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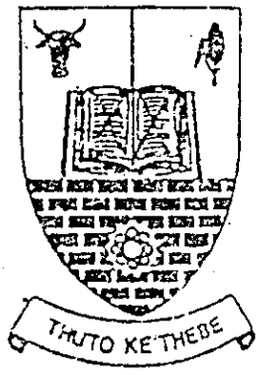

DEPARTMENT OF ECONOMICS

THE DYNAMICS OF THE INFLATION PROCESS IN MOZAMBIQUE: 1990/1996
A Cointegration and Error Correction Approach

By

SAIDE DADE

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT FOR
THE DEGREE OF MASTER OF ARTS (Economics)

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THUTO KE THEBE

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DEDICATION

To my mum and my son Amyr

SYMBOLS AND ABBREVIATIONS

Symbols

L Lag operator $LX = X_{t-1}$

Δ First-difference operator $\Delta X_t = (1-L)X_t = X_t - X_{t-1}$

Abbreviations

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ADL	Autoregressive-Distributed Lag
AR	Autoregression
CI(d,b)	Cointegrated of Order d,b
CPI	Consumer Price Index
CRDW	Cointegrating Regression DW statistic
DF	Dickey Fuller
DGP	Data Generating Process
DNE	Direcao Nacional de Estatistica (Statistics National Directorate)
DNP	Diracao Nacional do Plano (National Planning Directorate)
DW	Durbin-Watson statistic
ECM	Error Correction Model/Mechanism
EIU	Economist Intelligence Unit
ERP	Economic Rehabilitation Program
FIML	Full Information Maximum Likelihood
GDP	Gross Domestic Product
GNC	Granger Non-Causality
GNP	Gross National Product
I(d)	Integrated of Order d
IID	Independently and Identically Distributed
$IN(\mu,\delta^2)$	Independently and Normally Distributed with mean μ and variance δ^2
INE	Instituto Nacional de Estatistica (Statistic National Institute)

ABSTRACT

This dissertation investigates the dynamics of inflation in Mozambique using secondary data for the period 1990-1996. The choice of the period is based purely on the availability of data which have to be on monthly basis to provide a relatively sufficient degree of freedom. Relevant statistics were collected from Central Bank and Statistic Institute of Mozambique's publications, and International Monetary Fund's International Financial Statistics Database.

In this study, we tried to answer the question of whether exchange rate movements, real income and money growth, world inflation and domestic interest rate cause domestic inflation in Mozambique. To put the answer in the right perspective we first reviewed the relevant theoretical and empirical literature on the issue, and later we derived a theoretical model of inflation determination and estimated a dynamic Error Correction Model. This takes the form of an Autoregressive Distributed Lag-Error Correction Mechanism and represents an equation that specifies the relationship of the long-run behaviour of Mozambican prices to its short-run values.

The major conclusion from the theoretical and empirical review is that inflation in Mozambique has been consistently high at an average annual rate of 51.2 percent for the period 1990-95 and then slowed down to below 20 percent in 1996. The factors which have contributed to the 1990-95 inflation can be described as excessive demand pressure fuelled by monetary growth attendant upon fiscal deficit financing and the correction of prices which include exchange rate adjustment together with the freeing of many products prices and adjustment of fixed prices.

Our major empirical findings following the estimation of our inflation equation are as follows: while the explicit link between inflation and the rate of growth of money supply exceeding money demand professed by the monetarist theory of inflation is not refuted by this study, we found that factors other than monetary factors have played an important role in determining the curse of inflation in the short-run in Mozambique. These include exchange rate devaluations, real GDP growth and imported inflation. A particularly interesting feature of our dynamic error-correction model is the strong impact and speed of adjustment process equilibrium value.

As for policy implications, a major conclusion is that it would be seriously misleading to rely only on monetary policy as a way of containing the Mozambique inflationary process. The results have demonstrated the important role that foreign factors play in causing domestic inflation, such that a failure to consider these factors, in designing of any policy may frustrate the attainment of the policy objectives.

1.2 Macroeconomic Performance

Mozambique's performance must be assessed against a background of immense challenges when, in January 1987, the Government announced the adoption of the three-year Economic Rehabilitation Programme (ERP). By that time, the advantages it inherited at independence in 1975 - a good basic infrastructure and export base - were all gone, as a result of long years of rigid central planning, a one-party state, and a vicious ongoing civil war. The consequences where a sharp fall in Mozambique's GDP and extreme aid dependency. "By 1986 real GDP had fallen to two thirds its 1980 level, exports were reduced to less than a third of their value and equalled only around 15 percent of imports, and the resulting trade deficit led to the rapid accumulation of external debt arrears" (WB, 1992:375).

The basic issue behind the policy reform has been that the decline in the growth rate of real GDP in the last decade resulted from policy-induced distortions. Therefore, by adopting relevant policy measures and removing the serious cost/price distortions, the economy could operate on its potential production frontier.

In the initial period of the government's rehabilitation program, priority was given to reversing the decline in output by restoring producer financial incentives, reducing price and exchange distortions, administrative controls and reducing domestic and external imbalances. Improved financial incentives were achieved mainly through exchange rate adjustments and major changes in pricing and distribution policy. These policies characterize the traditional model of stabilization and structural adjustment program (SAP), with specific elements of an economy in transition from central economy planning to the market economy (Wuyts, 1989).

while public investment has been largely financed by donor grants. As a result, the overall budget deficit (after grants) declined from 13.5 percent of GDP in 1987 to 5.2 percent in 1993.

Monetary policy has aimed at reducing inflation by absorbing excess liquidity and improving the efficiency of credit utilization. Monetary expansion has been restrained by reducing domestic bank financing of the budget deficit from 16.5 percent of GDP in 1986 to 1.4 percent of GDP in 1993, and by establishing ceilings on commercial bank credit.

1.3 Computation of the Consumer Price Index[1]

The first attempt to introduce the Consumer Price Index (CPI) in Mozambique begun on experimental basis in 1989. This was compiled by the National Planning Directorate (DNE) and comprised a basket of 1060 items whose weights were derived from an August 1984 expenditure survey of randomly selected households.

In 1995 the National Statistic Institute (INE) started the compilation and diffusion of an alternative index with an updated and improved basket of goods that is considered to better represent the reality of the evolution of purchasing power for the average Mozambique consumer. This has a December 1994 base and become official in January 1997.

[1] This section is based heavily on the report presented by National Statistic Institute (INE) at Regional Seminar under SADC in 1998 in Gaborone-Botswana.

1.4 Statement of the Inflation Problem in Mozambique

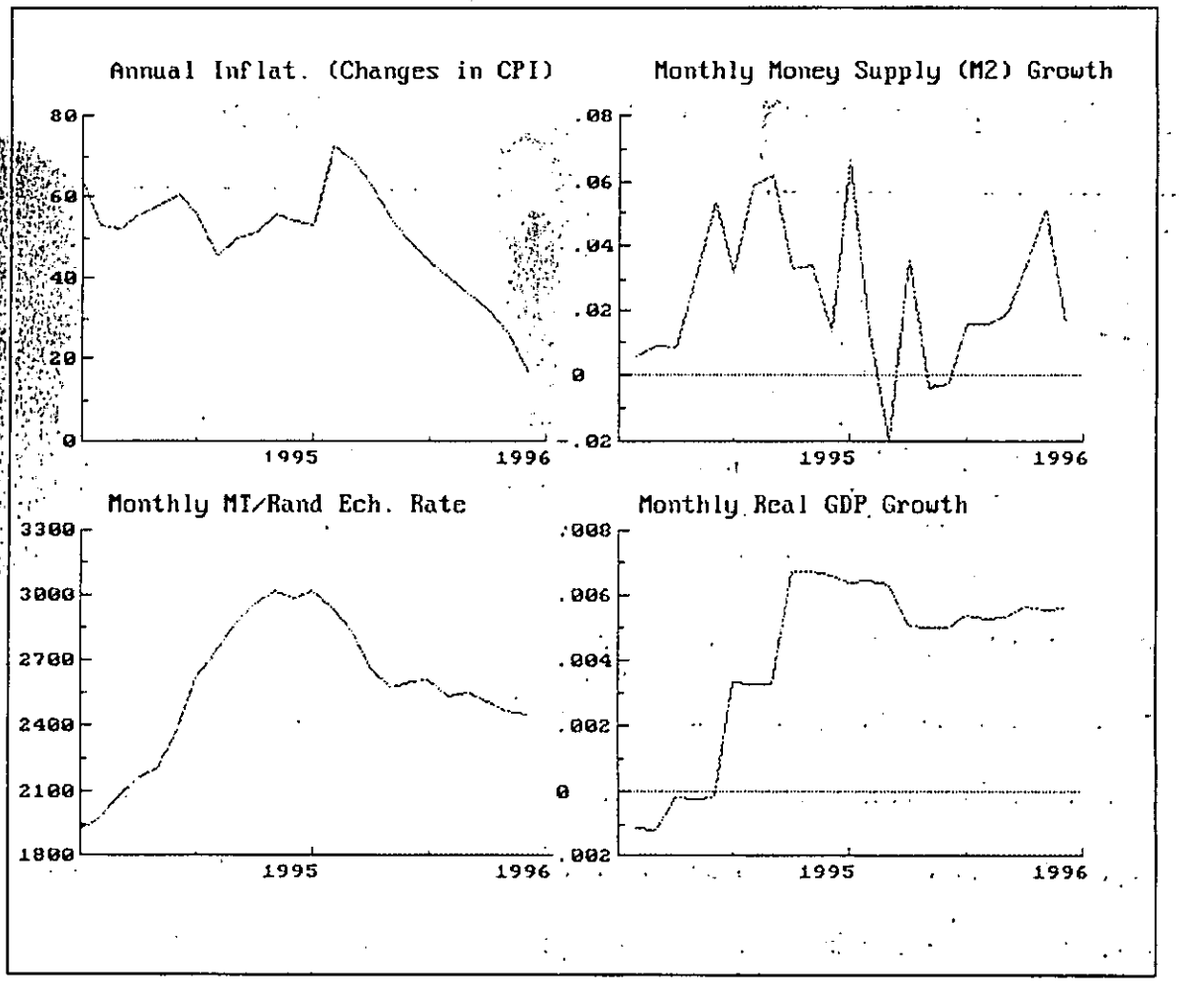
One of the major issues in Mozambique's policy arena today is how to bring inflation under effective control. It has shown an upward trend ever since Independence, but it was not until the late 1987 that inflation became a serious problem, after the government, prompted by the serious deterioration of the economy, launched a comprehensive Economic Rehabilitation Program (ERP) in January 1987 to deal with the structural problems and widespread distortions in the economy.

The ERP, which was based mainly on the principle of "getting prices right", had exchange rate policy as its central focus. The ERP had involved large price rises, removal or reduction of subsides and massive devaluation. Quantitatively, the Metical which traded at 39.74MT:$1.00 at the inception of ERP in January 1987, had by the end of the 1987 exceeded 289.44MT:$1.00. During the same period, inflation leapt from 12.2 percent in January 1987 to 163.8 percent in December 1987.

The Table 1.2 below shows the development of prices for the period 1988-95. While the annual rate of inflation decelerated from 163.8 percent in 1987 to 35.2 percent at end of 1991, reflecting adjustment in the official exchange rate and administrated prices as well as tighter monetary and fiscal policies, the drought had a significant impact on inflation in 1992, which peaked at 54.5 percent by year end. This was followed by a brief period of respite during 1993. In this year, the inflation rate slowed down to 43.6 percent, exceeding nonetheless the 30 percent target. The overly-ambitious 1994 target, also 30 percent, was surpassed with annualized inflation reaching 70.8 percent in December.

devaluation of Metical and reduction of money growth have a role to play in Mozambique recent inflationary process.

Figure 1.1: Trend in Inflation, Money and GDP growth, and exchange rate (1995/6)



There is a general consensus that the inflation in Mozambique may be largely attributed to excessive demand pressure fuelled by monetary growth attendant upon fiscal deficit financing and correction of prices. These include exchange rate adjustment together with the freeing of many product prices and adjustment of fixed prices. In fact, the gap of past prices and the diversion of relative prices of goods made necessary the correction, so that these prices could be charged at their real level and structural cost.

c) To assess the role of real income and interest rate in driving inflation in Mozambique;

d) To make exchange rate and monetary policy recommendations based on the empirical investigation.

1.6 Significance of the Study

The theme of this study is relevant for a number of reasons: Firstly, controlling domestic inflation remains one of the prime objectives of the government; therefore, identifying variables affecting inflationary process may help policy makers to predict and influence the behaviour of inflation; secondly, this is one of important factors that determine macroeconomic performance of a country; thirdly, is one of the first attempts to apply cointegration in the context of country such as Mozambique; finally, this study will serve also as a springboard for further research in this area.

of money in macroeconomic analysis. Thus, money demand theory forms a critical element in the monetarist approach to economic behaviour.

In the monetary growth equation, real money demand grows as a consequence of increases in real income at a given rate of interest (or other opportunity-cost proxy). When the money supply rises more than the money demand, the expenditure on goods and services rises with a consequent increase in either output or prices. For developing countries that have a limited domestic supply of goods and services, the expansion in aggregate demand tends to exceed supply and a sustained rise in the general price level inevitably results as depicted by the equation of exchange.

A popular theoretical representation of demand for money balances can be written as

$$(M/P)^d = f(Y, r) \quad \text{..... (2.1)}$$

Where $(M/P)^d$ stands for demand for real money balances, Y is real income ($f_y>0$), and r is interest rate ($f_r<0$).

If the money market is to be in equilibrium, then we must have the real stock of money (M^s/P) equal to the demand for real money balances, formally:

$$(M^s/P) = (M/P)^d = f(Y, r) \quad \text{..... (2.2)}$$

We can also express equation (2.2) in log form as

$$\ln M^s - \ln P = \ln(M/P)^d \quad \text{..... (2.3)}$$

3. The neutrality of money. If money is not neutral, so that real income rises in response to nominal monetary expansion, then the growth in the money supply itself generates a demand for additional money balances in order to finance a higher real value of transactions.

2.1.2 The Structuralist Theory of Inflation

A structuralist approach to macroeconomic questions has a certain identifiable characteristics: To summarize, structuralist models ... "is based on the relative prices that changes when economic structure changes, downward inflexibility of (some) money prices, and a passive money supply closing the inflationary gap caused by price increases" (Canavese, 1982:523).

There are thus major methodological differences between structuralist and neo-classical models. While the latter build on principles of optimization and the analysis of market behaviour, the structuralist models incorporate a wider range of behavioural assumptions. According to structuralist, the problem of inflation stems from structural characteristics and bottlenecks that exist in developing economies as the causes of changes in relative prices. Such characteristics and bottlenecks include the relative inelasticity of food supply in, the nature of the tax system and budgetary process, foreign exchange constraints, the nature of the labour market, the role of controlled market and administrative prices, etc. (Shamsul and Kamath, 1986).

In fact, crucial structural constraints of Mozambique's economy may have contributed significantly to high rates of inflation namely: "structural rigidities, the low price-elasticity of demand at lower levels of income, which prevents further reduction in consumption, and the

The exchange rate pass-through equation is of the form:

$$P = f(e, P^f) \quad \text{..... (2.5)}$$

where P is the domestic price level, e is the nominal exchange rate and P^f represents the world price level.

A logarithm transformation of 2.5 yields:

$$P = P^f + e \quad \text{or} \quad e = P - P^f \quad \text{..... (2.6)}$$

2.1.3.1 Incorporating Chhibber Mark-up Model of Inflation

The Chhibber model is derived using a combination of a monetarist and a mark-up model (Chhibber et al, 1989). This extends the basic pass-through model developed in previous section by including additional variables as regressors. They argue that inflation originates from three major sources:

1. Direct Cost-Push factors: this include the direct impact of increases in the domestic price of import prices on the overall price level due to discrete currency devaluation;

2. Demand-Pull forces when there is excess demand created by excessive credit expansion in the economy, and

Chhibber et al (1989) assume that the cost of imported materials will equal to changes on foreign prices plus changes in exchange such that:

$$\dot{mc} = \dot{P}^{f} + \dot{e} \quad \text{..... (2.10)}$$

The reasoning here is that any devaluation engenders a series of developments that often fuel the inflationary process. For example, the devaluation of exchange rate makes the imported materials more expensive which will make the cost of production to increase. This makes the domestic markets to be affected accordingly. When the market prices are affected, there is a tendency for labour union to agitate for increase in wages. When such demands are granted without a corresponding increase in productivity, again, production costs and, therefore, market prices are affected.

For commodities under price control (P_3), they distinguish high and low-income inflation which is due intirely to the effect of price intervention on some sectors such as foodstuffs and public services. Thus.

$$\dot{P}_3 = \dot{c}_f + \dot{c}_s \quad \text{..... (2.11)}$$

where $\dot{c}_f$ represent the difference between food inflation for low-income versus high income and $\dot{c}_s$ the difference between service inflation for low-income versus high income.

The results from the theoretical model suggests that the Metical/Rand exchange rate has a significant short-run effect on inflation. Money supply, represented by M2, has no contemporaneous effects on inflation. Expected inflation was found to be insignificant. The variable rainfall was found to be significant, but the income proxied by monthly agricultural index was found to be weakly significant. The results from the inflation equation suggest the dynamic nature of the inflation transmission mechanism, and the presence of the feedback effects among prices, exchange rates, and money.

2.2.2 Studies of Inflation in Africa

Many other studies of inflation in developing world have generated a great deal of empirical attention. It is our task to document the findings of those related to the present study. In this respect, the work of Atta et al (1996) is illuminating. These authors developed the Botswana's price and inflation relationships and their interaction, using Cointegration analysis to develop a dynamic Error-Correction Model that establishes the link between long run equilibrium prices and short run inflation. Empirical estimates from their study indicate that there is a strong long-run influence of South African prices and of the rand/pula exchange rate on Botswana prices.

Chhibber et al (1989) developed a highly disaggregated econometric model which takes into account both monetary and structural factors in the causes of inflation in Zimbabwe. Their investigation shows that monetary growth, foreign prices growth, exchange and interest rates movements, unit labour costs and real income growth are the determinants of inflation in this country.

foreign inflation, the results provide evidence for influence of foreign inflation on domestic inflation in four of the six countries (Egypt, Nigeria, Morocco and Sudan).

A related methodology was adopted by Canetti and Greene (1991) to evaluate the relative strength of exchange rate and monetary expansion in propagating inflation in ten African countries. They show that exchange rate changes and monetary expansion predict the rate of inflation with feedback effects.

Egwaikhide et al (1994), investigate the influence of domestic money supply and exchange rate movements in the inflationary process in Nigeria. Evidence from trend analysis indicates that money supply has a strong impact on price inflation.. But quantitative estimates from regression equations show that a combination of monetary factors and structural influences determines price movements in Nigeria.

Sowa and Kwakye (1993) specified a simple inflation model for Ghana using both monetary and real factors and expectation. Unlike Chhibber and Shafik (1990), the empirical results of their study shows that supply constraints is stronger force behind Ghana's inflationary push than monetary pressures. The exchange rate movements appears to have a significant effect on inflation, contrary to Chhibber and Shafik (1990).

2.3 Overview of the Theoretical and Empirical Literature

This chapter has been concerned with the survey of both theoretical and empirical literature which will form the basis for the model development in the next chapter. From the theoretical exposition,

All this suggest that it is not prudent to take the extreme positions taken by structuralist and monetarists but to develop a model that combines some of these elements of both schools of thought. Since these factor have also encompassed Mozambique's economy, they will guide us on our empirical investigation.

by the demand for money relation and the supply side is made up of the foreign sector. This approach has been used in numerous studies on inflation in developing countries under the name of the Chhibber mark-up model (see Atta *et al*, 1996), for both traded and non-traded goods. The prices of non-traded goods respond to disequilibrium in the money market and the price of traded goods are governed by the movements in the exchange rate and the foreign prices.

The channels through which the external sector links to domestic inflation behaviour are well known. Ndung'u (1997) distinguishes between two transmission channels: The first channel involves the transmission of inflation through import prices in foreign currency terms into domestic inflation. The other channel involves the transmission of inflation through currency depreciation. In fact; for an open economy like Mozambique, the external sector is the single most important influence on the supply side of the economy.

In the theoretical representation of the inflation equation, the model that will be adopted will be similar to that used by Atta *et al* (1996), with some modifications. The modifications to be made will be consistent with the non inclusion of Zimbabwe price and the exchange rate related to this country.

The model used by Atta *et al* (1996), is a modified version of Chhibber's mark-up model which extends the basic pass-through model by including additional variables as regressors. In this model the domestic prices level (P_d) is determined by both the prices of traded goods (P_T) and non-traded goods (P_N).

$$P_d = P_T^{\beta} + P_N^{1-\beta} \qquad 0<\beta<1 \qquad (3.1)$$

This can be written as

$$ED = \ln M^S - \ln P - \ln (M/P)^d \quad (3.6)$$

A theoretical representation of demand for money balances can be written in standard manner as follows:

$$(M/P)^d = f(Y, r) \quad (3.7)$$

where Y is real income and r the domestic interest rate. The theory predict that $f_y>0$ and $f_r<0$. Substituting into (3.6) we get:

$$ED = \ln M^S - \ln P - [\ln Y + r] \quad (3.8)$$

Substituting 3.8 and 3.2 into 3.1 gives the modified version of Chhibber's mark-up model which is assumed to be a linear function of a set of variables and implicitly specified in thefollowing form:

$$P_d = f(Y, P^f, NER, M, r) \quad (3.9)$$

Equation (3.9) specify that domestic prices (P_d) proxied by Mozambique consumer price index (CPI_{MZ}) are dependent on foreign prices (P^f), money supply (M), real output (Y), interest rate (r), the nominal exchange rate (NER) defined as the domestic price of foreign currency and it is interpreted as a vector of three countries, namely: South Africa ($NER_{MT/R}$), Portugal ($NER_{MT/Esc}$) and United State ($NER_{MT/\$}$). Similarly, the foreign price (P^f) should be interpreted as a vector of three elements: the RSA consumer price index (CPIsa), the Portugal Consumer price index (CPIpo) and US consumer price index (CPI_{US}).

$$\Gamma_0(L)cpi_{Mz} = \mu + \Gamma_1(L)y_t + \Gamma_2(L)m_t + \Gamma_3(L)cpi_{SA} + \Gamma_4(L)cpi_{us} + \Gamma_5(L)cpi_{po} + \Gamma_6(L)ner_{M/R}$$

$$+\Gamma_7(L)ner_{M/\$} + \Gamma_8(L)ner_{M/E} + \Gamma_9(L)r_t + \epsilon_t \quad \text{..... (3.11)}$$

Where (L) is the lag operator, Γ_i (I = 0, ..., k) are the vectors of coefficients to be estimated, and

μ the intercept term.

Equation (3.11) express the price level as a function of its lagged value, current and lagged values of nominal money supply, the real income, the rate of interest, the nominal exchange rates and the foreign prices, and ϵ_t is a white noise process with the usual properties.

On the basis of other studies of inflation, it is likely that most of the series of interest are integrated of order one [I(1)]. In which case, the estimation of linear regression with Mozambique prices as the dependent variable will be problematic, since most test statistics will have a non-standard distribution (see Engle and Granger, 1987). A regression in first differences comprising the dependent variable (Δcpi_{mz}) will not suffer from this problem.

However, as is pointed by Fielding (1994), if there is a long-run relationship, then a regression in first difference will embody an invalid restriction, namely that long-run coefficients are zero. To incorporate the long-run information assuming that the variables are I(1) and at the same time make sure our data is stationary, we suggest to reparametize the levels regression in the form of an error correction model (ECM), error correction in the sense that inflation adjust to its long-run level by some proportion of the gap between the actual inflation and its long-run values.

3.2 The Expected Signs of the Coefficients of the Explanatory Variables

The signs of the estimated coefficients are determined in accordance with theoretical expectations. Exchange rate movements affect the general price level. For instance, if we define the nominal exchange rate as units of local currency per one of foreign currency (the case of Mozambique), exchange rate depreciation makes price of imported goods more expensive in terms of domestic prices. Since the marginal propensity to import is fairly steady, and since the demand elasticity of imports is very low, the probability of imported inflation is very high under a continuous depreciation. Hence their parameter estimate should be of a positive sign.

The growth of the money base expands money supply. To keep the price level constant in the context of a limited supply of goods and services characterized by most developing economies, the nominal money supply (M^S) must grow at a rate equal to the rate of grow of real money demand $(M/P)^d$. An excess of money supply results in portfolio adjustment as people move out of money and into goods and other financial assets. The resulting manifestation of excess demand bids up the price level. Therefore the sign of the coefficient of money should be positive.

Cost-Push theory views inflation as resulting from non-monetary supply factors that increase costs of production which in turn exert upward pressure on domestic prices. Thus, the growth rate of foreign prices are expected to be positively related to domestic inflation. Similarly, the growth rate of real income is expected to be inversely related to domestic inflation since output shortages (as demand grows)are likely to lead to inflationary pressures.

integrated at a different order, the resulting series will be integrated at an order not greater than the order of integration of any of the explanatory variables (Hall and Hendry, 1988). Therefore, a major orientation that this study attempts to introduce in the dynamic specification of the inflation function is to be found in the analysis and modelling of the econometric time series. The application of new techniques in time series analysis allows us to investigate the nature of long-run equilibrium relationship without taking a strong position about the short-run dynamic of the data generating process.

3.4 Hypothesis to be Tested

The following hypotheses will be tested:

a) There is a long-run relationship between domestic prices and the exchange rate, money supply, real income, foreign prices and interest rate;

b) There is a positive and significant long-run relationship between domestic prices, the exchange rate and foreign prices;

c) There is a negative relationship between real income growth and inflation;

d) There is a short-run relationship between domestic inflation and foreign inflation, changes in exchange rate and domestic interest rate, growth rate of output and growth rate of money supply.

Ndung'u, 1997). Ubide (1997), in explaining the behaviour of inflation in Mozambique, used a monthly index of agricultural production constructed using information on agricultural prices. In this study, we follow the standard practice by employing real GDP as a measure of real income to estimate the inflation model for Mozambique. In making this choice, we have been motivated by two factors: first, GDP series have been the most consistently reported series in Mozambique; second, despite the fact that alternatives like permanent income or wealth have been suggested as the most appropriate scale variable for real income (see Friedman, 1956 and Laidler, 1985), no official statistics for the wealth variable exist in Mozambique.

Monthly figures for GDP will be generated from quarterly series through linear interpolation[6]. The quarterly series from annual data will be generated using the Lisman and Sandee method (see Appendix 1).

3.5.3.Interest Rate

The opportunity cost variable as which appears in many studies on inflation is intended to measure the yield on money against other assets which might be held. Ubide (1997:15) argues that "the lack of development of financial markets in Mozambique suggest that the relevant substitution is between goods and money, and not among different financial assets". He used the expected inflation as the opportunity cost of substitution between goods and money as follows:

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[6] The linear interpolation of monthly figures works as follows: $x_{1,t} = 2/3*y_t^{t-1} + 1/3*y_t^t$; $x_{2,t} = 1/3*y_t^{t-1} + 2/3*y_t^t$, and $x_{3,t} = y_t$; where $x_{m,p}$ (m=1,2,...12; and q=1,2...4) is the month m of the quarter q, and y_t^q is the quarter figures obtained in the Lisman and Sandee method (see appendix 1).

3.6 The Time Series Properties of the Data

The recent developments in the literature suggest that in modelling an econometric time series, it is important to first uncover the stochastic properties of the actual data set and then choose either a pure VARMA or an Error Correction model based on the obtained results. In this section we review the theoretical literature on time series characteristics of the data to assess the possibility of non-stationarity in the data and to ensure consistency in subsequent stationary econometric modelling.

Several methods are available to evaluate the time series characteristics of macro variables. The most commonly employed methods are the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF), and Sargan-Bhargava Durbin-Watson (SBDW) tests (see Atta et al, 1996; Adam, 1992; Egwaikhide et al, 1994; Ndung'u, 1997).

The Sargan Bhargava DW suggested by Sargan and Bhargava (1983), is computed in the same way as the usual DW statistic. The test, however, is based not on the residuals, but rather on the level of each individual time series. It is given by

$$SBDW = \Sigma(y_t - y_{t-1})^2/(y_t - \bar{y})^2 \quad \text{..... (3.14)}$$

Under the null hypothesis that y_t is a random walk, the DW statistic calculated from a given y_t will approach zero as $T \to \infty$. If the series is non-stationary, the DW will approach zero. The test will, however reject non-stationarity if the DW statistic is too big, that is, if it approaches 2:

$$\Delta y_t = \mu_0 + \alpha_1(t-T/2) + \pi y_{t-1} + \epsilon_t; \quad \text{(With trend and drift)}$$
$$\Delta y_t = \mu^*_0 + \pi^* y_{t-1} + \epsilon_t^*; \quad \text{(With drift)} \qquad (3.16)$$
$$\Delta y_t = \pi^{**} y_{t-1} + \epsilon_t^{**}; \quad \text{(Pure random walk)}$$

Where $\Delta y_t = y_t - y_{t-1}$ and $\pi=\rho-1$. The parameter of interest in all regressions is π. Therefore, testing the hypothesis $\rho=\rho^*=\rho^{**}=1$ in (3.15) is equivalent to testing the hypothesis $\pi=\pi^*=\pi^{**}=0$. If $\pi=\pi^*=\pi^{**}=0$ in (3.16), the $\{y_t\}$ sequence contains an unit root.

As can be seen above, the DF-test can be set up in three ways depending on the alternative hypothesis. The sequential testing technique helps to distinguish series which are trend stationary from those which are difference stationary.

It is a good strategy to start with the model containing both a constant and trend, because this model is the least restricted. Thus, starting with the general model (herein after referred to as Model 1) incorporating both trend and drift, we will test the null hypothesis that $\rho=1$ [i.e., that there is a unit root and the series is not I(0)]. If that is not rejected, the null hypothesis of $\alpha_1=0$ is tested (i.e., that the trend is insignificant). If this is not rejected, the model without a time trend might be better. Thus the simplified (Model 2) with drift is used and the null of $\rho^* = 1$ is tested. Again, if this is not rejected, we test the null hypothesis that $\mu_0^* = 0$. If this is not rejected, then a further simplified (Model 3) without trend or drift is used, and the null of $\rho^{**} = 1$ tested. Using this sequence of tests, it will be possible to determine which, if any, of the three possible unit root models will be appropriate (see Dolado et al 1990; Harris, 1995). However, if a unit root is rejected in the general model (due to a significance of ρ, i.e., $\rho<1$), there is no need to continue testing. Failure to reject $\rho=1$ (in the appropriate model), indicates that y_t is non-stationary and will need to be differenced at least once to render it stationary.

3.7 Theoretical Overview of Cointegration Analysis

Evidence from most empirical studies suggests that many economic time series are non-stationary (integrated of order one or higher) . Yet, it is possible that some combinations of time series may drift together, at least in the long-run. The intuition here is that for the two variables to form a meaningful long-run relationship, they must share a common stochastic trend in the long-run. That is, there may exist some linear combination of the variables that, over time, converges to an equilibrium. Otherwise, they would be drifting away from each other over time. Therefore, to build econometric models which makes sense in the long-run, we have to test if the variables are integrated and if they form cointegrating relationship. In this study, we expect to find some long-run (linear) relationships between money, foreign prices and nominal exchange rate with domestic prices.

Our objective in performing cointegration analysis is that it allows us to discriminate spurious from real relationship. So, by establishing that cointegration exist, "we validate the linear regression; we confirm the likelihood of a long-term structure by proving the absence of spurious correlation" (Atta et al, 1996).

Cointegration can be tested in two ways: the first involves testing the null hypothesis that residuals from cointegration regression has a unit root against the alternative that the residual series is stationary. An example of residual based test is the Engle and Granger two-step procedure. However, as Macdonald and Taylor (1991) in Macdonald and Taylor (1993) have indicated, "previous tests of the long-run relationship between the exchange rate and the monetary variables, which rely on the Engle-Granger (1987) two-step methodology, suffer from a number of

The Johansen method commences from a standard vector autoregressive (VAR) of the form

$$X_t = \Pi_1 X_{t-1} + ... + \Pi_k X_{t-k} + \mu + \theta D_t + \epsilon_t \quad \text{..... (3.20)}$$

where X is a Px1 vector of the I(1) variables of interest, μ is a vector of constants, D is a vector of centred seasonal dummies and ϵ_t are IN(0,Λ) error terms.

Letting Δ represent the first difference operator, Johansen and Juselius (1990) suggest writing equation (3.19) in the equivalent form as

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + ... + \Gamma_{k-1} \Delta X_{t-k-1} + \Pi x_{t-k} + \mu + \theta D_t + \epsilon_t \quad \text{..... (3.21)}$$

$$\Gamma_i = -I + \Pi_1 + ... + \Pi_i \quad (I = 1, ..., k-1) \text{ and } \Pi = -I + \Pi_1 + ... + \Pi_k$$

Equation (3.21) is a stationary Error-first differences VAR where the term Πx_{t-k} contains information on the long-run (levels) relationships between the variables in the VAR. Cointegration can be detected by examining the Π matrix. If the pxp matrix Π has rank 0, then all elements of X_t have unit root and first-differencing might be recommended. If Π is of full rank p, then all elements of X_t are stationary in levels. The interesting case in this study is when $0<\text{rank}(\Pi)=r<p$. In this case, it is said that there are cointegrating relations among the elements of X_t, and (p-r) common stochastic trends. If Π has rank $r<p$, this implies that

$$\Pi = \alpha\beta'$$

where α and β are VxP, with β containing the V cointegrating vectors, and α their corresponding

3.8 Scope of Study and Data Source

The study will cover the period 1990:1-1996:12. The choice of period is based purely on the availability of data. Monthly data about inflation in the Mozambique post-Independence are dated from January 1990. Although this study focuses on a relatively short historical episode, the use of monthly data will provide a relatively sufficient degree of freedom as well as to represent adequately the Mozambique inflationary process at disaggregated level.

Relevant statistics were collected from various sources. The following variables - Money supply, Mozambique Consumer Price Index, Meticais/US$ and Meticais/Rand exchange rate, and Rediscount Rate was obtained from Central Bank of Mozambique's publications. The annualized GDP will be obtained from Statistic Institute of Mozambique. The South Africa, Portugal and United State Consumer Price Index were obtained from the International Monetary Fund's *International Financial Statistics* database.

The reasoning here is that there is a problem of 'spurious regression' when non-stationary series are estimated at their levels in a stochastic equation. It follows, therefore, that knowing the order of integration of macroeconomic variables helps in a model specification. Based on Monte Carlos study, Engle and Granger (1987) recommended the ADF test. In this study, the procedure suggested by Dickey and Fuller (1979) and Sargan Bhargava (1983) were used with the following monthly data series:

Mozambique Consumer Price Index (CPImz)

Portugal Consumer Price Index (CPIpo)

South Africa Consumer Price Index (CPIsa)

United States Consumer Price Index (CPIus)

Nominal Exchange Rate Meticais/Escudo (NERpo)

Nominal Exchange Rate Meticais/Rand (NERsa)

Nominal Exchange Rate Meticais/US$ (NERus)

Narrow Money - Currency plus Demand Deposit (M1)

Broad Money - Money and Quasi-money (M2)

Nominal Gross Domestic Product (NGDP)

Real Gross Domestic Product (RGDP)

Rediscount Rate (RR)

Generated Variables

Portugal Relative Prices Index CPNpo=CPIpo*NERpo

South Africa Relative Prices Index CPNsa=CPIsa*NERsa

United States Relative Prices Index CPNus=CPIus*NERus

Table 4.2: ADF for Unit Root Test on Variables - Monthly Data, 1990:1-1996:12

Variables	Model 1			Model 2		Model 3	Differences		Remark
							--1st--------2nd--		
	Lag	τ_τ	t	τ_μ	$_\mu\tau$	τ_μ	τ_μ	τ_μ	
cpi_{mz}	2	-2.915	2.898*	-0.313	1.078	3.532	-4.456*		I(1)T
cpi_{sa}	2	-2.933	2.832*	-1.415	1.869	7.026	-4.935*		I(1)T
cpi_{ns}	2	-3.387	3.200*	-2.134	2.252	4.848	-5.523*		I(1)T
cpi_{po}	2	-0.672	-0.189	-3.295*	3.402*	2.796	-6.817*		I(0)D
ner_{sa}	2	-2.319	1.976	-1.717	1.932	2.132	-5.541*		(I(1)
ner_{us}	2	-1.307	1.158	-1.274	1.760	3.478	-5.776*		I(1)
ner_{po}	2	-1.570	1.408	-1.345	2.373	2.946	-5.046*		I(1)
cpn_{mz}	2	-2.311	2.024	-1.696	1.906	2.788	-5.425*		I(1)
cpn_{sa}	2	-1.590	1.465	-1.251	1.548	2.611	-3.802*		I(1)
cpn_{ns}	2	-1.181	0.990	-1.567	2.121	3.430	-4.954*		I(1)
ngdp	2	-1.220	1.139	-1.711	2.268	1.155	-0.872	-6.877*	I(2)
rgdp	2	-2.208	2.200	-0.282	0.355	2.497	-4.775*		I(1)
m1	2	-1.580	1.550	-0.395	1.339	3.801	-4.085*		I(1)
m2	2	-1.430	1.397	-0.438	1.486	3.707	-3.520*		I(1)
rr	2	-1.217	-0.081	-2.794*	2.940*	0.936	-6.609*		I(0)D
c.v (5%)*		-3.45	+/-2.79	-2.89	+/-2.54	-1.95	-3.45	-3.45	

Critical values for this test were extracted from Enders (1995) Table 4.1 p. 223

All series are in natural logs indicated by lower case letters.

In this study, with a sample of 84 observations, values of τ_τ less than -3.45 (i.e., more negative than -3.45) represent rejection of the null hypothesis that $\rho=1$ in favour of $\rho<1$ (i.e. stationarity) at 5 percent critical values for DF and ADF test with trend. Similarly, values of τ_μ less than -2.89 represent rejection of the null hypothesis that $\rho=1$ in favour of $\rho<1$ at 5 percent critical values for DF and ADF test with drift. Values of τ less than -1.95 represent rejection of the null hypothesis that $\rho=1$ in favour of $\rho<1$ at 5 percent critical values for DF and ADF without drift and time trend. Finally, values of the SBDW less than 0.38 represent rejection of the null hypothesis than in favour of the alternative that $\rho=1$ (i.e., non-stationarity) at 5 percent significance level under SBDW test.

Looking at results reported in the Table 4.1 we can note that while the SBDW test strongly rejects stationarity for all series at the 5 percent level of significance, the null hypothesis of non-

liner interpolation, which may account for this odd results. Atta et al (1996), used interpolated non-mineral GDP for Botswana and also found this variable be I(2).

The results are broadly consistent with the hypothesis that time series are individually I(1). Because the data appears to be stationary in first differences, further tests were performed only on ngdp and the I(2) assessment confirmed.

Having established the first necessary condition for cointegration (i.e., each of the series of interest are integrated of the same order), next step is to test for the presence of a long-run relationship between the variables. This forms the main focus of our investigation in the next section.

4.3 Cointegration Analysis

Since our data proved to be non-stationary, we proceed to test for the existence of a cointegrating relationship for the set of variables. Atta et al (1996:314) note that "by establishing that cointegration exists, we validate the linear regression; we confirm the likelihood of a long-term structural relationship by proving the absence of spurious correlation". Further, the cointegration approach allows us to specify an equation in which all terms are stationary, which allows the use of classical statistical inference and retains information about the long-run relationship between the levels of variables, which is captured in the (stationary) cointegrating vector.

Several static cointegrating exercises were conducted on the levels of each variable in order to search for a stationary linear combination of individually non-stationary time series. A

The fitted residuals ($\hat{e}_t$) from the cointegrating regression in (4.1) are used to test the null hypothesis that $\rho=1$ in the regression of the form given by

$$\hat{e}_t = \rho\hat{e}_{t-1} + u_t \qquad u_t \sim IID(0, \sigma^2) \quad \ldots\ldots (4.2)$$

The test is that of the null hypothesis of non-cointegration. If the series are cointegrated, the equilibrium residual $\hat{e}_t$ will be stationary.

Table 4.3 reports the results of the ADF test for cointegration together with the associated critical values at 5 percent level of significance.

Table 4.3: Static Cointegrating Regression and Test Statistics

Regression	R^2	CRDW	ADF With t & c	ADF With c	Lag
cpi_{niz} with					
cpi_{sa}	0.976	0.1270	-4.529*	-4.197*	2
cpi_{us}	0.967	0.0913	-4.261*	-3.579*	3
cpi_{po}	0.923	0.0400	-2.840	-1.935	2
ner_{sa}	0.930	0.2030	-3.461	-3.025	2
ner_{us}	0.971	0.1200	-3.579	-3.036	3
ner_{po}	0.969	0.1470	-3.520	-3.361*	2
cpn_{sa}	0.947	0.1920	-3.701*	-3.300*	2
cpn_{us}	0.972	0.1170	-2.904	-2.795	2
cpn_{po}	0.967	0.1170	-3.320	-3.123	2
d1ngdp	0.023	0.0093	-2.755	-2.635	3
rgdp	0.910	0.0049	-3.276	-3.078	2
m1	0.991	0.2760	-3.312	-3.289*	3
m2	0.989	0.2250	-3.195	-3.162	3
rr	0.713	0.1010	-1.611	-0.198	2
C.V. at (5%)		0.38	-3.62	-3.17	

CRDW is the Cointegrating Regression Durbin-Watson
t & c is the statistics value for ADF with constant and trend, and c with constant only.

Table 4.4: Static Cointegrating Regression and Test Statistics

Regression	R^2	CRDW	ADF With t & c	ADF With c	Lag
cpi_{mz} with					
cpi_{sa} ner_{sa}	0.976	0.127	-4.505*	-4.177*	2
m2 rgdp	0.991	0.291	-3.926	-3.885*	3
ner_{sa} rgdp	0.956	0.145	-2.976	-2.758	2
cpn_{sa} rgdp	0.963	0.153	-3.264	-3.044	2
C.V. at (5%)		0.380	-4.020	-3.620	

t & c is the statistics value for ADF with constant and trend, and c with constant only.

Table 4.5: Static Cointegrating Regression and Test Statistics

Regression	R^2	CRDW	ADF With t & c	ADF With c	Lag
cpi_{sa} ner_{sa} rgdp	0.981	0.139	-4.276	-4.084*	2
cpi_{sa} ner_{sa} d1ngdp	0.980	0.191	-3.348	-3.214	2
cpn_{sa} m1 rgdp	0.992	0.346	-3.791	-3.765	3
cpn_{sa} m2 rgdp	0.991	0.313	-3.871	-3.845	3
cpn_{sa} m1 d1ngdp	0.992	0.320	-3.365	-3.387	3
cpn_{sa} m2 d1ngdp	0.990	0.282	-3.287	-3.312	3
C.V. at (5%)		0.380	-4.360	-4.020	
cpi_{sa} ner_{sa} rgdp m1	0.992	0.349	-4.205	-4.162	3
cpi_{sa} ner_{sa} rgdp m2	0.991	0.309	-4.129	-4.089	3
cpi_{sa} ner_{sa} d1ngdp m2	0.991	0.278	-3.427	-3.469	3
C.V. at (5%)		0.380	a/	-4.360	

CRDW is the Cointegrating Regression Durbin-Watson; a/ critical value not available, but we assume to be greater in absolute terms than that of constant only.
t & c is the statistics value for ADF with constant and trend, and c with constant only.

Looking at the cointegrating regression, the high R^2 value for these regression suggests that there is a little evidence of bias. A high R^2 is necessary though not sufficient to ensure low biases.

The Johansen test involves testing the rank (r) of π. The rank of π gives the number of r independent cointegrating vectors and the maximum and trace eigenvalue statistics are used to determine the rank.

However, in order to implement this procedure, a lag length (k) must be chosen. To address this issue, equation (4.5) consisting of the following variables (cpi_{mz}, cpi_{sa}, ner_{sa}, m_2, rgdp and rr) was estimated with k arbitrarily set equal to 6. An intercept term was included since non-zero drifts are believed to be present in (at least) two series. All VAR(k), k=1,2,...6 models are estimated over the full sample period and the results are reported in Table 4.6. The maximized values of the log-likelihood function given under the column headed LL increase with k.

However, the Akaike information criterion (AIC) and the Schwarz Bayesian Criterion (SBC) select the order 3 and 1 respectively. Thornton and Batten (1985) argue that, although the SBC on average selects the correct lag asymptotically and, hence is asymptotically efficient, their experience indicate that it tends to select lags that are too short in finite samples. Given that, we choose the VAR(3) model as suggested by AIC.

Once a tentative lag has been determined, the residuals from the chosen VAR were then checked to confirm that k=3 is accepted in terms of residual whiteness. Serial correlation tests were carried out using k=3 in each equation of the levels VAR and again using the sample period 1990:1-1996:12, standard test statistics were applied to the residuals from these regression. Both Lagrange Multiplier and F-version of the Lagrange Multiplier tests for serial correlation results are also reported in Table 4.6 below. Since none of the statistics is significant at 5 percent level, the hypothesis of no-autocorrelation cannot be rejected. Thus our choice of k=3 is confirmed.

By imposing restriction on the cointegrating vector (-1,1,1) we tested for complete PPP that the coefficients on South African prices and Mt/Rand exchange rate are equal to 1[7]. This test follows a χ^2 distribution with k degrees of freedom, (k being the number of restrictions). The LR test of this restriction yielded a $\chi^2_{(=1)} = 8.5845[.014]$ which is marginally greater than the critical value at 5 percent level, and thus the restriction was rejected (although it should be noted that it would not be rejected at 1 percent level).

The presence of cointegration relationship found here (the cointegrating vector being 1.5623663; -0.038692; 0.66952; -0.30827), differs from the one found by an earlier study. Ubide (1997) found cpi_{mz} to be cointegrated with cpi_{sa}, ner_{sa} and m2, the cointegrating vector being (1.64; 0.18; 0.72). We should note, however, that Ubide's's study employed agricultural index as a proxy of real income instead of real GDP and the expected inflation in place of the domestic interest rate. The lag length used by Ubide also differs from those used in this study.

Note that although the cpi_{sa}, m2 and rgdp have the expected sign, indicating that the South African prices and domestic money are positively and real GDP inversely associated with domestic prices in the long-run, the coefficient of exchange rate being negative, cannot be easily explained. Barungi (1997), in her survey on exchange rate policy and inflation in Uganda, found that the real exchange rate devaluation was negatively related to inflation. She concluded that this may be due to the fact that a significant volume of imports was financed through import support grants. This may offset the inflationary impact of real devaluation. In Mozambique, about 70 percent of

[7] Purchasing-power parity (PPP) is a simple relationship linking national price levels and exchange rates. In its simplest form, PPP asserts that the rate of currency depreciation is approximately equal to the difference between the domestic and foreign inflation rates.

is found in Udide (1997) study. He argues that the existence of a cointegrating relationship including money implies a failure of the purchasing power parity hypothesis to hold in the long-run. We can infer that this is because under floating exchange rate regime, the exchange rate adjusts to the money stock.

In the light of these results we tested for cointegration among the vector of variables excluding ner and rgdp, as suggested by our test results above. The results reported in Table 4.9 are consistent with the previous finding that there is one cointegrating vector among the series - both the trace and maximum eigenvalue statistic results are less than the 5 percent critical values. The cointegrating vector (1.9149; 0.53537) strongly suggests that South African prices dominate the long-run domestic price equation. The same battery of tests were conducted on the new cointegrating vector and reported on the right side of Table 4.8 above.

Table 4.9: The Johansen Results for Cointegration - The Restricted VAR

Null	Alternative	Maximal Eigenvalue		Trace	
		Statistic	95% c.v	Statistic	95% c.v
r=0	r=1	34.1699	21.12	44.9909	31.540
r<=1	r=2	8.7600	14.88	11.400	17.860
r<=2	r=3	1.8450	8.07	0.121	8.070

Eigenvalues by order are: 0.34417; 0.10489; 0.022521

Table 4.10 presents formally the restricted long-run information to be included in our overparameterized ADL, as well as their weights, or error correction coefficients. Each eigenvector represents a stationary linear combination of the I(1) variables such that,

$$cpi_{nz} - 1.9149cpi_{sa} - 0.53537m2 = ecm_t \sim I(0)$$

In the n variable case in which $A_{ij}(L)$ represents the coefficient of lagged values of variable j on variable i, variable j does not Granger-cause variable i, if all coefficients of the polynomial $A_{ij}(L)$ can be set equal to zero. Here, three outcomes are possible: (i) one variable Granger-causes another (unidirectional causality); (ii) both variables Granger-cause each other (i.e., there is a feedback between them) and; (iii) the variables do not predict each other (no Granger-causality).

In this study, these tests were carried out in first difference among variables in the cointegrating vector. This is because, as pointed out by Pesaran & Pesaran (1997: 131), "Granger non-causality test may give misleading results if the variables in the VAR contain unit roots". Since our cointegrating vector contains three variables, a block Granger non-causality were carried out. In essence, this test restricts all lags of one variable into another two or more equations to be equal to zero. This cross-restriction is properly tested using the Likelihood ratio (LR) test which has a χ^2 distribution with 3p degrees of freedom (since p lagged values of that variable are excluded from each equation, three in our case). Table 4.11 reports the results of GNC-test.

Table 4.11: Granger-Causality Test

⇓ G-Caused by ⇒	Δcpi_{mz}	Δcpi_{sa}	Δner_{sa}	$\Delta m2$
Δcpi_{mz}	0.0	7.9513[.014]	6.6974[.082]	17.061[001]
Δcpi_{sa}	4.4378[.218]	0.0	8.5283[.202]	-
Δner_{sa}	13.6929[.033]	15.928[.014]	0.0	11.6184[.028]
$\Delta m2$	-	10.366[.016]	2.6007[.457]	0.0

The results appears to be consistent with the causality postulated by the monetary theory of inflation since the null hypothesis that money growth does not Granger-cause inflation is rejected at 5 percent level. The LR test also indicates that inflation is caused by South African prices and

coefficient reported in Table 4.10. However, although this study contains 84 observations, this sample is relatively short so that, as pointed by Adam (1992), "it is characteristic of high frequency data estimated over short period, to be subject to a low signal-to-noise ratio, thus requiring careful interpretation of the statistics". The results show that the long-run price equation has money elasticity equal to 0.53537 while the South African price elasticity is of about 1.915.

Looking to the α vectors, which indicate the rate of feedback of deviations from the long-run price relationship to the dynamic behaviour of the endogenous variables of the VAR, we note that the effect of the cointegrating vector is through their feedback onto domestic prices. Since the data are in logarithmic terms, the coefficients in α vector can be interpreted as the percentage feedback per period, which therefore indicate a feedback of approximately 23% per period.

In general, the long-run cointegrating vector is consistent with the data and provides the basis for a coherent economic interpretation of the underlying relationships determining the inflation process. Thus we can proceed to an Error Correction specification which is the subject of the next section.

4.6 ADL and Error Correction Model

Having confirmed that cointegration exists, the residuals from the cointegrating regression can now be used as the Error Correction variable in a dynamic Error Correction Model. The error correction term captures the adjustment towards the long-run equilibrium. On the basis of the previous analysis we follow a general-to-specific modelling approach and estimate a general dynamic error correction model. This takes the form of an Autoregressive Distributed Lag-Error

4.7 Analysis of Estimation Results

The results of estimating the general model are presented in Appendix 2 and although they indicate an insignificant error correction term (ecm_{t-1}), the coefficient is negative as expected[8], reflecting at least some long-run liner relationship between Mozambique prices and both money and South African prices. We proceed to reduce this model and the process of reduction has resulted in a series of parsimonious models which uniformly have increased efficiency over their nesting model and allow for a clear specification of the dynamic process. The steps required to achieve this final model are not reported here. The results from estimating the parsimonious model spaning the period from 1990:1-1996:12 are reported in the Table 4.12 below.

[8] The coefficient of Error Correction is expected to be negative. A positive value of Error Correction coefficient implies that the dependent variable is above its long run equilibrium, and will tend to reduce the change in dependent variable next period. In long run equilibrium, when all of the first differenced series in the model have settled down to their steady-state values, the cointegrating relationship is recovered (subject to a constant intercept) as the steady-state solution.

The results indicate that in the short-run, the Mozambique inflation is explained by lagged value of foreign inflation, lagged values of exchange rate movements, lagged money supply growth and growth of real GDP both contemporaneously and after 6 months lag period.

Comparing the general and the parsimonious model, it is clear that the process of simplification has transformed the general model to a more interpretable specification of inflation function. Of the immediate interest is the highly significant error correction term which appeared with the expected sign. One particularly interesting feature of our short-run model compared with earlier studies is the strong impact of the error correction term which shows that 14.9 percent of the disequilibrium is eliminated each month. In a similar study on inflation in Mozambique, Ubide (1997) found the adjustment process of the long-run price level toward its equilibrium value to be about 6 percent per period using either narrow money or broad money.

In addition to the error correction term, the estimated parameters of the short-run dynamic model indicate that the supply side is the strongest force behind the Mozambique's inflationary process as shown by the positive coefficient of inflation of the Mozambique's major trade partner.

The monetary pressures are the next strongest force behind the Mozambique's inflation. Although, it has no contemporaneous effect, it has an important effect after 6 months so that, after 6 months, about 21 percent of changes in money supply have fed through into change in Mozambique prices.

The exchange rate devaluations appear to have some short-run effect on inflation. Both the Metical/Rand and Metical/Escudo exchange rate devaluations have a short-run effect with lag

In general, most of variables have the correct sign and are statistically significant at 5 percent level and the F-statistics clearly reject the null hypothesis that all coefficients are jointly equal to zero. The statistical characteristics of our short-run dynamic equation are not significant at the 5 percent level of significance. Starting with the Autoregressive for the residual autocorrelation (AR), the null hypothesis that the error exhibit no significant first or higher-order autocorrelation cannot be rejected. With respect to ARCH, we were unable to reject the null hypothesis that the error term is homoscedastically distributed. On the basis of the distribution of the error term, the null hypothesis of normality could not be rejected at the conventional level. Thus we can move to the next step where economic interpretation of the results is given. This is the subject of next section.

4.8 Economic Interpretation of the Model

In our overview of cointegration analysis we discussed some major advantages of the emerging cointegration and error correction approach. First, we argued that cointegration analysis allows us to specify an equation in which all terms are stationary, which allows the use of classical statistical inferences; second, it allows us to retain information about the long-run relationship between the level of the variables, which is captured in the (stationary) cointegrating vector.

In this respect, the most important coefficient is that of the error correction term which represents the percentage of disequilibrium that is fed back each month into the current price change. The results suggest that there is almost twice as strong and faster as the adjustment speed per period implied by similar studies in Mozambique. For example, Ubide's (1997) studies found the speed of adjustment to be of about 6 percent per period. In our case, about 15 percent of previous disequilibrium from the long-run, is corrected each month in the short-run. Recalling that our

They indicate that about 16 percent of changes in exchange rate against US dollar and 14 percent of Portugal escudo feed into domestic inflation in a relatively short period of three and five months respectively after devaluation.

The wider negative net effect of real income is consistent with the theory. This indicates that in response of a 1 per cent increase in real GDP, *ceteris paribus*, leads to a 0.74 percent fall in the rate of inflation. Moreover, the coefficient of lagged money is also significant, an indication that money growth exert upward pressure on inflation but it takes six months before this is reflected on domestic inflation. These empirical evidences suggest that real income improvements and restrictive monetary policy can help to mitigate the Mozambique inflation. The rediscount rate which appeared with wrong sign is not easily interpretable. However, although significant it seems to exert small effects on inflation.

The two seasonal dummies found to be significant are not surprising given the structure of weights in the CPI basket (recall that foodstuffs account of about 73 percent, of which 22 percent are represented by fruits and vegetables which are characterised by strong seasonality). According to the Bank of Mozambique 1996 report, the increase in prices in 1996, had been stronger in the first quarter, resulting in a pick of 21.4 percent in March which is reported as the highest figure in the year. However, from April onwards, cumulative inflation decelerated progressively, culminating at 12.7 percent in August.

The observed deceleration of inflation during the second and third quarter is, among other factor, due to (a) a sharp improvement in the supply of cereals and vegetables as a result of an excellent crop, (b) an excellent reduction of custom duties for some products with high weights in the CPI

CHAPTER V

CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Conclusion

This study has employed Cointegrating and Error Correction approach to investigate the Dynamic of Inflationary Process in Mozambique using monthly data spaning the period from 1990:1-1996:12. This technique ensures that regression analysis is only performed on variables with long-run relationships to avoid the problem of spurious regression often associated with the use of non-stationary data. Given that, our investigation was conducted in three stages: firstly, we tested whether the macroeconomic variables entering in our model were non-stationary (integrated of order one or high). Secondly we tested for the existence of any long-run relationship between the dependent variable and any of the independent variables. Moreover, since some of the variables were found to be cointegrated, we added the cointegrating vector in a dynamic short-run model. Using this approach we get more efficient estimates and avoid losing information in the data.

The overall objective of this study was to establish whether exchange rate movements, real income and money growth, world inflation and domestic interest rate cause domestic inflation, and to determine which variables are relatively more important in this process, so that predictions about their behaviour and the effects of changes on these variables can be met with significant degree of accuracy for sound macroeconomic management.

The results also suggest that, while the explicit link between inflation and money supply growth professed by the monetary theory of inflation is not refuted in this study, our finding strongly suggests that factors other than money expansion, have played an important role in determining the course of inflation in both short-run and long-run, in Mozambique. Among these factor include exchange rate depreciation, foreign inflation, and real income constraints (proxing for growth of real GDP). Quantitatively, about 136 percent of changes in the prices of imports from South Africa, and about 7.3 percent of changes in Metical/Rand exchange rate are passed through to Mozambique prices.

Changes in US prices and Portugal prices do have significant effect but are statistically insignificant at the conventional levels. These results are not surprising given the small role US and Portugal prices play in the Mozambique CPI basket. About 74 percent of Mozambique CPI basket is comprised by foodstuffs, beverage and tobacco locally produced and/or imported from South Africa. With respect to domestic variables, the results indicate that monetary expansion, exchange rate depreciation and a slump in production, are responsables to a large extent for the inflationary process in Mozambique.

The GNC tests have established that the domestic prices are driven by South African prices, the Metical/Rand exchange rate and money and that there is a unidirectional causality from South African prices and money to Metical/Rand exchange rate. The causality coming from money to exchange rate, is not surprising. In a situation of a floating exchange rate, exchange rate has no independent influence on prices. Instead, the factor which drives the exchange rate (i.e., money supply) is also the main influence on prices. This is consistent with the conventional small-open-economy model with an exogenous money supply and endogenous exchange rate.

The control of money expansion can be used as an important tool of mitigating domestic inflation and to help to stabilize the Metical (recall that the GNC test found nominal exchange rate to be caused by money). The causality coming from South African prices to money found in this study, has also some policy implications. As pointed by Ubide (1997:29) "this reflect the mounting of inflows of capital from South Africa into Mozambique during 1996 as a result of the decrease of the inflation differential between the two countries". Thus, it is a matter of concern for the monetary authorities given its potential inflationary implications.

Another policy implication that this study does not address is whether a devaluation succeed in altering relative prices in the economy. The devaluation has been undertaken during periods of continuous inflation (more than 50 percent per year), which could undermine authorities's intent to depreciate the currency in real terms. For real exchange rate, the change in nominal exchange must be greater than the price inflationary differential between the domestic and trading partners for a real depreciation to obtain. Thus, given the mountain of inflows of capital from South Africa into Mozambique, which had prevailed during 1996, we can infer that at minimum, an official devaluation does depreciate the real exchange rate.

BIBLIOGRAPHY

Adam, C. (1992), "On Dynamic Specification of Money Demand in Kenya". ***Journal of African Economies***, Volume 1(2).

Adekunle, J.O. (1968), "The Demand for Money in Less Developed Countries", ***FMI Staff Paper*** No 15.

Atta, J.K., K.R. Jefferis, and I. Mannathoko (1996) "Small Country Experiences with Exchange Rate and Inflation: the case of Botswana", ***Journal of African Economies, Vol. 5(2) pp. 293-326.***

Bank of Mozambique, ***Annual Report 1993***, Maputo.

Bank of Mozambique, ***Annual Report 1994***, Maputo.

Bank of Mozambique, ***Annual Report 1995***, Maputo.

Barungi B.M. (1997), "Exchange Rate Policy and Inflation: the Case of Uganda, ***the AERC Paper No 59,*** Nairobi.

Baumol, W.J. (1952), "The Transactions Demand for Cash: An Inventory Theoretical Approach. ***Quarterly Journal of Economics***, Vol. 66, pp. 545-556

Banerjee, A. J. Dolado, J. Galbriath, and D. Hendry (1993), ***Co-Integration, Error-Correction, and the Econometric Analysis of Non-Stationary Data***. Oxford University Press.

Canavese, A. J. (1982), "The Structuralist Explanation in the Theory of Inflation". ***World Development***, Vol. 10(7). Pp. 523-529.

Canetti, E. And J. Greene (1991), ***Money Growth and Exchange Rate Depreciation as Causes of Inflation in African Countries: An Empirical Analysis***. IMF, Washington, DC.

Cargill, T.F. (1986), ***The demand for Money, Inflation and Income Velocity: a case study of Ghana (1956-1986)***. Prentice-Hall, Inc. New Jersey.

Castel-Branco, C.N. (1994), ***Mocambique: Prespectivas Economicas.*** Faculdade de Economia, Universidade Eduardo Mondlane, Maputo.

Crocket, A. D. and Evan, O.J. (1980), "Demand for Money in Middle Eastern Countries". ***Staff Paper***, Vol. 2(30).

Chhibber, A, J. Cottani, R. Firuzabadi, and M. Walton (1989), "Inflation, Price Controls and Fiscal Adjustment in Zimbabwe", ***The World Bank Working Papers,*** WPS 192, April.

Fielding, D. (1994), Money Demand in Four African Countries:, ***Journal of Economic Studies***, Vol. 21(2) pp. 3-37

Fisher, I. (1926), ***The Purchasing Power of Money,*** 2nd Edition. Macmillian, New York.

Friedman, M. (1956), "The Demand for Money: some theoretical and empirical results". ***Journal of Political Economy,*** Vol. 67(1).

Fuller, W.A. (1976), ***Introduction to Statistical Time Series***, New York, John Willey.

Hall, S. C. and Hendry, S. G. (1988), ***Macroeconomic Modelling,*** North-Holland, Amsterdam

Hanlon, J. (1997), ***Paz Sem Beneficio: Como o FMI Bloqueia a Reconstrucao de Mocambique***. Coleccao Nosso Chao No 10, Maputo.

Harris, R. (1995), ***Using Cointegration Analysis in Econometric Modelling***, Prentice Hall-Harvester Wheatsheaf, London.

Hendry, D.F. (1995), ***Dynamic Econometrics***. Oxford University Press.

Granger,

INE(Instituto Nacional de Estatistica) (1997), ***Mozambique in Figures - 1996.*** National Institute of Statistic, Maputo

Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors". ***Journal of Economic Dynamics and Control,*** Vol. 12(2/3).

Johansen, S. And Juselius, K. (1990), "Maximum Likelihood Estimation and Inferences on Cointegration with Application to the Demand for Money", ***Bulletin***, Vol:52, pp.169-210.

Keynes, J.M (1936), ***The General Theory of Employment, Interest and Money***, London, Macmillan.

Laidler, D. E. (1977), ***The Demand for Money: Theories and Evidences***, 2nd ed., Dunn-Donelly, New York.

Laidler, D. E. (1985), ***The Demand for Money: Theories, Evidences and Problems***. 3rd Ed. Harper and Row, Publishers, New York.

Levacic, R. and Rebmann, A. (1982), ***Macroeconomics: An Introduction to Keynesian-Neoclassical Controversies***, 2nd Edition, Macmillan Press Ltd, Uoundmills.

Lisman, J.N.C. and Sandee, J. (1964), "Derivation of Quarterly Figures from Annual Data", ***Applied Statistics***, Vol. 13, pp. 87-90.

London, A. (1989), "Money, Inflation and Adjustment in Africa: Some further Evidence". ***African Development Review***, June 1989, Vol.1

World Bank, (1994), Adjustment in Africa - Reforms, Results, and the Road Ahead, World Bank, Washington, DC

Wuyts, M.E. (1989), ***Money and Planning for Socialist Transition: the Mozambican experience***. Institute of Social Studies, London.

Step 3

The quarterly figures for the year which is in the middle position of the vector X_t is calculated by premultiplying X_t by the Lisman and Sandee interpolation matrix (L) given below

$$L = \begin{matrix} 0.291 & 0.793 & -0.084 \\ -0.041 & 1.207 & -0.166 \\ -0.166 & 1.207 & -0.041 \\ -0.084 & 0.793 & 0.291 \end{matrix}$$

Thus, for X_t quarterly data would given as

$$\begin{matrix} y_t^{i} \\ y_t^{ii} \\ y_t^{iii} \\ y_t^{iv} \end{matrix} = L \begin{matrix} x_{t-1} \\ x_t \\ x_{t+1} \end{matrix} = \begin{matrix} 0.291 & 0.793 & -0.084 \\ -0.041 & 1.207 & -0.166 \\ -0.166 & 1.207 & -0.041 \\ -0.084 & 0.793 & 0.291 \end{matrix} \begin{matrix} x_{t-1} \\ x_t \\ x_{t+1} \end{matrix}$$

Quarterly figures generated by the Lisman and Sandee method has the advantage of adding up to the annual totals, but it has the disadvantage of arbitrarily imposing restrictions on L matrix which results in the loss of seasonal information in the data.

Appendix 3: Data Bank

Date	CPImz	CPIsa	CPIus	CPIpo	NERus	NERsa	NERpo	M1	M2	NGDP	RGDP	RR	
1/90	120.50	94.99	97.51	94.04	847.62	331.68	5.68	374.61	391.10	285.05	113.91	12.00	
2/90	130.80	95.39	97.97	96.20	851.66	334.75	5.77	384.07	400.99	289.82	113.69	12.00	
3/90	137.60	95.59	98.50	96.77	898.85	343.87	5.97	393.53	410.98	294.58	113.47	14.00	
4/90	138.60	97.29	98.65	97.95	923.96	347.97	6.18	402.71	420.70	299.41	113.43	14.00	
5/90	133.80	99.19	98.88	99.01	927.27	350.66	6.31	411.89	430.41	304.25	113.38	14.00	
6/90	131.00	99.49	99.42	99.31	948.63	356.04	6.41	421.08	440.13	309.08	113.34	14.00	
7/90	128.30	99.99	99.80	100.03	950.18	361.65	6.60	433.03	453.07	320.16	113.62	14.00	
8/90	127.20	101.19	100.72	101.29	930.56	361.52	6.71	444.99	466.02	331.24	113.90	14.00	
9/90	130.80	102.69	101.56	102.42	947.93	368.69	6.82	456.94	478.96	342.32	114.18	14.00	
10/90	134.90	102.89	102.17	103.56	929.62	365.42	6.92	469.89	493.44	359.79	114.79	14.00	
11/90	139.60	105.29	102.40	104.28	968.32	688.17	7.41	482.84	507.92	377.25	115.40	28.00	
12/90	147.10	105.99	102.40	105.12	1024.97	727.27	7.75	495.79	522.40	394.72	116.01	28.00	
1/91	152.30	107.79	103.02	106.67	1032.94	738.34	7.68	497.43	526.49	409.59	116.81	28.00	
2/91	158.80	108.49	103.17	108.57	1024.80	751.47	7.86	499.07	530.58	424.47	117.61	28.00	
3/91	166.80	108.99	103.32	109.12	1088.51	733.95	7.81	500.72	534.67	439.34	118.41	28.00	
4/91	176.70	109.49	103.48	109.79	1266.19	696.93	8.57	526.23	561.98	451.91	119.07	28.00	
5/91	174.80	110.79	103.78	110.68	1408.29	681.47	9.42	551.74	589.29	464.49	119.74	28.00	
6/91	183.50	111.39	104.09	111.35	1506.80	667.70	9.64	577.26	616.60	477.06	120.40	28.00	
7/91	171.10	112.49	104.24	111.91	1513.97	666.63	9.80	576.17	617.40	495.63	120.60	28.00	
8/91	179.40	112.99	104.55	112.69	1504.33	670.30	10.06	575.08	618.19	514.19	120.80	28.00	
9/91	184.80	114.49	105.01	112.91	1547.16	684.77	10.61	573.99	618.98	532.76	121.00	28.00	
10/91	191.20	115.59	105.16	113.58	1796.16	708.02	12.35	602.74	648.97	557.55	120.73	33.00	
11/91	194.10	116.09	105.47	114.13	1768.56	725.18	12.50	631.50	678.96	582.35	120.46	33.00	
12/91	198.90	116.79	105.54	114.80	1755.90	733.48	12.61	660.26	708.96	607.14	120.19	33.00	
1/92	215.80	117.19	105.70	115.80	1876.31	730.76	13.73	686.09	736.94	556.75	119.25	33.00	
2/92	233.10	117.69	106.08	117.25	1911.30	731.35	13.71	711.93	764.93	506.35	118.31	33.00	
3/92	238.90	118.79	106.61	118.37	2011.52	733.00	14.06	737.77	792.91	455.96	117.37	33.00	
4/92	253.80	119.99	106.77	120.26	2294.02	784.23	16.29	780.92	841.80	435.19	116.64	39.00	
5/92	259.10	121.19	106.92	121.48	2343.12	822.53	17.36	824.07	890.68	414.43	115.91	39.00	
6/92	258.50	122.69	107.30	121.93	2462.12	864.24	18.82	867.22	939.57	393.66	115.18	39.00	
7/92	261.50	123.39	107.53	122.49	2745.97	996.95	21.76	881.26	960.17	429.09	116.09	39.00	
8/92	251.00	124.49	107.84	123.04	2921.13	1057.05	23.34	895.30	980.76	464.53	116.99	39.00	
9/92	253.60	124.89	108.14	123.15	2862.00	1022.74	22.48	909.35	1001.36	499.96	117.90	39.00	
10/92	269.60	125.69	108.53	123.49	2882.62	1001.66	21.81	947.52	1043.99	592.05	120.45	39.00	
11/92	291.40	125.59	108.68	123.93	2940.24	981.54	20.78	985.69	1086.62	684.14	123.00	43.00	
12/92	307.30	126.39	108.60	124.49	2948.25	978.29	20.76	1023.86	1129.24	776.23	125.55	43.00	
1/93	325.10	126.99	109.14	125.60	2958.30	964.44	20.33	1064.25	1180.53	893.54	128.54	43.00	
2/93	328.90	128.29	109.52	126.61	2972.64	951.96	19.86	1104.64	1231.81	1010.85	131.54	43.00	
3/93	343.30	128.99	109.91	127.05	2999.81	943.82	19.71	1145.03	1283.09	1128.16	134.53	43.00	
4/93	348.70	129.99	110.21	127.72	3038.25	959.35	20.53	1191.80	1343.73	1171.31	140.20	43.00	
5/93	357.20	129.99	110.36	128.39	3110.15	979.29	20.48	1293.18	1456.90	1214.45	145.86	45.00	
6/93	355.60	130.39	110.52	128.72	3399.55	1048.58	21.61	1325.62	1504.23	1257.60	151.53	45.00	
7/93	361.20	131.49	110.52	129.61	3692.04	1102.32	22.07	1400.25	1587.62	1315.07	149.43	45.00	
8/93	359.60	132.09	110.82	130.17	4108.80	1221.18	23.69	1455.40	1645.16	1372.55	147.34	45.00	
9/93	384.50	132.29	111.05	130.50	4610.65	1352.54	27.72	1559.12	1763.86	1430.02	145.24	45.00	
10/93	390.90	132.69	111.51	131.28	5009.35	1476.50	29.58	1665.01	1885.74	1502.56	145.40	43.00	
11/93	404.40	133.69	111.59	132.17	5221.38	1551.64	30.01	1782.49	2006.41	1575.09	145.55	43.00	
12/93	441.40	134.49	111.59	132.51	5369.92	1590.34	30.75	1795.81	2018.65	1647.63	145.71	43.00	
1/94	482.40	135.89	111.89	133.51	5437.37	1594.71	30.87	1842.12	2075.56	1709.99	145.98	43.00	
2/94	514.30	137.59	112.28	134.29	5509.15	1596.99	31.40	1982.79	2219.09	1772.35	146.26	43.00	
3/94	545.60	138.09	112.66	134.62	5615.36	1625.23	32.25	2033.58	2279.86	1834.71	146.53	43.00	
4/94	552.60	138.99	112.81	135.40	5723.23	1596.15	32.99	2104.91	2352.43	1892.25	147.25	43.00	
5/94	555.90	140.39	112.89	135.74	5785.62	1592.71	33.80	2228.19	2470.98	1949.80	147.97	43.00	
6/94	567.80	141.69	113.27	135.96	5916.86	1630.11	35.14	2332.71	2594.35	2007.34	148.69	55.00	
7/94	595.10	143.59	113.58	136.18	6138.20	1673.56	38.03	2338.18	2604.64	2087.75	149.09	55.00	
8/94	639.30	145.49	114.04	136.40	6296.97	1750.17	39.40	2467.86	2740.23	2168.15	149.49	55.00	
9/94	639.40	145.79	114.34	136.63	6397.00	1798.84	40.47	2255.37	2825.73	2248.56	149.89	55.00	
10/94	657.30	146.62	114.42	137.18	6473.01	1818.15	41.69	2759.18	3031.89	2352.87	149.91	55.00	
11/94	677.70	147.41	114.57	137.41	6552.29	1859.06	41.66	2861.89	3144.00	2457.17	149.93	55.00	