$\text{Where } V_t \sim NID (0; \ \sigma^2)$$

In the above equation, again P represents the Namibian consumer prices; Y represents real GDP, M is the nominal money supply; R and E are the nominal interest and exchange rates. SP represents the South African prices and USP represents United States prices. t is the time trend. Table 4.1 provides the full definition of variables. All the coefficients on the variables are expected to have a positive sign, except for real income and interest rate which has a negative relationship with inflation rate. All variables in equation 8 are expressed in a log-linear form.

Table 4.1 Definition of Variables

Variables	*Definition*
P	*Namibia Consumer Price Index (at 2000=100)*
Y	*Real Gross Domestic Product at 1995 constant prices (Millions of Namibian Dollar)-adjusted by the Namibian CPI*
M2	*Broad Money stock in Namibia-notes and coins outside the banking system +Demand Deposit +Savings +Time Deposit*
R	*Nominal Rate of Interest Proxied by the lending rate*
E	*Namibian Dollar/ United State Dollar*
SP	*South African Consumer Price Index (2000)*
USP	*United States Price Index (2000)*

4.3   Data Analysis

4.3.1   Data sources and transformation

The data in this study were collected from diverse sources and were all expressed in million of Namibian Dollars, unless otherwise stated. The data are quarterly, covering the period 1993 to 2003, or a total of 44 observations. The data on Real GDP were obtained from the *CBS* of Namibia. The *International Monetary Fund's International Financial Statistics CD-ROM* provided data on the Exchange rate, Namibia and South Africa's CPIs as well as the M2 data and the United States CPI.

4.3.2   Data Trends

Although a concise review of the inflation trend was provided in chapter 2, we feel it is necessary to reproduce the inflation rate trends for analytical purposes when comparing it with the trends of other variables. (*See table 4.1)*

Broad money supply

One of the key variables used in this analysis is Broad money supply (M2). M2 is defined to include currency in circulation, transferable and other deposits of the other non-financial corporation (BON 2004). Fig 4.1 illustrates the relationship between the inflation rate (as measured by the rate of change in the consumer price index) and the growth rate of the M2. According to economic theory, if the money supply grows faster

than the real GDP, then accelerated inflation can occur due to more money chasing a given quantity of goods and services. Thus we might expect a direct relationship between M2 and inflation rate. Nominal money supply data in Fig 4.1 shows considerable expansion in the first quarter of 1994, around 1995, 1996 and also 2002. However, money supply showed a low growth rate in 1998 and 1999.

The growth in M2 also accelerated during the first half of 1999, on account of an increase in the net foreign asset of the banking system and domestic credit, in particular credit to the government. The increase in net foreign asset of the banking system was most visible in the improvement of the net foreign asset position of domestic commercial banks. The graph indicates that periods of high monetary growth were followed by high inflationary trends. Thus, confirming our expectation in line with the economic theory; that there is a positive relationship between money supply growth and inflation rate through out the period under study.

Figure 4.1 Comparative trends between inflation rate and monetary growth
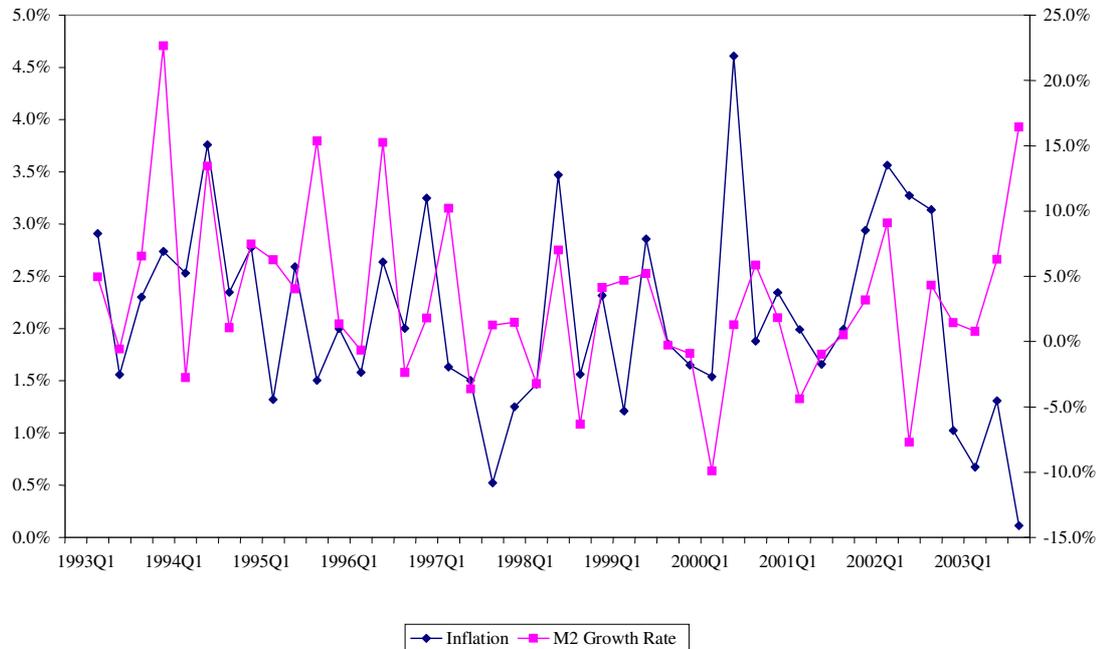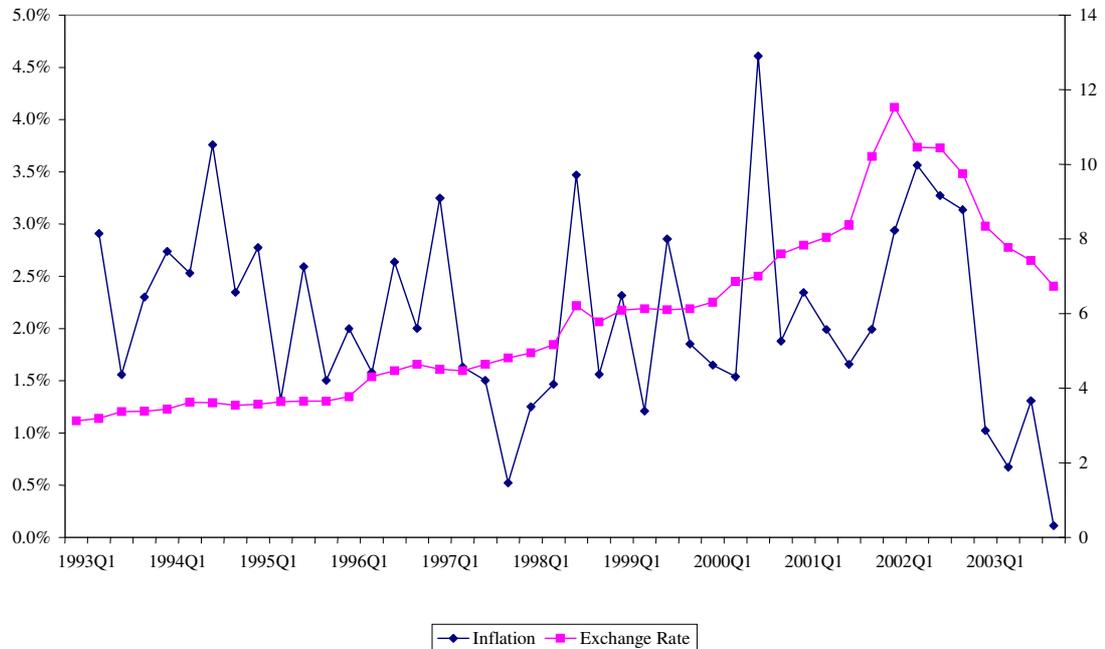

Source: Author's database, 2007

Exchange Rate

Exchange rate is defined as the number of units of foreign currency that can be purchased with one unit of domestic currency (Gottheil, 1996). This analysis uses the Namibian and USA exchange rate; this is the number of US dollar that can be purchased with one Namibian dollar. Unlike the exchange rate arrangement that exits between Namibia and its neighboring country, South Africa, the exchange rate that exists between Namibia and United States is determined strictly by the demand and supply for the nation's currency and it is known as a floating exchange rate. This study is concerned with the effect that movements in the exchange rate could have on the levels

of price in the country. These movements are often referred to as either an appreciation or depreciation. An appreciation occurs when there is a rise in the price of a nation's currency relative to a foreign currency. And depreciation occurs if there is a fall in the price of a nation's currency relative to a foreign currency. According to theory, depreciation could have both positive and negative effects on the economy. On the negative side, a depreciating currency results in high import prices and these high import prices leads to increases in domestic prices and eventually inflation.

On the positive side also, a depreciating currency makes domestically produced goods more competitive on the export market and could increase the demand for those goods. There are more benefits to this movement, such as increases in employment among others. As far as South Africa is concerned, through out most parts of the 1990s, the monetary policy continued to be oriented towards exchange rate stabilization through the maintenance of the fixed exchange rate between the Namibian dollar and the South African rand. This has been the objective of the monetary policy over the years and has proved to be effective in attaining the ultimate objective of price stability. The data indicate that the change in the Namibian dollar exchange rate against the United States remained relatively stable from 1993 to 1996 but started to appreciate in 1998, and heavily appreciated in 2001. It started to depreciate again in 2002. Fig 4.2 shows an existence of a positive relationship though out the period of the study.

Figure 4.2. Comparative trend between inflation rate and exchange rate growth
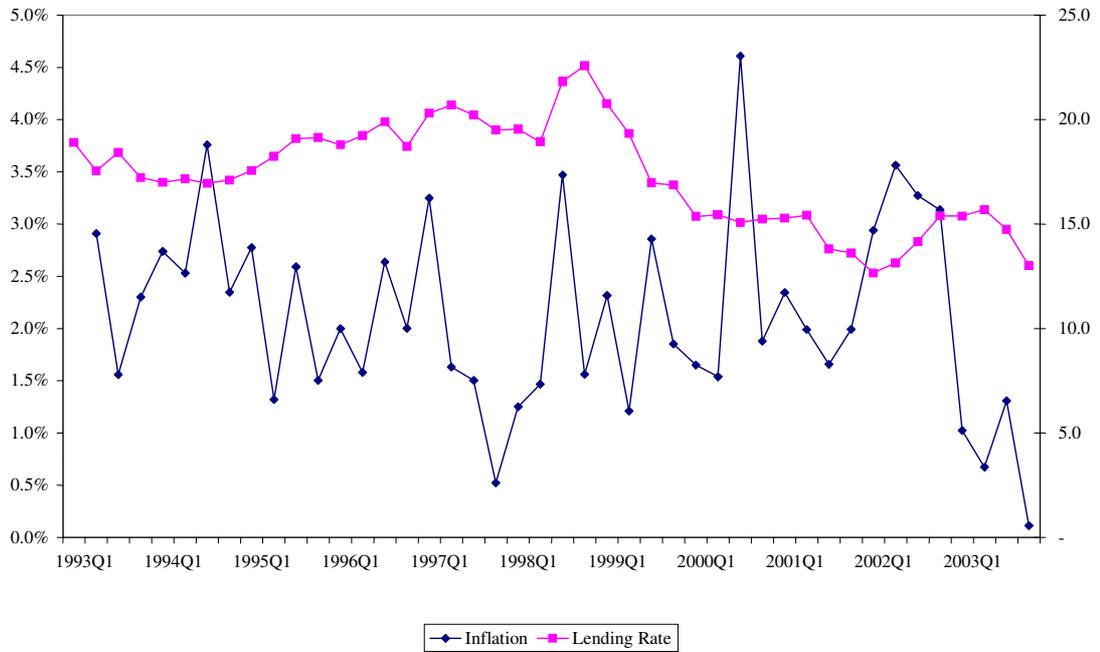

Source: Author's database, 2007

Lending rate

Interest rate is the price of money; it is the rate paid to lenders by borrowers in return for the use of money, normally expressed as a percentage of the amount borrowed per year. The level of interest rate plays an important role in an economy, and for that reason interest rate are often used by central bank as a policy tool to manipulate the economy in the interest of promoting growth and controlling inflation. For example if demand for goods and services in the economy is depressed, the central bank may lower interest rate to stimulate the demand for credit and hence the demand for goods and services.

Conversely, excessive demand, which usually leads to inflationary pressures, can be reduced by increasing interest rates.

Through out this analysis, and in Fig 4.3 below, we have represented interest rate by the lending rate; according to the Bank of Namibia, lending rate refers to the weighted average lending rates, i.e., the rate charged by Other Depository Corporations (ODCs) to borrowers. Fig 4.3 illustrates the relationship between interest rate and inflation rate. Our data seems to confirm the theoretical expectation that the two variables moves in different direction, that is they are inversely related with one another other.

The counter-cyclical movements that can be observed in the graph indicate that a negative relationship exists between the two variables, which is in line with theoretical expectations as pointed out earlier. During 2000 inflationary pressure started to mount in Namibia due to high international prices and the depreciation of the South African rand to which the Namibian dollar is linked. Despite these inflation pressures the Bank of Namibia did not raise interest rates aiming instead to stimulate economic growth.

**Figure 4.3. Comparative trend between inflation rate and interest rate growth**

Source: Author's database, 2007

GDP

GDP is the total market value of all final goods and services produced annually within a country. It measures production within national borders regardless of whether the factors of production are locally or foreign owned. A comparison analysis conducted on the data from 1993 to 2003, shows a high growth rate of GDP in the mid 90s. However, it remained stable between 2000 and 2002. Throughout the period of the study, there seems to be a countercyclical relationship between inflation and real GDP growth, which accords with theoretical expectation. It is visible in the figure those periods of higher GDP growth rate was followed with low inflation rates.

Figure 4.4 Comparison trend between inflation rate and GDP growth rate
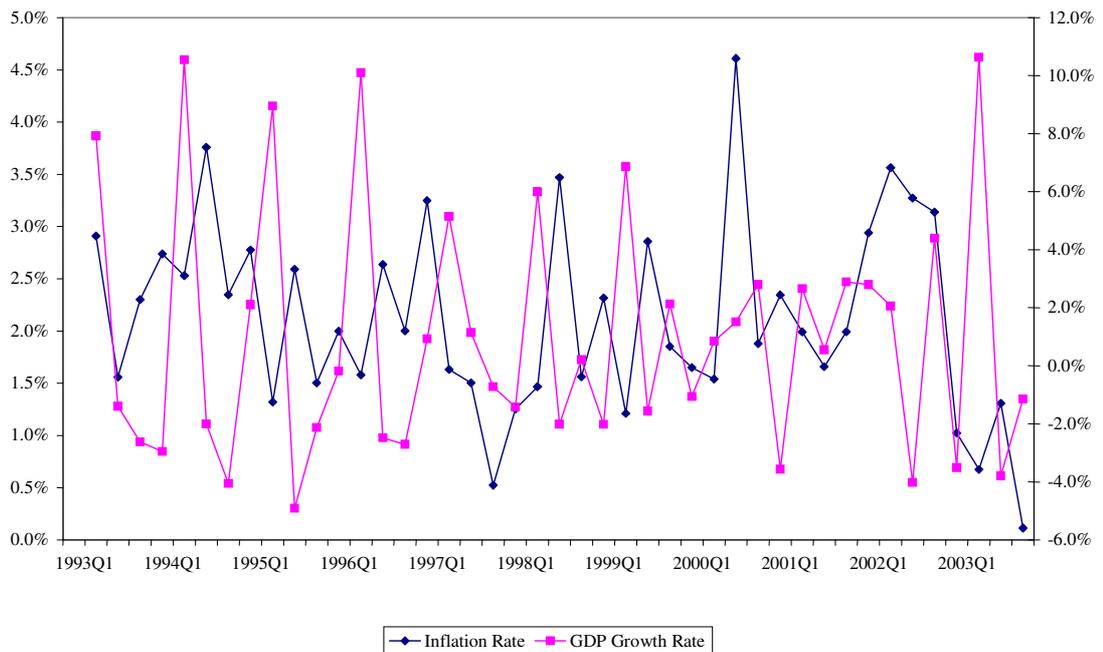
Source: Author's database, 2007

4.4 Modeling Strategy

A concise comparison of inflation and other variable that was provided in the previous section helped us establish the nature and signs of relationships that exist among them. This subsection further extends the previous framework; by bringing in some econometrics techniques that are used to estimate the model. Statistical characteristics (i.e. Stationarity) of our data will be examined with the use of various tests including

Unit Root Test, the subsection will also establish whether long run equilibrium exists or not by testing Cointegration.

The subsection will further present the model, and subsequently introducing lag structures to this model to determine the short rum impacts. The results of this exercise will then be presented and discussed.

4.4.1   Stationarity vs. Non-Stationarity

Trends in the data can lead to spurious correlation that implies relationships between the variables in a regression equation, when in fact none exists. Thus, using a standard regression technique, such as the straight forward Ordinary Least Squares (OLS) with trending or non-stationary data, can lead to the problem of spurious (misleading) regressions where R-squared is approximating unity and t and F-statistics look significant and valid. Hence, there is often a problem of falsely concluding that a relationship exist between two unrelated non-stationary series (Gujarati 1995).

This problem generally increases with the sample size, and is not normally solved by including a deterministic time trend as one of the explanatory variable in order to induce stationarity. In order to avoid spurious regression problem, with its related non-stationary pattern of the variables, differencing has become the common method of bringing non-stationary series to Stationarity. A variable is said to be integrated of order

one, or I (1), if it is stationary after differencing it once, or order two, I (2) if differenced twice. If the variable is stationary without differencing, then it is integrated of order zero, I (0), (Pindyck and Rubinfeld, 1991).

There is a striking graphical difference between I (0) and at least I (1) variables. *Appendix A2* shows the transformed variables M2, Exchange rate, GDP, Lending rate, Namibian CPI and South African CPI. All the series except for Lending rate, exhibit either upward (i.e. M2, GDP, Namibian, South African and USA CPIs) or downward trend (i.e. Exchange rate) over time. Lending rate shows a weak stationary pattern, although it also shows a continued, albeit slow trend over the estimated time period.

Differencing all the variables *(see Appendix A3)* shows no evidence of trending in any of the variable, except for the fact that there is large volatility in the movements suggesting outliers and maybe the presence of structural breaks in the differenced trends. When we difference all variables again *(see appendix A4)* for the second time, we now get a reliable picture of stationary variables, since the trends are fluctuating around the zero level. This suggests constant mean and variances compared to the differenced variable which fluctuated widely around non-zero levels. A visual inspection of the graph suggests that all the variables appears to be at least *I (1)* or *higher*. In the next section, we will use the unit root testing technique to validate this conclusion.

4.4.2   Unit Root Testing

Whilst the visual examination of graphs can be useful, as above, more formal tests of the time series properties of our variables are essential. The following testing strategy was employed in order to determine the order of integration (or Stationarity) using the Augmented Dickey Fuller (ADF) unit root test. The results of the test and the relevant critical values, as well as the number of lags to get rid of serial correlation are provided in table 4.2 and 4.3.

Table 4.2. ADF Tests for Unity Roots before differencing (Order of Integration)

Variable	Test Statistics	Longest lag	Order of integration
LY	-2.762545	4	I(I)
LM2	-2.677346	4	I(I)
LR	-1.485545	4	I(I)
LE	-0.132322	4	I(I)
LP	-1.955188	4	I(I)
LSP	-1.958577	4	I(I)
LUSP	-2.092986	4	I(I)

Table 4.3. ADF Tests for Unity Roots after differencing (Order of Integration)

Variable	Test Statistics	Order of integration
DLY	-13.75134	I(0)
DLM2	-8.342125	I(0)
DLE	-4.661946	I(0)
DLR	-5.375840	I(0)
DLP	-5.121754	I(0)
DLSP	-3.816911	I(0)
DLUSP	-4.863643	I(0)

The unit root testing has been calculated using the ADF unit root testing formula taking into account the intercept and the time trend and the lags to get rid of any serial correlation problems. The critical value for the unity root testing is shown below.

Table 4.4 Critical values for unit root test

Critical Values for unit Roots Test	
at 1%	-4.205004
at 5%	-3.526609
at 10%	-3.194611

The unit root testing results could have been confirmed by carrying out further tests, such as the Sargan-Barghava Durbin Watson Statistics (SBDW) and Phillips-Peron (PP) tests, as ADF tend to have low predictive power. The other tests, however, show greater bias in terms of the finite samples, such as the one being studied. Thus, the unit root

testing results of the ADF tests are treated as reliable, and hence it would seem reasonable to proceed on the basis that all the variable are I(1)

4.4.3   Cointegration

The theoretical interpretation of cointegration is that if variables are linked to form an equilibrium relationship spanning the long-run, then even though the variables are non-stationary in their levels, they will nevertheless move closely together overtime and the difference between them, overtime, will be stable or stationary. This statement infers that the concept of cointegration mimics the existence of a long-run equilibrium to which the system converges over time, and that the residual, or the disturbance term, obtained from the long-run equation can be interpreted as the distance, or the disequilibrium error, that the system is away from the equilibrium position at time t.

The following hypothetical illustration will help discuss the concept of cointegration further. Consider two time series X_t and Y_t that are both I(0). In general, a linear combination of the series $\alpha_1 X_t + \alpha_2 Y_t$ is also I(0). Suppose now, X_t is I(0) and Y_t is I(1). In this case, the linear combination $\alpha_1 X_t + \alpha_2 Y_t$ is I(1) because the variance of the I(1) series dominates that of the I(0) series. In general, then, if the X_t and Y_t that are both I(1), the linear combination of the series $\alpha_1 X_t + \alpha_2 Y_t$ is also I(1). Therefore, with two *I(1)* series resulting in spurious regression, we have the linear combination:

$u_t = \alpha_1 X_t + \alpha_2 Y_t$…………………………………………………………………….…………10

in which the error term u_t is *I(1)*

To put it into context, this analysis can be extended to a situation where one considers a special case of a causal relationship. Suppose there is a causal relationship between the two *I(1)* time series, X_t and Y_t. Even though the series are increasing through time they will tend not to drift apart from each other in the long run. That is because there is equilibrium between the long run components of this series. In this circumstance, the linear combination becomes:

$z_t = Y_t - \gamma_2 X_t$ is $I(0)$……………………………………………………………………………..10.1

According to Enders (1995), the long run components of *Y* and *X* cancel out in the linear combination and the deviation, z_t is stationary. In this case, the long run equilibrium of *Y* is $\gamma_2 X$ and *Y* fluctuates around this equilibrium with stationary z_t. Then according to this explanation, we can then say, if X_t and Y_t are both *I(1)* and there exists a linear combination:

$z_t = Y_t - \gamma_2 X_t$, …………………………………………………………………………………10.2

which is *I(0)* then *X* and *Y* are cointegrated.

Test of Cointegration

Test of Cointegration is relatively straight forward; in this study the procedure for testing Cointegration is the Engle-Granger (E-G) approach. We are still using our example of the last section and suppose on the basis of the unit root test explained in section 5.4.2, it is already known that two series *X* and *Y* are both *I(1)* and that the Cointegration regression is the regression of *Y* on *X* (or the regression of *X* and *Y*) $Y_t = \gamma X_t + u_t$ in which u_t is an error term. If the series *X* and *Y* are not cointegrated then the residuals, $\hat{u}_t$ will be *I(1)* and if *X* and *Y* are cointegrated then $\hat{u}_t$ will be stationary. On the basis of these scenarios, we can define or hypothesis as follows:

H_0: X and *Y* are not cointegrated, u_s are I(1); against

H_1: X and *Y* are cointegrated, u_s are *I(0)*

The tests of Cointegration are based on those introduced in section 5.4.2 and applied to the residuals of the cointegrated regression. For the sake of simplicity, let us discuss the cointegrating regression Dickey-Fuller (CRDF) test. Consider:

$\hat{u}_t = \rho\, \hat{u}_{t-1} + w_t$..*10.3*

Subtracting $\hat{u}_{t-1}$ from both sides

$\Delta\, \hat{u}_t = (\rho\text{-}1)\, \hat{u}_{t-1} + w_t$...*10.4*

or

$\Delta\, \hat{u}_t = \alpha\, \hat{u}_{t-1} + w_t$

Where $\alpha = \rho\text{-}1$

Notice that there is no constant in the regression. The null hypothesis is no Cointegration; the alternative hypothesis is that X and Y are cointegrated. We test

H_0: $\alpha = 0$ (hence $\rho = 1$) and $\hat{u}_t$ is I(1); against

H_1: $\alpha < 0$ (hence $\rho < 1$) and $\hat{u}_t$ is I(0)

Equation 11 is estimated by OLS. The test statistic is calculated as the t-statistic

associated with the coefficient on the residual

$$\frac{\alpha}{SE(\alpha)}$$

If the calculated value of the test statistic is less than its critical value then the null

hypothesis of no Cointegration is rejected; the series X_t and Y_t are cointegrated.

Coming back to our analysis, as mentioned earlier, the procedure in this paper is the E-G

approach. The final preferred long-run equation using the full sample period of 1993:I to

2003:IV, with quarterly data is as follows, with their respective coefficients and t-value

in parentheses *see appendix A6(I).* The dummy variable in this equation tries to capture

the effect of a policy change; the inflation targeting of 2001 in RSA.

P_t = -4.566 –0.041LY_t-0.090LM_t -0.143LR_t -0.019LE_t +0.98LSP_t +1.360$LUSP_t$ –

0.021$D1_t$…………………………………………………………………………………..11

    (-3.815) (-0.737) (-3.413) (-6.039)   (-1.488)   (9.001) (3.631) (-1.780)

    (0.0005) (0.4658) (0.0016) (0.0000) (0.1453)   (0.0000) (0.0009) (0.0834)

R^2 = 0.99, N = 44, D-W = 1.3

It is noticeable that all the Elasticities in equation 11 are significant and have the

expected signs (except for Y_t and M2, which is significant but have a negative sign). The

high R-squared of close to unit indicates the high degree to which variation in the price

level are explained by variation in the explanatory variables. The F-statistic, with a p-value of zero, indicates the joint significance of the explanatory variables. At this moment, it would be appropriate to refrain from interpreting the coefficients of the explanatory variable, as Cointegration relationship has to be established first. As mentioned earlier, if there is a cointegrating relationship in equation 11, then it becomes valid for a long run interpretation of the price level in the Namibian economy.

For us to determine whether Cointegration exist, we first obtain residuals in equation 11, which should be *I(0),* or stationary in its levels, in the case that the variables in the equation are all *I(1)* and are cointegrated. We shall then test the Stationarity of the residuals from the long run equation using ADF testing procedures *see appendix A6 (II)* but excluding the trend and the intercept. The result of the unit root test conducted on the residual is given below:

$\Delta u_t = -0.6768 u_{t-1}$

$\quad\quad$ *(-4.7208)*

$\quad\quad$ *(0.0000)*

$R^2 = 0.35$

$DW = 1.8$

$N = 44$

The Dickey Fuller Statistics obtained from the cointegration testing of this equation is -4.720787, and our DW statistic indicates no serial correlation. When we compare the results at 5 % and 10% critical values in the MacKinnon (1991) tables, with the number

of explanatory variables equals to 7, and a number of observation equals to 44, with no trend and constant, we can concluded that there is no unit root in the residual, therefore we reject the null hypothesis.

Our residual is stationary and integrated of zero or *I (0)*. The residual also appear to be stationary when we plot. (See appendix A5). This conclusion is a sufficient indication of the existence of a long-run relationship in our inflation function; therefore we can estimate an error correction model for inflation rate in Namibia.

4.4.4   Error Correction Modeling

Time series data on most developing countries such as Namibia are usually non-stationary. Estimation within such environment not only violates most classical assumptions, but also renders policy making from such econometric result less accurate. In cases where the data series exhibits unit roots, the short run dynamic properties of the model can only be captured in an error correction model, when existence of co-integration has been established. Our investigation of the time series properties of the data using the ADF tests has showed that all the variables have unit roots. That is, the autoregressive distributed lag functions of the variables are of *I (1)* series. This implies that the variables are non-stationary and hence may exhibit some spurious correlations. See appendix A6 (II)

Having established the unit root properties of the data series, we proceeded to ascertain if the residuals of our long run equation; equation 11 is of *I(0)* series, using the ADF testing procedure. In other words we wanted to establish if the inflation rate was cointegrated with GDP, the Money supply, interest rate and foreign prices. Our results showed that variables were indeed cointegrated using the test procedures.

According to Pindyck and Rubinfeld (1991), the existence of at least one Cointegration vector among the variable as showed above, implies that it is appropriate to estimate an ECM. The ECM is useful in the derivation of the short run impacts on the inflation rate in Namibia. The E-G approach is extended further by employing the following over-parametised second order ECM inflation model in a log linear form:

$\Delta LP_t = \alpha + \beta_1 \Delta LY_t + \beta_2 \Delta LY_{t-1} + \beta_3 \Delta LM_t + \beta_4 \Delta LM_{t-1} + \beta_5 \Delta LR_t + \beta_6 \Delta LR_{t-1} + \beta_7 \Delta LSP_t +$

$\beta_8 \Delta LSP_{t-1} + \beta_9 \Delta LUSP_t + \beta_{10} \Delta LUSP_{t-1} + \mu_{t-1} + \varepsilon_t$ ……………………………………………*12*

where $\varepsilon_t \approx NID\ (0; \sigma^2)$

In this equation, u_{t-1} is the lagged error correction factor, given by the residuals from the static cointegration 11. It was found appropriate to set the equation at one lag *see appendix A6 (III).* In an attempt to work toward a more parsimonious equation, some variables with low t-statistics in the equation were also dropped. The lags of some of those variables with low t-statistic were thus excluded from the equation as they were

highly insignificant and some were wrongly signed. Hence, the following results are produced in the following equation of a short run first order ECM:

$\Delta LP_t = 0.009 - 0.047\Delta LY_t + 0.003\Delta LM_t - 0.021\Delta LR_t + 0.652\Delta LSP_t + 0.022\Delta LUSP_t - 0.386u_{t-1}$..13

$\quad\quad\quad$ (3.991) $\;$ (-2.048) $\quad\quad$ (0.154) $\quad\quad$ (-1.037) $\quad\quad$ (5.651) $\quad\quad$ (0.065) $\quad\quad$ (-3.505)

$\quad\quad\quad$ (0.0003) $\;$ (0.0479) $\quad\quad$ (0.8009) $\quad\quad$ (0.8778) $\quad\quad$ (0.0000) $\quad\quad$ (0.9481) $\quad\quad$ (0.0012)

$R^2 = 0.60$

Adjusted $R^2 = 0.54$

$N = 43$

D-W = 1.7

The results produced in equation 13 indicate that our parsimonious model has nice statistical properties. The F-statistics indicates that the explanatory variables are jointly significant. The result shows that only real GDP and South African prices are significant in the short run, where as money supply, interest rate and United States prices are not. It is also interesting to note and observe that the error-correction term, u_{t-1} is significant at the 1 % level, confirming the point that the variable are cointegrated, the point which we alluded to earlier on. It also shows the rapid adjustment of inflation towards its equilibrium value, i.e. there is a 39% feedback from the previous period into the short run dynamic process.

Our estimations of the long run and short run equations; 11 and 12 has produced the following results, and for the sake of aligning the two models, they are summarized in the following table.

Table 4.5. Long and short run Elasticities.

Equation	Real GDP	Nominal Money Stock	Nominal Interest rate	South African Price level	United States Price level
Long run	-0.041	-0.090	-0.143	0.981	1.360
Short run	-0.047	0.003	-0.021	0.652	0.022

The results show that a 1% increase in real GDP leads to a decrease of 0.041 % in the price level of Namibia and that the coefficient is negative, thus the theoretical expectation of the existence of a negative relationship between inflation rate and GDP as alluded to earlier in section 5.3.2 is verified by the results. In the long run, a 1% increase in broad money supply leads to -0.09% decrease in price level, while a 1% increase in monetary growth leads to a 0.003% increase in the short run inflation. This tells us that monetary growth is only significant in the long run.

Interest rate as proxied by the lending rate plays a significant role in determining inflation in Namibia. The results indicate that a 1% increase in the lending rate will lead to a 0.143% decrease in inflation rate in the long run. However, interest rates are

insignificant in the short run, such that a 1% increase will lead to only a 0.021% decrease in inflation.

The most significant of all variable are the foreign prices. According to the results, there seems to be a strong influence of foreign prices on domestic prices. In the long run for instance, 0.98% of the increases in the domestic price are explained by increases in the South African price level by 1%. The strong influence of South African prices on domestic price is not surprising given that South Africa still remain Namibia major trading partner (Goamab 1998). In the short run, the rest of the world's price, as proxied by USA prices are insignificant, but Namibian price level adjusts by 0.65% in the same quarter of increase in RSA prices by 1%.

4.4.5   Diagnostic Testing

This section deals with econometric techniques of finding out whether the model adopted is a reasonable fit for the data. The following diagnostic tests were performed to confirm that our model track the data well over the sample period.

The R^2

R^2 measure the success of the regression model in predicting the values of the dependent variable within the sample. Theoretically, R^2 will be one if the regression fits perfects

and zero if the regression does not. The highly satisfactory R^2 of 0.60 is obtained in this model and shows that 60% of the variations in the Namibian inflation rate are explained by the variations in the changes of domestic real GDP and Foreign prices as well as in the residual error term.

The Histogram-Normality test

The other test that we used was the histogram normality test. The histogram displays the frequency distribution of the residuals. It divides the series range (distance between its maximum and minimum values) into a number of equal length intervals or bins and displays a count of the number of observation that fall into each bin. To measure symmetry of the histogram, skewness is used. The skewness of the symmetrical distribution, such as the normal distribution is zero. If the upper tail of the distribution is thicker than the lower tail, skewness will be positive.

To measure the tail shape of the histogram, we used the kurtosis. The kurtosis of a normal distribution is 3. If the distribution has thicker tail than does the normal distribution, its kurtosis will exceed three. In addition, the Jarque-Bera (JB) test was also used. The JB statistic tests whether a series is normally distributed. Under the null hypothesis of normality, the JB static is distributed Chi-square with 2 degrees of freedom. Nonnormality residual suggest outliers or general lack of fit of the model.

Using the JB test, if the computed p-value of the JB statistic in an application is sufficiently low, which will happen if the value of the statistic is very different from zero, one can reject the hypothesis that the residual are normally distributed. But if the p-value is reasonably high, which will happen if the value of the statistic is close to zero, we do not reject the normality assumption. Application of the JB test shows that the JB static is about 0.0007, and the probability of obtaining such a statistic under the normality assumption is about 99%. Therefore we do not reject the hypothesis that the error terms are normally distributed.

The D-W Test for serial correlation

One of the assumptions of the classical regression is that the disturbances in the model are not auto correlated. Another way of stating this assumption is that the correlation between disturbances from different observation period is zero. With economic time series data, it is unfortunately turns out to be the case that this assumption is often not true. To test for serial correlation, we used the D-W test. The rule of thumb for this test is that if d is found to be 2 in an application, one may assume that there is no first-order autocorrelation, either positive or negative. This also implies that the closer the statistic is to the better. In this analysis the d statistic was found to be 1.7, which is reasonably closer to 2, which shows very little evidence of a positive autocorrelation.

4.4.6 Structural stability

Several studies have shown that when we use a regression model involving time series data, it may happen that there is a structural change in the relationship between the regressand and the regressors. Generally what is meant by structural change is that the values of the parameters of the model do not remain the same through the entire time period. The significance of stability in our model is rested upon the effectiveness of anti-inflationary and hence the need for the following tests of stability.

Two types of test were employed in this analysis. The need for these tests is suggested by the fact that while long-run relationship may have been confirmed by the results of the Cointegration equation, it is possible that changes in the economy may have rendered unpredictable short-run deviations of inflation rate from its long-run equilibrium. Such deviations are observable from the instability of the coefficient of the determinants of domestic inflation in equation 13. In order to find out if the coefficients of the ECM are stable over the sample period, we performed the CUSUM and CUSUMQ test.

For these tests the existence of parameter instability is established if the cumulative sum of the residual goes outside the area between the two critical (dotted) lines. The CUSUM test is useful for detecting systematic changes in the regression co-efficient and the CUSUMQ tests is useful in situations where the departure from the consistency of the

regression coefficient is haphazard and sudden. Both tests are estimated at 5% level. From appendix A7 (I) and A7 (II) we can conclude that for the period 1993 to 2003 there has been no major structural changes.

CHAPTER 5

5.1 Conclusions

In this paper, we employed various econometric techniques to examine and explain the main determinants of inflation both in the long run and in the short run. To this effect, two equations were estimated and the results are to some extent comparable with the results obtained by other researchers.[3] And this has led to all papers reaching more or less the same conclusions. The study found that foreign prices, as proxied by South Africa and America CPI's, have a significant long run influence on the level of prices of Namibia. In the short run, inflation is only significantly influenced by the inflation coming from South Africa.

Even though the study did not consider openness as a variable in the model, the findings which led to this conclusion suggests that Namibia is an extremely open and import dependent economy. Consequently, the country remains vulnerable to foreign price development, especially from South Africa. The key policy implication from this study is the need to reduce the country's dependency on imports by placing more emphasis on promoting the manufacturing base in the country. This will not only help to reduce its dependency on import but it will also help to protect itself against changes in prices of these imports.

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[3] Goamab (1998), Odada etal (2000)

5.2 Policy Implications

The results discussed in chapter 4 have several implications for Namibia: it is suggested that inflation in Namibia is only significantly influenced by real GDP and South African prices in the short run.

A 1% increase in real GDP will lead to a 0.047% decrease in price. These results are in disagreement with the results of Goamab (1998); he found that a 1% increase in real GDP will lead a 0.14% increase in prices. The significance of the GDP variable in our analysis both in the long and short run suggest that the government can reduce inflation by increasing output, especially in sectors that they have potential growth for such agricultural output. This is because food accounts for about 30% of the weight used in the consumer price index *(see figure 1)*, efforts that are geared to raise real GDP will undoubtedly bring domestic prices down and control inflation rate. Thus Namibia in addition to agricultural products, should step-up efforts to promote more investment in other sectors of the economy in the country which will in turn lead to high economic growth. One area that the country could accelerate investment is the mining sector. Namibia is well endowed with mineral resources, and the rising of uranium prices on international markets should serve as an incentive to increase investments.

The regression results also show that domestic prices are highly influenced by foreign prices, South African prices in particular accounts for almost 1 to 1 pass-through of RSA prices to Namibian prices in the long run changes in Namibian prices. The significance

of foreign prices supports the hypothesis of *foreign price pass-through* advanced by Odada etal (2000) as one of the possible causes of inflation in Namibia. This proposition was also made by Goamab (1998); his study identified *foreign prices pass-through* effect as a significant determinant of the general price in Namibia.

Therefore, the significance of import price as a possible cause of inflation in Namibia calls for urgent consideration of import substitution possibilities, especially in the production of basic consumer goods which the country has hitherto been importing, and in whose production Namibia might be having reasonable degrees of comparative advantage.

Further more, the study found that broad money supply and interest rate cannot be used to control inflation in the short run. This is because the study failed to establish a significant relationship between the broad money supply, interest rate as proxied by lending rate and price level. In the long run however, interest rate did seem to have a significant effect but it was found to be too small. this perhaps suggest that Namibian consumers are less sensitive to changes in interest rate, which makes the domestic monetary policy less effective in controlling money supply in the economy.

APPENDICES

Appendix A1

List of variables and Description

|		
C	:	1
D1	:	1
DDLE	:	dle-dle (-1)
DDLM2	:	dlm2-dlm2 (-1)
DDLP	:	dlp-dlp (-1)
DDLR	:	dlr-dlr (-1)
DDLSP	:	dlsp-dlsp (-1)
DDLUSP	:	dlusp-dlusp (-1)
DDLY	:	dly-dly (-1)
DLE	:	le-le (-1)
DLM2	:	lm2-lm2 (-1)
DLP	:	lp-lp (-1)
DLR	:	lr-lr (-1)
DLSP	:	lsp-lsp (-1)
DLUSP	:	lusp-lusp (-1)
DLY	:	ly-ly (-1)
LE	:	log (e)
LM2	:	log (m2)
LP	:	log (p)
LR	:	log (r)
LSP	:	log (sp)
LUSP	:	log (usp)
LY	:	log (y)
P	:	Namibia Consumer Price Index
RESID1	:	Cointegration Residual
SP	:	South Africa Consumer Price Index
T	:	Time trend
USP	:	United States Consumer Price Index
Y	:	Real GDP

Appendix A2. Log-linear Graph of all variables
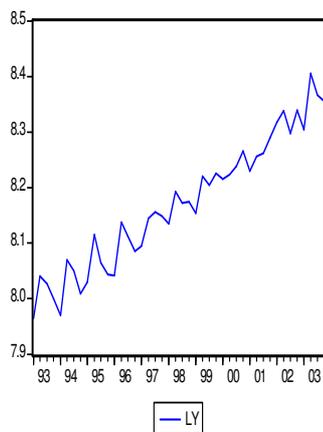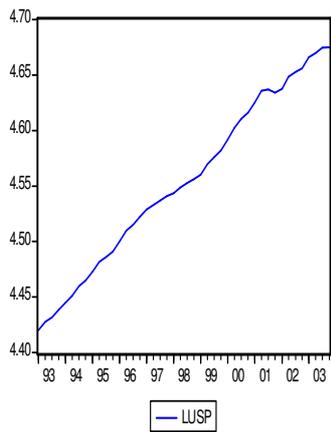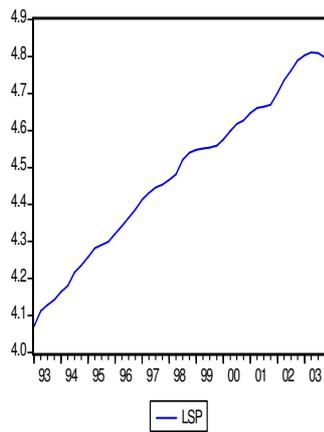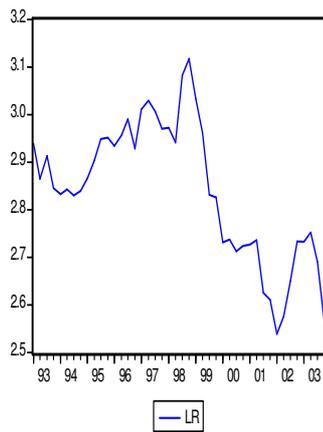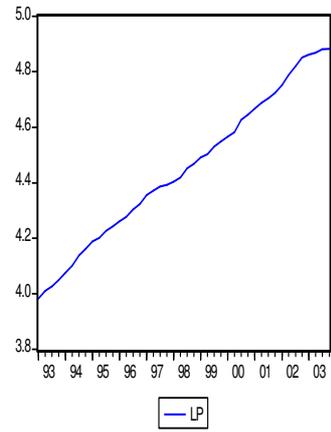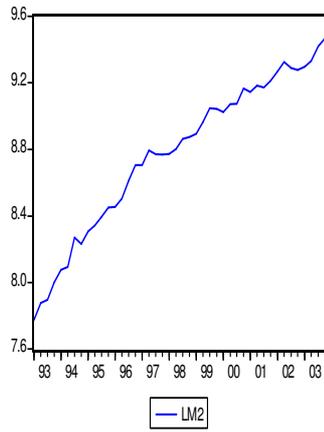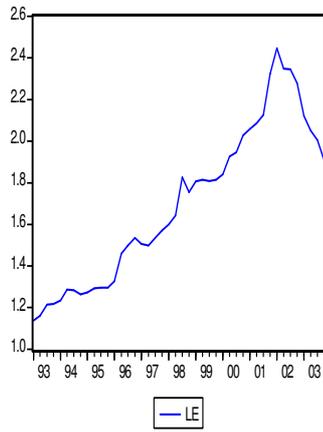
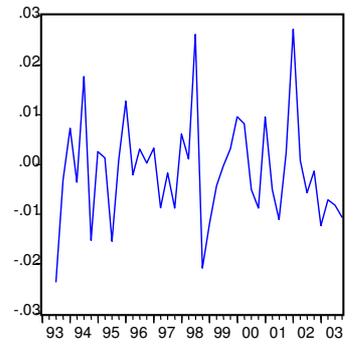**Appendix A3. First-Differenced log-linear graph of all variable**
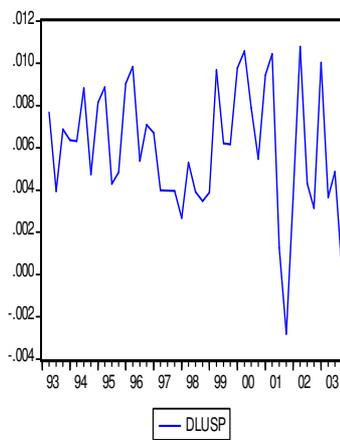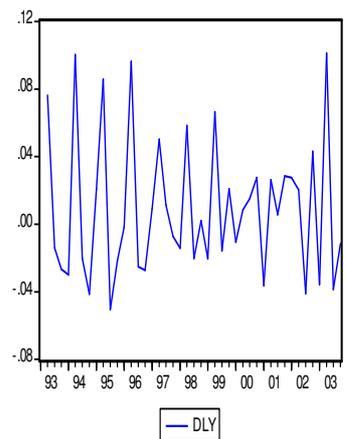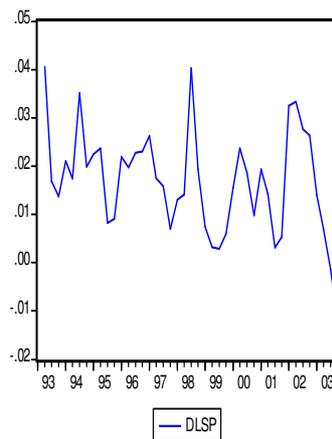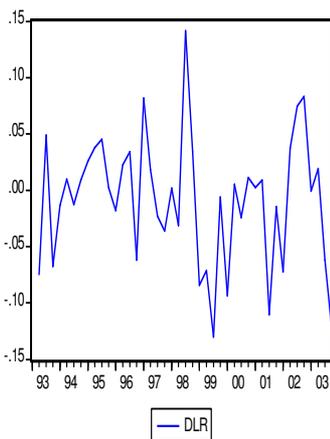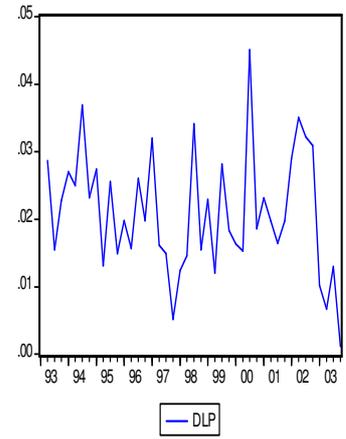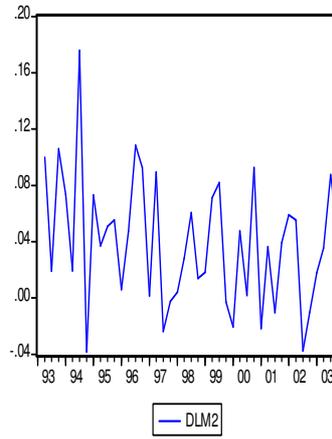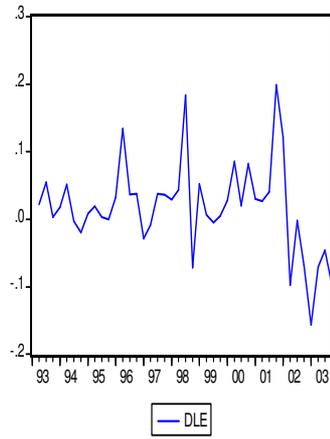
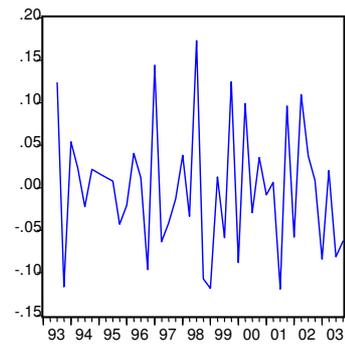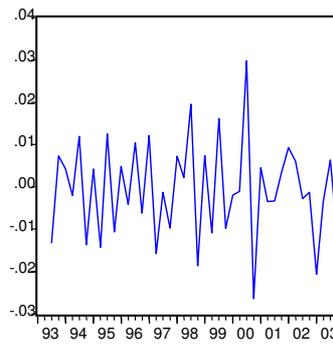**Appendix A4. Second-Difference log-linear graph of all variables**
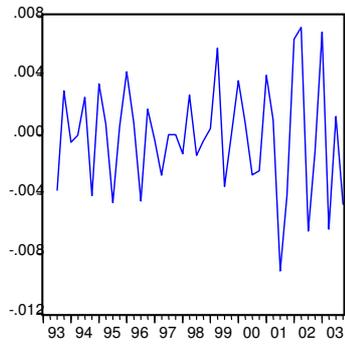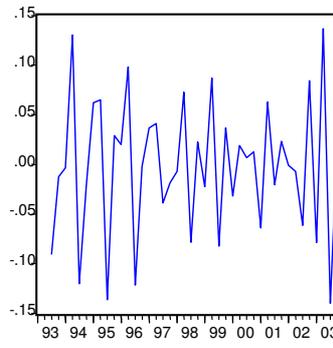
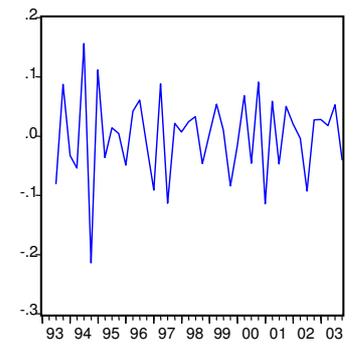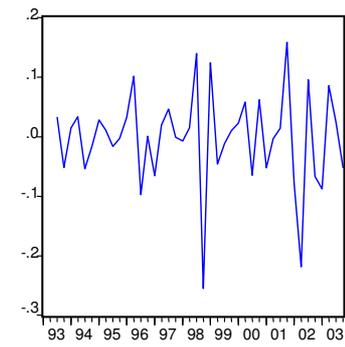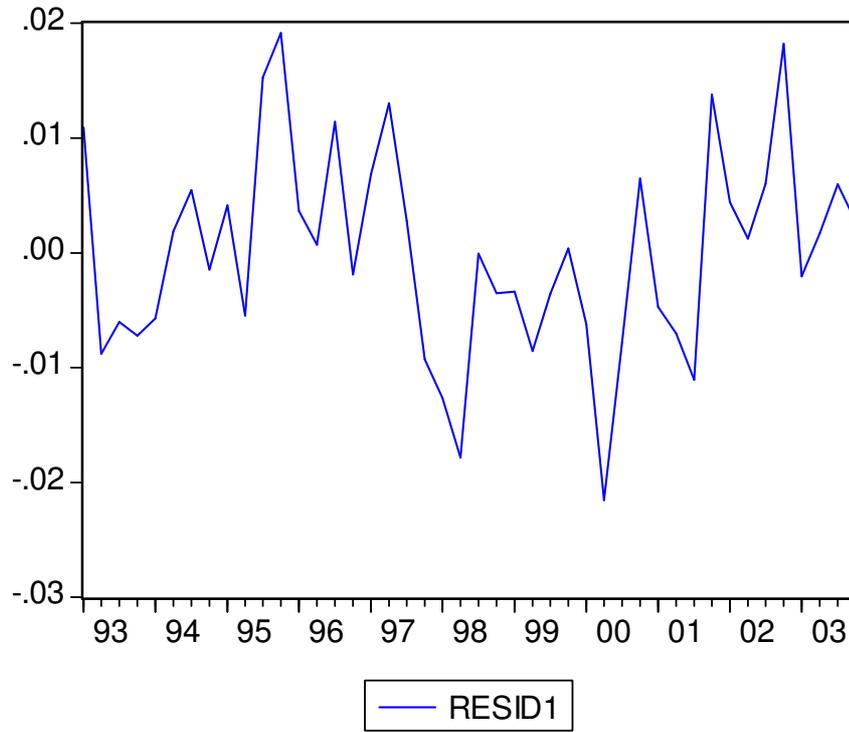**Appendix A5. Plot of Residual and Standard Error Bands**

Appendix A6 (I)

Dependent Variable: LP
Method: Least Squares
Date: 02/04/07   Time: 17:19
Sample: 1993Q1 2003Q4
Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.566134	1.196803	-3.815277	0.0005
LY	-0.041094	0.055750	-0.737120	0.4658
LM2	-0.090179	0.026420	-3.413304	0.0016
LR	-0.143073	0.023690	-6.039456	0.0000
LE	-0.019623	0.013182	-1.488661	0.1453
LSP	0.981405	0.109021	9.001971	0.0000
LUSP	1.360487	0.374619	3.631653	0.0009
D1	-0.020809	0.011686	-1.780598	0.0834

R-squared	0.998891	Mean dependent var	4.450013
Adjusted R-squared	0.998676	S.D. dependent var	0.269867
S.E. of regression	0.009820	Akaike info criterion	-6.245766
Sum squared resid	0.003472	Schwarz criterion	-5.921368
Log likelihood	145.4069	F-statistic	4633.824
Durbin-Watson stat	1.318432	Prob(F-statistic)	0.000000

Appendix A6 (II)

Null Hypothesis: RESID1 has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.720787	0.0000
Test critical values:	1% level	-2.619851	
	5% level	-1.948686	
	10% level	-1.612036	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RESID1)
Method: Least Squares
Date: 02/05/07   Time: 08:06
Sample (adjusted): 1993Q2 2003Q4
Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID1(-1)	-0.676766	0.143359	-4.720787	0.0000
R-squared	0.346443	Mean dependent var		-0.000191
Adjusted R-squared	0.346443	S.D. dependent var		0.010438
S.E. of regression	0.008438	Akaike info criterion		-6.689128
Sum squared resid	0.002990	Schwarz criterion		-6.648170
Log likelihood	144.8162	Durbin-Watson stat		1.818028

Appendix A6 (III)
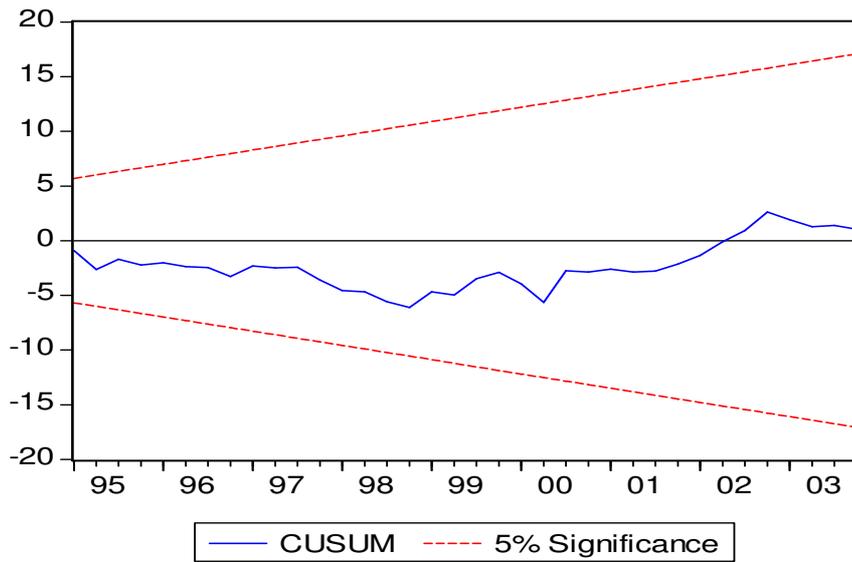
Dependent Variable: DLP
Method: Least Squares
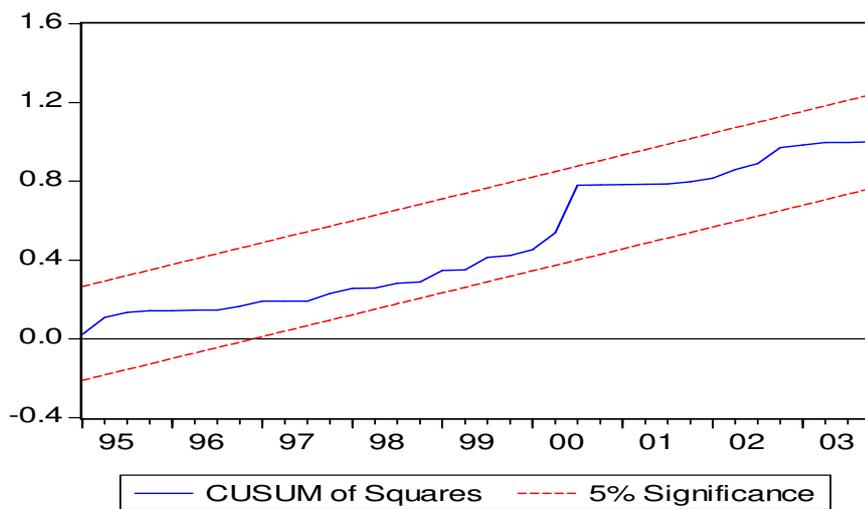Date: 02/04/07   Time: 17:22
Sample (adjusted): 1993Q2 2003Q4
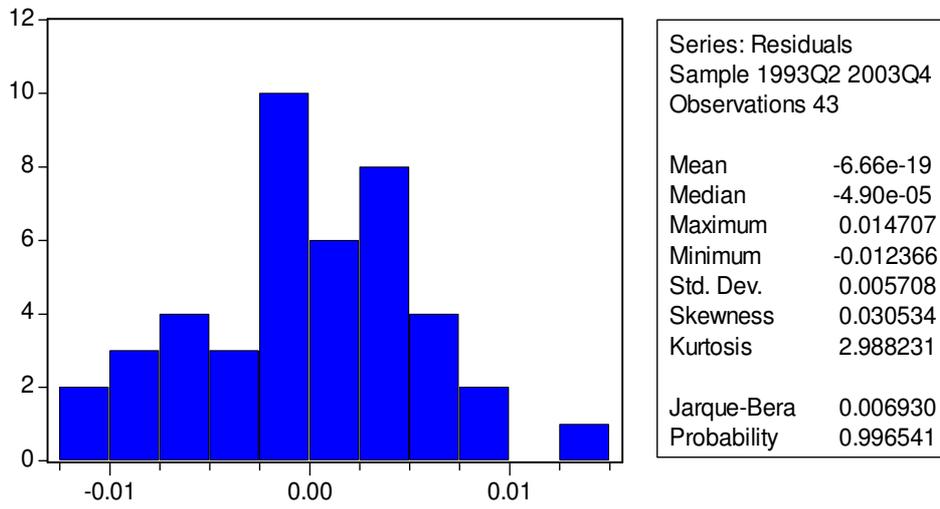Included observations: 43 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009873	0.002474	3.991065	0.0003
DLY	-0.047629	0.023252	-2.048355	0.0479
DLM2	0.003399	0.021958	0.154813	0.8778
DLR	-0.021352	0.020575	-1.037747	0.3063
DLSP	0.652048	0.115380	5.651284	0.0000
DLUSP	0.022992	0.350522	0.065593	0.9481
RESID1(-1)	-0.386782	0.110323	-3.505897	0.0012

R-squared	0.602020	Mean dependent var	0.020930
Adjusted R-squared	0.535690	S.D. dependent var	0.009049
S.E. of regression	0.006166	Akaike info criterion	-7.191685
Sum squared resid	0.001369	Schwarz criterion	-6.904978
Log likelihood	161.6212	F-statistic	9.076122
Durbin-Watson stat	1.676208	Prob (F-statistic)	0.000005

Appendix 7(I)

Appendix 7(II)

Appendix 8

	Series: Residuals
	Sample 1993Q2 2003Q4
	Observations 43
Mean	-6.66e-19
Median	-4.90e-05
Maximum	0.014707
Minimum	-0.012366
Std. Dev.	0.005708
Skewness	0.030534
Kurtosis	2.988231
Jarque-Bera	0.006930
Probability	0.996541

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