BANK OF NAMIBIA

RESEARCH DEPARTMENT

P.O. Box 2882, Windhoek, Namibia
Telephone: +264-61-2835111, Fax +264-61-2835067
E-mail: mihe.gaomab@bon.com.na

**Modelling Inflation in Namibia
Mihe Gaomab II**

October 1998

BoN Occasional

Bank of Namibia, Research Department produces the following publications:

Annual Report, which contains a detailed review of economic developments, a report of the operations of the Bank and the Registrar of the Banks.

Quarterly Report, which reviews developments of the Namibian economy on a quarterly basis.

Occasional Paper, which consist of the completed research projects of the bank which are produced on occasional basis.

Discussion Paper, which comprise a series of short papers which are in draft form.

Mission Statement of the Bank of Namibia

is to promote monetary and financial stability
in the interest of the Nation's sustainable economic growth and development.

Preface

The paper was presented at the seminar on "Inflation in Southern Africa" organised by the Bank of Botswana, 15-16 September 1997, Gaborone, Botswana. The seminar was organised by the Research Department of the Bank of Botswana. With the further comment incorporation and technical improvements, the first publication of this paper was produced for a special issue of "The Research Bulletin" of the Bank of Botswana titled "Inflation in Southern Africa"', Volume 16, No.1, page(s) 53-75.

ABSTRACT

This paper reviews the experience of inflation in the Namibian economy during the past twenty-four years, by utilising the theoretical and empirical determinants of inflation in the available literature. The project uses recently developed econometric techniques, namely cointegration (CI) analysis, error correction modeling (ECM) and structural stability testing for time series analysis and forecasting. The results obtained reveal that there is a dominant influence of foreign prices and imported inflation from South Africa on Namibian prices and inflation, which conforms to a priori empirical expectations. The rest of the world, as proxied by the United States prices, is also significant on Namibian prices in the long run, although, this effect may also be indirect through the SA prices. The broad money supply and money supply growth also tend to have significant long and short-run effects on the Namibian prices and inflation respectively. The real income and interest rate effects were also highly significant on Namibian prices in the long run, but not in the short run. Real income, however, showed a positive relationship with inflation, which is contrary to theoretical expectations. This situation could be ascribed to the export oriented productive activities of whose prices are not linked domestically but its production growth leads to higher incomes and increased domestic demand and therefore inflationary pressure. Another reason concerns the monopolistically competitive structure of the Namibian commercial sector with its price setting powers, which engenders increased inflation with increased output growth. The results therefore provide some insight into the impact of policies for the promotion of the manufacturing base and increased competition as anti-inflationary policy instruments. The results also show that there is a structurally stable inflation function in Namibia and indicates the reliability of forecasting using money supply growth and SA inflation as key determinants.

Table of Contents

1. Introduction

1.1 OVERVIEW

Available evidence suggests that a high proportion of consumer expenditure in Namibia is accounted for by the purchase of consumer goods from its neighbor, and the largest and most sophisticated economy in the region, South Africa (SA). Such a situation leads to the expectation that imports from SA play a significant role in determining inflation in Namibia, and that there should be similar movements of inflation rates in the two countries.

Such expectations were, however, questioned within research and business circles in Namibia when inflation rates between SA and Namibia showed divergent and dissimilar trends, especially over the early 1980s and in 1991-1992 *(see Graph 1)*. A recent study (Gaomab, 1996) that attempted to shed light on the divergent inflation rates of the two countries, attributed the divergence to technical differences between the consumer price indexes (CPI) of the two countries, and also gave an indication that possible errors may be present in the price collection methods, coverage, weights and weighting patterns, item and outlet substitution, and in the transcription and computation of the Namibian CPI. The study thus called for greater caution to be exercised in terms of the reliability of the Namibian CPI.[1]

The limitation of the above study is that it failed to provide a vigorous analysis of the real causes of

---

[1] For a full analysis on the Namibian CPI, see Gaomab II (1996). An additional useful reference is Simon Stone (1993).

inflation, and only compared the trends in the Namibian inflation with those of other economic data, including SA imported inflation. This meant that the study failed to provide a basis for any anti-inflationary policy objectives in the country. It is within this context that this study is undertaken, and because of the need to model the real causes of inflation in Namibia with a view to developing policies to combat it. This study is pioneering in the sense that there have not previously been any studies modeling inflation in Namibia. However, the study will attempt to draw comparative lessons from the empirical studies done so far in the Sub-Saharan African (SSA) countries.

1.2 RESEARCH OBJECTIVES

The objectives of this study include the following:

➡ to identify the relevant variables influencing inflation in Namibia, using both theoretical and empirical frameworks;
➡ to ascertain which explanatory variables are significant determinants of Namibian inflation and which may be useful for anti-inflationary policies;
➡ to ascertain the stability of the inflation function in Namibia over the sample period; and
➡ to investigate the projected path of the inflation rate using available historical data.

1.3 METHODOLOGY

The study covers the period of 1973-1996. It includes explanatory variables such as real income, nominal money supply, nominal interest and exchange rates and foreign prices. These variables are typical of those applied in other empirical analysis of inflation in the SSA countries. Namibian prices and inflation are used as the dependent variables in the estimation.

The study employs the relatively new econometric technique of cointegration and error correction modeling (ECM) in order to estimate a more specific relationship between inflation and its determinants. ECM, as a tool of analysis, circumvents the fundamental problem of spurious regression problem through the use of appropriate differenced variables in order to determine the short-term adjustments in the model, while cointegration analysis provides potential

information about the long-term equilibrium relationship of the model.[2] Since time series variables generally exhibit a non-stationary pattern in their levels, unit root testing as a pre-testing device for cointegration and ECM will be carried out in order to determine the degree of stationarity. Structural stability testing procedure will also be carried out in order to determine the behaviour of the inflation function in Namibia.

The study is therefore organised as follows. Section 2 provides a historical background of inflation in Namibia. Section 3 reviews the theoretical formulations of inflation, followed by section 4 on relevant empirical findings from SSA countries. Section 5 provides the modeling procedure on inflation in Namibia beginning with the model specification and data analysis and ending with the modeling strategy. Section 6 provides the policy implications thereof. Section 7 concludes with the limitations and future research implications of the study.

2. Historical Overview of Inflation in Namibia

The history of Namibian inflation data dates back to 1970, where the CPI was constructed as a sub-national index of the South African CPI. It was only in 1993, following independence, that the Central Statistical Office (CSO) in Namibia calculated a CPI, though covering only Windhoek, the capital city. Before 1990, the Namibian CPI items and weights were based on the Household and Income Expenditure Survey (HIES) of 1975 conducted by the Central Statistical Service (CSS) of SA, which covered most regions of SA and Windhoek.

Since expenditure patterns of households change over time, the relevance of the 1975 HIES was questioned, and in December 1992 an interim CPI was introduced by the CSO using the SA HIES weights of 1985, with December 1992 as a base year. This made the household expenditure pattern more relevant, but the coverage was still only limited to Windhoek. Currently, efforts are underway to use weights from the recently completed Namibian HIES of 1993/94 in order to create a nationally representative CPI for the country.[3]

An analysis of the inflation trend in Namibia since 1973 depicts two scenarios *(see Graph 1)*. First, during the 1973-83 period, the inflation rate for Namibia followed a similar trend to that of South Africa. This could be explained by the fact that Namibia was treated as a monetary province of South Africa. Second, the trend tends to differ markedly between 1984-88 (which is also a period of de facto rule by SA in Namibia) and significantly during the 1991-92 period. The reasons for such differentials may lie in the treatment of the basket of goods in the CPI's of the two countries, but it could also be due to other domestic factors that influenced inflation during the two periods.

Graph 1. Inflation Rates in Namibia and South Africa, 1973-96
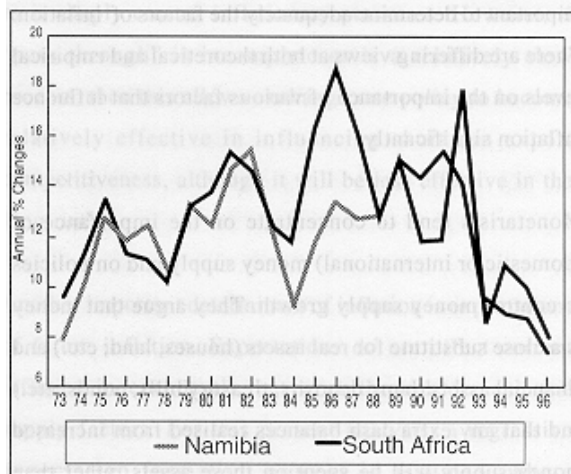
The peaks of the Namibian inflation rate are evident during 1973-74 (partly due to oil price increases); 1981-83 (due to cyclical drought); 1988-89 (partly due to currency depreciation in late 1985, a 10% surcharge on imports[4] and increased domestic demand due to the presence of the United Nations Transition Assistance Group (UNTAG) contingent); and the 1991-92 period (due to cyclical drought).[5]

The trough periods are evident in 1984-85 (due to slackened domestic demand and the post drought effect of excess supply of meat in South Africa); and 1990-91 (partly due to the departure of UNTAG in mid-1990 that dampened domestic demand and also due to increased stability of the Rand against other

---

[2] Spurious regressions are normally encountered by the application of the straightforward Ordinary Least Squares (OLS) regression on the Partial Adjustment Model (PAM) using, in addition to the explanatory variables, a lagged dependent variable to take into account adjustment factors - see Gujarati (1995), page 724 and Harris (1995), page 19.

[3] See Gaomab (1996), Page(s) 2, 17, and 19 on the full history, weight components of HIES 1985, and the conclusions for the future Namibian CPI.

[4] The 10% surcharge on imports resulted in price increases of 19.2% and 32.7%, respectively, for locally produced goods and imported items in South Africa, which filtered into Namibia (see Economic Review 1992).

[5] It is also worthwhile to note, however, that increased inflation during 1992 was also caused by domestically induced factors such as the wages and salaries increase awarded to the general government; low productivity and increases in local hire purchase credit from 6.2% in 1991 to 9.4% in 1994 (see Economic Review 1992).

currencies from mid-September 1989); and further in the post-1992 period, as a result of the implementation of the restrictive monetary policy that started in 1988.

3. Theories of Inflation

For the formulation of any monetary, exchange rate and/or fiscal policy to effectively combat inflation, it is important to determine adequately the factors of inflation. There are differing views at both theoretical and empirical levels on the importance of various factors that influence inflation significantly.

Monetarists tend to concentrate on the importance of (domestic or international) money supply and on policies to control money supply growth. They argue that money is a close substitute for real assets (houses, land, etc.) and financial assets (bank deposits, treasury bills, bonds, etc.) and that any extra cash balances realised from increased money supply will be spent on those assets rather than held as idle money balances. This situation will give rise to excess demand for assets, which will cause prices to rise, thereby ultimately leading to increased inflation.

Keynesians tend to attribute inflation more to demand pressures within an economy. The Keynesian view states that the money supply increases affect inflation through interest rate movements. In this view, money is considered a close substitute for a limited number of financial assets (i.e., bonds), and thus an increase in money supply causes excess demand for these assets, leading to an increased in their prices and subsequent fall in the interest rate. The decline in the latter, leads to increased investment depending on the interest rate sensitivity of investment. In turn, increased investment leads to increased aggregate demand, thereby triggering inflationary pressures in the economy. This theoretical explanation may, however, only apply in the short run. A fall in the interest rate may stimulate increased investment, thereby aggregate demand and increased inflation in the short run. But, in the long run, increased inflation may cause output to contract thereby leading to reduced demand for money in the economy. According to the money demand relationship, the reduced demand for money would lead to a rise in the nominal interest rate in the long run[6].

The argument advanced for an increase in the money supply to have an effect on inflation remains questionable however, in the light of the endogeniety of money. Critics argue whether monetary expansion is in itself a cause of inflation, or simply a reflection of other more fundamental factors. Nevertheless, Friedman [7] has always claimed that "inflation is

---

[6] See Kennedy (1984)

[7] See Friedman (1956)

always and everywhere a monetary phenomenon" and some empirical studies (as detailed in section 4.2) have supported this theoretical position. In the long-run, it seems likely that money supply has a major impact on inflation, but in the short run there are other phenomena, such as food shortages, oil price increases or wage increases, that are important determinants of inflation. Furthermore, critics have argued about the causality problem between inflation and the nominal interest rate in particular, and whether there is a direct effect between the two variables, or an indirect effect through the money supply.

Another postulated cause of inflation is the role of the cost-push factors. These factors operate through the supply side of the economy by increasing the unit cost of production, so that real output, or GDP contraction co-exists with resulting inflation. In other words, there is a possibility that increased inflation may have a negative impact on real GDP growth, which suggests again that the relationship between the variables should be investigated.

Other potential cost-push causes of inflation that could be looked at in the Namibian contexts are:

 a. increases in nominal wages in the economy in excess of productivity increases;
 b. a rise in imported raw material prices and costs of other goods and services caused by external shocks (leading to increased foreign prices of imports) or domestic currency depreciation; and
 c. increases in profit margins and mark-ups (on imports especially) of local business.

Considering the first factor, it can be argued that trade unions, because of their monopolistic bargaining power, become ambitious in their wage claims, which may exceed productivity growth. As labour costs constitute a large proportion of production and distribution costs, such large wage claims may force producers of goods and services to increase producer prices, thereby sparking off inflation. According to Chhibber and Shafik (1990), in a typical Sub-Saharan African country, wages constitute only a very small fraction of national income and organised labour unions are not very strong. In the case of Namibia, however, the converse may be true in the sense that wages form a significant part of national income in the economy and that there are relatively strong and well organised labour unions in the country. However, time series data on wages (and mark-up factors) are not available in Namibia, making it impossible for these variables to be empirically examined as determinants of inflation.

In the case of rising import prices and exchange rate depreciation, the major justification for including these variables is that they determine the export competitiveness of the economy. However, in an open and import dependent economy, where

domestic inflation is largely determined by foreign prices and nominal exchange rate depreciation, the initial improvement of export competitiveness resulting from depreciation may eventually be mostly offset by the consequent increase in prices.

In the extreme case, there is a complete and immediate "pass through" of exchange rate and foreign prices to domestic prices. Consequently, an exchange rate policy that entails a nominal depreciation, or devaluation, cannot promote export competitiveness in the economy, as it simply creates inflationary pressures. However, if "pass through" is incomplete or is a relatively slow process, then this allows exchange rate policy to become relatively effective in influencing short run export competitiveness, although it will be less effective in the long-run[8].

Another important determinant of inflation is expectations of future inflation. Expectations do not affect current inflation independently, but work through demand and supply factors. For this present analysis, a regressive expectation formation process is assumed, where expectations for the current period depend on the situation during the preceding period. Thus, this year's inflation can be proxied by the inflation experienced last year by including a one period lag value of the inflation variable. However, the estimation procedure with the inclusion of the lagged dependent variable can lead to spurious correlation, and therefore inferences and interpretation of an equation including this variable should be treated with utmost caution.

There are other factors, such as poor climatic conditions, wars, crop failures or drought, that could also act as cost push, or supply reducing factors causing inflation in an economy such as Namibia's. Since their impact is only significant in one-off periods, it was decided not to include these variables, but to assign, where appropriate, structural dummies to account for their effects.

There is also another explanation of inflation, which argues that it is strongly influenced by political and social factors, such as the norms and the values of the society. Since they are unquantifiable, they will not be considered for estimation purposes.

4. Empirical Evidence
4.1 THE CASE OF NAMIBIA

There has not been any quantitative or empirical study on the causes of inflation in Namibia. Theory predicts, however, that the pass through from the nominal exchange rate and foreign prices to domestic prices depends on the size and openness of the

economy. The larger and less open the economy, the smaller and slower will be the "pass through"[9], and vice versa. The criteria for determining the openness of the economy are the proportion of imports and exports in GDP. Table 1 shows the degree of openness of the Namibian economy in comparison to other selected economies over the period 1973-1996. The comparison shows that Namibia is a highly open economy, with imports and exports constituting a large share in GDP. This suggests that the pass through effect may be large and immediate (i.e., that short run exchange rate and foreign price changes could have a large impact on changes in domestic prices).

Table 1. Degree of Openness of Selected Economies, 1973-96

Country	Sum of Nominal Imports and Exports (as % of Nominal GDP)
Namibia #	1.18
South Africa	0.52
Zimbabwe	0.60
Botswana	1.15
United Kingdom	0.51
United States	0.17

Source: International Financial Statistics Yearbook, 1996, IMF

 # The Namibian figure is calculated from the Economic Review 1988 (SWA Department of Finance) and The National Accounts 1981-96, Central Statistical Office.

Attempts to test the theoretical framework of purchasing power parity (PPP), or the law of one price, indicate that PPP does perform better for countries which are geographically close and where trade linkages are high (Frenkel, 1981; Balassa, 1964). This may be applicable to Namibia, which has unrestricted trade with its Southern African neighbour, the Republic of South Africa (both are members of the Southern African Customs Union (SACU)). Namibia's imports and exports from and to SA currently account for more than 85% and 25% of Namibia's total imports and exports, respectively [10]. Its total trade with SA thus stands at around 56%. Namibia also has a fixed exchange rate mechanism with SA under the provisions of the Common Monetary Area (CMA), and this would tend to make the "pass through" effect of foreign prices even greater.

There is evidence, which suggests that even in open economies, complete "pass through", or the law of one price, is often not applicable. The evidence

---

[8] See Dornbusch 1987

[9] However, even in large and less open economies such as the USA, there is some degree of pass through (Dornbusch, 1987, pg 252)

[10] See Bank of Namibia Annual Report 1994 page 48-50,

shows that price differentials for the same goods in different countries are too large and/or long lasting, to be explained solely by transportation costs, trade duties, or simply a slow adjustment process. A number of reasons have been advanced from empirical studies to explain the failure of the law of one price in practice.[11] First, there are the risks and other costs associated with discovering and taking advantage of price differentials. Second, producers could take advantage of opportunities for price discrimination in markets with different demand elasticities. The third reason is the distinction between permanent and temporary nominal exchange rate changes. The last reason concerns the structure of the markets and the lack of perfect competition in product markets. In oligoplolistic market structures such as Namibia, reductions in the domestic currency cost of imports may encourage producers to increase their profits in the short term rather than engaging in domestic price reductions. This could also be applicable to exchange rate changes, in that nominal exchange rate appreciations will not lead to a price reduction in the economy, whereas depreciations may lead to price increases, hence profit margins between the two economies may vary.

4.2 Sub-Saharan African Countries (SSA)

There is a considerable body of empirical studies on inflation in the SSA economies. These have adopted a variety of approaches when examining the causes of inflation. Some of these studies have attempted to estimate causes of inflation from a structuralism and monetarist perspective. Chhibber *et al* (1989) developed a detailed econometric model for Zimbabwe, which includes both monetary and structural factors of inflation. The study showed that nominal monetary growth, foreign prices, exchange and interest rates, unit labour costs and real income are the determinants of inflation in that country. A similar model for Ghana was also employed by Chhibber and Safik (1990) covering 1965-88, using annual data. This model suggests that money supply is the key determinant of inflation in the Ghanaian economy, and variables such as the official nominal exchange rate and real wages were found to be insignificant (the study found, however, a highly significant parallel or unofficial exchange rates). These findings were re-confirmed by Sowa and Kwakye (1991) on Ghana, leading to the overall conclusion that Ghanaian inflation is monetary and structural in character.

Elbadawi's (1990) research on inflation in Uganda revealed that rapid monetary expansion and the depreciation of the parallel exchange rate were the principal determinants of inflation during the 1988-89 period, and generally supported the findings of Ghana by Chhibber and Shafik (1990) and Sowa and

Kwakye (1991) that the influence of the official exchange rate was insignificant. Tegene (1989) departed from the common application of an econometric model, and used Granger and Pierce causality tests in order to investigate the role of domestic money supply on inflation in six African countries. Evidence indicated a uni-directional causality from monetary growth to inflation in the sample countries. A similar analytical methodology was employed by Canetti and Greene (1991) on ten African countries during 1978-89, and the results are similar to that of Tegene (1989) that monetary growth (and the nominal exchange rate) had a significant causal influence on inflation. These findings also lend support on the issue of the exogeniety of the money supply.

London (1989) employed a pure Harberger monetarist model in 23 African countries with the growth of money supply, exchange rates, expected inflation and real income as determinants of inflation and found out that between 1974 and 1985 all variables were highly significant. In Botswana, earlier studies (Huda, 1987; Leith, 1991; and Ncube, 1992) concentrated on price and nominal exchange rate and foreign price relationships. They found a high explanatory power for the SA price index (used as a proxy for foreign prices) suggesting strongly the hypothesis that inflation in Botswana is essentially imported. These studies also found a small impact of nominal exchange rate changes on prices in Botswana (Huda 1987, Leith 1991), except in the case of Ncube (1992) where it was found insignificant.

The above studies on Botswana used more traditional econometric approaches, i.e. the specific to general approach. The regressions were undertaken without testing for stationarity of the variables and consequently the spurious regression, or correlation issue, was not resolved by means of estimating the equations in first differences. Masale (1993), however, solved this problem by testing for stationarity and employing cointegration analysis in order to identify both short and long run relationships in the equation. The findings were that Botswana and South African CPIs, as well as the Rand\Pula exchange rate, were indeed found to be non-stationary. However, the cointegration tests between the relative prices and the exchange rate did not confirm the existence of a long-run relationship. Estimation of a short-term relationship between the variables using first differences and error correction factor also led, surprisingly, to the rejection of the PPP model.

Atta *et al* (1996), building upon the model by Masale (1993), used monthly data from 1975 to 1993, thereby extending the sample size since the latter had used quarterly observations. The approach also employed a general to specific method using an unrestricted autoregressive distributed lag model, stationarity testing, cointegration analysis and error correction

---

[11] See Isard, 1987 and Dornbusch, 1987,

modeling to distinguish clearly between short- run and long-run price relationships.[12] The model employed by Atta *et al* incorporated a wider range of variables applicable to the Botswana situation, such as real income, nominal narrow money supply, nominal interest rate (proxied by the savings deposit rate), the nominal exchange rates of the Pula against the Rand, Zimbabwe dollar and USA dollar and foreign prices as represented by the South African, Zimbabwe, and American CPIs.

The results were a strong "pass through" cointegrated relationship of 92% between SA prices and Botswana prices. The changes in the Zimbabwean prices were also significant, with 14% after a one-year lag, but the influence of USA price changes, at 72%, was surprising (this was tentatively explained in terms of the larger proportion feeding through the SA price changes). Other variables also proved to be highly significant and had the expected signs, with changes in real income, money supply, interest rate and Rand/Pula nominal exchange rate explaining -28%, 2%, 1% and 3%, respectively, of changes in Botswana prices. The error correction term was negative 2%, and highly significant, which indicated that 2% of the past months disequilibria feeds back into the current Botswana price changes.

The approach in this study follows closely the approach by Masale (1993) and Atta *et al* (1996). However, while the study uses annual data, instead of monthly and quarterly observations, it will consider a wider range of variables. There is a valid reason for following the same approach since both Botswana and Namibia are closely situated geographically, and are heavily dependent on South African imports. Both are relatively open economies (see Table 1) and are highly affected by regional and international economic developments, notably price movements in SA. The approach will also lend support to the Namibia's broader trade pattern and consider the United States of America as the proxy for the rest of the world.

In conclusion, empirical results suggest that the prime determinants of the inflation function are the growth in nominal money stock, expected inflation, nominal interest and exchange rates, real income and foreign prices. This suggests that inflation in Africa could be the result of monetary and structural causes, as well as import price dependent.

---

[12]   For a full explanation on stationarity, cointegration as well as error correction modeling and the implications for regression models see Harris (1995) and Thomas (1993).

5. Modeling Inflation in Namibia

The empirical estimations of inflation in Namibia form part of this chapter, beginning with the model specification, the definition of the data used, the sources and transformations made in derivation of certain variables, and brief description of the data trends. The paper then approaches the estimation process in terms of stationarity, unit root testing, cointegration, error correction modeling, structural stability and forecasting.

5.1 Model Specification

In view of the above theoretical and empirical discussion, the inflation function is specified as follows:

$$In\ P_t = In \propto + \beta_1\ In\ Y_t + \beta_2\ In\ M_t + \beta_3\ In\ R_t + \beta_4\ In\ E_t + \beta_5\ In\ SP_t + \beta_6\ In\ UP_t + \mu_t \quad 2.1$$

$$where\ \mu_t . NID\left(0; \sigma^2\right)$$

In the above equation, P represents the Namibian consumer prices; Y is real income; M is the nominal money supply;

Table 2.   Data Definitions of Variables

Variables	Definitions
P	Namibian Consumer Price Index (at 1990=100)
Y	Real Gross Domestic Product at 1990 constant prices (Millions of Namibia Dollar) - adjusted by the Namibian CPI
M2	Broad Money Stock in Namibia - notes and coins outside the banking system + Demand Deposits + Savings + Time Deposits
R	Nominal Rate of Interest proxied by the 32 day Notice Deposit Rate
E	United States Dollar/Namibia Dollar (nominal) - US$ per N$
SP	South African Consumer Price Index (1990=100)
UP	United States Consumer Price Index (1990=100)

R and E are the nominal interest and exchange rates, respectively; SP and UP represents the South African and United States foreign prices, respectively. Table 2 provides the full definitions obtained from the data sources. All the coefficients on the variables in the model are expected to have a positive sign, except for real income, which is negative (while in a monetarist model real income would be expected, *a priori*, to have a negative sign, it is also an empirical issue depending on the nature of the economy[13]). All variables in the equation are expressed in a log-linear form.

---

[13] See Kallon (1993).

The reason for the inclusion of the SA CPI is obvious considering that SA still remains Namibia's main source of imports and its main market for non-traditional exports. The United States CPI is included as a proxy for the trade with the rest of the world and as the global impact of inflation on prices in Namibia.

5.2 DATA ANALYSIS

5.2.1 Data Sources and Transformations

All the data collected are expressed in millions of Namibia Dollar, unless otherwise stated. The data are annual, covering the period 1973 to 1996, or a total of 24 time series observations.[14] The data on P and Y were obtained from the *Central Statistical Office (CSO)* of Namibia, except for the 1973-79 period, where the figures for Y were obtained by extrapolation of the growth rates of real GDP figures published in the *Statistical/Economic Review of 1988* by the then *South West Africa/Namibia Department of Finance*.

The *M2* variable for the period 1983-96 was obtained from the *Quarterly Bulletin* of the Bank of Namibia, whereas the pre-1983 data was extrapolated using the South African growth rates of the SA M2.[15] For *R*, *Money and Banking Statistics of South Africa 1973-1992* served as a useful reference until 1990, whereupon the post-1990 figures where obtained from the Bank of Namibia internal sources. The data on *E, SP* and *UP* were sourced directly from the IMF's *International Financial Statistics Yearbook, 1996*.

5.2.2 Data Trends

Although a concise review of the inflation rate was provided in Graph 1, it was necessary to reproduce the inflation rate trends for analytical purposes when comparing it with the trends of other variables.

---

[14] Considering the fact that Namibia's independence was in 1990, and before that time, quarterly and monthly data was unavailable for most of the variables in Equation 2.1, it was appropriate to consider annual observations as these represent the most reliable data series. Although this provides only 24 observations, this number is similar to the number of observations used by Sowa (1996) when estimating Ghanaian inflation and Egwaikhide *et al* (1994) when studying Nigerian inflation.

[15] The assumption of using the South African growth rates on M2 in the pre-1983 data set is plausible given that Namibia was administered as a de facto province of South Africa and that any monetary pressure from South Africa was also applicable to the Namibian economy.

Comparing the Namibian inflation rate against the growth rate of real GDP (*see Graph 2*), real GDP recorded high growth rates in the late 1970s. Inflation, however, remained relatively stable during the 1970s. In the early 1980s, there does seem to be a counter-cyclical relationship between inflation and the real

Graph 2: Inflation and Real GDP Growth in Namibia, 1974-96
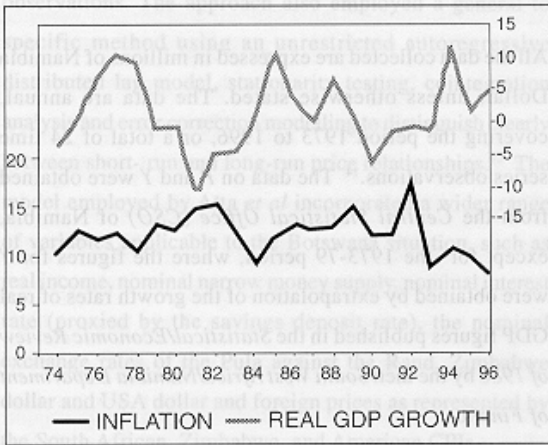
GDP growth, which accords with theoretical expectation: real GDP growth rose in the late 1970s with a stable, but declining inflation rate while in the early 1980s, real GDP growth declined to a negative level, with inflation rising from around 10% on average in the 1970s to about 15% in the early 1980s. During the mid-1980s and the 1990s, the negative relationship is even stronger, which gives the impression that the two variables are inversely related over the period.

Nominal money supply showed considerable expansion in the late 1970s, 1982 and 1988, and low growth rates in 1984 and 1990 (*see Graph 3*). Money supply growth, however, remained stable, but high in the 1990s. The periods of high monetary growth in the 1980s coincide significantly with a high inflationary trend, even though this does not seem to be the case in the 1990s. There seems to be a lagged effect of monetary growth on inflation over the 1970s and 1980s.

Graph 3: Inflation and Growth of M2. 1974-96
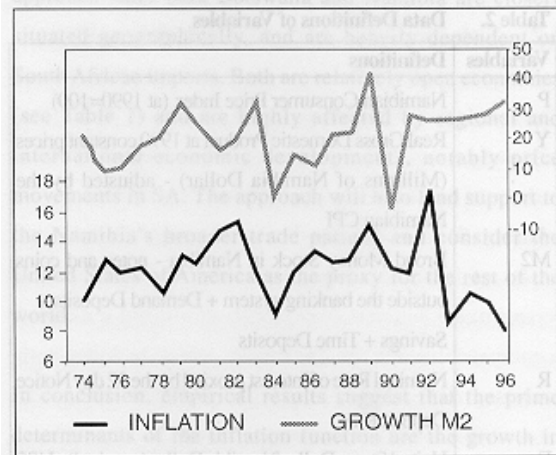
There seem to be similar movements of the inflation rate with nominal interest rates on call deposits, lending, and 32-day notice deposits (*see Graph 4*). These pro-cyclical movements indicate that there is a positive relationship between the two variables, which is in line with theoretical expectations. Interest rates remained very high during the early to mid-1980s, which could be ascribed to the gold price slump in 1984 and the implementation of the recommendations made for tightening monetary policy in the De Kock Commission of Inquiry into Monetary Policy in South Africa. It is noticeable that interest rates fell during 1985, when there was a debt crisis in SA, but since 1988 interest rates have remained at a higher level.

Graph 4: Inflation and Interest Rates: 1974-96
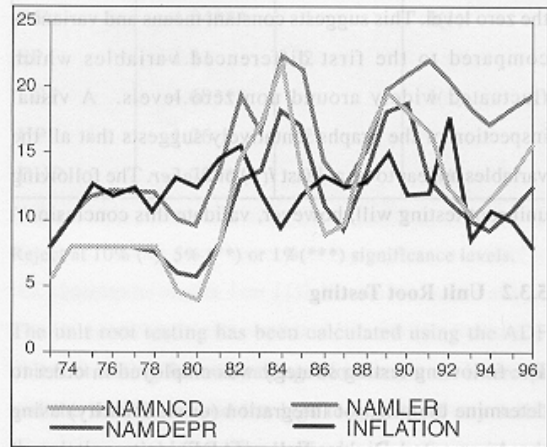
The Namibia dollar exchange rate against the United States dollar remained relatively stable from 1976-78, but started to depreciate in 1979 (*see Graph 5*). The exchange rate depreciated heavily in the 1980s (especially in 1984) but remained relatively stable during the 1990s, except in 1996 when it depreciated due to speculative attacks and outflow of capital from South Africa. However, there does not seem to be an

immediate, or significant, relationship between the exchange rate and inflation in Namibia in the 1970s, late 1980s and 1990s, although in the 1980-84 period, there is evidence of a strong positive relationship.

The data trends lead to the expectation that there are distinct structural breaks in the Namibian data set that

Graph 5: Inflation and Change in the Nominal Exchange Rate: 1974 - 96.
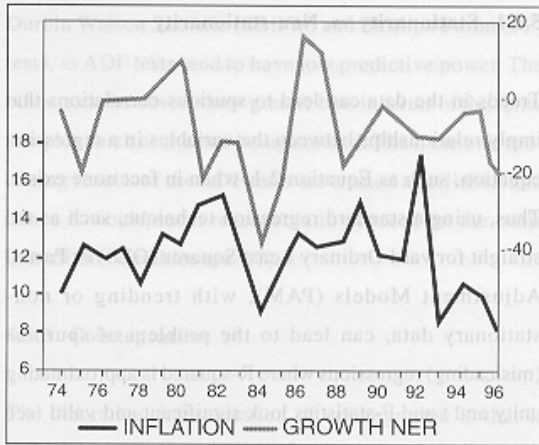
need to be taken into account for estimation purposes. Table 3 provides the additive and multiplicative dummies for the period under review.

Table 3.	Dummy Variables
d81	Drought of 1981-1983
d84	Gold price slump in 1984
d85	Sharp depreciation of the N$/R, and imposition of 10% surcharge on imports in 1985
d88	Restrictive monetary policy of South Africa commencing in 1988
d90	Government change in 1990 in Namibia
d92	Drought of 1991-1992
d93*	Namibia dollar introduction in 1993

*Indicates Multiplicative Dummy

After estimating Equation 2.1, inclusive of the above-mentioned dummies, all of them, bar *d85, d88* and *d92,* proved to be insignificant in the overall equation and were thus not considered for subsequent analysis on the inflation function in Namibia. The dummies *d85, d88 and d92* were significant at both the 5% and 10% levels, but *d85* was excluded on the grounds that

it produced heteroscedasticity problems. The final preferred long-run equation was Equation 2.1 with the addition of the dummy variables, *d88* and *d92.*

5.3 Modelling Strategy

5.3.1 Stationarity vs. Non-stationarity

Trends in the data can lead to spurious correlations that imply relationships between the variables in a regression equation, such as Equation 2.1, when in fact none exists. Thus, using a standard regression technique, such as the straight forward Ordinary Least Squares (OLS) or Partial Adjustment Models (PAM), 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 (see *Appendix 3*, for example). Hence, there is often a problem of falsely concluding that a relationship exits between two unrelated non-stationary series. This problem generally increases with the sample size, and is not normally solved by including a deterministic time trend as one of the explanatory variables in order to induce stationarity.

In order to avoid the 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 of order two, I(2) if differenced twice. If the variable is stationary without differencing, then it is integrated of order zero, I(0).

There is a striking graphical difference between I(0) and at least I(1) variables. *Appendix 2.1* shows the variables *P, Y, M2, R, E, SP,* and *UP*. All the series, except for *Y* and *R,* exhibit either upward (i.e., *P, M2, SP, UP*) or downward (i.e., *E*) trending movements over time. *Y* and *R* show a weak stationary pattern, although it also shows a continued, albeit slow, trend over the estimated time period.

Differencing all the variables (see *Appendix 2.2*) shows no evidence of trending in any of the variables, except for the fact that there is large volatility in the movements suggesting outliers and the presence of structural breaks in the differenced trends. This occurs especially within the years examined above, namely 1973-74, 1981-83, 1984, 1988 and 1990-92. Differencing all the variables again twice (see *Appendix 2.3*) gives a reliable picture of stationary variables, since the trends are fluctuating around the zero level. This suggests constant means and variances compared to the first differenced variables, which fluctuated widely around non-zero levels. A visual inspection of the graphs tentatively suggests that all the variables appear to be at least *I(1)* or

higher. The following unit root testing will, however, validate this conclusion.

5.3.2 Unit Root Testing

The following testing strategy was employed in order to determine the order of integration (or stationarity) using the Augmented Dickey Fuller (ADF) unit root tests.[16] Significant structural dummies were also introduced into Equation 2.1. The result of the tests and the relevant critical values, as well as the number of lags to get rid of serial correlation, is provided in Table 4.

The results show that all the variables have a unit root in their levels in the presence of structural breaks, thus indicating that the levels are non-stationary. The first differenced series, however, clearly rejects unit roots suggesting that the differenced variables are all stationary.

Table 4. ADF Tests for Unit Roots (Order of Integration)

VARIABLES	TEST STATISTIC	LONGEST LAG	ORDER OF INTEGRATION
P	-1.53	3	
DP	-3.81**	4	I(1)
Y	-2.21	5	
DY	-5.18***	3	I(1)
M2	-1.41	1	
DM2	-3.29*	1	I(1)
R	-2.81	3	
DR	-4.14***	3	I(1)
E	-2.74	1	
DE	-4.04***	1	I(1)
SP	-1.31	2	
DSP	-4.69***	1	I(1)
UP	-1.26-	2	
DUP	3.78**	1	I(1)

Notes: Reject at 10% (*), 5% (**) or 1%(***) significance levels.

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 values for unit root testing are shown below.

Critical Values for Unit Root Tests	
at 1%	-4.53
at 5%	-3.67
10%	-3.28-

The unit root testing results could have been confirmed by carrying out further tests, such as the Sargan-Barghava Durbin Watson Statistic (SBDW) and Phillips-Peron (PP) tests, as ADF tests 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 variables are I(1).

5.3.3 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 over time and the difference between them, over time, will be stable or stationary. It can then be interpreted 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 disequilibria error, that the system is away from the equilibrium position at time t[17]

The procedure for cointegration in this paper is the Engle-Granger (E-G) approach.[18] The static long-run

---

[16] For the testing procedure of unit root see R. Harris (1995), Chapter 2. The entire unit root testing estimation was done with the use of the econometric program *Microfit 3.0*.

[17] See Harris, 1995

[18] The limitations of the EG approach is applicable when more than two variables are involved in the model. Nevertheless, in spite of its limitations, it is a widely used method for its simplicity and straightforward application. The Johansen Maximum Likelihood procedure is an ideal approach to estimate when there are more than one cointegrating vectors or variables as in the case of equation 2.1. Since this approach is complex and difficult to estimate, it was preferable to use the E-G approach in this study.

Equation 2.1 is first estimated [19] inclusive of the two significant dummies (see *Appendix 3.1*). As evident from the appendix, the exchange rate was the only variable found to be insignificant, with a coefficient showing a 2% effect on prices. At this juncture, the variable deletion test was carried out *(see Appendix 3.2)*, and based on the results it was considered appropriate to exclude the insignificant exchange rate variable from Equation 2.1 as it can be argued that its effect is indirect and may operate through the foreign prices included in the equation. This is especially relevant for Namibia, which has a fixed exchange rate mechanism with South Africa.

The final preferred long-run equation using the full sample period is as follows, with their respective coefficients and t-values in parentheses (see also *Appendix 3.3*):

that they could not be rejected at 5% level as well, although there was some evidence of serial correlation at 10% significance level (see also *Appendix 3.2*).

The dummy variables are also highly significant at the 5% level, suggesting that the policy change in terms of monetary policy and drought had a significant effect on prices; they were 3% lower in the post-1988 period and 3% higher in the post-1992 period. It would be opportune to refrain from interpreting the coefficients of the explanatory variables, as a cointegrating relationship has to be established first. As mentioned earlier, if there is a cointegrating relationship in the above equation, then it becomes valid for a long-run interpretation of the price level in the Namibian economy. Hence, the procedure is to obtain the residual in Equation 2.1, which should be I(0), or

$$P_t = -1.42 + .137Y_t + .099M_t + .033R_t + .185UP_t + .685SP_t + .027D92_t - .029D88_t$$
$$[-3.79] \quad [3.14] \quad [5.18] \quad [3.34] \quad [6.73] \quad [22.69] \quad [3.04] \quad [-3.32]$$
$$R^2 = .999; \quad F(7,16)204 \; 05.8[.000]; \quad DW = 2.52; \quad N = 24;$$
$$\chi^2(12)LMtest = 20.3855[.060]; \quad \chi^2(11)ARCHtest = 8.8762[.633] \qquad 2.2$$

It is noticeable that all the elasticities in Equation 2.2 are significant and has the expected signs (except for real income, *Y,* which is positive). The high R-squared of close to unity indicates the high degree to which variations in the price levels are explained by variations in the explanatory variables. The F-statistic, with a p-value of zero, indicates the joint significance of the explanatory variables. The null hypothesis of no serial correlation, proper functional form specification, normality and homoscedasticity are all not rejected at 5% and 10% significant levels. Since the above tests lack power, the *Lagrange Multiplier Statistic (LM-tests)* of no serial correlation and the *Autogressive Conditional Heteroscedasticy (ARCH) tests* of homoscedasticity were carried out. The results show

stationary, in its level in the case that the variables in the equation are all I(1) and are cointegrated. The stationarity of the residual from the long-run equation is thus tested using the ADF testing procedure (see *Appendix 4.1* for more details), but excluding the trend and the intercept.

The Dickey Fuller Statistic, obtained from the cointegration testing procedure on this equation, is -6.4572, and the LM statistic indicates no serial correlation without the addition of lags to correct for serial correlation. Comparing the results at the 5% and 10% critical value in Mackinnon (1991) tables,

$$\Delta\mu_t = -1.3019\mu_{t-1}$$
$$[-6.4572]$$
$$R^2 = 0.65385; \; DW = 1.8307; \; N = 23;$$
$$F(serial correlation(1,21)test = 0.17434[.681];$$
$$2.3$$

with the number of explanatory variables equal to 5, and number of observations equal to 24 (with no trend, but a constant), gives -5.02361 and -4.58546 respectively.[20] The results indicate that the null hypothesis of a unit root in the residuals can be rejected convincingly at both levels, thus leading to

---

[19] It should be noted however that cointegration testing should be undertaken by beginning with the most general specification as in equation 2.1 and testing down to a bivariate relationships of the regressor on the regressand. This study however did attempt to test bivariate relationships in equation 2.1, but due to the fact that most tests (including the SA prices on Namibian prices) exhibit omitted variable bias (implying functional form mis-specification) and multicollinearity thus violating the classical linear regression model assumptions, it was appropriate to confine cointegration analysis on the most general specification. This approach is however limited in the sense that it is not exactly known which variable (or variables) are strongly cointegrated with the Namibian price level. Adams (1992) and Atta *et al* (1996) employed bivariate cointegrated relationship on their money demand and inflation functions respectively. The major drawback on these studies however is that they fail on not reporting the diagnostic tests of their cointegrated results which put the robustness of the long run cointegrated relationship in question.

[20] The constant is not included in equation 2.3 since it is already included in the long run equation of 2.2 (see Harris (1995), page 53). The cointegrated residual test of equation 2.3 was nevertheless carried out inclusive of the constant and the results showed that the coefficient on the constant also sum to zero and was highly insignificant, thus validating its exclusion according to theory.

the conclusion that the residuals are stationary and integrated of order zero or I(0). The residuals also appear to be stationary when shown graphically *(see Appendix 4.2),* except for the structural break in 1990-91 which could be ascribed to the change of government in Namibia, but which was insignificant in the equation (see section on data trends). The auto-correlation function also decline quite rapidly to the zero level suggesting the stationary pattern of the residual (see *Appendix 4.3*).

The above conclusion leads to the reasonable expectation that a long-run function exists in the estimation of the inflation function in Namibia. Thus, it can be reasonably assumed that an error correction representation exists in the equation as well.

5.3.4 Error Correction Modelling

The existence of at least one cointegration vector among the variables implies that an ECM can be estimated. 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-parameterised <u>second order</u> ECM inflation model in a log linear form:

$$\Delta P_t = \alpha + \beta_1 \Delta Y_t + \beta_2 \Delta Y_t + \beta_3 \Delta M_t + \beta_4 \Delta M_t + \beta_5 \Delta R_t + \beta_6 \Delta R_t$$
$$+ \beta_7 \Delta UP + \beta_8 \Delta UP_t + \beta_9 \Delta SP_t + \beta_{10} \Delta SP_t + \mu_t + \varepsilon_t \qquad 2.4$$
$$\text{where } \varepsilon_t \approx NID(o; \sigma^2)$$

In this equation, μ_{t-2} is the lagged error correction factor, given by the residuals from the static cointegration Equation 2.1, inclusive of dummies. The equation was set at one lag (see *Appendix 5.1*), due

$$\Delta P_t = 0.357 - .015 \Delta Y_t + .077 \Delta M2_t + .005 \Delta R_t + .116 \Delta P_t + .483 \Delta SP_t - 1.17 \mu_{t-1}$$
$$[1.66] \quad [-0.25] \quad [2.52] \quad [0.46] \quad [1.18] \quad [3.26] \quad [-3.49]$$
$$R^2 = .696; \quad f(7.16)6.1[.002]; \quad DW = 1.44; \quad N = 23;$$
$$F(1,15)SerialCorrolation = .85963[.369]; \quad F(1,15)FunctionalForm = 2.0081[.177],$$
$$\chi^2(2)Normality = .17061[.918], F(1.21)Heteroscedasticity = .45148[.509] \qquad 2.5$$

to the small number of observations and because lags of two or more produce meaningless results and led to serial correlation. In an attempt to work towards a more parsimonious equation, variables with low t-statistics in the equation were dropped. The lags of all the variables 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 <u>first order</u> ECM:

The equation shows that all the short run impacts are correctly signed, according to theoretical

$$\Delta P_t = .418 + .075 \Delta M2_t + .488 \Delta SP_t - 1.13 \mu_{t-1}$$
$$[2.32] \quad [2.49] \quad [3.26] \quad [-3.49]$$
$$R^2 = .650; \quad F(3.19)11.8[.000]; \quad DW = 1.22; \quad N = 23;$$
$$F(1,18)SerialCorrelation = 1.9080[.184]; \quad F(1,18)FunctionalForm = .1868[.671],$$
$$\chi^2(2)Normality = .97756[.613], F(1.21)Heteroscedasticity = 1.3946[.671]$$
$$\chi^2(12)LMtest = 13.3345[.345]; \quad \chi^2(10)ARCHtest = 10.990[.358] \qquad 2.6$$

expectations. The change in the money supply, *DM2,* and South African inflation, *DSP,* are statistically significant at the 5% level. The change in real income, *DY,* and the nominal interest rate, *DR*, as well as the United States inflation, *DUP,* are however highly insignificant in the ECM equation. Dropping the insignificant variables from the ECM equation therefore yields the final preferred equation (Equation 2.6):

The equation shows the changes in the money supply, *DM2,* and South African inflation, *DSP,* are statistically significant at the 5% level, and that all the short run impacts are right signed and are not different from the previous equation. The $R^2,$ which measures the goodness of fit of the equation, is highly satisfactory at 65%, indicating that 65% of the variations in the Namibian inflation rate are explained by variations in the changes of nominal money stock, the inflation rate in South Africa and the residual error term. The *F*-test statistic of 11.81, with a p-value of 0.00, indicates that both variables jointly determine inflation in Namibia.

All the diagnostic tests are satisfactory, and pass at both 5% and 10% significance level. The results of the *Lagrange Multiplier Statistic (LM-tests)* of no serial correlation and the *Autogressive Conditional Heteroscedascity (ARCH) tests* of homoscedasticity show that they could not be rejected at 5% as well. The disequilibria error term is highly significant and negative confirming the earliest assertion that the variables are cointegrated. The error term of -1.13 indicates that there is more than a 100% feedback from the previous year disequilibria into the short run dynamic process. This also

indicates that the speed of adjustment takes place of over 100% from actual inflation in the previous year to equilibrium inflation levels, and that errors or residuals within the estimated equation are corrected fully within the year. It can be noted that the additive dummies were not considered in this equation as they are captured in the disequilibria error.

5.3.5 Structural Stability and Forecasting

This section attempts to find out whether the inflation function encountered structural changes over the sample period and whether it can be reliable for predictive purposes. The approach employed was to conduct two tests: the Chow test for structural stability; and a predictive failure test[21] for prediction purposes.

Since Equation 2.6 is preferred as the final equation, the tests were conducted by setting the breaking point in 1988 because this was the year in which the Reserve Bank of South Africa introduced a restrictive monetary policy in order to achieve the anti-inflationary objective of single digit inflation in the economy. The results revealed that the tests do not reject the null hypothesis of structural stability and predictability (see *Appendix 6.1*), indicating that the inflation function in Namibia, as explained by money supply and SA inflation, does have a structurally stable inflation function which can reliably be used for predictive purposes. This result also indicate that in order to forecast the Namibian inflation for the future, it would be appropriate to take into account the current and future trends in the money supply growth and SA inflation.

The fitted and actual values for inflation are shown graphically in *Appendix 6.2*. The graph shows that the forecast under-predicts the 1989-92 period, and over-predicts inflation in 1995 and 1996. The reason for such a reversal is unclear. *Appendix 6.3,* however, shows that actual inflation does not always follow the fitted inflation trend, which suggests that there are other important variables that influence inflation in Namibia which are not included in the above equation.

In order to account for this type of problem, there are appropriate methods (such as the *Auto Regressive Integrated Moving Average (ARIMA)* and *Vector Auto Regressive Models (VAR))* that could act as reliable time series forecasting procedures in the presence of omitted variable bias and possible occurrence of endogenous variables among the explanatory variables. Due to the finite sample under study, these tests were not carried out as they require a longer time span on which to base their analysis. The examination of the forecast is useful to better understand the behaviour of the inflation function in

Namibia, and also to give some insight into the working of the structural breaks that are encountered over the modelling period.

---

[21] See Gujarati(1995), "Basic Econometrics". Page 263.

6. Economic Policy Implications

The results produced so far are summarised in the following table. Table 5 implies the following average significant relationships (under the assumption of *ceteris paribus*).

Table 5. Long and Short Run Elasticities

	Real Income	Nominal Money Stock	Nominal Interest Rate	U.S. Price Level	S.A. Price Level
Long Run Short Run	0.137* -.015	0.099* 0.074*	0.033* 0.004	0.185* 0.116	0.685* 0.488*

*Rejects null hypothesis of ßi = 0 at 5% significance level.

The results show that a 1% increase in real income leads to an increase of 0.14% in the price level. This finding supports the view that in Namibia the effects of higher real incomes on raising the price level outweigh the impact that the increased supply of goods and services can have on curbing price rises. This is certainly plausible in the Namibian context, because a large proportion of output, such as mining, commercial agriculture and manufacturing, is strongly geared towards production for export, and hence growth in these sectors does not provide additional goods and services for the domestic economy. Instead, it leads to higher incomes, which in turn create increased demand and inflationary pressures. In addition, the commercial sector in Namibia has few firms, and these may have important price setting powers in the country. Such an oligoplolistic or monopolistically competitive environment engenders inflation, because imperfectly competitive firms tend to restrict supply in order to charge higher prices than near perfectly competitive firms.[22] Hence, it can be concluded that policies that would promote more competition, or a level the playing field, in the economy could also increase economic growth and may result in significant lower inflation. In the case of the short run impact, real income is found to be negative, but insignificant.

As theory predicts, growth in the money supply tends to play a significant part in determining inflation in Namibia. The results of this study show that a 1% increase in broad nominal money supply leads to 0.10% increase in the price level, while a 1% increase in the rate of monetary growth leads to a 0.07% increase in short run inflation. This finding is, however, contrary to the monetarist specification, where there is a unitary relationship between money supply and the price level in the economy. The results

show, however, that both the long and short run impacts are highly significant suggesting that inflation is partially determined by monetary factors in Namibia. But, the interpretation of the money supply coefficients and its relationship towards the inflation rate in Namibia should be treated with utmost caution, as money supply can be deemed endogenous because Namibia has perfect capital movements with South Africa, and that there has only been limited scope for an independent monetary policy in Namibia. Nevertheless, capital controls with the rest of the world have been implemented in Namibia (these are in line with those of South Africa).

Interest rates tend to play a significant part in determining inflation in Namibia in the long run, by 3%[23], but are highly insignificant in the short run. The near zero and insignificant interest rate changes towards inflation may also explain the fact that there is a weak relationship between the two variables, suggesting that inflation is not interest rate-sensitive in the Namibian economy.

The results also show that there is a strong influence of foreign prices on Namibian prices. In the long run, close to 70% of the increase in the domestic price level is explained by increases in the South African price level, while almost 19% emanates from the rest of the world as proxied by the United States foreign price. The strong influence of SA prices on Namibia prices is not surprising given that South Africa still remains Namibia's major trading partner. The United States price link with Namibian prices can be both direct and indirect, as approximately 15% of Namibia's imports are directly from the rest of the world, and an unknown proportion of SA imports are from world markets and only traded through SA into Namibia. As regards the short run effects, SA inflation explains about 50% of Namibian inflation, but the US inflation rate in the short run is insignificant.

---

[22] Although care must be taken to distinguish between one-off price increases caused by a monopolistic/oligoplolistic competitive environment, and the impact of such an environment on price increases over time

[23] The results may imply an increase in interest rates increases the rate of inflation. See Kennedy (1984), page 326 for a theoretical justification of this.

7. Conclusion

The purpose of this study was to determine the causes of inflation in Namibia. The study found that foreign prices, as proxied by South Africa and American CPI's, have a significant long-run influence on the level of prices of Namibia. In the short run, inflation is also significantly influenced by the inflation emanating from South Africa. This suggests that Namibia is an extremely open and import dependent economy, which makes the country vulnerable to foreign price developments, especially in South Africa. The results, however, do not show significant evidence of the law of one price being applicable between Namibia and SA. This could be due to a number of reasons, such as transportation and mark-up costs differentials, the different structure of the markets and the lack of competition in product markets whereby producers take advantage of price differentials in the short term (see Section 4.1).

In order for Namibia to reduce its dependence on imports, and for policy makers to have greater success in meeting the objective of maintaining price stability, the policy implication from this study is the need to place more emphasis on the promotion of the manufacturing base in Namibia, as this should help to reduce its dependency on imports, and protect itself against the changes in prices of these imports.

The positive long-run relationship between real income growth and inflation also suggests that economic growth does not necessarily lead to reduced inflation, but can lead to increased inflation due to the monopolistically competitive structure of the economy that restricts supply thus keeping prices high.[24] The current discussion of putting in place a competitive legal framework may contribute, in the long run, to a more competitive commercial and trading environment, which will help limit the ability of traders to pass on price rises to consumers.

The results also show that monetary pressures have a significant (but small) effect on consumer prices in the long-run and inflation in the short run. The small effect could be because of the endogeniety of the money supply. It can also be because there is, as yet, no deficit financing of the Government by the Bank of Namibia that could lead to the expansion of money supply in Namibia and engender inflationary pressure. This is because the Bank of Namibia is legally empowered to limit advances and lending to Government. The Bank only grants advances to Government subject to repayment within six months at rates related to the current Treasury bill rate. In addition, the total of all outstanding advances by the Bank to the Government should not exceed 25% (or 35% upon the Ministers of Finance discretion, but only in exceptional circumstances) of the Government's average annual ordinary revenue for the immediately preceding three financial years[25].

Nevertheless, the monetary authorities in Namibia should guard against any decision to increase the money supply in Namibia through fiscal monetisation and should consider the potential economic implications of such a move on the Namibia economy.

The study also found that interest rates in Namibia couldn't be used as a tool to curb inflation in the short run, as there is no strong relationship between the two variables. While interest rates do have a significant effect on consumer prices in the long run, this proved to be small.[26]

Using money supply growth and SA inflation as key determinants of changes in the consumer price index, the study found a structurally stable inflation function, which can reliably be used for forecasting purposes.

The study is limited by the fact that it assumed all explanatory variables to be exogenous, whereas it would have been proper to test for weak exogeniety, Granger causality, and simultaneity. The major drawback of the study, however, is that it could not adequately account for the potential effects of nominal wages and fiscal policy on inflation in Namibia. To estimate the possible effect of fiscal policy on inflation, ideally a variable for final (or government) consumption expenditure, or a budget deficit as proxy for this, would have been appropriate. But, in this case, such a variable was excluded because final consumption expenditure is treated as a residual in the Namibia statistics, and thus could contain errors and omissions in its calculation. As regards government consumption expenditure of which its data is available, inclusion of this variable in Equation 2.1 produced serial correlation problems since the variable is highly correlated with real income. The budget deficit proxy could not be considered due to the unavailability of data. Future studies would, therefore, benefit enormously from considering a proxy variable for fiscal pressure in the estimation of the inflation function in the Namibian economy.

---

[24] This situation could also be characterised by the economic inefficiency and bottlenecks pervasive in the Namibian economy.

[25] See Government Gazette of the Republic of Namibia, "Bank of Namibia Act, 1990". No 42. Page 2.
[26] See Khan et al (1997), "Monetary Options for Namibia". Chapter 4.

References

Adam, C.S. 1992. *Recent Developments in Econometric Methods: an Application to the Demand for Money in Kenya*, AERC Special Paper 15, African Economic Research Consortium, Nairobi, Kenya.

Atta, J.K., Jefferis, K.R., and Mannathoko, I. 1996. Small Country Experiences with Exchange Rates and Inflation: The Case of Botswana, in the *Journal of African Economies*, Volume 5, Number 2, pages 293-326.

Balassa, B. 1964. The Purchasing Power Parity Doctrine: A Reappraisal, in the *Journal of Political Economy.* December Volume. Pages 584-96.

Bank of Namibia. Various. *Quarterly Bulletin* . Bank of Namibia Publications. Windhoek, Namibia.

Canetti, E. and Greene, J. 1991. *Monetary Growth and Exchange Rate Depreciation as Causes of Inflation in African countries: An Empirical Analysis*. Mimeo, IMF, Washington DC.

Chhibber, A., Cottani. J., Firuzabadi, D. and Walton, M. 1989. Inflation, Price Controls and Fiscal Adjustment in Zimbabwe. *World Bank Working Paper WPS 192*, World Bank, Washington DC.

Chhibber, A. And Shafik, N. 1990. Exchange Reform, Parallel Markets and Inflation in Africa: The Case of Ghana. *World Bank Working Paper WPS 427*, World Bank, Washington DC.

Dornbusch, R. 1987. Exchange Rates and Prices, in the *American Economic Review*, Vol 77, pages 93-106.

Egwaikhide, O.E., Chete, L.N., and Falokun, G.O. 1989. *Exchange Rate Depreciation, Budget Deficits and Inflation: The Nigerian Experience*, AERC Special Paper 26, African Economic Research Consortium, Nairobi, Kenya.

Engle, F.R. and Granger, C.W. 1991, Cointegration and Error Correction: Representation, Estimation and Testing in *Econometrica,* Vol 55 No 2, pages 251-76.

Engle, F.R. and Granger, C.W. 1991. *Long-Run Economic Relationships: Readings in Cointegration: Advanced Texts in Econometrics.* Oxford University Press, Oxford. UK.

Elbadawi, I.A. 1990. *Inflationary Process, Stabilisation and the Role of Public Expenditure in Uganda*. Mimeo, World Bank, Washington D.C.

Friedman, M. 1956. The Quantity Theory of Money - A Restatement in Friedman, M. (ed.). *Studies in the Quantity Theory of Money*, University of Chicago Press, Chicago.

Frenkel, J. 1981. The Collapse of PPP during the 1970s in the *European Economic Review*, Vol 16, pages 145-65.

Gaomab II, M. 1995. Review of Issues of Inflation in the Namibian Economy. *NEPRU Working Paper 30*, Namibian Economic Policy Research Unit, Windhoek, Namibia (unpublished).

Gaomab II, M. 1996. The CPI in Namibia: an Evaluation and an Analysis of its Reliability. NEPRU Working Paper 51, Namibian Economic Policy Research Unit, Windhoek, Namibia.

Granger C.W. and Newbold, Z. 1974. Spurious Regression in Econometrics, in the *Journal of Econometrics*, Vol. 2, pages 111-120.

Granger, C.W. 1990. *Modelling Economic Series: Advanced Texts in Econometrics*. Oxford University Press, Oxford, UK.

Gujarati, D. 1995. *Basic Econometrics*. Third Edition, Mc Graw-Hill International Editions, New York.

Harris, R. 1995. *Using Cointegration Analysis in Econometric Modelling*. Prentice Hall/Harvester Wheatsheaf.

Isard, P. 1987. How Far Can we Push the Law of One Price, in the *American Economic Review*, Vol 67, pages 942-48.

International Monetary Fund. 1996. *International Financial Statistics Yearbook 1996*. International Monetary Fund, Washington D.C.

Jenkinson, T. 1990. The Assessment: Inflation Policy, in the *Oxford Review of Economic Policy*, Vol 6 No.4. Pages 1-14.

Kallon, K.M. 1993. An Econometric Analysis of Inflation in Sierra Leone in the *Journal of African Economies,* Volume 3, Number 2.

Khan, B., Thlase, I., Motinga, D., Brits, A., and Mupotola-Sibongo, M. 1997. *Monetary Options for Namibia*. Namibian Economic Policy Research Unit, Windhoek, Namibia.

Kennedy, P.E. 1984. *Macroeconomics*. Third Edition. Allyn and Bacon Inc. Toronto, Canada.

London, A. 1989. Money, Inflation and Adjustment Policy in Africa: Some Further Evidence in the *African Development Review,* Volume 1, pages 87-111

Masale, S.M. 1993. *Inflation and Exchange Rate Policy in Botswana (1976-1992): an Exploratory Study.* MA dissertation (unpublished), University of Sussex.

Odedokun, M.O. 1993. An Econometric Analysis of Inflation in Sub-Saharan Africa. *Journal of African Economies,* Volume 4, Number 3, pages 436-51.

Republic of Namibia, National Planning Commission. 1997. *National Accounts 1981-1996.* Namibia Graphics, Windhoek, Namibia.

Republic of Namibia. 1990. *Bank of Namibia Act No 8 of 1990.* Government Gazette, National. Parliament Library, Windhoek, Namibia.

Stone, S. 1993. The CPI and Inflation in Namibia. *NEPRU Working Paper No 16.* Namibian Economic Policy Research Unit, Windhoek, Namibia.

South African Reserve Bank. 1995. *Money and Banking Statistics of South Africa 1973-94*. South African Reserve Bank, Pretoria.

Sowa, N.K. 1996. Policy Consistency and Inflation in Ghana. *AERC Research Paper 43*, African Economic Research Consortium, Nairobi, Kenya.

Sowa, N.K. and Kwakye, J.K. 1991. Inflationary Trends and Control in Ghana. *AERC Research Report No 22*, African Economic Research Consortium, Nairobi, Kenya.

Tegene, A. 1989. The Monetarist Explanation of Inflation: The Experience of Six African Countries. Journal of Economic Studies Vol 16, No 5-18.

The Department of Finance. 1989. *Statistical/Economic Review of 1988*. The SWA/Namibia Information Service, Windhoek, Namibia.

The Ministry of Finance. 1992. *Economic Review of 1992.* Republic of Namibia Publication, Windhoek, Namibia.

Thomas, R.L. 1993. *Introductory Econometrics: Theory and Applications*. Longman, London.
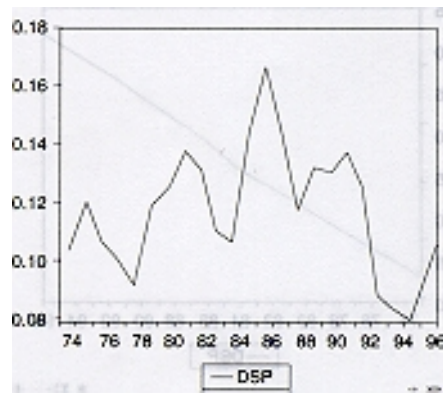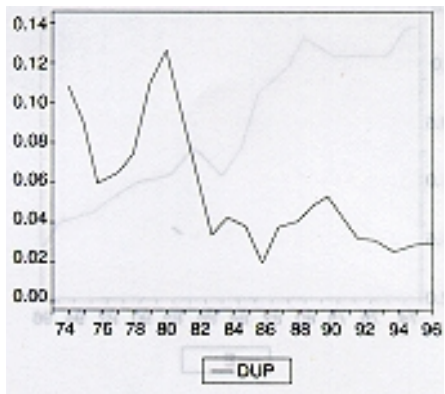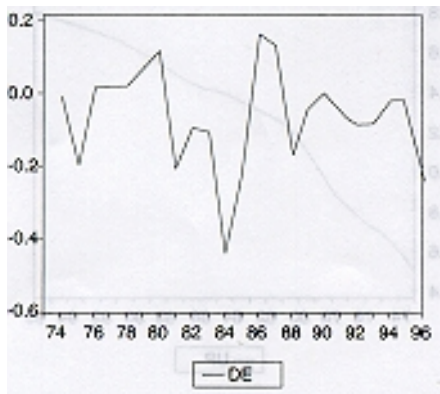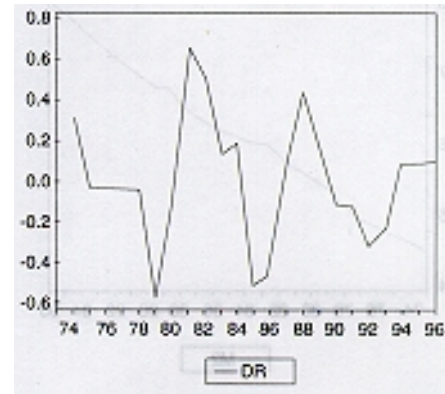
Appendix 1

List of Variables and their Descriptions

|		
C	:	1
D88	:	1
D92	:	1
DUP	:	up-up(-1)
DDUP	:	dup-dup(-1)
DDE	:	de-de(-1)
DDM2	:	dm2-dm2(-1)
DDP	:	dp-dp(-1)
DDR	:	dr-dr(-1)
DDSP	:	dsp-dsp(-1)
DDY	:	dy-dy(-1)
DE	:	e-e(-1)
DM2	:	m2-m2(-1)
DP	:	p-p(-1)
DR	:	r-r(-1)
DRES1	:	res1-res1(-1)
DSP	:	sp-sp(-1)
DY	:	y-y(-1)
E	:	log(ner)
INFLA	:	((namcpi/namcpi(-1))-1)*100
M2	:	log(namm2)
NAMCPI	:	Namibia Consumer Price Index
NAMDEPR	:	Namibia Deposit Rate
NAMLER	:	Namibia Lending Rate
NAMM1	:	Namibia Narrow Money Supply
NAMM2	:	Namibia Broad Money Supply
NAMNCD	:	Namibia 32 day Notice Deposit
NER	:	Nominal Exchange Rate (N$=US$)
NGDP	:	Nominal GDP
P	:	log(namcpi)
R	:	log(namncd)
R1	:	log(namler)
R2	:	log(namdepr)
RES1	:	Cointegration Residual
RGDP	:	NGDP/NamCPI*100
RSACPI	:	South African CPI
USACPI	:	United States CPI
SP	:	log(RSACPI)
UP	:	log(USACPI)
T	:	Time trend
Y	:	log(rgdp)

Appendix 2.1
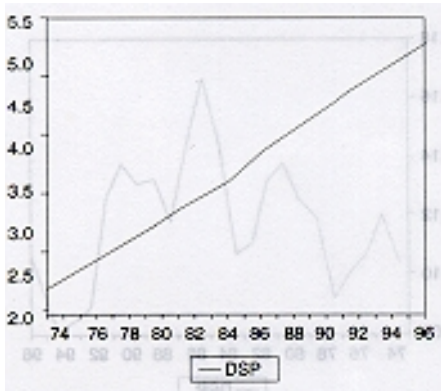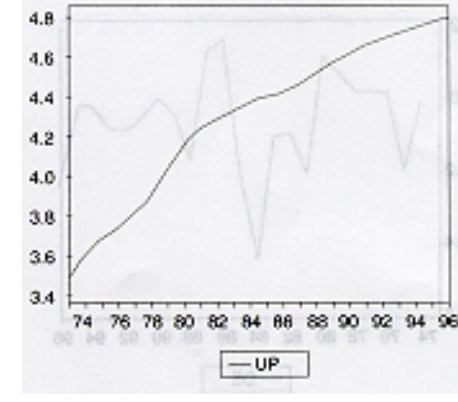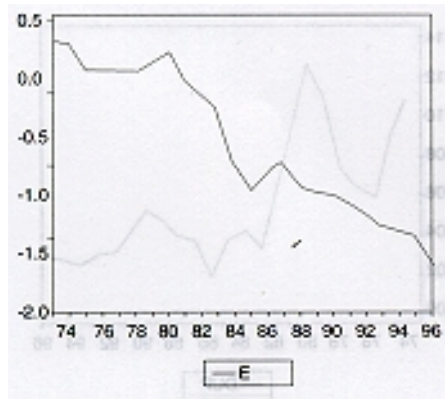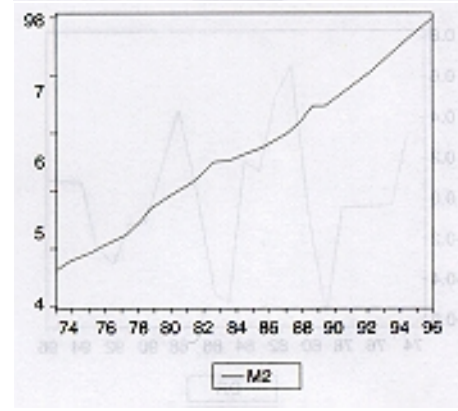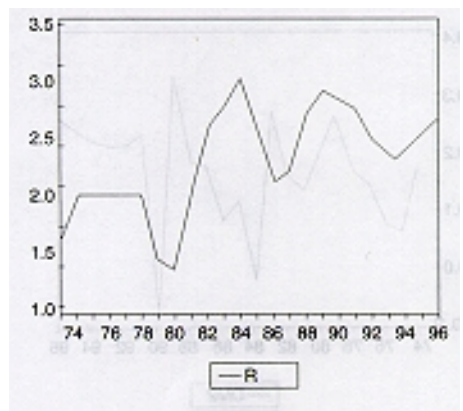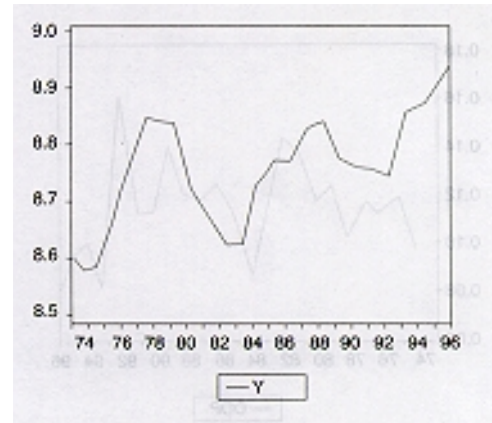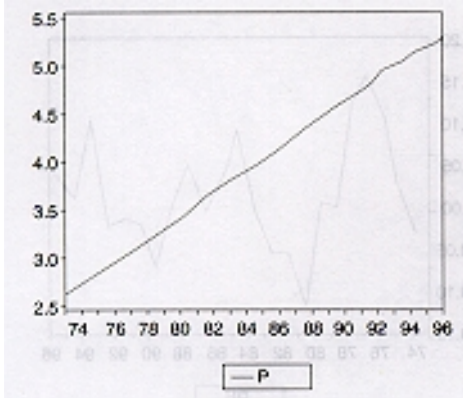
Appendix 2.2
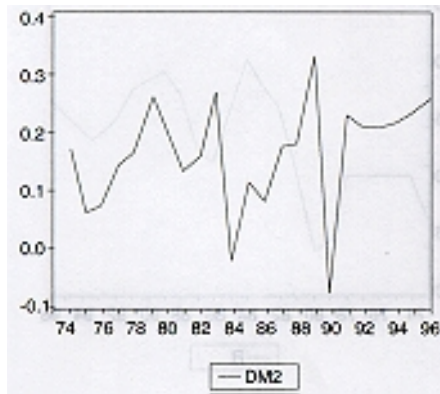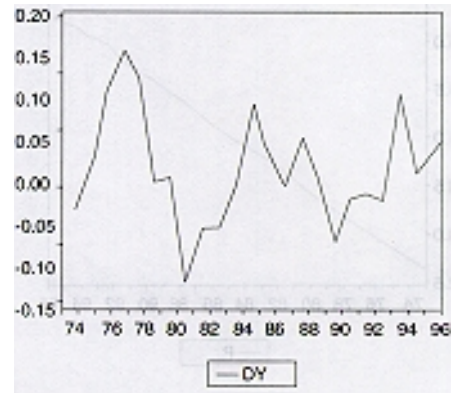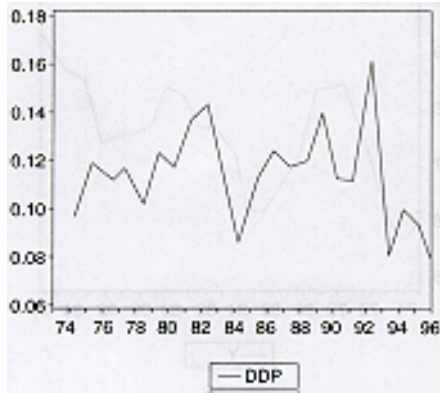
Appendix 2.3
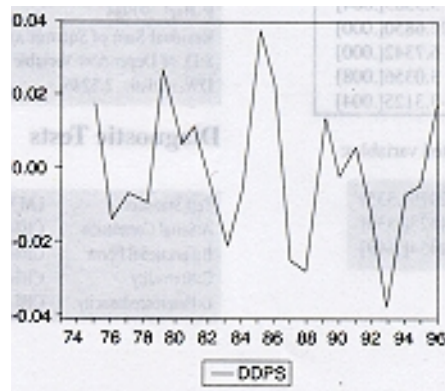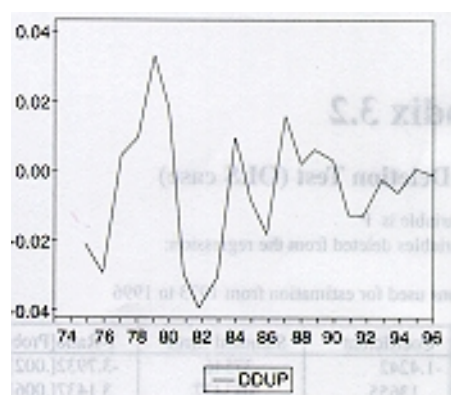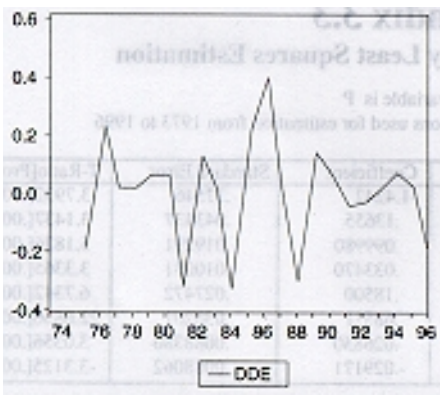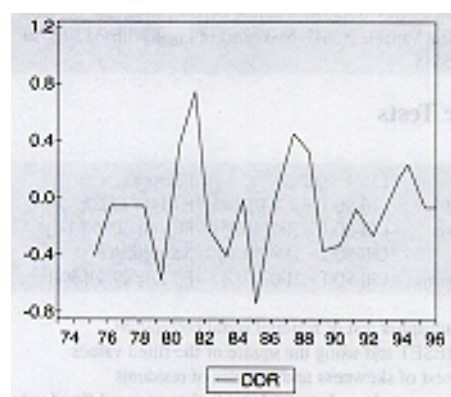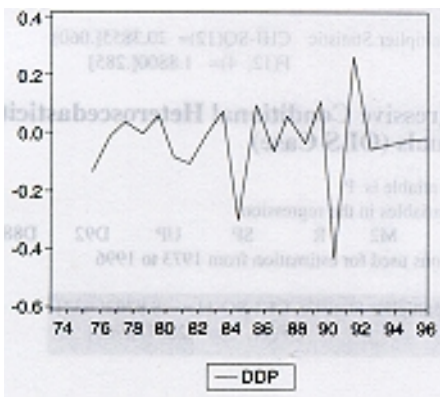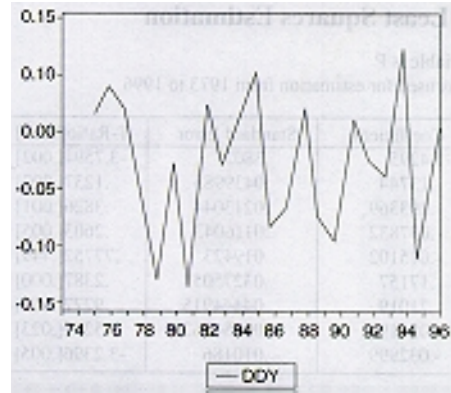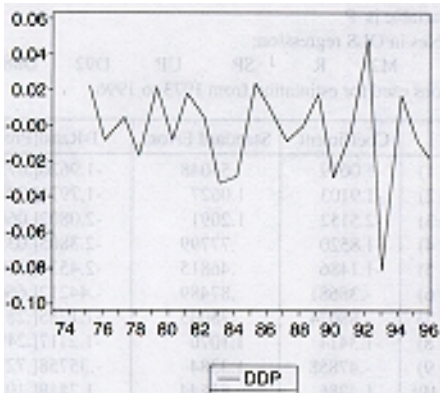
Appendix 3.1

Ordinary Least Squares Estimation

Dependent variable is P

24 observations used for estimation from 1973 to 1996

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-1.4295	.38025	-3.7594[.002]
Y	.13744	.0439983	.1237[.007]
M2	.093369	.0213044	.3826[.001]
R	.037832	.0116043	.2603[.005]
E	-.015102	.019423	.77752[.449]
UP	.17157	.0327505	.2387[.000]
SP	.71019	.04444915	.9777[.000]
D92	.024199	.00956862	.5290[.023]
D88	-.032999	.010186	-3.2396[.005]

R^2 .99983   F-statistic F(8,15) 17413.9[.000]
R-Bar^2.99983   S.E. of Regression .010747
Residual Sum of Squares.0017326   Mean of Dependent Variable 3.9403
S.D. of Dependent Variable .83647 Maximum of Log-likelihood 80.3799
DW-statistic 2.5515

Diagnostic Tests

Tests Statistics	LM Version	F Version
A:Serial Correlation	CHI-SQ(1)=2.7647[.096]	F(1,14)=1.8227[.798]
B:Functional Form	CHI-SQ(1)=.18716[.665]	F1(1,14)=.11004[.745]
C:Normality	CHI-SQ(2)=.94347[0624]	Not applicable
D:Heteroscedasticity	CHI-SQ(1)=.31427[.757]	F(1,22)=.29191[.594]

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

D: Based on the regression of squared residual on squared fitted values

Appendix 3.2

Variable Deletion Test (OLS case)

Dependent variable is P

List of the variables deleted from the regression: E

24 observations used for estimation from 1973 to 1996

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-1.4242	.37546	-3.7932[.002]
Y	.13655	.043437	3 1437[.006]
M2	.099980	.019291	5.1826[.000]
R	.033470	.010031	3.3365[.004]
SP	.68511	.030201	22.6850[.000]
UP	.18500	.027472	6.7342[.000]
D92	.026830	.0088386	3.0356[.008]
D88	-.029171	.0088062	-3.3125[.004]

Joint test of zero restrictions on the coefficient of deleted variables:

Lagrange Multiplier Statistic	CHI-SQ(1)=	.92979[.335]
Likelihood Ratio Statistic	CHI-SQ(1)=	.94828[.330]
F Statistic	F(1,15) =	.60454[.449]

Test of Serial Correlation of Residuals (OLS case)

Dependent variable is P

List of variables in OLS regression:

C	Y	M2	R	SP	UP	D92	D88

24 observations used for estimation from 1973 to 1996

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
OLS RES(-1)	-1.0019	.51048	-1.9626[.073]
OLS RES(-2)	-1.9103	1.0627	-1.7976[.097]
OLS RES(-3)	-2.5152	1.2091	-2.0802[.060]
OLS RES(-4)	-1.8520	.77799	-2.3805[.035]
OLS RES(-5)	-1.1486	.46815	-2.4534[.030]
OLS RES(-6)	-.38681	.87489	-.44212[.666]
OLS RES(-7)	-.88074	.78045	-1.1285[.281]
OLS RES(-8)	-1.3414	1.1070	-1.2117[.249]
OLS RES(-9)	-.47858	1.3384	-.35758[.727]
OLS RES(-10)	-1.4286	.81544	-1.7519[.105]
OLS RES(-11)	-.71059	.97672	-.72753[.481]
OLS RES(-12)	-.70060	1.1315	-.61917[.547]

Lagrange Multiplier Statistic   CHI-SQ(12)= 20.3855[.060]

F Statistic   F(12,4)   = 1.8800[.285]

Autoregressive Conditional Heteroscedasticity Test of Residuals (OLS Case)

Dependent variable is P

List of the variables in the regression:

C	Y	M2	R	SP	UP	D92	D88

24 observations used for estimation from 1973 to 1996

Lagrange Multiplier Statistic	CHI-SQ(11)=	8.8762[.633]
F Statistic	F(11,5) =	.26677[.968]

Appendix 3.3

Ordinary Least Squares Estimation

Dependent variable is P

24 observations used for estimation from 1973 to 1996

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-1.4242	.37546	-3.7932[.002]
Y	.13655	.043437	3 1437[.006]
M2	.099980	.019291	5.1826[.000]
R	.033470	.010031	3.3365[.004]
UP	.18500	.027472	6.7342[.000]
SP	.68511	.030201	22.6850[.000]
D92	.026830	.0088386	3.0356[.008]
D88	-.029171	.0088062	-3.3125[.004]

Diagnostic Tests

R^2 .99984   F-statistic F(7,16) 20405.8[.000]
R-Bar^2.99984   S.E. of Regression .010614
Residual Sum of Squares.0018024   Mean of Dependent Variable 3.9403
S.D. of Dependent Variable .83647 Maximum of Log-likelihood 79.9058
DW-statistic 2.5246

Tests Statistics	LM Version	F Version
A:Serial Correlation	CHI-SQ(1)=2.6713[.102]	F(1,15)=1.8786[.191]
B:Functional Form	CHI-SQ(1)=.24111[.623]	F1(1,15)=.15222[.702]
C:Normality	CHI-SQ(2)=.21780[.897]	Not applicable
D:Heteroscedasticity	CHI-SQ(1)=.53234[.466]	F(1,22)=.49904[.487]

Appendix 4.1

Ordinary Least Squares Estimation

Dependent variable is DRES1

23 observations used for estimation from 1973 to 1996

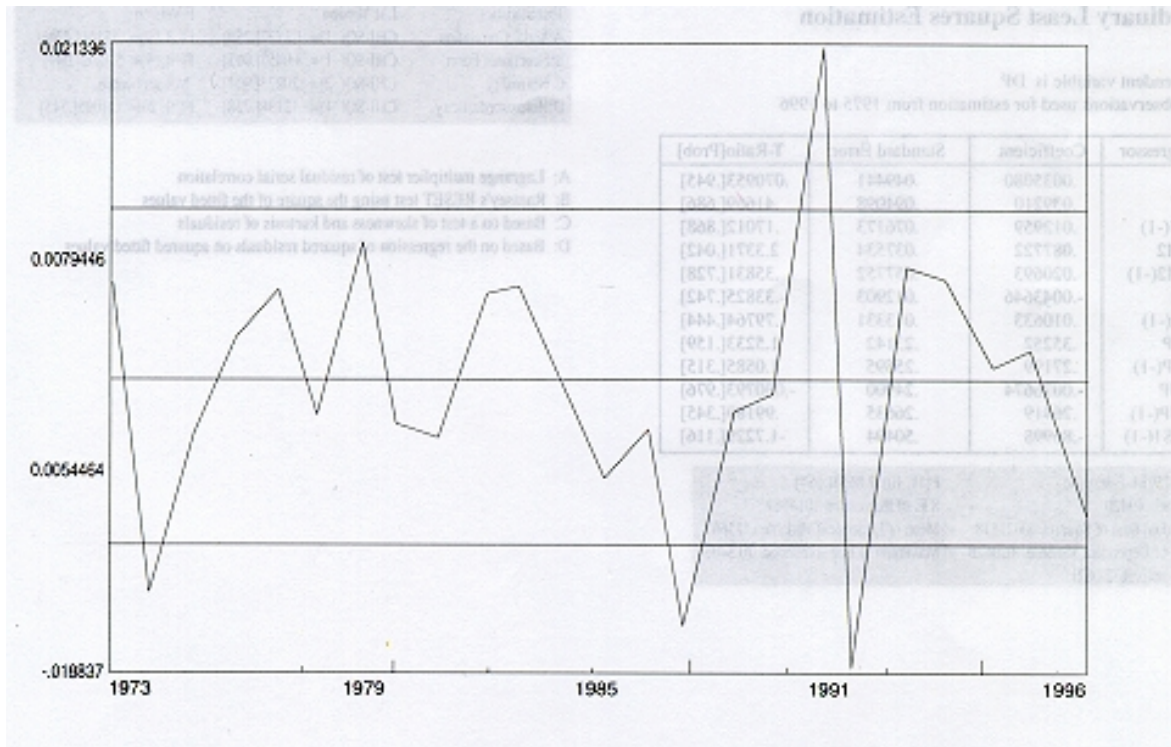| Regressor	Coefficient	Standard Error	T-Ratio[Prob]
RES1(-1)	-1.3019	.20163	-6.4572[.000]

R^2.65385	F-statistic None
R-Bar^2.65385	S.E. of Regression .0084522
Residual Sum of Squares.0015717	Mean of Dependent Variable -.6571E-3
S.D. of Dependent Variable .014366	Maximum of Log-likelihood 77.6621
DW-statistic 1.8307	

Diagnostic Tests

| Tests Statistics	LM Version	F Version
A:Serial Correlation	CHI-SQ(1)=18937[.663]	F(1,21)=.17434[.681]
B:Functional Form	CHI-SQ(1)=2.0232[.155]	F1(1,21)=2.0255[.169]
C:Normality	CHI-SQ(2)=.38262[.826]	Not applicable
D:Heteroscedasticity	CHI-SQ(1)=.001828[.966]	F(1,21)=.0016693[.968]

Appendix 4.1

Plot of Residual and Standard Error Bands

Appendix 4.3

Autocorrelation Function of residual, sample from 1973 to 1996
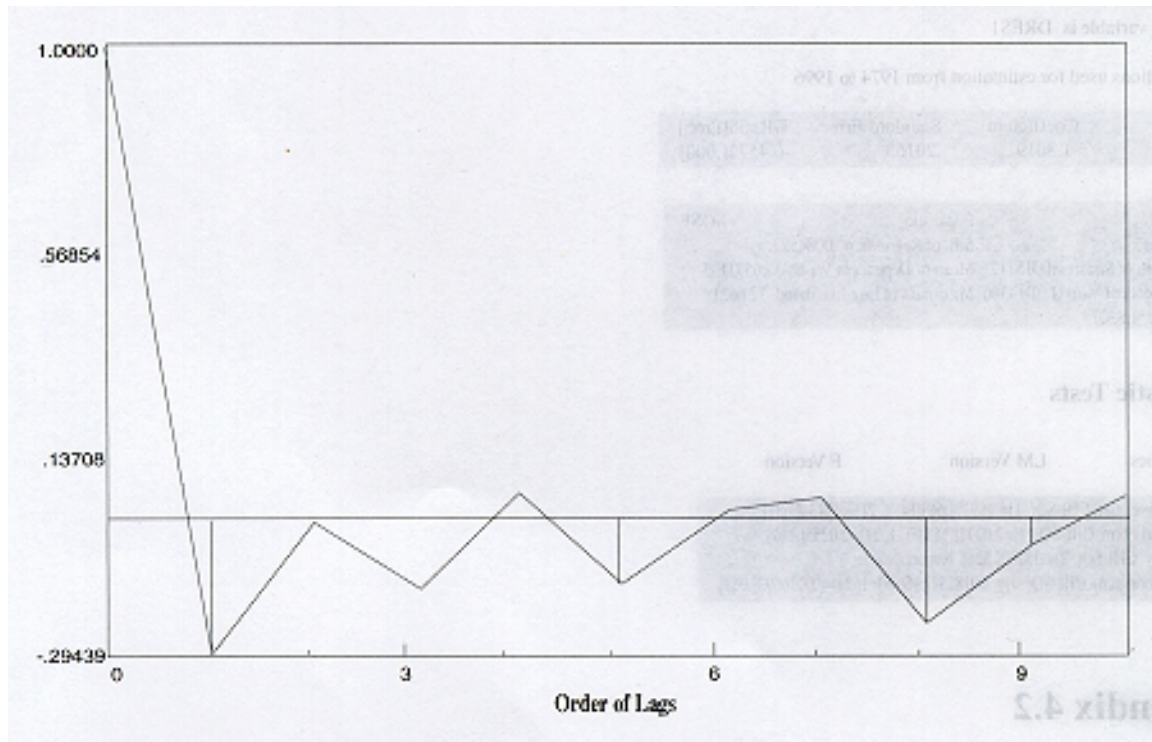
Appendix 5.1

Ordinary Least Squares Estimation

Dependent variable is DP

22 Observations used for estimation from 1975 to 1996

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	.0035080	.049441	-.070953[.945]
DY	.039210	.094098	.41669[.686]
DY(-1)	.012959	.076173	.17012[.868]
DM2	.087722	.037534	2.3371[.042]
DM2(-1)	.020693	.057752	.35831[.728]
DR	-.0043646	.012903	-.33825[.742]
DR(-1)	.010633	.013331	.79764[.444]
DSP	.35252	.23142	1.5233[.159]
DSP(-1)	.27199	.25695	1.0585[.315]
DUP	-.0076674	.24900	-.030793[.976]
DUP(-1)	.26419	.26635	.99189[.345]
RES1(-1)	-.86998	.50494	-1.7229[.116]

R^2	F-statistic F(8,15) 17413.9[.000]
R-Bar^2.99983	S.E. of Regression .010747
Residual Sum of Squares.0017326	Mean of Dependent Variable 3.9403
S.D. of Dependent Variable .83647	Maximum of Log-likelihood 80.3799
DW-statistic 2.5515	

Diagnostic Tests

Tests Statistics	LM Version	F Version
A:Serial Correlation	CHI-SQ(1)=1.2727[.259]	F(1,9)=.55261[.476]
B:Functional Form	CHI-SQ(1)=8.0457[.005]	F1(1,9)=5.1892[.049]
C:Normality	CHI-SQ(2)=.20225[.904]	Not applicable
D:Heteroscedasticity	CHI-SQ(1)=.12138[.728]	F(1,20)=.11095[.743]

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

D: Based on the regression of squared residuals on squared fitted values

Appendix 6.1

Static Forecasts

Based on OLS regression of DP on:

C   DM2   DSP   RES(-1)

15 Observations used for estimation from 1974 to 1988

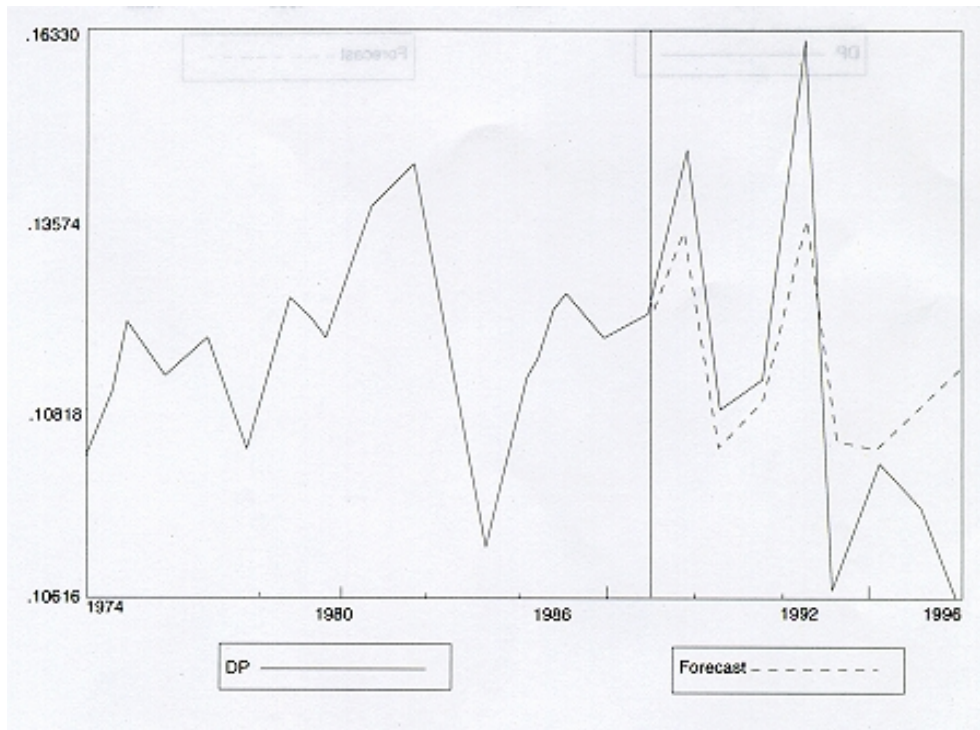| Observations	Actual	Prediction	Error	S.D. of Error
1989	.14701	.13615	.010862	.013089
1990	.10736	.10202	.0053382	.013647
1991	.11244	.11060	.0018400	.014657
1992	.16330	.13798	.025324	.013264
1993	.082008	.10366	-.021654	.011916
1994	.10215	.10334	-.0011975	.012222
1995	.095488	.10793	-.012444	.012631
1996	.080616	.11605	-.035434	.011726

Summary statistics for static forecasts

Based on 8 observations from 1989 to 1996

Mean Prediction Errors -.0034206   Mean Sum Abs Pred Errors .014262
Sum Squares Pred Errors 334oE-3 Root   Mean Sumsq Pred Errors .018275
Predictive failure test $F(8,11)=2.3421[.096]$
Structural stability test $F(4,15)=1.2333[.339]$

Appendix 6.2

Plot of Actual Static forcast(s)

Appendix 6.2
Plot of Actual Static forcast(s)