THE IMPACT OF OIL IMPORT DEPENDENCY ON A DEVELOPING COUNTRY: A KEYNESIAN ECONOMETRIC MODEL ANALYSIS OF THE KENYAN ECONOMY

BY

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DECLARATION

This research paper is my original work and has not been presented for a degree in any other University.

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DEDICATION

This work is dedicated to my most beloved Wife Elizabeth Nekesa, my daughter Elsie, sons Jeffrey & Duncan for their invaluable love, support and patience as I worked for long hours on it.

Thank you so much you are the reason for my struggle.

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ABSTRACT

Oil dependence remains a potentially serious economic and strategic problem to oil importing developing countries. Large oil imports draws heavily on the scarce foreign exchange earnings of the developing countries and hence leading to reduction in imports of capital goods and intermediate goods, with a result that other major macro economic variables shrink. This study evaluates this proposition by developing a Keynesian econometric model of the Kenyan economy using a VAR framework.

Kenya being a net importer of petroleum products has experienced an increasing trend in the value of oil imports for the period under review, an average of 26% per annum. This is an indicator of wealth transfer from Kenya to oil producing nations, which would otherwise have been used to import capital and intermediate goods. The highest annual growth rates were experienced in 1974 (264%), 1980 (90%) and 1993 (101%). The oil import bill was 26.01%, 37.26 and 24.3% during the same period respectively. The temporal rise in oil prices seem to have had temporal negative effect to the major macro economic variables immediately or within the next one or three years. The inverse relationship is much seen in imports of capital goods and investment. In 1974 and 1980 the value of oil imports grew by 264% and 90% respectively. Imports of Capital goods shows a drop in growth rate from 12% in 1973 to -2% in 1974 and a drop from 24% in 1980 to 12% in 1983. Investments fell from 26% in 1974 to -22 in 1975 and also dropped from 49% to 2% in 1981. Imports of Consumer goods and Government Expenditure show a direct relationship with sharp increase in oil prices.

The empirical results show that movements of the macro variables are interdependent and therefore all of them can be targeted indirectly in any policy move. Specifically most of the macro variables react to unit shocks in imports of petroleum products. Thus any factor such as price increase and short supply of petroleum products will influence the direction of the other variables. We found that imports of capital goods react positively to shocks in imports of petroleum products and the impact is persistent and only dies out at the very end of the forecast period. Investment and private consumption reacts cyclically to shocks from imports of petroleum products while imports of consumer goods react positively. Imports of petroleum products have a stable and uniform impact on government consumption.

We therefore infer that the long term prospects for economic development and the government's ability to manage the economy are to some extend jeopardized through this dependence on oil imports.

Reliance on oil is a component of the oil dependence problem, but "to import or not to import?" is not the question to the Kenya economy. Even when the oil prices jump the economy will be better off to pay the higher prices than to cut oil import supplies since oil is just another input in the production process. Therefore the ultimate solution to oil dependence lies in changing the fundamental factors that give the OPEC Cartel market power and create oil dependence problem to the oil importing countries and for the policy makers to put in place measures that enhance least cost and efficient supply of petroleum products.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Petroleum plays an important role in the economy of every nation in the world and will remain one of the world's most indispensable commodities. Although Petroleum is important to economies, it has not been evenly or fairly distributed around the world. Some countries are endowed with large quantities of oil resources and have reaped large financial gains because of their petroleum resources. Other countries have been unlucky and infact a majority of countries have no known oil resources for exploitation.

However irrespective of how nature has treated any one country or region of the world, every country that wants to build its economy, improve welfare of its people and become a hub of growth relies to some significant degree on petroleum fuels. Petroleum fuels therefore remain a vital but elusive issue for the whole world.

All economies are consumers of oil in its various forms: a few of these economies are also producers. Energy is the most important part of international trade, but oil alone being the most important item in world trade (PETRAD, Petroleum Down

stream Management, A policy Reference framework for Energy 1997).

Dependence on large oil imports lead to income transfers from oil consuming economies to oil producing economies, induce stagflation through the effect of oil price increases on other product prices and wages, decline in the use of capital intensity depending on whether energy from oil and capital are complements in production process and hence reduce output which leads to reduced demand for savings, investment and employment[1]. For oil importing nations there is always a corresponding worry, that the greater the oil import dependence of the nation, the larger and more persistent the current account deficit and the overall balance of payment difficulties (Richard Mattione 1982).

Oil dependence is the product of (1) a non-competitive world oil market strongly influenced by the OPEC cartel, (2) the importance of oil to oil importing countries (especially the

[1] If oil prices rise suddenly, economic dislocations cause losses of GDP. Delays in adjusting prices, wages and interest rates throughout the economy to the sudden price result in less than full employment of available resources. As a result, economic output falls below its full potential since such macroeconomic adjustment costs result from the economy's inability to respond quickly, they are temporary, and believed to dissipate within three to five years (see Greene et al . Cost of oil dependence: A 2000 update, p 7)

transportation sectors), and (3) the absence of economical and readily available substitutes.

1.2 Kenya Background

Kenya is a net importer of petroleum since it has no known oil deposits. The country imports all petroleum either in form of crude oil or refined petroleum products. The latter includes motor spirit premium (MSP), Motor Spirit Regular (MSR), illuminating kerosene (IK), Jet Fuel, light diesel (Automotive Gas Oil- AGO). The major source of liquidified petroleum gas (LPG), fuel oil, heavy diesel oil is the Kenya Petroleum Refineries Ltd (KPRL). These different petroleum products serve as a source of primary energy in Kenya and account for about 70% of the modern sector energy requirement. In the transport sector where there are no close substitutes the petroleum fuels are used to provide motive energy and in the commercial and industrial sector they provide process energy for production of goods and services including generation of thermal power. At household and institutional level they are used for cooking, lighting and heating. Kenya re-exports some of the petroleum products to the landlocked neighboring countries namely Uganda, Rwanda, Burundi and Democratic Republic of Congo (DRC) and some parts of Northern Tanzania and Southern Sudan.

The National Development Plan (Republic of Kenya; 2002-2008) emphasizes the effective management for sustainable economic growth and poverty reduction. Today the availability and the effective use of petroleum fuels will play a critical role in economic development and achievement of the stated national objectives, strategies and goals.

Kenya's energy sector is largely dominated by imported petroleum that account for 70% of her energy requirement. Despite over 30 years of exploration no commercially viable reserves of fossil fuel have been discovered. This is undesirable situation, which places the country's development at the mercy of international petroleum market, with potentially disastrous consequences as borne out by the oil price shocks of 1974 and 1979 1980.

1.3 Statement of the Research Problem

When the OPEC countries raised the price of crude oil in the 1973/74 period Kenya experienced adverse balance of payments and the country had to resort to heavy borrowing, particularly from the IMF, in order to stay afloat. The rate of employment generation declined, the government placed a freeze on promotions and the cost of living went up by about 35% in

Nairobi[2]. Thus the oil crisis not only slowed down the economic growth momentum in Kenya, but also affected the material well being of Kenyans adversely.

Despite the aforesaid oil import dependence problems, petroleum fuels have no close substitutes in terms of their convenience and range of possible uses. This therefore poses a challenge to policy makers in ensuring adequate supplies of petroleum fuels are made available, efficiently and at reasonable costs in line with the stated goals of government policies.

This study seeks to answer the pertinent question: what is the effect of reliance on oil imports on development of a developing country? Large oil imports often have a significant impact on the balance of payments account, and draws heavily on a country's foreign exchange earnings and other resources. The rate of production in any sector of the economy is to a greater extent influenced by the existing capacity to produce, which is dominated by imports of capital goods and intermediate goods. Given that foreign exchange reserves are limited and it is not easy for the country to raise short-term

[2] The petroleum Industry and Energy Sector Study (Dec 1977) by MASR Economic Services Limited

finance, temporary oil price increases can force the country to reduce her imports of other goods, with the result that domestic consumption, investment and employment generation also shrink. In view of this it is important for policy makers to be able to capture the effects of petroleum sector on the economy as a whole by evaluating the petroleum import expenditures[1] on the major macroeconomic variables such as total consumption, GDP, total imports, total exports, government expenditure and investment.

1.4 Objectives of the study

The main aim of this study is to evaluate the effects of reliance on oil-imports on the economy. The specific objectives include: -

1. Establishing the relationship between oil import Petroleum expenditures and imports of capital goods and intermediate goods over time.
2. Using appropriate macro economic model analyze the impact of oil import petroleum expenditures on major economic variables.

Based on the findings in (1) and (2) above, suggest appropriate policy recommendations on strengthening the role of petroleum sector on the economy as a whole.

[1] [illegible] value of imports of petroleum products in the Kenyan economy

1.5 Justification and Significance of the study.

The stated goal of the Kenya government economic policy is to raise the rate of economic growth to a level, which achieves a broad based improvement in the standards of living and well being of the Kenyans. It is recognized that economic growth of above 6.6% is required to achieve the poverty eradication targets set out in the National Poverty Eradication Plan (NPEP) while growth rates of above 7% are required to achieve the industrial transformation goals by 2020.[4]

Energy is essential to economic and social development. To achieve higher growth rates the developing countries needs sharp increases in energy supplies to improve the living standards of growing populations[5]. In the last 20 years these countries have expanded their manufacturing industries, which are energy intensive; have urbanized; have switched from traditional, non-commercial energy sources to modern fuels; and have seen a big expansion in the motor vehicle ownership. As a result the demand for oil has been on the increase. However developing countries face particular difficulties in this field. They rely on oil imports for almost all of their commercial energy needs (i.e. use more than twice as much oil

[4] National Development Plan 2002
[5] Cahit Gurkok, UNIDO-Energy Efficiency 2002

as industrialized countries do to produce each unit of output), spending substantial amount of their foreign exchange resources to buy more oil as energy source. The exchange reserves are limited and it is not easy for those countries to raise short term finance. Therefore, even temporary oil price increases can force the countries to reduce their imports of other goods, with the result that domestic consumption and investment also shrink. The debt-servicing costs are likely to increase, if higher oil prices lead to higher international interest rates (Aman K., 2000)

In view of the above Kenya being one of the developing countries has to find ways to accommodate the oil import problems, because oil will continue to remain an essential factor in expanding production to enable the economy reach a stage of self sustained economic independence. With the limited scope for replacing oil with other energy sources, as is the capacity, both technical and financial, to introduce more energy-efficient processes, the economy must continue to finance the oil import bill which accounted for 25.7% and 19.6% in 2000 and 2001 respectively.

This study will therefore investigate the effects of petroleum imports on major macro economic variables and if possible the

extent to which an expansion or contraction of the petroleum sector would affect other GDP components. This will enable policy markers to capture the effects of the petroleum sector on the economy as a whole.

Oil imports in developing countries account for substantial amount of total import expenditures that increase in periods of relatively high oil prices, such as during the early 1980's. Oil prices have continued to be very volatile. The macro economic effects of oil prices have been many and include stagflation, income transfers, reduction in growth and investment. Knowledge of the interrelationship between oil expenditures and macro economic variables will enable policy makers to adopt the appropriate financial risk management techniques and import control measures, which provide scope for smooth adjustment of the economy to oil price shocks and thus enhance their ability to plan. Further, the effects of oil imports to the economy would also prompt policy makers to think aggressively on any available alternatives or ways of conserving the use of petroleum products than ever before.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature

The two oil price shocks of 1973-4 and 1979-80 have been so far the largest price movements to occur in the international economy in the postwar period. Higher oil prices affect the world economy through several channels. The adverse effects on oil importing developing countries are particularly more pronounced.

Claessens and Varangis (1991) show how risk management instruments can be used by a state oil importing company to insure against price fluctuations for crude oil. They simulate two scenarios: the short term hedge, in which the state oil-importing company locks in a price for its imports for one month ahead and the long-term hedge, in which it locks in the price for six months ahead. The short-term hedge reduces oil price volatility a potential 72 percent to 85 percent; the long-term hedge, a potential 65 percent to 81 percent. Apparently oil importing developing countries could gain considerably from using financial risk management instruments. But several constraints, particularly negative publicity and legal obstacles, can impede a state oil-importing company's use of risk management instruments. Sensitizing government

policy makers and state enterprise officials about the proper use, limits and benefits of risk management instruments will make them more acceptable.

The macroeconomic effects of the oil price increases have been many and the extent to which they contributed to stagflation is still debated. A number of authors[8] have cited improper policy, rather than oil price increases, as the main cause of inflation and growth slowdown during the 1970s. Cleveland and Bhagavatula (1981) for example, placed most of the blame for American inflation and recession on inappropriate domestic monetary policy. Chenery (1981) attributes most of the growth slowdown to western anti-inflation policies, which overreacted to the oil price increases.

An OECD study (1999) found that a year-long US$10 per barrel hike in oil prices, an equivalent to about 37 percent increase over current levels would raise inflation rates in US, EU and Japan by 0.4 to 1.1 percentage points[9]. Real growth in these economies would be 0.2 to 0.5 percentage points lower. The study attributed lower inflationary impact to US and Japan to their greater short-term real wage flexibility compared to EU.

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[8] Also Richard P. Mattione reviewed the work of authors mentioned here in 1984.

[9] OECD Economic Outlook, December 1999.

The output effect is largest in Japan, reflecting its high dependence on oil imports. In the EU, the impact on growth is ameliorated by an increase in its exports to the OPEC countries, where it has a sizeable market share.

Howard G. (2001) asserts that the growing oil imports pose a serious threat to the US national security and economic well being. Imports account for over 50% of US oil use and are expected to exceed 60% within a decade. High and growing oil import dependence adds to US trade deficit, leaving the US economy vulnerable to oil spikes and increased dependence on the OPEC cartel. The study recommends that United States should therefore take steps to lower oil imports. Her best opportunity for cutting oil imports lies on the demand side, specifically by increasing passenger vehicle fuel economy. Adopting either tougher fuel economy standards or petroleum product consumption caps would be the most effective strategy for reducing US future dependence on oil imports. In addition, the ACEEE[8] recommends expanding taxes on gas guzzling vehicles, offering tax credits to buyers of efficient hybrid and fuel cell vehicles, increasing labeling and promotion of efficient and cleaner vehicles and continuing vigorous research and development efforts.

[8] American Council for an Energy Efficient Economy

2.2 Empirical literature

Shams (1988) undertook a study to test the impact of OPEC's oil revenues on the major macroeconomic indicators GNP, investment and inflation. For each of the OPEC countries a reduced form approach was used to assess the quantitative significance of oil revenues on the economy. The following equation was used to estimate three indicators of macroeconomic performance - GNP, real investment and the general price level.

$$Z_t = \alpha + \sum_{i=0}^{4} B_i M_{t-i} + \sum_{i=0}^{4} B_i G_{t-i} + \sum_{i=0}^{4} B_i R_{t-i} + \varepsilon_t \quad \text{..... 1}$$

Where Z is an indicator of macroeconomic performance, M_{t-i} is the money supply, G_{t-i} is the government spending measure of fiscal policy, and R_{t-i} is oil revenue, α constant term and Bs coefficients for each variable.

The econometric results showed a direct positive impact of oil revenues on GNP, but a rather weak influence on investment and the level of prices for almost all OPEC countries. Fiscal policy proved to be the major demand management tool in those countries where monetary policy is ineffective in influencing economic performance.

Pearce D. and Westboy R. (1985) carried out a study whose purpose was to measure the impact of the 1976 oil price 'hike' on a selected group of developing countries. The study adopted a straightforward income-determination model in which domestic oil revenues are treated as a 'tax' revenue from oil exports as an exogenous source of government revenue.

The basis of the model was a standard GDP accounting identity modified such that government expenditure is disaggregated into domestic oil revenue, foreign oil revenue, non-oil taxes and net government financing. Keynesian behavioural equations relate consumption and investment to national income net of non oil taxes and oil revenue, while the non-oil trade balance is a linear function of overall national income. Net government borrowing enters the model as an exogenous variable while domestic oil revenue is related directly to the aggregate oil ratio multiplied by national income (which equal domestic oil consumption) by making the oil price a numeraire. It follows that foreign oil revenue equals the external oil price multiplied by the shortfall between domestic oil production and domestic oil consumption. The model derived was as follows:

$Y = C + I + G + E - M + DOR + FOR + T + GF$ 2

Where

Y is national income

C is private consumption

I is private investment

G is Government expenditure

E is non-oil exports

M is non-oil imports

DOR is domestic oil revenue

FOR is foreign oil revenue

T is non-oil taxes

GF is net government financing.

The model is used in order to derive an elasticity of national income in world oil prices. This elasticity is calculated for a number of developing countries and it is employed to estimate the impact of the 1979 oil price 'hike'. In general they found that, dollar for dollar, a 1% change in world oil prices affects developing countries considerably more than the developed countries.

Khaoya D. (1998) in his study set out to estimate demand elasticities for motor spirit in Kenya. The study indicates that the demand for motor spirit in Kenya is determined by its own real price, the real price of Gas Oil, real income per

capita and stock of motor vehicles. The study also found that the long run demand for motor spirit is real price and income inelastic.

Pradeep M. et al (1992) analyses the nature and magnitude of the 1970s oil shocks, adjustment policies of oil importing developing countries and the effects of those events on economic growth, the sectoral composition of output and the distribution of income. The study identifies the patterns of successful and unsuccessful adjustment that can guide policy reform in the face of future terms of trade shocks. It also allows the development methods of comparative analysis which can be replicated in the study of similar episodes elsewhere.

Onjala D. (1992) conducted a study on the energy - economy interactions in Kenya. Based upon the estimated macro-model, simulation runs were conducted to study the impact generated by 10% to 20% increases in energy price on energy consumptions, economic growth and inflation. The results revealed a relatively weak long-run energy-economy linkage. However these price changes generate noticeable impact on energy consumption, inflation and export earnings.

Khan M.S. and Knight M. D. (1982) observed that a decline in the terms of trade of non-oil developing countries occurred after each episode of oil price increases and stood at 7.6 percent (1974-75) and 7.3 percent (1980-81). However in both cases, favourable movements in the prices of primary commodities coincided with the price increase and helped to mitigate part of the adverse effect. The average annual growth for non-oil primary commodities was nearly 12 percent for the period 1973-81.

2.3 Overview of the literature

While there has been a large body of literature on the petroleum studies on both oil producing and importing economies, as well as case studies of individual countries, few of these studies have dealt with the effects of dependency on oil-imports for developing countries and models of the world economy have tended to ignore the developing countries or treat them in a superficial manner.

Studies reviewed for the Kenya economy have tended to model the energy sector as a whole or an individual petroleum product. It is therefore difficult to capture the effects of the entire petroleum sector on the economy as a whole.

Although the impacts of energy generated from fossil fuels are relatively well understood our challenge is to effectively balance the complexities and interdependencies inherent in energy issues within the context of sustainable development. In order to explore the development implications of the petroleum sector more fully, an econometric model of the Kenyan economy is required. Our study will make a contribution in that direction and will be much interested on the petroleum import expenditures versus import of capital goods and intermediated goods and its correlation with other economic factors such as investments, consumption, and GDP.

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1 The Model Specification

The macro econometric model for this study is adopted from the previous works of Heidarian J. and Green R. (1989) with slight modifications to capture the effects of petroleum import expenditures on the other major macro economic variables in the Kenya context. The model depicts the economy of Kenya as a set of interrelated dynamic processes involving an income-expenditures sequence. A key role in these processes is played by the mutual feedback among the imports of the petroleum sector and exports of goods and services. The rate of production in any sector of the economy is strongly influenced by the existing capacity to produce, which is dominated by imports of capital goods. Given that the exchange reserves are limited and it is not easy for the country to raise short-term finance, temporary oil price increases can force the country to reduce her imports of other goods, with the result that domestic consumption, investment and employment generation also shrink. Imports of the petroleum sector are therefore a major determinant of expenditure flows.

In formulating a model of the Kenyan economy, total consumption, exports, imports and Government expenditures are

further divided into their main components. The objectives of the study will be evaluated by a Keynesian econometric model of the economy using a VAR framework. The definitions of the variables are given below, and a description of the functional relations follows.

Variables

C	=	Total consumption
CP	=	Private Consumption
CG	=	Government Consumption
Y	=	Gross Domestic Product
GE	=	Total Government expenditure
I	=	Domestic Investment
M	=	Total Imports
MP	=	Imports of petroleum products
MK	=	Imports of capital goods and intermediate goods
MC	=	Imports of consumer goods
X	=	Total Exports
XP	=	Petroleum Re-exports
XNP	=	Non-Petroleum Exports
PM	=	Imports price index

3.1.1 Consumption function

The consumption function is based on Keynes's fundamental psychological law[9], which hypothesizes that people will increase consumption as their incomes increases, but not by as much as the increase in their disposable income as shown in the following relation.

$C_{it} = Y_{it}$ 3

Where

[9] It should be noted that, in recent years, empirical observations have several times seemed to conflict with the Keynesian hypothesis. The attempt to reconcile the basic theory of consumption function with existing evidence has led to a series of modified theories aimed at solving different sets of statistical results.

C_{it} = real consumer expenditure for individual i at time t

Y_{it} = real disposable income for individual i at time t

Consumption behaviour in the Kenya economy can be estimated by incorporating some basic characteristics of the dualistic economy by disintegrating the consumption function into two parts: private consumption and Government consumption.

Private consumption is assumed to be a function of income in the same period and private consumption lagged one period, where lagged private consumption represents dependence on past behaviour.

Government consumption is taken as a function of total government expenditures. The consumption functions are therefore as follows:

$CP = a_{10} + a_{12}Y + a_{13}CP_{-1} + \varepsilon_i$ 4

$CG = a_{20} + a_{21}GE + \varepsilon_i$ 5

$C = CP + CG$ 6

3.1.2 Investment function

Acknowledging the recent developments in modeling the aggregate investment function which include the user-cost of capital, the partial adjustment model, the accelerator model, Tobin's Q and Empirical models our investment function developed here is basically on Keynesian theory. Theoretically, Keynes proposed that investment takes place as long as marginal efficiency of capital (MEC) is more than the market rate of interest. This implies that, given the investors expectation regarding the future, investment is inversely related to the interest rate. The interest rate is of little importance in explaining investment behaviour in the case of Kenya. This is because for a long time (until the decontrol of interest rates in Oct 1991) there has been no freely determined interest rate that reflected the real scarcity of loanable funds as well as organized capital market. Also in Kenya, the government has been the dominant investor in all sectors (public enterprises)[10], so the factors such as interest rate, sales and profits, which affect the direction of investment behaviour, could not necessarily

[10] Immediately after independence, the Government set out to strengthen the parastatal sector by reorganizing existing ones and creating new parastatals. The strategy of directly participating in productive activities was meant to decolonise the economy, promote development and regional balance, increase citizen participation in the economy and ensure greater public control of the economy. By 1982, the Philip Ndegwa report on Government expenditure noted that the Government had interest in some 323 parastatals

affect the direction of government investment. Therefore since the government has been the dominant investor, it could be safely said that investment is a function of total government expenditure and lagged investment. The Kenyan investment relationship is therefore specified as:

$$I = a_{30} + a_{31}GE + a_{32}I_{-1} + \varepsilon_3 \qquad \text{_____} \quad 7$$

3.1.3 Foreign trade relations

Foreign trade relations are modeled with import and export equations.

Imports are usually significantly related to changes in national income and price of imported goods relative to domestic prices. Here we divide imports into three functional categories; consumer goods, petroleum, and capital goods. This will allow for investigation of their interaction with investment and GDP. Four equations are used to explain the behaviour of the import sector, three of which are behavioural and the fourth an identity:

$$MC = a_{40} + a_{41}Y + a_{42}MC_{-1} + \varepsilon_4 \qquad \text{_____} \quad 8$$

$$MK = a_{50} + a_{51}I + a_{52}PM + \varepsilon_5 \qquad \text{_____} \quad 9$$

$$MP = a_{60} + a_{61}Y + a_{62}MP_{-1} + \varepsilon_6 \qquad \text{_____} \quad 10$$

$$M = MC + MK + MP \qquad \text{_____} \quad 11$$

Assuming a fixed exchange rate, exports depend on foreign circumstances, such as foreign national income and prices. While we are holding the domestic price level constant, this makes exports dependent only on foreign influences and hence makes them exogenous to the domestic economy (i.e. export are autonomous expenditure flows). Since Kenya re-exports petroleum products we have disaggregated Kenya's exports into petroleum products re-exports and non-petroleum exports. The following identity represents exports.

$$X = XP + XNP \quad \text{.....} \quad 12$$

3.1.4 Government Expenditure functions

Generally government plays a dominant role in economic activity in developing countries and hence government financial policies affecting the public sector have a major impact on the economy. Here GDP is taken as the major determinant of government expenditures.

The government expenditure function is as follows:

$$GE = a_{70} + a_{71}Y + \varepsilon_i \quad \text{.....} \quad 13$$

3.1.5 The aggregate demand function

Adding the identity of gross domestic product Y (which is equal to aggregate demand function) to this model makes it a complete system:

$$Y = C + I + (X-M) \quad \text{.....14}$$

Where

$$C = CP + CG$$

$$I = I$$

$$X = XP + XNP$$

$$M = MC + MK + MP$$

Therefore Equation 14 becomes: -

$$Y_t = CP_t + CG_t + I_t + X_t - MC_t - MK_t - MP_t + \varepsilon_t \quad \text{.....15}$$

3.1.6 The estimation Model

The empirical exercise involves estimation of a multivariate VAR that includes the variables of a Keynesian national income identity as explained under Variables. A VAR is chosen in this case based on the argument that for structural inference, VARs based on economic reasoning and institutional detail, at their best, can provide sensible estimates of some causal connections (Stock and Watson, 2001). The VAR approach side-steps the need for structural modeling by modeling every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system and can be used for analysing the dynamic impact of random

disturbances on the system of variables. However, even without a strong theory linking economic variables, an unrestricted VAR can be estimated and plausible non-parametric analyses made. The study begins by specifying the following general VAR (k):

$Y_t = A_1Y_{t-1} + A_2Y_{t-2} + \cdots\cdots\cdots + A_pY_{t-k} + \epsilon_t$ ——— 16

This can be expressed compactly as;

$Y_t = i_{-1}\sum^{p} A_iY_{t-k} + \epsilon_t$ 17

Where; Y_t = a 8 x 1 column vector comprising current values of the endogenous variables,

A_i = an 8 x 8 matrix of non zero coefficients,

ϵ_t = an 8 x 1 column vector of identically and independently distributed random errors.

From the VAR in equation 17, the basic equation of the Johansen procedure assuming the variables are I(1) and that they can form a cointegrating vector that can be given a structural interpretation can be derived as;

$\Delta Y_t = \pi Y_{t-k} + _{i-1}\sum^{k-1} \Gamma_i \Delta Y_{t-i} + \epsilon_t$ ----------18

The π matrix comprises the longrun beta coefficients. The significance of the Granger representation theorem is determined by the rank of the coefficient matrix π. The possibility of r cointegrating vectors means that there exists

an r by n matrix β', of rank r, such that $\beta' Y_t$ is stationary. The π matrix assuming there is cointegration can be decomposed into two matrices as;

$$\pi = \alpha\beta' \quad \text{------19}$$

$\alpha\beta$ represents the matrix of adjustment coefficients and longrun β coefficients with both α and β being n x r matrices of rank $r \leq n$. The β matrix is the longrun or cointegrating vectors and the α matrix contains the weighting elements or error correction coefficients, which indicate the speed of convergence towards long run equilibrium.

Equation 18 is reformulated into a Vector-Error correction model as:

$$\Delta Y_t = \alpha(\beta' Y_{t-k-1}) + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \xi_t \quad \text{----------20.}$$

With $\beta' Y_{t-1}$ representing the lagged error correction terms. We can interpret the relations $\beta' Y_{t-1}$ as stationary relations among non-stationary variables which ensures that Y_t converges to its equilibrium-steady-state (Hansen and Juselius, 2001). The Γ matrix captures the shortrun adjustments showing the various linear combinations of the variables in the VAR in their first differences. Equation 20 contains information-both the shortrun and longrun adjustment to changes in Y_t. Once $\alpha\beta$

are identified then equation 20 can be used for empirical analysis in this paper.

3.1.7 Empirical implementation

Before estimating the model, each series is tested for unit roots using the ADF and Philips-Perron tests. This is important because, according to the Granger representation theorem, if the variables of study are integrated of the same order, i.e., greater than zero, then there might exist a linear combination of them that is stationary, that is, the. π matrix is less than full rank. Having ascertained the order of integration of the variables, cointegration tests are carried out. To do this all of the variables must be integrated of the same order (greater than one). The Johansen (1988) procedure is employed to determine cointegration based on the stationarity tests. The approach estimates the maximum number of cointegrating vectors among the economic variables, using VARs, when there is little or no a priori knowledge of their association (Craigwell et al, 2001). If cointegration is established then equation 20 is estimated (the vector error correction model). If not then an unrestricted VAR model can be estimated without loss of information since the π matrix is null and the variables are stationary in first differences. Granger-non-causality tests, variance decompositions, and impulse response functions are then used in the next stage of

analysis. These statistics are used for portraying comovements of multiple time series captured in the VAR that cannot be detected in univariate or bivariate models. These summary statistics are useful because they provide targets for theoretical macroeconomic models.

3.4 Data Sources

Time series annual data for specified variables was collected from CBS Statistical Abstracts and Economic surveys (Government of Kenya). The study utilizes secondary data for the period between 1971 and 2001. Data for year 2002 is still provisional and hence omitted in this study.

CHAPTER FOUR
DATA ANALYSIS AND EMPIRICAL RESULTS

4.0 Overview

In this chapter we present the findings of our diagnostic tests of the data and empirical results of the model specified in chapter 3. Sections 4.1, 4.2 and 4.3 show the stationarity, cointegration and ECM analysis results while the succeeding section 4.4 derive the empirical results of our model.

4.1 Descriptive statistics

4.1.1 Data analysis and Preliminary empirical observations

The relationship between imports of petroleum products and other variables is analyzed here below. Kenya being a net importer of petroleum products has experienced an increasing trend in the value of oil imports for the period under review, an average of 26% per annum (figure 1). This is an indicator of wealth transfer from Kenya to oil producing nations, which would otherwise have been used to import capital and intermediate goods. The highest annual growth rates were experienced in 1974 (264%), 1980 (90%) and 1993 (101%). The oil import bill was 26.01%, 37.26 and 24.35 during the same period respectively. This is attributed to high oil prices as result of:

1. Yom Kippur War- Arab Oil Embargo

In 1972 the price of crude oil was about $3.00 and by the end of 1974 the price of oil had quadrupled to $12.00. The Yom Kippur War started with an attack on Israel by Syria and Egypt on October 6, 1973.

2. Crises in Iran and Iraq

Events in Iran and Iraq led to another round of crude oil price increases in 1979 and 1980. The Iranian revolution resulted in the loss of 2 to 2.5 million barrels of oil per day between November of 1978 and June of 1979. In 1980 Iraq's crude oil production fell 2.7 MMBPD and Iran's production by 600,000 barrels per day during the Iran/Iraq War. The combination of these two events resulted in crude oil prices more than doubling from $14 in 1978 to $35 per barrel in 1981.

3. OPEC's Failure to Control Crude Oil Prices

From 1982 to 1985 OPEC attempted to set production quotas low enough to stabilize prices. These attempts met with repeated failure as various members of OPEC would produce beyond their quotas. During most of this period Saudi Arabia acted as the swing producer cutting its production to stem the free falling prices. In August of 1985, the Saudis tired of this roll. They linked their oil prices to

the spot market for crude and by early 1986 increased production from 2 MMBPD to 5 MMBPD. Crude oil prices plummeted below $10 per barrel by midyear. A December 1986 OPEC price accord set to target $18 per barrel was already breaking down by January of 1987. Prices remained weak. The price of crude oil spiked in early 1990 with the uncertainty associated Iraqi invasion of Kuwait until 1994.

The temporal rise in oil prices seem to have had temporal negative effect to the major macro economic variables immediately or within the next one or three years. The graphs in appendix 1(figure 2 7) show the relationships between imports of petroleum products and other variables. The inverse relationship is much seen in imports of capital goods and investment. In 1974 and 1980 the value of oil imports grew by 264% and 90% respectively. Imports of Capital goods shows a drop in growth rate from 12% in 1973 to -2% in 1974 and a drop from 24% in 1980 to 12% in 1983. Investments fell from 26% in 1974 to -22 in 1975 and also dropped from 49% to 2% in 1981. Imports of Consumer goods and Government Expenditure show a direct relation ship with sharp increase in oil prices.

In the period 1971 to 1980 the average oil prices per barrel was US$31.74 while for the period 1981 to 1991 and 1991 to

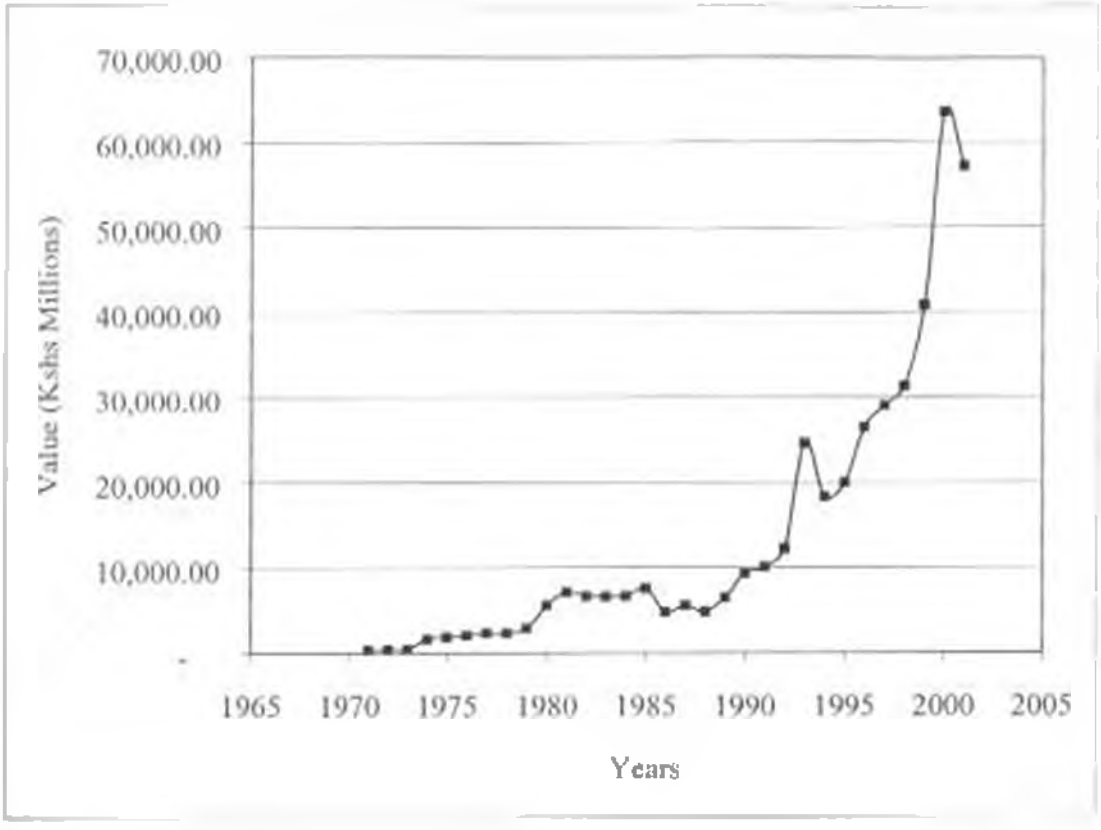
2001 the average prices were US$35.6 and US$ 18.93 respectively. The greatest economic damage was done during the first half of the 1980's, a period in which oil prices surged to peak of over US$60 per barrel in 1981 (1998 US $). Much of the decrease was on the imports of capital goods and intermediate goods. The oil crisis of 1973 -1974 appears to have had a much smaller economic impact, although it is remembered as a time of crisis and disruption.

However, the effects of oil price rise might not be well picked out because other factors such as government budgetary hikes/cuts, poor/good infrastructure, high/low interest rates, reduced/increased donor funds could have contributed to stableness or fluctuations in these economic variables. For example the low growth rates after 1995 especially on investment and imports of capital goods could also be attributed to reduced donor funding, poor infrastructure, corruption and uncertainty of the political environment in the country.

In addition, for a country like Kenya where the government has for a long time been the dominant investor in all sectors, the influence of oil increases would not to a large extend affect

the direction of investment and hence the imports of capital goods.

Figure 1: Value of Oil Imports in Kenya 1971 - 2001



Source: Authors own computation

4.2 EMPIRICAL RESULTS

4.2.1 Unit root tests

The results of the unit root tests indicated that all the variables are integrated of order one. The results are corroborated by inspection of the correlogram plots (autocorrelation functions). The autocorrelation functions for

all the variables showed stationarity after first differences. Table 1 shows the summary results of the unit root tests.

Table 1a: Unit Root Tests of variables in levels

Test	logy	logx	logmp	logmc	logi	logcp	logmk	Log cg
ADF	-2.328 (-3.58)	-2.051 (-3.57)	-2.98 (-3.57)	-1.99 (-3.57)	-2.12 (-3.57)	-2.41 (-3.57)	-2.18 (-3.57)	-2.21 (-3.57)
PP	-1.997 (-3.57)	-2.27 (-3.57)	2.67 (-3.57)	-2.56 (-3.57)	2.71 (-3.57)	-2.51 (-3.57)	-2.45 (3.57)	-1.789 (-3.57)

Table 1b unit root tests of variables in first differences

Test	dlogy	dlogx	dlogmp	dlogmc	dlogi	dlogcp	dlogmk	dl og cg
ADI	-3.67 (-3.57)	-3.59 (-3.57)	-3.89 (-3.57)	-4.59 (-3.57)	-5.01 (-3.57)	-5.05 (-3.57)	-3.16 (-3.57)	4.21 (-3.57)
PP	4.72 (-3.57)	-5.55 (-3.57)	-5.51 (-3.57)	-6.59 (-3.57)	-6.43 (-3.57)	-5.57 (-3.57)	-5.59 (3.57)	4.31 (-3.57)

The Mackinnon critical values for rejection of hypothesis of a unit root are shown in parentheses (at 5% level)

Since all the variables are I(1), we propose that the variables may be cointegrated since cointegration theory argues that although macro variables may tend to be nonstationary, groups of variables may drift together, that is their linear combinations may be stationary. If there is some tendency for some linear relationships to hold amongst a set of variables over long periods of time, then cointegration analysis helps discover it.

4.2.2 Cointegration analysis

We proceed from the conclusion that all the series are I(1) based on the above tests to analyze the cointegration relationships among the variables(see Ndung'u, 1999). Given

group of non-stationary series, we are interested in determining whether the series are cointegrated, and if they are, in identifying the cointegrating (longrun equilibrium) relationships. A VAR was employed in the Johansen maximum likelihood procedure to test for cointegration. Table 2 shows the results of the cointegration test. The likelihood ratio test rejects the hypothesis of no cointegration but not the hypothesis of at most one cointegrating equation at 1% level.

TABLE 2 Cointegration Test

Sample: 1971 2001
Included observations: 29
Test assumption: No deterministic trend in the data
Series: LOGY LOGCP LOGCG LOGI LOGMC LOGMK LOGMP LOGX
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.983092	238.4019	141.2	152.32	None **
0.720237	119.0351	109.99	119.8	At most 1 *
0.660869	82.09449	82.49	90.45	At most 2
0.474796	48.972	59.46	66.52	At most 3
0.368709	30.29093	39.89	45.58	At most 4
0.29005	16.95726	24.31	29.75	At most 5
0.210389	7.022097	12.53	16.31	At most 6
0.005939	0.172749	3.84	6.51	At most 7

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 1% significance level

Unnormalized Cointegrating Coefficients

LOGY	LOGCP	LOGCG	LOGI	LOGMC	LOGMK	LOGMP	LOGX
2.694505	-6.905142	5.320947	-1.44357	0.409152	0.031189	-0.59813	0.90245
2.53593	0.074497	-5.592384	1.114479	0.188536	1.678511	0.506752	-0.811933
0.153444	0.942742	0.91068	-1.423396	1.501098	0.500576	0.532692	1.185749
0.077851	1.488245	-0.65167	-0.499325	0.965588	-0.261624	-0.111446	-1.265748
-2.710185	1.593293	1.087252	1.258494	1.239586	-1.479712	-0.427221	1.966877
-1.011243	1.860855	3.325232	0.136628	0.108861	-0.453313	-0.571674	0.895995
0.422118	0.217539	0.411539	-0.073704	0.338642	0.147499	0.220638	-1.243365
-1.132979	0.167889	1.516749	0.405157	-2.155752	0.340503	-0.73722	1.675216

Normalized Cointegrating Coefficients 1 Cointegrating Equation(s)

LOGY	LOGCP	LOGCG	LOGI	LOGMC	LOGMK	LOGMP	LOGX
1	2.562818	1.978923	-0.535734	0.161843	0.011575	-0.221978	0.334915
	(0.09008)	(0.1261)	(0.02685)	(0.02494)	(0.02207)	(0.01828)	(0.04151)

Log likelihood 311.5867

The results provide a normalised cointegrating relation of the form: -

LOGY-2.563LOGCP+1.97LOGCG 0.54LOGI+0.152LOMC+0.011LOGMK-0.22LOGMP+0.33LOGX

The cointegrating equation shows that private consumption, investment and petroleum imports growths positively influence real income (Log Y) consistent with the propositions of the Keynesian national income identity model. On the other hand, government consumption, imports of consumer goods, imports of capital goods and exports moved oppositely with economic output. Economic growth may have been stagnated by oil price shocks, which affected exports and therefore government consumption. This cointegrating relation shows the longrun interlinkage of these macroeconomic variables in the real sector of the economy.

From the cointegration analysis, a Vector- Error Correction model was estimated which is found to be free of serial

correlation from inspection of the graphs of the residuals (appendix 1). The model results are shown in the appendix 3. The cointegrating coefficient (error correction term) shows a speed of adjustment of 0.2% that is significant to economic growth (log Y). It also shows a speed of adjustment of 3.95% to the log of petroleum imports, 1.37% to the log of investment, 0.1% to the log of imports of capital goods and 1.09% to the log of consumer goods imports which are significant.

We follow the standard practice in VAR analysis by reporting results from Granger causality tests, impulse responses and forecast error-variance decomposition. Stock and Watson (2001) argue that because of the complicated dynamics in the VAR, these statistics are more informative than are the estimated VAR regression coefficients or R^2 statistics.

4.2.3 Granger-non-causality tests

In this stage we use the cointegrating vector in a multivariate Granger non-causality tests, together with the variables in first differences to determine which variables drive each other. Finding cointegration is proof that the variables predict each other at least in one direction. When carrying out these tests for a particular variable, we

consider that in addition to entering the model in rates of change, it is also part of the error correction term- the cointegrating vector (see Ndung'u, 1997). This procedure pays attention to the long-run information in the data, and helps us get more efficient estimates and make sure that the standard distributions for statistical inference are valid since all variables are stationary (Ndung'u, 1997). Granger-causality statistics examine whether lagged values of one variable help to predict another variable. The existence of causal ordering in Granger's sense points to a law of causation and implies predictability and exogeneity. If the variables of interest are cointegrated, it implies that there exist stationary linear combinations. Finding cointegration among a set of variables implies Granger-causality at least in one direction. A lack of cointegration suggests that variables have no longrun link: in principle, they can wander arbitrarily faraway from each other (Hansen and Juselius, 2001).

Multivariate Granger-causality tests

The multivariate tests were carried out by least squares estimation of eight equations and from each equation we test for causality by way of the probability values reported and the coefficient restriction tests. The estimated OLS equations

are identical to the equations estimated in the VECM. This system helps capture the multivariate Granger-causality tests. The summary results are shown in the table 3 below.

Table 3: Multivariate granger causality tests

	Variables		A	B	C	D	E	F	G
	↓	equation →							
		lags	logy	logcp	logmp	logcg	logi	logmc	logmk
A	logy, Ecm,logx	1-2	3.17[0.004]	-1.14[0.26]	-1.586[0.12]	-0.322[0.75]	-0.627[0.53]	-1.939[0.06]	-2.456[0
B	logcp,Ecm,logx	1-2	2.83[0.009]	3.82[0.00]	-0.575[0.57]	1.76[0.09]	1.08[0.29]	1.757[0.09]	0.977[0.3
C	logmp,Ecm, logx	1-2	1.06[0.29]	-0.002[0.99]	3.68E+12[0.00]	0.61[0.54]	-3.322[0.003]	-2.460[0.002]	-1.351[0
D	logcg,Ecm,logx	1-2	-2.71[0.01]	0.48[0.63]	3.707[0.001]	1.79[0.08]	0.56[0.578]	0.600[0.55]	1.598[0.1
E	logi,Ecm,logx	1-2	2.69[0.013]	2.69[0.01]	-1.822[0.082]	2.52[0.02]	3.1[0.005]	-0.184[0.855]	0.868[0.3
F	logx	1-2	1.22[0.23]	1.741[0.09]	2.663[0.01]	1.26[0.22]	3.675[0.001]	4.784[0.0001]	2.256[0.0
G	logmc,Ecm,logx	1-2	-1.61[0.12]	0.389[0.70]	-0.552[0.58]	-1.06[0.30]	-3.519[0.001]	-2.616[0.015]	0.043[0.9
H	logmk,Ecm,logx	1-2	-0.50[.61]	-1.99[0.05]	-2.516[0.02]	0.19[0644]	-0.135[0.89]	-0.499[0.62]	0.375[0.7

Table 3 shows the t- statistics of the granger causality tests with the probabilities reported in parentheses. From a), the lagged values of log Y, log CP, log CG, Log I together with the cointegrating equation and the log of exports (Exogenously specified) granger cause the growth of real income (log Y).

In b), the lagged values of log CP, log I and log X granger-cause private consumption growth.

From c), the lagged values of log I, log X and log MK granger cause imports of petroleum products. This implies that imports of capital goods growth rate have a relationship with imports of petroleum products. Investment is also seen to influence/predict imports of petroleum products. Hence energy

from oil and capital are complements in the production process and would influence output and hence demand for investment.

From d), private consumption granger- cause government consumption. Investment is also seen to granger cause government consumption. Also imports of capital goods (which have a relationship with government consumption and hence indirectly, imports of petroleum products have an impact on government consumption through the longrun cointegrating relationship.

In e), Imports of petroleum products significantly predicts investment and hence the overall economy since investment in turn predicts real income growth. Exports and imports of consumer goods are also found to move investment growth.

In f), growths in imports of consumer goods are seen to be moved by income growths, private consumption, imports of petroleum products, exports growth and imports of consumer goods.

From g), imports of capital goods are granger-caused by income growth and exports.

The results can be summarized in an equation as follows:

$\log Y = f(\log CP_t, \log Y_{-1}, \log I_{-1}, \log CG_{-1})$

$\log CP = f(\log CP_{-1}, \log X_{-1}, \log I_{-1}, \log MK_{-1})$

$\log MP = f(\log MP_{-1}, \log X_{-1}, \log MK_{-1}, \log CG_{-1})$

$\log CG = f(\log CP_{-1}, \log MK_{-1}, \log I_{-1}, \log CG_{-1})$

$\log I = f(\log MP_{-1}, \log I_{-1}, \log X_{-1}, \log MC_{-1})$

$\log MC = f(\log Y_{-1}, \log CP_{-1}, \log MP_{-1}, \log X_{-1}, \log MC_{-1})$

$\log MK = f(\log Y_{-1}, \log X_{-1})$

4.2.4 Forecast Error variance Decomposition

The strength of the causation among the variables could be assessed by decomposing the forecast error variance (Ndung'u, 1997). Variance decomposition decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. It gives information about the relative importance of each random innovation to the variables in the VAR. The VAR model is used to decompose the innovations in the variables into portions that can be attributed to other variables[11]. The variance decompositions are shown in table 4

[11] See Ndung'u(1997) for a detailed step by step analysis of an example of a VAR model.

Table 4 Variance decompositions

Variance Decomposition of LOGY

Period	S.E.	LOGY	LOGCP	LOGCG	LOGI	LOGMC	LOGMK	LOGMP
1	0.054	100.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.123	85.284	1.035	0.214	0.980	4.531	0.507	7.449
5	0.179	84.145	0.861	0.762	1.753	4.704	1.030	6.746
7	0.232	82.256	0.998	1.523	1.866	5.334	1.565	6.458
9	0.281	80.900	1.279	2.221	1.915	5.562	1.950	6.183
11	0.326	79.730	1.562	2.783	1.919	5.748	2.281	5.978
13	0.369	78.865	1.786	3.216	1.916	5.866	2.523	5.827
15	0.408	78.182	1.975	3.553	1.910	5.956	2.713	5.711
17	0.445	77.654	2.123	3.817	1.904	6.022	2.858	5.623
19	0.479	77.234	2.243	4.028	1.898	6.072	2.973	5.554
21	0.512	76.897	2.341	4.194	1.894	6.112	3.064	5.498

Variance Decomposition of LOGCP:

Period	S.E.	LOGY	LOGCP	LOGCG	LOGI	LOGMC	LOGMK	LOGMP
1	0.044	17.769	82.231	0.000	0.000	0.000	0.000	0.000
3	0.099	40.539	43.863	5.685	0.089	0.129	3.381	0.315
5	0.142	59.897	22.926	13.225	0.370	0.746	2.494	0.342
7	0.187	65.226	13.753	16.566	0.432	1.250	2.254	0.519
9	0.231	66.985	9.048	18.742	0.486	1.604	2.494	0.581
11	0.273	67.656	6.493	19.959	0.514	1.976	2.747	0.656
13	0.312	67.856	4.975	20.766	0.536	2.195	2.972	0.701
15	0.349	67.891	4.001	21.306	0.551	2.381	3.153	0.737
17	0.383	67.860	3.339	21.603	0.563	2.484	3.297	0.764
19	0.415	67.809	2.864	21.980	0.571	2.580	3.411	0.784
21	0.445	67.753	2.511	22.199	0.578	2.655	3.503	0.801

Variance Decomposition of LOGCG:

Period	S.E.	LOGY	LOGCP	LOGCG	LOGI	LOGMC	LOGMK	LOGMP
1	0.043	34.175	0.849	64.977	0.000	0.000	0.000	0.000
3	0.116	48.565	2.538	45.435	0.477	0.110	2.544	0.333
5	0.194	47.331	5.536	40.875	0.176	1.139	4.760	0.383
7	0.268	47.434	6.440	38.322	0.109	1.617	5.562	0.511
9	0.337	47.029	7.318	36.936	0.094	1.963	6.093	0.567
11	0.401	46.826	7.810	36.042	0.092	2.193	6.419	0.617
13	0.461	46.639	8.183	35.434	0.096	2.358	6.648	0.648
15	0.516	46.506	8.443	34.999	0.099	2.474	6.808	0.673
17	0.567	46.402	8.639	34.678	0.103	2.563	6.926	0.691
19	0.614	46.321	8.789	34.433	0.106	2.631	7.016	0.705
21	0.659	46.257	8.906	34.243	0.108	2.684	7.086	0.716

ce Decomposition of LOGI

1	0.128	20.269	8.432	2.394	68.905	0.000	0.000	0.000
3	0.278	17.884	28.659	11.618	38.835	0.987	3.933	2.286
5	0.379	23.202	23.950	13.522	31.970	0.815	5.183	1.358
7	0.478	25.445	24.533	14.920	27.512	0.810	5.779	0.992
9	0.564	27.179	24.421	15.808	24.748	0.919	6.174	0.753
11	0.645	28.319	24.476	16.441	22.730	0.997	6.429	0.609
13	0.720	29.142	24.481	16.893	21.277	1.075	6.622	0.510
15	0.789	29.754	24.487	17.231	20.188	1.136	6.765	0.440
17	0.854	30.218	24.489	17.490	19.353	1.186	6.877	0.388
19	0.915	30.581	24.489	17.692	18.698	1.227	6.965	0.348
21	0.973	30.870	24.489	17.851	18.175	1.260	7.036	0.317

ce Decomposition of LOGMC

1	0.154	30.548	3.111	4.466	29.098	32.776	0.000	0.000
3	0.246	22.105	10.711	4.648	23.409	35.118	0.349	3.661
5	0.295	21.330	8.510	3.914	26.653	35.878	0.479	3.235
7	0.340	19.554	7.605	3.377	27.492	38.089	0.378	3.508
9	0.377	18.300	6.637	2.905	28.595	39.374	0.315	3.606
11	0.411	17.228	6.235	2.635	29.262	40.640	0.204	3.730
13	0.443	16.353	5.783	2.378	29.834	41.693	0.228	3.830
15	0.472	15.632	5.409	2.170	30.271	42.403	0.201	3.913
17	0.500	15.033	5.111	2.002	30.630	43.059	0.181	3.985
19	0.526	14.532	4.862	1.862	30.924	43.611	0.164	4.044
21	0.551	14.108	4.654	1.745	31.170	44.075	0.151	4.095

ce Decomposition of LOGMK

1	0.142	1.042	1.791	23.000	41.853	0.009	31.770	0.000
3	0.269	11.317	2.730	32.400	35.702	0.781	16.550	0.513
5	0.378	18.294	1.468	36.360	29.386	0.431	15.550	0.510
7	0.477	19.954	1.030	37.773	25.347	0.280	15.260	0.357
9	0.569	22.233	0.999	38.543	22.470	0.233	15.252	0.270
11	0.653	23.867	1.030	38.929	20.481	0.229	15.264	0.211
13	0.732	25.007	1.104	39.183	19.033	0.238	15.284	0.171
15	0.805	25.861	1.176	39.305	17.959	0.253	15.303	0.143
17	0.873	26.511	1.243	39.400	17.138	0.268	15.317	0.123
19	0.937	27.016	1.300	39.467	16.498	0.282	15.330	0.107
21	0.997	27.418	1.350	39.515	15.968	0.294	15.340	0.095

mposition of LOGMP

1	0.237	11.495	11.546	2.548	4.677	1.512	1.124	87.099
3	0.407	8.975	16.188	1.830	20.681	1.256	7.806	44.364
5	0.575	11.532	15.202	2.440	18.494	2.724	13.299	36.309
7	0.724	14.643	14.918	3.383	17.543	2.841	14.497	32.175
9	0.870	16.546	15.377	4.269	16.364	3.220	15.286	28.958
11	1.005	18.052	15.484	4.931	15.584	3.427	15.589	26.982
13	1.130	19.090	15.685	5.454	14.930	3.590	15.800	25.445
15	1.247	19.887	15.795	5.850	14.454	3.717	15.928	24.371
17	1.358	20.488	15.899	6.161	14.063	3.811	16.013	23.548
19	1.459	20.956	15.974	6.408	13.791	3.884	16.074	22.915
21	1.556	21.328	16.037	6.602	13.557	3.942	16.120	22.414

ring: LOGY LOGCP LOGCG LOGI LOGMC LOGMK LOGMP

Most innovations in real income growth are from own shocks. In the first horizon, 100% of innovations in log Y result from own shocks, which marginally decline as the forecast period increases and at the end of the forecast horizon, 76% of innovations are being accounted for by own disturbances. Imports of petroleum products account for about 5-7% of log Y shocks. This shows that shocks in petroleum products due to, for instance, import prices fluctuations, could account for the movements in real GDP growth. Imports of consumer goods, become important in accounting for log Y innovations as the forecast period rises (6%) and also capital goods imports show a rising pattern. This account suggests an important relationship between these variables. Government consumption also takes on an increasing role in accounting for the innovations in log Y.

The log of Y is seen to account for most of the innovations in the other variables. For instance, it accounts for over 60% of the innovations in log CP, 40% in log CG, 30% in log I, 27% in log Mk and about 20% in log MP. These results propose an important interlinkage between the home and foreign economies.

The log of Imports of petroleum products account for most of own innovations in the initial stages of the forecast period which die out slowly and seem to settle at 22% at the end of the forecast period. Investment growth, log of private consumption, log Y and the log of imports of capital goods assume increasing roles in accounting for innovations in imports of petroleum products with each accounting for over 15% of the innovations in log MP. The results show that movements in these macro variables are interdependent and therefore all of them can be targeted indirectly in any policy move.

In the case of innovations in imports of capital goods, it is government consumption that accounts for most of the innovations (about 35 - 40%), perhaps are undertaken by the government. Investment is also seen to account for about 16% of the innovations in imports of capital goods suggesting that

investment demand and imports of capital goods drive each other.

The variance decomposition results have uncovered evidence that the Keynesian income identity has longrun relationships and that they could be endogenous in each macroeconomic model of any of these variables.

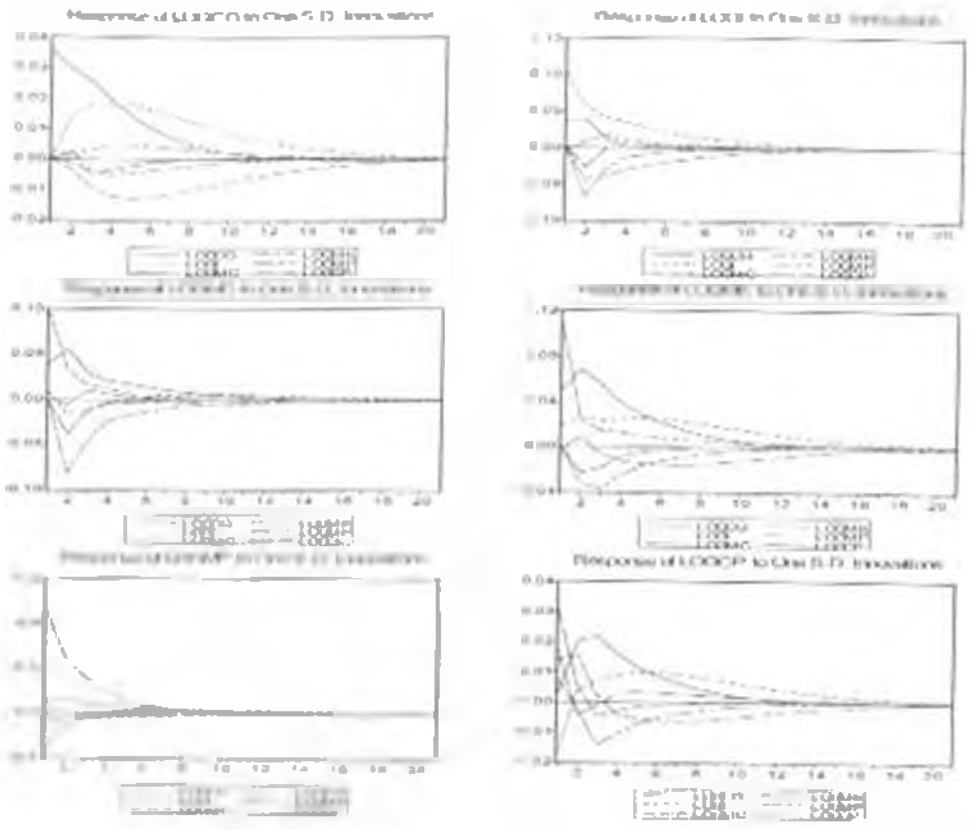
4.2.5 Impulse responses

The impulse responses of one unit shock are shown in figure 2. An impulse response function traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables

The impulse response functions have shown that the estimated model is stable since they are converging and not explosive. They therefore serve as diagnostic tests together with the variance decompositions. We look at how the variables react to unit shocks in imports of petroleum products.

In the case of government consumption, we see that a unit shock in imports of petroleum products has a stable and uniform impact on government consumption that only dies out at the end of the forecast period. Investment reacts cyclically to shocks from imports of petroleum products.

Figure 2: Impulse response functions



Imports of consumer goods react positively and the impact from imports of petroleum products is stable and persists up to the 14th horizon and then dies out. Imports of capital goods react positively to shocks in petroleum products and the impact is persistent and only dies out at the very end of the forecast period. Owns shocks in petroleum products imports dies out almost immediately (3rd period). The effect of a unit shock in imports of petroleum products are cyclical in private consumption and seem to stabilize in the 3rd year. Thus a shock in imports of petroleum products (say a price rise) or an oil

supply shortage due to cartel arrangements has a non predictable and persistent impacts on private consumption and shocks in all the imports of petroleum products have persistent impacts amongst themselves as well as in the other variables. Therefore, what happens in the oil producing countries affects petroleum products and hence any economy that is dependent on imports of petroleum products.

CHAPTER FIVE
CONCLUSION, POLICY RECOMMENDATIONS, LIMITATIONS AND FURTHER AREAS OF STUDY

5.1 Conclusion and Policy Recommendations

In this study, we set out to evaluate the effects of reliance on oil imports on the Kenyan economy with specific objectives of establishing the relationship between Petroleum import expenditures and imports of capital goods and intermediate goods over time and the correlation between major economic variables and petroleum import expenditures. The analysis rests on the simple Keynesian econometric model customized to the Kenyan economy. The results of the model are reasonable. However, it should not be viewed as a final product but as a part of a progressive research strategy where new models improve and encompass old ones.

Our most striking observation is the impact on most of the economic variables as a result of upward oil price changes. In the period 1971 to 1980 the average oil prices per barrel was US$31.74 while for the period 1981 to 1991 and 1991 to 2001 the average prices were US$35.6 and US$ 18.93 respectively. The greatest economic impact was felt during the first half of the 1980's, a period in which oil prices surged to peak of over US$60 per barrel in 1981 (1998 US $). The temporal rise

in oil prices seem to have had temporal negative effect to the major macro economic variables immediately or within the next one or three years. The inverse relationship is much seen in imports of capital goods and investment. In 1974 and 1980 the value of oil imports grew by 264% and 90% respectively. Imports of Capital goods shows a drop in growth rate from 12% in 1973 to -2% in 1974 and a drop from 24% in 1980 to -12% in 1983. Investments fell from 26% in 1974 to 22 in 1975 and also dropped from 49% to 2% in 1981. Imports of Consumer goods and Government Expenditure show a direct relation ship with sharp increase in oil prices.

Our key empirical finds are as follows: The cointegrating equations shows that private consumption and Investment growths positively influence real income while imports of capital goods and consumption goods growths negatively influence real income. This is consistent with the preposition of the Keynesian national income identity theory. However some variables failed to achieve the correct signs such as government consumption, imports of petroleum products and exports. The cointegrating coefficients show a speed of adjustment of 3.95% to imports of petroleum products.

The results also show that the lagged values of investment, exports and imports of capital goods granger cause imports of petroleum goods. Investment is also seen to influence or predict imports of petroleum products. These results are consistent with the prediction that energy from oil and capital goods are complements in the production process and hence influence output and demand for investment and employment.

Investment, private consumption, real income and imports of capital goods are found to assume increasing roles in accounting for innovations in imports of petroleum products with each accounting for over 15% of the innovations. The results thus show that movements in theses macro variables are interdependent and therefore all of them can be targeted indirectly in any policy move.

We also found that imports of capital goods react positively to shocks in imports of petroleum products and the impact is persistent and only dies out at the very end of the forecast period. Investment and private consumption reacts cyclically to shocks from imports of petroleum products while imports of consumer goods react positively. Imports of petroleum products have a stable and uniform impact on government consumption.

Thus, we safely conclude that the long-term prospects for economic development and the government's ability to manage the economy are to some extend jeopardized through this dependence on oil imports among other factors such as external loans, political uncertainties and government decisions.

5.2 Policy Recommendations

The terms energy security and oil dependence have been frequently used. Oil dependence is often equated with the quantity of oil supply that must be imported. Reliance on oil is a component of the oil dependence problem, but "to import or not to import?" is not the question to the Kenya economy. Even when the oil prices jump the economy will be better off to pay the higher prices than to cut oil import supplies since oil is just another input in the production process and more so in the transportation sector.

Therefore ultimate solution to oil dependence lies in changing the fundamental factors that give the OPEC Cartel market power and create oil dependence problem to the oil importing countries. Possible solutions to this include:

1. Developing advanced technologies to increase the efficiency in use of energy in transportation.
2. Lower the costs of alternative energy sources
3. Accelerate and improve the technology of oil exploration.
4. Enhance the recovery of both conventional and non conventional oil resources.
5. Enhance the procurement policies of oil imports.
6. Improve on oil transportation infrastructure with a view to increasing its exports of oil products to neighbouring countries.
7. Reviews strategic petroleum reserves policies.
8. Deepen the liberalization of the oil industry.

However, achieving such results is likely to require a significantly greater commitment in resources and resolve.

5.2 Limitations of the study and further area of research.

The study adopted a simple Keynesian econometric model while there are modern econometric models that have been developed.

The study uses secondary data, which might not be reliable. Quite often data on petroleum products imports and trade has not been accurately reported. Another limitation is the time lags in producing and capturing annual data for the specified variables in the model. Also the sample size is deemed to be small hence much of the data would have been lost during the estimations of the model.

We suggest that further studies should be conducted to examine and evaluate the responsiveness of an endogenous variable to a unit change in an exogenous variable, evaluate the economic costs of oil dependence to the Kenyan economy in terms of loss of potential GDP, Macroeconomic adjustment costs, and transfer of wealth.

REFERENCES

Andrew M. W (1993); Did the debt crisis or the oil Price decline cause Mexico's investment collapse? Policy research working paper by International Economic Analysis and Prospects

Brian P. (1987); Nigeria during and after the oil boom: a policy comparison with Indonesia, The World Bank Economic Review Vol.1, No.3.

Claessens and Varangis (1991); Study on benefits of using financial instruments to hedge the external exposures of developing countries, Policy research and external affairs working papers.

Craigwell R., Darrin D. and Michael H. (2001), "The finance-growth nexus: A multivariate VAR analysis of a small open economy." *Savings and development*, no. 2 vol. 25 pp. 209-221.

David P. and Richard W. (1985); World oil prices and output losses in developing countries, Centre for Economic Research Policy Research.

Edward S. (fifth edition); Macroeconomic analysis.

Festus O. E. (1999); Determinants of imports in Nigeria: A dynamic specification, African Economic Research Consortium.

Hansen, H. and Fredrick J. (2001), " CATS IN RATS; Cointegration Analysis of Time Series", *University of Copenhagen*.

Howard G. (2001), Strategies for reducing oil imports: Expanding oil production vs. increasing vehicle

efficiency, American Council for an Energy-Efficient Economy.

IEA publication; High prices hurt poor countries more than rich (Paris 20th March 2000)

IMF Institute (1981); Financial Policy Workshops: The case for Kenya.

Jamshid H. et al (1989); The impact of oil export dependency on a developing country, Energy Economics volume 11 Number 4 October 1989.

Khaoya W. D. (1998); Demand for motor spirits in Kenya: an econometric analysis, MA Research Paper University of Nairobi.

Kofi A.; Where the high oil prices really hurts (The international Herald Tribune, October 2000)

Mase economic services Ltd; The petroleum industry and energy sector study (1977), Kenya.

Michael B. (1987); The balance of payments of oil-importing developing countries: an aggregate econometric analysis, Centre for Economic Research policy Research.

Mohsin S. K. and Malcolm D. K., Determinants of current account balances of non-oil developing countries in the 1970s: an empirical analysis, African Economic Research Consortium.

Ndung'u, N.S. (2001); Liberalisation of the foreign exchange market and the short-term capital flows problem. AERC research paper 109.

Ndung'u, N.S (1999); Monetary and exchange rate policy in Kenya. AERC research paper 94.

Ndung'u, N.S (2002), "Synthesis on the papers for the financial sector reforms and restructuring." AERC plenary.

Ndung'u, N.S (1997) " Price and exchange rate dynamics in Kenya: An empirical investigation (1970 1993)". AERC research paper 58.

Onjala J. O (1992); Energy - economy interactions in Kenya, MA Research Paper University of Nairobi.

Pradeep K. M. (1992), Adjustment in oil importing developing countries: a comparative economic analysis.

Richard P. M. (1982), The role of oil exporting nations in world financial flows and payment imbalances, African Economic Research Consortium.

Samiei S. H. (1990), Testing for balance of payment constraints: the case of the oil exporters.

Shams (1988), The impact of oil revenues on the OPEC economy, Energy Economics volume 11 Number 4 October 1989.

Tran V. H., Recent significant advances in estimating and forecasting theories and economic modeling: with applications to ASEAN investment studies (University of Wollongong Department of Economics working paper series 2000).

APPENDICES

Appendix 1: Percentage Growth rates of Major Variable

Table 5

Year	CP	CG	GE	I	MP	MK	MC
1972	8%	11%	10%	0%	24%	13%	-11%
1973	3%	11%	15%	45%	12%	12%	15%
1974	26%	20%	42%	26%	264%	-2%	59%
1975	38%	26%	9%	22%	17%	56%	-16%
1976	14%	19%	16%	29%	9%	22%	11%
1977	15%	27%	37%	50%	13%	36%	37%
1978	21%	24%	21%	38%	0%	37%	29%
1979	16%	12%	16%	-15%	26%	-11%	-14%
1980	13%	19%	23%	49%	90%	24%	51%
1981	16%	17%	29%	-2%	28%	7%	-18%
1982	19%	4%	4%	2%	-7%	-4%	6%
1983	7%	13%	-13%	8%	0%	-12%	6%
1984	16%	6%	33%	12%	0%	32%	34%
1985	3%	13%	8%	39%	13%	-3%	10%
1986	22%	22%	27%	-3%	-37%	41%	32%
1987	16%	13%	13%	27%	16%	26%	-1%
1988	15%	12%	29%	18%	-13%	30%	33%
1989	19%	16%	44%	12%	34%	15%	30%
1990	14%	9%	9%	12%	44%	33%	0%
1991	13%	14%	14%	1%	7%	-4%	6%
1992	24%	5%	-5%	-5%	22%	-1%	14%
1993	16%	25%	45%	32%	101%	23%	77%
1994	20%	19%	5%	32%	-25%	19%	28%
1995	25%	12%	8%	31%	9%	69%	33%
1996	10%	24%	19%	7%	32%	2%	6%
1997	31%	18%	0%	6%	10%	5%	16%
1998	13%	13%	32%	4%	8%	8%	2%
1999	6%	11%	9%	0%	30%	-3%	0%
2000	13%	10%	21%	2%	56%	16%	10%
2001	14%	8%	15%	6%	10%	-4%	35%

Where

CP - Private Consumption

CG - Govt. Consumption

GE - Govt. Expenditure

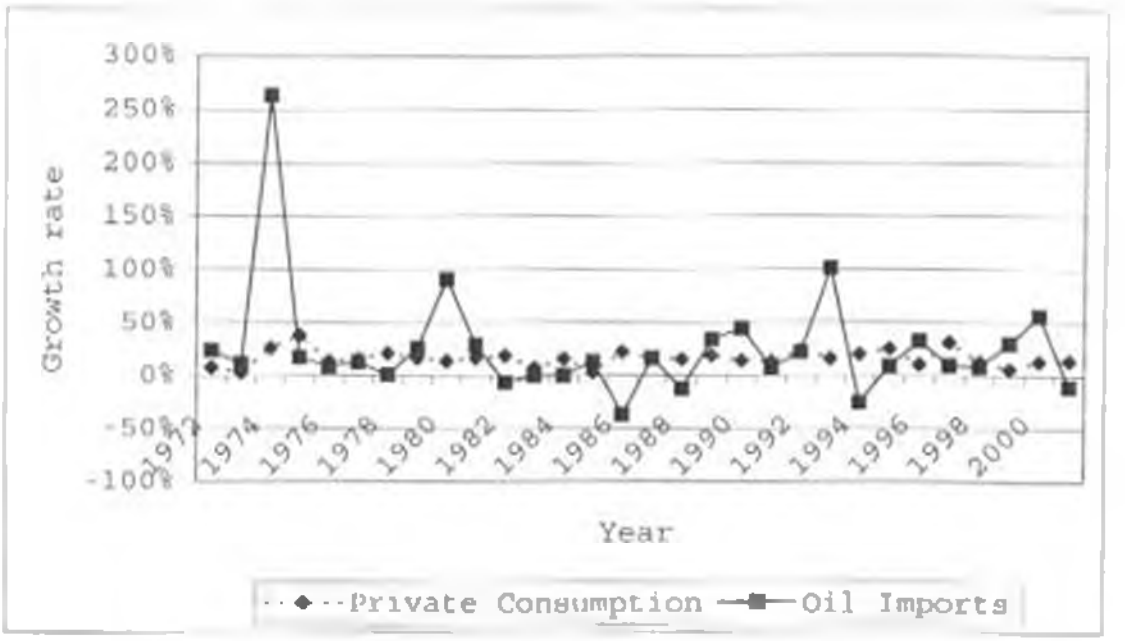
I - Investment

MP - Petroleum Imports

MK- Imports of Capital Goods

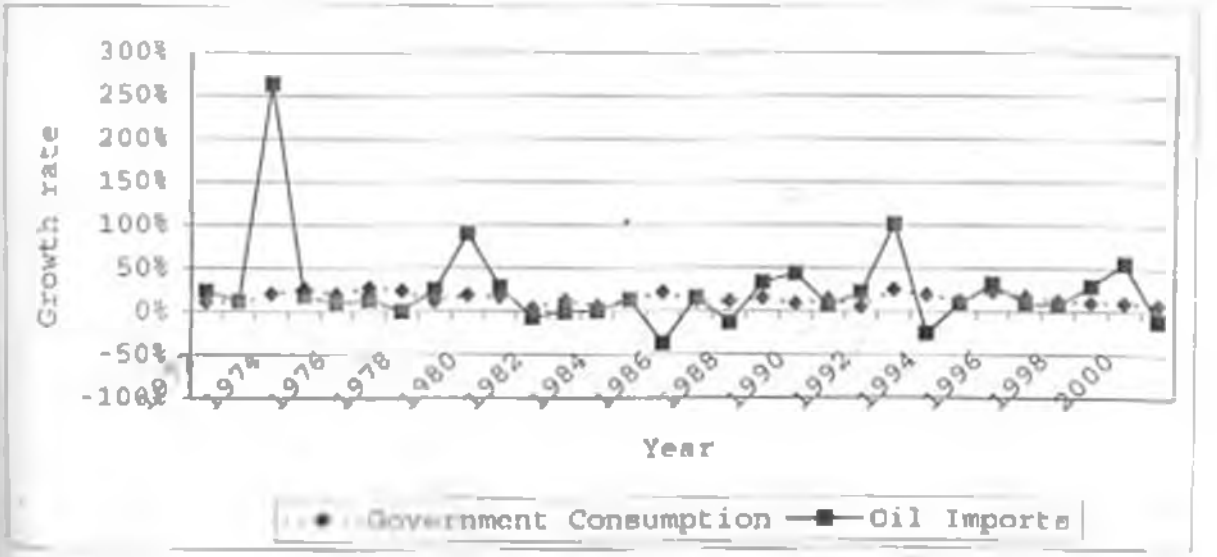
MC - Imports of Consumer goods

Figure 3: Growth rate of imports of petroleum products and private consumption



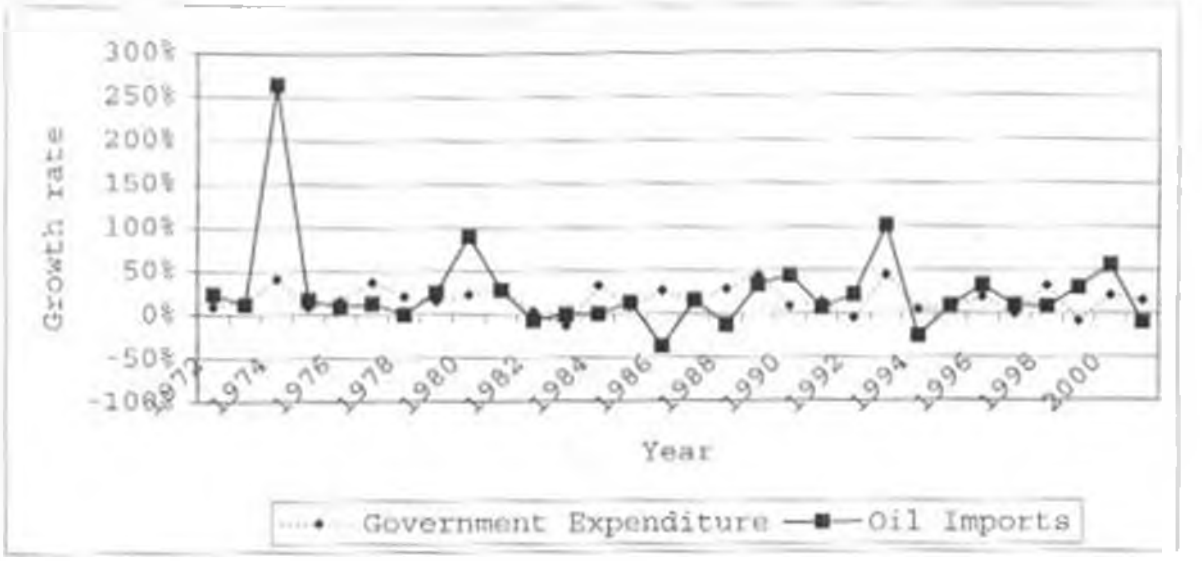
Source: Authors own computation

Figure 4: Growth rate of imports of petroleum products and Government consumption



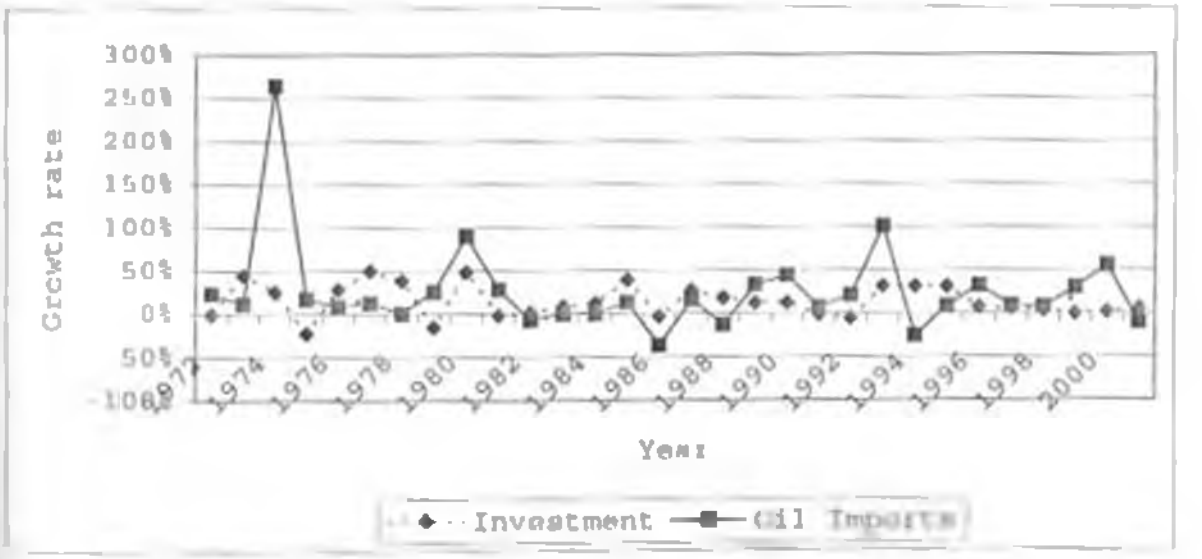
Source: Authors own computation

Figure 5: Growth rate of imports of petroleum products and Government Expenditure



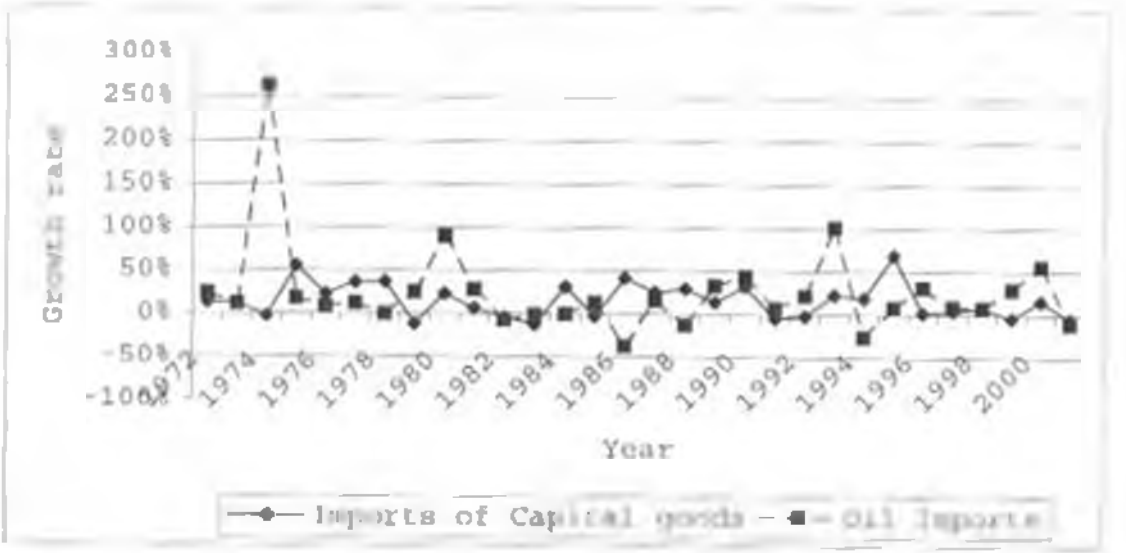
Source: Authors own computation

Figure 6: Growth rate of imports of petroleum products and investment



Source: Authors own computation

Figure 7: Growth rate of imports of petroleum products and imports of capital goods



Appendix 2: Unit Root Tests

Logy			
ADF Test Statistic	-2.328825	1% Critical Value*	-4.3382
		5% Critical Value	-3.5887
		10% Critical Value	-3.2279
*MacKinnon critical values for rejection of hypothesis of a unit root			
PP Test Statistic	-1.997880	1% Critical Value*	-4.2949
		5% Critical Value	-3.5870
		10% Critical Value	-3.2169
*MacKinnon critical values for rejection of hypothesis of a unit root			
ADF Test Statistic	-3.699058	1% Critical Value*	-3.6852
		5% Critical Value	-2.9709
		10% Critical Value	-2.6242
*MacKinnon critical values for rejection of hypothesis of a unit root			
PP Test Statistic	-4.720927	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220
*MacKinnon critical values for rejection of hypothesis of a unit root			
Logxp			
ADF Test Statistic	-2.601211	1% Critical Value*	-4.3382
		5% Critical Value	-3.5887
		10% Critical Value	-3.2279
*MacKinnon critical values for rejection of hypothesis of a unit root			
PP Test Statistic	-2.790841	1% Critical Value*	-4.2949
		5% Critical Value	-3.5870
		10% Critical Value	-3.2169
*MacKinnon critical values for rejection of hypothesis of a unit root			

ADF Test Statistic	-3.868417	1% Critical Value*	-3.8959
		5% Critical Value	-2.9750
		10% Critical Value	-2.6265

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-5.700669	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

Logarp

ADF Test Statistic	-2.089503	1% Critical Value*	-4.3226
		5% Critical Value	-3.5796
		10% Critical Value	-3.2239

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-2.362947	1% Critical Value*	-4.2949
		5% Critical Value	-3.5670
		10% Critical Value	-3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	3.828553	1% Critical Value*	-3.6862
		5% Critical Value	-2.9705
		10% Critical Value	-2.6242

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-5.498926	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root.

logmp

ADF Test Statistic	-2.980190	1% Critical Value*	-4.3082
		5% Critical Value	-3.5731
		10% Critical Value	-3.2203

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-2.671123	1% Critical Value*	4.2949
		5% Critical Value	3.5670
		10% Critical Value	3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	-3.893044	1% Critical Value*	-3.6862
		5% Critical Value	-2.9706
		10% Critical Value	-2.6242

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-5.509008	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

Logmc

ADF Test Statistic	-1.991307	1% Critical Value*	-4.3082
		5% Critical Value	-3.5731
		10% Critical Value	-3.2203

PP Test Statistic	-2.704313	1% Critical Value*	-4.2949
		5% Critical Value	3.5670
		10% Critical Value	3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	-5.008144	1% Critical Value*	-3.6852
		5% Critical Value	-2.9705
		10% Critical Value	-2.6242

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-6.433356	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

log

ADF Test Statistic	-2.413350	1% Critical Value*	-4.3226
		5% Critical Value	-3.5796
		10% Critical Value	-3.2239

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-2.512833	1% Critical Value*	-4.2940
		5% Critical Value	-3.5670
		10% Critical Value	-3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	-5.047763	1% Critical Value*	-3.6852
		5% Critical Value	-2.9705
		10% Critical Value	-2.6242

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-5.572412	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

log cg

ADF Test Statistic	-2.210106	1% Critical Value*	-4.3082
		5% Critical Value	-3.5731
		10% Critical Value	-3.2203

*MacKinnon critical values for rejection of hypothesis of a unit root.

PP Test Statistic	-1.788460	1% Critical Value*	-4.2949
		5% Critical Value	-3.5670
		10% Critical Value	-3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	-4.208883	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-4.309156	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	-2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root.

Log mk

ADF Test Statistic	2.181140	1% Critical Value*	-4.3082
		5% Critical Value	-3.5731
		10% Critical Value	3.2203

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-2.453694	1% Critical Value*	4.2949
		5% Critical Value	-3.5670
		10% Critical Value	-3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-5.500094	1% Critical Value*	-3.6752
		5% Critical Value	2.9665
		10% Critical Value	2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	-3.125821	1% Critical Value*	-3.6852
		5% Critical Value	-2.9705
		10% Critical Value	-2.6242

*MacKinnon critical values for rejection of hypothesis of a unit root

Log a

ADF Test Statistic	-2.051748	1% Critical Value*	4.3226
		5% Critical Value	-3.5798
		10% Critical Value	3.2239

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-2.270129	1% Critical Value*	-4.2949
		5% Critical Value	-3.5670
		10% Critical Value	-3.2169

*MacKinnon critical values for rejection of hypothesis of a unit root

ADF Test Statistic	-3.592279	1% Critical Value*	-3.6852
		5% Critical Value	-2.9705
		10% Critical Value	2.6242

*MacKinnon critical values for rejection of hypothesis of a unit root

PP Test Statistic	-5.548480	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665
		10% Critical Value	2.6220

*MacKinnon critical values for rejection of hypothesis of a unit root

Appendix 3: ECM Model Results

Sample(adjusted): 1973 2001
Included observations: 29 after adjusting endpoints
Standard errors & t-statistics in parentheses

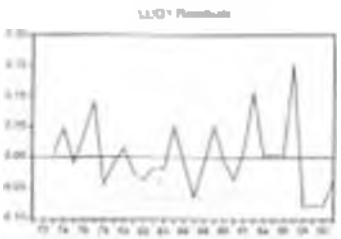
Cointegrating Eq	CointEq1
LOGY(-1)	1.000000
LOGCP(-1)	-1.764773 (0.15187) (-11.8356)
LOGCG(-1)	0.905045 (0.19883) (4.55191)
LOGI(-1)	-0.411846 (0.05642) (-7.29985)
LOGMC(-1)	0.038945 (0.03706) (1.05084)
LOGMK(-1)	0.249047 (0.04220) (5.90138)
LOGMP(-1)	0.147136 (0.02205) (6.67143)

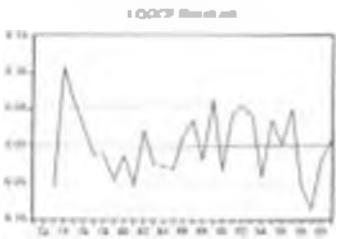
Error Correction	D(LOGY)	D(LOGCP)	D(LOGCG)	D(LOGI)	D(LOGMC)	D(LOGMK)	D(LOGMP)
CointEq1	0.208607 (0.23538) (0.88626)	-0.049069 (0.19435) (-0.25256)	0.371730 (0.18730) (1.98472)	1.374780 (0.56028) (2.45374)	1.091780 (0.67410) (1.61940)	-0.106954 (0.62191) (-0.17198)	3.954887 (1.03939) (3.80497)
D(LOGY(-1))	0.227223 (0.25555) (0.88913)	-0.125383 (0.21101) (-0.59421)	0.077698 (0.20335) (0.38209)	0.270410 (0.60831) (0.44453)	-0.120775 (0.73198) (-0.16500)	-0.333070 (0.67522) (-0.49328)	-1.414051 (1.12849) (-1.25305)
D(LOGCP(-1))	0.094318 (0.32122) (0.29361)	0.152282 (0.26088) (0.57050)	0.445320 (0.25719) (1.73151)	0.107544 (0.76936) (0.21777)	0.194529 (0.92578) (0.21012)	0.677985 (0.85399) (0.79390)	3.052890 (1.42727) (2.13897)
D(LOGCG(-1))	0.356631 (0.31533) (1.13099)	0.738748 (0.26036) (2.83738)	0.336261 (0.25091) (1.34016)	1.024394 (0.75056) (1.36480)	-1.335134 (0.90318) (-1.47826)	1.340846 (0.83314) (1.60939)	-4.189929 (1.39243) (-3.00837)
D(LOGI(-1))	0.114765 (0.11722) (0.97903)	0.153901 (0.09679) (1.59003)	0.135689 (0.09328) (1.45468)	-0.336851 (0.27903) (-1.20721)	0.045445 (0.33576) (0.13535)	0.196334 (0.30972) (0.64036)	-0.108186 (0.51704) (-0.20920)
D(LOGMC(-1))	-0.191629 (0.09771) (-1.96124)	0.010638 (0.08068) (0.13186)	-0.013216 (0.07775) (-0.16998)	0.084478 (0.23256) (0.36322)	-0.034007 (0.27986) (-0.12151)	0.156107 (0.25816) (0.60469)	0.357106 (0.43146) (0.82768)
D(LOGMK(-1))	-0.017147 (0.10347) (-0.16571)	-0.216282 (0.08544) (-2.53152)	0.031065 (0.08233) (0.38458)	0.306186 (0.24630) (1.24316)	-0.154184 (0.29637) (-0.52024)	-0.482445 (0.27339) (-1.76469)	0.221504 (0.45691) (0.48478)
D(LOGMP(-1))	0.080249 (0.04980) (1.61143)	0.015197 (0.04112) (0.36967)	0.087799 (0.03963) (2.21565)	0.019316 (0.11854) (0.16295)	-0.010065 (0.14264) (-0.07056)	0.092315 (0.13158) (0.70160)	0.355800 (0.21991) (1.61798)
LOGX	-0.037023 (0.05110)	-0.005734 (0.04219)	0.086257 (0.04066)	0.310514 (0.12164)	0.208150 (0.14637)	-0.020505 (0.13502)	0.662679 (0.22565)

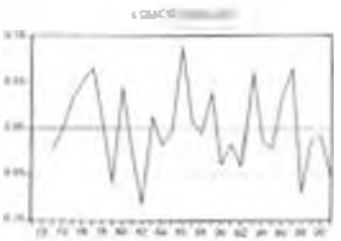
	(-0.72451)	(-0.13580)	[illegible]	(2.56280)	(1.81839)	(-0.21853)	[illegible]
R-squared	0.318641	0.530363	0.375560	0.397520	0.206987	0.263640	[illegible]
Adj. R-squared	0.046097	0.342909	0.129783	0.156527	0.015754	-0.030904	0.308073
Sum sq. resids	0.063688	0.057056	0.052989	0.474176	0.686580	0.584228	1.831887
S.E. equation	0.064887	0.059412	0.061473	0.153077	0.186281	0.170913	0.295647
[illegible]	1.169136	2.823286	1.503585	1.649512	1.086021	0.895077	1.925183
Log likelihood	43.64613	49.20051	50.27274	18.49612	13.12904	15.46980	9.575387
Akaike AIC	-2.388388	-2.772449	-2.846398	-0.664905	-0.284761	-0.448193	0.681008
Schwarz SC	-1.985055	-2.348116	-2.422062	-0.230572	0.139572	-0.021860	1.005341
Mean dependent	0.142806	0.150770	0.140654	0.127257	0.147582	0.136222	0.171584
S.D. dependent	0.066231	0.066871	0.058052	0.167866	0.168758	0.168332	0.321180

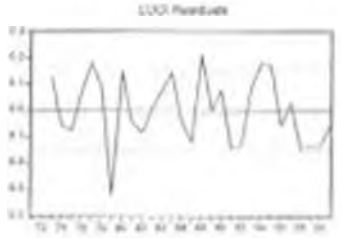
Determinant Residual Covariance	1.17E-16
Log Likelihood	243.8650
Akaike Information Criteria	-11.99069
Schwarz Criteria	-8.690318

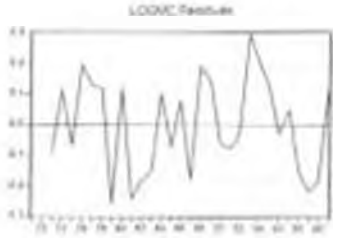
Appendix 4: Residual Graphs

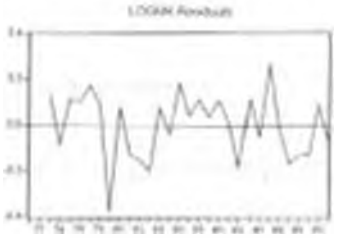


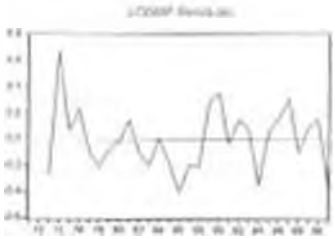




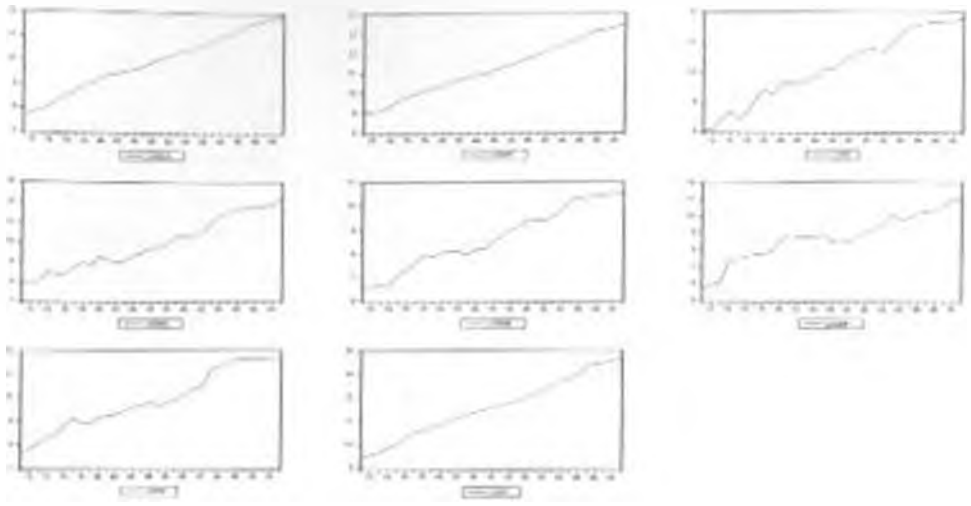




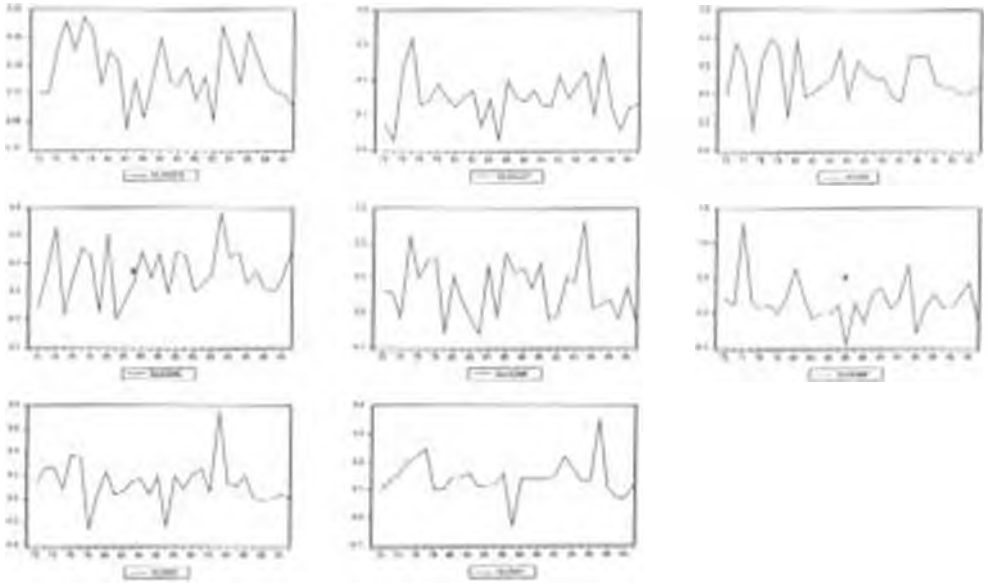




APPENDIX 4: Graphical Representation of Variables at Log Levels



APPENDIX 5: Graphical Representation of Variables at Log Differences



Appendix 7: Data used in Regressions (Kenya shillings millions)

Year	TC	CP	CG	Y	GE	I
1971	10,451.80	8,152.80	2,299.00	12,860.00	3,377.18	3,243.40
1972	11,324.00	8,778.00	2,546.00	14,236.40	3,699.18	3,233.40
1973	11,831.00	9,015.00	2,816.00	16,297.40	4,250.76	4,690.40
1974	14,770.20	11,390.20	3,380.00	19,044.60	6,022.60	5,895.60
1975	19,987.40	15,731.20	4,256.20	23,343.00	6,560.64	4,575.60
1976	22,984.60	17,908.80	5,075.80	29,072.00	7,632.64	5,885.40
1977	27,121.00	20,680.00	6,441.00	37,196.00	10,486.04	8,824.60
1978	32,949.20	24,977.20	7,972.00	41,163.80	12,698.94	12,212.00
1979	37,937.00	28,990.80	8,946.20	45,532.00	14,748.26	10,325.00
1980	43,491.80	32,818.40	10,675.40	52,511.60	18,197.80	15,341.60
1981	50,670.20	38,190.60	12,479.60	60,464.40	23,534.00	15,056.20
1982	58,222.20	45,273.40	12,948.80	70,874.40	24,438.00	15,268.00
1983	63,006.20	48,344.00	14,662.20	79,133.40	21,282.40	16,584.00
1984	71,481.60	55,969.60	15,512.00	88,826.20	28,330.40	18,573.60
1985	75,126.40	57,524.40	17,602.00	99,864.00	30,662.80	25,810.40
1986	91,839.60	70,321.40	21,518.20	116,863.80	39,050.80	25,024.20
1987	106,008.80	81,654.80	24,354.00	112,964.60	44,032.80	31,851.00
1988	121,244.40	93,951.60	27,292.80	129,612.40	56,691.00	37,736.80
1989	143,187.60	111,577.80	31,609.20	149,026.80	81,907.20	42,365.00
1990	161,600.40	127,083.20	34,517.20	170,807.20	89,093.80	47,533.20
1991	183,477.00	144,070.00	39,407.00	195,997.00	101,312.20	47,110.60
1992	220,046.40	178,571.20	41,475.20	228,050.60	96,491.20	44,674.60
1993	268,902.80	207,093.20	51,809.60	283,708.20	139,467.20	58,749.80
1994	310,795.80	249,175.40	61,620.40	338,064.80	145,899.60	77,299.60
1995	381,678.40	312,454.20	69,224.20	384,115.80	157,524.60	101,517.20
1996	430,501.10	344,936.00	85,568.40	437,711.60	187,543.80	109,063.20
1997	553,881.26	453,172.66	100,711.60	623,215.07	186,669.44	115,273.21
1998	623,698.35	510,129.93	113,568.40	690,909.98	246,394.55	120,068.74
1999	665,080.64	539,057.64	125,943.00	742,135.73	225,242.64	120,102.69
2000	749,096.76	609,938.21	139,158.55	795,972.46	272,440.68	122,510.21
2001	845,902.20	695,472.67	150,430.13	895,278.47	313,549.75	129,510.44

Source: Various Economic Surveys and statistic abstract.

(Government of Kenya)

Appendix 7: Continued.

Year	M	MP	MK	MC	X	XP	XNP	PM
1971	4,001.28	318.30	637.48	3,045.50	2,141.56	360.63	1,780.93	117.00
1972	3,821.82	394.89	722.14	2,704.79	2,467.68	381.86	2,085.82	131.00
1973	4,361.78	441.27	812.14	3,108.37	3,227.76	417.63	2,810.13	150.00
1974	7,327.22	1,605.75	792.84	4,928.63	4,225.64	903.60	3,322.04	178.00
1975	7,251.72	1,886.06	1,233.20	4,132.46	4,607.12	1,102.76	3,504.36	225.00
1976	8,139.94	2,050.72	1,510.42	4,578.80	6,707.90	1,371.20	5,336.70	261.00
1977	10,628.92	2,308.42	2,060.12	6,260.38	9,605.18	648.38	8,956.80	281.00
1978	13,222.50	2,318.96	2,821.48	8,082.06	7,380.00	940.50	6,439.50	108.00
1979	12,403.12	2,914.28	2,502.14	6,986.70	7,710.66	1,377.08	6,333.58	114.00
1980	19,202.54	5,545.54	3,092.08	10,564.92	9,752.88	2,327.84	7,425.04	132.00
1981	19,118.10	7,123.00	3,304.06	8,691.04	10,178.36	4,002.70	6,175.66	73.00
1982	18,006.10	6,652.14	3,182.68	8,171.28	10,914.74	2,986.92	7,927.82	220.00
1983	18,112.42	6,633.90	2,807.02	8,671.50	12,661.56	2,687.42	9,974.14	128.00
1984	21,944.12	6,648.58	3,697.80	11,597.74	15,096.26	2,843.82	12,252.44	131.00
1985	23,920.00	7,523.80	3,603.86	12,792.34	15,701.96	2,530.16	13,171.80	155.00
1986	26,757.86	4,771.02	5,089.26	16,897.58	19,159.40	2,136.94	17,022.46	147.00
1987	28,617.60	5,544.80	6,393.40	16,679.40	15,068.20	2,034.80	13,033.40	149.00
1988	35,302.80	4,851.60	8,285.40	22,165.80	18,354.80	2,301.00	16,053.80	134.00
1989	44,779.40	6,488.00	9,529.60	28,761.80	19,996.60	2,001.40	17,995.20	198.00
1990	50,912.80	9,356.20	12,682.80	28,873.80	24,647.60	3,003.20	21,644.40	238.00
1991	52,918.20	10,044.20	12,173.00	30,701.00	32,223.60	4,910.20	27,313.40	265.00
1992	59,097.20	12,237.60	11,993.00	34,866.60	34,161.60	4,391.40	29,770.20	307.00
1993	101,128.40	24,628.20	14,788.40	61,711.80	72,504.20	7,057.40	65,446.80	496.00
1994	115,079.80	18,352.80	17,668.60	79,058.40	83,414.40	5,418.20	77,996.20	445.00
1995	155,168.20	19,985.00	29,876.00	105,307.20	93,123.60	4,777.40	88,346.20	513.00
1996	168,486.00	26,467.60	30,594.00	111,424.40	113,926.00	7,865.20	106,060.80	560.00
1997	190,674.00	29,014.00	32,246.00	129,414.00	114,459.00	7,156.00	107,303.00	598.00
1998	197,789.00	31,354.00	34,867.00	131,568.00	114,445.00	9,127.00	105,318.00	614.00
1999	206,401.00	40,788.00	33,739.00	131,874.00	115,406.00	9,555.00	105,851.00	667.00
2000	247,804.00	63,680.00	39,227.00	144,897.00	119,764.00	9,429.00	110,335.00	739.00
2001	290,108.00	57,214.00	37,521.00	195,373.00	121,434.00	12,345.00	109,089.00	807.00