MACROECONOMIC PLANNING IN KUWAIT:
AN ECONOMETRIC SIMULATION APPROACH

A thesis submitted to the University of SURREY in fulfilment of the requirements for the degree of Doctor of Philosophy in Economics

by MR S SANGARABALAN

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This thesis investigates the various long term options in planning which are open to Kuwait. This is carried out in three stages.

In the first stage, the peculiar features of oil producing 'surplus' economics are discussed. This is followed by a discussion on the various development and growth theories. It is argued that any single theory - classical, Keynesian, structural - is not applicable to a country like Kuwait. Instead, a combination of all these theories and with a suitable depletion theory is recommended.

In the second stage, a macroeconomic model based on a Keynesian income - expenditure framework is constructed. Since the model is to be used as a long term growth model, a supply side is included. The supply side is further disaggregated into three - Manufacturing, Mining and Residual - subsectors. Each sector is represented in terms of a Cobb-Douglas production function.

In the third stage the various alternative plans are investigated by applying a dynamic simulation technique on the estimated model. The results obtained from the simulations are evaluated in terms of economic and social objectives. Economic objectives are judged in terms of the increase in consumption per capita, gross domestic product per capita level of domestic capital stock, level of foreign assets, reserves of oil, etc. Social objectives are judged in terms of the level of foreign population ex-patriate labour force, etc.

In the final chapter, a brief account on the theoretical advantages of Economic Integration is presented. Due to the small size of many countries in the Arabian Gulf, an economic union amongst them would be desirable. However, this possibility must be assessed and has been suggested as an exercise for further research.
To SHANTINI AND DHAMAYANTHI
I would like to express my thanks to Dr A EL-MOKADEM for his encouragement, critical comments and supervision of this research. I am grateful to Professor Colin Robinson, the Head of the Department of Economics for giving me the opportunity of pursuing this research. I am also grateful to the staff and colleagues in the Department of Economics for their assistance.

I would also like to thank Mr R Becker, PROPE Group, Imperial College, for helping me with the simulation programmes.

I would like to thank Ms C Bairstow and Mrs S Pathak for typing this dissertation with patience and care.

Finally, and most importantly, I am indebted to my family for giving me enormous support throughout the long period of this research.
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INTRODUCTION, OBJECTIVES, SCOPE, METHODOLOGY AND PLAN OF STUDY

1.1. Introduction

Since the formation of the Organisation of Petroleum Exporting Countries (OPEC) in 1960, we have witnessed a steady growth in the membership during the last twenty-three years (see Appendix 1). Much of the well documented literature about OPEC, notably A M Kubbah (1974), F Rouhani (1971), M S Al-Otaiba (1975) claims that the principal aim of OPEC has been the protection of its members from a potential decline in real oil prices. However, although the common factor that unifies the group is their ability to export a large percentage of world oil consumption, many differences exist between member countries. These differences can be seen in the form of socioeconomic structures, resource endowments, political systems etc. At the very simplest level one can divide the countries into two broad groups. The first group consists of countries like Saudi Arabia, Kuwait, United Arab Emirates (UAE), Libya, etc. These countries are mainly dominated by factors such as a relatively small population, limited absorptive capacity and a heavy dependence on oil revenues. The second group consists of countries such as Indonesia, Nigeria, Venezuela etc., whose main characteristics are large population and a complex socioeconomic structure.

It is of interest to look at some of the basic features of surplus economies(1) of which Kuwait is an example and these are as follows:

1.1.1 Oil Revenues

In rentier economies oil sector dominates over the other sectors of the economy(2). Since Government is the main recipient of oil

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1. The term 'surplus economies', 'rentier states', rentier economies' are used interchangeably.

2. See Appendix 2, Chapter 1
revenue it can, and often has, played a significant role in stimulating development and growth. Governments of most rentier states have taken independent and ambitious decisions in carrying out, in particular, large public expenditure programmes without resorting to tight fiscal measures or running into balance of payments problems. Such a high dependency on oil income also makes these economies vulnerable to fluctuations in oil revenues.

In the case of Kuwait, the oil revenues have increased by approximately 23% per annum from 564.5 mill. Kuwaiti Dinars (KD) in 1970 to 4,778.3 in 1980. Even in nominal terms the growth rate in oil revenue is a very significant one. However, in 1982, Kuwait, like many other OPEC partners, had a fall in income to 2,487 mill KDs. The fall in oil prices and low production levels of 1 mill. barrels per day (bd) has led to this situation.

1.1.2 Domestic Absorptive Capacity

A number of definitions have been given to the term 'Absorptive Capacity'. The most generally used interpretation is that 'Domestic Absorptive Capacity is said to be 'limited' when, at the margin, most projects in the domestic economy will yield zero or negative rates of return on investment. In addition, according to Mallach and Atta (1981) the absorptive capacity may be limited due to a number of factors:

i) Limitations due to physical characteristics of the country

ii) Lack of sufficient resources other than oil and gas

iii) Shortage of manpower, particularly skilled and semi-skilled

iv) Failure to formulate and implement long term planning

v) Political and sociological factors which tend to inhibit productivity

(1) See Appendix 2, Chapter 1
1.1.3 Expatriate Labour Force

Most of the rentier economies possess a small population and a low participation rate in the economic activity of the country. Therefore any programme of economic expansion in aggregate or sectoral economy leads to a significant inflow of foreign labour. This gives rise to two significant effects. The first effect is that savings accumulated via high earnings would be repatriated to the foreign country. The second effect is that since the foreign labour force comprises various nationalities and religions there is a possibility of disruption in the social harmony of the country.

The 1975 census—the latest officially published—shows that the foreign labour force has increased from 141,078 in 1970 to 190,851 in 1975. The proportion of foreign labour force to total labour force was 70%.

1.1.4 Present Consumption

The oil boom in these countries has taken place against the background of centuries of relative stagnation and poverty. Hence the present generation would like to maximise present consumption as much as possible. Policy makers, realising this need of the present population, will tend to provide a relatively high growth in consumption relative to investment. They are likely to choose a pattern of social time preference heavily weighted in favour of the present. Given that most of the rentier economies have a narrow economic base and a high income level consumption has been provided through imports⁽¹⁾. Such a level of imports has also given rise to high inflation rates in the late 1970's⁽²⁾.

Total consumption in Kuwait has increased from 485 mill KDs from 1970 to 2,558 mill KDs by 1979. Imports have also increased significantly from 814 mill KDs to 6,480 mill KDs during the same period. The average annual inflation rate in Kuwait from 1975 - 1980 was approximately 8%.

⁽¹⁾ (²⁾ See Appendix 4, Chapter 1
1.1.5 *Linkage Effects*

An important feature in these economies is the insignificant linkage effects between the oil and the non-oil sectors of the economy. This means that an increase of a unit of output in the oil sector stimulates a comparatively small change in output in the rest of the economy. In addition, Girgis (1980) argues that an economy which is heavily dependent on oil is likely to grow in spurts. The reason for this is that the oil sector has a relatively strong link with the finance and trade sector and a weak link with the manufacturing sector(1). The oil sector generates sufficient finance to the government which is used to provide the necessary expenditure on welfare programmes.

1.1.6 *Reverse Gap*

Most developing countries suffer from a deficiency in the levels of savings and an acute shortage of foreign exchange. Chenery and Strout (1966) identify these two factors as the most serious constraints to economic growth in developing countries. But the opposite case applies to oil rentier economies. Marzouk (1980) argues that despite the substantial increase in savings due to the high income earned through oil the gap between savings and investment has been widening. This Saving - Investment gap, also known as the 'Reverse gap' has taken place mainly due to the following reasons:

i) A relatively small domestic market and investment opportunities are limited

ii) The large differentials in rates of return between domestic and International Capital markets have led to a significant outflow of capital.

In order to arrest a large outflow of capital one may suggest raising the interest rate in the domestic economy, but this option may be contrary to many of the rentier economies whose religious faith of Koran prohibits the 'principle of interest' in the normal context.

(1) See Appendix 3A, 3B, Chapter 1
It is easily seen in some of these countries a considerable amount of pressure is exerted upon the banking system which operates a high interest rate. One solution proposed is the establishment of banks on the principle of 'Free Partnership' and 'Limited Partnership' as determined by Koran (Rahman (1974)).

1.1.7 Intergenerational Equity and Welfare

The subject of Intergenerational equity and welfare implications in a country which depends mainly on an exhaustible resource is complex. The decisions taken at present are bound to have an effect on the welfare of future generations.

There are two main views with regard to the assessment of this problem. The first view stems from the radical approach of Rawls (1971) which is based on the rules of distributive justice. He believes that there must be some hypothetical negotiations taking place among generations so that the level of welfare measured in terms of consumption per head is kept constant. The second view is that of Pigou (1932) who asserts that individual preferences of the present generation should not be considered in assessing the future since individuals lack foresight and tend to underestimate the welfare of future generations.

1.1.8 Foreign Assets

Because of their limited investment opportunities in their domestic economy, the surplus has accumulated in terms of foreign assets. The assets are mainly held in short-term deposits, namely US deposits, UK deposits and Eurodollars which have given them a high level of liquidity.

Kuwait's net foreign assets have increased from 324 mill KDs in 1970 to 18.3 bill KDs by 1980. Recently Kuwait has also diversified its portfolio by entering into various equity markets. At present it is believed that 50% of the country's portfolio is held in equities.

(1) See Appendix 4

(2) See Middle Eastern Economic Digest, Special report, Kuwait 1982
and of this 60% is held in the United States.

1.2. Objectives of the study

The objectives of this study are twofold. The first objective is to estimate the various structural relationships between the major macroeconomic variables. The second objective is to carry out long term planning exercises and discuss the various options that are open to Kuwait. It must be stressed here that planning must necessarily take into account the basic features of the economy. For example, a very high growth rate in the domestic economy may be preferred, but this may be achieved only by a large inflow of foreign labour. Instead it might be argued that a high growth rate should be achieved by the income derived from a high accumulation of foreign assets. This may be a dangerous policy since these assets are subject to threats of nationalisation or confiscation. A very low depletion rate might leave an excessive quantity of oil in the ground which may yield comparatively low revenue in the future. This may also lead to low consumption levels which may be unacceptable to the present generation.

Therefore it is imperative that the planner must try to balance these various factors. Y S F Al-Sabah states that national economic planning must be well integrated. He adds that priorities and goals must be established and the means by which these are achieved must be stated. The plan must not just be indicative but explicitly define the real social, economic and political problems involved.

There are a number of studies which have made a significant contribution to either the investigation of the structural relationships or in the use of long term planning in surplus economies. For Saudi Arabia F S Al-Bashir (1981) investigates the structure of the

(1) An example of this is the freezing of Iranian assets in the United States during the Hostage Crisis in 1980

(2) Y S F Al-Sabah, Chapter 8, Pages 108-109, The Oil Economy of Kuwait, published by Kegan Paul International Ltd., 1980
economy whilst J P Cleron (1978) provides a long term strategy for
growth using a simulation technique. On the other hand, H Motamen's
(1979) study is based on an optimal control approach and provides a
framework for long term planning in Iran. Similarly a part of
S M Al-Sabah's (1983) study provides a framework for Kuwait.
However, both H Motamen and S M Al-Sabah use a small macroeconomic
model. The studies that are compared with this study are those of
Ente Nazionale Idrocarburi (ENI), Khouja and Sadler and R Mallach
and J Atta.

The purpose of the ENI study (1981) is to assess the economic inter-
dependence between Arab oil exporting countries (OAPEC) and the
major industrialised countries. This is carried out through a
global economic model. Development scenarios for the various OAPEC
are discussed via cooperative and non-cooperative strategies with
major OECD countries. 'High' scenarios are achieved through
cooperative strategies and 'low' scenarios are the result of non-
cooperation.

The study for Kuwait is based on a macroeconomic model of Kuwait
estimated by ordinary least squares. The data used in this esti-
mation was from 1968 - 1977. The model consists of 24 equations
classified into four sections, namely gross domestic product
formation, imports, supply of resources and government sector.
There are 37 variables, 24 endogenous and 13 exogenous. The model
of OECD captures the energy transformation process, final energy
demand and the policies of international oil companies.

Although the ENI's approach is a very interesting concept the
validity of the model is questionable. The major drawback is its
estimation carried out using a very small sample. Hence estimates
of parameters of the ENI study will not be compared with this
study.

Khouja and Sadler (1978) study is focussed on the structure of the
economy of Kuwait. The major behavioural relationships are
investigated. However the study does not provide any scenarios for
long term planning. Khouja and Sadler suggest that the foreign
assets sector is likely to play a major role in the future. This
The analysis is based on the assumption that all government and private sector holdings are entirely deployed for the purpose of generating new forms of rentier income. The diagram illustrates the build up of income from foreign assets over time under the conditions of constant or falling oil revenues and foreign exchange requirements.

The net foreign exchange requirements are determined by the difference between the sum of imports and remittances less non oil exports. In the diagram:

- \( KK^* \) represents falling oil revenues over time
- \( FF^* \) represents rising foreign exchange requirements over time
- \( PP^* \) represents income generated from foreign assets.

Source: Khouja & Sadler, The Economy of Kuwait, Annexe to Chapter 9, Page 158

Fig. 1.1
The different positions in the diagram can be stated as follows. As long as the rate of reduction in KK* is less than the rate of increase in PP* the level of national income will go on increasing over time but at a diminishing rate. If, on the other hand, KK* falls at a rate faster than the rate of increase in PP* the potential future growth in income will depend on the intersection FF*. If the point of intersection is above FF* then net surplus will result which will increase the magnitude of foreign assets. If the point of intersection is below FF*, the growth in national income could not be sustained in the long run unless structural changes are made in the domestic economy.

At point Z, the income from foreign assets is sufficient to offset the effects of declining oil revenues. At this point there would be no further accumulation of foreign assets but the country's foreign exchange requirements are satisfied.

Khouja-Sadler's macroeconomic model is based on a Keynesian income expenditure model. The supply side is not explicitly specified. However, the model takes into account the money supply process. There are 10 behavioural equations in the model, 10 endogenous, seven exogenous and one dummy variable. The dummy variable is used to capture the possible structural shifts. The dummy variable takes the value of zero during the period 1962 - 1969 and takes the value of one during 1970 - 1975. The data series used for the estimation was from 1962 to 1975. The estimation is carried out using Ordinary Least Squares (OLS) and two Stage Least Squares (2SLS) techniques. The exercise is based on both current and constant prices. The results of Khouja and Sadler's study are compared with this study in Chapter 4.

Mallach and Atta's (1981) study focuses on the problem of domestic absorptive capacity and its impact on long term planning. They define absorptive capacity of a country as 'the ability of the domestic economy to absorb resources at an acceptable rate of return'. But this acceptable rate of return is not based on a financial criteria but on a social criteria. Hence they argue that projects must be assessed on the basis of social rate of return. This type
of investment may not be financially feasible at present but may prove to be socially acceptable if it aids the learning process and improves productivity.

The first stage of the study is the estimation of a macroeconomic model of Kuwait. The demand side of the model is based on a Keynesian income-expenditure framework. The model also includes stock variables such as foreign assets, labour supply, oil reserves. It also consists of equations which determine the general price level and money supply. The supply side of the model is disaggregated into nine sectors(1). Each sector is represented in terms of Leontief production function.

The constraints on absorptive capacity are investigated from both the supply and demand. The Leontief function determines output by the factor input which is minimum. Since labour is the input in short supply the implications of constraints on output can be studied. The constraints on the demand side can be expressed in terms of minimum acceptable level of income, consumption or imports. This can be further related to oil production and pricing policies since oil is the resource that can provide the necessary revenue.

The study discusses the policies regarding the oil sector of Kuwait, independently and as a member of OPEC. It argues that since Kuwait is only a small oil producer it has very little impact on prices and encourages an independent depletion policy. The optimal policy would be one that will enable Kuwait to achieve the best possible level in terms of objectives under a given set of constraints.

The macroeconomic model of Kuwait consists of forty equations with forty endogenous variables, twenty-one exogenous variables and four dummy variables. The data series is from 1965 - 1977.

(1) These are Agriculture, Mining, Manufacturing, Construction, Water and Gas, Trade, Communications, Finance, Services
The model in the second stage is used for forecasting from 1978 to 1990. In order to compare the various forecasts under various assumptions a control solution is determined. This control scenario forms the benchmark and the other scenarios are compared with this. The study is based on two control scenarios for two alternative price paths for oil.

The results of the estimation and forecasts will be compared and discussed in Chapter 4 and Chapter 5.

1.3. Scope of this study

Given the main objectives of the study and the various attempts that have been made already by others, it is important to explain the scope of this study.

The demand side of this model is based on a Keynesian income-expenditure framework. Since the model is to be used for long-term planning the empirical part of the study is carried out in real terms. There is no explicit aggregate or sectoral equation for determining the price level. Similarly there are no equations to represent monetary or fiscal policies(1) as these are only applicable for short-term stabilisation of the economy.

The income is generated through three sources, with the major part of the income derived through the oil and foreign assets sector and a minor role played by the domestic non-oil sector. Oil revenues are based on assumptions regarding long-term price paths and depletion rates. The price paths are chosen from a survey of a number of studies which will be discussed in Chapter 5. The depletion rate is set by the planner and this must lie between the maximum and minimum sustainable production capacity.

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(1) There is an equation for Taxes but this is mainly to determine part of Government Revenue and not used as an instrument of fiscal policy.
This study, however, is not based entirely on a Target Revenue model developed by economists Teece (1982), Cremei & Isfahani (1981) etc. The target revenue approach implies a backward bending supply curve for prices above those needed to support the target revenue. On the other hand, if the world price increases and the iso revenue curve is static then production falls. This is explained via the following diagram:

![Diagram showing demand shifts from $d^0$ to $d^1$ if absorptive capacity is unchanged. The shift leads to higher price and reduction in output, supply curve is given by $s_o$.]

Source: J H Griffin & D Teece. OPEC Behaviour and World Oil Prices, Chapter 3, Page 90

Fig. 1.2

This diagram shows demand shifts from $d^0$ to $d^1$ if absorptive capacity is unchanged. The shift leads to higher price and reduction in output, supply curve is given by $s_o$.

In this study it is felt that a target revenue only approach should not be adopted since it may lead to undesirable conclusions. For example, if oil prices are high and output is reduced in order
to maintain a target revenue, then a country like Kuwait -
edowed with a large reserve of oil - will be left with a large
quantity under the ground. If prices are likely to fall in the
future due to high elasticities of demand and substitution
possibilities then the future revenue will be substantially reduced.
Hence, it is important to maximise the revenue and if there is a
surplus then to examine to what extent this can be accumulated in
the form of foreign assets.

This study provides a balanced approach between the stock variables -
oil reserves, domestic capital stock and foreign assets. The income
from foreign assets is determined by a fixed rate of return.

In the final discussion the labour force and population - particularly
non-Kuwaiti - are also taken into account. Therefore the model
incorporates the relationship between these variables and analyses
the impact on the economy.

The supply side is disaggregated into three sectors. These are the
mining sector, manufacturing sector and a residual sector which
comprises the other seven sectors. Cobb-Douglas type production
functions are used to represent the supply sectors. Hence, this
study follows those of Motamen and Al-Sabah in that they too
use Cobb-Douglas production function but at an aggregate level.

The model is non-linear consisting of 60 equations. There are 20
endogenous and 43 exogenous and predetermined variables. A complete
discussion on Model Specification and Estimation is presented in
Chapters 3 and 4.

Finally, the scope of this study in terms of policy implementation
is rather limited. This is mainly due to the weakness in the model
resulting from a small sample size, definitional and interpretational
problems with respect to data etc. In practical terms, it only
partially fulfils the research and planning objectives. However,
it must be stressed that the framework itself is a valid one.
1.4. **Methodology**

The estimation is carried out using Ordinary Least Squares (OLS) on a data series which runs from 1962 - 1979. Due to lack of a large sample it was not possible to use a system estimation technique such as three stage least squares or maximum likelihood methods.

The planning exercise was carried out using a dynamic simulation technique. There was a choice between using an optimal control and a simulation technique. The former was used in the study by S M Al-Sabah. However, it was felt that a simulation technique is more suitable in this study for the following reasons:

i) In an optimal control approach the policy makers priorities must be not only ranked but also numerically weighted. The choice of such weights is fairly arbitrary.

ii) The data is relatively weak and any method such as an optimal control which provides a narrow but powerful solution is inappropriate.

iii) The solution procedure in optimal control uses a large number of iterative steps. Hence it is more readily applicable to a smaller or well defined model.

For these reasons, finally a simulation technique was chosen.

1.5. **Plan of Study**

This chapter is followed by a chapter which consists of various development theories. First it discusses the theories of early classical economists, followed by classical, Keynesian and structural theorists. The application of these theories to the Kuwaiti case is then discussed.

Chapter 3 consists of two sections. The first section provides a framework for growth in an exhaustible resource economy. By setting time limits such a framework can be used for planning. Hence, in the next section the specification of the model is discussed.

In Chapter 4, the estimation procedure and the results are presented. These results are also compared with those of Khouja-Sadler and
Chapter 5 provides a description of the simulation technique that is used. It also gives a justification for using certain values for the key exogenous variables. The results and conclusions are then summarised.

This is followed by a final chapter on conclusions and extensions for further research.
OPEC comprises the following countries

1. Algeria
2. Ecuador
3. Gabon
4. Indonesia
5. Iran
6. Iraq
7. Kuwait
8. Libya
9. Nigeria
10. Qatar
11. Saudi Arabia
12. United Arab Emirates
13. Venezuela
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<td>24.8</td>
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Sources: World Bank Atlas
OPEC Statistical Bulletin 1980
IMF International Financial Statistics 1981
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1974 - 1975 INPUT-OUTPUT TABLE

Source: Annual Statistical Abstract, Kuwait Planning Board, 1978
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**INPUT - OUTPUT COEFFICIENTS**

Source: Annual Statistical Abstract, Kuwait Planning Board, 1978
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Sources: OPEC Statistical Bulletin, 1980  
World Bank Debt Tables, 1980  
Bankers Trust Company Reports, 1980
Chapter 2
THEORIES OF DEVELOPMENT AND ITS APPLICATION
TO THE KUWAITI ECONOMY

This chapter begins with a discussion on various development theories. It encompasses the views of early classical economists, the classical theorists, Keynesians and structuralists. The chapter is concluded with a brief analysis on the applicability of such theories to the Kuwaiti Economy.

At this stage, it is necessary to distinguish between Economic development and growth which is sometimes treated as the same. Economic growth is the increase in real income over time. Development, on the other hand, refers to increase in real output and the impact of social and institutional factors.

2.1 An introductory overview

Early contributions to the study of development were made by well known classical economists such as A Smith, T Malthus, D Ricardo and J S Mill. They believed that economic output depended on the supply of labour, capital, technological progress and natural resources. However, each one focussed on different aspects of these factors.

Smith (1776) asserted that per capita output could be increased and improved through division of labour and its concomitant investment in capital. Malthus (1798) related food production to population. He suggested that if population grew faster than the growth in food production then the economy would collapse. Ricardo (1817) agreed with Malthus but suggested that as long as capital formation continued to grow, there was not a danger of collapse. The capital formation would be brought about by the rate of profit or interest. Mill (1848) incorporated most of these ideas into one system and added a sociological dimension. He claimed that output depended on all the factors mentioned earlier but in addition, they were conditioned by society's prevailing institutions and values.
During Ricardo's and Mill's period, an alternative theory was proposed by Marx and Engels. They claimed that at each stage of development man is faced with reality based on past and present levels of success. The degree to which he is able at each stage of history to produce his basic needs depends on the infrastructure of his economic environment. But this infrastructure is also dependent upon political, social, cultural and legal conditions. This is called the superstructure. The interplay between the infrastructure and superstructure was the basis for development. Thus, Marx theory of development is not significantly different from those of the classical economists, in particular, Mill. However, his disagreement lies in the ownership of capital, the level of wages of the worker, etc.

During the period of Marx and Mill, there was another school of thought which believed that development takes place in certain definite stages. The pioneers who contributed to the laws of development were List (1841) and Hildebrand (1848). They both believed that in order to have economic progress it is essential for societies to go through a number of stages. List claimed that these stages are the agricultural, manufacturing and commercial stages. When an optimal combination of these stages is achieved then the economy is meant to have reached maturity. The movement of one stage to another formed the foundations for economic change and progress. Hildebrand's criticism of List's theory was basically a rejection of the so-called 'Law of development'. In Hildebrand's view the method of beginning from the agricultural stage and continuing via a manufacturing stage and finally to a commercial stage was irrelevant as each mode of production was a product rather than the cause of a society's cultural position. He believed that it is the socio-economic state of the people which determines the mode of production. For example, he compared ancient Greece to medieval Europe, showing how the political and geographical division of the former forced Greek society to dominate navigation whilst European society, which was almost self-sufficient, had dominance over the agricultural sector. He implied that it is the cultural and political environment that produces economic progress and not the
Laws of stages. However, after criticising List's theory, Hildebrand proposed his own stages of development which comprised a Barter economy, money economy and a credit economy.

This basic theory was later taken up by Fisher (1939) and Clark (1940). They suggested countries start as primary producers, then as basic necessities of life are met resources are transferred into manufacturing activities. Owing to a rising income more leisure and an increasingly saturated market for manufactured goods, resources move into the services sector. The Fisher-Clark view was further strengthened by the empirical work carried out by Chenery (1960) and Maizels (1960). They provide sufficient evidence that in most cases resources are moved out of the agricultural sector into the manufacturing sector as a rise in income occurs.

The interest in stage theories of development grew even further as a result of the publication of Rostow's (1960) 'The Stages of Economic Growth'. The essence of this book is that it is possible to identify logically and practically the stages of development. There are five stages of development, namely (1) Traditional (2) Transitional (3) Take-off (4) Maturity (5) Mass consumption.

Traditional stage is characterised by a constraint upon production potentials imposed by the limitations of science. The basic requirement for a transitional stage is that the level of investment should be raised to at least 10% of national income to ensure self sustaining growth. The pre-condition for a take-off stage is that investment must rise in excess of 10% of national income. This level should ensure per capita income rises sufficiently to provide future requirements in saving and investment. In the maturity stage the economy has the capacity to move beyond the original industries which stimulated its take-off. This is achieved by adopting an advanced level technology efficiently. Finally, in the stage of high mass consumption the leading sectors produce a variety of consumer durable goods and services.
Though the classical economists have made a significant contribution to development they have also come under criticism. The major criticism is that these theories do not provide an answer to what determines the level of factor inputs. How does capital accumulation take place? How can profits and savings be transformed into investment?

In Marx’s theory, profits are distributed. But it does not explain how further investment takes place. The question on ‘incentives to invest’ is not adequately answered.

The stage theorists assume, however, that countries have to go through a number of stages in order to achieve growth. But why should a country with an advantage in, say, agriculture, move away from this sector? It is also not very clear where one stage terminates and the other stage begins. For example, when does the take-off stage end and the stage of maturity begin?

In the following sections answers to some of these questions will be discussed in classical, Keynesian and structural approaches. The relevance of these approaches to the Kuwaiti Economy is provided in the last section.

2.2 The 'classical' view

The two major contributions to the classical view are the models of 'economic dualism' and 'low-level equilibrium trap'.

2.2.1 Economic Dualism

The pioneering work on this subject was presented by Lewis\(^1\). In his much celebrated article 'Economic development with unlimited supplies of labour' he discusses the framework for solving the problems of distribution, accumulation and growth. The Dual economy

\(^{(1)}\) A Lewis, 'Economic Development with Unlimited Supplies of Labour', Manchester School, May 1954
consists of an advanced sector - usually an industrial sector - and a subsistence sector - usually an agricultural sector. The model assumes an unlimited supply of labour in the subsistence sector. This means that the supply of labour exceeds the demand for labour at the subsistence wage. Hence, there is 'surplus labour'\(^{(1)}\).

The question whether there is surplus labour or not has caused a considerable amount of controversy. Nurske (1953) introduced the 'Theory of surplus labour' and suggested that it was present in the agricultural sector in developing countries. Fei and Ranis (1963) distinguish between two types of surplus labour. In one the marginal product is zero and in the other the marginal product is not zero but less than the real wage.

However, in order to establish the presence or absence of surplus labour a number of empirical studies have been carried out. Schultz (1964) study supports the view that there is no surplus labour whilst Mehra (1966) provides the opposite case. Schultz investigated whether output fell as a result of an outbreak of influenza epidemic in India during 1918 - 1919. Approximately 8% of the agricultural labour force was killed due to the epidemic. Schultz found that yield per acreage fell significantly. Mehra argued that Schultz's study did not take into account the different seasonal variations. Mehra showed that output would have fallen even with the original labour because of low rainfall in the dry season. Mehra's view was further contested by Sen (1966). He argued even if output had remained constant this did not prove that there was surplus labour. It might be that the remaining labour would have contributed more in terms of man-hours.

Lewis assumes that surplus labour is present. However, the most attractive feature of his model is that it shows a method by which capital can be accumulated. The model is best explained by two

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\(^{(1)}\) In the Economic literature, 'surplus labour' is generally defined as that labour whose marginal product is zero.
diagrams. The first represents the subsistence sector.

The curve represents the marginal product of successive units of labour added to the land. After ox units marginal product tends to fall due to diminishing returns. At ox₁ marginal product is equal to the subsistence wage. After ox₁ it falls below the subsistence wage. The basic assumption of the Lewis's model is that labour is in excess of ox₁ in the subsistence sector. Let us now look at the advanced sector.
The supply of labour is assumed to be completely elastic, that is, at the wage level OW, the advanced sector can readily draw the labour from the subsistence sector. WW\textsubscript{1} represents the wage differential between the advanced and subsistence sectors. The total product of labour ONPM consists of wages and the surplus of the advanced sector, ie OWPM and WNP. The expansion of the advanced sector and further absorption of labour from the subsistence sector depends on the level of surplus and the extent of reinvestment. This can take place if wages remain constant and if there is an increase in productivity. This shifts the curve right to a new position given by N\textsuperscript{*}\textsubscript{1} P\textsubscript{1} R\textsubscript{1}.

The size of the surplus will increase from WNP to WN\textsuperscript{*}\textsubscript{1} P\textsubscript{1}, which could be reinvested and this process continues. The increase
in capital is dependent on the rate of profit which must rise over time. This happens when all the benefits of increased productivity accrue to capital when the real wage is kept constant.

The essence of the Lewis model is the importance of an advanced sector and the principle of surplus maximisation. He was concerned with the size of the advanced sector relative to the aggregate economy. He says 'If we ask why the less developed countries save so little the answer is not because they are poor but because the capitalist (advanced) sector is so small'.

There have been a number of criticisms made upon the Lewis model. Fei and Ranis (1964) have made a number of significant modifications so as to overcome some of the weaknesses in the model. According to Lewis the advanced sector will continue to absorb labour from the subsistence sector. However, the model does not indicate what happens when all the surplus labour is absorbed. Fei and Ranis argue that an equilibrium will be reached between the sectors. In order to increase productivity in subsistence sector investment has to take place. This equilibrium is not reached by labour alone. They also take into account the rise in prices of agricultural products and the consumption level of the subsistence sector. Increase in productivity in the subsistence sector will lead to higher wage rates which will be finally determined by equilibrium wage rates between the two sectors.

Harris and Todaro (1970) have argued that the initial migration from the subsistence sector to the advanced sector is not due to actual wage differentials between the two sectors. According to them the differentials must be based on the expected wage rate and the cost of living in the urban area in which the advanced sector is situated.

(1) The expected wage rate is the probability of finding a job multiplied by the actual wage.
Although there are a number of drawbacks in the Lewis model, it nevertheless provides an interesting framework. The modifications made by Fei and Ranis, Harris and Todaro, make the model even more acceptable. The major criticisms would be the empirical testing of these models and the definitional and statistical measurement of surplus labour.

2.2.2 Low-level equilibrium trap

This model investigates development by interdependence of three variables - population growth, national income growth and per capita income. The question here is what level of income growth in excess of population growth guarantees a rise in per capita income for a long period.

Nelson (1956) and Leibenstein (1957), among others, believed that the rapid growth of population relative to national income was the cause for economic stagnation. There are two reasons for this. Firstly, rapid population growth leads to a low per capita income and therefore restricts savings and investment. Secondly, since there is insufficient investment, industrial capacity does not expand to absorb the new labour force. This view is similar to the one held by Malthus.

The low level equilibrium trap is best explained by the following diagram
This model assumes that population increases with an increase in per capita income. Similarly, the growth in income is positively correlated with growth in per capita income. Curves P and Y represent the growth rates in population and income respectively. However, below a certain level of very low per capita income \( Y_t \) population growth tends to rise faster than income. This position is given by T at per capita income of \( Y_t \).

Rosentein - Rodan (1943) argues that at point T or below the economy is trapped and in order to escape a massive investment programme should take place. This is termed the 'Big Push' theory. The investment should push the economy to point B at per capita income of \( Y_b \). The point B is unstable: to the right increases in Y will not be reversed while to the left a decrease in Y will push the economy back to position T. There are a number of shortcomings in the model. Like Malthus' view, this model underestimates the technological factors which can accelerate growth. It does not allow for measures that can be taken to reduce the growth in population. It fails to comment or take into account any possible relationship between growth in income and population growth. This is an important factor since many developed countries are experiencing a negative relationship between income and population growth.

2.3 Keynesian theories of development

Although J M Keynes did not contribute to long term development problems, his major works have influenced his followers of growth theory. In 'General Theory' (1936) he emphasises the equilibrium between aggregate demand and level of output under full employment conditions. He discusses the problem of inflation in the 'Treatise on Money' (1930). The problem of unemployment is further discussed in 'Essays in Persuasion' (1931).

However, many followers of Keynes have mainly concentrated on the general theory. Ever since the publication of Keynes 'General Theory' many have attempted to use this framework to develop growth models. The major contributions fall into two groups. The first
category consists of Harrod (1939) - Domar (1946) type models. The fundamental principle of this model lies in full resource utilisation. It assumes that there is continuous equilibrium between desired saving and investment under full employment. The second type are the models of Samuelson (1939) and Hansen (1938). It is based on multiplier-accelerator interaction. It does not require equilibrium under full employment of resources. The major factor that distinguishes between the two models is the time variable. The Harrod-Domar models are capacity determined and hence useful in investigating long term growth prospects. On the other hand, Samuelson-Hansen models are demand determined. Therefore it is useful to determine short-run growth prospects. Since the interest here is to investigate long term growth, only the Harrod-Domar type models will be discussed.

The Harrod-Domar model is based on a number of assumptions. The output or supply is represented by a production function. The factor inputs can be used in fixed proportions. There is no provision for technological progress. There is no government intervention or fiscal policy\(^1\). The economy is a closed\(^2\) one with a constant price level\(^3\). Let us now look at a simple Harrod model.

The saving function is given by

\[
S^1_t = sY_t
\]  

(2.1)

where \(S^1_t\) is the net saving during period \(t\), \(Y_t\) is national income or output, \(s\) is the average propensity to save. \(S^1_t\) in the equation assumes that the amount of saving desired is realised during the same period.

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(1) D Hamborg, 'Economic growth and instability', New York, 1956
(2) Harrod modifies his model to take into account the foreign trade sector - 'Towards a Dynamic Economics', London 1948
(3) E D Domar 'Capital Expansion, Rate of Growth and Employment' Econometrica, XIV, April 1946

- 31 -
The investment function is given by

\[ I_t^1 = \beta(Y_t - Y_{t-1}) \]  \hspace{1cm} (2.2)

where \( \beta \) is the accelerator coefficient.

The investment is realised whenever the 'warranted rate' of growth takes place. Harrod defines the warranted rate of growth as "the rate of growth which if it occurs will leave all parties satisfied". Hence production has taken place optimally, i.e. there is no excess demand or excess supply. It also satisfies the condition for equilibrium rate of growth.

The solution can be given by

\[ S_t^1 = I_t^1 \]

\[ S_t^Y = \beta(Y_t - Y_{t-1}) \]

\[ (\beta - s) Y_t = \beta Y_{t-1} \]

\[ Y_t = \frac{\beta}{\beta - s} Y_{t-1} \]

\[ Y_t = \left( \frac{\beta}{\beta - s} \right)^t Y_0 \]

Domar's model does not contain lags and it is formulated in continuous time. Saving is instantaneously adjusted to income. Domar's approach to equilibrium rate of growth does not require the explanation of an unlagged accelerator in the investment equation. He investigates what rate of growth of income and investment are necessary to maintain full employment. In his analysis net investment adds to productive capacity.

The Harrod model shows that growth depends on the accelerator coefficient and the marginal propensity to save. A high accelerator
with a high marginal propensity to save leads to high growth. However, the Harrod-Domar type models are subject to a number of criticisms. The models do not explain how desired saving and investment are brought into equilibrium. The production function used is rigid and factor substitution is not permitted. There is no role for technical progress. For these reasons, many attempts were made to modify the basic Harrod-Domar models so as to take into account some of the factors mentioned above.

2.3.1 Modifications of Harrod-Domar Models

Amongst the many modifications of the Harrod-Domar models, two have received the most attention. These are the models of Solow (1956) and Kaldor (1957). Both have suggested methods which can bring about the equilibrium between desired saving and investment. Solow suggests the classical interest rate mechanism whilst Kaldor proposes the income distribution mechanism. They both have used a flexible production function where factor substitution can be permitted. This also avoids the problem of instability which occurs in Harrod-Domar models. They also take into account the role of technical progress - both factor augmenting and neutral. Tobin (1955) has followed Solow's framework but has also imposed a monetary phenomena.

In order to examine the determinants which affect growth, let us take a model by R Solow.

The production function is given by

\[ Y_t = \sigma K_t^\gamma L_t^{1-\gamma} \]  \hspace{1cm} (2.3)

\[ Y_t \] = output at t,
\[ K_t \] = capital stock at t
\[ L_t \] = Labour stock at t
\[ \sigma \] = technology coefficient

The function assumes constant returns to scale. Let the labour stock grow at the same exponential rate as the population, ie
\[ L_t = L_0 e^{nt} \]

\[ n = \text{growth rate} \]

\[ L_0 = \text{original labour stock at } t \]

assuming full employment

\[ Y_t = \int K^\tau (L_0 e^{nt})^{1-\tau} \]

(2.4)

using the identity, \( \frac{dK}{dt} = I_t = sY_t \)

\[ \frac{dK}{dt} = s \int K^\tau L_0^{1-\tau} e^{nt} (1-\tau) \]

(2.5)

Rearranging and integrating both sides, it can be shown that output depends on the marginal propensity to save, growth rate of population and the level of technology. Hence, unlike Harrod-Domar models, Solow emphasises the role of technical progress in economic growth.

2.3.2 Optimal Growth Models

The Equilibrium growth models that have been discussed so far assume constant saving propensities. Dixit (1976) argues that this approach is undesirable since such a behaviour is not forward looking. This is very important since saving is a commitment undertaken solely for the sake of returns in the future.

Some earlier models have assumed this phenomena. Pasinetti's (1962) model assumes that consumers save so that their future as old age pensioners will be taken care of. He also assumes that capitalists are interested in accumulating wealth and therefore save a greater proportion of their income. Kaldor's (1958) view is that saving is carried out by profit earners in the form of retained earnings. He differentiates saving by income type rather than recipient type.

The main point here is that saving propensities cannot be assumed to be constant. Dixit argues that a weighing up of intertemporal
opportunities and preferences should be a very important aspect of decisions to save and invest. Neoclassical optimal growth models take this as a starting point for determining growth paths. These models also take into consideration factors such as technological progress - especially embodied and depreciation.

The problem of optimal growth can be formulated in terms of state variables, control variables, equation of motion, objective function and the initial conditions of the economy. The objective function is then optimised over a time horizon. The main feature of these models is that it takes into account the decision by individuals to save and invest.

2.4 The structural view of development

The main feature of the structuralist view is that the developing economy is faced with rigidities and bottlenecks. It consists of imbalances and imperfections in markets such that prices are distorted. It is for this reason structuralists take a stronger view with regard to resource allocation.

2.4.1 Balanced versus Unbalanced growth

The choice between 'balanced' and 'unbalanced' growth is one of the topics in the theory of economic development which has evoked a vast amount of controversy. When Nurske \((1953)(1961)\) coined the term balanced growth, the objective he had in mind was to demonstrate the necessity for creating market incentives to invest. This is essential for generating growth under a free market mechanism. Scitovsky (1959) has used the term as a means of achieving greater diversification in view of trade barriers faced by developing countries. The original exponents, Rosentein - Rodan (1943) used it to indicate the scale of investment required for both the supply and demand side of the development process. Investment

(1) Embodied technological progress is not influenced by economic factors

(2) Depreciation comprises two components, one representing physical decay and the other obsolescence
on a large scale is needed to overcome indivisibilities on the supply side. This gave rise to the theory of 'Big Push'. These investments on a large number of activities simultaneously can take advantage of various external economies of scale. Indivisibilities on the demand side refer to the limitations imposed by the size of the market, profitability and feasibility of economic activities. The original doctrine can be expressed as the large scale expansion of activities to overcome divergences between private and social rates of return.

Hirschman (1958) held the opposite view. He argued that the question of priority between various sectors must be judged on a comparative appraisal of the strength with which progress in one sector will induce progress in another. Hirschman adds inducement stems from linkages between sectors. There are two forms of linkages, forward and backward. Forward linkages measure the proportion of an activity's output that does not go to meet final demand. Instead they are used as inputs into other activities. He advocates a development strategy that would encourage those activities with the potentially highest combined linkages. This will provide the greatest inducement and incentive to other activities to develop.

However, the empirical studies have failed to convince which theory is most favourable. Streeten (1959) cited the technological advances in textile and iron industries of England as instant success of unbalanced growth. Similarly, Ohlin (1959) did not find any evidence of balanced growth in the successful developed countries. On the contrary, Hughes (1960) found that western countries have followed balanced growth paths. Similarly, Youtopoulos and Lau (1970), using an international cross section data on 30 countries claimed that higher growths were achieved by adopting a balanced path.

2.4.2 Choice of Techniques

In development planning one of the major decisions to be made is

the choice of technique, that is, whether techniques should be capital or labour intensive. In a labour abundant economy, labour intensive techniques may be the obvious choice. By adopting this principle, a conflict arises between efficiency and growth. The problem is that if the wage rate is given, and if it varies with the technique of production, the more labour intensive the technique, the less saving is likely to take place. Hence, less saving is generated for future investment and this will hinder growth. Specifically, if the propensity to consume by the workers is higher than the owners of capital, the total surplus will be less than the surplus from a capital intensive technique. On the other hand, a capital intensive technique provides a lower level of consumption and employment for the present. This is explained by the following diagram.

![Diagram](image-url)
In this diagram output is measured on the vertical axis, capital in the vertical axis below o, and labour on the horizontal axis. The total output is shown by a production function curve exhibiting diminishing returns to scale. The total increase in wage bill is shown by OW. If all wages are consumed, OW also shows the level of consumption at each level of employment with a fixed amount of capital OK. Output is maximised with the employment of labour OT. Investible surplus is maximised with the employment of labour OR. The more labour intensive technique maximises output and consumption in the short-run. The more capital intensive technique provides a greater surplus for reinvestment for growth and consumption in the future.

This analysis assumes that wage rate is constant with respect to the technique of production. It may be that capital intensive technique requires skilled labour and hence wage rate may be higher.

2.4.3 Theory of Comparative Advantage

When discussing the theory of comparative advantage it is essential to know whether 'Trade' should be looked at from balance of payments view or as allocation of resources. Assuming full employment of resources, and that price of the commodity reflects its opportunity cost, this theory should lead to an optimum pattern of production and trade for a country. Efficiency is maximised when no commodity is produced which could be imported at a lower cost. On the other hand, if the objective is growth or employment the allocation of resources would be different. If growth depends on a healthy balance of payments it may be unwise to invest in activities which produce goods with low price and income elasticities. A low elasticity of demand will mean that for any given growth in global income, countries producing these commodities will be in at a disadvantage.

In the late 1950's and early 1960's, developing countries followed a strategy of Industrialisation. The type of industrialisation
falls into two broad strategies, namely (i) Import substitution(1) and (ii) Export orientation(2).

Import-substituting industrialisation (ISI) is a development strategy based on the planned substitution of domestically produced goods for imports. Countries like India and Argentina followed such a policy. Under this policy growth rate is not determined by domestic demand alone but also by the potential for replacing imports. In practice ISI policy does not eliminate exports to a great extent. It mainly shifts the composition of imports away from finished goods towards raw materials, intermediate goods and capital goods.

Strategies of ISI usually involve protection of domestic industry in the form of high tariffs. Protective tariffs which remain high for a considerable period of time have several disadvantages. There is little incentive for firms to lower costs since imports are restricted and the domestic market structure is likely to be one of oligopoly. If the market for the products is limited then these firms cannot take advantage of economies of scale.

On the basis of the above analysis and with some empirical evidence some countries like South Korea, Taiwan, Hongkong and Singapore have adopted an export orientated Industrialisation. They find this attractive since the policies are outward-looking. Countries with small domestic markets and a highly skilled labour force can take advantage of this strategy to a very great extent. The growth rate of these countries was particularly high, reaching 15 per cent per annum in the 1970's.


(2) For export expansion policy, see D Nayyar "Transnational Corporations and manufactured exports from poor countries" Economic Journal, March 1978
On balance, a United Nations study in 1978 shows that countries which followed an export orientated industrialisation policy have experienced a healthier growth rate than the other developing countries. But Alexander (1976) has argued that selective import substitution with a high proportion of domestic inputs can also result in high growth and full utilisation of resources. If markets are small then this can be widened through income redistribution.

2.5 Application of the theories to the Kuwaiti Economy

Unlike many other developing countries the Kuwaiti Economy comprises some unique characteristics:

i) It is at present a capital surplus, rather than a labour surplus economy

ii) There is a tremendous shortage of indigenous Kuwaiti labour

iii) It has an advanced oil sector, but this resource is exhaustible in the foreseeable future

iv) It has a small domestic market.

It is evident from the outset that the application of any one approach - classical, Keynesian, structuralist - does not provide the desirable path of development. Therefore the best strategy would be a mixed package of policies drawn from the various theories.

The classical theories of Lewis, Fei and Ranis have to be modified to take into account the shortage of labour. The question would be how to utilise the shortage of labour productively. The movement from a backward sector to an advanced sector has to be redefined. The classical theorists believed that the subsistence sector was agriculture and the advanced sector was the Urban industrial sector. But in Kuwait the need for the Commercial, Trade and Services sectors is more relevant. The existing advanced sector is the oil
sector but this is unlikely to absorb an adequate labour force. Besides, this sector also recruits a large percentage of skilled labour. It can be argued that there may be some scope for establishing oil-related industries and small scale rural industries. However, the level of operation is a matter for further research.

The main feature of the Keynesian type approach is the understanding of the macroeconomy. The model takes into account the various sectors of the economy. But this has to be extended to take into consideration the supply side. It is not sufficient to include just a production function. The real question would be the necessary condition for capital formation. That is to provide the mechanism that would bring the desired saving and investment to equilibrium. Keynesian type growth models also failed to comment on the role of technical progress Innovation and Productivity. As stated earlier Solow and Kaldor provide this. But they fail to explain why individuals save at present since saving delays their present consumption levels. Hence, Dixit's work is more applicable since he considers individuals discounted utility profiles. The main drawback of this type of approach is that it does not provide any comment on the institutional requirements.

The structuralist's approach has received a considerable amount of attention in developing countries. This is because it assumes that the developing economies are subject to a number of constraints. There are bottlenecks and rigidities and the structuralists believe that until these are removed the economy is not bound to succeed. In the case of Kuwait, these rigidities may be in the form of social, religious and cultural beliefs.

As explained in Chapter 1, the oil sector has a relatively weak linkage with the other sectors. If it is possible to identify another sector which may play a dominant role then investment should be directed towards this sector. This results in an application of 'Big Push' theory and stimulates unbalanced growth. But such a sector must possess very strong forward and backward linkages with the other sectors. On the other hand, it may be difficult to find such a sector and therefore investment must be directed to a number
of sectors. This is a view taken up in this study.

H Biblawi and E Shafey (1981) have suggested three sectors. They are Manufacturing, Human Capital Formation and Finance. In Manufacturing, as stated, it may be possible to expand the oil-related manufacturing sector. The manufacture of petrochemicals is profitable on a large scale because gains can be made from economies of scale, but large scale also means that it has to be export orientated since the size of the domestic economy is relatively small. Hence, Kuwait should follow an export-expansion policy. It is also important that it chooses a capital intensive technique so as to reduce the dependency on labour.

In the Human Capital Formation the investment can be made in education, training and health. However, it is difficult to assess the level of expenditure per head and therefore difficult to use within a modelling framework. The Finance sector can be developed domestically and internationally. If at present it was felt that domestic economy should not be developed then investments could be placed in international capital markets.

It is felt in this study that the development should be a balanced one. In the following chapter a framework for planning is discussed and a macroeconomic model is specified.
Chapter 3
MACROECONOMIC MODEL OF KUWAIT : SPECIFICATION

The main purpose of this chapter is to discuss the specification stage of the model. The specified model will be estimated and then used for simulation exercises. The results of estimation and simulation will be presented in the following chapters.

The main objective of the model once estimated is to carry out simulation exercises. These exercises provide the basis for examining the various options and plan accordingly. But planning must be based on certain objectives of which economic growth is an important one. Hence the model should be specified within a growth theory framework. The major difference between a growth model and the planning model is the role of time. In standard growth models time is taken to be infinite and these models can only provide analytical solutions. In planning models time is exogenous and finite. Hence these models provide empirical solutions.

Since the model adopts a growth theory framework, it is felt that omission of a discussion on growth models will make this chapter incomplete. In addition, since the Kuwaiti economy is highly dependent on its exhaustible resource, oil, the discussion is focussed on both growth and depletion theory.

3.1 Growth models with depletion theory

3.1.1 Depletion theory

The major contribution to the positive approach to depletion of exhaustible resources was made by Hotelling (1931). His pioneering work on exhaustible resources resulted in the so-called 'fundamental principle'. This states that under competitive conditions the net price(1) of the resource must rise at a rate

(1) The 'net price' is also referred to as 'Royalty', 'Profit' and 'rent'
equal to the rate of interest. This can be mathematically expressed as

\[ \frac{P_{t+1} - P_t}{P_t} = r_t \]

where, \( P_t \) = net price of resource
\( r_t \) = rate of interest

He suggested that the most important factors that affect the 'positive' theory of depletion are the rate of interest, resource availability, cost of extraction and demand for the resource. A fall in interest rate raises the initial royalty. A fall in market price reduces the rate of increase in royalty but extends the date of depletion. However, Gordon (1966) argues that lower interest rate does not necessarily delay the depletion time. This can happen since lower interest rate may lower the capital costs. A fall in marginal extraction costs will, other things being equal, lead to an increase in depletion rate. Herfindahl (1967) has argued that within the limiting conditions at which the demand for the resource falls to zero is unchanged, a rise in demand will increase royalties and reduce the length of time of exhaustion.

However, this positive approach does not answer the question of how fast a given stock of resource ought to be depleted. Since all countries, including Kuwait, are endowed with a 'finite' stock of resources it is important to know how the resource should be exploited. Hence a normative approach which provides an answer to such a question becomes more appropriate. This approach is based on two conditions, namely efficiency and intertemporal justice.

In standard economic theory, efficiency is based on Pareto efficiency. In a static sense, this is achieved if welfare of one person could be improved without making anyone worse off. In an exhaustible resource-based economy the problem must be treated in a dynamic sense, that is, welfare must be improved without making
anyone in any generation worse off\(^{(1)}\).

The Pareto efficiency condition does not take into consideration the intertemporal distribution of income. Little (1950) argues that the choice of the social welfare function should also take into account an improvement in the distribution of income. The properties of such a function \( U_i = U_i(C_i) \)

where \( U_i \) = utility of \( i^{th} \) individual

\( C_i \) = consumption of \( i^{th} \) individual

is given by

\[ U'_i(C_i) > 0 \quad \text{marginal utility is positive} \]

\[ U''_i(C_i) < 0 \quad \text{diminishing marginal utility} \]

This additive utilitarian objective has been severely criticised by J Rawls (1971). He argues that inequality in the distribution of wealth or utility is justified only if it is a necessary condition for improvement in the position of the poorest individual. In his view maximising social welfare must mean maximising the lowest utility level. Thus the welfare function is sensitive only to gains and losses of utility of the poorest person. Solow (1974) has criticised this maxi-min principle mainly on the fact that it is so much at the mercy of initial conditions. If the initial capital per worker is small, he argues that no more will be accumulated and the consumption level will be low forever\(^{(2)}\).

\(^{(1)}\) T Sandler and V K Smith 'Intertemporal and Intergenerational Pareto Efficiency' Journal of Environmental Economics and Management No. 2, 1976

\(^{(2)}\) see also T Koopmans 'Intertemporal Distribution and 'Optimal' Aggregate Economic Growth' in scientific papers of T C Koopmans Springerborlag, New York 1970, pp 563 - 594
3.1.2 Optimal growth with depletion - a general model

Let $W = \sum_{t=0}^{T} \delta^t U(C_t)$ \hspace{1cm} (1)

$W$ = welfare

$C_t$ = consumption at time $t$

$U(C_t)$ = utility function

$\delta$ = discount factor

Let output $Q_t$ be dependent on two inputs, namely capital and resource

$Q_t = F(K_t, R_t)$ \hspace{1cm} (2)

The output $Q_t$ is also assumed to be consumed or invested

$Q_t = C_t + I_t$ \hspace{1cm} (3)

$I_t = K_t - K_{t-1}$ \hspace{1cm} (4)

Combining (1), (3) and (4)

$F(K_t, R_t) = C_t + K_t - K_{t-1}$

The optimal growth problem can now be formally written as

Maximise $W = \sum_{t=0}^{T} \delta^t U(C_t)$ \hspace{1cm} (5)

subject to

$F(K_t, R_t) = C_t + K_t - K_{t-1}$

$R_t = \bar{R}$, $\bar{R}$ is the total stock of resource

---

The Lagrangean can be written as

\[ L = \sum_{t=0}^{\infty} U(C_t) + \sum_{t=0}^{\infty} \lambda_t \left[ F(K_t, R_t) - C_t - K_t + K_{t-1} \right] + \sum_{t=0}^{\infty} \lambda_t \left[ R_t - \sum_{o}^{t} \lambda_o \right] \]

First order conditions may be derived as follows:

\[ \frac{\partial L}{\partial C_t} = 0 \quad \Rightarrow \quad \delta t \quad U^i(C_t) = \lambda_t \quad (6) \]

\[ \frac{\partial L}{\partial K_t} = 0 \quad \Rightarrow \quad \lambda_t \quad F^i(K_t) = \lambda_{t-1} - \lambda_t \quad (7) \]

\[ \frac{\partial L}{\partial R_t} = 0 \quad \Rightarrow \quad \lambda_t \quad F^i(R_t) = \lambda_{2t} \quad (8) \]

From (6) we have

\[ \lambda_{1t} = \frac{U^i(C_t)}{(1+r)^t} \quad (9), \quad \delta t = \frac{1}{(1+r)^t}, \]

\[ r \text{ is the discount rate} \]

From (8) and (9)

\[ \lambda_{2t} = \frac{F^i(R_t) \cdot U^i(C_t)}{(1+r)^t} \]

From (7)

\[ \frac{\lambda_{1t} - \lambda_{1t-1}}{\lambda_{it}} = -F^i(K_t) \]

Combining (7) and (9)

\[ \frac{U^i(C_t) - U^i(C_{t-1})}{U^i(C_{t-1})} = r - F^i(K_t) \left[ \frac{U^i(C_t)}{U^i(C_{t-1})} \right] \]
This result shows that the marginal utility of consumption, under optimum conditions, should increase at a rate equal to the pure rate of discount less the second expression on the right hand side. If time intervals are progressively shorter this expression can now be written as

\[
\frac{U''(c)}{U'(c)} = r - F'(K_t)
\]

This result represents Ramsey's (1928) Rule of optimal growth.

3.1.3 Optimal Growth with depletion - Kuwaiti model

Since the rise in oil prices in 1973 - 1974 there has been a significant renewed interest in the economics of exhaustible resources. Cremer & Isfahani (1981), Koopmans (1975) discuss the problem within a limited domestic absorptive capacity. They assume there are no international capital markets and do not treat the problem of optimal depletion in an open economy. Maskin & Newbery (1978), Kemp & Long (1980) assume the presence of international capital markets but the markets are perfectly competitive. Aatrestaad (1979) takes into account that the international capital markets are imperfect but this study ignores the domestic physical capital. Dasgupte, Eastwood and Heal (1978) treat the case of an imperfect capital market but assume that the country has an unlimited domestic absorptive capacity.

The Kuwaiti economy has certain basic characteristics. It has a limited domestic absorptive capacity. There is an acute shortage of labour. The resource is mainly traded in the international market. Since it exports a comparatively small volume of oil, it is a price taker. It has accumulated a significant amount of foreign assets over the years. However, the share of Kuwaiti's foreign assets in the international capital market is small and therefore cannot influence the rates of return.

Amongst the many studies mainly the studies of Hoel (1981),
Dasgupte and Heal (1981) have taken most of the characteristics in their theoretical analysis. They do not take into account the shortage in the supply of indigenous Kuwaiti labour. However, using these studies as guidelines, the model can be formulated as follows:

The country's budget or overall balance equation is given by

\[ C + W = F(K, R, L) + r(W - K) + p x E \]

where

- **W** = Country's total wealth
- **C** = Consumption
- **K** = Capital stock (domestic)
- **R** = Resource
- **L** = Labour
- **E** = Exports of Resource
- **P** = Price of resource
- **r** = rate of return from foreign assets

**F(K,R,L)** = output

The country may hold its wealth in any of the three assets - domestic capital, foreign capital or unextracted resource. Let the rate of return on foreign assets be \( r \) and domestic investment \( F_k \) - marginal product of capital. The return to holding the unextracted resource is equal to the rate of increase in the amount that can be earned by using an extra unit. If this unit is exported this amount is the marginal revenue, \( m(E) \). An optimal investment policy will be one along which the rates of return on all three are equal.

\[ r = F_k = m(E) \]

\[ m(E) = \frac{d}{dt} \left( \frac{F_R}{F_k} \right) \]

Let the discounted utility function be given by

\[ \frac{U(C_t)}{(1+\tau)^t} \]

\( \tau \) is the rate of discount
For optimal depletion two conditions must be satisfied. These are the efficiency and the intertemporal conditions. The second condition is obtained by equating the social rate of time preference to the rate of return \(1\).

The problem can be formally written as

\[
\text{maximise } \int_0^\infty \frac{U(C_t)}{(1+r)^t}
\]

subject to efficiency condition

\[
r = F_k = \frac{\frac{d}{dt} (F_R)}{F_R}
\]

and

\[
C + \dot{W} = F(K, R, L) + r(W - K) + P x E
\]

\[
\int_0^\infty R_t \ dt = \bar{R} \quad \text{stock of resource}
\]

\[
L_t \leq L^* \quad \text{when } L^* \text{is the maximum permitted labour}
\]

\[
K_0 > 0
\]

\[
R_0 > 0
\]

\[
W_0 > 0
\]

\(1\) Dasgupte and Heal have shown that the second condition implies

\[
\frac{\delta - u^{11}(C_t)}{u^1(C_t)} \dot{C}_t = r
\]

See 'Economics of Exhaustible resources', Chapter 7
3.2 Specification of the macro-economic model

The growth models that have been discussed so far give rise to analytical solutions. In order to derive empirical results it is essential to estimate a model of the economy. But estimation can only be carried out on a 'specified' model. At the specification stage, various theories regarding the behaviour and functional forms of the different equations of the model are discussed. It provides the foundations required to build the model.

In this study, the model is built within a General equilibrium framework. It consists of a demand and a supply side. The Demand side is based on a Keynesian income-expenditure approach. The Supply side, disaggregated into three sectors, is represented in terms of neoclassical production functions. The complete model also consists of equations for stock variables such as domestic capital stock, foreign assets, oil reserves, population, etc. The model is open to take into account international trade. As a growth model this resembles the models of Solow and Kaldor. But unlike Solow and Kaldor the model does not consider the role of prices or technological progress. As a planning model this follows the model by Mallach and Atta with an emphasis on disaggregation. But unlike Mallach and Atta, the supply side of this model is represented by neoclassical production functions.

Let us now specify the demand side of the model.

3.2.1 Consumption - Personal and Public

The major contributions to the personal consumption function have been made by Keynes (1939), Duesenberry (1949), Ando and Modigliani (1963) and Friedman (1957).

The simplest form of the personal consumption function stems from Keynes' 'Treatise on money' which states that current consumption expenditure rises linearly with current disposable income. However, this does not capture the difference between short and long run effects. Duesenberry's relative income hypothesis is based on time series and cross-section analysis. The cross-section effect
assumes that a person's consumption behaviour is a function of his position in the income distribution. Hence, the individual consumption behaviour is assumed to be independent. The time series effect assumes that consumption behaviour is not readily reversible and so people react differently to upward and downward income changes rather than having a simple consumption-income relationship equally applicable to income movements in either direction.

Ando and Modigliani's 'Life-cycle Hypothesis' assumes that individuals plan their consumption and saving behaviour over long periods. They intend to allocate their consumption in a satisfactory manner over their entire lifetime. Such a view would have to take into account a number of factors such as wealth, age-structure of population etc. Friedman's 'permanent income hypothesis' argues that people plan their consumption behaviour to their permanent or long term income potentials.

Given the various theories of consumption function, a general consumption demand can be specified as:

\[ PC_t = f( PC_{t-1}, PIN_t, PIN_{t-1}, PA, PW_t, PW_{t-1}, \ldots) \]

where

- \( PC_t \) = Personal Consumption expenditure at \( t \)
- \( PIN_t \) = Personal Income at \( t \)
- \( PA \) = Population Age-profile
- \( PW_t \) = Personal Wealth at \( t \)

Unlike the personal consumption function, there are no standard theories which explain the behaviour of the public sector. The function can be specified, generally, to be dependent on government revenues and lagged values of government consumption and government revenues. This is similar to the function specified by Mallach and Atta. However, it is felt that since government expenditure is collective, the equation is specified as:
where

\[
\frac{GC_t}{TP_t} = f\left(\frac{GR_t}{TP_t}, \frac{GR_{t-1}}{TP_{t-1}}, \frac{GC_t}{TP_t}, \ldots \right)
\]

3.2.2 Investment function

There are numerous theories on the behaviour of private sector investment functions. Amongst these Chenery (1952), Chenery and Jack (1966), Jorgensen and Siebert (1968) and Lund (1971) have received most attention.

Chenery argues that there is an economically most profitable amount of capital required to produce a given level of output. The level of investment required is not related to the level of output but to the change in output. This theory is termed the crude accelerator theory. However, this theory has a number of limitations. For example, it does not take into account (i) the role of excess capacity, (ii) the expectations regarding future output and prices, (iii) constancy of the accelerator, (iv) the availability of finance.

This has led to various modifications. Chenery modified the theory by taking into account a flexible accelerator and excess capacity. Similarly, Jack argues that a new variable \( x^1 \) say, is relevant in determining whether a change in output is necessary where \( x^1 \) takes the maximum value of observed output, \( x \), during say the previous three periods.

Adopting the modifications by Chenery and Jack, an investment demand function can be specified as
where

\[ \text{PI}_t = f\left(\Delta x_t^1, \text{PI}_t^R, \beta \right) \]

\[ \text{PI}_t = \text{private sector investment expenditure} \]

\[ \text{PI}_t^R = \text{private sector replacement investment} \]

\[ \beta = \text{modified acceleration coefficient} \]

However, Chenery and Jack do not consider the financial availability. Lund overcomes the limitation on financial constraints of firms. He argues that the firm can invest from obtaining funds from sources such as depreciation allowances, net profits and equity issues. Funds can be raised from internal and external sources. If dividends are assumed to be determined by factors not directly relevant to investment then internal funds less dividends determine the desired level of capital stock.

Jorgensen's neoclassical theory argues that profits play an essential role in the optimal accumulation of capital. Entrepreneurs aim to maximise the net worth of a firm under conditions of perfect competition. This is carried out subject to two constraints:

(i) The net investment equals gross investment less depreciation

(ii) The production function is Cobb-Douglas.

By using the marginal condition of profit maximisation

\[ K_t = \frac{\beta P_t}{C_t} x_t \]

where

\[ K_t = \text{desired capital stock at } t \]

\[ x_t = \text{level of output at } t \]

\[ P_t = \text{price of output at } t \]

\[ C_t = \text{cost of capital services at } t \]
The value of $C_t$ depends on the price of investment goods, the rate of depreciation and the rate of interest as well as the various tax and depreciation allowances relating to investment goods.

By combining all the various theories the investment demand function can be specified as:

$$PI_t = f(\Delta x_t, PI^R_t, GI_t, K_t, L_t, P_t, r_t, PI_{t-1}, \ldots)$$

where

- $PI_t$ = private investment expenditure at $t$
- $\Delta x_t$ = change in output
- $PI^R_t$ = replacement investment
- $K_t$ = desired capital stock
- $L_t$ = Liquidity
- $P_t$ = price of output
- $r_t$ = rate of interest
- $GI_t$ = Government investment at time $t$

The variable Government investment, GI, is included in the private sector investment function. This is important since government participates in private sector investment through direct joint programmes and via the Industrial Bank of Kuwait providing loans at lower interest rates.

3.2.3 Balance of payments

The balance of payments is the record of transactions of the economy with the rest of the world. There are two main types of account: the current account and the capital account. The current account can be further divided into visible trade and invisible trade. The visible trade consists of trade in goods whilst the invisible trade records transactions in services such as freight, royalty payments
insurance payments and transfer payments. The capital account mainly records capital flows. The balance of payments equation can be represented as follows:

\[ BP_t = IM_t - EX_t - OF_t \]

where

\[ BP_t = \text{Balance of payments at } t \]
\[ IM_t = \text{Imports (visible) at } t \]
\[ EX_t = \text{Exports (visible) at } t \]
\[ OF_t = \text{Outflow of capital and invisibles} \]

This equation is particularly applicable to the Kuwaiti economy since the data on Kuwait does not permit any behavioural relationships to be developed for invisibles and capital transfers.

Leamer and Stern (1970) suggest that most of the large body of empirical work carried out on aggregate imports and exports - current account balances - is based on the following two specifications:

\[ M_i = f(Y, P_i) \]
\[ \log M_i = f(\log Y, \log P_i) \]
\[ X_i = f(Y, P_x) \]
\[ \log X_i = f(\log Y, \log P_x) \]

where

(1) Under Freely Floating exchange rate and unrestricted Capital Flows, the Balance of Payments is zero
Pearce (1970) and Orcutt (1950) argue that the elasticities obtained from such functions do not represent the actual elasticities of imports and exports. Such a method gives rise to a combination of demand and supply effects and thus the elasticities obtained are a mixture of the two. Ideally, one should separate the exports and exportables, imports and importables and then estimate the individual elasticities within the framework of a simultaneous system of equations.

In this study the Exports are divided into two categories, oil and non oil exports. The non oil exports are a function of the ratio of gross domestic product of the manufacturing sector to the total gross domestic product. The assumption here is that non oil exports will increase as manufacturing sector output increases relative to total GDP. The oil exports are given by the relationship

\[ \text{OLX}_t = \bar{p} \text{ OL}_t \times QOLX_t \]

where

\[ \text{OLX}_t = \text{oil export revenue at } t \]
\[ \bar{p} \text{ OL}_t = \text{price of oil (exogenous) at } t \]
\[ QOLX_t = \text{quantity of oil exported at } t \]
In the invisible accounts, only revenues are considered. These revenues are derived from the accumulation of a substantial amount of foreign assets. The income is divided into Government and private as each has its own assets. This distinction is essential for constructing the model properly. The functional form is given by a linear relationship:

\[
FI_{it} = RR \times FA_{t-1}
\]

\[
FI_{it} = \text{foreign income for recipient } i, \ i=1,2
\]

\[
RR = \text{Rate of return}
\]

\[
FA_{t-1} = \text{foreign assets held by } i, \ i=1,2
\]

In many large macroeconomic models, the Capital accounts are explained and modelled using a port-folio approach. The Treasury model of the United Kingdom follows this approach. Capital flow depends on changes in interest rates, cost of forward cover, expected exchange rate and level of wealth. The forward rate is a function of the uncovered interest rate and the expected exchange rate - representing Arbitrage and the speculative demand for forward cover - together with the official forward position. The cost of forward cover depends on the difference between the forward and spot exchange rates.

In this study, the outflow of capital and invisibles is treated as residuals in the national income identity equations.

\[
TO_t = PC_t + GC_t + PI_t + GI_t + IM_t = EX_t + OF_t
\]

(1) In Motamen and Al-Sabah's study, this function is assumed to be non linear and given by,

\[
FI_t = RR \times GPA_{t-1}^\alpha, \quad 0 < \alpha < 1
\]

implies decreasing returns to scale.

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where

\[ T_{0t} = \text{Total output} = \text{Total income} \]
\[ PC_{t} = \text{Private Consumption at } t \]
\[ GC_{t} = \text{Government Consumption at } t \]
\[ PI_{t} = \text{Private Investment at } t \]
\[ GI_{t} = \text{Government Investment at } t \]
\[ IM_{t} = \text{Imports at } t \]
\[ EX_{t} = \text{Exports at } t \]
\[ OF_{t} = \text{Outflow at } t \]

### 3.2.4 Income variable

In standard national income accounting methods disposable income is given by

\[ Y_{dt} = Y_{t} - T_{t} + R_{t} \]

where

\[ Y_{dt} = \text{disposable (personal) income at } t \]
\[ T_{t} = \text{Taxes} \]
\[ R_{t} = \text{Transfers} \]

In the case of Kuwait, Government revenue is not derived by taxes alone. Government is almost the sole benefactor of the income derived from oil. In addition there is a substantial amount of income derived from foreign assets. Hence in the case of Kuwait
the equation must be modified as

\[ Y^d_t = Y_t - T_t - OR_t - GFI + R_t \]

\[ OR_t = \text{oil income for Government} \]

\[ GFI = \text{Government Foreign Income} \]

Government Revenue, GR, is the sum of taxes, oil income and income from foreign assets owned by the Government. Tax income, TX_t, is specified to be a function of Gross Domestic Product. The income from foreign assets, as explained earlier, is assumed to be a linear function.

In summary the income-expenditure side of the economy follows the works by Ezzati (1976), Khouja and Sadler (1979), Mallach and Atta (1981).

3.2.5 Supply side - production functions

The production function relates the quantities of imports and quantities of outputs within a production unit which may be a firm, an industry or a national economy. It is usually regarded as a technical relationship between quantities of inputs and the maximum amount of output which can be produced with the given set of inputs. It is usually represented as

\[ Q = f(K,L) \]

\[ Q = \text{rate of output} \]

\[ L = \text{rate of labour input} \]

\[ K = \text{amount of capital input} \]

It is possible to add other inputs such as land, raw materials, technological progress as variables into the system. The classical theory of production assumes that the marginal products of capital and labour are positive but are diminishing.
An important feature of a production function is that it indicates that a given level of output can be produced by different combinations of capital and labour. Along the isoquant of \( f(K, L) \)

\[
\frac{\partial f}{\partial K} \cdot dK + \frac{\partial f}{\partial L} \cdot dL = 0
\]

and hence

\[
Q_K \cdot dK + Q_L \cdot dL = 0
\]
\[- \frac{dK}{dL} = \frac{QL}{QK} = R\]

R is the marginal rate of substitution which measures the rate at which one input can be substituted for the other input. It is normally assumed that as the quantity of one of the inputs increases, the marginal rate of substitution decreases so that the reductions in the level of one variable made possible by increases in the level of the other variable become progressively smaller. Hence the Isoquants are assumed to be convex to the origin as in Fig. 3.2

![](https://via.placeholder.com/150)

Fig. 3.2

A measure of the rate of change of R is given by the elasticity of substitution between the factors K and L which is defined as the proportionate change in the ratio K/L expressed as a fraction of the proportionate change in R. It can be shown that

\[
\sigma = \left( \frac{L}{K} \right) \frac{d(K/L)}{dR/R}
\]

where \(\sigma\) is the elasticity of substitution. \(\sigma\) is inversely proportional to the curvature of the constant product curve and measures the ease of substitution between input factors. If
If $\sigma = 0$, then substitution is impossible. The Leontief function\(^{(1)}\) is an example of this. In a Cobb-Douglas function\(^{(2)}\) the elasticity of substitution is constant and equals one. In translog production function\(^{(3)}\) the elasticity of substitution is a variable and enables the factors to be substituted in variable proportions.

Another property of the production function is whether or not there are constant returns to scale. That is, whether increasing the level of all inputs by a factor $\lambda$ increases output by the same factor. If this is so,

$$f(\lambda K, \lambda L) = \lambda f(K, L) = \lambda Q$$

Then there are constant returns to scale. The production function is homogenous and linear. Applying Euler's theorem gives,

$$Q = Q_K K + Q_L L$$

That is, if the input factors are paid their marginal products, then the total product, $Q$, is exhausted between them.

\(\text{(1)}\) Mallach and Atta have used a Leontief function in their study

\(\text{(2)}\) F M Fisher 'The existence of the aggregate production function' Econometrica, Vol. 37, 1969

\(\text{(3)}\) M Turnousky, M Folie and A M Ulph 'Factor Substitutability in Australian Manufacturing with emphasis on energy inputs' Economic Record, March 1982
In this study the three supply side sectors are selected to be (i) Manufacturing sector (ii) Mining sector (iii) Residual sector consisting of all the other sectors. The Manufacturing and Residual sector are specified as

\[ GDP_i = f(K_i, L_i) \]

where

\[ GDP_i = \text{net output or value added of sector } i \]
\[ K_i = \text{Capital (services) in sector } i \]
\[ L_i = \text{Labour (flow) in sector } i \]

The Mining sector which mainly comprises the oil sector is given by

\[ GDP_j = f(K_j, L_j, R_j) \]

where

\[ GDP_j = \text{net output or value added in sector } j \]
\[ K_j = \text{Capital (flow) in sector } j \]
\[ L_j = \text{Labour (flow) in sector } j \]
\[ R_j = \text{Resource (flow) in sector } j \]

3.2.6 Stock variables

The major stock variables are oil reserves, foreign assets, domestic capital stock, population and labour stock.

(i) Oil Reserves

The depleted oil is either consumed domestically or exported. The domestic consumption of oil is given as

\[ DOL_t = f(GDP_t, DOL_{t-1}, GDP_{t-1}) \]

where DOL is the Domestic Oil Demand. The total oil is then subtracted from the original oil reserves to obtain the new oil reserve.

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(ii) **Foreign Assets**

The major assumption here is that all outflows of capital and invisibles are accumulated as foreign assets.

\[ F_{A_t} = F_{A_{t-1}} + O_{F_t} \]

\[ F_{A_t} = \text{Foreign Assets at } t \]

\[ F_{A_{t-1}} = \text{Foreign Assets at } t-1 \]

\[ O_{F_t} = \text{Outflow at } t \]

The foreign assets sector is divided into private and government sector. This enables the income derived to be calculated separately.

(iii) **Domestic capital stock**

The accumulation of capital stock is given by

\[ K_{ST_{i,t}} = K_{ST_{i,t-1}} + N_{I_{it}} \]

\[ K_{ST_{i,t}} = \text{Capital stock of sector } i \text{ at } t \]

\[ K_{ST_{i,t-1}} = \text{Capital stock of sector } i \text{ at } t-1 \]

\[ N_{I_{it}} = \text{Net investment in sector } i \text{ at } t \]

(iv) **Population**

Population is divided into Kuwaiti and non-Kuwaiti. The Kuwaiti population increases at a geometric rate. This is given by
\[ KP_t = KP_o (1 + r)^t \]

\[ KP_t = \text{Kuwaiti population at time } t \]

\[ KP_o = \text{Kuwaiti population at time } o \]

\[ r = \text{growth rate} \]

The non-Kuwaiti population growth is made up of two factors. The first is the natural growth rate similar to the Kuwaiti population. The second is caused by the importation of foreign labour which takes place owing to a high expansion of the domestic economy. This labour is bound to bring in an addition to the population.

(v) Labour stock

The labour stock is also divided into Kuwaiti and non-Kuwaiti labour. The total labour demand is derived from the desired output paths of the economy. The production function will enable determination of the demand for labour.

The supply of Kuwaiti labour in each sector is a fixed percentage of total population. The residual supply, i.e., demand less supply of Kuwaiti labour, is provided by the non-Kuwaitis.

The following chapter provides the estimation of the complete model.
Chapter 4
MACROECONOMIC MODEL OF KUWAIT : ESTIMATION

4.1 An overview

The major aims of the model are for analysis and prediction. Analysis implies the explanation of the behaviour of economic units - consumers or producers - whereas prediction implies the possibility of forecasting or planning the effects of changes in some magnitudes in the economy. There is no general agreement regarding which of the above attributes of the model is more important. The views of economists range from M Friedman's (1) position that the most important criterion is the model's predictive performance to P Samuelson's (2) position that the power of the model to explain the behaviour of the economic agents is the most important role of the model. It is felt here that the model should satisfy both the attributes to a certain extent. However, there arises a number of problems in estimating a model for a country like Kuwait and these will be discussed in the next section.

4.1.1 Collection and definition of data

In Kuwait, like many other developing countries, the data is comparatively scarce and the accuracy is relatively weak. The Estimation of the model is carried out by using a time series data from 1962 to 1979. As the data series is relatively short it was not possible to test the validity or the forecasting performance of the estimated model. This is due to the fact that all the data points have been used in the estimation. There is also the problem of interpretation of data. For example, if one looks at the statistical abstracts of developed countries, the methods by which depreciation, stock adjustment etc have been calculated will

(1) M Friedman, 'Essays in Positive Economics' (Chicago University Press) 1953

(2) P A Samuelson 'Foundations of Economic Analysis' (Harvard University Press) 1947
be clearly defined. This is not so in the case of Kuwait.

Due to the lack of sufficient data, it is not possible to estimate the model using system estimation techniques such as three stage least squares (3SLS) or full information maximum likelihood methods (FIML). Since the model had to be estimated using real prices (1979 = 100) and sectoral deflators were not available, the data was adjusted in terms of wholesale, retail and import price indices wherever possible.

In addition to the problems described above - measurement and sample size of data, interpretation of data - there are a number of problems which arise in econometric estimation. These are mainly due to the various assumptions regarding the exogenous variables and the error term. The violation of such assumptions which normally occurs leads to problems of autocorrelation, multicollinearity, heteroscedasticity etc. If the estimation is to be carried out properly then these problems must be removed. Heteroscedasticity mainly arises in cross-section analysis and does not cause any serious problem in this study. The degree of multicollinearity is severe if a number of correlated exogenous variables are used in an equation. However, in this study only a few exogenous variables are used in an equation. The inclusion of a small number of variables also helps to preserve a relatively large degree of freedom. The problem of autocorrelation is generally associated with time series data and leads to unbiased but not efficient estimators. In order to reduce this problem the length of the autocorrelation must be first detected and by a suitable transformation of data, re-estimated. But transformation also reduces the size of the sample and hence the degrees of freedom. Since the main priority was the degrees of freedom, the various correction procedures that should have been carried out were not carried out. The selection of an estimated behavioural equation was based on mainly Regression Coefficient, $R^2$ (corrected) and t statistic.
4.2 Demand side of the Economy

As stated in the specification stage, the demand side of the economy is based on a Keynesian income-expenditure model. Unlike the standard Keynesian model, the model in this study represents an open economy. Estimated equations and values of parameters of this study will be compared\(^{(1)}\) mainly with those of Khouja and Sadler (1979) and Mallach and Atta (1981).

4.2.1 Consumption function - personal and public

The empirical work carried out on the various aggregate consumption functions is rather extensive. There are a number of studies which include modifications to the basic theories. However, due to lack of data on cross-sectional units, wealth, age structure of population etc. it was only possible to estimate a long run consumption function based on Friedman's permanent income hypothesis. In the simplest form the function can be written as

\[ C_t = c Y^P_t \]

where

\[ C_t \] = personal consumption expenditure at \( t \)

\[ Y^P_t \] = permanent income at \( t \)

\[ie \quad C_t = c + \beta Y^t + \beta Y_{t-1} + \ldots + e_t \]

\[ E ( e_t ) = 0 \]

Assuming that the distant history has less effect than the present the coefficient \( \beta \) may be expected to decrease over time.

\(^{(1)}\) The parameters of this study are not compared with the ENI study as it was felt that the parameters obtained from the ENI study are based on a relatively short time series data (1968-1978). The parameters in H Motamen and Al Sabah's study are not obtained by a formal estimation procedure and hence cannot be compared with this study.
Rearranging terms and lagging the equation, the final equation is given by,

\[ C_t = \alpha^* + \lambda C_{t-1} + \beta Y_t + e^* \]

where

\[ \alpha^* = \alpha (1 - \lambda) \]

\[ e^*_t = e_t - \lambda e_{t-1} \text{ autocorrelated error term} \]

\[ E (e^*_t) = 0 \]

Ideally, the technique that should have been used to estimate this equation should allow the constraint \( \lambda \) to lie between the values zero and one. Since such a technique was not available the following method was adopted. The equation is given by,

\[ C_t = \alpha^* + \lambda C_{t-1} + \beta Y^d_t + e^*_t \]

By selecting arbitrary values for \( \lambda \) ranging from 0.2 to 0.8 the various values for \( C_t - \lambda C_{t-1} \) were regressed on \( Y^d_t \). Amongst the many equations that were estimated, the following equation was selected for its econometric properties, using the abbreviations in this study,

\[ PC_t = 42.6 + 0.35 PC_{t-1} + 0.521 PIN_t \]

\[ (0.6) \quad (7.8) \quad DW = 1.3 \]

where

\[ PC_t = \text{private consumption expenditure at } t \]

\[ PIN_t = \text{private income at } t \]
-2  
R, corrected regression coefficient shows that the equation is a reasonably good fit. The Durban-Watson statistic, DW, of 1.3 indicates that there is positive autocorrelation which produces unbiased but not 'efficient' estimates (usually under estimates). The figures in parenthesis show the 't' values\(^{(1)}\) suggesting that personal disposable income is very significant. The income variable that is used here is obtained in the following manner

\[
PIN_t = GNP_t - TX_t + GT_t - OIN_t - GFI_t
\]

where

- \(PIN_t\) = personal disposable income at \(t\)
- \(GNP_t\) = National income at \(t\)
- \(OIN_t\) = Oil income (accuring to the Govt.) at \(t\)
- \(GFI_t\) = Government foreign income at \(t\)
- \(TX_t\) = income from taxes at \(t\)
- \(GT_t\) = Government transfers at \(t\)

In Khouja-Sadler, Motamen studies a Keynesian type consumption function is adopted. This function states that current consumption is determined only by current income. It presupposes that in the long run adjustments take place so that the marginal propensity to consume (MPC) is equal to the average propensity to consume (APC). The length of time it takes for MPC to equal APC should be tested empirically. The long run pattern of behaviour is not reflected fully by the initial reaction of consumers. Ideally a chosen theory should distinguish between short and long run behaviour. The permanent-income hypothesis, adopted in this study, does satisfy those requirements.

The estimated equation gives a short-run income elasticity of 0.81 and a long-run income elasticity of 1.26. The MPC's and APC's are

\[(1)\] The \(t\) values (in parenthesis) used for testing the significance of parameters are at 5\% level
compared with the other studies and the results are shown in table 4.1.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Propensity to Consume</td>
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<tr>
<td>Marginal</td>
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<td>----------------------</td>
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<tr>
<td>1. Khouja &amp; Sadler(1)</td>
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<td>2. Mallach &amp; Atta</td>
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<td>3. Sangarabalan</td>
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Table 4.1

Source: 1. M W Khouja & Sadler, The Economy of Kuwait, chapter 7

2. R Mallach & J Atta, The Absorptive Capacity of Kuwait, chapter 7

The income variable used in Khouja and Sadler's study is very similar to this one. Mallach and Atta use the sum of non-oil gross domestic product and net government injection as the income variable.

Mallach and Atta have introduced a dummy variable in their consumption function. This is to capture the effects of the periods before and after the year 1970. However, this proposition is debatable. It has been generally argued that due to the very large increases in income due to the oil price rise in 1973, it has become necessary to split the time series data into two parts. The first part denotes the low income period (the dummy variable takes the value of zero) and the second part represents a high income period (the dummy variable takes the value of one). It is therefore justified on the grounds that the entire time series data is a heterogenous one. The series is divided at the year

(1) Since Khouja and Sadler use a Keynesian type consumption function, it is not possible to calculate the average propensity to consume
1973. But, in this study, it is contested that by incorporating sufficient lags in the equation one can preclude the use of dummy variables. For example, the selection of a consumption function based on permanent income hypothesis gives rise to an infinite distributed lag function. It is also felt that if dummy variables are to be used then it should be included on both sides of the equation since consumption is also likely to rise substantially during the high income period.

However, an alternative specification with an inclusion of a dummy variable was also estimated. As before an iterative technique was used and the best equation is given by,

\[ PC_t = 10.47 + 0.35 PC_{t-1} + 0.23 PIN_t - 164.6 D_t \]
\[ (1.7) \quad (3.55) \quad (0.2) \]
\[ R^2 = 0.8 \quad DW = 0.6 \]

\( D_t \) is the dummy variable. Unlike the Mallach-Atta study the dummy variable proved to be insignificant. The low DW statistic of 0.6, indicates the presence of a high degree of positive autocorrelation. The income variable is significant but the degree of significance is, however, reduced.

Another version of a consumption function with an inclusion of a wealth variable was also estimated. As it is difficult to obtain the data for total wealth, a proxy variable was used. The wealth variable was represented by private sector bank deposits (time and demand) on per capita basis. As before, an iterative technique was used for values of \( \lambda \), ranging from 0.2 and 0.8. Dummy variables were also included. Amongst the many equations that were tried, the best equation was given by,

\[ PC_t = -420.7 + 0.421 PIN_t + 0.49 \frac{L_t}{KP_t} - 0.35 PC_{t-1} \]
\[ (1.99) \quad (5.78) \quad (1.69) \]
\[ R^2 = 0.8 \quad DW = 1.43 \]

\[ \frac{L_t}{KP_t} = \text{Liquid Assets/capita} \]
The results give a high regression coefficient of 0.8, but the wealth variable, \( \frac{L_t}{KP_t} \), proved to be insignificant at a 25% level\(^{(1)}\).

Since the other two studies do not carry out any estimation using a wealth variable it was not possible to compare the results.

Other functional forms such as first differences, log linear were also tried but these did not improve the mentioned results significantly.

Unlike the personal consumption function, there are not any standard theories which explain the behaviour of public sector consumption. Most of the studies, like the Khouja-Sadler and the Mallach-Atta studies, do not distinguish between Government consumption expenditure from Government investment expenditure. Both are taken together as Government expenditure. This variable is usually specified to be a function of Government revenues (mainly from taxes, royalties, borrowing etc.). Sufficient lags are added to capture the adjustments and dynamics of the model. Since this expenditure is on a collective basis, the variable is treated as per capita expenditure. In some cases Government expenditure is treated as a target variable based on some planned growth paths. The Government revenues in Kuwait are mainly obtained from oil revenues and revenues from assets held overseas by the public sector. Unlike many other countries, Kuwait does not need to raise revenues via high taxation, borrowing or both. Amongst the many estimated equations the following was selected,

\[
\frac{GC_t}{TP_t} = 141.4 + 0.045 \frac{GR_t}{TP_t} + 0.66 \frac{GC_{t-1}}{TP_{t-1}} \quad R^2 = 0.62 \quad DW = 2.03
\]

\( (1.43) \quad (2.44) \quad (3.7) \)

\((1)\) As economic theory suggests that the increase in wealth may have a positive or negative effect on consumption, a two tail-test is required to test the significance of this parameter. Hence a 25% level is used.
where

\[ \frac{GC_t}{TP_t} = \text{Government Consumption expenditure/per capita at } t \]

\[ \frac{GR_t}{TP_t} = \text{Government Revenue per capita at } t \]

This equation does not give a very high corrected regression coefficient (\( R^2 = 0.62 \)). Government revenue per capita and Government consumption per capita (lagged one period) are statistically significant. Normally a DW of 2.03 indicates that there is no autocorrelation. However, if an equation contains a lagged endogenous variable as one of the exogenous variables, then the DW will be biased towards 2.0 indicating that there is no autocorrelation. In such a case, for detecting the presence of autocorrelation Durban 'h' statistic instead of DW should be used\(^{(1)}\).

The Khouja-Sadler OSL estimate of Government Consumption function was

\[
GC_t = 47.5 + 0.08 Y_t + 0.048 Gr_{t-1} + 21.7 D_t \]

\( R^2 = 0.94 \)

\( (5.75) (4.28) (1.82) (2.45) \)

\( \text{DW} = 1.23 \)

where

\( GC_t = \text{Government Consumption at } t \)

\( Y_t = \text{Total National Income at } t \)

\( Gr_{t-1} = \text{Government revenue at } t-1 \)

The Mallach-Atta OLS estimate of Government consumption function was

\[
GC_t = 0.882 + 0.384 GOEX_t - 76.23 D_t \]

\( R^2 = 0.97 \)

\( (3.78) (14.42) (-3.0) \)

\( \text{DW} = 2.3 \)

\(^{(1)}\) see J Harvey, chapter 7, "Econometric Analysis of time series" 1981
where

\[ GC_t = \text{Government Consumption at } t \]

\[ GOEX_t = \text{Government total expenditure at } t \]

Since all three equations contain different specifications it is difficult to compare the results and comment upon it.

4.2.2 Investment function - private and public

Due to the lack of data on many variables discussed in the specification stage, it was not possible to test the various theories of investment behaviour. The most important variable in neoclassical investment functions is the price of capital. The rate of interest - as cost of borrowing - does not provide an adequate proxy since the capital markets are not fully developed in Kuwait. There are a number of distortions in the market regarding the availability of loans and the type of repayment\(^{(1)}\) etc. Hence it was only possible to choose an investment function without the inclusion of the price of capital. In this study private investment is specified to be a function of personal disposable income, private investment and Government investment. The reason for including Government investment is that participation of Government in the private sector is comparatively high. It takes part in many joint ventures with the private sector and also provides 'soft loans' - low interest rates and long repayment period - to the private sector\(^{(2)}\). The best estimated equation was,

\[
PI_t = 43.33 + 0.66 PI_{t-1} + 0.1 GI_t - 0.008 PIN_t \quad R^2 = 0.91
\]

\[
(2.55) \quad (3.8) \quad (3.5) \quad (-0.45) \quad DW = 1.65
\]

\(^{(1)}\) see M Girgis - An optimal industrial mix for Kuwait - paper presented to the Conference on Industrial Strategies and Policies for Kuwait, pages 1 - 5, Kuwait, 1980

\(^{(2)}\)
where

\[ PI_t = \text{Private investment at } t \]
\[ GI_t = \text{Government investment at } t \]
\[ PIN_t = \text{Personal disposable income at } t \]

Only the investment variables, and not the income variables, proved to be significant. This is in accordance with the presumption that investment does not take place via the relationship between aggregate planned savings and investment. It is likely to take place via an investment plan by the small entrepreneurial group. This group is assumed to adopt an investment programme with the cooperation from the Government.

Khouja and Sadler specify private sector investment as a function of total investment expenditure and the ratio of money supply to disposable income. Their OLS estimate is,

\[
Ip_t = -39.58 + 116.77 \left( \frac{Mo}{Yd} \right)_t + 0.368 (Ip + Ig)_t - 36.1 D_t \\
(-1.64) (2.76) (3.31) (-5.66)
\]

\[ R^2 = 0.83 \]
\[ DW = 1.7 \]

where

\[ Ip_t = \text{Private sector investment at } t \]
\[ (\frac{Mo}{Yd})_t = \text{Money supply/disposable income at } t \]
\[ Ig_t = \text{Government investment income at } t \]

Mallach - Atta OLS estimate of the private sector investment function is

\[
IP_t = 33.81 + 0.104GDPN + 0.55IP_{t-1} + 40.2 D62 \\
(-2.64) (5.76) (3.92) (3.86)
\]

\[ R^2 = 0.9 \]
\[ DW = 1.5 \]
Both the other studies have used dummy variables which proved to be significant. The inclusion of relative liquidity \( \left( \frac{M_0}{Y_d} \right)_t \) in Khouja-Sadler study is debatable, especially in the long run. Only in Mallach-Atta study on income variable, GDPN, did they prove to be significant.

Public sector investment was specified to be a function of Government revenue and private investment. The best estimated equation was,

\[
G_{It} = -55.3 + 0.134G_{Rt} + 0.34P_{It-1} + 0.51G_{I_{t-1}} + 0.95 \\
(-0.7) (4.5) (0.55) (2.63) \\
R^2 = 0.95 \\
DW = 3.07
\]

As expected Government revenue, \( G_{Rt} \), proved to be significant. It is worth noting here that Private investment lagged one period is insignificant indicating that Government investment, unlike private investment, is autonomous and independent.

Khouja-Sadler, Mallach-Atta do not estimate Government investment functions independently and therefore cannot be compared with this study.

4.2.3 Trade Sector - Balance of Payments

The equations for imports, non oil exports in current accounts were
estimated whilst for the capital accounts and invisibles the net flow was recorded as a residual item using the national income identity.

4.2.3.1 Import functions

Expenditure on imports is specified to be a function of gross domestic product, GDP, and lagged imports and GDP. Many variations of this general relationship were investigated. Amongst the many, two gave satisfactory results and these are

\[
\text{IM}_t = 34.9 + 0.12 \text{GDP}_{t-1} + 0.64 \text{IM}_{t-1}
\]

\[
\begin{align*}
(0.5) & \quad (2.7) & \quad (4.3) \\
\end{align*}
\]

\[
\frac{\hat{R}^2}{R^2} = 0.9 \\
\text{DW} = 2.01
\]

\[
\text{IM}_t = -157.5 - 0.005 \text{GDP}_t + 0.39 \text{GDP}_{t-1}
\]

\[
\begin{align*}
(1.8) & \quad (0.04) & \quad (2.47) \\
\end{align*}
\]

\[
\frac{\hat{R}^2}{R^2} = 0.83 \\
\text{DW} = 1.41
\]

The first equation was a better fit (\(\frac{\hat{R}^2}{R^2}\) of 0.9 compared to \(\frac{\hat{R}^2}{R^2}\) of 0.83 for the second equation). In addition, the correlation coefficient between GDP_{t-1} and IM_{t-1} was 0.7. The correlation coefficient of GDP_t and GDP_{t-1} was 0.95. This indicates that there is a high degree of multicollinearity in the second equation. Although multicollinearity does not cause any serious problems for prediction, it does affect the sample variances and parameter estimates. It is difficult to investigate the significance of the independent variables, in this case GDP and GDP_{t-1}, as they can only be taken as one variable.\(^{(1)}\)

The first equation also possesses a certain degree of multicollinearity, but in applied econometric work it is a choice between 'serious multicollinearity' and an 'acceptable multicollinearity'.

\(^{(1)}\) see R F Wynn and K Holden, An Introduction to Applied Econometric Analysis Introduction pages 14 - 16
The first equation was selected which gives a short run elasticity of 0.36 and a long run elasticity of 1.00.

In Khouja-Sadler study, the OLS estimate of the import function is given by

\[
M_t = -58.3 + 0.15Y_t - 1.44P_t + 243.0 \left( \frac{M_0}{Y_d} \right)_{t-1} \\
\hat{R}^2 = 0.84 \\
(-1.13) (6.75) (2.09) (2.77) \\
\text{DW} = 1.48
\]

where \( P_t \) is the consumer price index.

The Mallach-Atta OLS estimate of the import function is given by

\[
M_t = -110.27 + 0.611 \text{GDA} \\
\hat{R}^2 = 0.99 \\
(-6.27) (35.7) \\
\text{DW} = 1.69
\]

where GDA is the gross domestic absorption.

In all three studies the income variable proved to be significant. The relative liquidity is significant in Khouja-Sadler study. However, the inclusion of price variable can be contested. Firstly, an import price index and not the consumer price index ought to have been used. Secondly, if price level is to be included then relative price level - price of imports to price of domestic goods - should have been used. The elasticities are compared in the following table.

<table>
<thead>
<tr>
<th>Study</th>
<th>Elasticities</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short run</td>
<td>Long run</td>
<td></td>
</tr>
<tr>
<td>1. Khouja &amp; Sadler</td>
<td>0.61*</td>
<td>N/A</td>
<td></td>
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<tr>
<td>2. Mallach &amp; Atta</td>
<td>1.6*</td>
<td>N/A</td>
<td></td>
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<tr>
<td>3. S Sangarabalan</td>
<td>0.36</td>
<td>1.00</td>
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</tbody>
</table>

Table 4.2

* Calculations were carried out by S Sangarabalan
N/A - not available
4.2.3.2 Export Functions

The exports from Kuwait can be divided into two categories, namely (i) crude oil exports and (ii) non-oil exports. In the case of crude oil exports, the equation is given by

\[ \text{OLX}_t = p_t \times (QOLX_t) - c_t \times (QOLX_t) \]

where

\[ \text{OLX}_t \] = income from oil exports at \( t \)
\[ QOLX_t \] = volume of oil exported at \( t \)
\[ c_t \] = cost of oil extraction at \( t \)
\[ p_t \] = price of oil extraction at \( t \)

The non-oil exports are assumed to be manufactured goods mainly as oil products. Therefore it is reasonable to specify that non-oil exports as a function of the ratio of manufactured to total domestic product

\[ \text{NOX} = 163.1 + 2299.4 \frac{\text{GDP3}}{\text{GDP}} \quad \frac{2}{R} = 0.85 \quad \text{DW} = 2.12 \]

\[ (-4.6) \quad (7.9) \]

where

\[ \text{NOX} \] = non-oil exports
\[ \text{GDP3} \] = Gross Domestic Product of manufacturing sector

Khouja-Sadler do not estimate a function for non-oil exports. They take oil revenues from exports as given and use various price and production scenarios.

Mallach and Atta estimate two functions, one for oil and one for non-oil exports.
OILx = -1195 + 1.5 OIQx + 3.975 OILP

\[\begin{array}{c}
\text{(-3.14)} \\
\text{(4.03)} \\
\text{(18.29)}
\end{array}\]

\[R^2 = 0.97 \quad \text{DW} = 1.49\]

where

OILx = Value of oil exports

OIQx = Volume of oil exports

OILP = oil price index (1970 = 100)

\[NOLx = -41.3 + .097 GDPN + 0.1302M\]

\[\begin{array}{c}
\text{(-4.06)} \\
\text{(2.58)} \\
\text{(3.87)}
\end{array}\]

\[R^2 = 0.97 \quad \text{DW} = 3.87\]

where

NOLx = Non-oil exports

GDPN = Non-oil GDP

M = imports of goods and non-oil factor services

Since all three studies - Mallach & Atta, Khouja & Sadler and this study - have specified the export functions differently, it is not possible to compare the results of this study with the others and comment upon them in any meaningful manner.
4.3 Supply Side - Production Functions

The Supply side, as stated earlier, consists of three sectors. These are the Mining Sector, Manufacturing Sector and the Residual Sector. All three sectors are represented in terms of Cobb-Douglas production functions\(^{(1)}\). In general, the assumption of constant returns to scale is imposed. It may be argued that in a country like Kuwait, with under utilised resources, one may experience increasing returns to scale. On the other hand, as argued by Al-Sabah (1982) since there are limitations in absorptive capacity\(^{(2)}\) the assumption of constant returns to scale is justified\(^{(3)}\). This means that if all inputs are increased by a factor, say \(\lambda\), then the output is increased by the same factor.

4.3.1 Manufacturing Sector

As data for the Manufacturing Sector based on a time series was unavailable, the estimation was carried out using cross-sectional analysis. This data\(^{(4)}\) for 17 subsectors of the Manufacturing Sector was collected for the following variables.

\(\text{Motamen and Al-Sabah in their study have used Cobb-Douglas production functions. But unlike this study they have only used a single aggregate supply side.}\)

\(\text{Limited absorptive capacity results from severe constraints and bottlenecks in the non-oil sector.}\)

\(\text{Decreasing returns to scale is mainly applicable to 'mature' economies like the western economies.}\)

\(\text{The data was obtained from UN industrial statistics, 1976, 1977.}\)
Value added in dinars \(- Q_1 \)
Capital services in dinars \(- K_1 \)
Labour in hours worked \(- L_1 \)

Since the data for capital services was not available, it had to be generated. The series was obtained by multiplying the initial output value (in year 1962) by the capital-output ratio of 2:1(1) and multiplying this by a utilisation rate of 70%(2).

The Cobb-Douglas function is given by

\[ Q_{1t} = \alpha_0 K_{1t}^{\alpha_1} L_{1t}^{\alpha_2} U_t \]

Taking logs and rearranging terms the equation can be written as

\[ \log \frac{Q_{1t}}{L_{1t}} = \log \alpha_0 + \alpha_1 \log \frac{K_{1t}}{L_{1t}} + (\alpha_2 - 1 + \alpha_1)L_{1t} + \log U_t \]

The estimated equation was

\[ \log \frac{Q_{1t}}{L_{1t}} = -0.11 + 0.68 \log \frac{K_{1t}}{L_{1t}} + 0.14 \log L_{1t} \quad R^2 = 0.6 \]

(0.6) (5.22) (2.55)

This estimation was carried out without imposing any conditions on the economies of scale.

The estimation gives

\[ \alpha_1 = 0.68, \quad \alpha_2 = 0.46 \]

\[ \alpha_1 + \alpha_2 = 1.14 \]

(1) Ezzati has used a capital-output ratio of 2:1, see "Future OPEC price and production strategies as affected by its capacity to absorb oil revenues" European Economic Review, Vol. 8, 1976

This suggests that there is increasing returns to scale. The equation can be expressed as

\[ Q_{1t} = 0.9 K_{1t}^{0.68} L_{1t}^{0.46} \]

The estimation was also carried out with \( K_{1t-1}, L_{1t-1} \), but the results did not improve the above equation significantly.

When the assumption of constant returns to scale was introduced, the estimated equation was

\[ Q_{1t} = 0.647 + 0.6 \log K_{1t} + 0.4 \log L_{1t} \quad \bar{R}^2 = 0.68 \]

\[ (2.2) \quad (4.2) \quad (2.7) \]

\[ \text{ie. } Q_{1t} = 1.91 K_{1t}^{0.6} L_{1t}^{0.4} \]

4.3.2 Residual Sector

Due to the lack of reliable data, the estimation was carried out using the following assumptions:

1. There is perfect competition
2. Profit maximising behaviour
3. Constant returns to scale

Let the production function be given by,

\[ Q_{2t} = \alpha_3 K_{2t}^{\alpha_4} L_{2t}^{\alpha_5} \]

The production function can also be written in terms of a profit function

Let \( \Pi_t \) be the profits of the sector

\[ \Pi_t = Q_{2t} - r_t K_{2t} - w_t L_{2t} \]
where

\[ Q_{2t} = \text{value added} \]

\[ \gamma_{tK_{2t}} = \text{Cost of capital services} \]

\[ W_{tL_{2t}} = \text{Cost of labour services} \]

profits are maximised when

\[ \frac{\partial \Pi}{\partial K} = 0, \quad \frac{\partial \Pi}{\partial L} = 0 \]

These conditions give

\[ \gamma_{tK_{2t}} = Q_{2t} \alpha_4 \]

\[ W_{tL_{2t}} = Q_{2t} \alpha_5 \]

The estimated production function was given by

\[ Q_{3t} = 1.78 K^{0.69} L^{0.31} \]

Since the estimation was not carried out using formal economic procedure, it was not possible to investigate the significance of the parameters.

4.3.3 Mining Sector

As before, the data on the mining sector was scarce and therefore it was not possible to carry out a formal estimation procedure. Instead the parameters were determined using the average share of the inputs - capital, labour and resources (oil). The average was based on a 5 year period. The estimated production function can be written as

\[ Q_{3t} = 2.38 K_{3t}^{0.2} L_{3t}^{0.02} R_t^{0.78} \]
where

\[ Q_{3t} = \text{Value added in mining sector at } t \]
\[ K_{3t} = \text{Capital services} \]
\[ L_{3t} = \text{Labour, hours worked in mining sector at } t \]
\[ R_t = \text{Resource (Value added)} \]

4.3.4 Comparative results

Khouja and Sadler's model does not contain the supply side of the economy, hence the results cannot be compared. Motamen and Al-Sabah represent the supply side via an aggregate Cobb-Douglas production function. The estimates for the parameters are derived from data based on two time points. They also assume constant returns to scale. Mallach and Atta divide the supply into 9 sectors. Each sector is given by a Leontief production function. In such a function one factor, usually the input in short supply, in this case labour, forms the constraint on output. The incremental labour output ratio of the Mallach and Atta study is very similar in value to that obtained by Motamen and Al-Sabah. This is also very similar to the value (approximately 0.3) obtained for two sectors, Manufacturing and Residual, in this study.

4.4 Factor Supplies

From the production functions, the demand for factors can be derived. For equilibrium to exist these must be matched by the supply of inputs. However, it was not possible to estimate Neoclassical supply functions as data on prices of factors were not readily available. For example, Neoclassical supply is dependent upon - amongst many - two factors. The first concerns the ratio of active participation to the total population. The second concerns the wage/leisure rate\(^1\). However, only the first point

\(^1\) J Muellbaur "Linear aggregation in Neoclassical labour supply" Review of Economic Studies 1981
was taken into consideration.

In the case of labour, three types are introduced. Firstly there is the Kuwaiti labour force which is assumed to be a fixed proportion of population. Secondly there is an indigenous non-Kuwaiti labour force and thirdly the new non-Kuwaiti labour that has to be brought in during rapid economic expansion. This is important since it is not possible to expect the participation rate of indigenous non-Kuwaiti labour to be extremely high. The Kuwaiti labour supply in each three sectors is taken to be a proportion of total labour force of the 1975 census.

Only the studies by Al-Sabah and Mallach and Atta take into account the size of the population and labour force. In Al-Sabah's study the total demand for labour is determined from the aggregate production function. This total labour force consists of three types of labour, male Kuwaiti labour, female Kuwaiti labour and non-Kuwaiti labour. The male Kuwaiti labour is assumed to grow at 6% per annum, the female Kuwaiti labour is assumed to increase by 5% per annum in addition to an annual increase of 10% in the participation rate. The supply of non-Kuwaiti labour is the difference between the demand for labour and the supply of Kuwaiti labour. In Mallach and Atta's study the total demand for labour for each sector is determined from Leontief production function. The determinants are the labour - output ratio and the incremental labour - output ratio. The supply of Kuwaiti labour is exogenous and grows at a geometric rate. The size of the non-Kuwaiti labour force is obtained from the difference between the demand for total labour force and the supply of Kuwaiti labour in each sector. The population size is obtained from the exogenous assumption regarding the participation rate. The exogenous rate of growth of labour force, the participation rate etc are obtained from the 1976 - 1981 development plan. This plan consists of sectoral projections and these values are used by Mallach and Atta. However, they have not reported these values in their book.

4.5 General Comments
The initial oil reserves at 1979 are assumed to be 70 billion
barrels. The population growth rate of Kuwaitis of 3.55% per annum is obtained from the Central forecast made by the planning board. The board also made a central forecast of 5% per annum for the indigenous non-Kuwaiti population growth rate. The population of the new non-Kuwaitis depends on the participation rate and the labour requirements. The income from Foreign Assets is assumed to be a linear function and it is not based on an E Fama\(^{(1)}\) or Sharpe\(^{(2)}\) type risk-return portfolio function. The tax revenue is linearly related to the Gross Domestic Product. Gross capital stock demanded can be calculated from production functions. In order to obtain the net capital stock a depreciation rate of 8% is used.

There are certain other simple relationships in the model but these are self explanatory. In section 4.6 the complete macro-economic model is presented. This model is used in chapter 5 for producing simulation runs.


4.6 MACROECONOMIC MODEL OF KUWAIT
4.6.1 DEMAND SIDE OF THE ECONOMY

(1) National Income Identity

\[ \text{GDP}_t = \text{PC}_t + \text{PI}_t + \text{GC}_t + \text{GI}_t \]
\[ \text{GNP}_t = \text{GDP}_t - \text{BT}_t \]
\[ \text{PIN}_t = \text{GNP}_t - \text{GR}_t \]

(2) Private Consumption

\[ \text{PC}_t = -42.6 + 0.35 \text{PC}_{t-1} + 0.521 \text{PIN}_t \]
\[ (-0.56) \quad (7.8) \]
\[ R^2 = 0.85 \quad DW = 1.3 \]

(3) Private Investment

\[ \text{PI}_t = 43.33 + 0.66 \text{PI}_{t-1} + 0.1 \text{GI}_t - 0.008 \text{PIN}_t \]
\[ (2.55) \quad (3.8) \quad (3.5) \quad (-0.45) \]
\[ R^2 = 0.9 \quad DW = 1.63 \]

(4) Government Revenue

\[ \text{GR}_t = \text{GFI}_t + \text{OIN}_t + \text{TX}_t \]

(5) Government Consumption

\[ \frac{\text{GC}_t}{\text{TP}_t} = 141.4 + 0.045 \frac{\text{GR}_t}{\text{TP}} + 0.66 \frac{\text{GC}_{t-1}}{\text{TP}_{t-1}} \]
\[ (1.43) \quad (2.44) \quad (3.7) \]
\[ R^2 = 0.62 \quad DW = 2.03 \]
(6) **Government Investment**

\[ GI_t = -55.3 + 0.134 GR_t + 0.34 PI_{t-1} + 0.51 GI_{t-1} \]

\[ R^2 = 0.95 \]

\( (-0.7) \quad (4.5) \quad (0.55) \quad (2.63) \]

\[ DW = 3.07 \]

(7) **Tax Revenue**

\[ TX_t = 0.021 + 0.011 GDP_t \]

\[ R^2 = 0.92 \]

\( (0.6) \quad (7.2) \]

\[ DW = 1.3 \]

(8) **Private Foreign Income**

\[ PFI = RR \times PFA_{t-1} \]

(9) **Government Foreign Income**

\[ GFI_t = RR \times GFA_{t-1} \]

(10) **Capital Transfers**

\[ PS_t = PIN_t - PC_t - PIN_t \]

\[ GS_t = GR_t - GC_t - GI_t \]

(11) **Imports (visible)**

\[ IM_t = 34.88 + 0.23 GDP_t + 0.64 IM_{t-1} \]

\[ R^2 = 0.9 \]

\( (0.5) \quad (2.7) \quad (4.3) \]

\[ DW = 2.01 \]
(12) **Exports (visible)**

12.1 **Crude oil exports**

\[ \text{OLEX}_t = pOIL \times QOLX_t \]

12.2 **Non-oil exports**

\[ \text{NOX} = 163.1 + 2299.4 \frac{\text{GDP}}{\text{GDP}} \]

\( (4.6) \) \( (7.9) \)

\[ R^2 = 0.85 \]

\[ DW = 2.12 \]

(13) **Balance of Trade**

\[ BT_t = \text{OLEX}_t + \text{NOX} - \text{IM}_t \]

(14) **Balance of Payments**

\[ BP_t = \text{OLEX}_t + \text{NOX} - \text{IM}_t + \text{GFI} + \text{FPI} + \text{GS} + \text{PS} \]
Notations

(subscript \( t \) denotes time \( t \))

\[
\begin{align*}
\text{GDP} & = \text{Gross Domestic Product} \\
\text{GNP} & = \text{Gross National Product} \\
\text{PIN} & = \text{Private Sector Income} \\
\text{GR} & = \text{Government Revenue} \\
\text{PC} & = \text{Private Consumption expenditure} \\
\text{GC} & = \text{Government Consumption expenditure} \\
\text{PI} & = \text{Private Investment expenditure} \\
\text{GI} & = \text{Government Investment expenditure} \\
\text{TX} & = \text{Tax income} \\
\text{OIN} & = \text{Oil Income} \\
\text{PFI} & = \text{Private Foreign Income} \\
\text{GFI} & = \text{Government Foreign Income} \\
\text{RR} & = \text{Rate of Return on Foreign Assets} \\
\text{PFA} & = \text{Private Foreign Assets} \\
\text{GFA} & = \text{Government Foreign Assets} \\
\text{PS} & = \text{Private Surplus} \\
\text{GS} & = \text{Government Surplus}
\end{align*}
\]
GDP2 = Gross Domestic Product of Mining Sector

GDP3 = Gross Domestic Product of Manufacturing Sector

GDPR = Gross Domestic Product of Residual Sector

KST2 = Capital Stock in Mining Sector

KST3 = Capital Stock in Manufacturing Sector

KSTR = Capital Stock in Residual Sector

TLF2 = Total Labour Force in Mining Sector

TLF3 = Total Labour Force in Manufacturing Sector

TLFR = Total Labour Force in Residual Sector

TKL = Total Kuwaiti Labour

TKL2 = Total Kuwaiti Labour in Mining Sector

TKL3 = Total Kuwaiti Labour in Manufacturing Sector

TKLR = Total Kuwaiti Labour in Residual Sector

KPR = Kuwaiti Participation Rate

NKLi = Non-Kuwaiti Labour in Sector i , i=2,3,R

TKLi = Total Kuwaiti Labour in Sector i, i=2,3,R

TLFi = Total Labour Force in Sector i, i=2,3,R

TKP = Total Kuwaiti Population

INKP = Indigenous Kuwaiti Population

TFA = Total Foreign Assets

QOD = Annual Oil Production (volume)

POL = Price of Oil

ROL = Reserves of Oil (volume)

QOLD = Annual Domestic Oil Consumption (volume)
QOLX = Annual Oil Exports (volume)

OLEX = Annual Oil Exports (value)

NOX = Annual Non- Oil Exports (value)

IM = Annual Imports (value)

BT = Balance of Trade

BP = Balance of Payments

TP = Total Population
4.5.2 **SUPPLY SIDE OF THE ECONOMY**

(1) **Production Functions**

1.1 **Mining Sector**

\[ \text{GDP}_2 = 2.38 (KST2)^{0.2} (TLF2)^{0.02} (OLR)^{0.78} \]

1.2 **Manufacturing Sector**

\[ \text{GDP}_3 = 1.91 (KST3)^{0.6} (TLF3)^{0.4} \]

1.3 **Residual Sector**

\[ \text{GDP}_R = 1.78 (KSTR)^{0.69} (TLFR)^{0.31} \]

(2) **Labour Supply - Kuwaiti**

\[ \text{TKL}_2 = 0.02 \text{ TKL} \]

\[ \text{TKL}_3 = 0.026 \text{ TKL} \]

\[ \text{TKL}_R = 0.954 \text{ TKL} \]

(3) **Kuwaiti Participation Rate**

\[ \text{TKL} = 0.2 \left( 1 + \text{KPR} \right) \times \text{TKP} \]

(4) **Non-Kuwaiti Labour**

\[ \text{NKLi} = \text{TLFi} - \text{TKLi} \]
(5) Population

\[ TKP_t = TKP_0 (1 + 0.0355)^t \]
\[ INKP_t = INKP_0 (1 + 0.05)^t \]

(6) Oil Sector

\[ QOD_t = QOLX_t + QOLD_t \]
\[ QOLD_t = 0.043 + 0.45 QOLD_{t-1} + 0.0014 GDP_t \]
\[ DW = 1.25 \]
\[ R^2 = 0.9 \]

\[ ROL_t = ROL_{t-1} - QOD_t \]

(7) Foreign Assets

\[ TFA = GFA_t + PFA_t \]
\[ GFA_t = GFA_{t-1} + GS_t \]
\[ PFA_t = PFA_{t-1} + PS_t \]
STATISTICAL APPENDIX
Gross Domestic Product (at market prices)

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross Domestic Product (in mill. Kuwaiti Dinars)</th>
</tr>
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<tbody>
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<td>1962</td>
<td>653</td>
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<td>6743</td>
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Table 1

Source  
### Gross National Product

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<tr>
<th>Year</th>
<th>Gross National Product (in mill. Kuwaiti Dinars)</th>
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Central Bank Reports, Kuwait, 1971, 1976, 1978
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**Table 8**

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<td>1971</td>
<td>304.9</td>
<td>63.4</td>
</tr>
<tr>
<td>1972</td>
<td>346.1</td>
<td>90.4</td>
</tr>
<tr>
<td>1973</td>
<td>353.4</td>
<td>111.8</td>
</tr>
<tr>
<td>1974</td>
<td>477.4</td>
<td>125.2</td>
</tr>
<tr>
<td>1975</td>
<td>600.8</td>
<td>188.8</td>
</tr>
<tr>
<td>1976</td>
<td>826.4</td>
<td>264.6</td>
</tr>
<tr>
<td>1977</td>
<td>1078.0</td>
<td>339.8</td>
</tr>
<tr>
<td>1978</td>
<td>1314.0</td>
<td>459.4</td>
</tr>
<tr>
<td>1979</td>
<td>1593.3</td>
<td>453.5</td>
</tr>
<tr>
<td>1980</td>
<td>2136.8</td>
<td>469.5</td>
</tr>
</tbody>
</table>

Table 12
## INDUSTRIAL STATISTICS - 1976

<table>
<thead>
<tr>
<th>Industry</th>
<th>Value added (mill KD's)</th>
<th>Gross fixed capital formation (000' KD's)</th>
<th>Average number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Products</td>
<td>26.1</td>
<td>4330</td>
<td>5413</td>
</tr>
<tr>
<td>2 Beverages</td>
<td>1.9</td>
<td>282</td>
<td>592</td>
</tr>
<tr>
<td>3 Textiles</td>
<td>0.5</td>
<td>6</td>
<td>296</td>
</tr>
<tr>
<td>4 Wearing apparel</td>
<td>11.5</td>
<td>260</td>
<td>6067</td>
</tr>
<tr>
<td>5 Wood Products</td>
<td>5.1</td>
<td>243</td>
<td>1324</td>
</tr>
<tr>
<td>6 Furniture, Fixtures</td>
<td>12.6</td>
<td>131</td>
<td>3305</td>
</tr>
<tr>
<td>7 Printing</td>
<td>5.3</td>
<td>294</td>
<td>1615</td>
</tr>
<tr>
<td>8 Industrial chemicals</td>
<td>16.2</td>
<td>1151</td>
<td>1902</td>
</tr>
<tr>
<td>9 Plastic Products</td>
<td>2.1</td>
<td>28</td>
<td>538</td>
</tr>
<tr>
<td>10 Non-metal Products</td>
<td>35.8</td>
<td>349</td>
<td>3714</td>
</tr>
<tr>
<td>11 Iron and steel</td>
<td>7.6</td>
<td>1992</td>
<td>515</td>
</tr>
<tr>
<td>12 Non Ferrous metals</td>
<td>1.1</td>
<td>38</td>
<td>273</td>
</tr>
<tr>
<td>13 Metal Products</td>
<td>9.0</td>
<td>113</td>
<td>3007</td>
</tr>
<tr>
<td>14 Machinery</td>
<td>1.0</td>
<td>138</td>
<td>437</td>
</tr>
<tr>
<td>15 Transport equipment</td>
<td>2.5</td>
<td>1758</td>
<td>976</td>
</tr>
<tr>
<td>16 Motor vehicles</td>
<td>2.5</td>
<td>79</td>
<td>654</td>
</tr>
<tr>
<td>17 Professional goods</td>
<td>0.3</td>
<td>14</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 13
Source: Yearbook of Industrial Statistics
United Nations 1979
<table>
<thead>
<tr>
<th>Industry</th>
<th>Value added (mill KD's)</th>
<th>Gross fixed capital formation (000's KD's)</th>
<th>Average number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Products</td>
<td>12.8</td>
<td>1555</td>
<td>4640</td>
</tr>
<tr>
<td>2 Beverages</td>
<td>5.3</td>
<td>231</td>
<td>1144</td>
</tr>
<tr>
<td>3 Textiles</td>
<td>0.9</td>
<td>38</td>
<td>266</td>
</tr>
<tr>
<td>4 Wearing apparel</td>
<td>11.9</td>
<td>49</td>
<td>5772</td>
</tr>
<tr>
<td>5 Wood Products</td>
<td>6.1</td>
<td>441</td>
<td>1508</td>
</tr>
<tr>
<td>6 Furniture, Fixtures</td>
<td>10.3</td>
<td>154</td>
<td>3347</td>
</tr>
<tr>
<td>7 Printing</td>
<td>8.1</td>
<td>247</td>
<td>1561</td>
</tr>
<tr>
<td>8 Industrial chemicals</td>
<td>23.8</td>
<td>6718</td>
<td>2411</td>
</tr>
<tr>
<td>9 Plastic Products</td>
<td>2.3</td>
<td>3078</td>
<td>607</td>
</tr>
<tr>
<td>10 Non-metal Products</td>
<td>23.0</td>
<td>7273</td>
<td>4145</td>
</tr>
<tr>
<td>11 Iron and Steel</td>
<td>4.3</td>
<td>915</td>
<td>742</td>
</tr>
<tr>
<td>12 Non-Ferrous metals</td>
<td>0.8</td>
<td>218</td>
<td>316</td>
</tr>
<tr>
<td>13 Metal Products</td>
<td>12.3</td>
<td>1494</td>
<td>6435</td>
</tr>
<tr>
<td>14 Machinery</td>
<td>0.9</td>
<td>43</td>
<td>489</td>
</tr>
<tr>
<td>15 Transport equipment</td>
<td>4.8</td>
<td>78</td>
<td>1056</td>
</tr>
<tr>
<td>16 Motor vehicles</td>
<td>3.9</td>
<td>35</td>
<td>826</td>
</tr>
<tr>
<td>17 Professional goods</td>
<td>0.5</td>
<td>15</td>
<td>89</td>
</tr>
</tbody>
</table>

Table 14

Source: Yearbook of Industrial Statistics
United Nations 1980
5.1 Introduction

Estimated macroeconomic models can be used for various forms of prediction. The major types of prediction are 'Forecasting' and 'Planning'. In a forecasting exercise the policy maker places a number of assumptions regarding the exogenous variables and prepares forecasts of the important endogenous variables. Forecasting the future is usually referred to as ex-ante forecasting. However, such a forecasting exercise is subject to a number of errors. These errors are due to the degree of reliability of the estimated equations, the stochastic nature of the model, the shifts in the structure of the relationships used between the observation period and forecast period, the reliability of the assumptions of the exogenous variables, etc.

The difficulty of tracing the sources of error in ex-ante forecast can be reduced by adopting other kinds of forecasts. In particular the accuracy with which a model 'forecasts' observed past values of certain variables is likely to prove instructive. This is known as ex-post forecasting and takes a number of forms. One possibility is to use actual values of predetermined variables to obtain predicted values of endogenous variables within the observation period in estimating the model. A second possibility is that ex-post forecasts may be extended beyond the observation period to either preceding or succeeding intervals of time which allows the effects of structural changes between an observation and forecast period to be felt. A third possibility is that a distinction may be made in the treatment of exogenous and lagged endogenous variables within the category of predetermined variables. Known values are used only for the first and for initial values of the second in preparing the forecasts in which subsequent values of lagged endogenous variables generated by the model itself are used rather than actual values. The use of a model to obtain a series of forecasts through time in which only the initial values of lagged
endogenous variables and values of exogenous variables are used from outside the model is often referred to as dynamic simulation. This type of prediction is often referred to as an ex-post simulation forecast.

Economic planning is mainly based on the premise that policy makers have preferences regarding certain key endogenous variables. In order to achieve a desired level or growth rate for these variables policy makers use some variables which could be controlled. In the literature the endogenous variables are called 'targets' and the controllable variables 'instruments'.

The two most popular works on the subject of Planning are those of J Tinbergen (1952) and H Theil (1961). Although both attempt to provide a framework for planning, there are a number of differences between their approaches. Tinbergen, unlike Theil, pays little regard to model reality and neglects disturbances across the equations. But the major difference between the two is related to the policy maker's choice and the approach adopted to achieve this. Tinbergen fixes a priori, certain desirable 'target values' and he tries to find those 'instrument values' which help to achieve those targets. In this case the number of targets must necessarily be equal to the number of instruments. Theil, on the other hand, sets the 'maximum values attainable' for the targets and tries to achieve this using the appropriate instruments. In Theil's approach, it is not a necessary condition for the number of targets to be equal to the number of instruments.

During recent years a number of optimisation techniques have been developed and applied to various economic problems in the United Kingdom(1,2,3). The technique developed by PROPE(4) group at


(4) PROPE - Programme Review into Optimisation of Economic models
Imperial College London is adopted here. In PROPE's Optimisation approach, the policy maker must necessarily set some desired paths for the targets. Given a particular target the programme will tend to minimise the cost associated by deviating from the path. In a macroeconomy one is faced with a number of targets with different weights - priorities - attached to each target. For example, if the policy maker feels that controlling inflation is more important than unemployment then a larger weight should be attached to inflation than unemployment in order to bring the difference between the actual and desired for inflation closer than the difference between actual and desired in unemployment.

This programme can also be used for simulation purposes. This is done by simply setting some exogenous growth rates for certain variables and investigating the impact on the other important variables in the economy. This is the method adopted here as it was felt that optimal control techniques are mainly applicable to either a small model or a well defined macroeconomic model. Before proceeding to present the results of the simulation, an assumption of the exogenous variables is discussed.

5.2 Sectoral growth rates

The Supply side of the Economy, as explained in chapter 4, consists of three sectors. These are the mining sector, the manufacturing sector and the residual sector. Certain growth rates - values ranging from high, moderate and low - are assumed for the manufacturing sector and the residual sector. Growth rate for the mining sector cannot be assumed independently as it depends on the oil depletion policy.

One way to choose the growth rates is to use some observed growth rates in the past. However, in the past, especially between 1974 - 1980, the sectors have been growing at a very rapid rate. These phenomenally high real growth rates are unlikely to continue as that particular period can only be taken as a transitional period. In the simulations three real growth rates are assumed; the high growth rate of 7.5%; the moderate growth rate of 5% and
a low growth rate of 3% per annum\(^{(1)}\).

One major criticism regarding this approach is related to the assumption of dependency between the manufacturing and the residual sector\(^{(2)}\). In the case of Kuwait it could be argued that the linkage effect between the two sectors is negligible. This can be established from the input-output table 3A and 3B in chapter 1.

### 5.3 Long-term price of oil

One of the key exogenous variables that is used in the simulations is the long term price of oil. It is assumed that Kuwait is a small oil producer and therefore it does not have a significant influence on world oil prices. It must be stressed here that the appropriate price that should be used in this study is the long term price of oil. Therefore, it is argued that the instability in the oil market during the past three years is a short term phenomena and does not have any significant effect on the long term trend path.

Ever since the rise in oil prices in 1973 - 1974 there has been a significant interest shown by economists in trying to predict the long term trends. The empirical studies fall mainly into two categories\(^{(3)}\), the 'optimisation approach' and the 'energy balances approach'. The optimisation approach has been adopted under two market structures. One treats OPEC as a cartel and the other as a competitive producer. A Johany (1980) argues that the rise in oil prices was mainly a result of a change in property rights. The property rights were passed on to the oil producers from oil companies. This meant that under competitive wealth maximisation, the discount rates changed from high to low and this has resulted in high oil prices.

\(^{(1)}\) These rates are chosen arbitrarily. However, the model is able to handle any assumed growth rate.

\(^{(2)}\) Cambridge 'multisectoral growth project' treats the sectors as interdependent

\(^{(3)}\) There have been a few simulation studies, for example D Gately 'Simulating OPEC pricing behaviour in World Energy Market', International Energy Program discussion paper, Stanford, 1980
Cremer and Isfahani also take the view that OPEC is a competitive producer and because of their inability to absorb the large revenues, high oil prices are likely to result. However, these studies only provide some explanation for the high oil prices and do not empirically forecast the long term trends in oil prices.

Amongst the studies which treat OPEC as a cartel, R S Pindyck (1978), Cremer-Weitzman (1976) and S Salant (1979) have received the most attention. These studies suppose OPEC acts as a profit maximising group subject to a number of factors. These factors are (i) Demand and Supply specification of oil; (ii) Reserves; (iii) Price of substitutes; (iv) Introduction and availability of alternative energy sources etc. All three studies assume that OPEC is the residual supplier. However, the treatment of members within OPEC in each model is somewhat different. OPEC is assumed to be a monopoly in Cremer-Weitzman's study. In Pindyck's study OPEC is divided into two blocks, one consisting of savers; Saudi Arabia, Kuwait, UAE and Libya, and another consisting of spenders; Indonesia, Nigeria, Venezuela etc. In Salant's study OPEC consists of a number of groups and these groups are involved in an optimal bargaining situation. These studies provide the following forecasts for long term oil prices.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Base Year</th>
<th>Final Year</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cremer - Weitzman</td>
<td>1975</td>
<td>2015</td>
<td>2.0%</td>
</tr>
<tr>
<td>Pindyck - Hnyliciza</td>
<td>1975</td>
<td>2010</td>
<td>1.5%</td>
</tr>
<tr>
<td>S Salant</td>
<td>1980</td>
<td>2020</td>
<td>2.3%</td>
</tr>
</tbody>
</table>


On the other hand, the 'Energy balances approach' takes into account the institutional aspects of the oil market, availability of substitutes, world economic growth rates etc. The price of oil is determined by bringing demand and supply into equilibrium. The model is then tested under various conditions.

This is the approach taken up in Exxon's Energy Outlook (1980), Chase
Econometrics Group (1980), Economic Intelligence Unit (1981) etc. These studies have been mentioned since they provide low, medium and high growth rates in oil prices.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Base Year</th>
<th>Final Year</th>
<th>Growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exxon</td>
<td>1979</td>
<td>2000</td>
<td>2%</td>
</tr>
<tr>
<td>Chase Econometrics</td>
<td>1980</td>
<td>1990</td>
<td>3%</td>
</tr>
<tr>
<td>E I Unit</td>
<td>1980</td>
<td>1990</td>
<td>5%</td>
</tr>
</tbody>
</table>

Source: The Exxon Outlook, 1980
Chase Econometric Reports, 1981
Economic Intelligence Energy Report, 1981

In general, the energy balance approach forecasts tend to be for a shorter time period.

In addition to the two main approaches, there are a number of other views regarding oil prices. One of the earlier views has been the 'scarcity rent view' which has been reinforced by the recent study by Roumasset, Isaak and Fesheraki (1983). This view asserts that the quadrupling of the oil price in 1973 was simply an attempt to correct for years of extravagant use of a scarce natural resource. Another view, especially propounded by Moran (1983) is that OPEC should be modelled within economic and political objectives. However, these views do not provide any forecasts for the long term price of oil.

In this study, three price paths of 1% (low), 1.5% (moderate) and 2% (high) are assumed. In addition, a few simulations are carried out with two different price paths for two different time periods.

5.4 The rate of return on foreign assets

The rate of return, like the price of oil, plays an important role in this study and the appropriate variable to use is the long term rate of return. However, it is extremely difficult to forecast this variable and it is even more difficult to justify a positive value for it. This is mainly due to the fact that during the 1970's the real rate of return on liquid financial
assets has been negative.\(^{(1)}\)

<table>
<thead>
<tr>
<th>Year</th>
<th>Real Rate of Return (%) on US Deposits</th>
<th>Real Rate of Return (%) on UK Deposits</th>
<th>Real Rate of Return (%) on Euro dollars*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>1.54</td>
<td>-1.0</td>
<td>2.38</td>
</tr>
<tr>
<td>1972</td>
<td>2.81</td>
<td>3.8</td>
<td>2.25</td>
</tr>
<tr>
<td>1973</td>
<td>0.82</td>
<td>3.3</td>
<td>2.94</td>
</tr>
<tr>
<td>1974</td>
<td>-2.8</td>
<td>-8.2</td>
<td>0.11</td>
</tr>
<tr>
<td>1975</td>
<td>-1.0</td>
<td>-6.3</td>
<td>-2.21</td>
</tr>
<tr>
<td>1976</td>
<td>2.07</td>
<td>-4.5</td>
<td>0.22</td>
</tr>
<tr>
<td>1977</td>
<td>1.9</td>
<td>-3.0</td>
<td>0.5</td>
</tr>
<tr>
<td>1978</td>
<td>0.9</td>
<td>4.2</td>
<td>1.61</td>
</tr>
<tr>
<td>1979</td>
<td>-1.7</td>
<td>-0.5</td>
<td>0.93</td>
</tr>
</tbody>
</table>

* Euro dollars held in London

Fig. 5.4

It can also be argued that since Kuwait has reached a mature stage in managing its portfolio of foreign assets it can expect much higher rates of return in the future. However, placement on high yielding assets may also involve high risk, specially in the equity markets. Ideally as financial wealth continues to grow the need for diversification, risk bearing control, liquidity etc will become extremely important. K J Arrow (1964) has suggested that the investment institution should select a utility function \( U(y) \) such that it satisfies the following condition

\[
\begin{align*}
U'(y) &> 0, \text{ marginal utility is positive} \\
U''(y) &< 0, \text{ diminishing marginal utility}
\end{align*}
\]

\(^{(1)}\) See also P Hallwood and S Sinclair 'Oil, Debt and Development: OPEC and the Third World' George Allen and Unwin. London 1981
In addition the function should take into account two other assumptions - marginal absolute risk aversion decreases with an increase in wealth and marginal proportional risk aversion increases with an increase in wealth.

The studies by H Motamen(1) and S M Sabah(2) adopt a risk-return function approach. By setting the first derivative to the predetermined rate of return the parameters of the function are calculated. H Motamen and S M Sabah choose 8% and 7% respectively for their rates of return (nominal). If an inflation rate of 5% is assumed then the real rates of return are around 2 - 3%.

In this study a real rate of return of 3% is assumed.

5.5 Other Exogenous Factors

There are three other exogenous factors used in the simulation. These are the percentage increase in the participation of the Kuwaiti labour, the percentage increase in the indigenous non-Kuwaiti labour and the oil depletion rate.

As in the other exogenous variables, it is very difficult to forecast the increase or decrease in the participation rate of Kuwaitis. Economic factors such as high wage incentives, longer leisure etc alone are not sufficient to determine this. In order to increase the participation rate other factors may have to play a dominant role. Various Government policies both economic and social may have to be implemented. This may take the form of on the job training, higher and skilled educational programmes etc. In the case of female labour social factors such as commitment between family and work, status in society, duration of working period may be important. However, at present the only guidelines for a forecast is the past

(1) (2) The function is given by,

\[FI = \alpha_1 F_{t-1}\]

\[0 < \alpha_1 < 1\]

see H Motamen, Expenditure of oil revenue, chapter 5

see S M Sabah, Development planning in an oil economy, chapter 5

- 120 -
rate. Over the last ten years (1970 – 1979) the increase in the participation rate has been approximately 2%.

In addition to the Kuwaitis there is another participation rate that is used in the simulation. This is the rate for the indigenous non-Kuwaitis, whose status is based on the duration of their stay – 10 years or more – in Kuwait. This increase is controlled and acts as a constraint on the non-Kuwaitis settled in Kuwait and it also emphasises the role of imported labour. If this rate is not explicitly defined there may be a case in which scenarios for high economic growth rate may produce results of 90% participation for the non-Kuwaitis which is clearly unrealistic.

In all the simulations a rate of increase of 2% is used for both Kuwaitis and non-Kuwaitis.

The oil depletion rate can be treated as a controllable variable. But what is optimal in the future is debatable. Kuwait has produced a maximum of 3.3 million barrels per day in 1972 and 1.6 million barrels per day in 1980. The large variabilities in production and exports can be seen in fig. 5.5.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production mill.b/d</th>
<th>Exports mill.b/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>2.99</td>
<td>0.58</td>
</tr>
<tr>
<td>1971</td>
<td>3.20</td>
<td>2.78</td>
</tr>
<tr>
<td>1972</td>
<td>3.30</td>
<td>2.93</td>
</tr>
<tr>
<td>1973</td>
<td>3.02</td>
<td>2.64</td>
</tr>
<tr>
<td>1974</td>
<td>2.55</td>
<td>2.21</td>
</tr>
<tr>
<td>1975</td>
<td>2.09</td>
<td>1.80</td>
</tr>
<tr>
<td>1976</td>
<td>2.15</td>
<td>1.79</td>
</tr>
<tr>
<td>1977</td>
<td>1.97</td>
<td>1.62</td>
</tr>
<tr>
<td>1978</td>
<td>2.13</td>
<td>1.76</td>
</tr>
<tr>
<td>1979</td>
<td>2.50</td>
<td>2.08</td>
</tr>
<tr>
<td>1980</td>
<td>1.66</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Fig. 5.5
Source: OPEC Annual Statistical Bulletin 1980
Since there are indications that Kuwait might reduce output over a long period the simulations are carried out with three values 1.0 m b/d, 1.5 m b/d and 2.0 m b/d. It must be pointed out that the model is able to produce results with any given value. However in order to reduce the number of simulations to a manageable size the depletion rates mentioned above are used.

5.6 Simulation Runs

There are a large number of simulation results which can be produced from the model given the assumptions regarding the exogenous variables. By just selecting 3 different values for 5 exogenous variables 243 different simulations can be obtained. Hence there is a need to limit this to some manageable number of runs in order to make sensible comments. It must also be pointed out that it is not possible to adopt the normal procedure in which comparisons are usually made between a particular case and a standard case. This is due to the fact that in this study it is difficult to establish the standard case. Hence simulations are carried out within a range and the results are presented in the Appendix.

The format of the simulation runs is as follows:

The assumptions for the exogenous variables

1) The rate of growth of manufacturing sector
2) The rate of growth of residual sector
3) The rate of increase in Kuwaiti participation rate
4) The rate of increase in indigenous non-Kuwaiti participation rate
5) The rate of oil depletion
6) The rate of growth of oil price
7) The rate of return on foreign assets

The results are tabulated for important stock variables and some other variables which measure welfare.
Stock Variables

1) Total population of Kuwait
2) Total oil reserves
3) Total foreign assets
4) Total domestic capital stock
5) Total Kuwaiti labour force
6) Ratio of Kuwaiti population to total population
7) Ratio of Kuwaiti labour force to total labour force

Welfare measure variables

1) Growth rate of consumption per capita
2) Growth rate of GDP per capita

Thirty-eight simulations are produced and they fall into two categories. In the first category the assumptions are made at the beginning of the simulation period (1980) and they remain at that level during the entire period until 1999. In the second category, the period is broken down into two: 1980 - 1989 and 1990 - 1999. This enables changes to be made to the assumptions during the second period if desired.

All the thirty-eight simulations are checked for certain constraints to be held such as minimum import requirements, positive balance of payments, non negative values for population, labour, etc. In simulation studies, usually sensitivity analyses are carried out to investigate mainly the robustness of the model. In this study such tests were not carried out as it was felt that it would have increased the number of simulations to an intractable dimension.

The thirty-eight simulation results are presented in the Appendix. Seven simulations are selected and a discussion is presented in the following pages.
5.7 Selected Results

As suggested earlier, many different assumptions can be made regarding the exogenous and policy variables and accordingly, many different simulation results can be produced. In reality there are a number of issues which have an effect on the Kuwaiti economy, but in order to keep the discussion as general as possible, the focus is made on a limited number of cases. These selected results must represent the broad spectrum of alternative long term plans. In the case of Kuwait, as pointed out in chapter 1, the policy that is finally adopted should be based on a compromise between social, political and economic objectives. The economic objectives may be judged in terms of rate of increase in consumption per capita, growth (GDP) per capita, the level of domestic capital stock, foreign assets etc. The socio political objectives may be judged in terms of the level of foreign population, expatriate labour force etc.

In this study seven basic categories are identified:

Policy A : high depletion, high growth, high price
Policy B : high depletion, high growth, low price
Policy C : moderate depletion, moderate growth, moderate price
Policy D : low depletion, low growth, high price
Policy E : low depletion, low growth, low price

These policies are based on assumptions taken at the beginning of the planning period and maintained throughout the 20 year period. In addition to the above, two more simulations are carried out in which some of the assumptions are changed after 10 years of the 20 year period.

1990 - 1999 : high depletion, high growth, low price
Policy G : 1980 - 1989 : high depletion, high growth, high price
5.7.1 Policy A: high depletion, high growth, high price

The depletion rate that is assumed in this simulation is 2 mn barrels per day. A high growth policy assumes a growth rate of 7.5% per annum for the manufacturing and the residual sector. A high price path for oil of 2% is used here.

This simulation would generate a growth rate in Gross Domestic Product (GDP) per capita of 5.1% per annum. The consumption per capita would increase at a rate of 3% per annum. In the final year of the planning period, the initial reserves of 70 billion barrels of oil would be depleted to 55.4 bn barrels. The domestic capital stock, initially estimated at 4.3 bn KD's would increase to 37.9 bn KD's. The level of foreign assets, initially estimated at 18 bn KD's would increase to 114.5 bn KD's. The huge increase in foreign assets is due to a growth of a healthy balance of payments which rises from 4.2 bn KD's in 1979 to 13.3 bn KD's by 1999.

On the other hand, there are some discouraging results in the Demographic and labour markets. The population of Kuwait will approximately reach 3.86 mn of which only 28% will consist of Kuwaitis. The labour force of approximately 2.29 mn will consist of 14% Kuwaitis and 86% non-Kuwaitis.

5.7.2 Policy B: high depletion, high growth, low price

As in 5.7.1 the depletion rate of 2 mn barrels per day and a growth rate of 7.5% is assumed here. A low price path for oil of only 1% increase per annum is assumed in this simulation.

This simulation would generate a growth rate in GDP per capita of 3.5% per annum and an increase in consumption per capita of 1.5% per annum. In the final year of the planning period, the reserves of oil will stand at 55.4 bn barrels. The domestic capital stock would reach 35.5 bn KD's and the foreign assets 107.0 bn KD's. The balance of payments remains in surplus, rising from 4.2 bn KD's in 1979 to 11.5 bn KD's by 1999.
The population will increase to 3.85 mn of which 28% will consist of Kuwaitis. The labour force of 2.29 will consist of 15% Kuwaitis and 85% non-Kuwaitis.

5.7.3 Policy C: moderate depletion, moderate growth, moderate price

The moderate depletion rate is taken to be 1.5 mn barrels per day. A moderate growth rate in sectoral GDP of 5% per annum is assumed here. The moderate price increase for oil of 1.5% is assumed in this simulation run.

This policy will generate a growth rate in GDP per capita of 3% per annum and an increase in consumption per capita of 1% per annum. In the final year of the planning period the reserves of oil will stand at 59.05 bn barrels. The domestic capital stock would reach 27.5 bn KD's and the foreign assets 83.6 bn KD's. The balance of payments remains in surplus during the planning period, rising from 4.2 bn KD's in 1979 to approximately 7.2 bn KD's by 1999.

In this case, the dependency on non-Kuwaitis is reduced. The population is estimated to be 2.9 mn of which approximately 38% will consist of Kuwaitis. The labour force of 1.43 mn will consist of 23% Kuwaitis and 77% non-Kuwaitis.

5.7.4 Policy D: low depletion, low growth, high price

A low depletion rate of 1 mn barrels per day is assumed here. An increase of 3% per annum for sectoral GDP is assumed in this simulation. For the price of oil an increase of 2% per annum is used in this simulation.

This simulation will generate a growth rate in GDP per capita of 1.5% per annum and a growth rate in consumption per capita of 1% per annum. In the final year, 1999, the reserves of oil will stand at 62.7 bn barrels. The Domestic Capital stock would have increased to 20.4 bn KD's and the foreign assets to 62.5 bn KD's. The balance of payments rises from 4.2 bn KD's to 6.5 bn KD's.

However, the most appealing feature of such a policy is the
comparatively low level of dependency on non-Kuwaitis. The population is estimated to reach 2.38 mn of which 46% will be Kuwaitis. The labour force of approximately 1 million will consist of 33% Kuwaitis and 67% non-Kuwaitis.

5.7.5 Policy E: low depletion, low growth, low price

In this simulation a depletion rate of 2 mn barrels, a growth rate in sectoral GDP of 3% and increase in the price of oil of 1% is assumed.

This policy would generate a growth rate of GDP per capita of 1% per annum and an increase in consumption per capita of 0.9% per annum. In the final year of the planning period, the reserves of oil will stand at 62.7 bn barrels. The domestic capital stock would reach 19.23 bn KD's and the foreign assets 59 bn KD's. The balance of payments remain in surplus during the entire period, rising steadily from 4.2 bn KD's to 5.6 bn KD's.

The population of Kuwait would reach 2.38 million of which 46% will be Kuwaitis. The labour force of approximately 1 million will consist of 32% Kuwaitis and 68% non-Kuwaitis.

5.7.6 Policy F: 1980 - 1989: low depletion, low growth, high price
1989 - 1999: high depletion, high growth, low price

In the first period, a low depletion rate of 1 mn barrels per day, a low growth rate of 3% per annum and a high price increase of 2% per annum is assumed. During the second period, a high depletion of 2 mn barrels per day, a high growth rate of 7.5% per annum and a low price increase of 1% per annum is assumed.

This simulation would generate a growth rate in GDP per capita of 3.9% per annum and a growth rate in consumption per capita of 1.9% In the final year of the planning period the reserves of oil will stand at 59.05 bn barrels. The domestic capital stock would reach 28.93 bn KD's and the foreign assets 85.74 bn KD's. The balance of payments remains in surplus during the entire planning period rising from 4.2 bn KD's to 11.14 bn KD's by 1999.
The population of Kuwait is expected to reach 2.97 million of which 37% will consist of Kuwaitis. The labour force of 1.5 mn will consist of 22% Kuwaitis and 78% non-Kuwaitis.

5.7.7 Policy G: 1980 - 1989: high depletion, high growth, high price
1990 - 1999: low depletion, low growth, low price

During the first period, a high depletion rate of 2 mn barrels per day, a high growth rate of 7.5% per annum and a high price of 2% per annum is assumed. In the second period, a low depletion rate of 1 mn barrels per day, a low growth rate of 3% per annum and a low price of increase of 1% per annum is assumed.

This simulation would generate a growth rate in GDP per capita of 2% per annum and an increase in consumption per capita of 0.5% per annum. In the final year, 1999, the reserves of oil will stand at 59.05 bn barrels. The domestic capital stock would reach 27.41 bn KD's and foreign assets 85.14 bn KD's. A balance of payments surplus is maintained throughout the period and it rises from 4.2 bn KD's to 6.2 bn KD's by 1999.

The population of Kuwait is expected to reach 2.96 mn of which 37% will be Kuwaitis. The labour force of 1.49 mn will consist of 22% Kuwaitis and 78% non-Kuwaitis.

It must be stressed that the results obtained in the simulations must be treated with caution. This is due to a number of reasons. The sample size of the data that is used to estimate the model is relatively small. In addition the data lacks reliability and has interpretational problems. Due to these difficulties the model had to be restricted in its specification and estimation stages. Apart from the problems of data, the model contains a number of shortcomings.

(a) The major weakness in the model is the link between the population, labour and sectoral output levels. The link between population and labour is represented in terms of simple fixed proportions. Ideally, with more information and
data on demographic factors such as fertility rate, incentives for participation, sectoral wage rates, educational attainment, proportion of skilled and unskilled workers etc would have helped to establish statistically the relationship between population, labour and output. In addition if a production function such as translog was used then this would have enabled investigation of the degree of substitution between capital and labour. It would have given the possibility of choosing a technique which is more capital intensive and less labour - specially expatriate labour - intensive.

(b) The oil price is assumed to be exogenous to the model. The depletion rate is taken to be a policy variable. It would have been preferable if the oil sector of Kuwait was modelled within a global oil or energy model. This would have captured some of the relationship between the oil sector and the world oil market. In this study only a subjective value is used for high, moderate and low prices and depletion rates. It could be argued that certain combinations such as high price and high depletion rate cannot be sustained. This suggestion is put forward by economists who assert that OPEC acts as a Cartel in the oil market. It intends to set high prices - especially in the short run - with a policy of production quotas for member countries. For whatever reason, it is felt that forecasting of future oil prices with a use of an econometric model should be treated with caution. As prices depend on growth in demand, price of substitutes, levels of future reserves, growth in income levels etc which are subject to a great degree of uncertainty and instability.

(c) The equation that relates the income and foreign assets is rather inadequate. Since Kuwait is likely to move away from liquid assets into neutral investments and equity markets much higher incomes from foreign assets are expected in the future. It would have been better to use
a risk-return portfolio model with the two parameters which measure the rate of return and risk - variance can be used as a proxy - changing over time.

Given these drawbacks, the model used in this study does provide some broad policy conclusions.

Every relevant simulation has shown that high growth in the non-oil sector does lead to an influx of expatriate labour and a large foreign population. On the other hand a high depletion policy which gives high growth rate for the mining sector does not bring in a significant amount of foreign labour and population. This is due to the fact that the mining sector - mainly consisting of the oil sector - is highly capital intensive.

A high oil revenue results in an outflow of capital and thus gives rise to an accumulation of foreign assets. For example, the foreign assets reach a maximum of 114.5 bn KD's in Policy A simulation run. In this run the ratio of domestic capital stock to foreign assets stands at 3 : 1, denoting a degree of high risk as the foreign assets are liable for nationalisation or confiscation. The low oil revenue, on the other hand, gives a same ratio of 3 : 1 but in addition leaves a high reserve of oil of 62.7 bn barrels as compared to the former case of 55.4 bn barrels.

An interesting case arises in Policy F and Policy G simulation. The level of capital stock, foreign assets and reserves of oil are almost equal in both cases. So is the level of population and labour force of non indigenous Kuwaitis and Kuwaitis. However, the welfare measure variables, consumption per capita and GDP per capita is much higher in Policy F simulation than in Policy G simulation. This gives a clear choice to the planner who is persuaded to adopt Policy F.
APPENDIX

SIMULATION RUNS
SIMULATION RUN 1

Assumptions

1. Rate of growth of Manufacturing Sector 3%
2. Rate of growth of Residual Sector 3%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.0 mill. b/d
6. Rate of growth of oil price 1.5%
7. Rate of return on Foreign Assets 3%

Results

Years 1979-1999

1. Total population of Kuwait
   i) Kuwaiti population ratio

2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio

3. Total oil reserves

4. Total foreign assets

5. Total domestic capital stock
   i) Manufacturing
   ii) Residual

6. Growth rate (annual) consumption per capita

7. Growth rate (annual) Gross Domestic Product per capita

Year 1999

1. Total population of Kuwait 2,383,809
   i) Kuwaiti population ratio 0.46

2. Total Labour Force of Kuwait 976,107
   i) Kuwaiti labour ratio 0.33

3. Total oil reserves 6.27 bill. barrels

4. Total foreign assets 60.7 bill. K. dinar

5. Total domestic capital stock 19.82 " " 
   i) Manufacturing 333.8 mill. K. dina
   ii) Residual 19.27 bill. K. dina

6. Growth rate (annual) consumption per capita 0.5%

7. Growth rate (annual) Gross Domestic Product per capita 1%
### Assumptions

<table>
<thead>
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<th>Years 1979-1999</th>
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<td>1. Rate of growth of Manufacturing Sector</td>
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<tr>
<td>2. Rate of growth of Residual Sector</td>
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</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
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</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
</tr>
<tr>
<td>5. Rate of daily oil depletion</td>
<td>1.0 mill. b/d</td>
</tr>
<tr>
<td>6. Rate of growth of oil price</td>
<td>1.5%</td>
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<tr>
<td>7. Rate of return on Foreign Assets</td>
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### Results

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<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
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Assumptions

1. Rate of growth of Manufacturing Sector 7.5%
2. Rate of growth of Residual Sector 7.5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.0 mill. b/d
6. Rate of growth of oil price 1.5%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio 0.283
   Total population

2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio 0.142
   Total

3. Total oil reserves 6.27 bill. barrels
4. Total foreign assets 78.34 bill. K. dinara
5. Total domestic capital stock
   i) Manufacturing 562.4 mill. K. dinara
   ii) Residual 25.25 mill. K. dinara
6. Growth rate (annual) consumption per capita 1.3%
7. Growth rate (annual) Gross Domestic Product per capita 3.4%

Year 1999

Total population of Kuwait 3,851,090
Kuwaiti population ratio 0.283
Total Labour Force of Kuwait 2,284,289
Kuwaiti labour ratio 0.142
Total oil reserves 6.27 bill. barrels
Total foreign assets 78.34 bill. K. dinara
Total domestic capital stock
   Manufacturing 562.4 mill. K. dinara
   Residual 25.25 mill. K. dinara
Growth rate (annual) consumption per capita 1.3%
Growth rate (annual) Gross Domestic Product per capita 3.4%
SIMULATION RUN

Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

Years 1979-1999

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<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<td>5.</td>
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<td>6.</td>
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Results

Year 1999

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<td>3. Total oil reserves</td>
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Assumptions

1. Rate of growth of Manufacturing Sector 5%
2. Rate of growth of Residual Sector 5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.5 mill. b/d
6. Rate of growth of oil price 1.5%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti Total population ratio 0.376
2. Total Labour Force of Kuwait
   i) Kuwait Total labour ratio .227
3. Total oil reserves 59.05 bill. barre
4. Total foreign assets 83.57 bill.K.din
5. Total domestic capital stock
   i) Manufacturing 417 mill.K.din
   ii) Residual 26.83 mill.K.din
6. Growth rate (annual) consumption per capita 1%
7. Growth rate (annual) Gross Domestic Product per capita 3%
SIMULATION RUN 6

Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

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<td>1.5 mill. b/d</td>
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Results

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<tr>
<td>1,849,574</td>
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<td>0.176</td>
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<td>50.05 bil. barrels</td>
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<td>1 mill. b/d</td>
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### Results

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<td>5. Total domestic capital stock</td>
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<td>i) Manufacturing</td>
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### Results

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<td>4. Total foreign assets</td>
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<td>ii) Residual</td>
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<td>2. Rate of growth of Residual Sector</td>
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<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
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### Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Year 1999</th>
</tr>
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<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td>3,363,506</td>
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<tr>
<td>i) Kuwaiti population ratio</td>
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<tr>
<td>2. Total Labour Force of Kuwait</td>
<td>1,921,011</td>
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<tr>
<td>i) Kuwaiti labour ratio</td>
<td>0.169</td>
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<tr>
<td>3. Total oil reserves</td>
<td>62.7 bill. barrels</td>
</tr>
<tr>
<td>4. Total foreign assets</td>
<td>70.49 bill. K. dinars</td>
</tr>
<tr>
<td>5. Total domestic capital stock</td>
<td>23.24 bill. K. dinars</td>
</tr>
<tr>
<td>i) Manufacturing</td>
<td>473 mill. K. dinars</td>
</tr>
<tr>
<td>ii) Residual</td>
<td>22.55 bill. K. dinars</td>
</tr>
<tr>
<td>6. Growth rate (annual) consumption per capita</td>
<td>1.1%</td>
</tr>
<tr>
<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
<td>2.6%</td>
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</tbody>
</table>
**Assumptions**

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

<table>
<thead>
<tr>
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<tbody>
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<td>Rate of growth of Manufacturing Sector</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Rate of growth of Residual Sector</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Rate of increase in Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of daily oil depletion</td>
<td>1.5 mill. b/d</td>
<td>1.5 mill. b/d</td>
</tr>
<tr>
<td>Rate of growth of oil price</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
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</tbody>
</table>

**Results**

1. Total population of Kuwait
   i) Kuwaiti population ratio
   2. Total Labour Force of Kuwait
      i) Kuwaiti labour ratio
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing
   ii) Residual
6. Growth rate (annual) consumption per capita
7. Growth rate (annual) Gross Domestic Product per capita

<table>
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</tr>
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<tr>
<td>Total Labour Force of Kuwait</td>
<td>979,789</td>
</tr>
<tr>
<td>Kuwaiti labour ratio</td>
<td>0.33</td>
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<tr>
<td>Total oil reserves</td>
<td>59.05 bill. barrels</td>
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<tr>
<td>Total foreign assets</td>
<td>76.14 bill. K. dinars</td>
</tr>
<tr>
<td>Total domestic capital stock</td>
<td>24.82 bill. K. dinars</td>
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<tr>
<td>Manufacturing</td>
<td>333.8 bill. K. dinars</td>
</tr>
<tr>
<td>Residual</td>
<td>24.27 bill. K. dinars</td>
</tr>
<tr>
<td>Growth rate (annual) consumption per capita</td>
<td>3.1%</td>
</tr>
<tr>
<td>Growth rate (annual) Gross Domestic Product per capita</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
SIMULATION RUN 11

Assumptions

1. Rate of growth of Manufacturing Sector  5%  5%
2. Rate of growth of Residual Sector  5%  5%
3. Rate of increase in Kuwaiti participation  2%  2%
4. Rate of increase in indigenous non-Kuwaiti participation  2%  2%
5. Rate of daily oil depletion  1.5 mill. b/d  1.5 mill. b/d
6. Rate of growth of oil price  1%  2%
7. Rate of return on Foreign Assets  3%  3%

Results

1. Total population of Kuwait  2,897,027
   i) Kuwaiti population ratio  0.376
2. Total Labour Force of Kuwait  1,433,676
   i) Kuwait labour ratio  0.226
3. Total oil reserves  59.05 bill. barrels
4. Total foreign assets  82,59 bill. K. dinars
5. Total domestic capital stock  27.13 bill. K. dinars
   i) Manufacturing  417.1 mill. K. dinars
   ii) Residual  26.49 bill. K. dinars
6. Growth rate (annual) consumption per capita  1%
7. Growth rate (annual) Gross Domestic Product per capita  2.9%
Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Rate of growth of Manufacturing Sector</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Rate of growth of Residual Sector</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Rate of increase in Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of daily oil depletion</td>
<td>1.5 mill. b/d</td>
<td>1.5 mill. b/d</td>
</tr>
<tr>
<td>Rate of growth of oil price</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
</tr>
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Results

1. Total population of Kuwait
   i) Kuwaiti population ratio
2. Total Labour Force of Kuwait
   i) Kuwait labour ratio
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing
   ii) Residual
6. Growth rate (annual) consumption per capita
7. Growth rate (annual) Gross Domestic Product per capita

<table>
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<th>Year 1999</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>Total population of Kuwait</td>
<td>3,855,220</td>
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<tr>
<td>Kuwaiti population ratio</td>
<td>0.283</td>
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<tr>
<td>Total Labour Force of Kuwait</td>
<td>2,287,971</td>
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<td>Kuwait labour ratio</td>
<td>0.142</td>
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<tr>
<td>Total oil reserves</td>
<td>59.05 bill. barrels</td>
</tr>
<tr>
<td>Total foreign assets</td>
<td>93.62 bill. K. dinars</td>
</tr>
<tr>
<td>Total domestic capital stock</td>
<td>31.03 bill. K. dinars</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>562.4 mill. K. dinars</td>
</tr>
<tr>
<td>Residual</td>
<td>30.25 bill. K. dinars</td>
</tr>
<tr>
<td>Growth rate (annual) consumption per capita</td>
<td>2%</td>
</tr>
<tr>
<td>Growth rate (annual) Gross Domestic Product per capita</td>
<td>4.2%</td>
</tr>
</tbody>
</table>
SIMULATION RUN 13

Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

<table>
<thead>
<tr>
<th>Years 1979-1999</th>
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</thead>
<tbody>
<tr>
<td>3%</td>
</tr>
<tr>
<td>3%</td>
</tr>
<tr>
<td>2%</td>
</tr>
<tr>
<td>2%</td>
</tr>
<tr>
<td>2 mill. b/d</td>
</tr>
<tr>
<td>1.5%</td>
</tr>
<tr>
<td>3%</td>
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</tbody>
</table>

Results

<table>
<thead>
<tr>
<th>Year 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,393,308</td>
</tr>
<tr>
<td>0.456</td>
</tr>
<tr>
<td>324,092</td>
</tr>
<tr>
<td>0.33</td>
</tr>
<tr>
<td>55.4 bill. barrels</td>
</tr>
<tr>
<td>93.54 bill.K.dinars</td>
</tr>
<tr>
<td>30.5 bill.K.dinars</td>
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<tr>
<td>333.8 mill.K.dinars</td>
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<tr>
<td>29.95 bill.K.dinars</td>
</tr>
<tr>
<td>1.2%</td>
</tr>
<tr>
<td>3.2%</td>
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</tbody>
</table>
Assumptions

1. Rate of growth of Manufacturing Sector 5%
2. Rate of growth of Residual Sector 5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 2 mill. b/d
6. Rate of growth of oil price 1.5%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio
      \[ \frac{\text{Kuwaiti}}{\text{Total}} \]

2. Total Labour Force of Kuwait
   i) Kuwait labour ratio
      \[ \frac{\text{Kuwait}}{\text{Total}} \]

3. Total oil reserves
   55.4 bill. barrels
4. Total foreign assets
   99.93 bill. K. dinars
5. Total domestic capital stock
   i) Manufacturing
      417.1 bill. K. dinars
   ii) Residual
      32.17 bill. K. dinars
6. Growth rate (annual) consumption per capita
   2%
7. Growth rate (annual) Gross Domestic Product per capita
   3.9%
Assumptions

1. Rate of growth of Manufacturing Sector 7.5%
2. Rate of growth of Residual Sector 7.5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 2 mill. b/d
6. Rate of growth of oil price 1.5%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio 0.282
2. Total Labour Force of Kuwait
   i) Kuwait labour ratio 0.141
3. Total oil reserves 55.4 bill. barrels
4. Total foreign assets 110.9 bill. K. dinars
5. Total domestic capital stock
   i) Manufacturing 562.1 bill. K. dinars
   ii) Residual 35.9 bill. K. dinars
6. Growth rate (annual) consumption per capita 2.9%
7. Growth rate (annual) Gross Domestic Product per capita 4.9%
### Assumptions

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. Rate of growth of Manufacturing Sector</td>
<td>3%</td>
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</tr>
<tr>
<td>2. Rate of growth of Residual Sector</td>
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<td>3%</td>
</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>5. Rate of daily oil depletion</td>
<td>2 mill.b/d</td>
<td>2 mill.b/d</td>
</tr>
<tr>
<td>6. Rate of growth of oil price</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
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</table>

### Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Year 1999</th>
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</thead>
<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td></td>
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<tr>
<td>i) Kuwaiti population ratio</td>
<td>0.456</td>
</tr>
<tr>
<td>2. Total Labour Force of Kuwait</td>
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</tr>
<tr>
<td>i) Kuwaiti labour ratio</td>
<td>0.33</td>
</tr>
<tr>
<td>3. Total oil reserves</td>
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<tr>
<td>4. Total foreign assets</td>
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</tr>
<tr>
<td>5. Total domestic capital stock</td>
<td></td>
</tr>
<tr>
<td>i) Manufacturing</td>
<td></td>
</tr>
<tr>
<td>ii) Residual</td>
<td></td>
</tr>
<tr>
<td>6. Growth rate (annual) consumption per capita</td>
<td>1.2%</td>
</tr>
<tr>
<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
<td>3.3%</td>
</tr>
</tbody>
</table>
**Assumptions**

1. Rate of growth of Manufacturing Sector
   - 1979-1989: 5%
   - 1989-1999: 5%
2. Rate of growth of Residual Sector
   - 1979-1989: 5%
   - 1989-1999: 5%
3. Rate of increase in Kuwaiti participation
   - 1979-1989: 2%
   - 1989-1999: 2%
4. Rate of increase in indigenous non-Kuwaiti participation
   - 1979-1989: 2%
   - 1989-1999: 2%
5. Rate of daily oil depletion
   - 1979-1989: 2 mill. b/d
   - 1989-1999: 2 mill. b/d
6. Rate of growth of oil price
   - 1979-1989: 1%
   - 1989-1999: 2%
7. Rate of return on Foreign Assets
   - 1979-1989: 3%
   - 1989-1999: 3%

**Results**

1. Total population of Kuwait
   - 1979-1989: 2,902,675
   - 1989-1999: 2,902,675
   - Kuwaiti population ratio: 0.376
2. Total Labour Force of Kuwait
   - 1979-1989: 324,092
   - 1989-1999: 324,092
   - Kuwait labour ratio: 0.23
3. Total oil reserves
   - 1979-1989: 55.4 bill. barrels
   - 1989-1999: 55.4 bill. barrels
4. Total foreign assets
5. Total domestic capital stock
   - i) Manufacturing: 417.1 mill. K. dinars
   - ii) Residual: 31.89 bill. K. dinars
6. Growth rate (annual) consumption per capita
   - 1979-1989: 1.9%
   - 1989-1999: 1.9%
7. Growth rate (annual) Gross Domestic Product per capita
   - 1979-1989: 3.9%
   - 1989-1999: 3.9%
### Assumptions

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Rate of growth of Manufacturing Sector</td>
<td>7.5%</td>
<td>7.5%</td>
</tr>
<tr>
<td>2. Rate of growth of Residual Sector</td>
<td>7.5%</td>
<td>7.5%</td>
</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>participation</td>
<td></td>
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<tr>
<td>5. Rate of daily oil depletion</td>
<td>2 mill. b/d</td>
<td>2 mill. b/d</td>
</tr>
<tr>
<td>6. Rate of growth of oil price</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
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### Results

<table>
<thead>
<tr>
<th>Results</th>
<th>Year 1999</th>
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</thead>
<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td></td>
</tr>
<tr>
<td>i) Kuwaiti population ratio</td>
<td>0.282</td>
</tr>
<tr>
<td>Total population ratio</td>
<td></td>
</tr>
<tr>
<td>2. Total Labour Force of Kuwait</td>
<td>324,092</td>
</tr>
<tr>
<td>i) Kuwaiti labour ratio</td>
<td>0.14</td>
</tr>
<tr>
<td>Total labour ratio</td>
<td></td>
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<tr>
<td>3. Total oil reserves</td>
<td>55.4 bill. barrels</td>
</tr>
<tr>
<td>4. Total foreign assets</td>
<td>110.15 bill. K. dinars</td>
</tr>
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<td>5. Total domestic capital stock</td>
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<tr>
<td>i) Manufacturing</td>
<td>36.44 bill. K. dinars</td>
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<tr>
<td>ii) Residual</td>
<td>562.4 mill. K. dinars</td>
</tr>
<tr>
<td>6. Growth rate (annual) consumption per capita</td>
<td>2.4%</td>
</tr>
<tr>
<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
<td>5%</td>
</tr>
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### Assumptions

<table>
<thead>
<tr>
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<th>Years 1979-1999</th>
</tr>
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<tbody>
<tr>
<td>1. Rate of growth of Manufacturing Sector</td>
<td>8%</td>
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<tr>
<td>2. Rate of growth of Residual Sector</td>
<td>3%</td>
</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
<td>2%</td>
</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
</tr>
<tr>
<td>5. Rate of daily oil depletion</td>
<td>1 mill. b/d</td>
</tr>
<tr>
<td>6. Rate of growth of oil price</td>
<td>1%</td>
</tr>
<tr>
<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
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### Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Year 1999</th>
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<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td>2.38 mill.</td>
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<tr>
<td>i) Kuwaiti population ratio</td>
<td>0.46</td>
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<td>2. Total Labour Force of Kuwait</td>
<td>975,349</td>
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<tr>
<td>i) Kuwaiti labour ratio</td>
<td>0.33</td>
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<tr>
<td>3. Total oil reserves</td>
<td>62.7 bill. barrels</td>
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<tr>
<td>4. Total foreign assets</td>
<td>59.0 bill. K. dinars</td>
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<tr>
<td>5. Total domestic capital stock</td>
<td>19.23 bill. K. dinars</td>
</tr>
<tr>
<td>i) Manufacturing</td>
<td>383.8 mill. K. dinars</td>
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<tr>
<td>ii) Residual</td>
<td>18.68 bill. K. dinars</td>
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<td>6. Growth rate (annual) consumption per capita</td>
<td>0.8%</td>
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<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
<td>1%</td>
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</table>
Assumptions

1. Rate of growth of Manufacturing Sector  5%
2. Rate of growth of Residual Sector   5%
3. Rate of increase in Kuwaiti participation  2%
4. Rate of increase in indigenous non-Kuwaiti participation  2%
5. Rate of daily oil depletion  1 mill. b/d
6. Rate of growth of oil price  1%
7. Rate of return on Foreign Assets  3%

Results

Year 1999

1. Total population of Kuwait  2.89 mill.
   i) Kuwaiti population ratio  0.38

2. Total Labour Force of Kuwait  1,429,236
   i) Kuwait labour ratio  0.23

3. Total oil reserves  62.7 bill. barrels
4. Total foreign assets  65.5 bill. K. dinars
5. Total domestic capital stock  21.5 bill. K. dinars
   i) Manufacturing  417.1 mill. K. dinars
   ii) Residual  20.9 bill. K. dinars

6. Growth rate (annual) consumption per capita  1%
7. Growth rate (annual) Gross Domestic Product per capita  1.75%
**Assumptions**

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Years 1979-1999</th>
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<tbody>
<tr>
<td>1. Rate of growth of Manufacturing Sector</td>
<td>7.5%</td>
</tr>
<tr>
<td>2. Rate of growth of Residual Sector</td>
<td>7.5%</td>
</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
<td>2%</td>
</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
</tr>
<tr>
<td>5. Rate of daily oil depletion</td>
<td>1 mill. b/d.</td>
</tr>
<tr>
<td>6. Rate of growth of oil price</td>
<td>1%</td>
</tr>
<tr>
<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
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</tbody>
</table>

**Results**

<table>
<thead>
<tr>
<th>Results</th>
<th>Year 1999</th>
</tr>
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<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td>3.85 mill.</td>
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<tr>
<td>i) Kuwaiti population ratio</td>
<td>0.28</td>
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<tr>
<td>2. Total Labour Force of Kuwait</td>
<td>2,283,500</td>
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<tr>
<td>i) Kuwaiti labour ratio</td>
<td>0.14</td>
</tr>
<tr>
<td>3. Total oil reserves</td>
<td>62.7 bill. barrels</td>
</tr>
<tr>
<td>4. Total foreign assets</td>
<td>76.6 bill. K.dinars</td>
</tr>
<tr>
<td>5. Total domestic capital stock</td>
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<td>24.7 bill. K.dinars</td>
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<td>6. Growth rate (annual) consumption per capita</td>
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<tr>
<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
<td>3.3%</td>
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</table>
Assumptions

1. Rate of growth of Manufacturing Sector 3%
2. Rate of growth of Residual Sector 3%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.5 mill. b/d
6. Rate of growth of oil price 1%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio

2. Total Labour Force of Kuwait
   i) Kuwait labour ratio

3. Total oil reserves

4. Total foreign assets

5. Total domestic capital stock
   i) Manufacturing
   ii) Residual

6. Growth rate (annual) consumption per capita 1%

7. Growth rate (annual) Gross Domestic Product per capita 1.9%
Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio
   \[
   \frac{\text{Kuwaiti}}{\text{Total}}
   \]
2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio
   \[
   \frac{\text{Kuwaiti}}{\text{Total}}
   \]
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing
   ii) Residual
6. Growth rate (annual) consumption per capita
7. Growth rate (annual) Gross Domestic Product per capita

Years 1979–1999

1. Rate of growth of Manufacturing Sector
   - 5%
2. Rate of growth of Residual Sector
   - 5%
3. Rate of increase in Kuwaiti participation
   - 2%
4. Rate of increase in indigenous non-Kuwaiti participation
   - 2%
5. Rate of daily oil depletion
   - 1.5 mill. b/d
6. Rate of growth of oil price
   - 1%
7. Rate of return on Foreign Assets
   - 3%

Year 1999

1. Total population of Kuwait
   - 2.9 mill.
   i) Kuwaiti population ratio
   - 0.38
2. Total Labour Force of Kuwait
   - 1,433,091
   i) Kuwaiti labour ratio
   - 0.23
3. Total oil reserves
   - 59.05 bill. barrels
4. Total foreign assets
   - 81.01 bill. K.dinars
5. Total domestic capital stock
   - 26.58 bill. K.dinars
   i) Manufacturing
   - 417.1 mill. K.dinars
   ii) Residual
   - 25.95 bill. K.dinars
6. Growth rate (annual) consumption per capita
   - 1.3%
7. Growth rate (annual) Gross Domestic Product per capita
   - 2.7%
SIMULATION RUN 24

Assumptions

1. Rate of growth of Manufacturing Sector 7.5%
2. Rate of growth of Residual Sector 7.5%
3. Rate of increase in Kuwati participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.5 mill. b/d
6. Rate of growth of oil price 1%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio 0.282
2. Total Labour Force of Kuwait
   i) Kuwati labour ratio 0.14
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing
   ii) Residual
6. Growth rate (annual) consumption per capita 2%
7. Growth rate (annual) Gross Domestic Product per capita 4%
1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

Assumptions

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<td>2 mill. b/d</td>
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Results Year 1999

1. Total population of Kuwait
   i) Kuwaiti population ratio

2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio

3. Total oil reserves

4. Total foreign assets

5. Total domestic capital stock
   i) Manufacturing
   ii) Residual

6. Growth rate (annual) consumption per capita

7. Growth rate (annual) Gross Domestic Product per capita
Assumptions

1. Rate of growth of Manufacturing Sector 5%
2. Rate of growth of Residual Sector 5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 2 mill. b/d
6. Rate of growth of oil price 1%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio
      \[
      \frac{\text{Kuwaiti}}{\text{Total}}
      \]

2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio
      \[
      \frac{\text{Kuwaiti}}{\text{Total}}
      \]

3. Total oil reserves
   55.4 bill. barrels
4. Total foreign assets
   96.51 bill. K. dinars
5. Total domestic capital stock
   i) Manufacturing
      417.1 mill. K. dinars
   ii) Residual
      30.0 bill. K. dinars
6. Growth rate (annual) consumption per capita 1.6%
7. Growth rate (annual) Gross Domestic Product per capita 3.6%
Assumptions

1. Rate of growth of Manufacturing Sector 7.5%
2. Rate of growth of Residual Sector 7.5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 2 mill. b/d
6. Rate of growth of oil price 1%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait 3.86 mill.
   i) Kuwaiti population ratio 0.28
2. Total Labour Force of Kuwait 2,291,000
   i) Kuwait labour ratio 0.14
3. Total oil reserves 55.4 bill. barrels
4. Total foreign assets 107.5 bill. K. dinars
5. Total domestic capital stock 35.5 bill. K. dinars
   i) Manufacturing 562.4 mill. K. dinars
   ii) Residual 34.8 bill. K. dinars
6. Growth rate (annual) consumption per capita 2.7%
7. Growth rate (annual) Gross Domestic Product per capita 4.7%
Assumptions

1. Rate of growth of Manufacturing Sector 3%
2. Rate of growth of Residual Sector 3%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1 mill. b/d
6. Rate of growth of oil price 2%
7. Rate of return on Foreign Assets 3%

Results

Year 1999

1. Total population of Kuwait
   i) Kuwaiti population ratio 0.46

2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio 0.33

3. Total oil reserves 62.7 bill. barrels
4. Total foreign assets 62.5 bill. K. dinars
5. Total domestic capital stock 20.44 bill. K. dinars
   i) Manufacturing 333.8 mill. K. dinars
   ii) Residual 19.9 bill. K. dinar
6. Growth rate (annual) consumption per capita 0.49/6
7. Growth rate (annual) Gross Domestic Product per capita 1.2%
Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio
2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing
   ii) Residual
6. Growth rate (annual) consumption per capita
7. Growth rate (annual) Gross Domestic Product per capita

Years 1979-1999

1. Rate of growth of Manufacturing Sector
   5%
2. Rate of growth of Residual Sector
   5%
3. Rate of increase in Kuwaiti participation
   2%
4. Rate of increase in indigenous non-Kuwaiti participation
   2%
5. Rate of daily oil depletion
   1 mill. b/d
6. Rate of growth of oil price
   2%
7. Rate of return on Foreign Assets
   3%

Year 1999

1. Total population of Kuwait
   2,893,000
   0.38
2. Total Labour Force of Kuwait
   1,430,823
   0.23
3. Total oil reserves
   62.7 bill. barrels
4. Total foreign assets
   69.04 bill. K. dinars
5. Total domestic capital stock
   22.75 bill. K. dinars
   417.3 mill. K. dinars
   22.10 bill. K. dinar
6. Growth rate (annual) consumption per capita
   0.8%
7. Growth rate (annual) Gross Domestic Product per capita
   2.2%
Assumptions

1. Rate of growth of Manufacturing Sector 7.5%
2. Rate of growth of Residual Sector 7.5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1 mill. b/d
6. Rate of growth of oil price 2%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio 0.28
2. Total Labour Force of Kuwait
   i) Kuwait labour ratio 0.14
3. Total oil reserves 62.7 bill. bbl.
4. Total foreign assets 80.6 bill. K. dinars
5. Total domestic capital stock
   i) Manufacturing 562.4 mill. K. dinars
   ii) Residual 25.9 bill. K. dinars
6. Growth rate (annual) consumption per capita 1.5%
7. Growth rate (annual) Gross Domestic Product per capita 3.6%
Assumptions
1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

Results
1. Total population of Kuwait
   i) \(\frac{\text{Kuwaiti}}{\text{Total}}\) population ratio
2. Total Labour Force of Kuwait
   i) \(\frac{\text{Kuwait}}{\text{Total}}\) labour ratio
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing
   ii) Residual
6. Growth rate (annual) consumption per capita
7. Growth rate (annual) Gross Domestic Product per capita

Years 1979-1999

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<td>Foreign Assets</td>
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Year 1999

<table>
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<td>Total population of</td>
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<td>Kuwait</td>
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<td>Total oil reserves</td>
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<td>Total foreign assets</td>
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<td>Total domestic capital</td>
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<tr>
<td>stock</td>
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<td></td>
<td>25.6 bill. K. dinars</td>
</tr>
<tr>
<td></td>
<td>0.5%</td>
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<tr>
<td></td>
<td>2.5%</td>
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</table>
Assumptions

1. Rate of growth of Manufacturing Sector 5%
2. Rate of growth of Residual Sector 5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.5 mill. b/d
6. Rate of growth of oil price 2%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwaiti population ratio 0.38
2. Total Labour Force of Kuwait
   i) Kuwait labour ratio 0.23
3. Total oil reserves
4. Total foreign assets
5. Total domestic capital stock
   i) Manufacturing 417.1 mill. K. dinars
   ii) Residual 27.8 bill. K. dinars
6. Growth rate (annual) consumption per capita 1.2%
7. Growth rate (annual) Gross Domestic Product per capita 3.3%
Assumptions

1. Rate of growth of Manufacturing Sector 7.5%
2. Rate of growth of Residual Sector 7.5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 1.5 mill. b/d
6. Rate of growth of oil price 2%
7. Rate of return on Foreign Assets 3%

Results

1. Total population of Kuwait
   i) Kuwait population ratio
   \[
   \frac{\text{Kuwait}}{\text{Total}}
   \]
   Year 1999
   3,857,000
   0.28
2. Total Labour Force of Kuwait
   i) Kuwait labour ratio
   \[
   \frac{\text{Kuwait}}{\text{Total}}
   \]
   Year 1999
   2,289,766
   0.14
3. Total oil reserves
   Year 1999
   59.05 bill. barrels
4. Total foreign assets
   Year 1999
   97.3 bill. K. dinars
5. Total domestic capital stock
   i) Manufacturing
   Year 1999
   31.5 mill. K. dinars
   ii) Residual
   Year 1999
   562.5 mill. K. dinars
6. Growth rate (annual) consumption per capita
   Year 1999
   2.3%
7. Growth rate (annual) Gross Domestic Product per capita
   Year 1999
   4.5%
### Assumptions

1. Rate of growth of Manufacturing Sector  
2. Rate of growth of Residual Sector  
3. Rate of increase in Kuwaiti participation  
4. Rate of increase in indigenous non-Kuwaiti participation  
5. Rate of daily oil depletion  
6. Rate of growth of oil price  
7. Rate of return on Foreign Assets

### Results

1. Total population of Kuwait  
   i) \( \frac{\text{Kuwaiti}}{\text{Total}} \) population ratio  
2. Total Labour Force of Kuwait  
   i) \( \frac{\text{Kuwait}}{\text{Total}} \) labour ratio  
3. Total oil reserves  
4. Total foreign assets  
5. Total domestic capital stock  
   i) Manufacturing  
   ii) Residual  
6. Growth rate (annual) consumption per capita  
7. Growth rate (annual) Gross Domestic Product per capita

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<thead>
<tr>
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<th>Year 1999</th>
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<td>Rate of growth of Manufacturing Sector</td>
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<tr>
<td>Rate of increase in Kuwaiti participation</td>
<td>2%</td>
</tr>
<tr>
<td>Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
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<tr>
<td>Rate of daily oil depletion</td>
<td>2 mill. b/d</td>
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<tr>
<td>Rate of growth of oil price</td>
<td>2%</td>
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<tr>
<td>Rate of return on Foreign Assets</td>
<td>3%</td>
</tr>
<tr>
<td>Total population of Kuwait</td>
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<td>Total Labour Force of Kuwait</td>
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<td>Total domestic capital stock</td>
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<tr>
<td>Growth rate (annual) Gross Domestic Product per capita</td>
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</table>
Assumptions

1. Rate of growth of Manufacturing Sector 5%
2. Rate of growth of Residual Sector 5%
3. Rate of increase in Kuwaiti participation 2%
4. Rate of increase in indigenous non-Kuwaiti participation 2%
5. Rate of daily oil depletion 2 mill. b/d
6. Rate of growth of oil price 2%
7. Rate of return on Foreign Assets 3%

Results

Years 1979-1999

1. Total population of Kuwait
   i) Kuwaiti population ratio Total 0.38
2. Total Labour Force of Kuwait
   i) Kuwaiti labour ratio Total 0.26
3. Total oil reserves 55.4 bill. barrels
4. Total foreign assets 103.6 bill. K.dinars
5. Total domestic capital stock
   i) Manufacturing 417.1 mill. K.dinars
   ii) Residual 33.4 bill. K.dinars
6. Growth rate (annual) consumption per capita 2.1%
7. Growth rate (annual) Gross Domestic Product per capita 4.2%
Assumptions

1. Rate of growth of Manufacturing Sector
2. Rate of growth of Residual Sector
3. Rate of increase in Kuwaiti participation
4. Rate of increase in indigenous non-Kuwaiti participation
5. Rate of daily oil depletion
6. Rate of growth of oil price
7. Rate of return on Foreign Assets

Years 1979-1999

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Results

Year 1999

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<td>Manufacturing</td>
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<tr>
<td>Residual</td>
<td>37.2 bill.K.dinars</td>
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### Assumptions

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<tr>
<td>2. Rate of growth of Residual Sector</td>
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<td>7.5%</td>
</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>5. Rate of daily oil depletion</td>
<td>1.0 mill. b/d</td>
<td>2.0 mill. b/d</td>
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<td>6. Rate of growth of oil price</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
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### Results

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td></td>
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<tr>
<td>i) Kuwaiti population ratio</td>
<td>2.97 mill.</td>
</tr>
<tr>
<td>Total population ratio</td>
<td>0.37</td>
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<td>2. Total Labour Force of Kuwait</td>
<td>1.5 mill.</td>
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<tr>
<td>i) Kuwaiti labour ratio</td>
<td>0.22</td>
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<td>3. Total oil reserves</td>
<td>59.05 bill. barrels</td>
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<td>4. Total foreign assets</td>
<td>85.74 bill. K. dinars</td>
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<td>5. Total domestic capital stock</td>
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<td>i) Manufacturing</td>
<td>28.93 bill. K. dinars</td>
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<td>ii) Residual</td>
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<td>6. Growth rate (annual) consumption per capita</td>
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<td>8. Growth rate (annual) Per Capita</td>
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</table>
### Assumptions

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. Rate of growth of Manufacturing Sector</td>
<td>7.5%</td>
<td>3%</td>
</tr>
<tr>
<td>2. Rate of growth of Residual Sector</td>
<td>7.5%</td>
<td>3%</td>
</tr>
<tr>
<td>3. Rate of increase in Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>4. Rate of increase in indigenous non-Kuwaiti participation</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>5. Rate of daily oil depletion</td>
<td>2.0 mill. b/d</td>
<td>1.0 mill. b/d</td>
</tr>
<tr>
<td>6. Rate of growth of oil price</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>7. Rate of return on Foreign Assets</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

### Results

<table>
<thead>
<tr>
<th>Result</th>
<th>Year 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total population of Kuwait</td>
<td>2.96 mill.</td>
</tr>
<tr>
<td>i) Kuwaiti population ratio</td>
<td>0.37</td>
</tr>
<tr>
<td>2. Total Labour Force of Kuwait</td>
<td>1.49 mill.</td>
</tr>
<tr>
<td>i) Kuwait labour ratio</td>
<td>0.22</td>
</tr>
<tr>
<td>3. Total oil reserves</td>
<td>59.05 bill. barrels</td>
</tr>
<tr>
<td>4. Total foreign assets</td>
<td>85.14 bill. K.dinars</td>
</tr>
<tr>
<td>5. Total domestic capital stock</td>
<td>27.41 bill. K.dinars</td>
</tr>
<tr>
<td>i) Manufacturing</td>
<td>459 mill. K.dinars</td>
</tr>
<tr>
<td>ii) Residual</td>
<td>26.7 bill. K.dinars</td>
</tr>
<tr>
<td>6. Growth rate (annual) consumption per capita</td>
<td>0.5%</td>
</tr>
<tr>
<td>7. Growth rate (annual) Gross Domestic Product per capita</td>
<td>2%</td>
</tr>
</tbody>
</table>
Chapter 6

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This final chapter consists of three sections. In the first section, the economic viability of small nations is discussed. It draws attention to the subject of Optimum size and Economic Integration. In the next section, a brief account of the essential features of this study is presented. This is followed by various suggestions which could be pursued for further research.

6.1 Economic Viability of Small Nations : Size and Integration

The major objective of this study was to investigate the various long term plans which could be adopted in Kuwait. It was argued earlier, that due to the peculiar characteristics of the Kuwaiti economy, it was not appropriate to adopt a standard development or growth theory. The conventional theories- Classical, Keynesian, Structural -were mainly developed and applied to countries with low per capita income and low marginal propensity to save and invest. Kuwait, with a high per capita income, surplus capital, exhaustible resource base, limited absorptive capacity and high dependancy on expatriate labour does not fall into the category of developing economies. Hence, it needs a different development plan which satisfies both economic and social objectives. The variables which contribute to the economic goals are the level of domestic capital stock, reserves of oil, level of foreign assets, growth in GDP per capita, growth in consumption per capita, etc. The variables which affect the social goals are the level of foreign population, expatriate labour force, etc. All these variables are inter-dependant.

For example, a policy that rapidly accumulates domestic capital stock would lead to an influx of foreign labour, since the indigenous Kuwaiti labour is unlikely to satisfy the demand for labour required to produce an acceptable level of output and consumption levels. It may be argued that this same level of output and consumption can be attained by the accumulation of sufficient foreign assets. This would alleviate the problem of a large influx of expatriate labour. But such a policy will leave Kuwait in a very vulnerable position as these assets are liable to a
potential threat of nationalisation or confiscation by the host country in which these assets are held. Some may argue, assessing both these views, that the best policy would be to slow down the depletion rate of the resource. This means that revenues from oil would be substantially reduced and, therefore, insufficient to allow the possibility of rapid accumulation of domestic capital stock or foreign assets. However, such a policy would increase the depletion time of the resource and leave behind a considerable quantity of resource in the ground which may yield low revenues in the future if the price is low.

In the practical implementation of a policy, the planner in Kuwait has to tradeoff between social and economic objectives. Since the total number of variables in both the objectives are large, let us make two assumptions so as to make the analysis simpler. Firstly, since Kuwait is a small oil producer the level of production does not have a significant effect on world oil prices. It also faces an exogenously given demand for world oil. Secondly, the level of foreign assets to be held is pre-determined and this does not have a significant effect on International Capital Markets. From the first assumption it follows that Kuwait is only allowed to decide on its depletion policy. From the second assumption it follows that the rate of interest on International Capital Markets is given exogenously. This leaves us, very broadly speaking, with the question on the rate of capital accumulation and population size. Let us first look at some of the general theories and evidence on this subject and then the application to the Kuwaiti economy.

6.1.1 Optimum Size of Nations

The question of Optimum population size and the standard of living has been a major concern of even early classical economists, notably Malthus, Ricardo and Mill. Malthus predicted that the geometric rate of population growth on an arithmetic rate of food production growth would lead to
'over population'. He believed that the amount of population that can be supported by agricultural production is limited. Ricardo agreed with Malthus, but asserted that with increasing productivity levels of arable land, agricultural output could be increased. Ricardo and Malthus were mainly concerned with agricultural production. Mill, on the other hand, was concerned with industrial production and the impact of natural resources and raw materials on output. All three economists were interested in the question of the optimum level of population that is sustainable given the limitations of land and raw materials as inputs to the production process.

The debate on optimum level of population during the 1950's and 1960's was focussed on the role of capital stock in production. Enke (1966) argued that rapid population growth leads to relatively high consumption and low investment. Hence, this results in low growth in capital stock. If the rate of technological progress cannot be increased, a rapid proportionate growth in population can cause an actual reduction in income per capita. Enke's empirical study shows that there is a negative relationship between population growth and capital accumulation if total factor productivity growth is held constant. Arrow (1962) has argued that if the growth in employment occurs as a result of growth in population, then the rate of technical progress is likely to increase. This view was subsequently tested by Thirwall (1972). His cross-section study based on thirty-two developing countries and seven developed countries, concludes that curbing population growth does not increase output per capita. As population growth decelerates, total productivity growth also decelerates, thereby slowing down the rate of growth of output accordingly. This conclusion seems to support the views held by Arrow, Clark and Kaldor.
The discussion so far, on the optimum population size, has been confined to the important role played by the various input factors in production. However, in the 1970's, economists began to address this question using the theory of welfare economics developed earlier by Baumol (1952), Samuelson (1947), Pigou (1951), etc. In essence, the optimum population size is determined by the welfare function and production function. Votey (1969) claims that since there is positive utility in having children, the population size should be included as one of the variables in the welfare function. Samuelson (1975) argues that optimum population should be viewed in a dynamic context. Hence, his welfare function includes differentiated periods of life, work and retirement (endogenous), investment in heterogeneous capital goods, etc. as variables in the welfare function. In addition, the growth rate is also dependent on biological and cultural factors.

Let us now divert our attention to Kuwait. As suggested earlier, let us assume that the rate of capital accumulation is given. By selecting a desired level for income and consumption, the optimum population size can be determined. Without any extensive investigation, one can easily argue that the optimum level is bound to be higher than the level of Kuwaiti population. This is due to the fact that the capital stock is likely to grow much faster than the growth in population of indigenous Kuwaitis. In order to balance the difference between optimum and Kuwaiti growth rates, labour and population has to be imported. Therefore, the level of foreign population that satisfies the welfare function of Kuwaitis is what determines the optimum size.

However, there are two - economic and social - consequences which may result due to foreign population. The economic implication is that a large proportion of expatriate savings and profits are likely to be
repatriated and thereby cause balance of payments difficulties for Kuwait. The social implication is that a large heterogenous group may create unrest and disrupt social harmony. In order to avoid the first problem, the planner may follow the study carried out by Michalopoulous (1968) and choose to maximise per capita income and consumption of Kuwaitis only. He can also impose some restraint on the outflow of expatriate's savings and profits. On the other hand, following the study by Scott and Grubel (1966) one can argue that if immigration of foreign labour increases the welfare per capita of the residents, then it should be encouraged. The second problem, related to the social disruption is not quantifiable. It is impossible to estimate the degree to which social harmony will be disrupted by a given proportion of foreign population. It is also impossible to estimate the level of disruption if this proportion is increased. Hence, one can only assess this in terms of an 'Indifference curve' analysis. One way to avoid this problem is to attract foreign labour which blends with the indigenous Kuwaitis and forms a homogenous population. In other words, the foreign labour and population should possess some common characteristics with the indigenous population. These characteristics could be based on language, religion and culture.

Undoubtedly, the best alternative would be to increase the growth in Kuwaiti population size and manpower supply. Farooq (1975) emphasises four factors - age structure, participation rate, fertility rate and mortality rate - as the major determinants of manpower supply. Comparing the activity rates by sex in four selected countries, he concludes, that since 40% of the total population in developing countries is under the age of 15, a large increase in labour force in a relatively short time is not possible. The female participation in the labour force is negligible in most developing countries. In many developing countries, notably in Thailand and Indonesia, the reporting of female activity is
influenced by traits of cultures and tradition, concepts and definitions, enumeration procedures, etc. rather than by economic factors. In recent years the influence of declining mortality rate and fertility rate has been significant in developing countries like Brazil. Farooq asserts that this has caused a shift in the age structure, increasing the proportion of population in the adult age group. It may be argued that Kuwait needs a strategy which stimulates a high participation rate specially among Kuwaiti females, increases the fertility rates and decelerates the mortality rates. In general, participation by females could be achieved by offering adequate incentives and breaking down the rigid social and cultural barriers. However, one may argue that high fertility rate may act as an obstacle to an increase in participation as females may have to then commit towards a larger family size. Another factor which may hinder the participation rate is the relatively high standard of living in Kuwait. This may discourage females from going to work. The decline in mortality rate has increased the population size but not necessarily the supply of manpower. This extra population falls into an age group which is inactive. In order to increase the population size and the supply of labour, Kuwait could adopt a programme of naturalisation of non-Kuwaitis based on such criteria as duration of stay, contribution towards the national interest, etc.

On the other hand, in order to avoid the influx of foreign population and labour force a number of decisions have to be taken. First, as Farooq suggests, decisions on priorities have to be made usually at a sectoral or subsectoral level. Two further decisions have to be taken; one on the economic ranking among sectors and the other on the optimal technique of production for each industrial activity.

Harris and Todaro (1968), Fei and Ranis (1964) have generally argued that industrial sectors and sub-sectors which guarantee employment prospects, should receive priority in their development. In the case
of Kuwait, it could be argued that sectors which are likely to show a high labour productivity for Kuwaitis should be recommended. Once these sectors are ranked according to this criterion, a capital intensive technique of production should be chosen. The second decision involves relative factor prices and the availability of a technique in the sector concerned. It must be stressed here that although the market price of capital may be relatively cheaper than the price of labour, the shadow price of it is much higher.

So far, the discussion has been mainly focused on the population size. Let us now look at the general theory of the size of nations and their success.

The obvious criteria of the size of nation is its geographical area; a small nation covers a small surface, and a large nation covers a large surface. Hence, a small nation is likely to have less agricultural land and few mineral resources. Other popular classifications are, the size of the population, land per capita, resource per capita etc. Marcy (1960) argues that such a classification is unsatisfactory since countries like Belgium and Switzerland, although small according to the above criteria, have proved to be successful. In the newly industrialising countries, Singapore and Hongkong can be cited as small, successful nations.

How can one explain the success of small nations? Kuznets (1960) argues that there are two basic reasons. First, since economic growth is a process of unequal change of structural shifts within an economy, some established interest groups are bound to lose and others gain. This will undoubtedly cause differential rates of return to various groups and resources will have to move to productive and profitable sectors. If these changes can take place swiftly for the community's long term interest, then even smaller countries can succeed. Secondly, an economy
with a smaller homogenous population is likely to adjust rather than resist to changes. Kuznets argues that many small nations show a strong feeling of community and solidarity. He also points out to two other items of evidence. Firstly, there is a better distribution of income in smaller countries. Secondly, there is a smaller infrastructure which can adjust rapidly to changing conditions.

On the other hand, Scitovsky (1960) argues that in order to derive advantages from international trade and large scale production, the smaller economy should get larger. He believes that most small countries are sub-optimal. Technologically, an economy can be too small if its market is too small to provide a sufficient outlet for the full capacity output of the most efficient productive plant in a given industry. If the economy is too small from the point of view of some industries but not others, then Scitovsky claims that the composition of trade is determined by technology and not by comparative advantages in international trade. In contrast to technological efficiency, economic efficiency is reached with competition. However, in a small economy, with a limited number of entrepreneurs there is not sufficient competition within each industry. Each entrepreneur is likely to choose the technical optimum size in each industry. Kuznets also argues that a country with a smaller population does not have the potential to develop the variety of specialities in the intellectual hierarchy and provide the tools for adequate participation in the larger community.

Kuznets and Scitovsky claim that the condition for efficient production is very often the large scale production at a stable rate of a relatively few varieties of products. Scitovsky asserts that for mass production methods to become profitable, it requires a market outlet
that is large, homogenous and stable over time. Kuznets also argues that smaller nations, particularly those that have attained a high level of per capita consumption place a greater weight on foreign trade. For some final consumers, the goods demanded by them is far wider than that of domestic output of final goods. Hence, imports play a major role in their consumption patterns.

Scitovsky, referring to foreign trade, argues that export markets in recent years have become extremely unstable and unreliable. Markets are likely to be closed off suddenly for political reasons or as a result of balance of payments problems. In order to maintain long term stability, International commodity agreements and long-term contracts are essential. But the range of products to which these contracts are suited is rather limited. For example, agreements can be maintained successfully, over a long period, for primary products rather than for industrial products. The latter needs a more stable market since the capital costs of mass production equipment is relatively high.

Scitovsky concludes that, if an economy is technologically small, then international trade is of limited purpose. He believes that, economic Union is more reliable and suitable. Biblawy and El-Shafey (1980), Al-Sabah (1983) among others, have also asserted that industrialisation on any significant level in Kuwait will depend on the extent to which various countries in the Arabian Gulf can successfully form a Union. The first stage of such a Union was the formation of the Gulf Council. What type of integration this should develop into is a matter for further research.

6.1.2. Economic Integration

El-Agra (1980) has suggested the various forms of Integration;

(1) Integration takes place at a single commodity level, for example, Organisation of Arab Petroleum Exporting Countries (OAPEC), European Coal and Steel Community, etc.
Free trade Areas where member countries abolish all trade impediments between them but retain their freedom with regard to the determination of their policies vis-a-vis the outside world.

Customs Union which are very much like Free Trade Areas except that member countries are obliged to conduct common external relationships.

Monetary Union which means maintaining overall equilibrium in the balance of payments of the monetary Area rather than merely a member's balance of payments equilibrium. This may also include currencies within a region to vary against each other within a specified range.

Common markets which are Customs Unions that allow for free factor mobility across the national member boundaries. Capital, labour, etc. should be able to move without hindrance between the participating nations.

Complete economic unions which are common markets that call for unification of monetary and fiscal policies. There is a central authority which controls these aspects so that existing nations become regions of the Union.

One of the major contributors to the developmental theory of Integration in terms of comparative static analysis was Viner (1950). His theory analyses the effects of integration mainly in terms of trade creation and trade diversion that would result. Trade creation involves a shift from high-cost domestic production to lower cost production in a partner country. Trade diversion involves a shift from the lowest cost external producer to a higher cost partner. Viner points out that trade creation raises the home country’s welfare and trade
diversion lowers it. The implications of economic integration can be considered from a broader framework which takes into account economies of scale. The following analysis by Robson (1983) adheres to the original formulation of developmental theories of integration with special reference to industrialisation. This may be appropriate for Kuwait and similar countries around the Arabian Gulf area, which are endowed with oil and gas resources and want to develop their manufacturing sector based on these resources. Figure 6.1 illustrates the demand and cost condition in the domestic markets of two countries - H, the home country and P, the partner country. These countries are to form an integration - a Customs Union - for a planned new product. $D_H$ is the home country's demand curve for the product and $AC_H$ is the average cost curve. $D_P$ and $AC_P$ are the corresponding demand and cost curves in the prospective partner country. $D_{H+P}$ represents the combined Customs Union demand curve. $P_w$ represents the constant price at which the produce can be imported from $w$, the rest of the world. Terms of trade effects are ignored.

It is assumed that there is a single producer in each country enjoying internal economies of scale, so that the traditional assumption of perfect competition is not maintained. The inclusion of economies of scale, however, gives rise to certain problems of monopolistic behaviour which are not crucial to the analysis. In order to avoid monopolistic price it is assumed that tariffs are adjusted so that tariff inclusive import price equals average costs. In each country the domestic price is determined by the cost of imports from the rest of the world plus the tariff.
Prior to the formation of a Customs Union, the home country produces and consumes OM, which sells in the domestic market at a price $OP_H$.

A tariff of $\frac{PP}{WH}$ is required to make the industry viable. The more efficient partner produces and consumes ON at price $OP_p$ with a lower tariff $\frac{PP}{WP}$. If the two countries integrate and production is undertaken by the producer whose cost conditions are more favourable, the combined requirement of the market would be produced by the partner country at a price $OP_{cu}$. The required union tariff being $\frac{PP}{WP_{cu}}$. Consumption in the home country increases to OM and in the partner country to ON.

In this case country H would gain an amount equal to the areas b + a. These are the traditional gains from trade creation, although now to be seen in the context of scale economies. Country P would gain c from the cost reduction effect plus d, representing the gain in consumers' surplus, plus e, representing the gain from the sales to a partner country at prices in excess of world market prices. This may suggest that country H does not gain very much since it could obtain similar benefits from a non-discriminatory unilateral tariff reduction to $\frac{PP}{WP_{cu}}$. However, there is a difference in this case for country P since it could not secure as large gains for itself in the absence of a Customs Union merely by unilaterally reducing its tariff to the same level. This results in the disappearance of the home country's industry with the advent of the Customs Union. Under these circumstances, if a range of industrial production exists in both countries of which demand and cost curves merely illustrate one case, it may be possible, depending on the empirical relationships for both countries, to gain by exchanging markets in a Customs Union.

Regional economic integration has been a prominent feature of development strategy for more than two decades. Examples of such integration are Latin American Free Trade Area (LAFTA), Association of South-East Asian Nations (ASEAN), Economic Community of West African States (ECOWAS), Caribbean Common Market (CARICOM) though
the type of integration is different in each case.

Theoretically, many benefits can be derived from such an integration. However, the important areas are:

1. Benefits from production
2. Benefits from Trade
3. Benefits from Monetary integration.

The major benefits from production are in internal and external economies of scale. Scitovsky (1958) asserts that as a general rule, the more efficient the method the higher the rate of output to reach minimum per unit costs or in other words, the larger the optimum size of the plant. An increase in the size of the market would shift the demand curves for the products of the imperfectly competitive firms and the expansion of production would make possible the use of more efficient production methods. The opportunities for standardisation in a wider market offer further potential gains. Finally, the larger yearly increase in the demand for various commodities will necessitate the introduction of large scale production in newly established plants. The possibility of standardisation on a large market gives rise to two consequences. Firstly plants in a small country may specialise in a few varieties of a product manufactured on a small scale thereby foregoing economies internal to the plant. Secondly each plant may produce many varieties of given commodity and thus restrict the advantages of manufacturing large series. An increase in the size of the market with a variety of products maintained will then have a double effect: plants producing on a small scale can extend their operation and plants that have formerly manufactured a large variety of commodities can now specialise in a few lines of production.

Balassa (1975) asserts that the economic integration in Europe has contributed to an increase in productivity though standardisation has not been achieved in the heterogenous European market. Empirical studies on several industries show an increase of 18% - 20% in labour productivity as accumulated output doubled. Verdoorn (1960) suggests
that productivity differentials (with a similar plant size) between the United States and Europe are significant. These differences are caused by the differences in the length of production runs. There is a greater degree of product differentiation in European countries and hence production takes place in more diversified establishments in Europe. Diversification in turn requires frequent changeover in production and the short production runs impose additional costs on the firm and the economy.

However, available information on possible economies of scale in the Latin-American integration suggests that only a few industries have shown gains in economies of scale. Balassa has used Bain's (1958) estimates which reflect economic conditions in the United States and claims that different factor price ratios in the developing countries of Latin America may warrant smaller optimum size. The advantageous position of the Latin-American countries with regard to product differentiation should also be noted. More uniformity in tastes could be observed which is contrary to the situation in Europe. Overall, Balassa concludes that observations on the extent of national markets, the size of average plants and the possibilities of standardisation indicates the scope for gains from economies of scale is considerably greater in the Latin American integration projects than in Europe.

There are also benefits from external economies of scale. These include the various economies of specialised skill, increased facilities of communication, trade knowledge, skilled labour force, etc. Among non-market interactions, external economies in technical and organisational knowledge are likely to be more important than labour skills. The balancing of surpluses and deficits in various skills can be achieved by migration between countries so that new skills can be acquired by the inhabitants of any country who formerly lacked them. Nelson (1958) claims that with regard to technological and organisational know-how, the effect of economic integration will be felt in four ways. First, discoveries in basic research may be made better use of in a larger and more diversified market. Second, through spreading of existing knowledge among particular industries of different countries. Third, closer contact
between competing industries is likely to increase the rate of technological change. Fourth, the trend toward larger business units can be conducive to technical progress.

Further gains are made from increased specialisation in a wider market. The importance of the economies of specialisation for European integration is noted. For example, Robinson (1960) has argued that British home market is too small to encourage the growth of specialist producers of equipment, who themselves might have created new possibilities of progress. Among industries, the increased specialisation due to wider market is apparent in the automobile industry and various metal industries.

The net welfare impact of a Customs Union or free trade area in a comparative-static partial-equilibrium framework depends on the amount of trade creation and trade diversion. These quantities must be related to the change in equilibrium prices induced by tariff changes in order to specify the actual welfare gains and losses. In order to assess the magnitude of trade creation and trade diversion one would need information on substitution elasticities between the domestic and partner country goods and between partner country and foreign goods.

For the European Economic Community, Scitovsky (1958) argues, from his study, that intra European trade will increase by 17%. If this increase is weighted by the proportion of purchase price of each commodity that is made up of tariff and estimates for the reduction in trade in other directions are also made, the final figure for the gains from trade to the European countries was equal to .05% of their annual incomes. In this analysis an elasticity of substitution between domestic goods and imports of - 0.5 was assumed. The elasticity for competing imports of - 2.0 was also assumed. Verdoorn and Schwartz (1972) have also asserted that the elasticity of substitution between domestic products and imports is smaller than between competing imports. For the UK, a study by Johnson (1958) concluded that the possible gain to Britain from joining the Free Trade Area, as an absolute maximum was 1% of the national income of the United
Kingdom. But others have argued that this analysis did not consider economic benefits which may arise due to economies of scale or increased efficiency.

To examine the effects of trade creation and trade diversion on welfare and economic growth in the Common Market, we need to consider the increases in intra-Area trade. Balassa (1966) presented evidence indicating that the expansion of intra-EEC trade in manufacturing took the form of intra-industry rather than inter-industry specialisation. Thus, rather than shifting resources from import-competing to export industries, reductions in tariffs in the Common Market were shown to have been accompanied by increased specialisation within particular industries.

Two important aspects of long-term advantages from monetary integration are freeing of capital movements and exchange-rate stability within the member countries. Balassa (1975) has argued that removal of restrictions on capital movements in an integrated capital market will help to adjust the balance of payments problems. However, he emphasises that the co-operation of central banks is necessary for fixing discount rates. Discount rate policies aimed at attracting short term funds can impede the operation of the adjustment mechanism. In an open economy, if suitable arrangements for co-operation between central banks are not made, then a country may run a deficit with third countries and finance this deficit with capital funds from member countries attracted by high interest rates. Furthermore, the application of co-ordinated governmental measures will be necessary if, on balance, the Union runs a deficit or incurs a surplus. In the latter case capital movements cannot bring about equilibrium. One of the preconditions of the system of adjustment is the need for a highly developed money and capital markets in the member countries. This condition is fulfilled in European integration projects.

With reference to exchange rates, Balassa claims that immutably fixed parities would be undesirable as it would entail compromising national objectives. Since the fixed exchange parities are undesirable, the choice is among a system of adjustable pegs, fully flexible exchange rates and the crawling peg. Balassa concludes that
uncertainties in forward transactions and inefficiencies in resource allocation can be reduced if fluctuation in real exchange rates are avoided. This in turn can be accomplished by adopting a system of crawling pegs. Decision making on parity changes involves some bargaining and gives rise to speculation. This has lead to, in the EEC, the adoption of crawling pegs accompanied by the creation of a common currency unit around which the currencies of member countries are allowed to fluctuate.

6.2 Conclusions
The major aim of this study was to investigate the various long-term plans which are open to Kuwait. This was carried out in three stages. Firstly, the major characteristics of 'surplus' or 'rentier' economies of which Kuwait is an example were discussed. The particular features such as the limited absorptive capacity, high dependency on single resource and dependency on foreign labour were pointed out. Given these peculiar characteristics, the applicability of various development theories - classical, Keynesian, structural - were examined.

The classical view which stems mainly from the works of Lewis, Fei and Ranis mainly concentrated on the existence of surplus labour in the agricultural sector and the process by which this labour can be transferred to the urban sector. This they believed would alleviate the problem of low per capita income. The Keynesian view, further developed by Harrod, Domar, Solow and Kaldor, emphasised the role of savings and the incentives to save which eventually would be transformed into productive investment. Solow and Kaldor proposed methods by which all savings could be transformed into investment, the former stressing the interest rate mechanism whilst the latter the income distribution mechanism. They argued that in the long term, high level of savings and propensity to save would lead to growth in income. The structural view, mainly stems from the fact that many developing countries face rigidities and bottlenecks which retards development. This view was mainly held by Hirschman who suggested that developing countries should adopt unbalanced growth which encourages the concentration of investment in few leading sectors. Such sectors would stimulate the other sectors
by their forward and backward linkages. Nurske, however, held the opposing view that equal emphasis should be placed for every sector. This would eliminate the dependency on the few sectors and help to create market incentives in all sectors so that any fall in income from one sector would be offset by the rise in income of another sector. As Kuwait does not possess many of the typical features of developing countries - especially low income per capita and large population size - it was argued that any one theory is inadequate. Instead a combination of all the various theories and with the inclusion of a suitable depletion policy seems appropriate.

In the second stage, a macroeconomic model of the Kuwaiti economy based on a Keynesian income-expenditure framework was constructed. Since the model had to be used for long-term forecasting exercises, a supply side represented by a Cobb-Douglas production function was included. The supply side was further disaggregated into three - Manufacturing, Mining, Residual - sectors. The model was estimated using Ordinary Least Squares (OLS) method as the sample size and the reliability of data did not permit the use of any sophisticated systems estimation techniques.

The estimated parameters were mainly compared with the parameters obtained by Khouja and Sadler and Mallach and Atta. In the above mentioned studies a macroeconomic model of Kuwait was estimated using a formal estimation procedure. The estimated personal consumption function in this study gave a marginal propensity to consume (MPC) of 0.473 and an average propensity to consume (APC) of 0.73. Mallach and Atta's estimate for MPC was 0.134 and for APC was 0.84. However, they use a different variable for the personal income (sum of non-oil gross domestic product and net Governmental injection). Khouja and Sadler, on the other hand, using a similar income variable to this study, obtain a marginal propensity to consume of 0.424. Since their model is static it was not possible to obtain an average propensity to consume.

According to the estimates of this study, the average propensity to save is 0.27. This suggests that in the long run 27% of income can be saved and invested. But the estimated equation on private
investment suggests that the income variable is insignificant at 5% level. Even if it was significant, the low propensity indicates that only 9% of savings are invested in the domestic economy by the private sector. On the other hand, the Government has played a major role in domestic investment. Over a long period it has spent approximately 45% of its revenue per annum on expenditure programmes.

The estimated import equation in this study indicates that although in the short-run (income elasticity of imports is 0.36) a fall in income, especially from exports, is likely to cause substantial balance of payments deficits, in the long-run (income elasticity of imports is 1.00) it does not result in any serious problems. It was not possible to compare these values with the other two studies since they have not reported on elasticities. However, the author has calculated only the short-run elasticity for the other two studies since the 'static' specification did not permit the calculation of long-run elasticities. Khouja and Sadler's study gives a short-run elasticity of 0.61 which lies in between the two values of this study. However, Mallach and Atta's study gave a short-run elasticity of 1.6 which suggests that even in the short-run a fall in income does not cause any serious balance of payments problem.

The incremental labour-output ratio and Capital-output ratio was obtained from the Cobb-Douglas function. For the Manufacturing sector these parameters were obtained with and without imposing the condition of constant returns to scale. The estimates for incremental labour-output and capital-output ratio was 0.46 and 0.68 respectively. Assuming constant returns to scale, these values were 0.4 and 0.6 respectively. It was not possible to compare the results in the other two studies as Khouja and Sadler did not include the supply side of the economy whilst Mallach and Atta did not use a Cobb-Douglas type production function. The studies by Motamen and Al-Sabah assume constant returns to scale and use 0.3 for aggregate labour-output ratio and 0.7 for aggregate capital-output ratio although these values were not estimated statistically.
In the third stage the long-term (terminal period 1999) forecasts were produced using dynamic simulation technique. Thirty-eight simulation runs were presented. However, sensitivity analyses were carried out by only varying the values for certain exogenous variables. If proper sensitivity analysis - varying parameter values - were to be carried out then this would have led to results of intractable dimension. It would not have been possible to present broad policy conclusions. In order to keep the results within limits the values for certain exogenous variables were allowed to take three - low, medium, high - values. The justification for the choice of the values used in the simulations is explained in chapter 5.

Before we discuss the essence of the policy simulation it must be pointed out that the results should be dealt with some caution. This is due to the fact that in addition to the data being scarce and unreliable, the model consists of a number of shortcomings. The first drawback is the relationship between output and factor inputs. Although in this study a neoclassical production function (Cobb-Douglas) is employed, it does not allow investigation of the extent to which factors can be substituted. Ideally, if data on prices were available, a more flexible production function such as Translog of Generalised Leontief could have been adopted.

The second shortcoming in the model is the treatment of the oil sector. The long-run price path for oil is based on a number of empirical studies and three values - high, moderate, low - of 2%, 1.5%, 1% per annum were finally chosen. Most of these forecasts are based on known reserves of oil, subjective view of market structure, estimated price of substitutes, demand, supply and cost schedules. All these factors are subject to uncertainties in the future. The oil market is one which has undergone several structural changes in the recent years and there is a great deal of instability arising from the behaviour of consumers, Governments and producers. Therefore any forecast on oil prices, however sophisticated the method may be, must be treated with a good deal of caution. The choice of a depletion rate, especially by surplus countries like Kuwait, has
caused a great deal of controversy. This stems from the two contrasting views held by economists, one group recommending a market rate and the other an optimal rate of depletion. In a sense this discrepancy occurs whether one adopts a positive or normative approach. It is also argued that Kuwait, being a member of OAPEC, cannot independently determine its depletion policy. Ideally the oil sector of Kuwait should be modelled within a general global oil model which is clearly beyond the scope of this study. The depletion rates of - high, moderate, low - 2 mn b/d, 1.5 mn b/d, 1 mn b/d - are used in the simulations.

The third drawback is the treatment of income derived from foreign assets. The expected rate of return from foreign assets is assumed to be 3% per annum. It may be argued that this rate of return is rather low. Unlike the other surplus countries Kuwait's financial institutions have reached a mature stage. They have successfully shifted away from short-term liquid assets to long-term loans, equities and other neutral investments. These assets are likely to give higher yields although there are risks involved. Ideally a risk-return type of function should have been specified and applied in the simulation.

Undoubtedly these drawbacks are likely to weaken the reliability of various policy decisions. Nevertheless it does throw some light into the future position of Kuwait. From the outset, it is claimed that the major objective is to strike a balance between economic and social goals. The variables which affect the economic goals are the level of domestic stock, foreign assets, reserves of oil, growth in GDP per capita and consumption per capita. The variables which affect the social goals are the level of foreign population, expatriate labour, etc. All these variables are inter-dependent.

In recent years, Optimisation techniques have been widely applied to policy and planning problems. Contrary to this view, it is argued that dynamic simulation techniques can play an important role in the same area of research. In reality both tend to achieve the same
objectives and this can be explained using an example. In optimisation, one would be trying to achieve the desired level of capital stock by using an instrument such as investment. In simulation studies, a growth in output is first assumed. What would be the corresponding level of investment and capital stock? By assuming various growth rates in output the corresponding levels of capital stock are determined. One of these values of capital stock would match the desired level in the optimisation method. Hence the simulation method achieves the same objectives with many more runs.

In every simulation, the rate of growth in gross domestic product of the Manufacturing and Residual sectors from 1980 to 1999 was assumed to take the same value. In a sense this may be interpreted as a form of 'balanced' growth between the two sectors. However, it could also be argued that if initially these sectors were 'unbalanced' then assigning the same growth rate does not necessarily lead to balanced growth.

The essence of the study can be summarised in terms of three policy simulations:
Policy (1) : high depletion, high growth, high price for oil
Policy (2) : moderate depletion, moderate growth, moderate price for oil
Policy (3) : low depletion, low growth, low price for oil.

The attractive feature of the first policy is that it generates a high growth in GDP per capita, 5.1% per annum, when compared to other two policies which give 3% per annum, 1% per annum respectively. The consumption per capita is also the highest giving 3% per annum whilst the other two give 1% per annum and 0.8% per annum respectively. By adopting the first policy a highest level in domestic capital stock and foreign assets are attained. The level of capital stock reaches 37.9 bn KDs and the foreign assets 114.5 bn KDs compared to 27.5 bn KDs and 83.6 bn KDs in Policy 2 and 19.23 bn KDs and 59.0 bn KDs in Policy 3 respectively. The appealing feature of the third policy is its relatively low dependency on foreign labour and population. By adopting this policy, 58% of the labour force and
54% of the population will be non-Kuwaitis. This is relatively low when compared to policy 2 and policy 1 where 77% of the labour force and 62% of the population will be non-Kuwaitis for the former and 86% of the labour force and 72% of the population will be non-Kuwaitis for the latter. Policy 3 also leaves 62.7 bn barrels of oil in the ground.

The attractive feature of the second policy is in its moderation. Although policy 1 gives a higher level of foreign assets, as stated before, these are subject to a potential threat of Nationalisation. Although policy 3 is appealing in terms of low foreign labour force and population, it leaves a considerable amount of oil in the ground which may yield low revenues in the future.

It must be stressed here that in all the simulation runs, the balance of payments is in surplus. According to the estimates of this study—short-run elasticity of 0.36 and long-run elasticity of 1.00—a fall in income may cause a balance of payments problems in the short run, but in the long run it does not result in any serious consequences.

6.3 Concluding remarks and suggestions for further research

In the standard theories of economic development, major emphasis is placed on the process which would alleviate the problem of low capita income. The classical theorists identify a dualistic economy, consisting of a small advanced capitalist sector (usually an urban industrial sector) and a backward sector (usually a large agricultural sector). They encourage the capital formation in the advanced sector so that surplus labour from the backward sector could be absorbed into the productive advanced sector. The Structural theorists assert that developing economies face rigidities and bottlenecks which retards progress, and focus on the methods by which these problems could be overcome.

It is argued that Kuwait does not fall into the category of developing economies in the traditional sense. It has a potentially large revenue earning oil sector and a small indigenous population. However, the oil sector is exhaustible in the foreseeable future. It is also likely that
in the future this sector may provide low revenues if prices are low. Hence, there is a need to transform these oil revenues into other forms of re-produceable capital stock. This can only be achieved by adopting a long term plan. Such a plan must contain two aspects. Firstly, it needs to consider a diversified 'Portfolio Selection' approach with the economy comprising of oil stock, foreign assets and domestic capital stock. The investment in domestic capital stock should be based on structural complimentarity. This means that sectors which have strong forward and backward linkages with the oil sector should be encouraged. Moreover, the selection of such sectors should be also based on a criteria of long term viability and stability. Secondly, due to the small population and market size of the economy some form of Economic Integration amongst the Gulf states is imperative.

With reference to the first aspect, there are a few studies which have focussed on the importance of holding a diversified portfolio of assets. Amongst these, the two studies mentioned in this thesis- Khouja & Sadler, Mallach & Atta- should be noted. However, it is felt that these studies do not take a balanced view. Khouja & Sadler place strong emphasis on the role of a rentier economy whilst Mallach & Atta stress very heavily on the domestic economy. Unlike the two, this study advocates a balanced portfolio selection approach. In addition, it also takes into account other important variables such as the level of expatriate labour, foreign population and welfare measure variables such as growth in GDP per capita, consumption per capita, etc.

The second aspect relating to the question of an Economic Union should be investigated with a great deal of caution. The theoretical literature on Integration discussed earlier in this chapter emphasises the benefits which could be derived from production (via internal and external economies of scale), trade (via a larger market size) and monetary (via exchange rate stability) sectors. However, the empirical evidence of EEC and Latin American countries suggest that, overall, the former has not made any significant gains from Integration whilst the latter has. Hence, this leads to the conclusion that the merits of each type of Union should be assessed independently. In the case of the Gulf states, the growth in market size
is unlikely to be significant. However, the area that is worth investigation is the manufacturing sector, especially, the oil refining sector. Kuwait has a comparative advantage in this activity since it is endowed with the raw material and the technique used is capital intensive. The latter reduces the dependence on labour, especially, expatriate labour. But it must be borne in mind that the other countries in the Gulf area – Saudi Arabia, Qatar, United Arab Emirates etc. – also possess a similar advantage. Hence, if a country embarks independently on a refinery expansion programme then this is likely to result in excessive competition and output. Therefore, in the long term, it is important to have a co-ordinated approach (with an agreed allocation of production) amongst the Gulf nations. This may also require a monetary union specially in the areas of exchange rate stability and freeing of capital movements. An extensive investigation into the areas of Economic Integration should be treated as high priority.

In addition, there are a number of other areas which could be recommended for further research. On the theoretical side, the work that has been carried out so far on exhaustible resource is rather limited. Optimal depletion and growth within a closed economy is satisfactorily covered by Dasgupta and Heal (1979). Kemp and Long (1980) have investigated the impact of international capital markets (treated as a perfect market) on resource based economies. The study in the future should be directed towards expanding the present theories by incorporating factors such as imperfections in capital markets, constraints in some input factors, etc. The extension on the empirical side should be to improve the modelling of the economy of Kuwait. As and when new and reliable data becomes available the model should be re-specified and re-estimated. It would be useful to build a macroeconomic model for carrying out forecasting exercises in the medium term. This would enable the planner to examine the interactions between the medium and long term objectives. In addition, empirical investigation into specific issues must be pursued. An important area is the study of future manpower levels. Undoubtedly, undertaking all the above mentioned research would be an arduous task, but it is felt that the benefits which can be derived from it will vastly outweigh the costs.
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