GOVERNMENT EXPENDITURE AND GROWTH IN LIBYA

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Declaration This is to certify that this thesis is the result of an original investigation. The material has not been used in a submission for any other qualification. Full acknowledgement has been given to all sources used

Signature...........................

Dedication

To my own dear family: to my precious Mother and beloved Father, my lovely wife Muna, our beautiful children, Murad, Fatma, Abdurahman, and Maha, my dear sister Fathia, and her family, my older brother Sayad, and his family, my younger brother Salem.
I love you all

Abstract

Keywords: Libyan Economy, Government expenditure, Economic Growth, Macro-economic Model, Econometric, Stationery, Co-integration, Johansen Approach, Error Correction Model, Simulation, Forecasting, Multiplier Analysis.

This study attempts to answer two main questions. First, how does the composition of public expenditure affect the economic growth rate of macro-economic variables such as the real output of the non-oil sector, employment, and total imports in Libya? Second, what is the appropriate fiscal and/or monetary policy to be used by the Libyan government to finance public expenditure, especially after the collapse in the oil price in the 1980s? To achieve these ends, a small macro-econometric model of the Libyan economy is constructed for the period 1962-1992 and estimated using the Johansen approach. The model reflects the Libyan institutional environment relevant to the observation period. The model links public finances to the monetary sector, the real sector, the role of foreign trade and the balance of payments, and the labour market. The model is utilised to (1) examine the impact of government expenditure on the growth of the macro-economic variables mentioned above; (2) examine the impact of different ways of funding these expenditures; (3) examine long-run equilibrium relationships estimated through the cointegration approach. The short-run dynamics was modelled via error correction models. Evaluation of the model was through standard single equation diagnostics, model simulation, and forecasting. Policy simulation was used to evaluate macro-economic policy options open to the government of Libya.

As a result this study provides considerable knowledge about the structure of the Libyan economy through the period 1962-1992, and about the impact of government expenditure and its finance instrurment (fiscal and/or monetary means) on growth.

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I wish to acknowledge my indebtedness to **EL-TAAHADI UNIVERSITY**, Sirt Libya for granting me a scholarship to pursue my graduate studies leading towards PhD degree of economic.

I am grateful to express my love and my heartfelt appreciation to the spirit of my Mother **Fatma** who died on 22.12.1999 in a crucial moment of my life. By her death I lost the most prayer to ALLAH to help me and pleased me in my life and the hereafter. May ALLAH accept her and enter her his paradise. My great love to my father. I pray to ALLAH to give him good health in his life.

I would like to express my heartfelt appreciation to my wife; Muna, her constant support and encouragement during the study period can hardly be expressed in words, our children, my sister and brothers for their patience, support and encouragement during the course of my studies.

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Chapter One

Introduction

1.0-Introduction

The last two decades have witnessed drastic changes in the world oil market. In the 1970s, the world oil price increased sharply during 1973-1974 and 1979-1980 as a result of the Arab-Israeli war and the Iranian crises respectively. These led to an increase in oil revenues for all the oil producing counties. As a consequence, most of these countries, and Libya was no exception, established ambitious plans for economic and social development. These plans depended on oil revenue for their finance. In the early 1980s, in particular in 1982, the picture changed. The world recession led to a sharp decrease in the price of oil. As a result, oil revenues for all oil producing countries decreased and the governments faced financial problems. For Libya in particular this problem was deeper due to the USA ban on importing Libyan oil from 1981, (40% of Libyan oil exports was imported by the USA) (El-Fituri, 1992).

1.1-Research Problem

In 1959, oil was discovered in Libya. The first shipment of Libyan crude oil exports began in September 1961, and in subsequent years this resulted in large revenues for the government. From the start the government intended to use these revenues to support public sector investment in the Libyan economy with the aims of becoming self-sufficient in food production and developing other industries. This proceeded satisfactorily until the collapse of oil prices from 1982, when the government was faced with a drop in oil revenue and, in order to maintain its level of investment, it needed to borrow from the central bank. This resulted in a large public sector debt, which by 1992 had reached 58.5 percent of gross domestic product (GDP) (75.5 per cent of output of the non-oil sector "GDPN") and was a serious problem for the government. This problem is wide spread for less developed countries (LDC's) and has promoted much research (see e.g. Murinde, 1993 and Jha, 1994).

1.2-The Objectives of the Study

Government fiscal policy has different impact on different macro-economic variables. The main objectives of this study are to investigate the impact of government expenditure on real output of the non-oil sector, employment, and total imports, in Libya using a suitable econometric model. The implications of the different methods of financing the government expenditure will be examined. In general, government expenditure can be financed by taxation, by borrowing from the central bank or by issuing new money. However, because of absence financial market bond financing note used in the case of Libya. This study will provide tests of the various economic theories of the effects of the different ways of increasing government expenditure on the economy. It will also allow policy makers in Libya to decide which is the most appropriate form of government finance, given the objective of growth.

1.3-Previous Studies

Macro-econometric model building has become widely accepted as a standard approach to forecasting and policy evaluation in both industrial countries and LDCs.

For Libya several econometric models have been constructed. Some e.g. Baryun (1980) divided the economy into the monetary sector, the real sector (oil and non-oil sectors), and the balance of payments. Abosedra (1984) divided the economy into two sectors: oil and non-oil. Others, e.g. Moustafa (1979), and Abohobiel (1983) prefer more sectors, with agriculture, manufacturing, construction and services being incorporated in the model. The more recent study of Mohamed (1998) divided the economy into: aggregate demand which includes consumption, investment, prices, employment, public finance, and aggregate supply, which includes the estimation of production functions of the oil and the non-oil sectors. With the exception of Baryun's model, these models basically adopt the standard Keynesian approach, with an emphasis on national income accounting relationships, short-run behaviour and a neglect of monetary and financial influences on growth and inflation. With the exception of Mohamed's model, the models are also unsatisfactory by modern econometric standards, since their treatment of dynamics, equilibrium requirements and the statistical properties of the data leave much to be desired.

In contrast, the recent developments of Engle and Granger (1987) and Johansen (1988), and their application to the UK (by Johansen and Juselius, 1990), to financial markets (by e.g. Sarantis and Stewart, 1995) and to developing countries (by e.g. Moosa, 1992-93 and Atingi-Ego, 1996) provide an alternative approach to econometric modelling which places a greater emphasis on the contribution of economic theory and the statistical properties of the data.

1.4-Data and Computer Programmes

Data availability is the main problem with most macro-econometric modelling studies of development countries. *The problems in these countries include short time series of data, a lack of monthly and quarterly data, missing observations and variables and the imposition of secrecy on some data and information (Al-Jebory, 1991; 4).* For Libya quarterly data are available only for the monetary sector, therefore, this type of data can not be used. Data, which are annual, are only available covering the period 1962-1992. This is the largest sample for all the variables in the model. Accordingly, the present study is based on the time series annual data (see section 5.4 for more details). The year 1962 is considered as the initial year because *the year 1962 is the first complete year of oil exports, and secondly, it is the starting year of the systematic National Accounts in Libya (Zarmouh, 1998; 12).*

Concerning the data sources, the annual data for Libya for 1962-1992 are available from:

1- Publications of Libyan Central Bank (LCB) (economic bulletin, the annual report various issues).

2- Secretariat of planning (socio-economic indicators in Arabic).

3- Publications of Arab Monetary Fund (national accounts of Arab countries, annual Arab economic report, balance of payments and external public debt of Arab countries, foreign trade of Arab countries, money and credit in Arab countries, various issues).

4- Publications of the International Monetary Fund (International Financial Statistics Yearbook, International Trade Statistics Yearbook, various issues).

The estimation will be done on standard econometric packages including Microfit (Pesaran and Pesaran, 1997) and TSP (Hall, 1993) which are available in the Liverpool Business School.

1.5-Methodology and Contribution

This study will involve the construction of a macro-econometric model of the Libyan economy, which will be used to examine the impact on output, employment and total imports of different ways of funding government expenditures. The model will consist of equations and identities, which represent both national income variables and also variables from money and financial markets. Emphasis will be placed on long-run equilibrium relationships, which will be estimated through the approach adopted by Johansen and Juselius (1990). Estimation of the short-run dynamics will be via the error-correction model. Evaluation of the model will be carried out through the use of both standard single-equation diagnostics and model tracking simulations.

Finally, policy simulations will be utilised to evaluate the macro-economic policy options open to the government of Libya.

The model will differ from earlier ones of Libya in the following ways:

(a) The money and financial markets will be assumed to be important in determining behaviour.

(b) It will use the co-integration approach of Johansen (1988), and Johansen and Juselius (1990). to test whether any stable, long-run relationships exist between endogenous and exogenous variables.

(c) It will use the widely accepted dynamic modelling procedures of Hendry and Mizon (1993) to include constraints from economic theory in the estimated model.

1.6-Outline of Thesis

For the purpose of the study this thesis will be divided into nine chapters as follows:

Chapter one serves as an introduction. Chapter two provides a brief survey of financial and economic development in the Libyan Economy. In chapter three a review of the literature on the impact of government expenditure on economic growth, the analysis of public expenditure growth, and basic background to econometric modelling are discussed. A review of a selection of empirical studies of the Libyan economy to give some guidelines to the approaches they adopted will be discussed in chapter four. The specification of the theoretical model is presented in chapter five. Estimation of the model including applications of stationarity tests, co-integration tests, and the error correction models of the Libyan data are presented in chapter six. Model evaluation including model simulation, forecasting, and multiplier analysis is provided in chapters seven and eight respectively. Finally, chapter nine draws some conclusions, policy implications, and some comments on possible future research.

Chapter TWO

Financial and Economic Developments in the Libyan Economy

2.0-Introduction

Prior to the discovery of oil in 1959 and the commencement of production, the Libyan economy had the same characteristics as any underdeveloped country, such as declining national income level, and low productivity in all economic sectors. It had no important economic resources to begin the development process; also it did not have suitable funds to finance the development plans. Taking into account all these characteristics *describing Libya as a developing country is deemed to be exaggerated (Farely:1971; 30)*

The purpose of this chapter is to show the characteristics of the Libyan economy prior to the discovery of oil and to discuss the financial and economic developments in the economy after the discovery of oil.

2.1-The Libyan Economy Prior to the Discovery of Oil

Most economists who examined the Libyan economy at that time had doubts about the development potential of the country. (El - Hassia & El - Megarbi, 1984). The total population in 1954 was 1.1 million. Primitive agriculture was the major source of income for more than 70 per cent of the population and contributed an estimated not more than 26 per cent of the gross national income (GNI). This was due to low capital formation, and a lack of water resources. The situation was not much different for the manufacturing sector, which was very limited. There was a number of small firms in such industries as canning tomatoes, flour milling, olive oil refining, tobacco and traditional handicrafts, and employment had been estimated in 1958 to be between 15-20 thousand in the manufacturing sector, and the contribution to GNI was less than 10 per cent. Furthermore the output of other sectors was at low levels, as a result of the lack of investment. In fact *Libya has great merit as a case study as a prototype of a poor country. We need not construct an abstract model of an economy where the bulk of the people live on a subsistence level, where per capita income is well below $40 per year, where there are no sources of power and no mineral resources, where agricultural expansion is severely limited by climatic conditions, where capital formation is zero or less, where there is no skilled labour supply and no indigenous entrepreneurship (Higgins: 1959,pp; 26).* Consequently, Libya had been classified as one of the poorest countries in the world. Moreover, *Libya combines within the borders of one country virtually all the obstacles that can be found anywhere: geographic, economic, political, sociological, and technological. If Libya can be brought to a stage of sustained growth; there is hope for every country in the world (Higgins: 1959; 37).* However, the Libyan economy was in equilibrium between demand and supply sides. This equilibrium *was not a result of an efficiency of* *production.... But it was the outcome of the balancing between the elements of economic backwardness and poverty (Autiga; 1972, cited in Zarmouh: 1998; 19).*

Since the funding to finance state expenditure was not available, the government depended at that time on foreign assistance (especially from the USA and the UK as a rent of their military base in Libya) to finance its expenditure, as table 2.1 shows.

Table 2.1

Government Revenue and Expenditure 1954/55-1958/59

Million LP *Nominal*

Year	1945/55	1995/56	1956/57	1957/58	1958/59
Expenditure	7.897	12.978	15.433	17.031	19.179
Domestic Revenue	5.549	7.061	8.147	9.595	12.049
Foreign Revenue	5.641	6.270	4.234	12.069	11.045
Total Revenue	11.190	13.331	15.381	21.664	23.094
Surplus or Deficit	3.293	0.353	-0.052	4.633	3.915

Source: International Bank Reconstruction and Development of Libya, 1960. P347

Because of the poor situation of the Libyan economy in general at that time and for the financial market in particular, when Libya gained its independence from Italy on 24 December 1951, there was no monetary sector, also there was no Libyan currency. [In its place. the Egyptian pound was used in Cyrenica (in the east), the British military authority used British pound in Tripolitania (in the west), and the Algerian Franc was used in Fazan (in the south)]. The Libyan Currency Commission was established in March 1951. This was the first Libyan monetary institution. It issued Libyan pounds. The Libyan National Bank "Libyan Central Bank " (LCB) was established in April 1956. The Bank was divided into two departments. The Issue Department, and the

Banking Department. The Bank's objectives are *To regulate the issue of bank notes and coins, to keep reserves with a view to maintain monetary stability in Libya and external value of Libyan pound, to influence the credit situation to the Kingdom's advantage and to act as banker to the government and to the provincial administration. (Economic Development of Libya. The International Bank Report; 1960: 378).* On the eve of independence there were two commercial banks offering primary banking services.

The discovery and export of oil in the late fifties and at the beginning of the sixties brought a remarkable change in the Libyan economy. It stopped being an example of a poor and underdeveloped economy and actually became a model of dis-equilibrium development. Since then annual personal incomes have increased, the standard living has improved and the Libyan economy has changed from a primitive agricultural economy to petroleum one as a result of discovering, producing and exporting oil.

The financial and economic developments in the Libyan economy after the discovery of oil are discussed briefly below.

2.2-The Libyan Economy 1962-1992

Despite the gloomy conclusion that was reached by Higgins (1959) above, in the early sixties foreign oil corporations working in Libya discovered oil in commercial quantities. The first impact of the discovery and export of oil was on expenditure by corporations working in the country, the second was on government expenditure, which increased, as well as oil revenue, which become the main resource to finance government expenditure. As a consequence of the increase in government expenditure, the demand for goods and services increased, as also, due to oil corporations working in the country, did commercial banks deposits. This gave a chance for these banks to give the private sector suitable loans to establish commercial firms to produce and import goods and services to supply the increasing demand in the domestic market. Because of this, loans (in nominal terms) increased from 6.031 million Libyan pounds (MLP) in 1956 to 88.846 MLP in 1969. (Attiga, 1972).

Since the revenue from oil goes directly to the government, the government became responsible for finding the best way to spend the oil money. Consequently, various development plans have been undertaken since 1962, for either three-year or five-year periods. None was implemented between 1986-1992, when priority was given to pushing ahead with the Great Man - Made River project (GMR) and curbing the fiscal deficit. The philosophy of planning and the objectives of each plan are, therefore, important in charting the future evolution of any given sector. Two fundamental considerations should be emphasised. First, the Libyan economy is a developing one, with a relatively large geographical area (1754 million square kilometres), a small population base (4.9 million in 1998), and dependent on oil, which is, of course, a depletable resource. Second, the economy has been developed according to a philosophy of socialism since September 1975.

Since 1970 the Libyan economy has witnessed steady and systematic changes. These changes were aimed at reforming the economy from being a market economy to beinga socialist one. It is natural that behavioural and institutional changes should *follow the structural changes in the economy. The first of these changes was introduced in September 1975, when the Libyan government started the process of nationalising foreign trade. Government agencies and corporations replaced the private sector in importing and trading most goods and services. Two years later the government abolished wholesale and retail trading. (Abdussalam, A; 1985:P77).*

The planning objectives which are relevant for long-range planning in Libya can be summarised as follows (El-Jehaime; 1987):

1- To alter the structure of the economy in favour of agriculture and industry.

2- To gradually reduced the role of the oil sector and to limit exports to the financing requirements of other sectors.

3- To achieve a greater degree of self-sufficiency in broad agricultural and industrial products, particularly in certain key food groups and industries catering for people's basic needs.

4- To build industries based on oil and natural gas, to capitalise on areas where the country possesses clear advantages for exports.

5- To develop an indigenous manpower base capable in due course of carrying out the development effort with minimum foreign participation.

The rest of this chapter will be organised to review the sectors, which will be covered by the econometric model in chapter five.

2.2.1-The Real Sector

Since oil is a natural resource it is important from the economic development point of view to investigate the growth of the non-oil sector. The oil sector can be viewed as a source of net foreign assets, which provides the government with finance. In the Libyan Central Bank Economic Bulletin, the actual development expenditure budget dis-aggregates the Libyan economy into four sectors: (1) commodity production sector (agriculture, manufacturing, and oil & natural gas), (2) economic service sector (electricity, housing, construction, and transport & communication), (3) social service sector (labour force, health, and information & culture), and (4) other sectors (social affairs & security, sport, economic planning, rural area development, and marine wealth). Since the goal of this study is to investigate the impact of government expenditure on economic growth gross domestic product is dis-aggregated into the oil output (GDPO) sector and the non-oil output (GDPN) sector. To get a clearer picture, the GDPN is dis-aggregated into four sectors as follows: First, the commodities sector (CGDP) (agriculture, & forestry, manufacturing industries and mining & quarrying production). Second, the economic services sector (EGDP) (electricity, water & gas, housing, transport, communication & storage, and construction). Third, the distributive services sector (DGDP) (commerce, restaurant & hotels, and finance, insurance & banking), and fourth, the social services sector (SGDP) (public services, education, health, and other services). This dis-aggregation of GDP reflects the main features of the Libyan economy.

This section discusses the growth of GDP in both the oil and the non-oil sectors. Gross domestic product increased from 1135.0 MLP in 1962 to 10553.8 MLD in 1980 and decreased to 9642.2 MLD in 1992 at 1980 constant prices (see table 2.2). (On 1 September 1971, the Libyan Dinar, equal to the Libyan Pound was introduced). GDP recorded a negative growth rate during 1980-1985 (see table 2.2). This was due to the fall in oil output (see table 2.2).

As mentioned above discovering and exporting of oil in the 1950s and 1960s brought remarkable changes to the Libyan economy. One of these was improving living standards. These are reflected in the increase in per capita GDP from 810.7 LP in 1962 to 3908.8 LD in 1980. However, it decreased to 2405.7 and 2142.7 LD in 1985 and 1992 respectively. The fall in per capita GDP in the 1980s was due to the decrease of the growth rate of the GDPO (see table 2.2) as a result of political factors which affected Libyan oil exports (which is discussed below). The structure of gross domestic product will be now being considered.

Table 2.2

GDPO, GDPN, and GDPPCI

At 1980 constant prices

Million Libyan Dinars

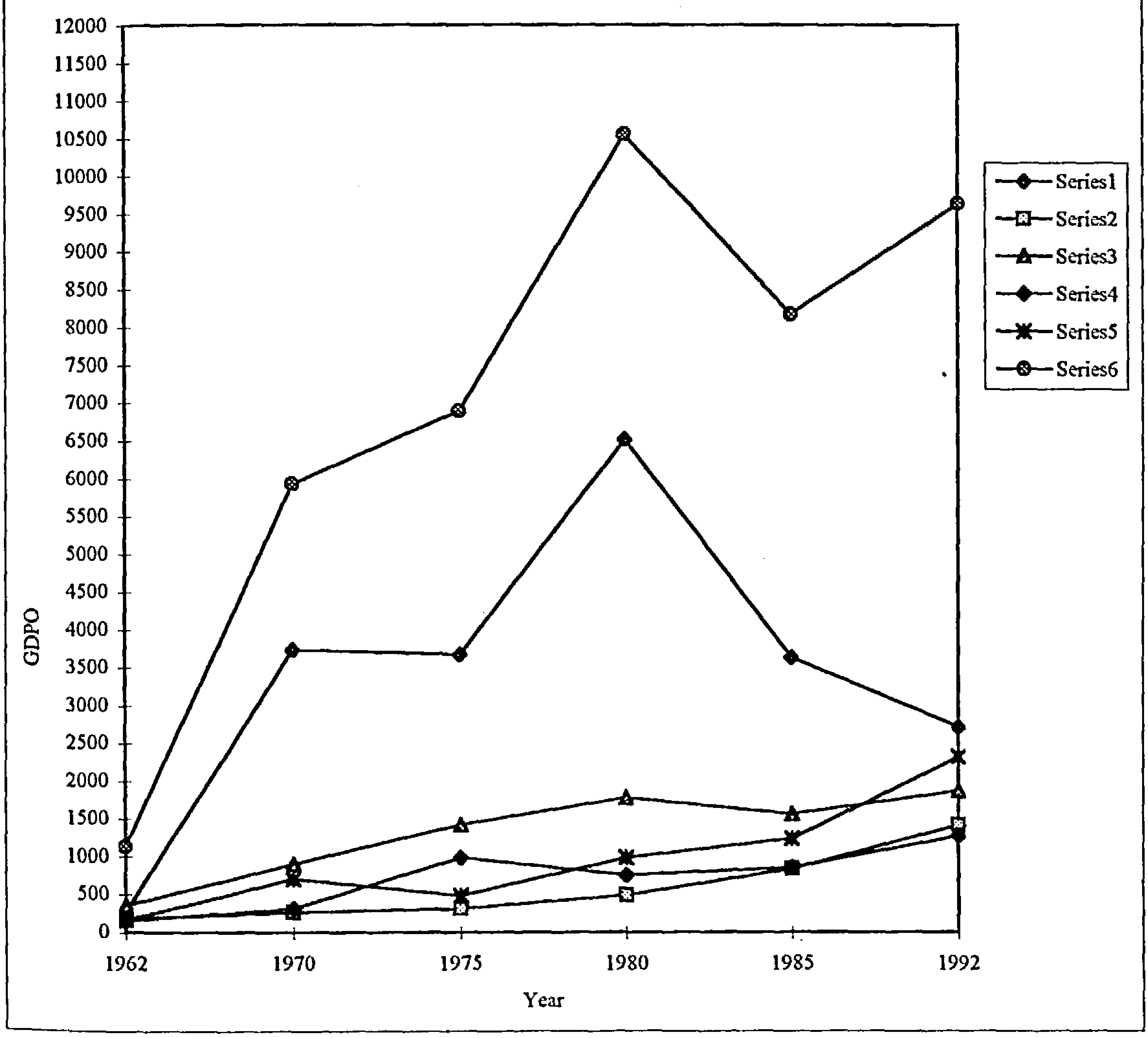
					Average annual growth rate %			
Year	GDPO	GDPN	GDP	GDPPCI*	dGDPO	dGDPN	dGDP	dGDPPCI
1962	277.4	857.7	1135.0	810.7				
1970	3744.7	2192.2	5936.9	3298.3	156.2	19.4	52.9	38.4
1975	3684.2	3218.5	6902.7	3137.6	-0.3	9.4	3.3	-1.0
1980	6525.7	4028.1	10553.8	3908.8	15.9	5.0	10.6	4.9
1985	3646.3	4533.0	8179.3	2405.7	-9.5	2.5	-4.5	-7.7
1992	2725.7	6916.5	9642.2	2142.7	-2.7	7.5	2.6	-1.6

GDPO is oil output, GDPN is non-oil output, and GDP is gross domestic product.
GDPPCI is GDP per capita income.
d denotes to growth rate.
* In Libyan Dinars.
Source: National Accounts 1962-1971, 1972.
National Accounts 1971-1979, 1982
National Accounts 1980-1992, 1997

2.2.1.1-Oil Sector

The importance of oil in the Libyan economy can be seen from an investigation of gross domestic product of the country. The economic variables through the period 1962-1980 indicate that the Libyan economy was dominated by the oil sector. GDPO increased from 277.4 MLP in 1962 to 6525.7 ML.D in 1980 at 1980 prices (see Figure 2.1).

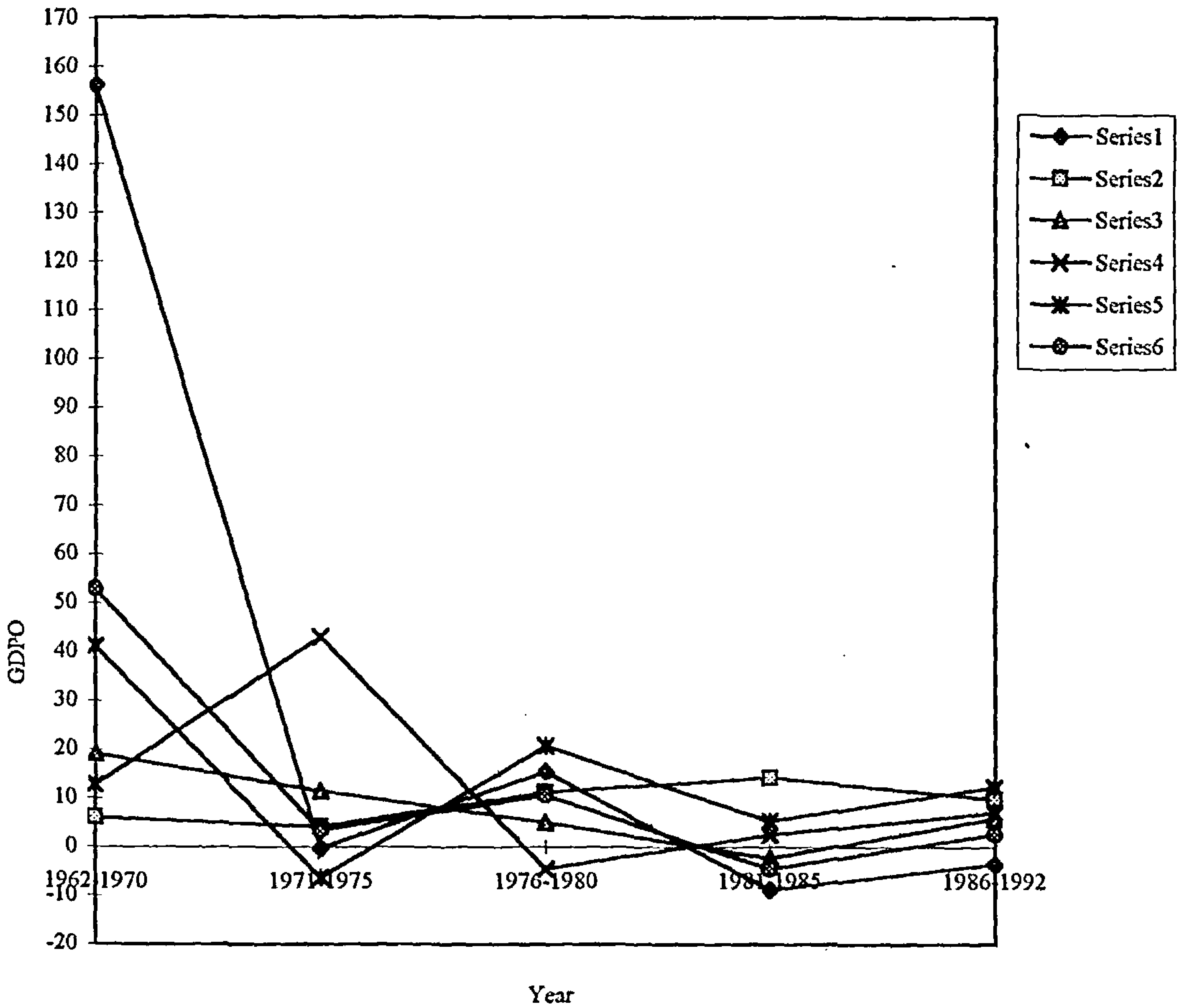
Figure 2.1 Gross Domestic Product by Sector 1962-1992



Series 1 GDPO is oil sector output. Series 2 CGDP is commodity sector output.
Series 3 EGDP is economic sector output. Series 4 DGDP is distributive sector output.
Series 5 SGDP is social services sector output. Series 6 GDP is gross domestic product.
Source: Calculated from data in Appendix.

By 1970 the share of the oil sector in GDP was more than 63 per cent. The new government, which came into force after the First September Revolution in 1969, nationalised the oil sector in 1970 and decided to reduce oil production after 1971. This lead to a negative growth rate of the GDPO by -0.3 per cent per year during 1971-1975 (Figure 2.2).

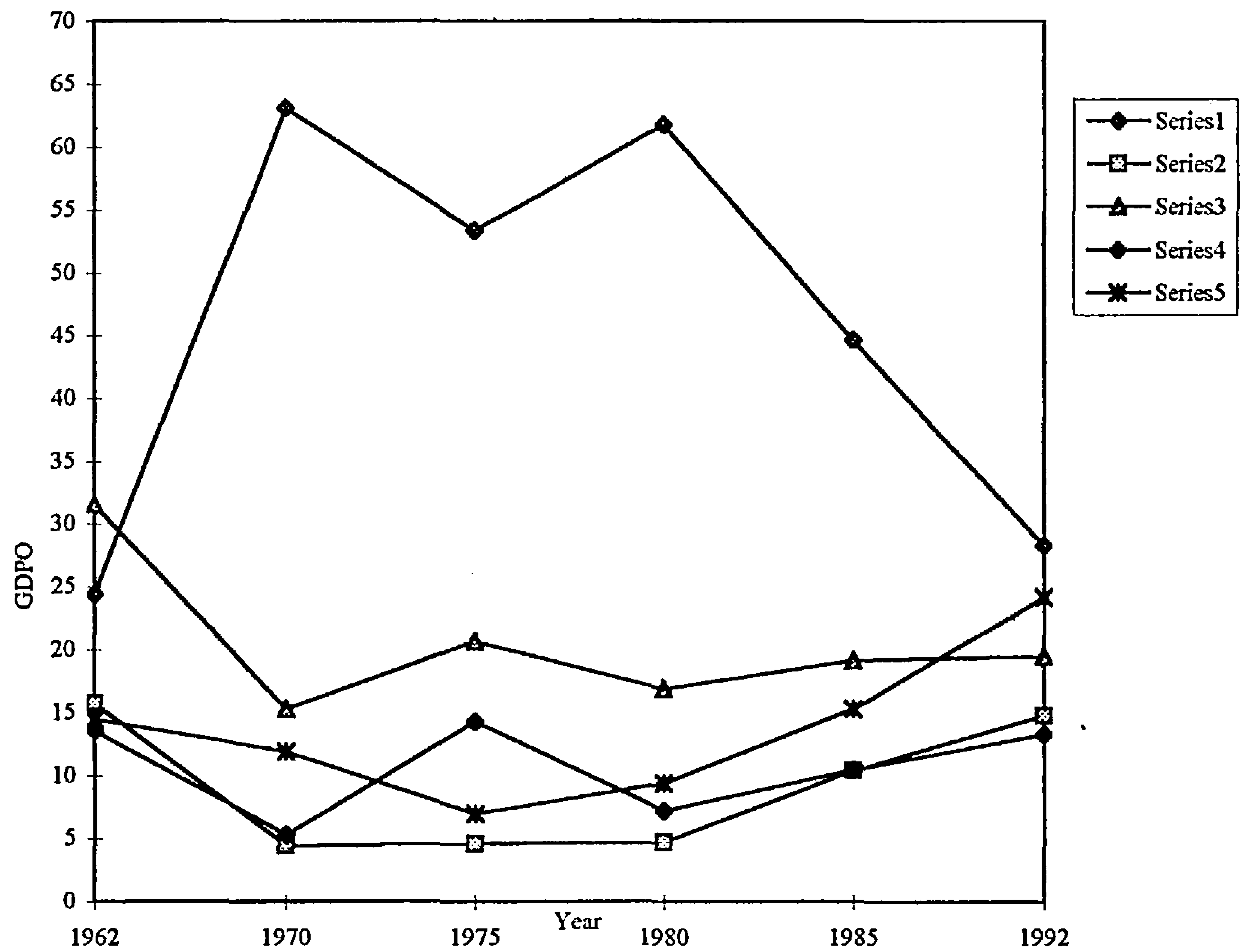
Figure 2.2 Average Growth Rate of the GDP by Sector 1962-1992



Series 1 GDPO is oil sector output. Series 2 CGDP is commodity sector output.
Series 3 EGDP is economic sector output. Series 4 DGDP is distributive sector.
Series 5 is SGDP is social services sector output. Series 6 is gross domestic product.

As a result its share in GDP reduced to 53.4 per cent by 1975 (see figure 2.3). By 1980, it was more than 61 per cent of GDP as figure 2.3 illustrates.

Figure 2.3 Sectoral Relative Shares into GDP 1962-1992



Series 1 GDPO is oil sector output. Series 2 CGDP is commodity sector output.
Series 3 EGDP is economic sector output. Series 4 DGDP is distributive sector.
Series 5 is SGDP is social services sector output. Series 6 is gross domestic product.

This increase of its share in GDP can be explained by the increase of the world oil prices just after the Iranian crisis in 1978-1979. During 1986-1992 the average annual growth rate of oil output was -3.6 per cent per year. The share of the oil sector in GDP had fallen by 1992 to 28.3 per cent. The main reasons for this reduction were government policies to reduce oil production and to increase the contribution of other sectors to GDP (see figure 2.3). Also important were the fall in crude oil prices in the 1980s, in particular since 1981, and the oscillations in crude oil exports as a result of the slump in output in the West, which followed the oil price, increases. Additionally, the foundation and operation of OPEC, which attempted to control prices and oil production and exporting quantities, and the USA ban on importing Libyan oil in 1986, reduced Libyan oil revenues (see table 2.3).

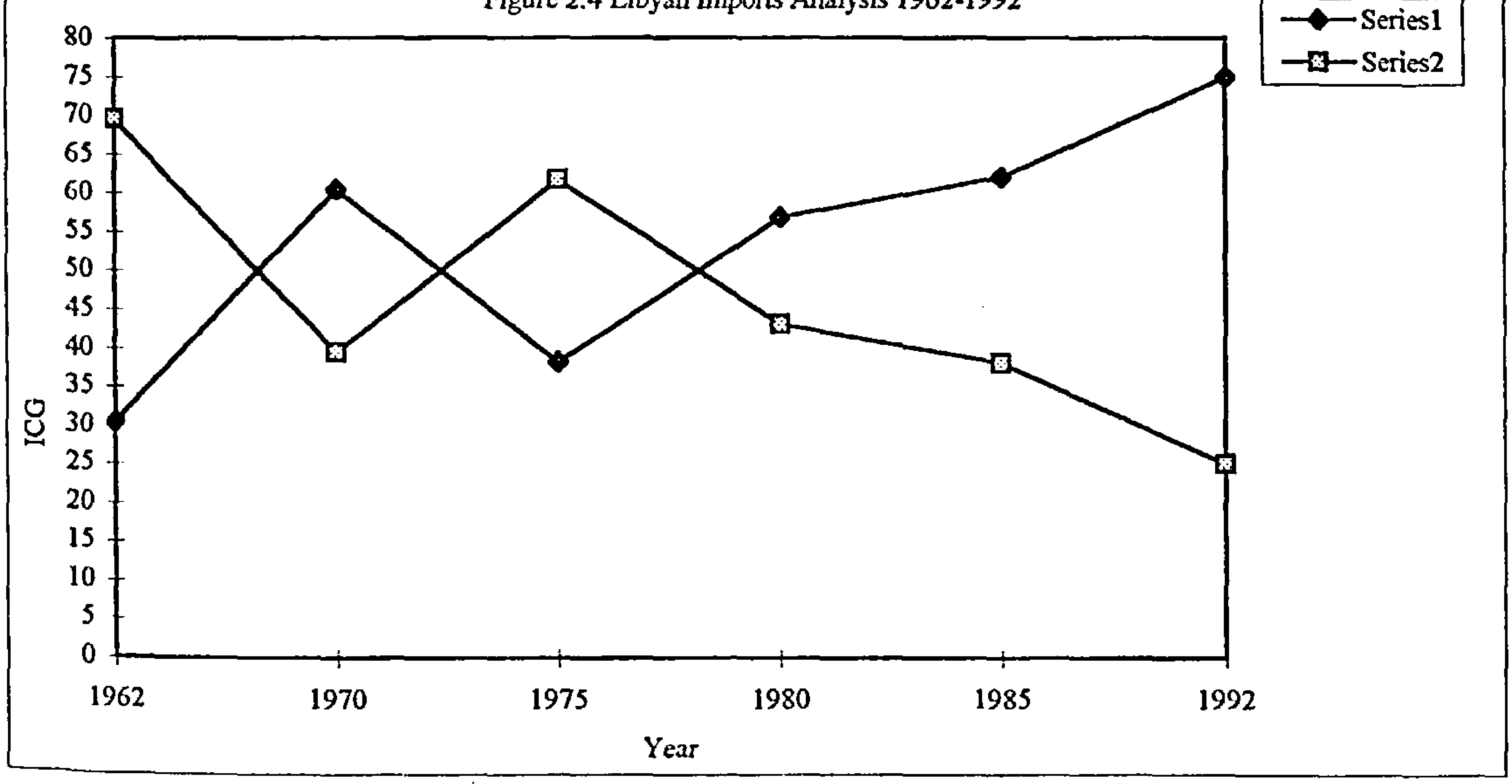
Table 2.3
The main political factors affecting Oil Production, Prices and Exports
1973-1992

Year	Political Factors	Results
1973	Israeli Arab war.	Increased oil prices
1979	Iranian crisis.	Increased oil prices
1980s	(1) Different measures taken by industrialised countries (the West) to reduce their dependence on OPEC oil. (2) OPEC operation to control prices and oil production and oil exports quantities.	Reduced oil production, oil exports, and oil prices. Reduced oil production, and oil exports.
1986	The USA's ban on importing oil from Libya.	Reduced oil exports.
1992	The UN sanctions.	Reduced oil production and oil exports.

2.2.1.2-Commodity Sector

The output of the commodity sector (CGDP) (Agriculture, Manufacturing) increased from 178.8 MLP in 1962 to 1426.8 MLD in 1992 at 1980 constant prices (see figure 2.1). To increase the contribution of this sector to GDP attention was given to agriculture activity, through the social and economic development programmes of 1962-1970, 1971-1975, and 1976-1980, to achieve self-sufficiency in food. As a result, the average annual growth rates of this sector were 6.0%, 4.1%, and 11.2% respectively (see figure 2.2). Priority was given to manufacturing activity in 1981-1985 social and economic development plan. This aimed to substitute home produced goods for imports with any surplus being exported. Also, some manufacturing goods, such as in the petrochemical industries, were produced for export. The result was an average growth rate of the commodity sector of 14.2 per cent for 1981-1985 and an increase in the share of GDP from 4.7 per cent in 1980 to 10.4 per cent in 1985. However, the country was still unable to supply the goods needed in the domestic market. Therefore, imports of consumption goods are more than 75 per cent of total imports in 1992 (see figure 2.4).

Figure 2.4 Libyan Imports Analysis 1962-1992



Series 1 ICG is imports of consumer goods. Series 2 IKRMG is imports of capital and raw material goods.

2.2.1.3-Economic Services Sector

Because of the large development expenditure invested in this sector (62 per cent of total social and economic development plan for 1962-1969), its output increased from 359.1 MLP in 1962 to more than 906 MLD in 1970 at 1980 prices (see figure 2.1), with an annual average growth rate of 19.1 per cent per annum (see figure 2.2). Further emphasis was given to the economic services sector through the 1970-1975 development plans, when more than 35 per cent of total development expenditure was allocated to this sector. However, the average annual growth rate of its output (EGDP) decreased to 11.4 per cent per year during 1971-1975 (see figure 2.2), and its share in GDP decreased from 31.6 per cent in 1962 to 20.7 per cent in 1975 (see figure 2.3). The world recession in the 1980s affected the Libyan economy by reducing its ability to fund its development plans. As a result, many projects were cancelled, and the average annual growth rate of EGDP was -2.3 per cent during 1981-1985 (see figure 2.2). Because of the negative growth rate of the oil sector during the 1980s and 1990s, its share in GDP decreased to 28.3 per cent in 1992 resulting an increase in the share of the other sectors in GDP, so that the share of EGDP in GDP increased from 16.9 per cent in 1980 to 19.5 per cent in 1992.

2.2.1.4-Distributive Services Sector

Because of the limitations of the financial market in the Libyan economy, where there is only one insurance company and five commercial banks all owned by the state, on one hand, and because of the limitation of the hospitality industry on the other, the distributive services sector (DGDP) (Commerce & hotels, Insurance & banking), was the smallest of the five sectors, totalling in 1962 only 154.7 MLP at 1980 prices (see figure 2.1). However, following the increase in per capita income, the commercial boom, and the banking consciousness in the 1970s, its average annual growth rate was the highest compared with the other sectors, at 43.1 per cent per year during 1970-1975 (see figure 2.2), and its share in GDP increased to 14.3 per cent in 1975 (see figure 2.3). As a result of socialist thinking, which was introduced by the new regime after the First September Revolution in 1969, in September 1975 the government nationalised foreign trade, and the private sector was prevented from importing most goods and services. By 1977 the government had abolished wholesale and retail trading. This lead to a negative growth rate of DGDP of -4.6 per cent per year during 1976-1980 (see figure 2.2). The State supermarket network, which was established in the early 1980s, was poorly organised. In September 1988 the government proposed an increase in privatisation and announced that Libyans would be able to import and export in complete freedom. The private sector was encouraged to expand, and steps were taken to dismantle barriers to trade and tourism. As a consequence, the DGDP average annual growth rate increased from 2.5 per cent per year in 1981-1985 to

7.0 per cent per annum in 1986-1992 (see figure 2.2), and the contribution of DGDP to GDP increased to 13.3 per cent in 1992 (see figure 2.3).

2.2.1.5-Social Services Sector

In general the situation of the social services such as health and education was very poor before the 1960s. Libyan social and economic planners recognised that investment in human capital is very important for development programmes. Therefore, the main objectives of the first five-year plan (1962-1968) were to improve the living standards of the Libyan people. Hence, the priority was given to improve the health and education services. As a consequence education and health services were introduced free of charge for all the residents in the country. Therefore, the output of the social services sector (SGDP) increased from 165.0 MLP in 1962 to 707.8 MLD in 1970 at 1980 prices, with an average annual growth rate 41.1 per cent. The one-year plans (1971-1972) and the three-year plan 1973-1975 aimed to increase the output of the commodity sector (CGDP) and economic services sector. This procedure reduced the growth rate of the SGDP to -6.3 percent per year during 1970-1975 (see figure 2.2). SGDP's share in GDP decreased to 7.0 per cent in 1975 (see figure 2.3). One of the objectives of the 1976-1980 five-year plan was to increase the efficiency of the labour force. This was achieved in the social services sector by increasing the SGDP at an average annual growth rate 20.7 per cent per annum during 1976-1980. In the second year of the third five-year plan (1981-1985) the Libyan economy was affected financially by the world recession and the slump of oil prices. This meant that the government could not continue its pattern of spending for development programmes. As a result restrictive fiscal, monetary, and commercial policies, was introduced and foreign exchange was controlled to deal with this problem (El-Fituri, 1992; 63-76). However, the Libyan economy suffered from a shortage of skilled labour, and as a consequence, depends on foreign labour, especially for education and health services. Because the government could not continue to pay the foreign labour their high salaries in foreign currency, most of them left the country. As a consequence, the growth rate of the SGDP was only 5.3 per cent per year during 1981-1985 (see figure 2.2.). During 1986-1992 the government did not establish a development plan. The priority was given to completing projects from the development plan for 1981-1985. The average annual growth rate of the SGDP increased to 12.4 per cent per year during 1986-1992 (see figure 2.2), and its share in GDP increased to more than 24 per cent in 1992. This is the highest contribution to GDP after the oil sector (see figure 2.3).

2.2.2.Public Finance

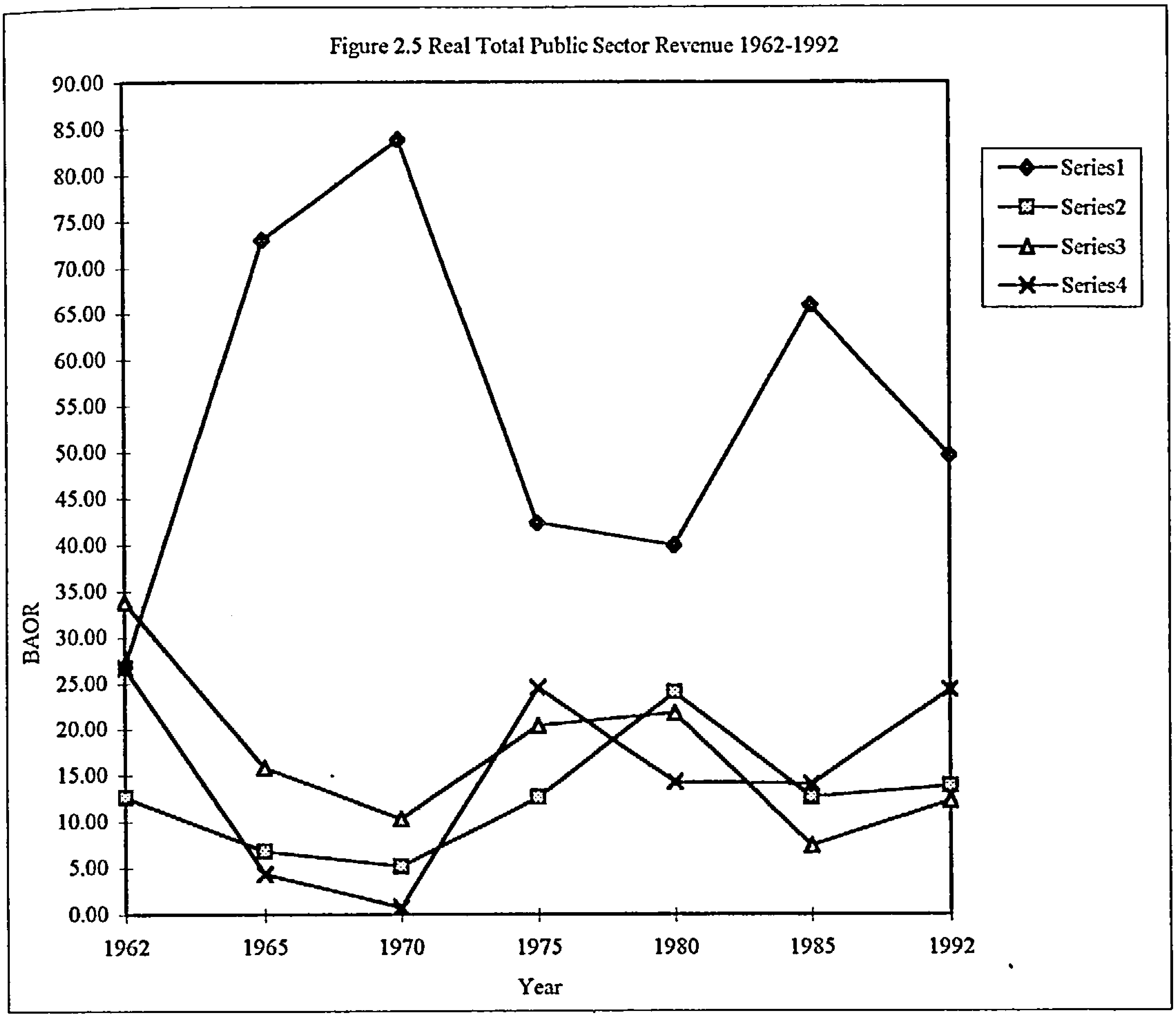
In the literature there are five different views of defining the public sector in the form of five questions (1) what resources does the government use? (2) How much does the government spend? (3) What does the government own? (4) What does the government control? And (5) What does the government produce? Much of the theoretical and empirical literature on public sector growth, however, has *concentrated on the second of these- public expenditure. This is partly because of the ease of measurement and availability of data via government and national accounts. However, it also reflects economists interest in the non-market aspects of the provision of goods and services to consumers via government expenditure rather than through the price mechanism (Gemmell, N: 1993, pp. 2, 4).*

The impact of government expenditure depends not only on the size of the public sector, but also on its activities. A large public sector may be helpful to growth if the activities are in areas of the economy where the market is weak (Gemmel, 1993).

Therefore, government expenditure is the main tool used by the government to affect the Libyan economy. Also, monetary policies, which control the money supply, would have a limited effect due to the absence of financial markets in Libya. However, oil revenue has been the main source for the government to finance its expenditure. We expect oil revenue and its fluctuations to have a great impact on government expenditure and macro-economic performance. The purpose of this section is to show the structure and growth of both government revenue and expenditure from 1962.

2.2.2.1-The Structure and Growth of Public Revenue

The discovering and exporting the oil in the late fifties and the early of the sixties had great impact on the government budget. The structure of total public sector budget revenue (TPSBR) can be classified into four groups; budget allocation from value of oil exports (BAOR), direct tax revenue (DTXR), indirect tax revenue (IDTXR), and other revenue (OTXR). By the fiscal year 1965 BAOR clearly came to dominate the government budget (see figure 2.5).



Series 1 BAOR is budget allocation from oil revenue. Series 2 DTXR is direct tax revenue. Series 3 IDTXR is indirect tax revenue. Series 4 OTXR is other tax revenue.

In that year allocations from oil revenue accounted more than 72 per cent of total domestic revenue. The budget allocation from oil revenue fluctuated through 1962-1992 as a result of changes in both oil prices and oil exports quantities (see table 2.4).

Table 2.4

Oil Production, Exports, Prices, and Oil Revenue 1962-1992

Year	OPR*	OEX*	OP**	VOEX***
1962	65.50	65.20	10.47	682.34
1965	445.30	442.4	10.47	4629.85
1970	1208.80	1206.80	11.95	14422.86
1975	540.10	522.30	13.33	6959.98
1980	669.80	619.80	10.47	6486.40
1985	365.40	325.20	14.45	4700.40
1992	565.30	476.30	10.80	5145.29

Source: LCB economic bulletin, Vol. VI, No, 3-4 Table 23, 1966.
LCB economic bulletin. Vol. XXIV, No, 1-3 Tables 36&37, 1984.
LCB economic bulletin, Vol. 36. No, 3-6 Table 33, 1996.
LCB economic bulletin. Vol. 31. No, 4-6 table 27, 1991.
International Financial Statistics, Yearbook, 1995.
Annual Economic Arab Report, table ¾, Sep, 1995.
* Million barrels.
** Libyan Dinar.
*** Million Libyan Dinar.
OPR is oil production, OEX is oil exports, and OP is oil prices.

BAOR share in total public sector budget revenue (TPSBR) reached its peak in 1970 when it was more than 83.0 per cent at 1980 prices. As a result of the policy in the early of 1970s to conserve oil, oil production was reduced, leading to a reduction in oil exports (OEX) and value of oil exports (VOEX) (see table 2.4). Therefore, the budget allocation from oil revenue (BAOR) in total public sector budget revenue (TPSBR) decreased to 40.0 per cent in 1980 (see figure 2.5).

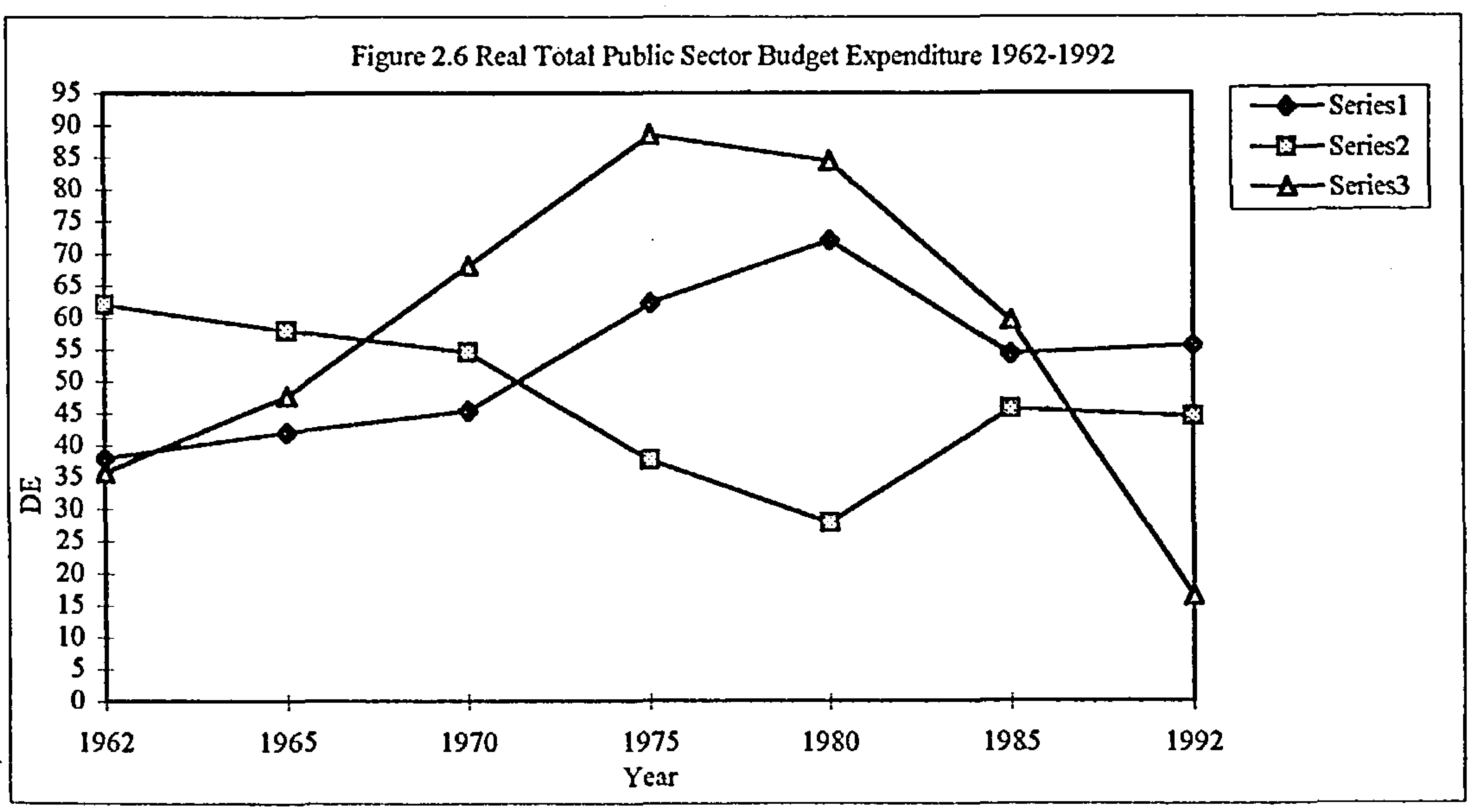
The increase in GDP per capita income (GDPPCI) since 1962 (see table 2.2) affected consumption patterns as a consequence of the boom in purchasing power after discovering oil, leading to an increase in the demand for goods and services by individuals. The increase of government revenue from exporting oil from 1962 to 1980 allowed the Libyan government to expand its expenditure on capital goods as well as consumption goods through the economic and social development plans. Because of low domestic capacity, the Libyan economy remained heavily dependent on foreign markets for supplying the demand for raw material and capital goods and consumption goods (see sub-section 2.2.4.1.2). Total imports (TIM) increased from 249.89 MLP in 1962 to 2055.9 MLD in 1980 in 1980 prices leading to an increase in indirect tax revenue (IDTXR) from 128.5 MLP in 1962 to 308 MLD in 1980 in 1980 prices (see figure 2.5). However, its share to TPSBR decreased to 10.3 per cent in 1970 as a result of the increase of BAOR share in TPSBR. As a result of the increase of total imports, the decrease of BAOR's share in TPSBR, and the new tax system, which was introduced in 1973, IDTXR's share in TPSBR increased to 21.8 per cent in 1980. The world recession in the 1980s affected the Libyan economy through the drop its income from oil, the value of imports decreased, and the share of IDTXR fell to 12.3 per cent in 1992 (see figure 2.5).

The third source of government revenue is direct taxes. Direct taxes were 12.7 per cent of TPSBR in 1962. The increase of budget allocations of oil revenue in the 1960s, resulted in DTXR's share in TPSBR decreasing to 5.19 per cent by 1970. Direct tax revenue depends on income levels. As a result of the new tax system, which was introduced in 1973, and the social and economic plans, both Libyan and non-Libyan labour increased (see sub-section 2.2.5) together, leading to an increase in direct tax revenue. Its share in TPSBR increased from 12.67 per cent in

1962 to 24.0 per cent in 1980. The large BAOR during 1983-1992 lead to a decrease in the share of DTXR in TSPBR to 13.8 per cent in 1992 (see figure 2.5). The share of other tax revenue (OTXR) in TPSBR decreased from 26.7 per cent in 1962 to 24.5 per cent in 1975, falling to 14.1 per cent in 1985. However, its share in TPSBR showed a slight increase during the period 1985-1992.

2.2.2.2-The Structure and Growth of Public Expenditure

During the period 1962-1992 the share of total public sector budget expenditure in non-oil gross domestic product (GDPN) increased to 84.5 per cent by 1980. The long-term pattern of public expenditure (TPSBE) as a share of GDPN for Libya is shown in figure 2.6.



Series 1 DE (development expenditure). Series 2 OE (ordinary expenditure).
Series 3 TPSBE (total public sector budget expenditure).

Public expenditure is dis-aggregated into two main groups: ordinary expenditure (OE) and development expenditure (DE). Ordinary public sector expenditure is administration expenditure, such as compensation of employees, purchases, and maintenance. Because all social services are free to residents, the social services sector (SSS) and other social services depend on the public budget to finance their expenditure. The share of ordinary public expenditure in total public sector budget expenditure decreased from 62.0 per cent in 1962 to 27.9 per cent in 1980 (see figure 2.6). This was due to the large public economic and social development expenditure by the government to improve living standards and to build an economy that could grow spontaneously.

Development expenditure (DE) is government investment in the various sectors to establish new economic and social projects, or to maintain or to improve the productivity of the current projects. The goal was to improve the living standards for the Libyan people and to change the structure of the economy by increasing the contribution of the non-oil sectors in GDP. The share of development expenditure in total public sector budget expenditure increased from 37.96 per cent in 1962 to 72.1 per cent in 1980 (see figure 2.6). However, because of the world recession in 1980s and as a result of the measures taken by industrialised countries aimed at reducing their dependence on OPEC oil, Libya's oil production and sale prices went down. The income from oil went down drastically as a result of this drop in prices and decrease in production. This loss of income affected the government's ability to continue its time trend pattern of expenditure. Consequently, development expenditure declined during 1986-1992 (see figure 2.6) and its share in total public budget expenditure (TPSBE) decreased to 55.6 per cent in 1992. As a result, ordinary expenditure has showed an opposite trend and reached 44.4 per cent of TPSBE in 1992 (see figure 2.6).

2.2.2.3-Public Debt

Because of the large allocation to finance the economic and social development plans through the 1970s, and due to the poor finance circumstances facing the Secretary of the Treasury during the 1980s as a result of the drop of oil income, the public budget ran a deficit in several years (see table 2.5).

Table 2.5

Summary of Real Government Revenue, Expenditure, and Public Debt

1962-1992

Million Libyan Dinar *At 1980 constant prices*

Year	TPSBR	TPSBE	S	PD	PD/GDPN%	GDPN
1962	380.29	305.91	-74.38	0.00	0.00	857.66
1965	1011.18	622.35	-388.82	0.00	0.00	1305.88
1970	2662.67	1490.78	-1171.89	0.00	0.00	2192.17
1975	1468.53	2850.46	1381.93	1045.31	32.48	3218.49
1980	1414.20	3401.60	1987.40	320.00	7.94	4028.10
1985	2915.42	2697.60	-217.81	492.25	10.86	4533.02
1992	2805.49	1134.62	-1670.88	1721.53	24.89	6916.48

Sources: Tables 2.8 and 2.10. LCB Economic Bulletin. Vol. XXIV. No, 1-3, Table 2 1984 And Vol., 26. No, 10-12 1986, and Vol., 36. No, 4-6 1996.

TPSBR is total public sector revenue. TPSBE is total public sector expenditure. S denoted to Surplus..PD is public debt. GDPN is non-oil sector output. Negative sign denoted to Deficit.

- refers to a surplus

In the literature, *in the public sector budget, any excess of public spending over public revenues must be financed by borrowing domestically, by borrowing abroad, by printing money or by running down the stock of official foreign exchange reserves. (Murinde; 1993:22).* In Libya, the Secretary of the Treasury borrows from the Libyan Central Bank (LCB) to finance the excess in expenditure. Therefore, public debt (PD) (its components are treasury bills and bonds, and credit facilities from LCB to the treasury), increased from 1.08 MLD at 1980 prices in 1971 to 1045.3 MLD in 1975 and to 1721.5 MLD in 1992, reaching 24.9 per cent of GDPN in 1992 (see table 2.5).

The large proportion of PD to GDPN is troublesome especially as most of it was used to finance ordinary expenditure, in particular in the years 1986-1990. The problem from using PD to finance ordinary expenditure and/or to finance the budget deficit is that the outlay does not generate any goods or services. Therefore, any increase of this PD will increase imports of goods and services, leading to (1) a deficit in the balance of payments and a decrease in overseas reserves abroad or (2) an increase in the domestic price level leading to a depreciation of the domestic currency, or both of these phenomena. These problems have faced the Libyan economy since the early 1980s (LCB, annual report, No, 37).

2.2.3.The Monetary Sector

The first impact of discovering and exporting of oil was on expenditure by corporations working in the country; the second was on government expenditure, which increased at the same time as oil revenue. As a consequence of the increase in government expenditure, the demand for goods and services increased, as also, due to oil corporations working in the country, did commercial banks deposits. This gave a chance for these banks to give the private sector suitable loans to establish commercial firms to produce and import goods and services to supply the increasing demand in the domestic market (Attiga, 1972). Because of this, commercial banks credits (CBC) increased from 16.21 MLP in 1962 to 2812.3 MLD in 1992 (see table 2.6).

Table 2.6

Money Supply and Factors Affecting It 1962-1992

Million Libyan Dinar *At current prices*

Year	CC	DD	Ms	FAN	*CBC*	dFAN	dMs
1962	15.12	13.98	29.10	0.00	16.21	-	-
1965	33.64	33.14	66.78	87.11	35.417	-	129.12
1970	112.28	128.80	241.08	571.86	96.198	556.48	261.01
1975	345.99	498.44	844.43	690.07	641.903	20.67	250.27
1980	682.27	2174.56	2856.83	4206.61	1321.21	509.59	238.31
1985	985.00	2507.20	3492.20	1926.50	2033.00	-54.2	22.24
1992	1982.20	3005.00	4987.20	1721.90	2812.30	-10.63	42.81

Source: Central Bank of Libya, Economic Bulletin, Vol. 6, No. 3-4. 1966. & Vol. XXIV, No. 1-3. 1984 & Vol. 26, No. 10-12. 1986 & Vol. 36, No. 6-4. 1996.

CC is currency in circulation. DD is demand deposits. Ms is money supply. FAN is a net foreign asset. CBC is commercial banks credit. d is denoted to change rate.

In the economics literature two definitions of money supply have been introduced. The money in the hands of the non-bank public (currency in circulation, CC) plus checking account balance (demand deposits, DD) in commercial banks. This definition of money supply is known in the literature as a narrow definition of money supply (M1).

M1 = CC + DD

The second definition of money supply is M1 plus time deposits and saving deposits. This definition is known as a broader definition of money called (M2). The narrow definition of money, M1, is the most widely used money supply concept. In the Libyan economy M1 is the usual measure of the money supply (Ms). Hence, M1 = Ms.

During the period 1962-1992 Ms increased from 29.10 MLP in 1962 to 4987.2 MLD in 1992 (see table 2.6). In an oil-based economy the factor responsible for the changes in money supply is net foreign assets (FAN). In Libya, FAN is monetary and commercial gold, cash and sight bills in foreign currency, foreign government and other securities, and balances with foreign correspondent. The increase of oil exports by 1970 lead to an increase in value of oil exports (VOEX) and as a result, FAN increased by 556.5 per cent compared with its level in 1965. This lead to an increase in money supply by 261.01 per cent compared with its level in 1965. As mentioned before, the conservative oil policy adopted by the Libyan government after 1971 to reduce oil production and exports meant that by 1975 FAN had increased only by 20.7 per cent compared with 1970. Together with the increase of DE's share in TPSBE in 1975 by more than 62 per cent (see figure 2.6) Ms increased by 250.3 per cent from its level in 1970 (see table 2.6). When oil prices increased for the second time in 1979 as a result of the Iranian crisis FAN increased by 509.6 per cent in 1980 compared with its level in 1975, again associated with the increase of DE in 1980, and leading to an increase in Ms by 238.3 per cent (see table 2.6).

The different measures taken by the industrialised countries to reduce oil consumption and the drop in oil prices at the beginning of the 1980s resulted in government oil revenue falling, and as a consequence, FAN declined in 1985 by 54.2 per cent compared with 1980, while money supply increased by only 22.2 per cent compared with 1980. By 1986, the ban on importing Libyan oil by the USA, together with the world economic recession, resulted in FAN in 1992 being 40.9 per cent of its level in 1980 (see table 2.6).

The money supply (Ms) in the Libyan economy consists currency out side of banks (CC) and demand deposits (DD) held by the public. By 1981 two actions had been taken by the monetary authority. The first was to replace old 5 and 10 Libyan dinar notes with new ones and the other was to restrict cash withdrawals from any one account to 500 dinar per month. Both these actions were aimed at absorbing liquidity from outside the banking system. As a result, CC in 1985 increased by 44.4 per cent compared with its level in 1980. In 1989, the Libyan economy witnessed other actions. The government permitted the private sector to practice in different economic activities without transferring any foreign currency to finance their importation of commodities.

As a result, the monetary authorities abolished the restriction on cash withdrawals. This lead to an increase in the money demand by the public for two reasons. First, businessmen bought foreign currency (from the black market of hard currency) to finance their importation of goods. The second, consumers financed their purchase of commodities and services in the domestic market. As a result CC in 1992 increased by 101.2 per cent and DD increased only by 19.9 per cent compared with their levels in 1985. The ratio of demand deposits to total money supply decreased to 60 per cent in 1992 compared with 71.8 per cent in 1985 (see table 2.6).

2.2.4.Foreign Trade and Balance of Payments

As a result of discovering oil there were increases in government revenue from oil, per capita income, and the standard of living, The increase in income generated a continuous growth in demand from both individuals and the government. Despite the great expenditure on development by the government, even by 1999 the country does not yet produce enough capital and consumer goods. It remains heavily dependent on the foreign sector for supplying consumption and capital goods for public and private needs as well as providing the funds to finance imports and the national development plans.

The trade balance (TB) analysis and the balance of payments (BOP) will be reviewed in this section.

2.2.4.1. The Balance of Trade Analysis

Before the discovery of oil the balance of trade suffered from a chronic deficit. *By 1963 because of oil exports Libya enjoyed for the first time in its history a favourable overall foreign trade balance. (Farely; 1971:30).* This was because of the increase in the value of exports. The trade balance reached a peak (13898.48) MLD in 1970 at 1980 prices (see table 2.7).

Table 2.7

Foreign Trade 1962-1992

Million Libyan Dinar *At 1980 constant prices*

Year	VOEX	OEXN	TEXP	ICG	IKRMG	TIM	TB
1962	682.34	451.27	1133.61	75.92	173.97	249.89	883.72
1965	4629.85	94.58	4724.44	141.53	295.33	436.86	4287.57
1970	14422.86	28.77	14451.63	334.55	218.60	553.15	13898.48
1975	6959.98	6.10	6966.07	685.66	1105.08	1790.74	5175.33
1980	6486.40	2.80	6489.20	1169.11	886.81	2055.93	·4433.27
1985	4700.40	95.00	4795.40	748.12	459.02	1207.14	3588.26
1992	5145.29	573.99	5719.28	870.76	289.96	1160.71	4558.56

Source: Abohobiel 1983. Foreign Trade of Arab Countries 1973-1984. No, 6 1986, and 1984-1994 No, 3 1995. VOEX is value of oil exports. OEXN is non-oil exports. TEXP is total exports. ICG is imports of consumer goods. IKRMG is imports of capital and raw material goods. TIM is total imports. TB is trade balance.

The conservative policy to reduce oil production and exports in the 1970s, the world recession in the 1980s, and the ban by the USA of imports of Libyan oil in 1986, together lead to a reduction in the TB surplus. The TB surplus in 1992 was only 32.8 per cent as its level in 1970 at 1980 prices (see table 2.7). However, the value of the balance of trade does not provide any idea about its composition.

Therefore, exports and imports will be analysed separately through the period 1962-1992.

2.2.4.1.1-Analysis of Libyan Exports

Libyan exports can be dis-aggregated into oil exports and non-oil exports. Table 2.7 shows that the value of total exports (TEXP) increased through the period 1962-1970 as did value of oil exports (VOEX). The share of value of oil exports in total exports was 99.96 per cent in 1980. In general, since 1965 value of oil exports never amounted to less than 90.0 per cent of total exports, and in several years its share was nearly 100 per cent. The value of exports has fallen since 1980 as a result of the world recession. It also fell sharply in 1987 and 1988, after the USA stopped importing Libyan oil in 1986. Therefore, oil exports had fallen in 1988 by 42.0 per cent from the 1980 value. Because of the Gulf war in 1991, oil exports in 1992 increased by 15.3 per cent compared with their level in 1985. Consequently, the total exports by 1992 had increased by 19.3 per cent compared with the level in 1985. This reflects the strong relation between oil exports and total exports.

2.2.4.1.2-Analysis of Libyan Imports

During 1963-1969 and as a result of the first economic plan, the demand for heavy machinery and transport equipment from abroad for development projects and for expansion in the oil industry increased. Furthermore, three economic and social plans (1970-72) (1973-75) (1976-80) were undertaken. Because of the low capacity of the Libyan economy, the country could not meet its needs from its own goods and services. It was not difficult for the country to import the goods required by the plans, as well as importing all kinds of consumer goods and of meeting security demands. However, the world recession in the 1980s reduced the income from oil and this affected the country's ability to continue to finance its high level of imports. Therefore, the government took austerity measures to balance its income and expenditure. The first measure *was to stop the importation of a number of commodities. It also started preparing what it called the "commodities budget " which was a sort of quota system for imported goods, including only those it considered "necessary"(Ghanem; 1985:226)*. The second was an emphatic policy to control foreign currency. These two measures aimed to balance the balance of trade and current transfers. As a result of those measures the value of total imports decreased gradually from 2055.93 million LD in 1980 to 1207.14 million LD in 1985 and to 1160.7 in 1991 at 1980 prices as table 2.7 shows.

Total imports can be classified into imports of consumption goods (ICG), imports of capital goods (IKG), and imports of raw material goods (IRMG).

TIM = ICG + IKG + IRMG

For estimation purpose, in chapter five IKG and IRMG are aggregated to give a single variable, imports of capital and raw material goods (IKRMG). Therefore, they are aggregated here as well. The two goods (ICG, and IKRMG) showed a continue growth through 1962-1980. The average annual growth rate during 1962-

1980 was 75.8 and 21.6 per cent per year for ICG, IKRMG respectively (see table 2.7). The high rate of population growth, improvement in the standard of living, and the low capacity of the commodity and the economic services sectors to meet the increasing demand for such goods, were the main factors causing imports of consumption goods to increase. The increase in capital and raw material goods can be attributed to the highly ambitious development programmes implemented by the government during 1962-1969, 1970-1975, and 1976-1980 and to the lack of such goods in the country. The world recession in the 1980s and the austerity measures taken by the government reduced the imports of ICG and IKRMG during the 1980s. In 1992 ICG was 74.5 per cent of its value in 1980 and IKRMG was 32.7 per cent compared with 1980. However, in 1992 ICG amounted 75.0 per cent of total imports (see figure 2.4).

2.2.4.2-The Balance of Payments

The balance of payments is divided into current account (CA), capital account (KAB), and net errors and omissions (EON).

BOP = CA + KAB + EON

The current account in the balance of payments can be divided into trade balance (TB), services and income balance (SIB), and net unrequited transfers balance (UTB).

CA = TB + SIB + UTB

The services and income balance components are investment income from abroad, and income from other services on the receipt side. On the payments side, its components are services and transfers from oil sector, shipping and insurance, travel and transportation, and other government services. Since the Libyan economy does not provide many services to the rest of the world, the services and income balance ran a deficit through 1962-1992. Because of the shortage of the Libyan labour, the Libyan economy depends on foreign labour. Therefore, the balance of unrequited transfers recorded a continuous deficit over the period 1962-1992. However, its deficit decreased sharply from -335.63 MLD in 1985 to -187.47 MLD in 1992 (see Table 2.8).

Table 2.8

Balance of Payments 1962-1992

Million Libyan Dinars *At 1980 constant prices*

Year	TB	UTB	KAB	EON	SIB	BOP
1962	883.72	-33.46	33.46	136.76	221.14	1241.62
1965	4287.57	16.52	-13.21	13.21	-2365.31	1938.78
1970	13898.48	-732.20	53.16	-622.46	-4082.85	8514.13
1975	5175.33	-173.66	-656.33	-265.85	-2462.35	1617.14
1980	4433.27	-335.80	-463.80	-63.80	-652.50	2917.37
1985	3588.26	-335.63	-47.76	-67.65	-732.37	2404.85
1992	4558.56	-187.47	184.35	18.36	-499.34	4074.46

Source: IMF Balance of Payments Vol. 21, 1962-69. Central Bank of Libya Economic Bulletin Vol. XIV No, 1-6, 1974. LCB. Economic Bulletin, Vol. XXIV, No. 1-3, 1984. LCB. Economic Bulletin. Vol. 25, No. 10-12 1985. LCB Economic Bulletin. Vol. 26. No. 10-12. 1986. LCB. Economic Bulletin. Vol. 31. No, 4-6. 1991. LCB Economic Bulletin Vol. 37. No. 4-6. 1996.

TB is trade balance. UTB is unrequited transfers balance. KAB is capital account balance. EON is net error and omissions. SIB is services and income balance. BOP is balance of payments.

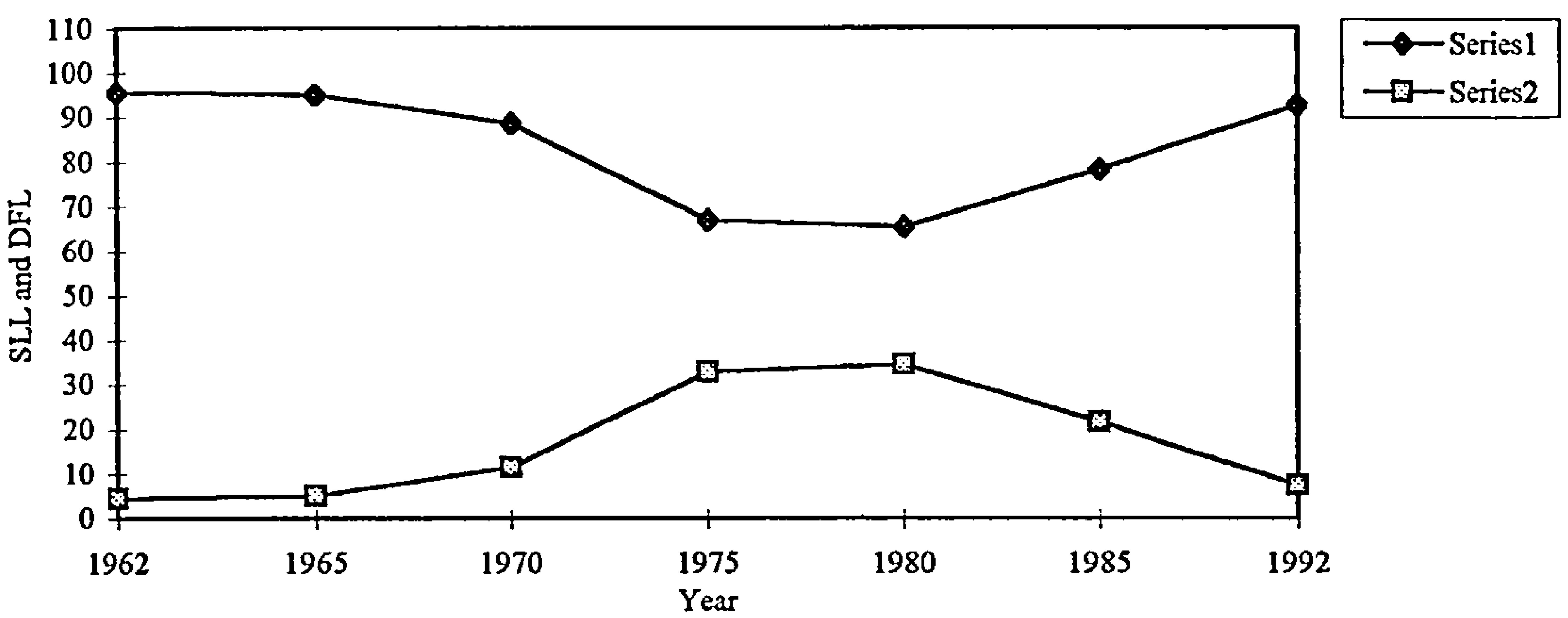
This is due to a decrease the non-Libyan employment (DFL) from 194.2 thousand in 1985 to 77.0 thousand in 1992 (see figure 2.7).

Table 2.8 summarises the balance of payments identity (BOP = TB + SIB + UTB + KAB + EON). The Libyan balance of payments is characterised by a surplus in most of the years during the period 1962-1992. In several years a considerable deficit appeared (see table 1, appendix 1). This was caused by a large increase in the deficits in SIB, UTB and KAB. Finally, the continuous decrease in UTB during 1985-1992 lead to a surplus in the BOP through the same period (see table 2.8).

2.2.5.Employment Sector

Libyan economic policy has aimed at increasing the gross domestic production from the various sectors so as to achieve self-sufficiency. Large amounts of money have been spent as development expenditure in the various sectors resulting in an increase in the demand for labour and capital goods. Libyan labour was only able to satisfy part of the required demand for labour. The solution was for Libyan planners to import labour from abroad. Therefore, during the period 1962-1985 the ratio of foreign labour to total employed labour increased from 4.5 per cent in 1962 to 34.4 per cent in 1980 (see figure 2.7).

Figure 2.7 Development of Libyan and Foreign Labour 1962-1992



Series 1 is SLL (supply of Libyan labour).
Series 2 is DFL (demand of foreign labour).

The fall in oil revenue at the beginning of the 1980s affected the labour market. The government imposed controls on transfers of foreign currency by foreign workers. The goal of such a policy is to balance the current transfers account. As a result, the share of non-Libyan employees to total employees went down to 21.7 and 7.4 per cent in 1985 and 1992 respectively.

Conclusion

This chapter discussed the characteristics of the Libyan economy since oil production started and has demonstrated the importance of oil for Libya. The Libyan economy was divided into five sectors, which will form the basis of the econometric model in chapter five. The economic and political events through the period 1962-1992 have been discussed and will need to be taken into account in the model. Furthermore, since 1962 the government has funded various development plans to improve living standards, to increase the contribution of the output of the non-oil sector of the GDP, to keep the inflation in a low rate, and to build an economy that could grow spontaneously. Despite different attempts at economic planning these ends have not achieved yet. The world recession and oil price crisis are the main factors, which have caused the government financial problems since the early 1980s. Hence it is important to create alternative sources of financing for the economic development plans.

In the economic literature there are different views regarding the impact of government expenditure on economic growth and the public sector growth. This will be the subject of the next chapter.

Chapter Three

Literature Review

3.0-Introduction

The goal of this study is to build an econometric model to examine the influence of government expenditure on the economic growth of the non-oil sector of the Libyan economy. In addition, it is to find the best way to finance this expenditure. This chapter is divided into three sections: The impact of government expenditure on economic growth and macro-economic performance will be reviewed in the first section. A theoretical analysis of public expenditure growth will be presented in section two, and the background to econometric modelling in section three.

3.1-The Impact of Government Expenditure on Economic Growth and Macro-Economic Performance

Two different views have been presented in this regard. The first (Ram, 1986, Bhat, Nirmala, and Kannabiran, 1994) is that large government size is likely to be an impediment to economic growth on account of (a) Government operations are often conducted inefficiently, (b) the regulatory process imposes excessive burdens and costs on an economic system, (c) fiscal and monetary policies tend to distort economic incentives and lower the productivity of the system, (d) government taxation may produce a misallocation of resources as well as disincentives.

The second view (Ram, 1986, Lin, 1994), is that large government size is more helpful for economic growth because (a) the government can play a role in harmonising the conflicts between private and social interests; (b) there is a prevention of exploitation of the country by foreigners; (c) productive investment will be high and will provide a socially optimal direction to growth and development; (d) the government can provide the economic infrastructure to facilitate economic growth and improve resource allocation; (e) government transfer payments can help to maintain social harmony and improve labour force productivity; (f) government expenditure on health and education can improve the quality of the labour force and productivity; (h) subsidies to targeted export industries can improve the trade balance and accelerate economic growth.

In this context, empirical investigations (Libya is not included in any of these studies) reveal conflicting results on this issue. Horowitz (1965) found a positive relation between the growth of gross domestic product (GDP) and the ratio of public expenditure to GDP for a sample of 64 developed (DCs) and less developed (LDC's) countries during the period 1952-1960. Ram (1986), using cross section and time series data on 115 countries, through the period 1960-1980 found a positive and significant effect of government expenditure on economic growth. This could well be stronger in lower income countries. Landau (1983), using cross section data for 104 countries observed that a larger government size, measured by the ratio of government consumption to GDP, depresses the rate of growth of per capita GDP. Barth and Bardy (1987), using time series data through the period 1971-1983 found a negative correlation between the growth rate of real GDP and the share of government consumption expenditure in GDP for 16 OECD countries. Landau (1985), and Marlow (1986), concluded that there was a negative correlation between the GDP growth rate and government expenditure. Barro (1991) analysed 98 countries for the time period 1960-1985. He found negative and significant relations between non-productive government service expenditure and annual growth rate of real per capita GDP. Lin (1994) used the rate of change in the share of government consumption in GDP as a proxy for government size, for a sample of 62 countries (20 were advanced developed countries ADCs, and 42 were LDCs). He found that non-productive government expenditure had a negative yet insignificant impact on ADCs economic growth in the short and intermediate run, while it had a positive but insignificant impact in the short run and negative insignificant impact in the intermediate run for LDC's. Bairam (1990) estimated the role of government expenditure on economic growth in twenty African countries. A framework based on conventional demand theory was tested using annual time -series data for the period 1960-1985. He found that in eleven African countries an increase in government expenditure had an adverse effect on economic growth. For the other nine countries under consideration an increase in government expenditure accelerates economic growth. Katz, Mahlar and Franz (1983) examined the impact of taxes on growth and distribution in 22 developed capitalist countries through the period 1970-1979. They observed no relation between these variables. While the size of the government is believed to be important in determining the rate of growth, the mixed empirical evidence suggests that other variables are relevant. The first of these that is considered is the government deficit, the difference between government revenue and expenditure. Barro (1991) opines that the influence of government debt on growth will be irrelevant. This may be because of the fact that the positive effect of the government debt on wealth should be exactly matched by the future tax liability necessary to service that debt (see, Martin and Fardmanesh, 1990 and Bhat et. al, 1994). Martin and Fardmanesh (1990) examined the impact of fiscal variables such as the ratio of taxes, government expenditure, and budget deficits to GDP on economic growth for 76 developed and developing countries for the period 1972-1981. They found a negative correlation between these fiscal variables and growth performance. The level of development (measured by income per capita) seemed to influence the linkage between fiscal variables and GDP growth. Dividing the sample into low, middle, and high-income countries, higher GDP growth was observed to be associated with smaller shares of taxes and larger shares of government expenditure in GDP in low-income countries. The magnitude of the budget deficits was found to be not important for these countries growth. In middle income countries, the budget deficit and taxes had negative effects on economic growth. On other hand government expenditure had a positive impact on economic growth. In high-income countries, the three fiscal variables had no significant association with the average rate of GDP growth during the sample period. However, in Martin and Fardmanesh's work it seems obvious that the level of income should be included as a variable, rather than splitting the countries into low, medium and high-income groups. Bhat, Nirmala, and Kannabiran (1994) examined the influence of fiscal variables such as the ratio of government expenditure, taxes, and deficits in state domestic product on the growth of real state domestic product of 22 Indian states. They found that the ratio of public expenditure to state domestic product had a negative influence on the growth of Indian states. In addition, the impact of the ratio of budget deficit to state domestic product is identified to be contradicting the Keynesian view. However, the real interest rate has competing impacts in relation to its effect on investment. Higher rates raise the cost of capital thus reducing the level of investment. Hence, at higher real interest rates, productive investment is crowded out. This does not apply for the Libyan case since the interest rate is being fixed by the government for long periods, and the private investment in the Libyan economy is negligible. Also, there is no Libyan private investment is crowded out because of the interest rate.

Table 3.1 shows a summary of the evidence on the links between size of government and growth. The table and the previous discussion indicate that there is no simple relationship between the size of the government and the rate of economic growth, and that the evidence is contradictory. The various studies cover different periods, different groups of countries, different combinations of variables and used different techniques of analysis, and what is needed is a more general theoretical model showing the link between size of government and growth.

Table 3.1

Evidence on the links

Between size of government and growth

Study	Period Sample	Relationship Found
Horowitz (1965)	1952-60 (64) (14 DC & 50 LDC)	Positive
Ram (1986)	1960-80 (115) (21 DC & 94 LDC)	Positive
Bairam (1990)	1960-85 (20 LDC)	Negative and Positive
Lin (1994)	1960-85 (62) (20 DC & 42 LDC)	N & P for DC, N for LDC
Katz and et. al (1983)	1970-79 (22 DC)	No Relationship
Landau (1983)	1960-77 (104) (20DC & 56 LDC)	Negative
Landau (1985)	1952-76 (16 DC)	Negative
Barth & Bardy (1987)	1971-83 (16 DC)	Negative
Marlow (1988)	1960-80 (19 DC)	Negative
Barro (1991)	1960-85 (98) (21 DC & 77 LDC)	Negative
Martin & Fardmanesh (1990)	1972-81 (76) (21 DC & 55 LDC)	Negative
Bhat et. al (1994)	1978-88 (22 Indian States)	Negative

DC = Developed Countries.
LDC = Less Developed Countries.
N = Negative.
P= Positive.

3.2-The Theoretical Analysis of Public Expenditure Growth

Public expenditure reflects the policy choices of government and represents the costs of carrying out of these policies. (Brown & Jackson; 1994: 118). Public expenditure can be classified into two categories of government activity. First, exhaustive public expenditure is those expenditures corresponding to the government's purchases of current goods and services such as labour, and capital goods and services such as Public sector investment in roads, schools, hospitals etc. Second, transfer expenditures, for example, public expenditures on subsidies, debt interest, pensions etc. *These expenditures do not represent a claim on the society's resources by the public sector as in the case of exhaustive public expenditure. Instead, transfers are a redistribution of resources between individuals in society (Brown & Jackson; 1994: 120).* Factors that affect one of these categories may not have the same impact on the other. To examine the growth of public expenditure and to know which factors influence the growth of public expenditures; it is helpful to keep the above two categories of public expenditure separate. (Brown & Jackson 1994).

The purpose of this section is to evince the theoretical analysis of public expenditure growth. Therefore, two types of model of public expenditure, which have been discussed in the literature, are considered. The first can be described as macro - models. These models begin with data on public expenditure in terms of broad aggregate variables such as GNP or the rate of inflation. The second class of models can be described as micro - models or decision process models of public choice. These micro-models attempt to explain the underlying micro - economic foundations of the decision processes that finally give rise to public expenditure. (Brown & Jackson, 1994). Therefore, the two models (Macro and Micro-models) of public expenditure are presented below.

3.2.1-Macro - Models of Public Expenditure

The purpose of the macro-models of public expenditure is to explain how the government has behaved over the long term. For example, they analyse the time pattern of public expenditure. In this regard they differ from short-run macro-economic forecasting models in their treatment of public expenditure, as the latter treat government expenditure as exogenously determined. Macro-models of public expenditure are classified into three groups: first, what can be described as development models of public expenditure growth; second, the model based on Wagner's law of expenditure for government activity; third, Peacock and Wiseman's classic models of public expenditure growth. (Brown & Jackson, 1994).

3.2.1.1-Development Models of Public Expenditure Growth

Musgrave (1969) and Rostow (1971) have adapted this approach. Musgrave distinguishes between three stages of economic growth and development: early stage, the middle stage, and the advanced stage of growth and development. Also he discriminates between government consumption and investment spending and transfers, and discusses how each expenditure may change at different stages of economic growth. He argues that in the early stages of economic growth, public sector investment forms a large share of total investment of the economy. Such investment covers social infrastructure, health, education, and other investment in human capital. This public sector investment is necessary to build up the economy to the following stage (middle stage). In the middle stage of economic growth and social development, subsequent rises in private investment serve to reduce the public share as incomes increase but a tendency for the share of total investment in GNP to rise helps to weaken the decline in the public investment/GNP ratio (Gemmell; 1993: 107).

Rostow (1971) argues that when the economy reaches the maturity stage spending will transfer from expenditures on infrastructure to increasing expenditure on education, health, and welfare services.

3.2.1.2-Theory of Public Choice

This model is based on Wagner's law of expanding state activity (Brown & Jackson, 1994). In the literature this is defined as the Demand Side Approach. Following Musgrave's (1969) interpretation, and referring to Wagner's law as the hypothesis that deals with the growth of the relative size of government activity in the national economy, one can write Wagner's law as the following: as real per capita income increases in an economy, the public sector grows in relative proportion. (Brown & Jackson 1994 and Mann, 1980). In Wagner's own words *the law of increasing expansion of public, and particularly state, activities* *becomes for the fiscal economy the law of the increasing expansion of fiscal requirements. Both the state's requirements grow and, often even more so, those of local authorities, when administration is decentralised and local government well organised. Recently there has been marked increase in Germany in the fiscal requirements of municipalities, especially urban ones. The law is the result of empirical observation in progressive countries, at least in our Western European civilisation; its explanation, justification and cause is the pressure for social progress and resulting changes in the relative spheres of private and public economy, especially compulsory public economy. Financial stringency may hamper the expansion of state activities, causing their extent to be conditioned by revenue rather than the other way round, as is more usual. But in the long run the desire for development of a progressive people will always overcome these financial difficulties. (Gemmell; 1993: 104).*

The foundation of Wagner's law was empirical observation. He had observed the growth of public activity in industrialising economics. This growth is associated with technological and institutional factors and political participation. According to Wagner, there are intrinsically three factors, which result in the growth in public activity. First, as the economy becomes more industrialised, the legal relationships and communications between the expanding markets and the agents in these markets become more complex. This complexity of the market interaction leads to a need for greater public regulative and protective functions of the government. Furthermore, the government needs to expand administration and law and order services and socio-economic regulation due to increased urbanisation and population densities and social conflicts, to allow the economy to continue to grow in an economically and socially efficient method. Secondly, in Wagner's view, public expenditure on education, relaxation, and culture and health and social welfare services would increase as a result of social progress. In other words social development would involve an increase in public goods, particularly for a more equitable distribution of resources. For Wagner public services such as education and other services presented above have high income-elasticity. Thus as real incomes in the economy increase public expenditure on these services would rise by more than unity, which would explain the expansion of the ratio of government spending to GNP. Thirdly, establishing new industries requires a large investment, which either is too much for the private sector to finance on an efficient scale or if it were it would result in private monopolies, which would not be socially acceptable. Wagner therefore, suggests (a) government intervention would be necessary to control such monopolies and (b) in some cases, growth of government intervention would not be in evidence of the growth public expenditure but in the establishment of public projects. (Brown & Jackson, 1994, Mann, 1980, and Gemmell, 1993).

Finally, Wagner noted some helpful elements for public sector growth. *(1) Wagner seems to have in mind the notion that the more society values a given government activity the more willing it will be to bear the necessary tax burden. In modern terms this implies that the value of a society's willingness to pay for public* *services (as reflected, for example, in an implicit tax price) is relevant for government expansion. (2) For similar reasons, the more efficiently public services are produced, the lower tax burdens can be for a given level of service. Here Wagner also highlights the significance for government growth of supplying income - elastic services; if these services meet social demands beyond 'basic needs' they will be more highly valued by society. Lastly, Wagner envisaged public enterprises as being commercially profitable and therefore able to contribute to exchequer funds; a prediction which, though never rigorously tested in the literature, seems unlikely to be one with much empirical support. (Gemmell; 1993: 106).*

3.2.1.3-The Time Pattern of Public Expenditure Approach

Peacock and Wiseman (1961) had adopted this approach. In the literature this analysis is known as a Supply Side Approach. The background of this analysis is the time pattern of public expenditure. The analysis basically depends upon a political theory of public expenditure determination. The three ''political '' propositions underlying Peacock and Wiseman's analysis are: *(a) governments like to spend more money, (b) citizens do not like to pay more taxes, (c) governments need to pay some attention to the wishes of their citizens. (Peacock and Wiseman; 1961:xxiii).* Therefore Peacock and Wiseman recognised that public expenditure can be influenced by the ballot box or reasonable burdens of taxation. They pointed that *when societies are not being subject to unusual pressures, people's ideas about tolerable burdens of taxation, translated* *into ideas of reasonable tax rates, tend also to be fairly stable. (Peacock and Wiseman; 1961: xxiv).* In their view, tax rates work as a constraint on government expenditure growth. As a consequence, *the limited revenue capacity of the government in peacetime prevents major increases in expenditure. (Henrekson; 1993: 54).* However, economic growth and thus income growth increases tax revenue at fixed tax rates, and therefore, public expenditure would grow in line with real output. In settled times, therefore, *public expenditure would show a gradual upward trend, even though within the economy there might be a divergence between what people regarded as being a desirable level of public expenditure and a desirable level of taxation. (Brown and Jackson; 1994: 124).* This divergence is likely to be narrowed by social upheaval, such as war, famine or some large-scale social disaster. Such disturbances create a need to expand public expenditure. In order to finance the expansion of public expenditure, governments would raise the taxation level. Therefore public revenue and expenditure would shift to new levels. The final result is that a new acceptable tax level emanates, and a new level of expenditure will continue even after the disturbance period. *Peacock and Wiseman referred to this as the displacement effect. Public expenditure is displaced upwards and for the period of the crisis displaces private expenditure. The process represents an upward shift in the trend line of public expenditure. Following the period of crisis, however, public expenditure does not fall to its original level. (Brown and Jackson; 1994: 124).* In general social disasters are not completely financed by taxation because taxpayers cannot stand the strain of such large burdens. Governments therefore borrow.*

*A related point concerns 'crowding out' discussed in section 3.1.

3.2.2.Micro - Models of Public Expenditure

The standard micro-economic model of public expenditure is based on public choice analysis. The purpose of such a model is to provide an explanation of the level of public expenditure and the growth of public expenditure. The political process is the key point of any explanatory model (Barr & Davis, 1966). The median voter's theorem model and pressure (interest) groups are used in the literature. Both the median voter's theorem and pressure groups are presented briefly below.

3.2.2.1-The Median Voter Model

The starting point for public choice analysis is based on demand for public expenditure is the median voter model of Dawns (1957). The major determinant of the demand for public goods and services is the relative prices of public and private goods and services, as recognised by the voter, the income of the voter, and the underlying tastes of the median voter (Mueller,1987) (Barr & Davis,1966). The static comparison between the level of public expenditure on goods and services would rise under the median voter model and the optimal level of public expenditure depends upon the details of the case. If public goods are produced under constant returns to scale, and if consumers have similar preferences, and they differ in their income. If the median voter's income is greater or less than the mean income, the aggregate level of public expenditure under the median voter model will be greater or less than the welfare-maximising level.

In the case of redistributive public expenditure, Meltzer and Richard (1978, 1981, 1983) presented a model, which presumes that all government activity consists of redistribution. This redistribution consists of a per capita lump-sum grant and a proportional income tax. The government is required to balance its budget. Individuals are assumed to differ only in their productivity (income). They assumed that income depends on a productivity factor and the tax rate is determined by the political process (Mueller, 1987). In this setting all individuals with income below the mean income will vote for higher taxes and more redistribution, so that when the mean income rises, taxes rise, and vice versa (Meltzer and Richard, 1981).

Finally, the median voter model concerning the relation between median and mean income, indicates that the public sector will be concerned with redistribution. The consequences do not provide the basis for a general theory of public expenditure determination. The median voter theorem postulates a one-dimensional space in which issues are decided by a direct vote of the citizen-voters (Mueller, 1987). The major public choice reaction to the failure of the simple median voter model is concerned with analysis of the revealing majorities associated with the operation of pressure groups.

3.2.2.2-Interest Groups

Tullock (1959) illustrates how government may become too large under majority rule. Becker (1983) has developed a model of the influence of interest groups (pressure groups) that is relevant to the level of the government expenditure. Becker is analysing the purely redistributive gains of interest groups. *The basic assumption of the analysis is that taxes, subsidies, regulations, and other political* *instruments are used to raise the welfare of more influential pressure groups (Becker; 373-374,1983).* Each group applies pressure to increase (reduce) its subsidies (taxes). The marginal cost of each group applying additional pressure just equals the marginal gain from reduced taxes or increased subsidies. *Competition among pressure groups favors efficient methods of taxation (Becker;386,1983).* Those groups that can be cheaply subsidised or are expensive to tax do better. In particular, *politically successful groups tend to be small relative to the size of the groups taxed to pay their subsidies (Becker;386,1983).* Becker's analysis is entirely couched in terms of taxes, subsidies, and regulations, as if all government activity were of a redistributive nature, one of the implications of the analysis is that the government provides public goods and alleviate externalities whenever the collective gains from these activities exceed the transaction costs of bringing them about. *Political policies that raise efficiency are more likely to be adopted than policies that lower efficiency (Becker;384,1983).* This proposition has broad implications for types of activities that are subsidised and taxed and for the types of interest groups helped and harmed (see Mueller 1987). Becker (1983) illustrates how interest group and government activities to be linked, also demonstrates that the expenditures and taxes that interest groups bring about have more than merely redistributive characteristics. *Groups whose interests have public good or externality attributes are more likely to be successful than those seeking pure redistribution. Groups whose productive activities have negative externalities are more likely to be taxed (Mueller;131-132,1987).* However, Mueller and Mueller

(1985, 1986) presented evidence that interest groups affect the size of government. Becker (1983) and Mueller and Mueller (1985, 1986) are essentially static, describing an equilibrium in which interest-group pressures are in balance, an equilibrium in which government is bigger than it would be in the absence of interest groups. However, Olson (1982) and Mueller (1984) have discussed the conditions favouring the growth of interest groups. If the number of effective interest groups in developed countries has grown since World War II, then, their growth could help to explain the relative growth of government. Hence, government growth and macroeconomic inefficiency would in turn be tied together.

3.3-The Econometric Background

The aim of this study is to construct a small macro-econometric model for the Libyan economy to investigate the influence of government expenditure on economic growth. In order to do this a basic econometric background is needed. As mentioned in chapter one the Johansen co-integration approach will be used to investigate the long-run relationships between exogenous and endogenous variables as well as the short-run relationships using the Error Correction Models (ECM). Also, a test is need to determine the maximum lag in a Vector Auto-regression (VAR) model and unit root test for the order of integration of variables is required for co-integration analysis. Therefore, this section presents the basic background for the concepts of vector auto-regression, stationarity, the co-integration approach, and error correction models respectively.

3.3.1-Vector Auto-regression Modelling

Vector auto-regression (VAR) models are reduced form time series models. The variables in these models are explained by their own past values in the system. Thus, ordinary least squares (OLS) is an efficient way to estimate each equation. To illustrate this, a simple VAR model to explain the two variables x and y is given by:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \alpha_3 y_{t-1} + \alpha_4 y_{t-2} + \varepsilon_{1t} \quad (3.1)$$

$$y_t = \beta_0 + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \beta_3 y_{t-1} + \beta_4 y_{t-2} + \varepsilon_{2t} \quad (3.2)$$

Where the ε_i are random errors which in general will be correlated. The general VAR model can be written as

$$\mathbf{Y} = \mathbf{A}_1 \mathbf{Y}_{t-1} + \ldots + \mathbf{A}_k \mathbf{Y}_{t-k} + \varepsilon_t \qquad \varepsilon_t \sim IN(0, \Sigma) \quad (3.3)$$

Where **A.** is an (n x n) matrix of parameters in the lag operator, **Y** is the vector of variables, and ε is a vector of random errors. The VAR model has been used widely in macro-econometric and finance since Sims (1980) presented his work as procedure to estimate dynamic relationships. Following Holden (1995), a general dynamic linear simultaneous econometric model can be written in the structural form

$$\mathbf{HY}_t + \mathbf{JX}_t = \mathbf{K}\varepsilon_{1t} \quad (3.4)$$

In this context Sims (1980) criticised the traditional economic modelling procedure. He *questions the validity of restrictions from economic theory, the arbitrary normalisation of equations, the imposition of lag patterns, and the assumptions concerning identification. Sims rejects conventional economic models in favour of an atheoretical reduced form-form approach based on VAR models. (Holden; 1995:162).* Also, Cooley and LeRoy (1985) criticised this approach, arguing that the atheoritical approach implies a particular economic structure that is difficult to reconcile with economic theory (Keating, 1992). As a result of these criticisms Bernanke (1986), Blanchard and Watson (1986) and Sims (1986) have further developed the atheoritical approach. This development suggests using economic theory to transform the reduced-form VAR model into a system of structural equations to determine what contemporaneous structural restrictions should be imposed. The results are the 'structural VAR'. *The crucial difference between atheoretical and structural VAR_s is that the latter yield impulse responses and variance decompositions that can be given structural interpretations (Keating; 1992:37).* Shapiro and Watson (1988) and Blanchard and Quah (1989), who use long-run properties to identify the economic structure from the reduced-form have proposed different structural VAR methods. *Such models have long-run characteristics that are consistent with the theoretical restrictions used to identify parameters. Moreover, they often exhibit sensible short-run properties as well. (Keating, 1992:37).*

3.3.2-Stationary and Non-stationary Time Series

In addition to the choice of estimation techniques for an econometric model, it is necessary to consider whether the time series variables are stationary or non-stationary. *The reason stationarity is important is because it is one of the basic assumptions made in modelling and forecasting (Holden and Thompson; 1992:76).* The non-stationarity of variables often leads to a problem of spurious regression. Stationarity is defined as the tendency of a variable to return to its mean value and fluctuate around it, while a non-stationarity series has a different mean at different points in time (Holden and Thompson, 1992, Moosa, 1992-1993, and Harris, 1995). Suppose, that a variable Y_t is generated by first-order auto-regression process.

$$Y_t = \alpha + \rho Y_{t-1} + u_t \qquad (3.5)$$

In the above equation the variable Y_t will be stationary if $|\rho| < 1$. If $|\rho| \geq 1$ Y_t will be non-stationary. The variable Y_t depends on last period's value Y_{t-1}, and an error term.

The variable Y_t is covariance stationary if:

1- $EY_t = \mu$, constant for all t.

2- Var. $Y_t = E(Y_t - \mu_t)^2 = \gamma_0 = \sigma_Y^2$, constant for all t.

3- Covar $(Y_t, Y_{t+n}) = E(Y_t, - \mu_t)(Y_{t+n} - \mu_t) = \gamma_n$, constant for all t (Thomas, 1993, Harris, 1995).

Thus, it is possible to conclude that a stochastic process is stationary if the mean, variance, and covariance of a series remain constant over time (Holden and

Thompson, 1992, Thomas, 1993, and Harris, 1995). Examples of possibly non-stationary series are the level of GDP and, the price level. Examples of series, which might be stationary, are the growth rate of GDP, the inflation rate, interest rates, and unemployment rate. It is clear that if the level of a series is non-stationary, the rate of change may be stationary. Hence, some non-stationary series can be transformed to be stationary by taking their first differences. For example, if Y is non-stationary the first difference

$$\Delta Y_t = Y_t - Y_{t-1} \quad (3.6)$$

may be stationary, or, the proportionate rate of change, which for $\log Y_t$ is

$$\Delta \log Y_t = \log (Y_t / Y_{t-1}) \approx (Y_t - Y_{t-1})/Y_{t-1} \quad (3.7)$$

may be stationary.

A stationary series is said to be integrated of order zero, I (0). If Y_t is non-stationary but its first difference is stationary Y is integrated of order one, I (1). In summary the series is integrated of order d, I (d) if it needs to be differenced (d) times to become stationary. *The number of times a variable needs to be difference in order to induced stationarity depends on the number of unit roots it contains (Harris; 1995:18).*

3.3.2.1-Testing for Stationarity

Since the stationarity of the data series is important in regression analysis, this should be tested before estimating the model. In this context, testing for unit roots (stationarity) has received a great deal of attention in the literature in the last decade.

In the literature, several methods of testing for the presence of unit roots (stationarity) in time series data have been introduced. These methods consider the null hypothesis that a series contains a unit root (it is non-stationary). Sargan and Bhargava (1983) introduced the Co-integrating Regression Durbin- Watson statistic (CRDW) based on the usual Durbin-Watson statistic (DW) to test the null hypothesis that a variable is stationary or a group of variables are not co-integrated. Phillips and Perron (1988) developed non-parametric (Z) tests based on Phillips (1987) paper which transform the test statistic to eliminate any auto-correlation in the model. Dickey and Fuller (DF) (1979, 1981) provide test statistics similar to the standard t tests but with different critical values. The most popular one are probably the basic DF and ADF tests because of their *simplicity or their more general nature (Harris; 1995:28)*. Thus, the next sub-section is addressed to provide the Dickey-Fuller methodology of testing for unit roots.

3.3.2.2.Dickey-Fuller Tests

Dickey-Fuller tests can be carried out by considered three regression specifications.

$$Y_t = \alpha Y_{t-1} + u_t \tag{3.8}$$

$$Y_t = \alpha_0 + \alpha Y_{t-1} + u_t \tag{3.9}$$

$$Y_t = \alpha_0 + \alpha Y_{t-1} + \gamma t + u_t \tag{3.10}$$

The three regressions differ according to whether the mean of the series is zero [as in (3.8)] or the mean is not-zero [as in (3.9)] or the mean is not-zero and a time trend, t is included [as in (3.10)]. The tests involve estimating whether the value of α is equal to one, or less than one. If $|\alpha|$ is one (or greater than 1) the Y series is not stationary, if $|\alpha|$ is less than one the Y series is stationary. (Holden & Thompson, 1992; 12-13).

Considering a series described by equation (3.8), Y is to be stationary only if $-1<\alpha<+1$. If it is not, Dickey and Fuller (1981) suggested some transformations to remove the complication of non-stationarity. Now, (3.8) can be re-written as

$$Y_t - Y_{t-1} = (\alpha - 1)Y_{t-1} + u_t \qquad (3.11)$$

Suppose $(\alpha - 1) = \beta$. Equation (3.11) can be re-parameterised as follows

$$\Delta Y_t = \beta Y_{t-1} + u_t \qquad (3.12)$$

In the case of the above equation, two general tests are defined: the Dickey-Fuller test and the Augmented Dickey-Fuller (ADF) test*. The DF test involves estimating the above equation and testing if β is zero. It is only valid if the residuals from the above equation are free from auto-correlation. If auto-correlation is present, the introduction of lags of the first difference of the series on the right hand side of the above equation is required to remove it. This gives the ADF test. In both tests the significance of the "t" statistic on the Y_{t-1} variable is checked by comparing it with the appropriate value in special tables provided by Fuller (1976) and Dickey and Fuller (1981). In the similar way (3.9), (3.10) can be re-

*The tests cover the case of I(1) and I(0) variables. While I(2) and I(3) variables sometimes occur, the most common cases are I(1) and I(0).

parameterised to

$$\Delta Y_t = \alpha_0 + \beta Y_{t-1} + u_t \tag{3.13}$$

$$\Delta Y_t = \alpha_0 + \beta Y_{t-1} + \gamma t + u_t \tag{3.14}$$

Thus, three specifications of DF and ADF tests are defined τ, τ_u, and τ_t, in which the τ statistic is relevant for the regression with no intercept and time trend, τ_u with just the intercept, and τ_t with both intercept and time trend (Dickey and Fuller, 1981).

3.3.3-The Co-integration Concept

The importance of stationarity had been well recognised for many years. Wold's (1938) theorem states that a stationary time series process with no deterministic components has an infinite moving average (MA) representation. In general, this can be represented by a finite auto-regressive moving average (ARMA) process. (Box and Jenkins, 1970, Hannan, 1970). However, as mentioned in section 3.1. Some economic time series need to be differenced in order to achieve stationarity. Hence, Engle and Granger (1987) introduced a definition of integration: *A series with no deterministic component which has a stationary, invertible, ARMA representation after differencing d times, is said to be integrated of order d, denoted $x_t \sim I$ (d). (Engle and Granger;1987:253).* Thus, a time series integrated of order zero I (0) is stationary in its level while a time series integrated of order one I (1) is stationary in its first differences. Examples of time series integrated of order zero I (0) are a white noise series, and a stable first order auto-regressive [AR (I)] process. A random walk process is an example of time series integrated of order one I (1). (Dolado & al, 1990). The differences between series integrated of order zero I (0) and order one I (1) have been recognised and discussed by Engle and Granger (1987). *They pointed out that an I (0) series (i) has finite variance which does not depend on time, (ii) has only a limited memory of its past behaviour (i.e. the effects of a particular random innovation are only transitory), (iii) tends to fluctuate around the mean (which may include a deterministic trend), and (iv) has autocorrelations that decline rapidly as the lag increases. For the case of an I(1) series, the main features are (i) the variance depends upon time and goes to infinity as time goes to infinity, (ii) the process has an infinitely long memory (i.e. an innovation will permanently affect the process), (iii) it wanders widely, and (iv) the autocorrelations tend to one in magnitude for all time separations. (Dolado et al;1990:251)*. Now consider two time series y_t and x_t both I(d). It is normally true that any linear combination of the two variables (y and x) will also be I(d). *More generally, the addition or subtraction of two series integrated to different orders will result in a third series which is integrated to the same order as the more highly integrated of the two original series. This because the variance of the higher order series will dominate that of the lower order series. (Holden and Thompson;1992:7)*. If, however, there exists a vector β, such that, the combination

$$u_t = y_t - \beta x_t \qquad (3.15)$$

is of a lower order of integration, I(*d-b*), where *b*>0, Engle and Granger (1987) define y_t and x_t as cointegrated of order (*d, b*) and denoted CI(*d, b*). The most common cases are $d = 1$ and $b = 1$ but other cases might arise. Here β is the constant of cointegration and in the case of more than two variables it becomes the cointegration vector. The above discussion can be summarised in Engle and Granger's (1987) own words:

Consider $z_t = \alpha^1 x_t$

The components of the vector x_t *are said to be co-integrated of order d,b, denoted* $x_t \sim CI(d,b)$, *if (i) all components of* x_t *are I(d); (ii) there exists a vector* $\alpha \neq 0$ (0 is a *vector) so that* $z_t = \alpha^1 x_t \sim I(d-b)$, $b>0$. *The vector* α *is called the co-integrating vector (Engle and Granger;1987:253).* Consequently, the co-integration concept specifies the existence of a long run equilibrium to which an economic system converges over time. Thus, u_t in equation (3.15) can be interpreted as the equilibrium error (Dolado et al, 1990, and Holden & Thompson, 1992).

3.3.3.1-Testing for Co-integration

Several statistical tests have been developed to test for co-integration in time series. Dickey and Fuller (1981), Sargan and Bhargava (1983), Engle and Granger (1987), Stock and Watson (1988), and Johansen (1988) have suggested alternative tests and methods for testing and estimating the co-integration vectors. Surveys of this literature include Dolado el al, 1990, Holden & Thompson, 1992, and Muscatelli & Hurn, 1992.

Given two I (1) series, y_t, x_t one test for co-integration is to estimate (3.15) in the form

$y_t = \alpha + \beta x_t + u_t$

By ordinary least squares and test if u is I (0) by means of the Dickey-Fuller test. This involves estimating

$\Delta u_t = \alpha_0 + \beta_0 u_{t-1} + \varepsilon_t$

where ε is white noise. The second test for stationarity is on the size of β_0. If there is co-integration then Engle and Granger (1987) suggest a two-step method, which determines u as above in the first step. The second step is to test u for stationarity since they are the residuals of the co-integration regression. If the residuals are stationary, the variables in the co-integration regression are co-integrated.

The Engle and Granger (1987) two-step method is valid only if the co-integration vector is unique which will be the case with two variables when economic theory suggests y depends on x. However, real world economic relationships are complicated, and theoretical relationships frequently include more than two variables. Thus, the property of uniqueness may be lost, and more than one co-integration vector is possible. Johansen (1988) proposed a method to identify the maximum number of co-integration vectors in a multivariate framework. As mentioned in section 1.5 the Johansen (1988) method will be used to investigate whether any stable, long-run relationships exist between exogenous and endogenous variables of the model. Therefore, brief discussion of this method will be the subject of the following sub-section.

3.3.3.2-The Johansen (1988) Method

The approach presented by Johansen (1988) serves two purposes. First, to determine a maximum likelihood estimator of the co-integration vectors for an auto-regressive process. Second, to propose a likelihood ratio test for the hypothesis that there are a particular number of co-integration vectors. The advantage of this method is that it takes into account the error structure of the underlying process. The Johansen procedure is as follows. The auto-regressive representation of X_t is

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \ldots + \Pi_k X_{t-k} + \varepsilon_t \qquad t = 1,2 \qquad (3.16)$$

Where X is a vector of variables (X_t is integrated of order I (1), such that ΔX_t is stationary), k is the maximum lag, and ε is a vector of error term. Following Johansen (1988) and Johansen and Juselius (1990) equation (3.16) can be written as an error correction model as in the following;

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \varepsilon_t \qquad (3.17)$$

Where

$$\Gamma_i = -(I - \Pi_1 - \ldots - \Pi_i) \qquad (i = 1, \ldots\ldots k-1), \qquad (3.18)$$

Note that (3.16) is an unrestricted vector auto-regression (VAR) and is a reduced form rather than a structural equation. In equilibrium the time subscripts and the error term can be ignored and the coefficients on X in (3.16) can be written.

$$\Pi = I - \Pi_1 - \ldots - \Pi_k \qquad (3.19)$$

Where Π *is the matrix of cointegrating vectors.*

The matrix Π should not have full rank. The rank r, is known as the order of co-integration (or the co-integration rank), and is equal to the number of distinct co-integration vectors amongst the variables in X. If n, the number of variables is 2, and the variables are co-integrated there are can be only be a unique co-integration vector. If n > 2, this is not the case. In order to illustrate this, Holden and Thompson (1992) consider a simple two variables dynamic model with the maximum lag 2.

$$Y_t=\Pi_{11}Y_{t-1}+\Pi_{12}Z_{t-1}+\Pi_{13}Y_{t-2}+\Pi_{14}Z_{t-2}+\mu_1+\varepsilon_{1t} \quad (3.20)$$

$$Z_t=\Pi_{21}Y_{t-1}+\Pi_{22}Z_{t-1}+\Pi_{23}Y_{t-2}+\Pi_{24}Z_{t-2}+\mu_2+\varepsilon_{2t} \quad (3.21)$$

Y and Z are assumed to be integrated of order I (1). In order to test whether the above two equations are co-integrated, one can rewrite them in error correction form as following;

$$Y_t-Y_{t-1}=(\Pi_{11}-1)Y_{t-1}+\Pi_{12}Z_{t-1}+\Pi_{13}Y_{t-2}+(\Pi_{12}-\Pi_{12}+\Pi_{14})Z_{t-2}+\mu_1+\varepsilon_{1t} \quad (3.22)$$

or

$$\Delta Y_t=-(1-\Pi_{11})Y_{t-1}+\Pi_{12}\Delta Z_{t-1}+\Pi_{13}Y_{t-2}+(\Pi_{12}+\Pi_{14})Z_{t-2}+\mu_1+\varepsilon_{1t}$$

$$=-(1-\Pi_{11})\Delta Y_{t-1}+\Pi_{12}\Delta Z_{t-1}-(1-\Pi_{11}-\Pi_{13})Y_{t-2}+(\Pi_{12}+\Pi_{14})Z_{t-2}+\mu_1+\varepsilon_{1t} \quad (3.23)$$

and similarly for (3.21)

$$\Delta Z_t=\Pi_{21}Y_{t-1}-(1-\Pi_{22})Z_{t-1}+(\Pi_{21}-\Pi_{21}+\Pi_{23})Y_{t-2}+\Pi_{24}Z_{t-2}+\mu_2+\varepsilon_{1t}$$

$$=\Pi_{21}Y_{t-1}-(1-\Pi_{22})\Delta Z_{t-1}+(\Pi_{21}+\Pi_{23})Y_{t-2}-(1-\Pi_{22}-\Pi_{24})Z_{t-2}+\mu_2+\varepsilon_{2t} \quad (3.24)$$

In this case Π, the equilibrium matrix, can be written as

$$\Pi = \begin{bmatrix} -(1-\Pi_{11}-\Pi_{13}) & (\Pi_{12}+\Pi_{14}) \\ (\Pi_{21}+\Pi_{23}) & -(1-\Pi_{22}-\Pi_{24}) \end{bmatrix}$$

The matrix Π has rank r, where r<p (p is the number of equations). Johansen and Juselius (1990) and Holden and Thompson (1992) discuss three possible cases related to the information about long run relationship between the variables in the data vector. In other words, related to the rank or number of independent rows or columns of Π:

(i) Rank (Π) = 0. In this case Π is the null matrix, this reduces (3.17) to

$$\Delta X_t=\Gamma_1\Delta X_{t-1}+\Gamma_2\Delta X_{t-2}+\ldots+\Gamma_{k-1}\Delta X_{t-k+1}+\varepsilon_t \quad (3.25)$$

which is a VAR model in first differences. Because both of the two time series (Y, Z) are integrated of order one, I (1), ΔX is integrated of order zero, I (0), and there is no co-integration.

(ii) Rank (Π) = 1 implying that, there is one independent row and the determinant of Π is zero or

$$(I-\Pi_{11}-\Pi_{13})[I-\Pi_{22}-\Pi_{24}]-(\Pi_{12}+\Pi_{14})(\Pi_{21}+\Pi_{23})=0 \quad (3.26)$$

(ii) Rank (Π) =2. In this case the matrix Π has full rank indicating that the vector X is stationary. This contradicts the assumption that Y and Z are I (1). Hence, ΔX is over-differenced and the correct model would be in levels rather than in first differences.

Thus, at least one of the elements of Π must be $\neq 0$. Each of the terms in brackets in (3.26) is the long-run relationship or equilibrium coefficient on the data vector (on Y or Z) in (3.23) or (3.24). Accordingly, at least one of their variables must be included in the equilibrium relationship. In the above example,, where the rank is one, there are only two variables, and there can only be one co-integrating vector.

In general, if rank (Π) = r there are r cointegrating vectors. Hence, it is possible to express Π as

$$\Pi = \alpha\beta' \quad (3.27)$$

for suitable p x r matrices α and β, where β represents the matrix containing the r co-integration vectors, and α [the "loading" or "adjustment"] represents the matrix of weights, and can be given an economic interpretation in terms of the speed of adjustment.

However, it is not possible to estimate the elements of the matrices α and β directly by using standard estimation methods since they are not identified. Johansen (1988, 1989) uses the maximum likelihood method to obtain an estimate of the space spanned by β from the r largest canonical correlation coefficients between the residuals of X_{t-k} and ΔX_t obtained from regressing these variables on their lagged differences.

The Johansen procedure may be applied, first, by regressing ΔX on its lagged differences giving the residuals R_{0t} and then regressing X_{t-k} on its lagged differences giving the residuals R_{kt}.. To estimate Π by maximum likelihood, one can use OLS to estimate the following regressions.

$$\Delta X_t = \Gamma_{01}\Delta X_{t-1} + \ldots + \Gamma_{0k-1}\Delta X_{t-k+1} + R_{0t} \quad (3.28)$$

and

$$X_{t-k} = \Gamma_{11}\Delta X_{t-1} + \ldots + \Gamma_{1k-1}\Delta X_{t-k+1} + R_{1t} \quad (3.29)$$

and define the product moment matrices of the residuals as

$$S_{ij} = T^{-1} \sum_{t=1}^{T} R_{ij} R'_{ij} \qquad i,j = 0,1 \qquad (3.30)$$

The likelihood ratio (LR) test statistic for the hypothesis that there are at most r co-integration vectors is

$$-2\ln(Q) = -T \sum_{i=r+1}^{p} \ln(1-\lambda) \qquad (3.31)$$

Where $\lambda_{r+1} \ldots \lambda_p$ are the p-r smallest squared canonical correlations.

The statistic in (3.31) is called the Trace statistic. An alternative LR statistic, given by

$$-2\ln Q_{r|r+1} = -T\ln(1-\lambda_{r+1}) \qquad (3.32)$$

this called the Maximal eigenvalue statistic. The percentiles distribution for both the trace and the maximal eigenvalue statistics are tabulated in Johansen and Juselius (1990; table A2: 208) using simulation analysis.

Under the hypothesis that there are at most r co-integrating vectors, Johansen (1988) provides the critical values of the likelihood test for r up to 5. He also states that the quantiles can be obtained by approximating the distribution by $c\chi^2$ (f) for suitable values of c and f. By equating the mean of distributions based on 10,000 observations to those of cX^2 with $f=2m^2$ degrees of freedom, values of c are obtained $c = 0.85-0.85/f$,

Where X^2 is a central chi-square distribution with $f= 2(p-r)^2$ degrees of freedom.

3.3.4-Estimation of Error Correction Models

Estimating the long run of the co-integration relationships is the first step for estimating the complete model. The short-run structure of the model also needed. Engel and Granger (1987) present a theorem (it is called the Granger representation theorem) that, if two variables are integrated of order one I(1) and are cointegrated *CI*(1, 1), then an error correction model (ECM) exists. For ease exposition one can assume that the co-integration regression has the following form

$$Y_t = B_0 + B_1X_t + B_2X_{2t} + \ldots\ldots + B_nX_{nt} + u_t \qquad (3.33)$$

the estimated value of the dependent variable Y is given by

$$Y_t = b_0 + b_1X_t + b_2X_{2t} + \ldots\ldots\ldots + b_nX_{nt} + Z_t \qquad (3.34)$$

In this case the ECM is given as follows

$$\Delta Y_t = \theta_0 + \theta_1 Z_{t-1} + \Sigma\theta_2\Delta X_{t-j} + \Sigma\theta_3\Delta Y_{t-j} + \varepsilon_t \qquad (3.35)$$

$$Z_t = Y_t - b_0 - b_1X_t - b_2X_{2t} - \ldots\ldots - b_nX_{nt} \qquad (3.36)$$

where Δ denotes the first difference (i.e.Y_t - Y_{t-1}), Z is the residual from (3.34), θ_I are parameters, and ε is a vector of random variables with mean zero and variance σ_ε^2. The ECM shows that changes in Y_t depend not only on changes in X_t but, also on the extent of disequilibrium between the levels of Y and X as measured by Z. If Y is above its

equilibrium value in (3.34) for the given values of X, X_2, ...X_n, then from (3.36) Z will be positive, and since in (3.35) θ_1 is expected to be negative, the net effect of the Z term in (3.35) will be to reduce ΔY so that Y moves back towards the equilibrium value. That is, the "error" at time t-1 is partially "corrected" at time t, with the extent of the correction being determined by the sizes of θ_1 and Z. Estimation of (3.35) is by the "general to specific" procedure of Hendry (see Davidson et al. 1978) where enough lags are included in (3.35) to make ε random. The error correction model (ECM) based on the co-integration tests using the Johansen method will be estimated to give the short run dynamics of the Libyan economy.

3.4. Conclusions

The impact of government intervention in the economic activities on economic growth, is the subject of controversy. Empirical studies (presented in section 3.1), have examined the impact of the fiscal policy variables such as the tax ratio, government expenditure, and the budget deficit on economic growth, with contradictory results. These different results may be due to (a) different measures of the size of the government, and/or (b) different degrees of economic growth of the countries under consideration. Consequently, the results suggest that the effects of fiscal policy variables on economic growth differ from one country to an other and hence they cannot be generalised. However, in the literature, there are no empirical studies examining the effect of government expenditure on economic growth for an oil producing country. Recently, most of the oil producing countries have run a budget deficit following the collapse of oil prices in 1982. These countries are now faced with the problem of how to finance their expenditure. This is to be examined using the model to be presented in chapter five. It is clear from the above discussion that government expenditure is important especially for LDC's. The subject has never been examined for the Libyan economy. Direct assessment of this issue is the subject of this study.

Macro-models of public expenditure are classified into (1) development model of public expenditure growth, (2) the model based on Wagner's law of expenditure for growth, and (3) Peacock and Wiseman's classic models of public expenditure growth. The conclusion is that public policy influences the economic activity. Median voter theorem models and interest (pressure) groups are used in the literature as micro-models or decision process models of public choice. However, the possible interrelationships of interest groups, government growth, and macroeconomic performance remains unexplored.

Public sector economics examines the relationships between public expenditure, the financial methods, and the behaviour of different sectors. However, the market system especially in developing economics does not bring high employment, price stability, and desired rate of economic growth. Public policy is needed to secure these goals. Therefore, this study concentrates on macro-economic policy in examining the macro-relationships of the public sector. This includes the revenue and expenditure measurements of the public budget (see chapter five).

This chapter has also reviewed some recent econometric techniques, which will be used to estimate a model in chapter 6. First, however, some of the previous models, which have been built for the Libyan economy, are revised in chapter four.

Chapter Four

Review of Economic Models of the Libyan Economy

4.0-Introduction

During the last three decades several models have been built for the Libyan economy. Most of these investigate the influence of the oil sector on the economic growth of the economy. This chapter reviews a selection of empirical studies of the Libyan economy. The models discussed below are by Baryun (1980), Abohobiel (1983), Abosedra (1984), and Mohamed (1998). In sections 4.1-4.4 descriptions of these models are provided and, since most critical comments apply to more than one model, the criticisms are included in section 4.5.

In terms of basic philosophy, Baryun's model is monetarist and Abohobiel's; Abosedra's and Mohamed's models are Keynesian. The notation used is as in their original models to help the readers if they return to the original studies.

The main goal of the present study is to construct a macro-econometric model to investigate the influence of government expenditure on economic growth on the one hand and the appropriate way to finance these expenditures on the other hand. *An econometric model is a complex structure so considerable simplification is necessary to summarise the mass of detail coherently (Thompson;5; 1988).* Consequently, this chapter discusses the public finance and the monetary sectors relations of these models to give same guidelines to the approàches they adopted.

4.1- Baryun (1980) Model

According to Baryun (1980) oil exports amounted to 99.9 per cent (in 1980) of total exports of Libya and foreign assets are earned only from oil exports. Libyan currency issued is not less than 90 per cent backed by foreign currency and gold. The money supply can be expected to reflect those changes in the net foreign assets, which are shown in the balance of payments. Also, since the government dominates the production and export of oil, government deposits are the only source of foreign exchange to the Libyan Central Bank. The money market in Libya is very limited and money supply is affected only when the government starts spending its revenue. (In spite of the influence of public policy on economic activity through the monetary sector, Baryun's model does not estimate the relations of the public sector). So the money supply in Libya can be related to the surplus or deficit of the balance of payments. Baryun's study was concerned with the problem of whether the money supply can influence prices and output in Libya on the one hand, and its influence on the balance between income and expenditure on the other. Therefore a monetary macro-econometric model was constructed using annual data for 1962-1977. Notice that the move of the economy towards socialism was from 1975, which was towards the end of Baryun's data period. The model contains twenty-one equations, of which nine are behavioural equations. The model was estimated by both the ordinary least squares (OLS) method, and the two-stage least squares (2SLS) method in linear and log-linear forms.

The model divided the Libyan economy into a monetary sector, real sector, and the balance of payments.

4.1.1-The Monetary Sector

The monetary sector was divided into three parts: Demand for money, prices, and money supply.

4.1.1.1-Money demand

The demand function of money was based on Klein's (1974) model, and it was modified to be appropriate for the Libyan case. The demand for money function for Libya was defined as follows:

$(M/P)^d = f(Y/P, RM, RS, (RG \text{ or } T), (M/P)^d_{-1}, DR, D76)$ (4-1)*

The expected signs are: f1, f3, f5, f6>0, f2, f4, and f7 <0 Here $(M/P)^d$ is demand for real money balances, (Y/P) is real income, RM is the price of the monetary services stream from a unit of money, or it is the own price of money. RS is the rental price paid for the monetary service stream from a unit of money substitutes, or it is the cross price of money. The rate of interest in Libya has been fixed since 1963, so it was not appropriate to be taken as a proxy explanation in the demand money function. Actual development expenditure RG was used as a proxy for the technological change variable, and as it was not appropriate in some cases, a time trend (T) was considered. The importance of this variable was to avoid

* The use of f(...) notation in specifying an equation usually indicates a linear or log-linear formation so that f_1, f_2,...are coefficients.

the interdependence between the opportunity cost of holding money and the technological change variable, and to introduce stability into the money demand equation. Two dummy variables (DR and D76) were used to capture the impact of the economic and social system changes which arose with the first September revolution 1969, and the government nationalisation of buildings and houses late in 1975 respectively. DR=1 for 1969-1977 and zero otherwise, D76=1 for 1976-1977 and zero otherwise. The demand for money function was dis-aggregated into real demand for currency (RCC), real demand for demand deposits (RDD) and real demand for time and saving deposits (RTS). These functions were as follows:

$$RCC = f(RER_{-1}, RS, (T \text{ or } RG), DR, D76, RCC_{-1}) \quad (4\text{-}2)$$

$$RDD = f(RY, RM, RS, RDD_{-1}, DR, D76, RG) \quad (4\text{-}3)$$

$$RTS = f(RY, T, D76, RTS_{-1}) \quad (4\text{-}4)$$

Where RER_{-1} is real total transactions lagged one year, RY is real gross national product, and all the other variables as defined above.

4.1.1.2-Money Supply

The money supply is influenced by three factors: (1) the Central Bank has some control over the monetary base, and some control over the value of commercial bank reserves, (2) the commercial banks are hypothesised to have a desired relationship between reserves and deposits, and hence they may determine the reserves - deposits ratio (R/DD), (3) the non banking public is hypothesised to have a desired relationship between currency and commercial banks deposits, and hence the public controls the currency - deposits ratio (CC/DD). The money supply was affected through the two ratios: the currency-deposit ratio and the reserve-deposit ratio. Thus the main equations of the money supply were as follows.

$$(CC/DD)_t = C[RY, rd1, WY, (CC/DD)_{t-1}] \quad (4\text{-}5)$$

$$(R/DD)_t = R[LR, rd2, GR, DD/TD, (R/DD)_{t-1}] \quad (4\text{-}6)$$

Where RY is real gross national product, WY=WS/Y, where WS is wages and salaries (component of GNP), Y is gross national product at current prices. LR is legal reserve requirement ratio. GR is growth rate of reserve (R), TD is total deposit (including time and saving deposits). rd1 and rd2 are the competitive rates of interest paid on demand deposits (total deposits). The expected signs for these equations are: C1, C2 <0 and C3, C4 >0, and R1, R3, R5 >0, and R2, R4 <0. Baryun justifies the negative sign for C1 as follows; as incomes increase, the demand for money increases. But as the country develops and the government sector and business sector become larger, the growth of deposits is expected to be higher than that of currency, because cheques become more acceptable. Therefore, it is expected that the demand for demand deposits will have higher income elasticity than the demand for currency. Urbanisation and increasing familiarity with the advantages of checking accounts may reduce the relative use of currency and lead to a greater decline in the currency-deposits ratio. The money supply, as a proxy for the effective demand for goods and services, is found to have a considerable impact on prices and nominal income and a negligible effect on real income.

4.1.1.3-Prices

Two price equations were estimated. First, a general domestic prices level equation.

$P_t = p$ (Ph, PMC, DS.PMC, E, DE.E, MX, DV, P_{t-1}) (4-7)

The expected signs are P1, P2, P4, P5, P6, P7, P8 >0, P3 <0 where Ph is the price level of housing (or non - tradable goods), PMC is the foreign price of imports of consumer goods in foreign currency, E is the exchange rate of foreign currency in terms of domestic currency, P_{t-1} is the lagged price variable and MX is an index number of money supply (1964 = 1.00), DV is a dummy variable which denotes a big increase in development expenditure, DE is a dummy variable which denotes big changes in the exchange rate, and exchange rate floating, DS is a dummy variable which denotes subsidies to some consumer commodities. DV=DE=DS=1 for years 1971-1977 and zero otherwise. Since aggregate demand is mainly a function of fiscal policy actions and monetary policy actions, the fiscal policy variable (net earnings of foreign exchange, NX) appears to be very important. However, in Libya where money is issued automatically when the government increases its expenditure, it is reasonable to consider money as a proxy for the aggregate demand variable.

The second price equation is for housing, which is a non-tradable good

Ph_t = Ph (W, PB, E, MX, DR×MX, Dh, Ph_{t-1}) (4-8)

The signs of the coefficients are: Ph1, Ph2, Ph3, Ph4, Ph7 >0 and Ph5 <0 while Ph6 can be negative or positive. The housing price equation is influenced by two main factors (a) wages in the housing production sector (W), since it was considered as a proxy for cost-push inflation, and wages are very sensitive to the rising demand for housing, (b) imported inflation due to the fact that imports of building materials were a main factor in housing costs. Thus the price of imports of building materials (PB) in terms of foreign currency, and the exchange rate in terms of home currency (E) were included in the housing price function in order to capture the effects of the dinar appreciation on the housing price level. The index number of money (MX) was used as a proxy for the demand vector representing demand pressures for housing in Libya. It represents the demand pull inflation in the housing sector. This variable was not appropriate for the period (1969-1977) without introducing a corrective variable to represent the new social ideology which encourages people to hold their wealth in more liquid assets. During the last two years of the period the new measures discouraged people from holding houses as assets. Thus a dummy variable (DR=1 in 1976,1977, DR=0 otherwise) was needed to correct the slope of the demand vector

4.1.2-Evaluation of the Model

To compare the predicted values and their relationship to the actual values, the mean absolute percentage error (MAPE) was used. Both dynamic and static simulation and the static simulation during the historical period (1963-1977) for the complete and the reduced model (excluding the foreign sector) were calculated (see Baryun, 1980, tables XXIV and XXV, pp 231, 234). In general the static simulation performs somewhat better than the dynamic simulations. The estimation of money supply (MS1) yielded a MAPE of 5.1 per cent when the complete model was concerned and only 1.8 per cent when the reduced model was concerned. According to the simulation, the predicted value of real expenditures on imports of capital goods (RMKP) and consumer goods (RNC) yield a MAPE of 8.3 per cent and 3.6 per cent respectively, while their nominal values including net imports of services (net imports of goods and services), yield a MAPE of only 2.7 per cent. The predicted value of net foreign assets yields a MAPE of 2.8 per cent. The complete model indicates more accurate estimates with respect to demand for money (RM1), housing prices (Ph) and gross national product (Y). The estimate of nominal money supply (MS1) appears to be less accurate than that given by the reduced model simulation. However, the within-sample performance of a model is not a rigorous test of how satisfactory the model is.

To evaluate the forecasting ability of the model, the ex-post forecast for 1978 was made. This is to show how closely the simulated values of the endogenous variables track their actual value beyond the sample period (see Baryun, 1980, table XXIX, PP 248). The results indicate some of the simulated endogenous variables were very close to their actual data, namely P, GDP, Y, and RY and others were not, such as Ph, (CC/DD), OY, RYP, RMKP, RS, MS1, and MX1. As with within-sample performance, the forecasting ability for a single observation is not a good test of a model.

There are also other weaknesses of this model. Setting DV=DE=DS=1 in the general domestic price level equation (4.7) is strange, if these are all the same, a single dummy variable for 1971-77 should have been used. It would represent all the effects listed (and any other special features of 1971-77). It is incorrect to separate out the development expenditure, exchange rate, and subsidies effects since they all accrued together, along with other special features of this period.

It would seem to be incorrect to have the price building materials (PB) in terms of foreign currency, and the exchange rate (E) in the housing price equation (4.8) as separate variables rather than having the price of imported building materials in domestic currency. Also, there is no reason for having the exchange rate and the price of oil exports in dollars (OPX) in domestic production in the oil sector (4.9) and in the non-oil sector (4.10) as separate variables. Furthermore, equation (4.9) has no lagged dependent variable, which is strange and implies rapid adjustment of production to desired levels. This may be reasonable for a reduction in output but is not for increases in output. With respect to the balance of payments equations, both the real imports of capital goods equation (4.15) and real imports of consumer goods equation (4.16) yield a wrong sign for the W/PK and E variables, and for both PMC/P and E variables respectively. These results may be due to having the exchange rate E and the other two variables W/PK and PMC/P, as separate variables. Overall, this model has serious weaknesses.

4.2-Abohobiel (1983) Model

This model is basically Keynesian and aims to provide a statistical explanation of the economic and non-economic forces, which directly or indirectly determine the country's capacity for economic growth. Data, which are quarterly, are only available for the financial and balance of trade variables. Abohobiel, interpolated the annual data and combined these with published quarterly data to construct a quarterly macro-econometric model for the Libyan economy over the period 1962-1977. However, the author does not mention seasonal variation. The study attempted to provide answers to two main questions:

1) How can one build a macro-econometric model that reflects the real structure of the Libyan economy?

(2) What does a model of Libya reveal?

In other words, what can be said about the Libyan problems through the period (1962-1977) and proposed policy solutions by extrapolation from the resulting model?

A sample of 64 observations (1962:1-1977:4) was used. In estimating the behavioural equations, the ordinary least squares single equation method was used, and where first-order serial correlation problems seemed to be present a Maximum Likelihood Iterative technique for regression with first-order autoregressive errors was adopted. This method is generally not recommended as a way of dealing with auto-correlation when the cause is likely to be mis-specified equations. Estimation was by the TSP regression package and different tests were applied to evaluate the model. The model was divided into 6 main sections; aggregate demand, aggregate supply, employment and labour force, prices, public finance; and money supply. As mentioned before in section 4.0, the public finance and money supply will be discussed here.

4.2.1-Public Finance and the Money Supply

Three equations for sources of government income were estimated: oil revenue, direct taxes, and indirect taxes.

4.2.1.1-Oil Revenue

Government oil revenue (GOILR) was explained by five variables: the lagged dependent variable, the amount of the oil exports (EXOILC), the price of oil (PEO), and two dummy variables DGOR1 to reflect the reduction in GOILR during 1971:4-1973:2 and DGOR2 for 1974:4-1975:2, when oil exports were restarted.

$$GOILR = f(GOILR_{t-1}, EXOILC, DGOR1, DGOR2, PEO) \qquad (4.9)$$

4.2.1.2-Taxes

Changes in direct (INCTAX) and indirect (INDTAX) taxes were explained by the lagged dependent variable and ΔGNP. The equation form was as follows:

$$\Delta INCTAX = f(\Delta INCTAX_{t-1}, \Delta GNP) \qquad (4.10)$$

$$\Delta INDTAX = f(\Delta INDTAX_{t-1}, \Delta GNP) \qquad (4.11)$$

4.2.1.3-Money Supply

The specification of the money supply (MS) in the model was based on the definition of the monetary base (high-powered money). The three explanatory variables were the lagged dependent variable one period, the stock of net foreign assets (IR), and the stock of net domestic assets (NDA). The estimated equation was as follows:

$$MS=f(MS_{t-1}, IR, NDA) \quad (4.12)$$

4.2.2-Evaluation of the Model

Three experiments were carried out by the model builder to evaluate the model. These were a dynamic simulation within the sample period, the one-period ahead forecast within the sample, and multipliers and policy evaluations. The estimation period was 1962:1-1977:4. All experiments were done for the period 1973:1-1975:4. The reasons for choosing this period are oil prices increased sharply in the fourth quarter of 1973. However during this year (and since 1962) the balance of payments ran a deficit. By 1974, government consumption and total public investment increased by 85.5 percent and 56.1 percent respective to their values in 1973. The financing of these huge expenditures came from two sources: oil exports and taxes. In 1974, the value of oil exports doubled on a smaller volume because of the large price rise, and income and indirect taxes grew by 52.4 and 66.3 percent respective to their values in 1973. Because of the world recession in 1975 the value of oil exports was almost half its value of 1974 and GDP dropped by 3.1 percent relative to its value in 1974. Oil production in 1975 fell by 17.6 percent. To offset the reduction in its income from the oil sector, the government increased its dependence on taxes, and both direct and indirect taxes increased by roughly 33 percent with respect to their values in 1974. In the first experiment the simulated values of the endogenous variables are obtained by solving the model for all or some of the sample period quarters, and comparing the estimated values of the endogenous variables with the actual values. The Mean Absolute Error (MAE), the Mean Absolute Percentage Error (MAPE), the Root Mean Square Error (RMSE), and the Root Mean Square Percentage Error (RMSPE) were used to measure how closely the simulated value track their actual values (see Abohobiel, 1983, tables 5.2.1-5.2.22, PP 148-169). However, *as suggested by Klein in models of LDC's, a variable is considered to have done well in simulation if RMSPE is 15 or less, with the exception of the foreign trade sector, where an RMSPE of 25 or less is generally acceptable. (Abohobiel; 1983: 147).* Therefore, the results of the dynamic simulation were quite satisfactory, with exception of government consumption (CGC) and the value added in the oil sector (XOC). According to Abohobiel, the change in government in 1969 and the erratic behaviour of government consumption which coincided with the oil price increase of 1973:4 made this variable (government consumption) hard to explain, although two dummy variables were introduced into the equation to account for this unusual behaviour. On the other hand, the non-existent link between the value added in the oil sector and oil production or oil exports suggest there is a more fundamental problem with the model.

The second experiment was the forecast for one quarter ahead within the sample period. The goal of such an exercise is to show how closely the simulated values of the endogenous variables track their actual values within the sample period (see Abohobiel, 1983 tables 5.3.1-5.3.27, PP 172-197). The results of this exercise indicate that, with exception of balance of trade (BOTGS) and balance of payments (BOP), all variables have satisfactory RMSPE.

The third exercise is the multiplier analysis and policy evaluation. The multiplier analysis shows the effects of a hypothetical change in several independent variables and/or coefficients. Abohobiel reports nine policy simulations for the period 1973:1-1975:4, three of which are for policy investment variables;

(1) Government real investment in agriculture (policy IGAR).

(2) Government real investment in manufacturing (policy IGMR)

(3) A combination of (1) and (2) above (IGAMR).

Three for policy variables of the oil sector, namely:

(4) Oil exports (policy (EXOILR1)

(5) Actual price of oil exports (EXOILR2).

(6) Policies (4) and (5) combined (EXOILR3).

And three for tax policy;

(7) Income tax (policy TAX1).

(8) Indirect tax (policy TAX2).

(9) Policies (7) and (8) combined (policy TAX).

In each experiment, all other exogenous variables except the one to be changed were maintained at the actual values prevailing during the simulation period. The value by which the control variable in this simulation is shifted is different from one policy variable to another. The change in public investment is more than 20 per cent of its actual value, it is less than 50 per cent of the change in real value of oil exports (see

Abohobiel, 1983, table 5.4.1, PP 205). The shift under any tax policy is a rather small fraction of the shift in public investment. The higher the shift in the control policy variables, the higher the induced shift in the endogenous variables in the model, according to Abohobiel (1983) that is one reason for the higher multiplier due to oil and public investment policy control variables compared to the shifts in the tax variables.

An obvious weakness of Abohobiel's model is that the data end in 1977, and so as with Baryun's model, the moves towards socialism will affect the predictions. The data period of the present study will include more variation in the variables and so will give more reliable estimates.

4.3-Abosedra (1984) Model

The aim of this model was to investigate the contribution of oil sector growth in the development of the Libyan economy. The study constructed a macroeconomic model, based on the Keynesian approach. The model was divided into five parts. (1) Estimates of aggregate supply components, which were divided into gross domestic product in the oil and in the non-oil sector, in the first part. (2) Aggregate demand components, which include consumption, investment, and foreign trade relations. Following the division of the Libyan economy into oil and non-oil sectors, investment was dis-aggregated into those two sectors. (3) The government sector equations. (4) The monetary sector and price equations. (5) The labour market equations, where employment and wages in the oil and non-oil sectors were determined. All equations in the model were estimated on the basis of annual data for the period 1962-1978. The model contained 36 relations of which 19 were behavioural equations and 17 were identities. There were a total of 51 variables, of which 36 were endogenous and 15 were exogenous.

The study used a simulation package SIMULATE program, developed by the Social System Research Institute of the University of Wisconsin, to estimate the model for the period 1962-78. Ordinary least squares (OLS) and Two Stage Least Squares (TSLS) were used to estimate the model. In order to evaluate the results of the simulation the R-squared, t ratio, F ratio, Durbin - Watson, and Durbin's h were reported.

Taking into account the main goal of this study, the government sector and the monetary sector in Abosedra's model will be discussed.

4.3.1The Government Sector

4.3.1.1-Oil Revenue

To estimate the government oil revenue (GOR) a dynamic simulation equation in the log form was used. The following equation was estimated.

$$GOR = f(GDPO, GDPO_{t-1}) \qquad (4.13)$$

where GDPO is nominal gross domestic product of oil sector at factor cost.

4.3.1.2-Direct Taxes

Direct taxes (DT) were postulated to depend on the absolute level of income. The following equation was estimated.

DT = f (DGNP) (4.14)

where DGNP is nominal gross national product at market prices.

Indirect Taxes:

Since indirect taxes (ITX) are mostly imposed on imports they were postulated as a function of total imports (IMP

ITX = f (IMP) (4.15)

In addition to the last three equations describing the government revenue (oil revenue, direct and indirect taxes) total government revenue (TGR) was defined as:

TGR=(DT + ITX) + (NNR + other) + GOR. (4.16)

where NNR is nominal government non-oil, non-taxes revenue, and other denotes nominal government revenues from other sources.

4.3.2-The Monetary Sector and Prices

4.3.1.2-Monetary Sector

Two equations were estimated for this sector. First, high-powered money (HP) is dependent on government net domestic expenditure. Second, money supply (MS) was regressed against high-powered money. The two equations were as follows:

HP=f (NGEJ) (4.17)

MS=f (HP) (4.18)

where NGEJ is nominal net government domestic expends.

4.3.1.3-Prices

Four price indexes were estimated. Those are the consumer price index (CPI), the non-oil gross domestic product price index (PGDPN), the oil gross domestic product price index (PGDPO), and the gross domestic product price index (PGDP). The PGDP was being determined by an identity as follows:

PGDP=[(RGDPO×PGDPO)+(RGDPN×PGDPN)]/[RGDPO+RGDPN] (4.19)

where RGDPO, and RGDPN are real gross domestic product in the oil and the non-oil sectors respectively. CPI and PGDPN were estimated as.

$CPI=f(MS, CPI_{-1})$. (4.20)

$PGDPN=f(WN)$ (4.21)

where WN is nominal non-oil wage rate. PGDPO is treated as exogenous.

4.3.3-Evaluation of The Model:

To evaluate the forecasting ability of the model two experiments were carried out. These were a dynamic simulation of the model for the period 1964-1978 and an ex-post forecast for 1979. In the first experiment the simulated values of the endogenous variables were

obtained by solving the complete model simultaneously, using the simulated values rather than the actual values of all lagged endogenous variables. The closer the simulated values to the actual values, the more confidence there is that the model is a stable description of the Libyan economy.

The root mean square percent error (see Abosedra, 1984 table 3.2, pp 85) indicates that most of the key variables in the model, such as DGNP, SGDP, GDPN, GDPO, IMP, GOR, and LABT, did fairly well in reproducing their historical series. The second experiment, which was used to establish the forecasting ability consists of an ex-post, forecast for the single year 1979 (see Abosedra, 1984, table 3.3, pp 89). The results indicate that most of the simulated endogenous variables were very close to their actual data. However, the accuracy of forecasts for a single year is not a strong test of a model and that it would have been better if more forecasts had been evaluated.

Alternative future scenarios of the Libyan economy were examined for 1980-1987 by performing an ex-ante simulation for this period. This simulation was divided into two sections. The first covered the period 1980-1983 for which actual data for oil prices (PGDPO) and the volume of real oil exports (ROEX) were available. The ex-ante simulation results for the period 1980-1983 show that oil revenue, has a big effect on the key variables of the model. For example, in 1980 the boost in oil prices which caused the oil gross domestic product price index (PGDPO), to increase by 63% resulted in an increase in nominal gross domestic product at market prices (DGDP), which in turn caused nominal gross national product at market prices DGNP to grow by 44%. As the different components of DGDP increased and the change in PGDPO worked its effect throughout the model, the real gross domestic product of the non-oil sector (RGDPN) increased by 22%. Nonetheless, the real gross domestic product of oil sector (RGDPO) declined by 8%, mostly due to the increase in PGDPO and in part due to the moderate decline in real oil exports (ROEX). The 22% increase in RGDPN, the

22% increase in PGDP, and the 16% increase in nominal non-oil wage rate (WN) resulted in a 13% increase in the labour force in the non-oil sector (LABN). The labour force in the oil sector (LABO) also increased by 4%, as the nominal oil wage rate (WO), PGDP, and the nominal oil investment (OIV) shifted upward. According to Abosedra, the increase in LABN and LABO by 13% and 4% respectively caused the total labour force (LABT) to grow at 13% between 1979 and 1980, and with the local labour force (LABC) growing by 4%, the foreign labour force (LABF) grew by 28%. The high rate of growth in LABF contributed to the 16% growth in WN. (Abosedra, 1984; table 4.1 pp. 98)

In summary, the increase in PGDPO during 1980 showed that the economy was very sensitive to changes in this variable and the results showed that the country must adopt a policy aiming at reducing its dependence on oil revenues. In 1980 as economic activities in most industrialised countries weakened and as conservation measures spread in response to the oil price shock that resulted from the oil market disruptions of 1979-1980, Libyan ROEX declined by 38%. This in turn had affected GOR, which the model forecast to decline by 30% in 1981 as compared to 1980. As the decline in GOR worked its effect throughout the model DGNP was forecast to decline by 18% in 1981 as compared with the previous year. According to Abosedra, in 1982, and as result of a 3.7% increase in ROEX while PGDPO decreased by 11%, the overall performance of the economy had improved to a little extent when compared with 1981, as DGNP is projected to grow by 2% in 1982. This was attributed mostly to the 14% decline in GOR in that year, as compared with a 30% decline in 1981. In 1983 GOR declined by

23% as compared with previous year, and this would eventually be transmitted into a 6% decrease in the level of DGNP.

The second section of the ex-ante simulation covered the period 1984-1987. This assumed a scenario with the world oil prices level from 1984-1987. The output indicates that most of the stimulation would accrue in the economy's aggregates between 1986-1987. (Abosedra, 1984; table 4.3, pp. 108). However, the dynamics of the model are very simple since generally the only lagged variable is the dependent variable, and this is something that requires further development.

In addition the analysis was performed by establishing a new world oil price scenario. In which oil prices were 10 per cent higher than the basic scenario. The result was Gross national product would be higher by 4.2% in 1984 and 2.9% in 1987. It is also found that the expansion of the economy due to the higher level of world oil prices would have little effect on the consumer price index (CPI). The wage rate in the non-oil sector (WN) showed more sensitivity than did the consumer price index, and the wage rate in the oil sector (WO). In addition, government total expenditure (TGEX) and money supply (MS) were found to be relatively insensitive to changes in world oil price level. Nonetheless, government total expenditure (TGEX) was more affected by the higher level of world oil prices than was the money supply. (Abosedra; 1984, table 4.4, pp.111). However, the ex-ante simulation for the period 1980-1987 was based on changing the oil price. In fact this cannot be controlled by the Libyan government. Also, it is a general result for a small oil based economy that changing the oil price will affect the rest of the macro-economic variables. Hence, it is not worth examining this factor.

4.4-Mohamed (1998) Model

The aim is to construct a Keynesian annual macro-econometric model for the Libyan economy over the period 1962-1991 and to use the model to forecast future economic activities under different scenarios. The study tries to answer exactly the same two questions introduced by Abohobiel (1983), using the latest available data and new econometric techniques.

A sample period of 30 years (1962-1991) was used. In estimating the model recent techniques were used. The Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests, with and with out time trend, were applied to test for the stationarity of the variables. The cointegration approach based on the Engle-Granger (1987) two -step method was used to estimate the cointegration regression. The calculations were carried out using the TSP package. Different statistical criteria were used in the selection procedure amongst the different forms of each equation. Model estimation carried out includes model evaluation (tracking performance and dynamic properties) and multiplier analysis. Two different scenarios were used for forecasting (ex-post and ex-ante) the effects of different sets of oil prices and production for the period 1996-2005. The model was divided into: aggregate demand which includes consumption (for the private and government sectors), investment (for manufacturing, agriculture, the services, and the construction sectors), prices, employment, public finance (which includes the estimation of the oil revenue function and the indirect tax function), and aggregate supply. This includes the estimation of production functions of the oil and non-oil sectors. As mentioned in section 4.2, the public finance sector will be discussed here.

4.3.1-The Public Finance Sector

Two sources of government revenues were estimated: oil revenue and indirect tax revenue. Government oil revenue (ROILREV) is explained by real oil exports (ROEXP) and the dependent variable lagged one year.

$$ROILREV_t = f(ROEXP_t, ROILREV_{t-1}) \quad (4.22)$$

For tax revenue, only real indirect tax revenue (RINTAX) was estimated. The equation is.

$$RINTAX_t = f(RTIMP_t, RINTAX_{t-1}) \quad (4.23)$$

Where RTIMP is real total imports.

4.3.2-Evaluation of The Model

The model simulation and the ability to track the historical data has been carried out in an aggregated and a disaggregated version. The ordinary least squares (OLS) and two stage least squares (2SLS) estimation methods were applied. Its evaluation used the Root Mean Square Percent Error (RMSPE) (see Mohamed.1998, tables 7.2, 7.3, 7.5, 7.6, 7.8, 7.9, and 7.11, pp 180-192). The study concluded that the disaggregated version of the model using 2SLS estimators gives the best results in tracking the historical data as measured by RMSPE. Therefore, this version was adopted in the multiplier analysis.

In the validation of the forecasts, multiplier analysis was used. In this regard three exogenous variables: oil revenue ($OILREV_t$), total government spending ($TGSP_t$), and money supply ($MONEY_t$) were used and a shock was imposed on their historical path.

Also, three different starting years 1964, 1973, and 1982 were chosen for introducing the shocks. The impact, intermediate, and the long-run elasticities of gross domestic product, private consumption, total government investment and price were calculated (see Mohamed, 1998, tables 8.1-8.6, pp 203-211). The analysis indicates that TGSP is very sensitive to slight shocks to oil revenue.

Also, TGSP was found to be more sensitive towards a shock in the oil price or oil revenue than towards any shock in MONEY. Furthermore, the consumer price index was found to be highly sensitive to any increase in money supply.

To evaluate the forecast ability of the model, the ex-post forecast for the period 1991-1996 was carried out and the results are close to the historical data. The forecast values for real investment in the manufacturing sector ($RMANI_t$) were less than the recorded ones. This lead to an adjustment in the weight of the government's annual appropriation for investment in this sector. The RMSPE of $RMANI_t$ declined from 13. % to 2.2%. This adjustment pulled down the RMSPE for the model from 3% to 2.06%.

To carry out the ex-ante forecast, two scenarios were examined in this regard. The first one assumed that both oil prices and Libyan oil production will rise steadily at 8% p.a. and 4% p.a. respectively for the period 1996-2005, starting from 1.5 m b/d in 1996. In the second, was assumed that the oil revenue falls considerably. The results of these two scenarios indicate the Libyan economy's heavily dependence on oil revenue. Also, inflation was often related to the higher oil revenue (see Mohamed 1998, appendix 2 tables 1.7 & 1.8, pp 272-275).

4.5.Conclusions and Critical Review

During the last three decades several models have been built for the Libyan economy in order to investigate the influence of the oil sector on the development of the Libyan economy. Four of these have been reviewed in this chapter. However each of these models is found to be deficient in more than one aspect. First, with exception of Abohobiel and Mohamed models, the other two models suffer from limited availability of data for the Libyan economy, only 16 or 17 annual observations and some of the estimated equations suffer from auto-correlation. For some equations the first three models claim to have "corrected for auto-correlation'' but this has been unsuccessful. It is also not a good strategy when the cause of the auto-correlation is not known. If it is the result of omitting important variables, the auto-correlation should be removed by re-specifying the equation to include different variables. Second, the dynamic structures, which have been incorporated in selected equations in the four models, have a maximum lag of one period, and usually include only the lagged depended variable. Also, many equations in the first three models just have current variables, and there are only a few equations in logarithmic form, or non-linear forms. Third, since the target of the models was to investigate the influence of the oil sector on the economic growth in Libya, with the exception Abohobiel and Mohamed's models, the other two models do not dis-aggregate the real sector. On the other hand both Abohobiel and Mohamed do not give any justification for their dis-aggregation.

In Abohobiel's model, most equations include the lagged dependent variable for one period and no other lagged variables. This is strange in a quarterly model, where the dependent variable lagged 4 quarters might be important. Also there is no treatment of seasonal variation. Furthermore, the use of OLS, which gives biased and inconsistent estimators in simultaneous systems, and the use of first-order auto-regressive error terms is evidence of mis-specified equations, either important variables are omitted or the lag is wrong. Final point is related to the large negative values in 1975-4 for IGAR, IGMR, IGAMR, EXOILR2, EXOILR3, TAX1, TAX2, TAX3 are all worrying. They suggest that any beneficial effects from earlier positive multipliers are swamped in the long run. The TAX ones in particular have almost no effect until 1975-3, and then a big impact. This suggests that the long-run properties of the model need to be carefully examined.

In Baryun's and Abosedra's models, the experiment which was used to establish the model's forecasting ability consists of an ex-post forecast for one period ahead. This is to show how close the simulated values of the endogenous variables track their actual values beyond the sample period. However, it is unwise to judge the validity of a model on the evidence of a forecast for just one period.

In Mohamed's model despite using the recent econometric techniques and latest available data the model can be criticised. Firstly, there is no mention of the Johansen co-integration approach. The Engle-Granger two-step method is only valid when there are two co-integrated variables. If there are more than two I (1) variables then it is necessary to use Johansen's approach to test for the number of co-integrating vectors and then use maximum likelihood estimation to obtain them. Secondly, in the last two decades great attention has been given to the monetary approach, and the role of the monetary variables in econometric models. However, the monetary sector is not estimated. Therefore, the model does not give any guidelines in this regard. Thirdly, there is very limited work on co-integration and error-correction models. Fourthly, the labour market plays a crucial role in macro-econometric models. However, Libyan labour can only supply a part of the total Libyan labour demand. As a result, the Libyan economy relies on foreign labour. Despite this fact, the model does not mention the role of foreign labour in the Libyan economy.

Turning to the monetary sector, the three models (Baryun, Abohobiel, and Abosedra) have monetary sectors covering the same period, (1962-77, 1962-77, and 1962-78) respectively, but they do not use the same variables to explain the supply of and the demand for money. In the literature, two different approaches have been used to determine the changes in domestic liquidity in an oil-based economy such as Libya. First, the consolidated accounts of banking system approach. Second, the alternative approach identifies the growth of government net domestic expenditure for consumption or investment purposes as the main determinant of the rate of monetary expansion. Jakublack and Dajani (1976) argued that employing the first approach does not provide full explanation of how money supply expands or contracts in oil based economy. The same conclusion had been reached by Looney (1977). The second approach has been suggested by Jakublack and Dajani to deal with the features of oil exporting countries. An increase in government oil revenue results in an increase in domestic liquidity. This approach has been adopted by El-Fakhery, (1978) and Abosedra, (1984). Despite practicing the private sector in limited activities during 1962-1975 the government still controlled the price level especially for the necessary goods. Hence the price equation estimated in the above models does not provide the right explanation for the price behaviour in the economy. However, the first three models mentioned above are based on conventional econometric techniques, which now seem inappropriate. *Recent econometric work has shown that a straightforward application of these techniques to the levels of macro-economic variables is bound to produce misleading results since these techniques were developed for stationary time series. (Moosa; 1993: PP 439).*

Furthermore, there have been developments in modelling and theory (e.g. choice of endogenous/exogenous variables, estimation methods, use of level / differences of variables, treatment of expectations, theoretical ideas for the consumption function, real variables matter, estimation diagnostics, simulation methods) since 1980, which can improve the models.

Finally, taking into account the deficit aspects of the revised models, and the development in modelling and theory mentioned above, the theoretical model of the Libyan economy, which will be used for the purpose of this study, will be presented in the next chapter.

Chapter Five

The Theoretical Model of the Libyan Economy

5.0-Introduction

This study attempts to answer two main questions. First, how does the composition of public expenditure affect the economic growth rate of the non-oil sector in Libya? Second, what is the appropriate fiscal and/or monetary policy to be used by the Libyan government to finance public expenditure especially after the collapse in the oil price in the 1980s? The study focuses on growth because *(i) inasmuch as growth is one of the objectives of a government, it is useful to know the contribution of different types of expenditure to this objective as a means of assessing the cost of pursuing other goals, and (ii) per-capita income is easier to measure than some of the other objectives of government. (Devarajan & al, 1996:314).* Economic theory and empirical studies do not provide a clear answer to the question of how the composition of public expenditure affects economic growth. *The theory develops a rationale for government provision of goods and services based on the failure of markets to provide public goods, government intervention in a related market can be justified. Sound as they are, these theoretical notions do not translate easily into operational rules about which component of public expenditure is to be cut. (Devarajan & al, 1996:314).*

On the empirical side, a few studies have tried linking particular components of government expenditure to economic growth. Most of these attempts seem to be deficient in not having a rigorous theoretical framework (Diamond, 1989). The expenditure composition issue has been investigated by many authors (i) using theoretical models focused on the productivity of public expenditure in the United States (Aschauer, 1989, Morrison and Schwartz, 1991), (ii) focusing on the productivity of public expenditure in developing countries (Devarajan & al, 1996). The purpose of this chapter is to build a model taking into account the structure and features of the Libyan economy presented in chapter two.

History of the post-oil period indicates three important characteristics which should be incorporated in any macro-econometric model of the Libyan economy. These are the role of the government, the role of the oil sector, and the role of the foreign assets. Government activity is important because of its size. In Libya the government owns and controls manufacturing firms, and the commercial banks. By the end of 1970s, the government owned all the wholesale and retail trade. Also, the government owns the oil sector, which is the major source of external income for the country. In short, the government is the unique investor and producer of goods and services in the economy. In 1983, total public sector budget expenditure (ordinary and development expenditure) amounted to more than 44 per cent of GDP at current prices. Revenue from taxes and revenue from oil exports finance the public sector budget expenditure. Selling treasury bonds and bills to the Libyan central bank covers the difference between total public sector budget expenditure and total public sector budget revenue.

The importance of the oil sector arises from the fact that it is the main exporter of the Libyan economy. Oil exports amounted to between 85-99.9 per cent of total exports during 1962-1992 (see table 2.7). This means that most of Libya's foreign assets are earned from oil exports. Also the revenue from oil exports is the main source to finance (i) government expenditure to supply the social and the economic needs from goods and services, and (ii) government imports. Again, oil income is the main source of the foreign assets, which affect the monetary sector.

In this chapter, the relation between econometrics and economic policy as well as the problems of economic modelling will be discussed in sections 5.1 and 5.2 respectively. Section 5.3 presents an explanation of inflation in developing countries. The rest of the chapter will be divided into six main sections discussing and developing the model which will be presented in the final section in this chapter.

5.1-Economic Policy and Econometric Models

Since Keynes produced his work "The General Theory'' (1936) it has been known that government intervention can affect the path of the economic activity to improve macro-economic performance. This has led to various attempts at improving the performance of both developed and developing countries, and Libya is no exception to this. *Since the mid - 1960s attempts have been made (and continue to be made) at systematically analysing the interrelationships between the major macro-economic variables with a view to forecasting both the future behaviour of the economy and the future effects of current policy decisions. (Holden el. al, 1982:1).* This study builds a macro-econometric model of the Libyan economy. An econometric model for any country should consider the real economic and social construct of the country. The rationale for the construction of an econometric model is to use economic theory to determine the specification of the real world (the economic and social construct) of the country under consideration in the form of equations which can then be estimated by an appropriate statistical method. The other main purpose of econometric modelling is to test economic theory to determine whether the theory is supported by, or compatible with, the evidence. Also models can be used for forecasting purposes. *The characteristics of an econometric model used for forecasting are: (a) economic theory provides the basis for each of the fundamental relationships in the model; (b) data on the economy are used to obtain numerical values of the unknown parameters of the model; and (c) once the model is estimated the short-term and long-term effects of different combinations of policies can be evaluated. (Holden et al, 1982:2).* Macro-economic theory provides the basis for the construction of macro-economic models. However, different theoretical concepts lead to different models. The IS-LM model developed by Hicks (1937) is the traditional basis of macro-economic theory. The standard IS-LM model is used to generate aggregate demand. In particular to investigate relationship between inflation and unemployment. The traditional view of the IS-LM model has serious limitations. First, the IS/LM model is often presented as a static. In this traditional model the price level and money stock are exogenous. Second, the IS-LM model neglects the supply side which, in LDCs, would reveal the nature of the production function (in other words, the supply side would be affected by the nature of the input factors of the production function) and the rigidities in the labour market. Third, the traditional IS-LM model postulates that prices clear markets, when in LDCs markets are cleared by quantity adjustment or by queues. (Holden et al, 1982, Murinde, 1993).

Keynesian theory stresses that dis-aggregation both by sector and expenditure category is necessary for a good understanding of a complex economy. Therefore, Keynesians tend to build large-scale models. Monetarists believe the effect of monetary changes on aggregate output is important. This leads to small structural models (Thomas, 1993).

In this context, in literature there are three major debates (Holden, et al, 1982). The first, concerns the role of money. *Monetarists and most Keynesians accept that money influences economic activity and prices. Money is neutral in long-run adjustment, when price anticipation fully reflects monetary conditions, but adjustment of anticipations is often delayed by uncertainty about the nature of shocks and their persistence. During the transition money is not neutral (Brunner & Meltzer, 1997:55).* The radical Keynesians' assume that money plays a minor role in their model. Second, there is controversy over whether models should be of an equilibrium or a dis-equilibrium. *In practice equilibrium models incorporate some form of dynamic adjustment process (Holden et al, 1982:8).* Failure within equilibrium models may appear from a number of factors such as long-term contracts, and costs of adjustment. Engle and Granger (1987) propose a method of modelling in which long-run properties rely on co-integration of the variables and with error-correction processes to model short-run dynamic behaviour. The third, concerns the formalisation of expectations and the diversity of techniques for formulating forecasts. These techniques use the behaviour of the economic variables over time. In other words, expectations of future values of a variable (variables) under consideration are determined by its own past values, or by a variety of other variables (Minford, 1980, Holden et al, 1982). As part of the modelling strategy the co-integration techniques of Johansen will be used in the present study to test whether any stable, long-run relationships exist between output, and government expenditure.

5.2-Problems of Economic Modelling

Economic theory is important in determining the specification of the model. It is important to distinguish between an economic model and a purely statistical time-series model. An econometric model provides an explanation while a time-series model provides a description. In both cases there is recognition of the importance of the role of time in determining the values of the variables.

The model builder faces serious problems relating to the period length, the dynamics of adjustment, and the estimation technique. There is a need to make arbitrary choices. Holden et al, (1982) among others argue that economic theory uses the short and long run concepts, which cannot be automatically linked to specific numbers of calendar months, quarters, or years. These are useful to the model builder who wants to link the existing condition of the economy to a particular calendar period. The choice of data period for an econometric model is mainly determined by the availability of data. The time unit for the data and the unit of observation should be well selected. A quarterly or half-yearly unit of observation is usually preferable with a short-term forecasting model. These allow the utilisation of the available macro-economic data. Annual data is preferred for medium or long-run models, because forecasting exactness relies on the number of periods covered by the forecast rather than on the length of the time unit. With respect to the dynamic adjustment mechanism, this must be incorporated in the model, and economic theory does not provide much guidance in this regard. In this context, three methods (of providing the essential dynamic structure) have been widely used by economic model builders, each of which depends on the quality of the estimated equation rather than on theoretical specification. These three methods are:

(i) *to use lagged values of independent variables.... The number of lags would be determined by the fit of the equation and the signs of the coefficients. (ii) to include the lagged value of the dependent variable. (iii) to include short-run explanatory variables that are mainly chosen according to statistical criteria such as the significance of the relevant coefficient and goodness of fit of the resulting equation. (Holden et al,1982:9-10).* More recently, Engle and Granger (1987) have contrasted long-run behaviour (modelled by co-integrated variables) and short-run behaviour (modelled by error-correction mechanisms).

When a theoretical model has been built, the next step is to estimate the unknown parameters. The choice of data and estimation technique is required. The goodness of statistical estimation of the parameters improves as the number of observations increases. Also, the reliability of the data can have a great influence on the goodness of the model and the results.

Estimation techniques for econometric model can be classified into two categories: (i) single equation methods, which deal with the estimation of each equation individually. An example of such a method is Ordinary Least Squares (OLS). The advantage of this technique is it is easy to apply, and changing any variable included in any equation does not affect the parameter estimates for the other equations. (ii) systems methods, which deal with the simultaneous estimation of the full model. Examples are: Three Stage Least Squares (TSLS), and Full Information Maximum Likelihood (FIML). The dis-advantage of these methods is that changing the variables in any equation leads to the re-estimation the whole model. Also, a serious specification error in any equation can affect all the parameter estimates. Finally, estimation can be time-consuming and costly. Therefore, such methods are generally avoided (Thomas, 1993). But this is less of a problem with modern computers.

However, the use of co-integration properties and error-correction mechanisms has been facilitated by the maximum likelihood method of Johansen (1988), which, together with the general-to-specific approach of Hendry, provides a coherent estimation procedure. This will be used here

Any econometric model is a simplification of the complex real world, and so requires arbitrary choices. For example, decisions on which variables are to be endogenous and which are to be exogenous, the way in which the endogenous variables are determined, and the mechanics of adjustment processes. All such choices are guided by economic theory, but are subject to the judgement of the model builder.

5.3-Explanation of Inflation in Developing Countries

Two different schools of thought have been used to explain inflation in less developed countries (LDCs). The monetarists' view explains inflation as a purely monetary phenomenon. They believe that the money supply is exogenous and can be controlled by the monetary authorities. Monetarists do not deny the importance of structural bottlenecks in LDCs. However, they argue, these structural problems are the consequences of the wrong policies being followed by the government rather than the causes of inflation. (Murinde, 1993, Jha, 1994). In this context, empirical studies show conflicting evidence. In order to examine the relevance of the monetarist interpretation, De Silva (1977) estimates the influence of monetary expansion on inflation in Sri Lanka during the period 1959-1974. The results suggest that money supply has exerted an influence on inflation. Saini (1982) used a monetary model to investigate the inflation experience of Asian countries. His findings suggest that the monetarist model does not explain inflation in these countries. Tegeue (1989) employs a monetary model of six African economies. The results obtained do not reject the monetarist explanation of inflation. It is shown that money supply expansion and real income changes lead to inflation in these economics.

On the other hand, the structuralist school argues that the structural characteristics of LDCs cause the economy to be inflation prone. Inelastic supply of foodstuffs, the price structure, foreign exchange constraints, and exports instability are some examples of structural bottlenecks. So, here the remedial policy for inflation is to remove the various structural bottlenecks.

The structural interpretation of inflation has been subject to considerable empirical tests. Argy (1970) tested the impact of the structural elements of inflation for 22 LDCs for the period 1958-1965. The results suggest that structural factors do not explain the different rates of inflation in developing countries. Vogel (1974) found that inflation in LDCs could not be attributed to structural factors but rather should be attributed to the behaviour of money supply.

An explanation of inflation that appears to blend both monetarist and structuralist arguments is the budget deficit. Indeed, the causality between the budget deficit and inflation is one on which professional opinion is divided. On the one hand, inflation is regarded as a cause of the budget deficit. Specifically, it is argued that budget deficits are high because of inflation. It is argued that inflation enlarges the public sector deficit due to the lag in the collection of tax receipts, erosion of the tax base and price freezes on products of state owned corporations. (Murinde, 1993:21-22). Killick (1984) and Buiter (1986) argue that the relation between budget deficit, money growth, and inflation is strong in LDCs. They note that capital markets are not well developed in LDCs and they face difficulties in borrowing externally. As a consequence, LDCs have to depend on their central banks to finance their deficits. This leads to further inflation. Recently, Abdulghani (1991), Park (1993), Rankaduwa & Tomson (1995), and Mohamed (1998) argue that structural elements such as the import price, the inflexibility of the production system, the exports price as well as monetarist factors such as the interest rate, and the stock of money supply together combine to cause inflation in developing countries.

In the case of Libya, the boom in purchasing power after discovering oil and the increase of government revenue from exporting oil, lead to an increase in the demand for goods and services by individuals and to an expansion of government expenditure on capital and consumption goods. As mentioned in section 2.2.2, borrowing domestically from the Libyan central bank (public debt, PD), finances the difference between total public sector budget expenditure and total public sector budget revenue. Public debt reached 24.89 per cent of GDP in 1992 (see table 2.5). Any increase of PD will lead to a deficit in the balance of payments and (or) an increase in the domestic price level.

Also, as mentioned in section 2.2.3, the oil era increased the bank deposits. This lead to an increase in the commercial banks credits (CBC) to both private sector and government agencies through 1962-1992, to produce and import goods and services to supply the excess demand in the domestic market. Again, (see section 2.2.3) in May 1980 two actions were taken by the monetary authority, aimed at reducing money in circulation. The first was to replace the old 5 and 10 Libyan dinar notes with new ones, the other was to restrict cash withdrawals from any one account to 500 dinar per month. In 1989 other actions had been taken by the government to encourage the private sector to take part in economic activities. The government permitted the private sector to practice in different economic activities without transferring any foreign currency to finance their importation of commodities. As a result the monetary authorities abolished the restriction on cash withdrawal. This lead to an increase in money demand. However, from 1962 the government controls the prices. Therefore, it is not expected that these liberalisation procedure have an immediate effect on the official price level.

5.4-Theoretical Foundation of the Model

In constructing the model, the intention is to investigate the influence of government policy (government expenditure) on the output of the non-oil sector, employment, imports, and macro-economic performance.

It is important to chose a suitable period and time unit for the data. *In most countries the national income accounts are published both quarterly and annually. The advantage of quarterly data is the larger number of observations it makes available (Holden & al,1982:31).* Unfortunately, for the Libyan economy quarterly data is available only for the monetary sector. As mentioned in section 4.2, Abohobeil (1983) interpolated annual data and combined them with published quarterly data to construct quarterly data for the Libyan economy. However, the present study has not used this quarterly data because of its limited coverage, only 1962-1977, and doubts about the procedures.

The present study will use annual data over the period 1962-1992 for the model. This period has been chosen on the grounds of the availability of data. *In Libya, the process of compiling national accounts takes some time and the final estimates are not usually ready for publishing before the lapse of about two or three years after the close of the year. (Keibah, 1987:4).* The first national accounts for the

Libyan economy were published in 1971, covering the period 1962-1970, and the most recent ones published in July 1997 covered the period 1980-1992.

Since the present study focuses on the role of government financial policy on economic growth, a convenient starting point for specification of the model is with public finance, and to link it to the monetary sector, the real sector, the role of foreign trade and the balance of payments, and the labour market. Annual data will be used for the 1962-1992. All the variables are in real terms taking 1980 as the base year with the exception of the ordinary expenditure*, and money supply. Also, data are expressed in log form except for real unrequited transfers balance (UTB) equations.

The next five sections (5.5-5.9) will discuss and describe the model. The complete model and a list of the variables is included in section 5.10. In general the equations are in real terms and include logarithms of the variables (denoted by L). However, the pre-fix N is used for nominal variables. Exogenous variables are in *italic*.

5.5-Theoretical Model for the Public Finance

Usually public finance is divided into two components namely: public sector revenue, and public sector expenditure. The purpose of this section is to discuss which variables determine these components.

*See P. 29 for a definition of ordinary expenditure.

5.5.1.Public Sector Revenue

There are four major variables, which can effect public sector revenue in the Libyan economy. These variables are the budget allocation from oil revenue (*BAOR*), direct taxes revenue (DTXR), indirect taxes revenue (IDTXR), and other tax revenue (*OTXR*). *OTXR* includes services revenues, sea ports and light house, civil aviation, miscellaneous services, and other revenues "not specified". It will be considered as exogenous..

In the case of Libya, public expenditure can be divided into two categories: development expenditure (DE), and ordinary expenditure (OE). In countries which find it difficult to finance their expenditure, economic planners estimate their revenue from various sources and then determine their expenditure. In the case of Libya, because it is an oil economy on the one hand, and because the government is the owner of this fortune on the other hand, the government does not face this problem. In particular in the seventies, there was an abundance of oil revenue as a result of the increase in the world oil price. Libyan economic planners did not face difficulties due to shortages of funds when they made their development plans. In other words, the planners were confident that there were enough funds to finance the development expenditure. More recently, since the collapse of the world oil prices in the beginning of 1980s, the government has had problems in financing its expenditure. Hence, the budget allocation from oil revenue essentially depended on the planned development expenditure. This expenditure is decided by the firms, projects, institutions, and the related Secretariat (Ministry) of each sector. Once the Secretariat of each sector has approved the budget, it is submitted to the Secretariat of planning to determine the final figures. Therefore, the government determines the budget allocation from oil revenue (*BAOR*). In other words, the planners take into account the development expenditure approved in the previous year and the un-implemented projects from the previous year or previous plan in deciding the current budget allocation from oil revenue. Therefore, in this model *BAOR* is an exogenous variable.

The second factor, which can affect public sector revenue, is real direct tax revenue (DTXR). In order to explain variation in direct taxes, they are related to the output which they are imposed. The hypothesis here is that, direct tax is directly related to the output (GDP). Wages and salaries in Libya are fixed by law No. 15 declared by the government in January 1981. Therefore, a dummy variable (D_{81}) is used. D_{81} takes 1 in 1981-1992 and zero otherwise. Direct taxes are imposed to depended on the following equation.

$$DTXR = f(GDP, D_{81}) \qquad (5.1)$$

Therefore, GDP and D_{81} have a positive effect on DTXR, hence f_1 and $f_2 > 0$.

The final variable, which affects the public sector budget revenue, is real indirect tax revenue. All transactions with the external world (imports or exports of goods or services) are subject to customs duties. In the literature these customs duties could be indirect tax revenue (IDTXR). However, the Libyan economy depends heavily on the external world to supply the equipment (capital goods) for development projects, raw materials to produce a few goods to supply the domestic market, and consumption goods to meet needs for foodstuffs and beverages. To keep the consumption goods at low prices, these goods are free from tax or subject to low customs duties. These consumption goods amounted to 75% of total imports in 1992 (see chapter 2, figure 2.4). Therefore, the capital and raw material goods and consumption goods are expected to effect the IDTXR. For estimation purposes, imports of capital goods and raw material goods and consumption goods will be aggregated to give a single category of total imports (TIM). In addition a dummy variable (D_{74}) reflects the new tax system which was introduced in 1974. $D_{74} = 1$ in 1974 and after, and zero otherwise. Therefore, real total imports (TIM) will be used to determine indirect tax revenue as follows,

$$LIDTXR = f(LTIM, D_{74}) \qquad (5.2)$$

Both of the independent variables are expected to have a positive effect on the dependent variable, $f_1, f_2 > 0$.

The following identity gives real total public sector budget revenue (TPSBR) by adding the real budget allocation from oil revenue (*BAOR*) to the real direct (DTXR) and real indirect (IDTXR) tax revenue in addition to the real other tax revenue (*OTXR*).

$$TPSBR_t = BAOR_t + DTXR_t + IDTXR_t + OTXR_t \qquad (5.3)$$

5.5.2-Public Sector Expenditure:

In the literature, empirical studies classify government expenditure into different types: social services expenditure, economic services expenditure and, invisible goods and services expenditure (Medel et al, 1992) or, as capital expenditure, and current expenditure (Devarajan et al, 1996). In this study, public sector expenditure has been aggregated into ordinary expenditure (OE) and development expenditure (DE). In general, ordinary expenditure is financed by tax revenue in the previous year. However, in the Libyan economy, ordinary expenditure comprises wages and salary outlay and administration expenditure. This expenditure is related to the projects, which are implemented by the government through development plans. This means increasing the amount of the salary and wages outlay because of the increase in the number employed in the economy to run these projects. Hence, the government decides its current ordinary expenditure according to the development expenditure. Therefore, development expenditures in nominal terms will be used as the explanatory variable in the OE equation as in the following equation:

$$LNOE = f(LNDE). \qquad (5.4)$$

Since the Libyan government is the oil owner, and the income from oil goes directly to the government, the government becomes responsible for finding the best way to spend the revenue from oil. Consequently, it turned to planning. On 20th of August 1963, the National Assembly approved the first five-year development plan drawn up by the government. The plan was to be financed by oil revenue of which 70 per cent was allocated to development by law (because of the low capacity of the Libyan economy this percentage has never been reached in any period). Also, since all development projects are implemented by foreign corporations, and need to import equipment, this means these expenditures must be financed in foreign currency. Therefore, real net foreign assets (FAN) are the most appropriate variable, which can be used to explain development expenditure.

Since 1986 no further development plans have been implemented. Instead annual development expenditure to complete incomplete projects from the previous plan were undertaken. *However, all the stated one-year plans are not actually economic plans in accurate terms since each plan was including merely an annual economic development budget allocating resources according to sectors and projects, but with no clear quantitative objectives (Zarmouh;1998:36).* Therefore, a dummy variable (D_{ade}) reflects government annual development expenditure since 1986 will be used. $D_{ade} = 1$ from 1986 and zero before 1986. For each three or five year development plan (which had been taken through 1963-1985) and the annual development expenditure since 1986, the government allocates a particular amount of FAN to spend in the plan period. In both cases, the government takes account of the past level of real net foreign assets (FAN) in deciding its real current development expenditure. Development expenditure depends positively on real net foreign assets and negatively on D_{ade}. Hence, $f_1 > 0$, and $f_2 < 0$. The real development expenditure equation can be written as

$$LDE = f(LFAN, D_{ade}). \qquad (5.5)$$

FAN can be determined as follows:

$$FAN_t = FAN_{t-1} + BOP_t \qquad (5.6)$$

Where BOP is the balance of payments in real terms, which represents the foreign assets flow.

Real total public sector budget expenditure (TPSBE) can be found by adding the components of public sector expenditure as follows.

$$TPSBE_t = OE_t + DE_t \qquad (5.7)$$

5.5.3-The Public Sector's Budget Constraint

As mentioned above, the budget deficit (BD) can be financed by borrowing domestically, by borrowing from abroad, by creating new money, or by running down foreign exchange reserves. In the Libyan economy, because of the absence of financial markets, the Libyan Central Bank (LCB) is the unique buyer of treasury bills and bonds. The public sector's budget constraint in real terms can be written as

$$BD_t = \Delta PD_t - \Delta FAN_t + TTXR \quad (5.8)$$

In the above public sector budget identity, and from equation (5.3) any excess of real total public sector budget expenditure, TPSBE, over real total public sector budget revenue, TPSBR, must be financed by increasing real total tax revenues (TTXR), by borrowing domestically (PD) from the LCB, or by running down real net foreign assets (FAN). Public debt can be determined as following

$$PD_t = PD_{t-1} + BD_t \quad (5.9)$$

5.6-Theoretical Model for the Money Sector and Prices

The money sector components are money supply and money demand. Data for money demand is not available. Therefore, the purpose of this section is to determine the factors, which affect the supply side of the monetary sector. The government controls the price level during 1962-1992 therefore, price equation is not being interesting to estimate.

5.6.1-Money Supply

This sub-section provides an attempt to explain the pattern of money supply. Foreign and domestic assets are the main factors affecting the money supply. This approach has been questioned for an oil-based economy like Libya (Jakublack and Dajani 1976). They argue that this approach does not provide a full explanation for money supply. However, in an oil-based economy the revenue from oil exports raises foreign assets. This has an immediate effect on money expansion (Looney, 1980). Hence, based on the discussion in chapter two, money supply in the Libyan economy can be determined by net foreign assets FAN, which has a positive effect on money supply. Therefore, money supply for the Libyan monetary sector is determined as follows;

$$LNMs = f(LNFAN) \qquad (5.10)$$

It is expected that $f_1 > 0$.

5.7-Theoretical Model for the Real Sector

The impact of government intervention on economic activity has been subject of controversy since Adam Smith. As mentioned in section 5.0, economic growth is one of the objectives of the government. Therefore, it is useful to assess the different policies used to achieve this objective. In the literature there is no standard theoretical framework of the growth process, which is appropriate to investigate the role of the government expenditure on economic growth. Different variables have been used in empirical studies. For example Marsden (1983) investigates the relation between GDP growth and taxes. Others such as Horowitz

(1965), Landau (1985), Marlow (1986), and Ram (1986) investigate the association between GDP growth and either taxes or government expenditure. Martin & Fardmesh (1990), and Bhat, Nirmala, & Kannabirn (1994) examine the influence of fiscal variables such as taxes, government expenditure and the budget deficit on economic growth performance. The results in this literature are mixed. In the Libyan case, as mentioned in section 5.0, in 1983, total public budget expenditure amounted to more than 44 per cent of GDP at current prices. This expenditure is financed by revenue from taxes, and from oil exports. Again, as mentioned in section 5.0 and sub-section 5.5.3, borrowing domestically from the LCB covers the difference between total public expenditure and total public revenue. However, when oil was discovered, Libyan gross domestic product (GDP) increased. This was because of the oil sector outcome rather than the increase of the other sectors production or productivity, since GDP is dominated by the oil sector. Output of this sector is determined by supply and demand in the international oil market, by Libyan government policy with regard of this sector, and by OPEC operations (see table 2.7). From the economic development point view it is important to investigate the growth of the non-oil sector output. One of the aims of this study is to investigate the impact of public sector expenditure on economic growth of real gross domestic product in the non-oil sector (GDPN). In order to examine the influence of fiscal variables on growth of real GDPN in Libya, real total public sector expenditure, (i.e. the split between real development expenditure, DE, and real ordinary expenditure, OE), and real size of public debt (PD) will be used. As mentioned before, the world recession in the 1980s, reduced the income from oil. This affected the government's ability to finance its high level of development expenditure. However, in 1983, the government applied what it called the "commodities budget" for imported goods including only those it considered necessary. In other words it limited quantitatively non-essential imports (Ghanem, 1985 and El-Fituri, 1992). Therefore, a dummy variable (D_{83}) can be used in this regard. The following equation will be used to reflect the supply side of the non-oil sector.

$$LGDPN = f(LTPSBE, LPD, D_{83}) \quad (5.11)$$

Real gross domestic product of the economy can be found as

$$GDP_t = GDPN_t + GDPO_t \quad (5.12)$$

where *GDPO* is real gross domestic product of the oil sector.

In less development economies (LDEs) the government plays a significant role in the economy. Libya is no exception. *A big push was needed to overcome its retarded state. (Abohobiel; 1983:61).* Therefore, both TPSBE and PD are expected to have a positive effect on gross domestic product of the non-oil sector and in (5.11) $f_1, f_2 > 0$.

5.8-Theoretical Model for Foreign Trade and Balance of Payments

The importance of the external sector comes from its role in supplying goods and services to the economy as well as supplying the government with foreign currency, which allows the government to finance its development programs. This section discusses the variables which affect both the balance of payments and the trade balance.

5.8.1-The Balance of Payments

The balance of payments reflects the economic and financial relations between the economy under consideration and the rest of the world. The balance of payments, as discussed in sub-section 2.2.4.2., comprises the current account balance (CAB), capital account balance *(KAB)*, and net errors and omissions *(EON)*. For Libya, *KAB* was in deficit in most years through 1962-1992 (see table 2.8). This indicates a net outflow from the economy. *KAB* and *EON* can be considered as exogenous (Aghevli, 1977 and Baryun, 1980). The following form illustrates the balance of payments identity in real terms.

$$BOP_t = CAB_t + KAB_t + EON_t \quad (5.13)$$

The components of CAB are trade balance (TB), services and income balance (*SIB*), and unrequited transfers balance (UTB) and so the current account balance identity in real terms can be written as follows.

$$CAB_t = TB_t + SIB_t + UTB_t \quad (5.14)$$

Since Libyan investment abroad is very small, its returns are negligible and do not effect the receipts side in the balance of payments. On the payments side, the monetary authority applies exchange control on such transfers. Therefore, *SIB* is also considered as an exogenous variable. Because the Libyan economy depends on foreign labour, UTB can be estimated as a function of the demand of foreign labour (DFL) as follows:

$$UTB = f(DFL) \quad (5.15)$$

it is expected the $f_1 > 0$.

where UTB is the real unrequited transfers balance.

Trade account balance components will be discussed in the next sub-section.

5.8.2-The Trade Account Balance

The trade account balance is divided into exports and imports. As mentioned in section 2.2.4.1 Libyan exports are dominated by oil sector exports. Therefore, the value of oil exports (VOEX) is the only equation to be estimated for Libyan exports.

Two possible factors may determine VOEX: oil production (*OPR*), and the quantity of oil exports. The first factor is determined by the Libyan government, and therefore is treated as exogenous. On the other hand, the quantity of oil exports is determined by the Organisation of Oil Exporting Countries (OPEC) operations (see table 2.7) which, especially since the collapse of oil prices in the 1980s, has tried to maintain oil price stability and aggregate oil demand by oil consumption countries. A single dummy variable was used to avoid using up too many degrees of freedom. Therefore, a dummy variable (D_{po}) reflects the political factors which affect Libyan oil exports (see table 2.7). D_{po} takes the value one in 1974 when oil prices increased as a result of the Israel Arab war in October 1973, in 1980-1981 as a result of the Iranian crisis in 1979, and through 1982-1992 as a result of the other political factors presented in table 2.7 and zero otherwise. The real value of oil exports (VOEX) equation can be specified as follows, and it is expected that in (5.16) $f_1>0$, $f_2<0$.

$$LVOEX = f(LOPR, D_{po}) \qquad (5.16)$$

Imports have been dis-aggregated into imports of consumption goods (ICG), imports of capital goods (IKG), and imports of raw material goods (IRMG). As mentioned in section 2.2.4.1 the high rate of population growth, improvement in the standard of living, and the low capacity of the commodity and economic services sector to meet the increasing demand for such goods, were the main factors causing imports of consumption goods to increase.

Again as mentioned in section 2.2.4.1, the increase in both capital goods and raw material goods imports can be attributed to the highly ambitious development programmes during 1963-1985. In many empirical studies the import price index or an imports price deflator and domestic output or domestic absorption capacity are used as variables in the imports function (see Aghevli, 1977, Baryun, 1980, Abohobeil, 1983, and Abosedra, 1984). For Libya the increase in income from oil reduced the pressures on the government. *In the trade sector commodities were imported from all over, with no attention as to whether or not they were necessary... The government also directed its efforts to heavy industry. Some of the industrial projects bore very little relation to the country. The machines were imported, as were the technical knowledge, raw materials, and labour. (Ghanem; 1985:225-226)*. Up to 1980 due to the increase in income from oil, it was not difficult for Libya to finance its imports of capital and raw material goods for development projects. However, as a result of the world recession at the beginning of the 1980s, oil prices dropped and the income from oil went down. This loss of income affected the country's ability to continue its imports policy. The government recognised that it could not continue to finance this high level of imports. *The value of projects signed in Libya as part of the five-year plan, which* *was drawn up before the sudden fall in oil resources was 11.827 billion US dollars in 1981. The value of the projects signed in 1982 went down to 1.374 billion US dollars (Ghanem; 1985:228).* It is clear from this discussion that development expenditure is the main determinant of capital and raw material imports. Therefore, for estimation purposes, these two goods will be aggregated. Also, as mentioned in section 2.2 the increase of commercial banks deposits gave a chance for these banks to increase their loans to the private sector as well as for the government agency to import goods and services to supply the increased demand in the domestic market. Hence, real commercial banks credit (*CBC*) is used. The following equation will be used to estimate the real total imports (TIM). It is expected that TPSBE and *CBC* have a positive effect on TIM.

LTIM = f (LTPSBE, *LCBC*). (5.17)

f_1 and $f_2 > 0$

The trade account balance in real terms is determined as the difference between real total exports (VOEX + *OEXN*) and real total imports (TIM). Hence, the following identity specifies the real trade balance equation.

$TB_t = (VOEX_t + OEXN_t) - (TIM_t)$ (5.18)I

where *OEXN* is real non-oil exports.

5.9-Theoretical Model for the Employment Sector

The labour market plays a significant role of any macro-economic model. This is particularly true in an economy like Libya, where labour shortage is considered one of the main impediments facing the country's development. As discussed in section 2.2.5 Libyan labour is only able to satisfy part of the required demand for labour. Hence, the Libyan economy has to rely on the external labour market to fill the gap between aggregate demand and the supply of domestic labour. The objective of this section is to determine the demand and the supply of labour in aggregate form.

5.9.1-Labour Supply

This sub-section is concerned with the determination of the supply side of the employment sector. The aggregate supply of labour consists only of the supply of Libyan labour (SLL). Economic theory suggests that wages and output can be used as explanatory variables in the labour supply function (Branson, 1979). Also, gross domestic product (GDP) has been effected by the world recession in the 1980s, hence, a dummy variable (D_{80}), which reflects this matter, can be used. $D_{80} = 1$ from 1980 and zero earlier. As mentioned before, wages and salaries in Libya are fixed by law No. 15 declared by the government in January 1981, therefore, the SLL is inelastic with respect to wages. Hence, wages and salaries cannot be used in determining the Libyan supply labour. Instead, the supply of labour is determined by demographic and social factors rather than by real wages. This approach was adapted in previous studies of the Libyan economy (Mustafa, 1979. Abohobeil, 1983, and Abosedra, 1984) and will be used here. The equation for the supply of Libyan labour (SLL) is:

$$LSLL = f(LPOPL, D_{80}) \qquad (5.19)$$

Where *POPL* is Libyan population. It is expected $f_1, f_2 > 0$,

5.9.2-Labour Demand:

Because the Libyan economy relies on foreign labour, the present study assumes that there is no unemployment. Therefore, only one demand for labour equation will be estimated. This is the total employment (TLD). The real wage rate and real output level are usually taken as proxy variables in the demand for labour equation. Therefore, GDP is used in determining total labour demand. However, the government faced financial problems because of the world recession since 1980. As a result the government relies on public debt in financing a part of its expenditure especially wages and salary. Therefore, the public debt (PD) and a dummy variable (D_{81}), which reflects the new wages and salary law No. 15 declared by the government in January 1981, are used as explanatory variables in the total labour demand equation, which is:

$$LTLD = f(LGDP, LPD, D_{81}) \quad (5.20)$$

With f_1, f_2, and $f_3 > 0$.

The demand for foreign labour (DFL) is determined as follows:

$$DFL_t = TLD_t - SLL_t \quad (5.21)$$

5.10-The Complete Model

In this section the complete model will be specified. There are 21 equations, of which 11 are behavioural and 10 are identities (I). The 41 variables consist of 21 endogenous, 14 exogenous (denoted by *italics*) and 6 dummy variables. In general the equations are in real terms and include logarithms of the variables (denoted by L). However, an exception is for ordinary expenditure (5.4), which is in nominal terms. Furthermore, the equations for direct tax revenue (5.1) and unrequited transfer balance (5.15) are in level form. Also, theoretically the money supply equation (5.10) is in nominal form. The coefficients' expected signs are shown after the behaviour equations. Finally, the basic inter-relationships and feedback among the different components of the model are shown in chart 5.1

A. ***The public finance sector equations:***

A.1.Public finance revenue.

$DTXR=f(GDP,D_{81})....f_1,f_2>0$ (5.1)

$LIDTXR=f(LTIM, D_{74})....f_1, f_2>0$ (5.2)

$TPSBR_t=BAOR_t+DTXR_t+IDTXR_t+OTXR_t$ (5.3) (I)

A.2. Public finance expenditure.

$LNOE=f(LNDE)...f_1>0$ (5.4)

$LDE=f(LFAN,D_{ade})....f_1>0,f_2<0$ (5.5)

$FAN_t=FAN_{t-1}+BOP_t$ (5.6) (I)

$TPSBE_t=OE_t + DE_t$ (5.7) (I)

B. The public budget sector's constraint:

$BD_t = \Delta PD_t - \Delta FAN_t + TTXR$ (5.8) (I)

$PD_t=PD_{t-1}+BD_t$ (5.9) (I)

C. The monetary sector equation:

C.1. Money supply.

$LNMs=f(LNFAN)....f_1>0$ (5.10)

D. Output equations:

$LGDPN=f(LTPSBE,LPD,D_{83})....f_1,f_2>0 and f_3<0$ (5.11)

$GDP_t= GDPN_t + GDPO_t$ (5.12)(I)

E. Foreign trade and balance of payments:

E.1. The balance of payments identities.

$BOP_t=CAB_t+KAB_t+EON_t$ (5.13)(I)

$CAB_t=TB_t+ SIB_t + UTB_t$ (5.14)(I)

$UTB=f(DFL)...f_1>0$ (5.15)

E.2. The trade balance equations.

E.2.a. Oil exports equation.

$LVOEX=f(LOPR,D_{po})....f_1 >0 and f_2 <0$ (5.16)

E.2.b. Imports equations.

$LTIM=f(LTPSBE,LCBC)....f_1,f_2>0$ (5.17)

$TB_t=(VOEX_t+OEXN_t)-(TIM_t)$ (5.18)(I)

F. Employment sector equations:

F.1. Labour supply equation

$LSLL = f(LPOPL, D_{80})....f_1, f_2 >0$ (5.19)

F.2. Labour demand equations.

$LTLD=f(LGDP,LPD, D_{81})....f_1, f_2, f_3 >0$ (5.20)

$DFL_t = TLD_t - SLL_t$ (5.21)(I)

The variables are defined as below.

Endogenous variables.

BAOR is real budget allocation from oil revenue. (Million of Libyan Dinars)

BD is real public sector budget deficit. (Million of Libyan Dinars).

BOP is real balance of payments. (Million of Libyan Dinars)

CAB is real current account balance. (Million of Libyan Dinars)

DE is real development expenditure. (Million of Libyan Dinars)

NDE is nominal development expenditure (Million of Libyan Dinars).

DFL is demand for foreign labour. (Thousands of persons)

DTXR is real direct tax revenue. (Million of Libyan Dinars)

GDP is real gross domestic product. (Million of Libyan Dinars)

GDPN is real gross domestic product in the non-oil sector. (Million of Libyan Dinars)

IDTXR is real indirect tax revenue. (Million of Libyan Dinars)

NMs is nominal money supply (narrow definition). (Million of Libyan Dinars)

FAN is a real net foreign asset. (Million of Libyan Dinars).

NFAN is nominal net foreign assets (Million Libyan Dinars).

PD is real public debt. (Million of Libyan Dinars).

NPD is nominal public debt (Million Libyan Dinars).

OE is real ordinary expenditure. (Million of Libyan Dinars)

NOE is nominal ordinary expenditure (Million of Libyan Dinars).

SLL is supply of Libyan labour. (Thousands of persons)

TB is real trade balance. (Million of Libyan Dinars).

TIM is real total imports (Million of Libyan Dinars).

TLD is total labour demand. (Thousands of persons)

TTXR is total tax revenue (Million of Libyan Dinars)

TPSBE is real total public sector budget expenditure. (Million of Libyan Dinars).

TPSBR is real total sector public budget revenue. (Million of Libyan Dinars).

UTB is real unrequited transfer balance. (Million of Libyan Dinars)

VOEX is real value of oil exports. (Million of Libyan Dinars).

Exogenous variables.

CBC is real commercial banks credits. (Million of Libyan Dinars).

D_{ade} is a dummy variable to reflect annual development expenditure. $D_{ade} = 1$ in 1986-1992, and zero otherwise.

D_{po} is a dummy variable to reflect the political factors effecting oil sector exports. $D_{po} = 1$ in 1974, 1980-1992, and zero otherwise.

D_{74} is a dummy variable to reflect the new tax system, introduced in 1974. $D_{74} = 1$ in 1974 and after, and zero otherwise.

D_{80} is a dummy variable to reflect the world economic recession. $D_{80} = 1$ in 1980 and after, and zero otherwise.

D_{81} is a dummy variable to reflect the new wages and salaries system (law No.

15 for wages and salaries). D_{81} = 1 in 1981 and after, and zero otherwise.

D_{83} is a dummy variable to reflect the government measurements to apply what calld "commodity budget. D_{83} takes 1 during 1983-1992 and zero otherwise.

EON is real net error and omissions. (Million of Libyan Dinars).

GDPI is GDP price index (1980 = 100).

GDPO is real gross domestic product of the oil sector. (Million of Libyan Dinars).

KAB is real capital account balance. (Million of Libyan Dinars).

OEXN is real non-oil exports (Million of Libyan Dinars).

OTXR is real other tax revenue. (Million of Libyan Dinars).

OPI is oil price index (1980 = 100).

OPR oil production (quantity, in million of barrels).

PI is price index level. (1980 = 100).

POPL is Libyan population (Thousands of persons)

SIB is real services and income balance. (Million of Libyan Dinars).

TEXPI is total export price index (1980 = 100).

TIMPI is total import price index (1980 = 100).

5.11-Conclusion

The purpose of this chapter is to construct an econometric model for the Libyan economy. The model is based on annual data covering the period 1962-1992. The relation between econometric and economic policy was discussed in section 5.1. Also, the problems of economic modelling were discussed in section 5.2. These problems can be related to (i) the period length, (ii) dynamic of adjustment, and

(iii) the estimation technique. The explanation of inflation in developing countries was discussed in section 5.3. The model has five sectors, with the public finance linked to the monetary sector, the real sector, the foreign trade and the balance of payments, and the labour market. All the data are in real terms and valued in the Libyan currency (Libyan Dinar). Dummy variables were used to reflect the economic and political events. The aim is that the model would contend is applicable the Libyan economy. To translate this theoretical framework into an empirical macro-model of the Libyan economy. The estimation of the model will be the subject of the next chapter.

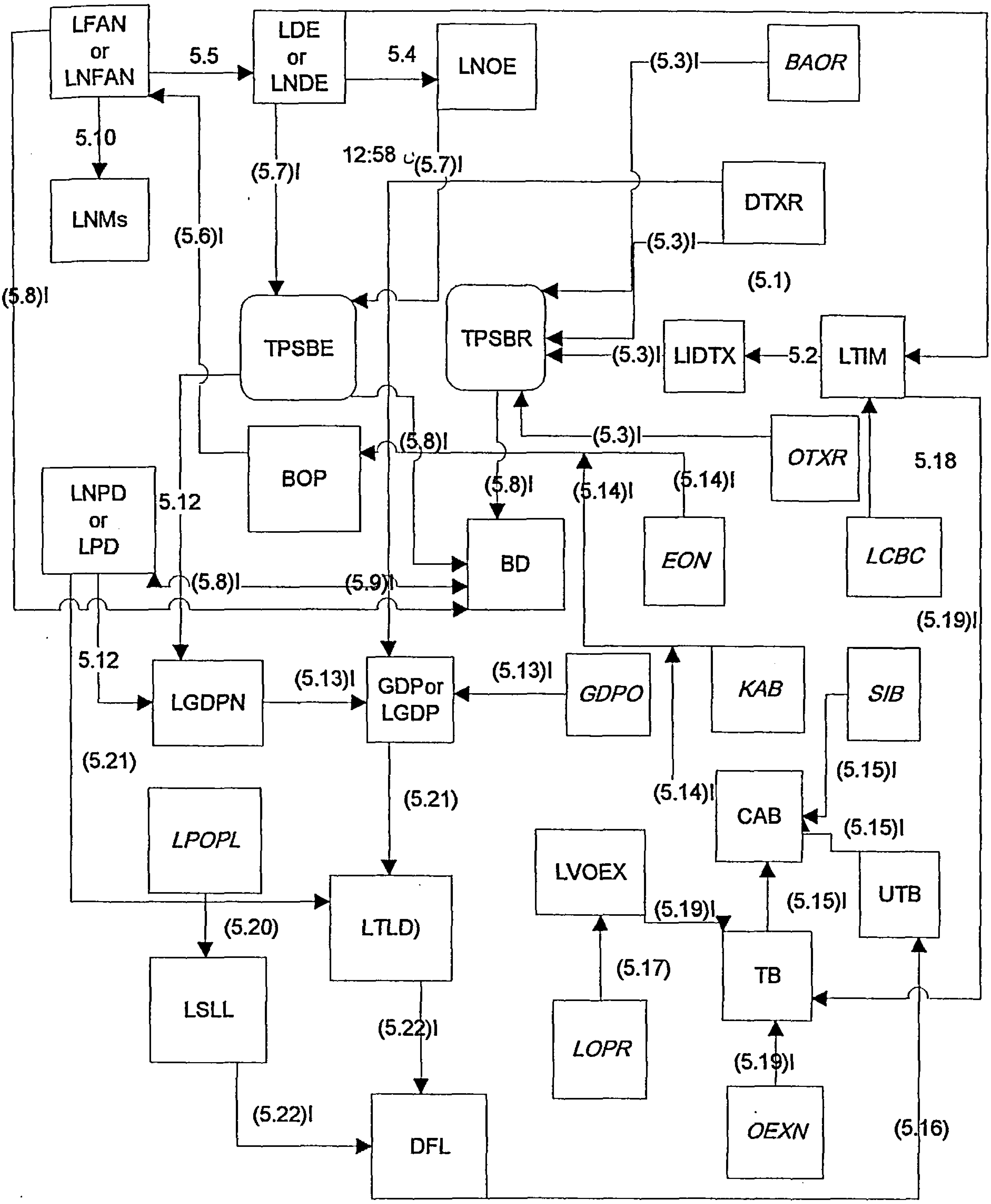


Chart 5.1. Flow chart of the Macro-econometric Model of the Libyan Economy.

Chapter Six

Estimation of the Model

6.0-Introduction

In this chapter the model of the Libyan economy outlined in the previous chapter will be estimated. As mentioned before, the aim of this study is to investigate the impact of government expenditure on economic growth, employment, and total imports in the Libyan economy. The Johansen approach will be used to estimate the model. The rest of this chapter is divided into three main sections. First, the Dickey-Fuller test will be used to check the stationarity and the order of integration of each individual variable in section 6.1. Estimating the long-run cointegration relationships, which exist between the endogenous and exogenous variables, is carried out in section 6.2. In section 6.3, the Error Correction Model for each behavioural equation of the model is estimated to give the short-run dynamic relationship. However, the lack of current information leads to decisions being based on the last previous year's observe values in determining the current value of the dependent variable of each behaviour equation. Economic theory suggests the sign and the size of the coefficients of the explanatory variable. Also, statistical criteria will be used in selecting the best equation to explain the short-run dynamic relationship.

6.1-Applications of Stationarity Tests to Libya

All the data are annual and are for calendar years. Econometricans suggest that, *the first step in any empirical analysis should be examine each of the variables individually to check their unit roots and their order of integration (Holden and Thompson; 1992:10).* The Dickey-Fuller test is used to test for unit roots for each variable. The essence of the Dickey-Fuller test [Fuller(1976) and Dickey and Fuller (1979), (1981)] is that rejection of the null hypothesis implies stationarity. This requires negative and significant test statistics. Although the test statistics are calculated as t-ratios in the Dickey -Fuller (DF) and Augmented Dickey-Fuller (ADF) regressions, the non-stationarity implies that they do not have standard t-distributions and so the tables of Mackinnon (1991) are used. DF and ADF test statistics have been calculated for the variables, which the model includes, both in their levels and in first differences. The unit root tests has been carried out for each variable by applying (3.13) or (3.14) which are represented below, and testing whether $\beta < 0$.

$$dY_t = \alpha_0 + \beta Y_{t-1} + u_t \qquad (6.1)$$

$$dY_t = \alpha_0 + \beta Y_{t-1} + \gamma t + u_t \qquad (6.2)$$

where dY is the first difference of Y.

Table 6.1 presents the results of these tests for the behavioural equations variables in real terms (with the exception of NOE, and NMs, which are in nominal terms) in levels and in their first differences. All variables are expressed in log form (with exception DTXR and UTB). Development expenditure is estimated in real (DE) and in nominal (NDE) terms as they both occur in the behavioural equations.

The DF and ADF test statistics are calculated both with and without time trend. When the DF equation was estimated the Lagrange Multiplier test for auto-correlation was used. If auto-correlation was present, the ADF test was applied, with one lagged dY term. This was sufficient to remove any auto-correlation. The values of these test statistics with 5 per cent critical values, as tabulated in Mackinnon (1991), are included in table 6.1. The results indicate that none of the variables is stationary in its level except for LNDE, LGDP, LNMs, UTB, LOE, LTPSBE, LVOEX, LNFAN, and LPD. However, DF and ADF test statistics for the variables in their first differences (table 6.1) indicate the stationarity of all the variables.

Table 6.1

Unit Root Test

	Level			First Difference				
Variable	**DF**	**ADF(1)**	**LM(1)**	**DF**	**ADF(1)**	**T**	**LM(1)**	**Conclusion**
LNDE	-3.2603		0.76 (0.38)	-3.4987			1.99 (0.16)	I(1)
LDE	-2.8607		0.80 (0.37)	-3.7287			0.50 (0.48)	I(1)
LDFL	-1.2449		1.62 (0.20)	-4.2035			0.07 (0.7)	I(1)
DTXR	-0.9779		0.01 (0.92)	-5.1649			0.04 (0.85)	I(1)
LGDP	-6.04		0.95 (0.33)	-3.2206			2.07 (0.15)	I(1)
LGDPN	-2.7813	-2.1748	2.02 (0.16)	-8.4034			2.31 (0.13)	I(1)
LIDTXR	-1.9267		3.70 (0.05)	-7.4318			3.52 (0.06)	I(1)
LTIM	-2.6009		0.23 (0.63)	-4.337			0.00 (0.57)	I(1)
LNMs	-3.6568		0.29 (0.59)	-4.0901			3.60 (0.06)	I(1)
UTB	-4.8886		2.20 (0.14)	-10.7782			0.08 (0.77)	I(1)
LNOE	-2.7163		0.91 (0.34)	-5.4216			0.22 (0.64)	I(1)
LSLL	4.3609		3.02 (0.08)	-3.849		2.4456	0.50 (0.48)	I(1)
LTLD	-1.053		3.22 (0.07)	-3.646			1.16 (0.28)	I(1)
LTPSBE	-4.446		2.93 (0.09)	-8.5418			1.93 (0.17)	I(1)
LVOEX	-4.4703		1.09 (0.30)	-5.0301			4.38 (0.04)	I(1)
LNFAN	-3.207		0.08 (0.78)	-4.2006			1.14 (0.29)	I(1)
LCBC	-2.6249	-1.9791	0.38 (0.54)	-3.081		-1.62	1.11 (0.29)	I(1)
LFAN	-2.507		0.96 (0.33)	-4.006			0.06 (0.80)	I(1)
LOPR	-2.466	3.5441	0.26 (0.61)	-4.0949			1.01 (0.31)	I(1)
GDP	-2.1872		3.90 (0.05)	-7.3699			0.28 (0.60)	I(1)
LPD	-5.1772		1.34 (0.25)	-3.6025			7.37 (0.01)	I(1)
LPOPL	6.282	1.607	0.97 (0.32)	-4.373		-2.074	0.24 (0.63)	I(1)

5% Critical values.	Without time trend.	With time trend
DF	*-2.9665*	*-3.5731*
ADF	*-2.9706*	*-3.5796*

LM is Lagrange Multiplier test for auto-correlation to order (1)
For LM(1) tests the figures in brackets are probabilities.

Another method which can be used to check stationarity of the variables is to graph the series The graphs of these variables are shown in Figure 6.1 (in levels and in first differences) and support the view that the levels variables are I (1) rather than I (0).

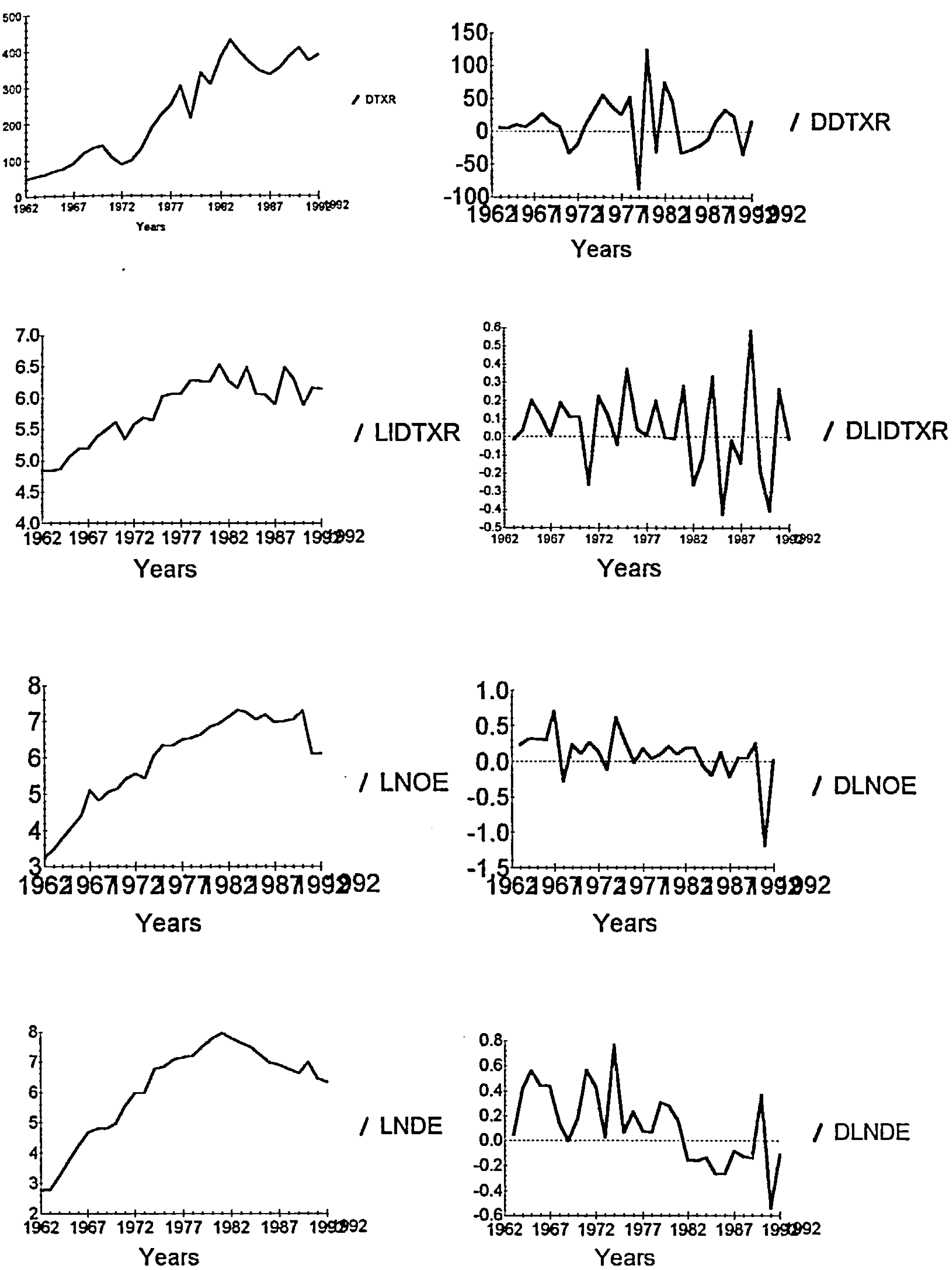
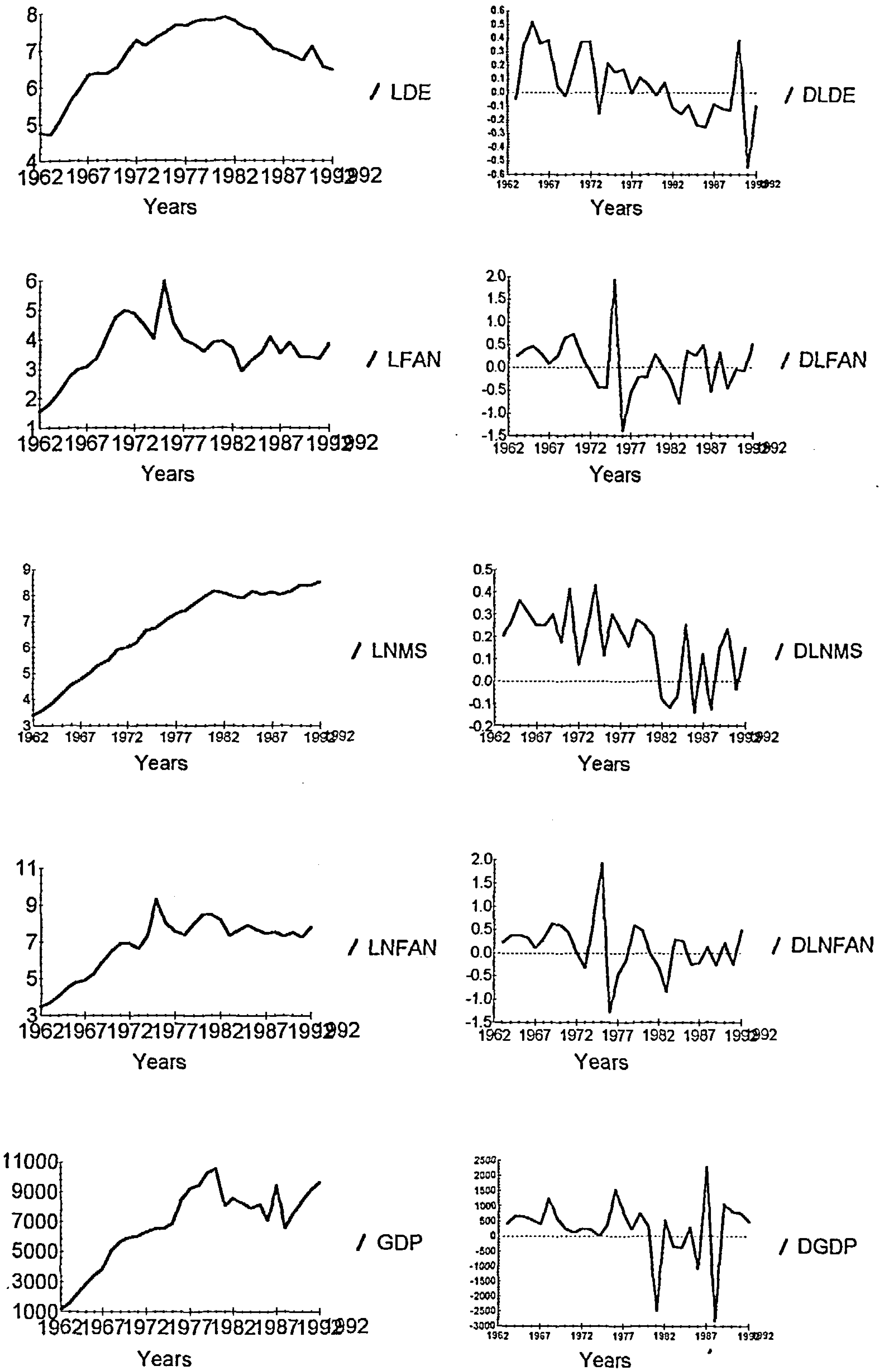


Figure 6.1 Continue



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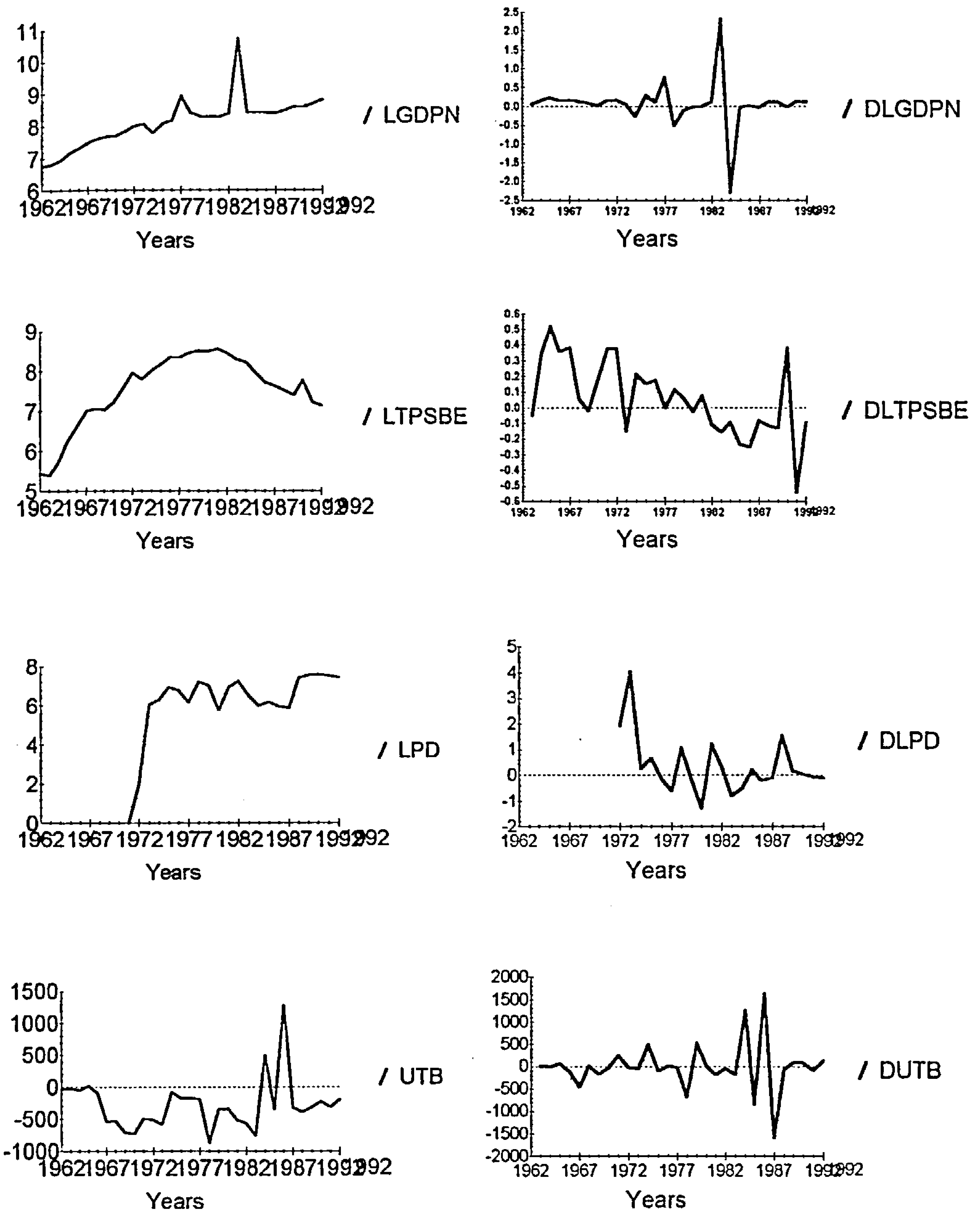

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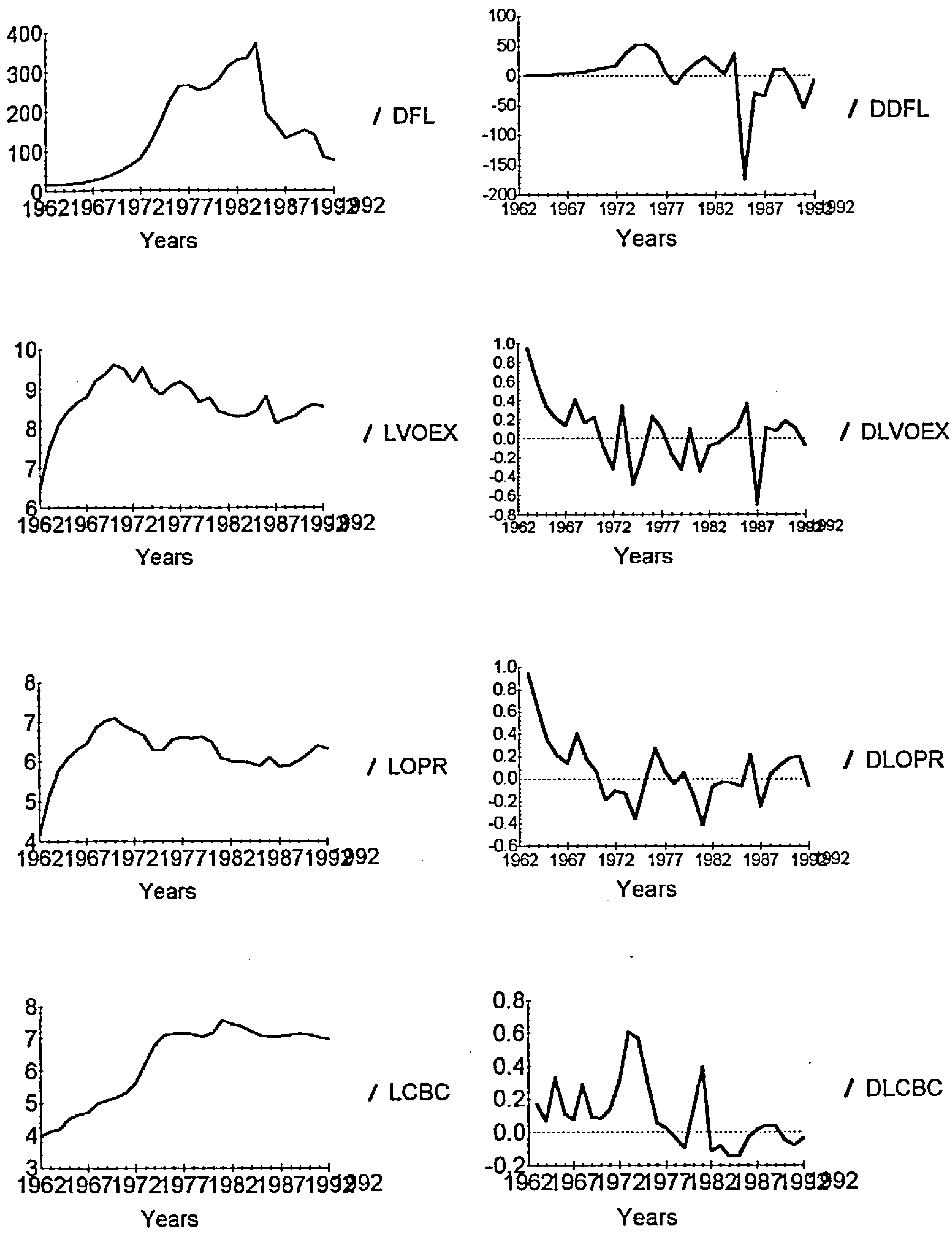


Figure 6.1 Continue

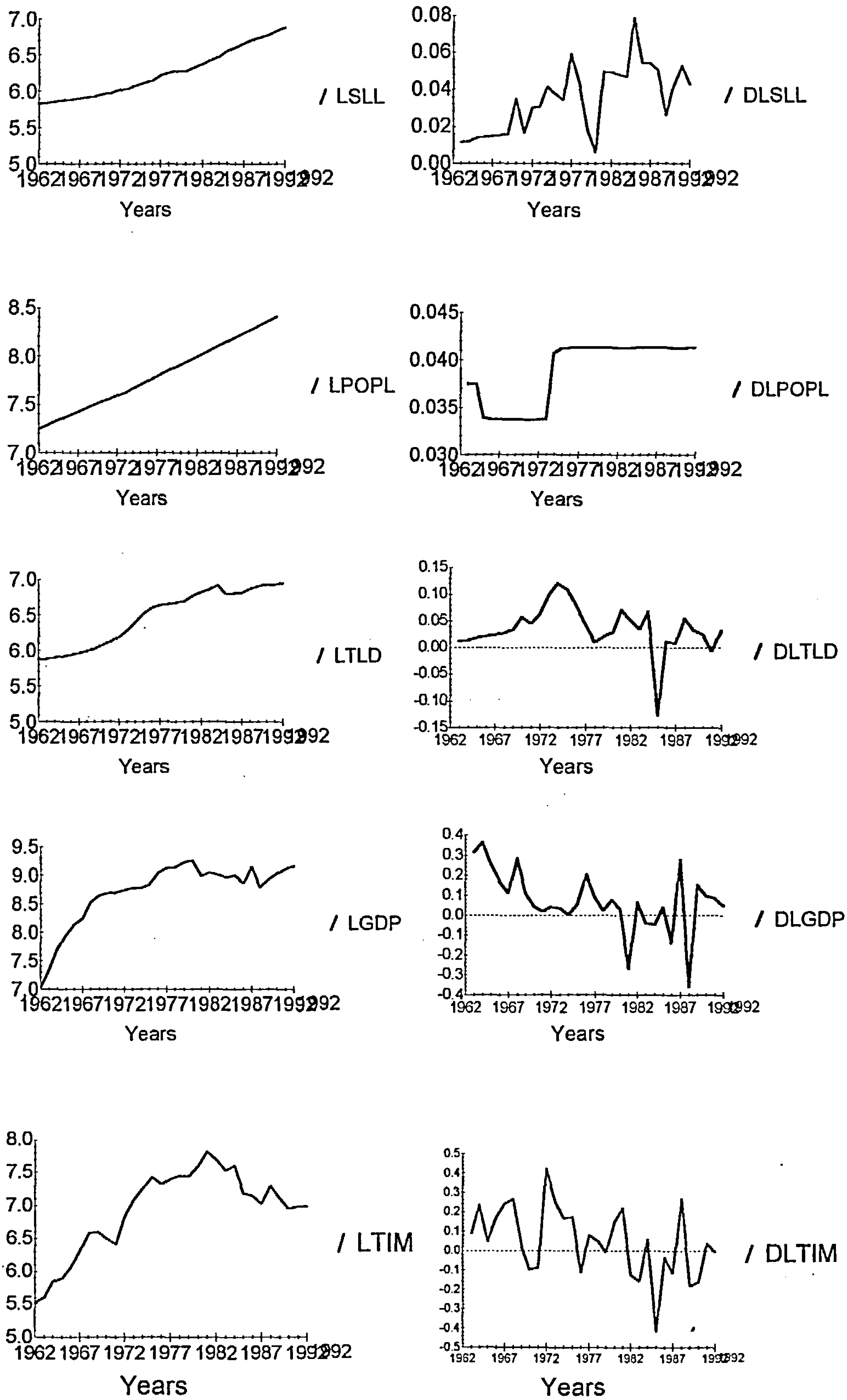


Figure 6.1 Stationarity Test

According to the above, the results indicate that all the variables are stationary in first differences. Hence, the variables are integrated of order one. Consequently, it is possible to move on to the next step, attempting to detect whether or not some of these variables are co-integrated.

6.2-Applications of Co-integration Tests to Libya

The Johansen approach discussed in the sub-section 3.3.3.1 can be used for two purposes (i) determining the maximum number of co-integrating vectors for the sets of variables under consideration and (ii) obtaining maximum likelihood estimates of the co-integrating vectors and adjustment parameters. This is obtained by employing the canonical correlation method and utilising the eigenvalue and eigenvectors revealed by the matrix of correlation coefficients. The Johansen (1988) method is superior to other method (e.g. the Engle and Granger, 1987 method) in two respects. *First, it produces results that are invariant with respect to the direction of normalisation, simply because all of the variables are assumed to be endogenous in a vector auto-regressive framework. Second, it makes it possible to estimate all of the linearly independent co-integrating vectors, whereas it is not clear whether the co-integrating relation obtained from the Engle and Granger method is a unique co-integrating vector or linear combination of them (Moosa, 1992-93:446).*

The Johansen (1988) procedure has received a great deal of attention in the literature. Johansen and Juselius (1990) applied the procedure on Danish and Finnish demand for money data. Muscatelli and Papi (1990) construct a model of the demand for M2 in Italy. Holden and Thompson (1992) applied the Johansen procedure to explain the level of trade union membership in Australia. Moosa (1992-93) applied the Johansen method to investigate the relation between money and prices, and the controllability of the money supply in India. Muscatelli and Hurn (1992) applied the Johansen procedure for the demand for money in the UK. More recently, Williams and Bessler (1997) used the Johansen co-integration approach to investigate the dynamic relationship between high fructose corn syrup prices and refined sugar price, and Chowdhury (1997) to investigate the demand for money in Thailand.

The purpose of this section is to apply the Johansen (1988) method to Libyan data to investigate whether any stable, long-run relationships exist between exogenous and endogenous variables. The Johansen procedure provides two test statistics for the number of independent co-integrating vectors, r, based on the number of significant eigenvalues of the co-integrating matrix. The Maximal eigenvalue (Max) test for the null hypothesis that $r \leq q$ against the alternative hypothesis that $r = q$ and the Trace test for the null hypothesis that $r \leq q$ against the null hypothesis that $r \geq q + 1$. However, to carry out the co-integration test it is necessary to select the Vector Auto-regression (VAR) model for the behavioural equations of the model. Since the aim is to select the 'optimal' order of the VAR, it is important to select an order high enough to be reasonably confident that the optimal order will not exceed it. In the case of the present application, because of the limitation of the data, 4 was used as the maximum order of the VAR for Microfit version 4.0 (developed by Pesaran and Pesaran). The Johansen likelihood ratio (LR) test statistics for the hypothesis that there are at most q co-integration vectors is carried out for each of the behavioural equations of the model from the previous chapter by applying equations (3.30) and (3.31) using microfit. Both of these equations represented below.

$$S_{ij} = T^{-1} \sum_{t=1}^{T} R_{ij} R'_{ij} \quad i,j = 0,1 \qquad (6.3)$$

$$-2\ln(Q) = -T \sum_{i=r+1}^{p} \ln(1-\lambda) \qquad (6.4)$$

The values obtained from the likelihood ratio (LR) test statistics determine the number of co-integration vectors (r). The Schwarz Bayesian criterion (SBC) suggests a VAR of order one for most of the equations of the model. However, the later results based on the VAR (1) model were unsatisfactory for most of the equations. It was decided to follow the advice *it is possible to try a higher order of VAR model - although this is not recommended by the selection criteria or the likelihood ratio test statistics. (Pesaran & Pesaran 1997; 276).* Therefore, an order of up to 3 for the VAR was tried. Table 6.2 presents the results for order of VAR and the co-integration test for each behavioural equation. When the different tests give contradictory values for r, the number of co-integration vectors, a decision has to be made as to which value to use.. It is easy to interpret the results in economic terms when the number of co-integration vector (r) is one. Therefore, the one co-integration vector is accepted when is suggested by the Max, Trace, or SBC statistics.

Table 6.2

Order of VAR and Co-integration Tests

Equ. No	Equation	Order of Var	Max Test	Trace Test	SBC Test	Concluded
5.1	DTXR=f(GDP, D_{81})	2	1	1	1	1
5.2	LIDTXR=f(LTIM, D_{74})	1	1	0	1	1
5.4	LNOE=f(LNDE)	2	1	1	2	1
5.5	LDE=f(LFAN, D_{ade})	1	0	1	2	1
5.10	LNMs=f(LNFAN)	2	0	1	2	1
5.11	LGDPN=f(LTPSBE, LPD, D_{83})	2	1	1	1	1
5.15	UTB=f(DFL)	2	1	1	1	1
5.16	LVOEX=f(*LOPR*, D_{PO})	2	0	0	1	1
5.17	LTIM=f(LDE, *LCBC*)	2	1	1	2	1
5.19	LSLL=f(*LPOPL*, D_{81})	2	0	0	1	1
5.20	LTLD=f(LGDP, PD, D_{81})	2	1	1	2	1

Based on the above results the co-integration vector (CV) is estimated to obtain the long-run relation for each behavioural equation. The following sub-sections discuss and present the results, which are summarised in table 6.3. The coefficients are significant, and have the expected signs.

Table6.3

Co-integration Vector (CV)

Eq. No	Equation
5.1	DTXR = 0.0298GDP
5.2	LIDTXR = 0.5001LTIM
5.4	LNOE = 0.5311;NDE
5.5	LDE = 0.2699LFAN
5.10	LNMs = 0.4244LNFAN
5.11	LGDPN = 0.6586LTPSBE + 0.0570LPD
5.15	UTB = 0.6368DFL
5.16	LVOEX = 0.6692*LOPR*
5.17	LTIM = 0.5167LTPSBE + 0.0619*LCBC*
5.19	LSLL = 0.9827*LPOPL*
5.20	LDFL = 0.2803LGDP + 0.0439LPD

6.2.1-Co-integration Vector for DTXR equation

The real direct tax revenue equation is

$$DTXR = f(GDP, D_{81}) \qquad (5.1)$$

The results in table 6.2 suggest an order of VAR 2, and a single co-integration vector. The following equation presents this long-run relationship.

$$DTXR = 0.0298GDP \qquad (6.5.1\text{-CV})$$

6.2.2-Co-integration Vector for LIDTXR equation

The real indirect tax revenue equation is

$$LIDTXR = f(LTIM, D_{74}) \qquad (5.2)$$

Table 6.2 suggests an order of VAR of one for real indirect tax revenue (LIDTXR) equation. Max and SBC test for number of co-integration vector in table 6.2 suggest one co-integration vector to give the long-run relationship between LIDTXR and real total import (LTIM) as the following equation illustrates.

LIDTXR = 0.50LTIM (6.5.2-CV)

Microfit can include I (0) variables such as D_{74} in the tests for co-integration but these have no effect in the long-run and so are omitted from the co-integration equation.

6.2.3-Co-integration Vector for LNOE equation

The nominal ordinary expenditure equation is

LNOE = f (LNDE) (5.4)

The results in table 6.2 suggest VAR of order 2. The maximal eigenvalue (Max) test and the Trace test suggest a single co-integration vector, which may be interpreted as a long-run ordinary expenditure (OE) relationship as presented by the following equation.

LNOE = 0.53LNDE (6.5.4-CV)

6.2.4-Co-integration Vector for LDE equation

The real development expenditure equation is

LDE = f (LFAN, D_{ade}) (5.5)

The procedure suggests the order of VAR is 1 as, presented in table 6.2. The Trace test in table 6.2 suggests one co-integration vector, giving the long-run relationship between LDE and LFAN as:

LDE = 0.27LFAN (6.5.5-CV)

6.2.5-Co-integration Vector for LNMs equation

The nominal money supply equation is

LNMs = f (LNFAN) (5.10)

Equation 5.10 table 6.2 presents order of VAR 2 for the equation. The Trace test for co-integration in table 6.2 suggests one co-integration vector exists. The following equation presents the co-integration vector.

LNMs = 0.42LNFAN **(6.510-CV)**

6.2.6-Co-integration Vector for LGDPN equation

The GDPN equation is

LGDPN = f (LTPSBE, LPD) (5.11)

From table 6.2 the results indicate order of VAR 2, also, the co-integration tests all suggest one co-integration vector. The long-run relationship is:

LGDPN = 0.66LTPSBE + 0.06LPD (6.5.11-CV)

6.2.7-Co-integration Vector for UTB equation

The of UTB equation is

UTB = f (DFL) (5.15)

The real unrequited transfer balance (UTB) in Libyan economy is determined by the demand for foreign labour (DFL). For these variables the results suggest an order of VAR of 2. Also, the Max test, the Trace and the SBC tests in table 6.2 suggest one co-integration vector. Based on the above results, the long-run relationship between the two variables is:

UTB = 0.64DFL (6.5.15CV)

6.2.8-Co-integration Vector for LVOEX equation

The value of oil exports equation is

LVOEX = f (*LOPR*, D_{PO}) (5.16)

The results suggest an order of VAR of 2. The SBC test suggests a single co-integration vector. The following equation presents the long-run relationship.

LVOEX = 0.67*LOPR* (6.5.16-CV)

6.2.9-Co-integration Vector for LTIM equation

As mentioned before Libyan imports dis-aggregated into ICG, IKG, and IRMG. For estimation purposes, the last three variables are aggregated to give a single variable TIM. The TIM equation is:

LTIM = f (LTPSBE, *LCBC*) (5.17)

The results in table 6.2 indicate an order of VAR of 1. The Max and the Trace tests in table 6.2, suggest a unique co-integration vector. This is accepted and the long-run relationship between the variables:

LTIM = 0.52LTPSBE + 0.06*LCBC* (6.5.17-CV)

6.2.10-Co-integration Vector for LSLL equation

Following previous studies for the Libyan economy Libyan population (LPOPL) is used to determine the supply of Libyan labour (LSLL) and a dummy variable (D_{80}) reflects the world recession in the 1980s. The LSLL equation is:

LSLL = f(*LPOPL*, D_{80}) (5.19)

An order of VAR of 2 is selected (see table 6.2). The SBC test indicates a single co-integration vector and the estimated equation is:

$LSLL = 0.98LPOPL$ (6.5.19-CV)

6.2.11-Co-integration Vector for LTLD equation

The total labour demand equation is

$LTLD = f(LGDP, LPD, D_{81})$ (5.20)

The results suggest an order of VAR of 2. The Max, and the Trace tests suggest a single co-integration vector (see table 6.2). The long-run relationship between the variables is;

$LTLD = 0.28LGDP + 0.04LPD$ (6.5.20-CV)

6.3-Application of Error Correction Model of Libyan Data

Having estimating the long-run relationships between the variables in each behavioural equation, the short run dynamic structure of the model is also needed. This is addressed here. Johansen starts with the vector auto-regression (VAR)

$Y_t = f(Y_{t-1}, Y_{t-2}, \ldots X_{t-1}, X_{t-2}, \ldots Z_{t-1}, Z_{t-2}, \ldots\ldots)$ (A)

Where there is a maximum lag of L. If there is co-integration the model can be written as the error correction model

$dY_t = f(ECT_{t-1}, dY_{t-1}, \ldots, dX_{t-1}, \ldots dZ_{t-1}, \ldots)$ (B)

Where ECT is the error-correction term for the co-integration variables. There are also similar equations for dX and dZ. Once the cointegration vector has been estimated the lagged value of the residual can be included in (B) to give the short-run dynamic model or ECM. From the earlier tests the maximum lag in the VAR is known and this indicates the maximum lag in (B). The modelling strategy is to estimate (B) including the lagged variables from the theoretical model and then to check if the diagnostic statistics are satisfactory and the lagged error correction term has a significant negative coefficient. Should these not be the case the model needs to be improved by adding suitable I(0) variables (possibly including dummy variables) until satisfactory results are obtained. The variables newly included should have an economic justification for their role in the short-run equation. Finally, the size of the model is reduced by deleting those variables with insignificant coefficients until a valid small model is found. The variables with non-significant t-ratios on their coefficients were deleted in turn, checking each time for signjficance in the main diagnostic statistics, until an acceptable equation with significant coefficients was obtained. The significance of the coefficient on the EC term confirms the presence of cointegration.

This section is now divided into 11 sub-sections estimating, discussing, and presenting the ECM for the 11 behavioural equations including in the model.

6.3.1-Error Correction Model for DTXR equation

An error-correction model is estimated to determine the short-run relationship for DTXR. Equation (1) in table 6.4 presents this model.

Table 6.4

Error-Correction Model for DTXR 1962-1992

Order of Var 2
Dependent Variable is $dDTXR_t$

	1	2	3	4
Constant	8.643	6.939	3.145	15.285
t	0.7048	0.5923	0.272	2.0088
$dDTXR_{t-1}$	-0.229	-0.2445		
t	-1.241	-1.3611		
$dGDP_{t-1}$	-0.004			
t	-0.5591			
Ecm_{t-1}	-0.331	-0.32	-0.357	-0.137
t	-1.8227	-1.7971	-1.9917	-1.7000
D_{81}	38.091	39.036	44.018	
t	1.185	1.2331	1.3775	
R-Bar-squared	0.34	0.56	0.56	0.58
S S R	35336.8	35797.00	38449.7	41255.8
LM(1)	0.02 (0.97)	0.04 (0.85)	3.15 (0.08)	2.52 (0.110
RESET(1)	1.06 (0.30)	0.92 (0.34)	1.29 (0.26)	0.41 (0.52)
Normality(2)	0.33 (0.85)	0.54 (0.76)	0.07 (0.97)	1.21. (0.55)
ARCH(1)	3.83 (0.05)	3.83 (0.05)	3.20 (0,07)	0.28 (0.60)

t are t-statistics for the hypothesis that the coefficient is zero.
LM(1) is the Lagrange multiplier test for serial correlation of order 1.
RESET test is for functional form mis-specification when the squares of the predicted values are added, and are $\chi^2(1)$.
Normality test is the Bera and Jarque test whether of the residuals are normally distributed and is $\chi^2(1)$.
ARCH test is for a first-order auto-regressive conditional heteroskedastic error and is $\chi^2(1)$.
The numbers in brackets in the body of the table are the probabilities of the null hypothesis being true.

Equation (1) in table 6.4 has insignificant diagnostics at the 5% level. The coefficient for $dDTXR_{t-1}$, $dGDP_{t-1}$, and D_{81} have low t-values. This lead to re-estimating the equation omitting the insignificant variable. Equation (4) in table 6.4 is satisfactory. The final model equation is the ECM in table 6.4

$$dDTXR_t = \underset{(2.0088)}{15.285} - \underset{(-1.7000)}{0.137} ecm_{t-1} \qquad (6.5.1\text{-EC})$$

6.3.2-Error Correction Model for LIDTXR equation

Having estimated the long-run relationship (6.5.2-CV), the short-run relationship can be estimated. Note that the VAR lag length of 1 prevents the inclusion of lagged first-difference variables in the ECM here. Equation (1) in table 6.5 presents the error-correction mechanism for LIDTXR.

Table 6.5

Error-Correction Model for LIDTXR 1962-1992

Order of Var 1

Dependent Variable is $dLIDTXR_t$

1	Constant	ecm_{t-1}	D_{74}	R-Bar-squared	S S R	LM(1)	RESET(1)	Normality(2)	ARCH(1)
	1.8894	-0.7661	0.2395	0.37	0.8521	2.53 (0.11)	2.27 (0.13)	2.02 (0.36)	0.02 (0.88)
t	4.4575	-4.3124	2.5092						

The diagnostic statistics are not significant at the 5% level and the t-values for the coefficients of the ecm_{t-1} and D_{74} are significant at 5% level. Therefore, equation (1) is a satisfactory model. The final equation is the ECM (1) from table 6.5

$$dLIDTXR_t = \underset{(4.4575)}{1.8894} - \underset{(-4.3124)}{0.766} ecm_{t-1} + \underset{(2.5092)}{0.2395} D_{74} \qquad (6.5.2\text{-EC})$$

Therefore, in the long-run via the error-correction term, LTIM has a positive effect on the LIDTXR.

6.3.3-Error Correction Model for LNOE equation

The error-correction model is given in table 6.6. The RESET (1) and ARCH (1) are significant at the 5% level. Figure 6.2 suggests that there is an outlier in 1991 and that a dummy variable (D_{91}) can be used to reflect the 42% fall in nominal development expenditure in 1991 (D_{91} = 1 in 1991 and 0 otherwise). Equation (2) in table 6.6 has insignificant diagnostic for ARCH (1), but the t-values of

$dLNOE_{t-1}$ and $dLNDE_{t-1}$ are insignificant at the 5% level. Equation (2) re-estimated omitting the variable ($dLNDE_{t-1}$) which has the lowest t-value. However, equation (3) still has an insignificant t-value at the 5% level for $dLNOE_{t-1}$.

Table 6.6

Error-Correction Model for LNOE 1962-1992

Order of Var 2

Dependent Variable is $dLNOE_t$

	1	2	3	4
Constant	1.704	0.879	0.887	0.859
t	4.561	2.623	3.86	3.918
$dLNOE_{t-1}$	0.138	-0.059	-0.055	
t	0.63	-0.35	-0.491	
$dLNDE_{t-1}$	-0.497	0.008		
t	-1.781	0.035		
ecm_{t-1}	-1.123	-0.271	-0.274	-0.266
t	-4.389	-2.309	-3.319	-3.338
D_{91}		-1.079	-1.075	-1.09
t		-4.509	-5.196	-5.415
R-Bar-squared	0.38	0.65	0.67	0.68
S S R	1.6358	0.090844	0.88658	0.89513
LM(1)	3.05 (0.08)	3.99 (0.05)	3.95 (0.05)	3.26 (0.07)
RESET(1)	4.95 (0.03)	3.4 (0.07)	3.22 (0.07)	3.41 (0.07)
Normality(2)	2.46 (0.29)	0.89 (0.64)	0.88 (0.64)	1.25 (0.54)
ARCH(1)	6.91 (0.01)	0.27 (0.60)	0.27 (0.60)	0.24 (0.62)

LNOE

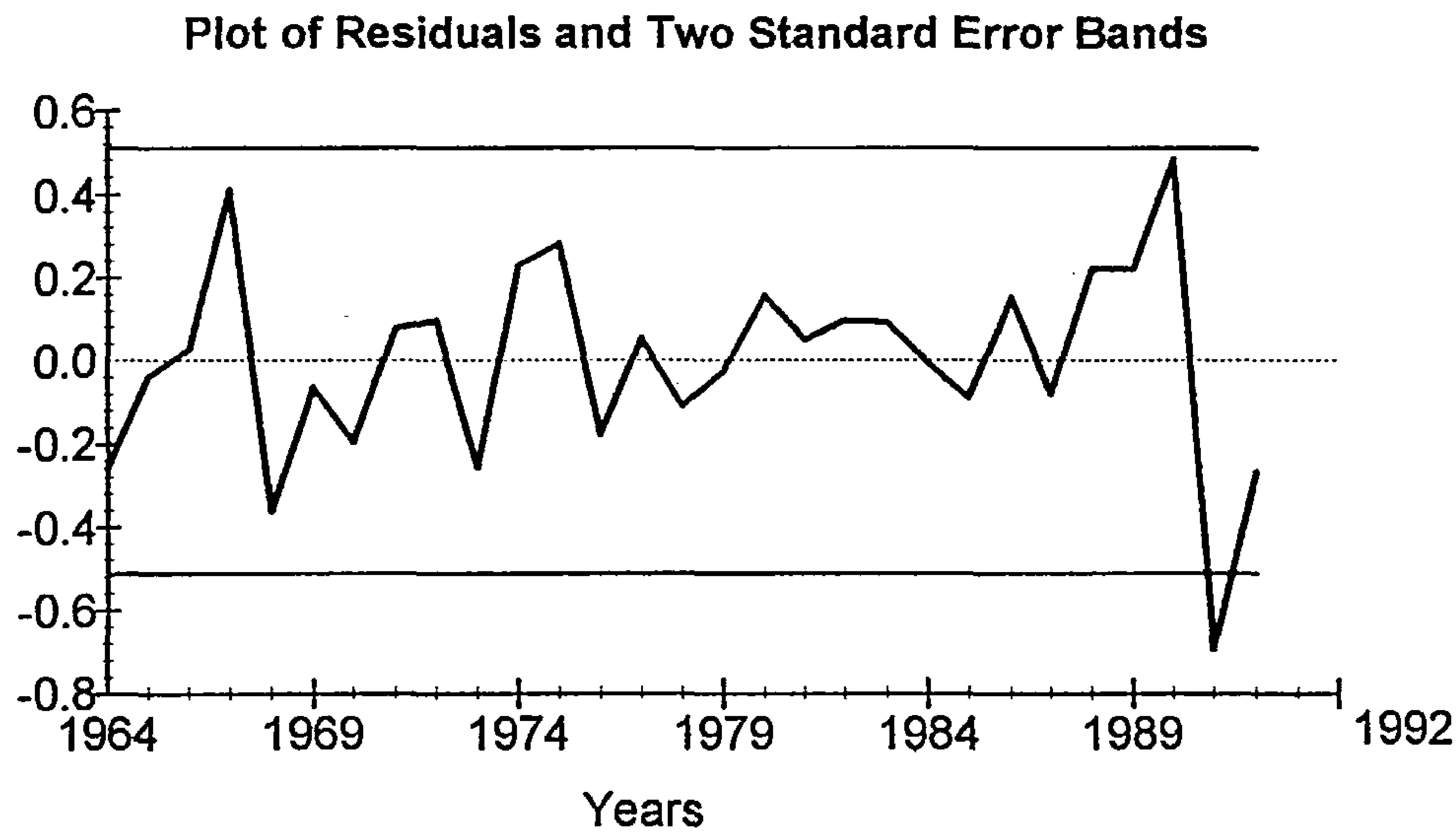


Figure 6.2 Residuals for LNOE

Equation (3) is re-estimated omitting $dLNOE_{t-1}$ to give equation (4). The independent variables have significant t-values at the 5% level and the R bar squared is improved to 68% reflecting the good fit. Also, all the diagnostic statistics are insignificant at the 5% level. Hence, equation (4) is a satisfactory model. The final equation is the ECM (4) from table 6.6

$$dLNOE = \underset{(3.918)}{0.859} - \underset{(-3.338)}{0.266ecm_{t-1}} - \underset{(-5.415)}{1.09D_{91}} \quad (6.5.4\text{-EC})$$

6.3.4-Error Correction Model for LDE equation

The equation in table 6.7 has insignificant diagnostic statistics and a significant t-value at the 5% level for ecm_{t-1}, and D_{ade}. The short-run relationship between the variables is

$$dLDE = \underset{(3.82)}{0.911} - \underset{(-3.405)}{0.6405ecm_{t-1}} - \underset{(-3.488)}{0.292D_{ade}} \quad (6.5.5\text{-EC})$$

Table 6.7

Error-Correction Model for LDE 1962-1992

Order of Var 1

Dependent Variable is $dLDE_t$

1	Constant	ecm_{t-1}	D_{ade}	R-Bar-squared	S S R	LM(1)	RESET(1)	Normality(2)	ARCH(1)
	0.911	-0.645	-0.292	0.38	0.9695	.020 (0.65)	2.05 (0.15)	0.53 (0.78)	0.92 (0.34)
t	3.82	-3.405	-3.488						

6.3.5-Error Correction Model for LNMs equation

Turning to the short-run dynamic relationship for LNMs, equation (1) in table 6.8 presents the first attempt for this purpose. None of the diagnostic statistics are significant at the 5% level. All the t-values for the independent variables except for ecm_{t-1} are insignificant. Equation (1) is re-estimated omitting the variables which have insignificant t-values. Equation (3) gives a satisfactory model to present the short-run relationship between the variables. The final equation (3) from table 6.8

$$dLNMs = \underset{(5.393)}{0.645} - \underset{(-4.050)}{0.138} ecm_{t-1} \qquad (6.5.10\text{-EC})$$

Table 6.8

Error-Correction Model for LNMs 1962-1992

Order of Var 2

Dependent Variable is $dLNMs_t$

	1	2	3
Constant	0.692	0.692	0.645
t	4.165	4.455	5.393
$dLNMs_{t-1}$	-0.087	-0.087	
t	-0.418	-0.492	
$dLNFAN_{t-1}$	0.549		
t	0.004		
ecm_{t-1}	-0.466	-0.148	-0.138
t	-3.514	-3.72	-4.05
R-Bar-squared	0.31	0.34	0.35
S S R	0.43968	0.43968	0.44376
LM(1)	0.52 (0.47)	0.51 (0.48)	0.56 (0.46)
RESET(1)	2.97 (0.09)	2.81 (0.09)	3.22 (0.07)
Normality(2)	1.32 (0.52)	1.32 (0.52)	1.47 (0.48)
ARCH(1)	3.03 (0.08)	3.03 (0.08)	3.21 (0.06)

6.3.6-Error Correction Model for LGDPN equation

Equation (1) in table 6.9 shows the first attempt to construct the ECM model for LGDPN. The low t-values for $dLPD_{t-1}$, and $dLTPSBE_{t-1}$ suggest re-estimating the equation omitting $dLPD_{t-1}$. However, $dLTPSBE_{t-1}$ variable in (2) still has a low t-value and so it is omitted.

Table 6.9

Error-Correction Model for LGDPN 1962-1992

Order of Var 2

Dependent Variable is $dLGDPN_t$

	1	2	3
Constant	4.4877	4.426	4.376
t	5.7747	6.0806	6.3638
$dLGDPN_{t-1}$	0.4212	0.4192	0.4154
t	2.1818	2.2517	2.3034
$dLTPSBE_{t-1}$	-0.1613	-0.1553	
t	-0.2969	-0.2965	
$dLPD_{t-1}$	0.003		
t	0.0343		
ecm_{t-1}	-2.5363	-1.8176	-0.8031
t	-5.92	-6.163	-6.3836
D_{83}	1.3142	1.3086	1.334
t	4.2401	4.4136	4.8386
R-Bar-squared	0.70	0.72	0.73
S S R	2.5698	2.57	2.5851
LM(1)	0.00 (0.92)	0.00 (0.97)	0.04 (0.85)
RESET(1)	0.66 (0.42)	0.64 (0.42)	0.70 (0.40)
Normality(2)	1.06 (0.59)	1.1 (0.58)	1.54 (0.46)
ARCH(1)	1.54 (0.21)	1.56 (0.21)	1.65 (0.20)

The equation is reduced to give equation (3). The variables in equation (3) have significant t-values at the 5% level and the highest R bar squared. Therefore, equation (3) in table 6.9 is accepted as the short-run dynamic relationship for $dLGDPN_{t-1}$.

$$dLGDPN_t = \underset{(6.364)}{4.376} + \underset{(2.303)}{0.415} dLGDPN_{t-1} - \underset{(-6.384)}{0.803} ecm_{t-1} + \underset{(4.839)}{1.334} D_{83} \qquad (6.5.11\text{-EC})$$

6.3.7-Error Correction Model for UTB equation

The short-run dynamic relationship for UTB is in table 6.10. The diagnostic statistics are insignificant at the 5% level. The coefficient of $dUTB_{t-1}$ in equation (1) has a low t-value. When this variable is omitted, R bar squared is improved and the coefficients

Table 6.10

Error-Correction Model for UTB 1962-1992

Order of Var 2
Dependent Variable is $dUTB_t$

	Constant	$dUTB_{t-1}$	$dDFL_{t-1}$	ecm_{t-1}	R-Bar-squared	S S R	LM(1)	RESET(1)	Normality(2)	ARCH(1)
1	-356.828	-0.012	-6.172	-1475.9	0.64	2868979	2.50 (0.11)	1.05 (0.31)	0.93 (0.63)	0.28 (0.60)
t	-3.474	-0.07	-3.427	-4.357						
2	-361.167		-6.237	-0.961	0.65	2869599	2.51 (0.11)	0.86 (0.35)	0.95 (0.62)	
t	-4.265		-4.098	-6.373						

for the independent variables are significant at the 5% level. Therefore, equation (2) in table 6.10 is accepted.

$$dUTB = -361.167 - 6.237dDFL_{t-1} - 0.961ecm_{t-1} \qquad (6.5.15\text{-EC})$$
$$(-4.265) \quad (-4.098) \quad (-6.373)$$

6.3.8-Error Correction Model for LVOEX equation

The ECM for LVOEX is given in table 6.11. The diagnostic statistics are insignificant but the coefficients of the $dLVOEX_{t-1}$ and $dLOPR_{t-1}$ in equation (1) are insignificant at the 5% level. Equation (1) was re-estimated omitting $dLVOEX_{t-1}$. The diagnostic statistics in equation (2) are insignificant at 5% level, and $dLOPR_{t-1}$ still has a low t-value. Equation (2) re-estimated omitting $dLOPR_{t-1}$. Equation (3) in table 6.11 is satisfactory and is accepted as a final short-run dynamic model

$$dLVOEX_t = \underset{(5.598)}{4.218} - \underset{(-5.461)}{0.898ecm_{t-1}} - \underset{(-5.973)}{0.309D_{PO}} \qquad (6.5.16\text{-EC})$$

Table 6.11

Error-Correction Model for LVOEX 1962-1992

Order of Var 2

Dependent Variable is $dLVOEX_t$

	1	2	3
Constant	4.074	4.065	4.218
t	3.22	4.384	5.598
$dLVOEX_{t-1}$	0.003		
t	0.01		
$dLOPR_{t-1}$	0.046	0.05	
t	0.107	0.293	
ecm_{t-1}	-0.653	-0.866	-0.898
t	-3.213	-4.354	-5.461
D_{po}	-0.295	-0.294	-0.309
t	-2.564	-3.117	-3.973
R-Bar-squared	0.50	0.52	0.54
S S R	0.99042	0.99042	0.99383
LM(1)	0.36 (0.55)	0.32 (0.57)	0.02 (0.88)
RESET(1)	0.0008 (0.99)	0.0000002 (1.0)	0.03 (0.87)
Normality(2)	0.82 (0.66)	0.84 (0.66)	0.69 (0.71)
ARCH(1)	0.25 (0.62)	0.25 (0.62)	0.17 (0.68)

6.3.9-Error Correction Model for LTIM equation

Table 6.12 presents the error-correction model for LTIM. Equation (1) in table 6.12 has insignificant diagnostics at the 5% level and significant t-values for ecm_{t-1}. It is accepted as a final short-run dynamic model

$$dLTIM_t = \underset{(5.6737)}{2.0755} - \underset{(-5.5502)}{0.6954ecm_{t-1}} \qquad (6.5.17\text{-EC})$$

Table 6.12

Error-Correction Model for LTIM 1962-1992

Order of Var 1

Dependent Variable is $dLTIM_t$

1	Constant	ecm_{t-1}	R-Bar-squared	S S R	LM(1)	RESET(1)	Normality(2)	ARCH(1)
	2.0755	-0.6954	0.51	0.43952	0.18 (0.67)	0.19 (0.67)	0.06 (0.97)	0.88 (0.35)
t	5.6737	-5.5502						

6.3.10-Error Correction Model for LSLL equation

Equation (1) in table 6.13 has low t-values for $dLSLL_{t-1}$, and $dLPOPL_{t-1}$,. This suggests omitting the variables and the equation is re-estimated. Equation (3) in table 6.13 has insignificant diagnostic statistics and significant t-values for the explanatory variables at the 5% level. The final equation is

$$DLSLL_t = 0.694 - 0.126ecm_{t-1} + 0.03D_{80} \quad (6.5.19\text{-EC})$$
$$(3.215)\ (-3.09)\qquad (5.682)$$

Table 6.13

Error-Correction Model for LSLL 1962-1992

Order of Var 2

Dependent Variable is $dLSLL_t$

	1	2	3
Constant	-0.225	0.936	0.694
t	-2.89	2.559	3.215
$dSLL_{t-1}$	0.136	0.091	
t	0.731	0.457	
$dLPOPL_{t-1}$	0.446		
t	0.501		
ecm_{t-1}	-0.035	-0.116	-0.126
t	-2.901	-2.4836	-3.09
D_{80}	0.016	0.027	0.03
t	2.418	3.264	5.682
R-Bar-squared	0.55	0.51	0.52
S S R	0.0034432	0.0038978	0.0039303
LM(1)	0.35 (0.56)	1.18 (0.28)	0.05 (0.83)
RESET(1)	0.02 (0.89)	0.02 (0.89)	0.008 (0.98)
Normality(2)	0.46 (0.79)	0.48 (0.79)	0.39 (0.82)
ARCH(1)	0.84 (0.36)	0.20 (0.66)	0.38 (0.54)

6.3.11-Error Correction Model for LTLD equation

Equation (1) in table 6.14, shows the RESET(1) and Normality statistics are significant at the 5% level. Figure 6.3 shows an outlier in 1985. A dummy variable (D_{85}) reflects the action taken by the government to reduce foreign labour as a result of financial problems following the decrease of oil prices. can be used to solve this problem (D_{85} = 1 in 1985 and 0 otherwise). Equation (2) has insignificant diagnostic statistics at the 5% level. However, $dLGDP_{t-1}$ and $dLPD_{t-1}$ have low t-values, and this suggests re-estimating equation (2) omitting these variables respectively. Equation (4) has insignificant diagnostic statistics and significant t-values at the 5% level for all the independent variables in the regression.

The final equation is

$$dLTLD_t=1.73-0.258dLTLD_{t-1}-0.301ecm_{t-1}+0.073D_{81}-0.134D_{85} \qquad (6.5.22\text{-EC})$$

(5.239) (2.718) (-5.071) (3.817) (-6.181)

Table 6.14

Error-Correction Model for LTLD 1962-1992

Order of Var 2
Dependent Variable is $dLTLD_t$

	1	2	3	4
Constant	1.785	1.737	1.137	1.73
t	3.986	5.148	4.562	5.239
$dLTLD_{t-1}$	0.065	0.203	0.253	0.258
t	0.358	2.123	2.574	2.718
$dLGDP_{t-1}$	-0.005	0.014		
t	-0.078	0.447		
dPD_{t-1}	0.001	-0.003	0.002	
t	0.124	-0.615	0.381	
ecm_{t-1}	-0.137	-0.087	-0.292	-0.301
t	-3.911	-5.065	-4.43	-5.071
D_{81}	0.102	0.074	0.071	0.073
t	2.754	4.091	3.532	3.817
D_{85}		-0.135	-0.134	-0.134
t		-6.735	-6.004	-6.181
R-Bar-squared	0.55	0.89	0.87	0.88
S S R	0.017238	0.0038706	0.0049378	0.004989
LM(1)	2.59 (0.11)	2.36 (0.13)	0.06 (0.81)	0.009 (0.98)
RESET(1)	6.43 (0.01)*	0.62 (0.43)	0.66 (0.42)	0.90 (0.34)
Normality(2)	9.89 (0.01)*	1.04 (0.59)	0.65 (0.72)	0.45 (0.80)
ARCH(1)	0.26 (0.61)	2.18 (0.14)	1.25 (0.26)	1.28 (0.26)

LTLD

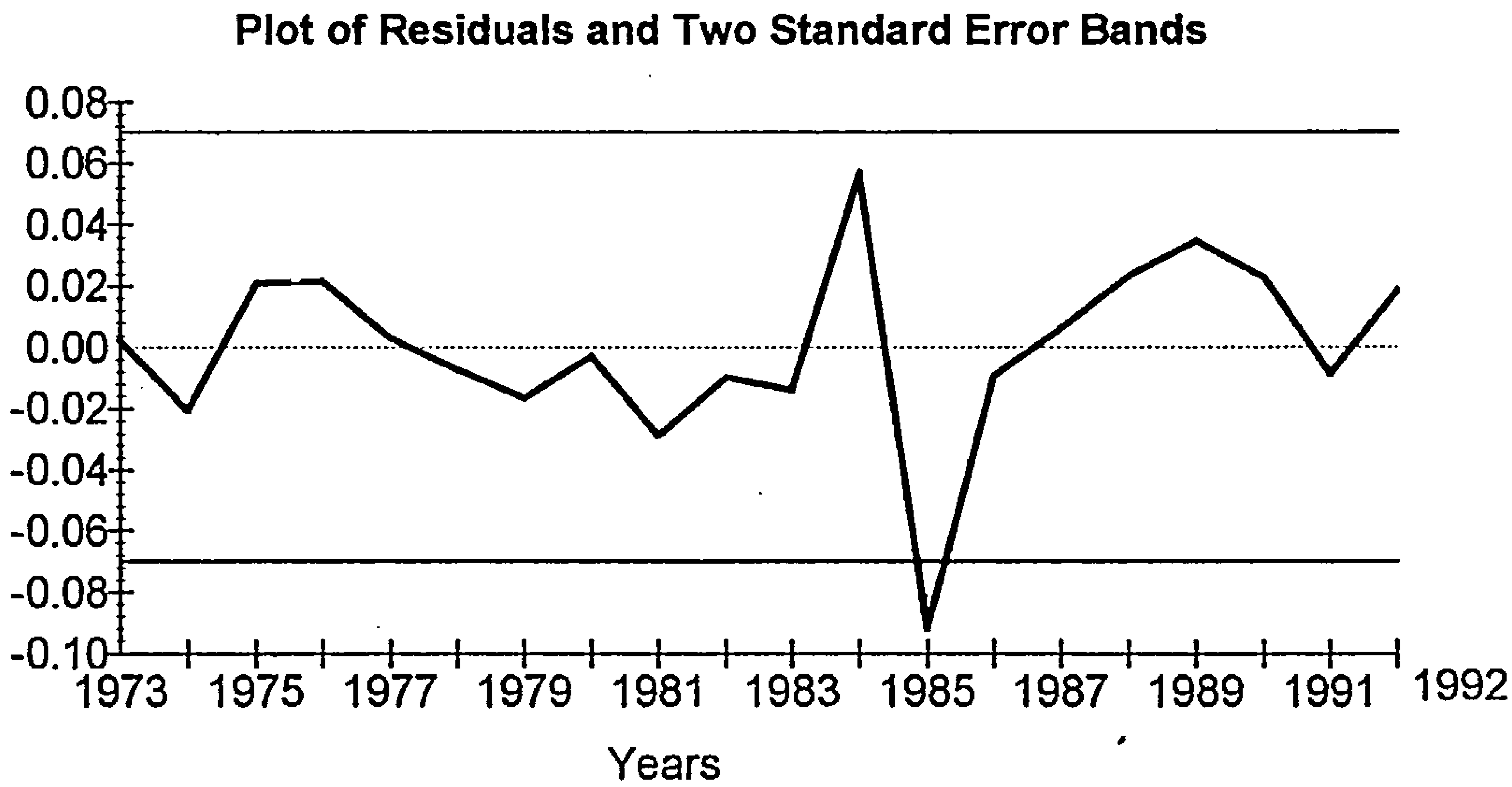


Figure 6.3 Residuals for LTLD

6.4-The Final Model

This consests of the long-run equations and the error-correction equations.

6.4.1-Public Finance Sector Equations

$DTXR = 0.0298GDP.$ (6.5.1-CV)

$dDTXR = 15.285 - 0.1368ecm_{t-1}.$ (6.5.1-EC)
(2.88) (-1.700)

$LIDTXR = 0.5001LTIM$ (6.5.2-CV)

$dLIDTXR_t = 1.8894 - 0.7661ecm_{t-1} + 0.2395D_{74}$ (6.5.2-EC)
(4.4575) (-4.3124) (2.5092)

$LNOE = 0.5311LNDE$ (6.5.4-CV)

$dLNOE = 0.8587 - 0.2657ecm_{t-1} - 1.0902D_{91}$ (6.5.4-EC)
(3.918) (-3.338) (-5.415)

$LDE = 0.2699LFAN$ (6.5.5-CV)

$dLDE = 0.9115 - 0.6405ecm_{t-1} - 0.2921D_{ade}$ (6.5.5-EC)
(3.8203) (-3.4052) (-3.4878)

6.4.2-The Money Sector Equations

$LNMs = 0.4244LNFAN$ (6.510-CV)

$dLNMs = 0.645 - 0.138ecm_{t-1}$ (6.510-EC)
(5.393) (-4.050)

6.4.3-The Gross Domestic Product Equations

$LGDPN = 0.6586LTPSBE + 0.06LPD$ (6.5.11-CV)

$dLGDPN_t = 4.376 + 0.415dLGDPN_{t-1} - 0.803ecm_{t-1} + 1.334D_{83}$ (6.5.11-EC)
(6.364) (2.303) (-6.384) (4.839)

6.4.4-Foreign Trade and Balance of Payments Equations

$UTB = 0.6368DFL$ (6.5.15-CV)

$dUTB = -361.1667 - 6.2366dDFL_{t-1} - 0.9608ecm_{t-1}$ (6.5.15-EC)
(-4.265) (-4.098) (-6.373)

$$LVOEX = 0.6692LOPR \quad (6.5.16\text{-}CV)$$

$$dLVOEX_t = \underset{(5.598)}{4.2177} - \underset{(-5.461)}{0.8979}ecm_{t-1} - \underset{(-3.973)}{0.3092}D_{PO} \quad (6.5.16\text{-}EC)$$

$$LTIM = 0.5167LTPSBE + 0.0619LCBC \quad (6.5.17\text{-}CV)$$

$$dLTIM = \underset{(5.6737)}{2.0755} - \underset{(-5.5502)}{0.6954}ecm_{t-1} \quad (6.5.17\text{-}EC)$$

6.4.5-Employment Sector Equations

$$LSLL = 0.9827LPOPL \quad (6.5.19\text{-}CV)$$

$$dLSLL_t = \underset{(3.215)}{0.6939} - \underset{(-3.09)}{0.1258}ecm_{t-1} + \underset{(5.682)}{0.0298}D_{80} \quad (6.5.19\text{-}EC)$$

$$LTLD = 0.2803LGDP + 0.0439LPD \quad (6.5.21\text{-}CV)$$

$$dLTLD_t = \underset{(5.239)}{1.734} + \underset{(2.718)}{0.2579}dLTLD_{t-1} - \underset{(-5.071)}{0.3012}ecm_{t-1} + \underset{(3.817)}{0.0726}D_{81} - \underset{(-6.181)}{0.1336}D_{85} \quad (6.5.21\text{-}EC)$$

6.5-Conclusion

In this chapter the model of Libyan economy outlined in the previous chapter was estimated. The Johansen approach was used. Three econometric techniques, which were presented in chapter three, were applied. First, the Dickey-Fuller test was used to test the stationarity and the order of integration of each individual variable in section 6.1. The results indicate that all the variables are stationary in their first differences. Second, the long-run cointegration relationships, which exist between the endogenous and exogenous variables, were estimated using the Johansen co-integration approach in section 6.2. The Max, the Trace, and the SBC were used to determine the number of co-integration vectors. However, to carry out the co-integration test the Vector Auto-regression (VAR) model for the behavioural equations of the model was used to determine the lag length. Third, in section 6.3, the Error Correction Model (ECM) for each behavioural equation of the model was estimated to give the short-run dynamic relationship. However, most of the short-run dynamic model equations have only the ECM term. This means that the causal variables have no effect in the short-run and a significant effect in the long-run. This is might be because the short-run effects are concealed by the use of annual data. The coefficient of the error correction term, ECT, in all the error correction equations is highly significant. This provides additional evidence of co-integration. Economic theory suggests the sign and the size of the explanatory variable coefficients in the long-run and these were satisfactory. Also, statistical criteria were used in selecting the best equation to explain the short-run dynamic relationships.

The next step is to test how the single equations estimated above function as a complete model. This will be the subject of the next chapter.

Chapter Seven
Model Evaluation

7.0-Introduction

This chapter is concerned with the evaluation of the model. Each individual equation of the model has been estimated and discussed in the previous chapter. *The test of any model is not only by how will it perform for individual equations but also how it functions as a complete system in prediction, simulation, and policy evaluation (Abohobel; 1983: 140).* To achieve this goal, in section one, the simulation process will be discussed. The methods, which can be used to evaluate the simulation and forecasting models, are presented in section two. The simulation within the sample period (1962-1992) will be used to test the model's performance in section three, including validation of the static and dynamic simulations. The validation of the model's ability to forecast outside of the sample period will be considered in section four. Section five is allocated to summarising the main conclusions of this chapter.

7.1-The Simulation Process

The word "Simulation" has three different meanings in econometrics: (1) to examine variations in parameter estimates due to the estimation method. This is also known as a Monte Carlo Study. (2) To examine the properties of a model for a given set parameter estimates. This is known as a Model Simulation and (3) to examine the effects of variations in the data on the properties of a model. This is known as a Stochastic Simulation. (1) and (3) above are out side the scope of this study. Model simulation will be used to examine the properties of the model, which was built and estimated in the previous two chapters.

In the econometric literature simulation experiments are used for testing and evaluating the model, for historical policy analysis, and for forecasting (Pindyck and Rubinfeld, 1998). These purposes of the simulation process are now discussed briefly.

7.1.1-The Model Evaluation

The horizon over which the simulation performed will depend on the objective of the simulation (Pindyck and Rubinfeld, 1998:pp383). If the simulation of the model is carried out over the estimation period T_1-T_2 (see figure 7.1) for all the variables this type of simulation is known as an ex-post (or within sample or historical) simulation. This can be used to examine the effects of changes in the exogenous variables. By simulating the model during the historical data (ex-post simulation) where data for all the variables are available, a comparison of the original data with the simulation series for each endogenous variable is a useful test of the validity of the model.

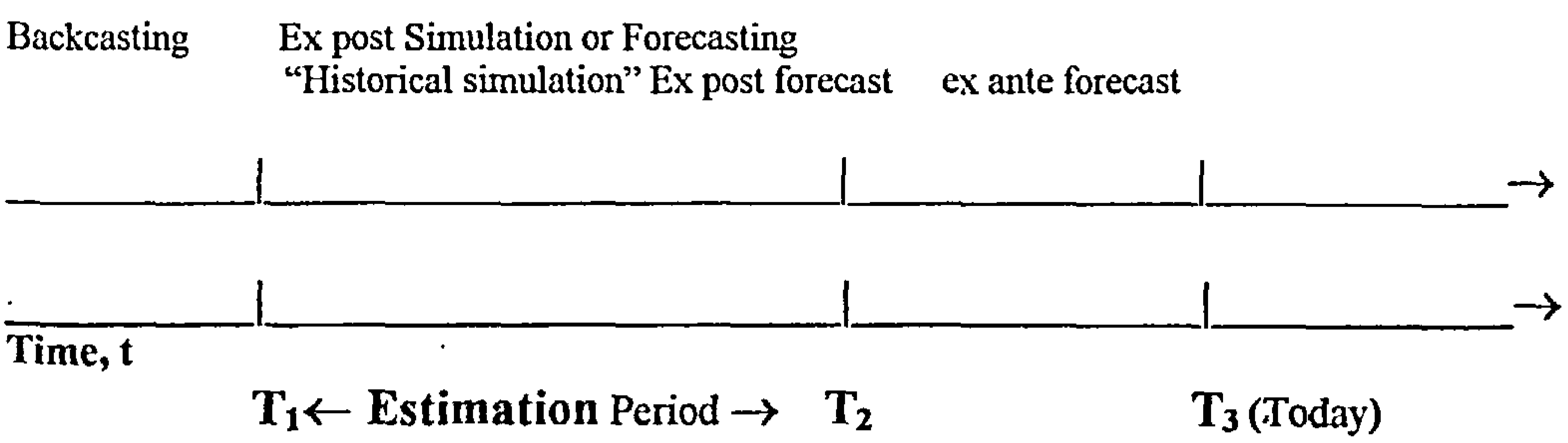


Figure 7.1 Simulation Time Horizons (Cited in Pindyck & Rubinfeld, 1998; 383).

7.1.2-Historical Policy Analysis

Ex-post simulation is used for policy analysis by evaluating the results of alternative policies. This can be carried out by changing parameter values or letting exogenous policy variables follow different time paths. For example, the effects of different financial modes of increasing government expenditure are considered in chapter 8.

7.1.3-Forecasting

Forecasting can be used to evaluate the model, or evaluate the impact of alternative economic polices, or to predicate the likely outcome of a particular policy (Darnell, 1994, Holden et al, 1990). The accuracy of a forecast depends on: (1) the specification of the model (a good specification of a model should generate a good forecast), (2) the accuracy of the estimates of the parameters of the model, (3) the goodness of fit of the model, and (4) the accuracy of any assumptions about exogenous variables which are necessary to construct the forecasts (Darnell, 1994).

Two different types of analysis can be used to examine the model's ability to forecast beyond the estimation period. If the forecast is generated with knowledge of both the exogenous and endogenous variables, it is known as an ex-post forecast. Any errors are due to inaccuracy of the model and to random fluctuations. On the other hand, if unknown values of the exogenous variables are required this is an ex-ante forecast. Errors in ex-ante forecasts are caused by inaccuracies in the model, random fluctuations and errors in forecasting the exogenous variables.

7.2-Evaluating Forecasting and Simulation Models

After estimating the model, one can simulate the model by solving it over time using actual values for the explanatory variables. In addition, the model can be used for forecasting beyond the estimation period. The objective is to check how closely the forecast variables track their outcomes.

In the econometric literature (see Holden et al, 1990, and Pindyck and Rubnfeld, 1998) different statistics have been introduced as quantitative measures of how closely the individual simulated and forecasted variables track their corresponding actual series.

The most popular one is used is Root Mean Squared Error (RMSE). The RMSE for the variable Y_t is defined as

$$\text{RMSE} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^s - Y_t^a)^2}$$

Where Y_t^s = simulated or forecasted value of the variable Y_t.

Y_t^a = Actual value of the variable Y_t.

T = number of periods in the simulation or forecasting.

The RMSE is a measure of the deviation of the simulated variable from its actual time path. Of course, the magnitude of this error can be evaluated only by comparing it with the average size of the variable in question (Pindyck and

Rubinfeld, 1998:385). One simulation error statistic which is used for this purpose is the Root Mean Squared Percent Error (RMSPE) which is defined as

$$\text{RMSPE} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{Y_t^s - Y_t^a}{Y_t^a}\right)^2}$$

Other descriptive measures of forecasting or simulation accuracy included the Mean Error or Mean Simulation Error (ME) which is defined as

$$\text{ME} = 1/\text{T}\sum_{t=1}^{T} (Y_t^s - Y_t^a)$$

and the Mean Percent Error (MPE) which is defined as

$$\text{MPE} = \frac{1}{T}\sum_{t=1}^{T}\frac{Y_t^s - Y_t^a}{Y_t^a}$$

Y_t^s, Y_t^a, and T are as defined before.

A low RMSE for simulation or forecasting purposes is a desirable measure of simulation or forecasting fit. The RMSE for forecasting or simulations computed over the forecast range *provides a measure of the ability of the model to forecast. It is possible for some endogenous variables to have large RMS forecast errors while others have small errors. Unless the forecasting objective is centred on only one or two variables, all the RMS forecast errors must be evaluated jointly (Pindyck and Rubinfeld, 1998; 387).* Theil (1966) introduced a useful simulation statistic related to the RMSE which known as Theil's inequality coefficient (U) and its decompositions, into bias proportion (UM) (the fraction of error due to bias), regression proportion (UR) (the fraction of error due to difference of regression coefficient from unity) and disturbance or random proportion (UD) (the fraction of error due to residual variance) which are defined as

$$U = \frac{RMSE}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^a)^2}}$$

$$UM = \frac{(\bar{Y}^s - \bar{Y}^a)^2}{(RMSE)^2}$$

$$UR = \frac{S_F^2(1-B)^2}{(RMSE)^2}$$

$$UD = \frac{(1-r^2)S_A^2}{(RMSE)^2}$$

where Y^s, Y^a, and T are as defined before, S_F is standard deviation of the forecasts, S_A is standard deviation of the actual values, r is correlation of the forecast and actual values, and B is slope coefficient of the regression of actual values on the forecasts. The numerator of U is the RMSE and the denominator is the sum of the Root Mean Squares of the actual values. If U = 0, $Y_t^s = Y_t^a$ for all t and there is a perfect fit. Thus, a low value of U indicates a good set of forecasts. UM and UR also tend towards zero for a perfect simulation or forecasts fit, while UD tends to unity (UM = UR = 0 and UD = 1) (see Holden et, al, 1990 chapter 1 & Pindyck Rubinfeld, 1998 chapters 8 & 13 for a survey of these measures). A problem with the RMSE is that it is affected by the units of measurement of data. Theil's (U) is unitless and was proposed for forecast *changes*, but it is commonly used for forecasts of levels also (Holden et.al; 1990). U will be used in evaluating the model simulation and forecasting results in sections 7.3 and 7:4 below.

7.3-Validation of the Model

The concern of this section is to evaluate the performance of the model, which was estimated in the previous chapter. The simulations are carried out by solving the complete model simultaneously using TSP version 4.2B. In general the Gauss-Seidel method is the most widely used technique used to solve non-linear models such as the present one. The goal of such a simulation is to observe how closely the simulated values of the endogenous variables track their actual values. The closer the simulated values to the actual values, the more confidence there is that the model is producing a good description of the economy. Model simulation involves the mathematical solution of (possibly simultaneous) difference equations. In multiple-equation models each individual equation may fit the historical data very well. If the model simulation does not track the historical data perfectly, this could be due to the political and economic environment during the data period. Simulations are classified into static and dynamic simulation. *A static simulation is one in which the actual values of the predetermined variables are used for the solution each period. A dynamic simulation is one in which the predicted values of the endogenous variables from the solutions for previous periods are used for the values of the lagged endogenous variables for the solution for the current period (Fair, 1986; 1981).* Both static and dynamic simulations are carried out to test the model performance and are presented in the next two sub-sections respectively. However, mis-specification or bias in one part of the model may cause the whole model to perform poorly in a simulation context. This can be corrected by an appropriate adjustment in a coefficient value, and re-estimating the constants in the model by using Full Information Maximum Likelihood (FIML) estimation. Alternatively, for large econometric models used for forecasting purposes small changes to some of the model's coefficients and the introduction of adjustable parameters at key points in the model can improve the ability to forecast (Pindyck and Rubinfeld, 1998).

7.3.1-Validation of the Static Model

The first simulation within the sample period to check the model performance is the static simulation. The historical static simulation of the key endogenous variables indicates that the simulated time paths of most of the endogenous variables are close to the actual values (see appendix 3, table 1). Figures 7.2-7.12 present the historical simulations of the static model of the endogenous variables.

Figure 7.2 Simulated and Historical DTXR 1964-1992 of the Static Model

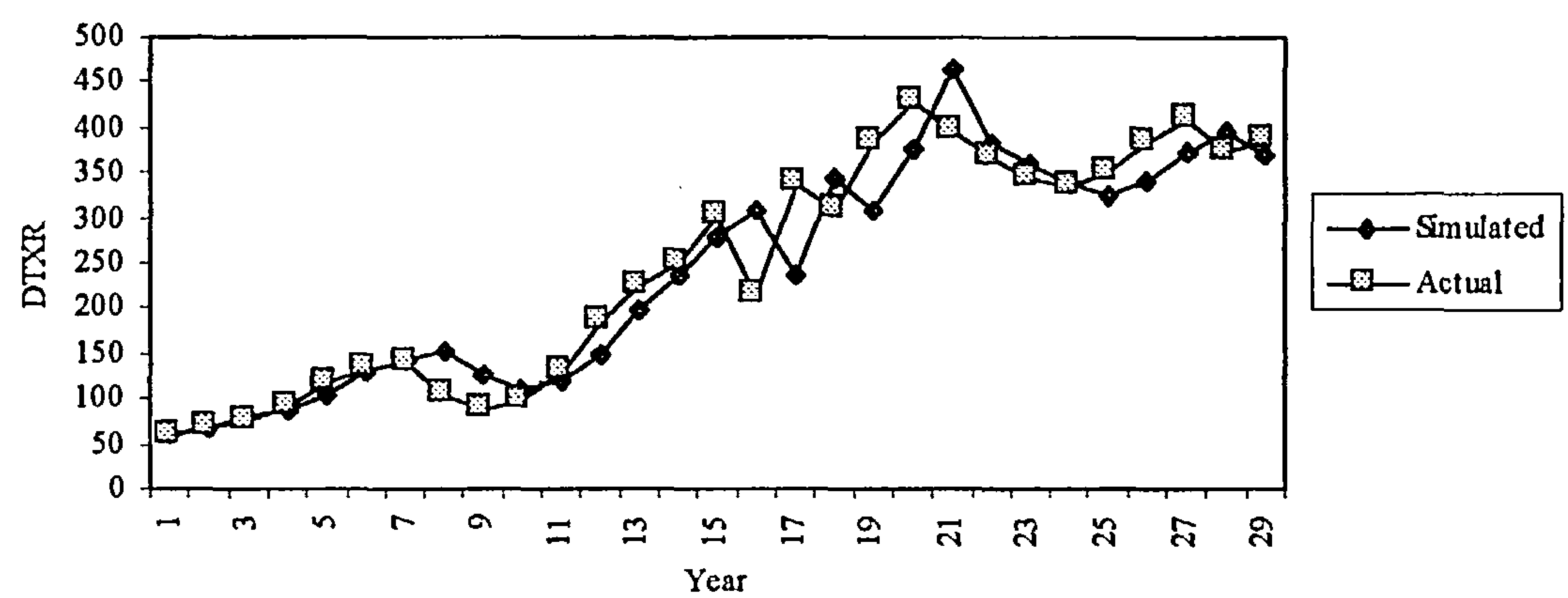


Figure 7.3 Simulated and Historical LIDTXR 1964-1992 of the Static Model

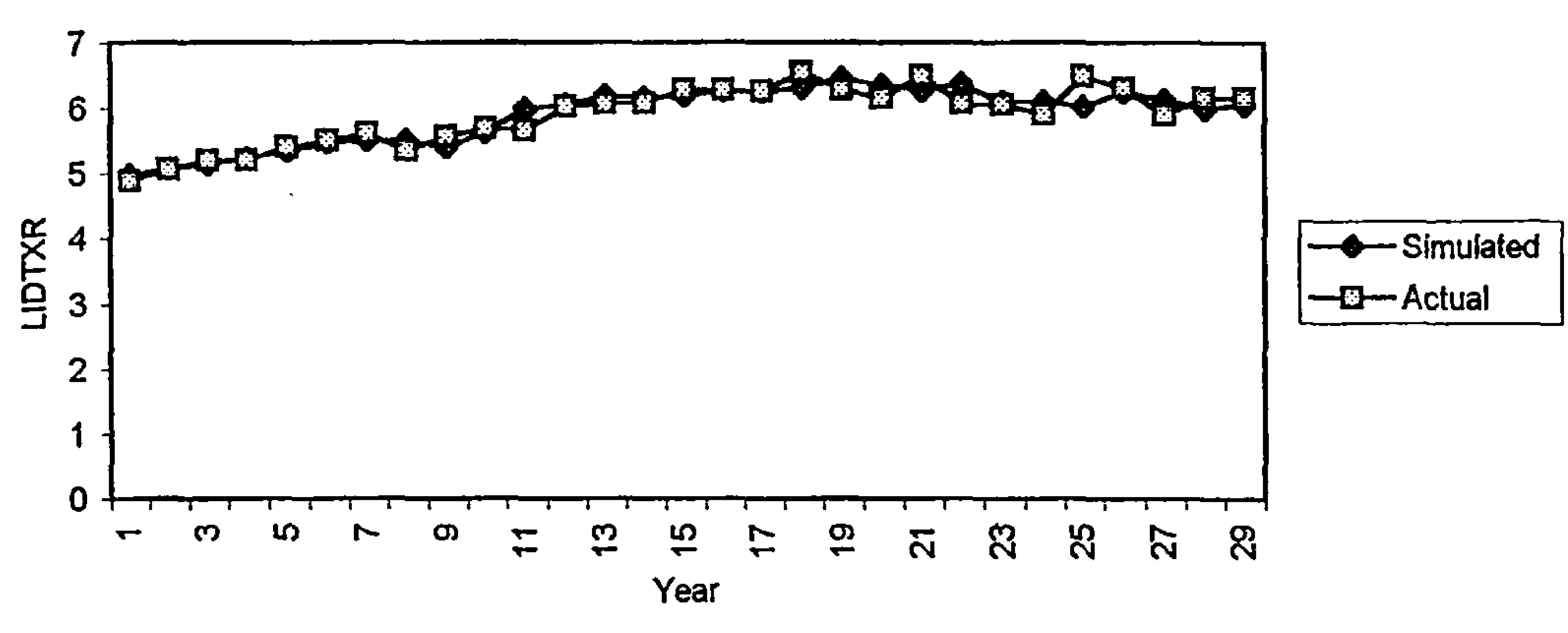


Figure 7.4 Simulated and Historical LNOE 1964-1992 of the Static Model

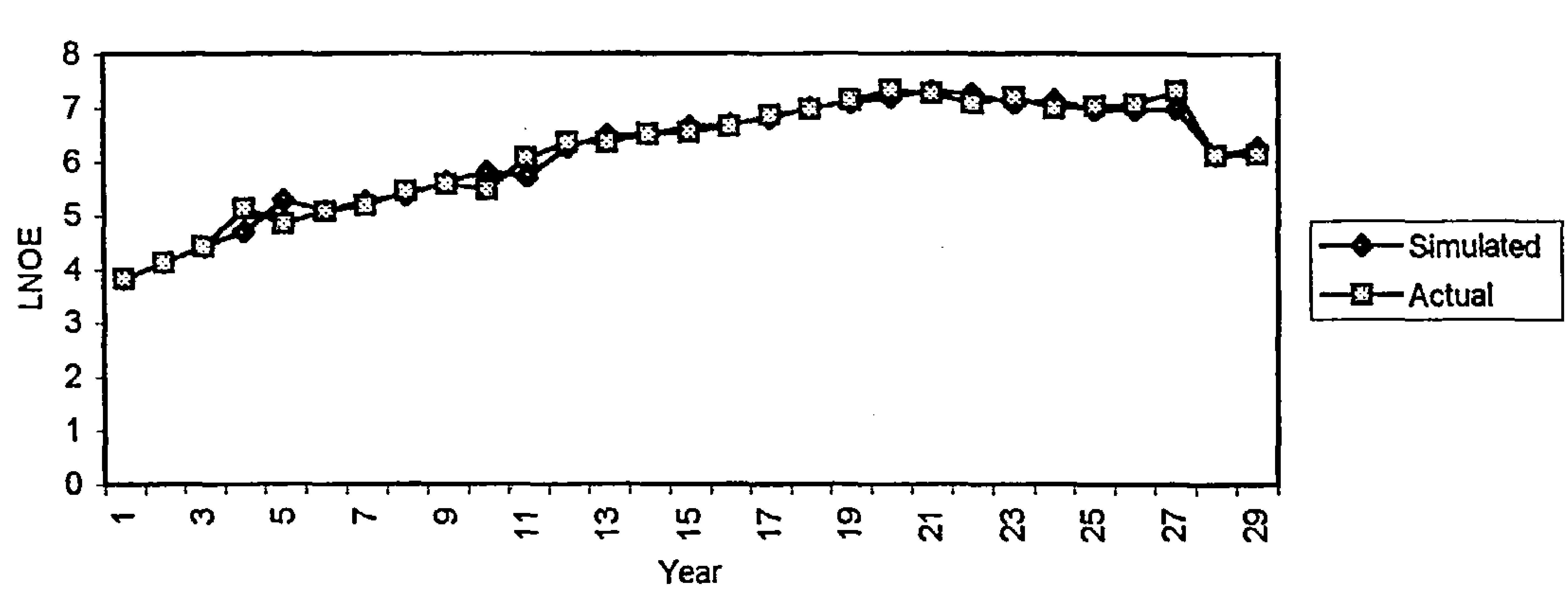


Figure 7.5 Simulated and Historical LDE 1964-1992of the Static Model

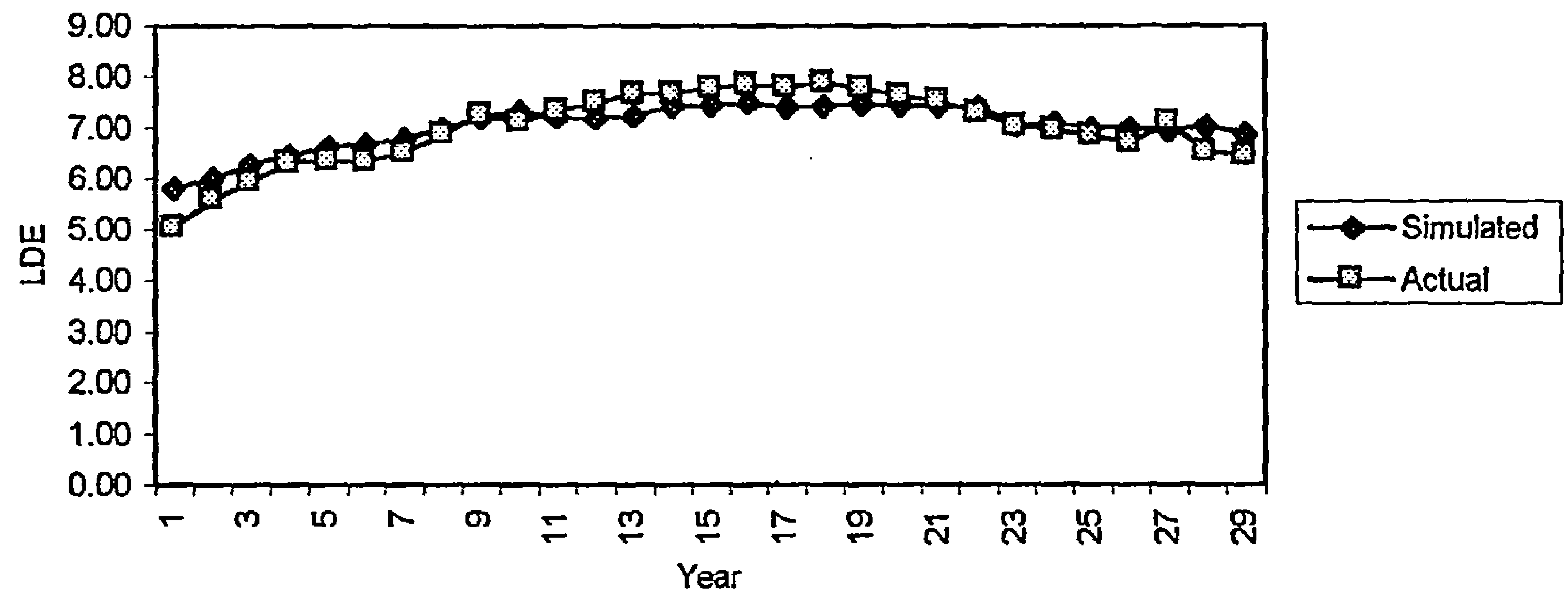


Figure 7.6 Simulated and Historical LNMs 1964-1992 of the Static Model

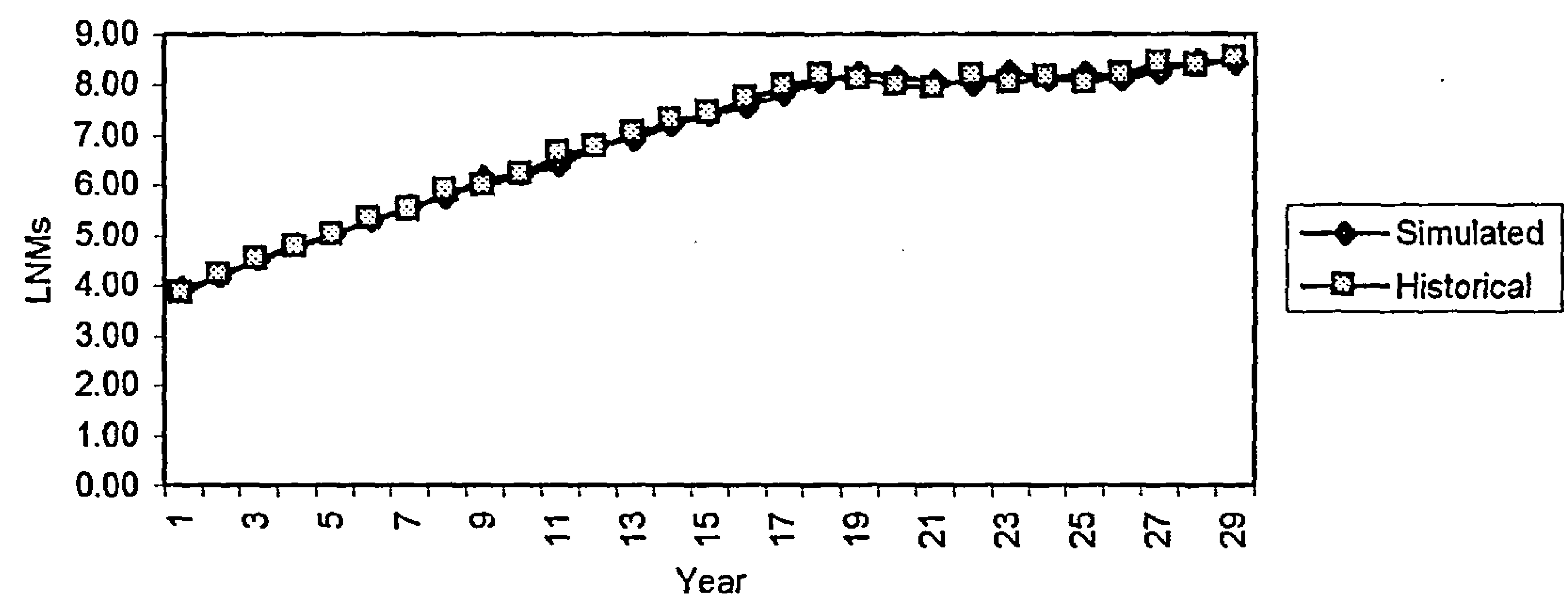


Figure 7.7 Simulated and Historical LGDPN1964-1992 of the Static Model

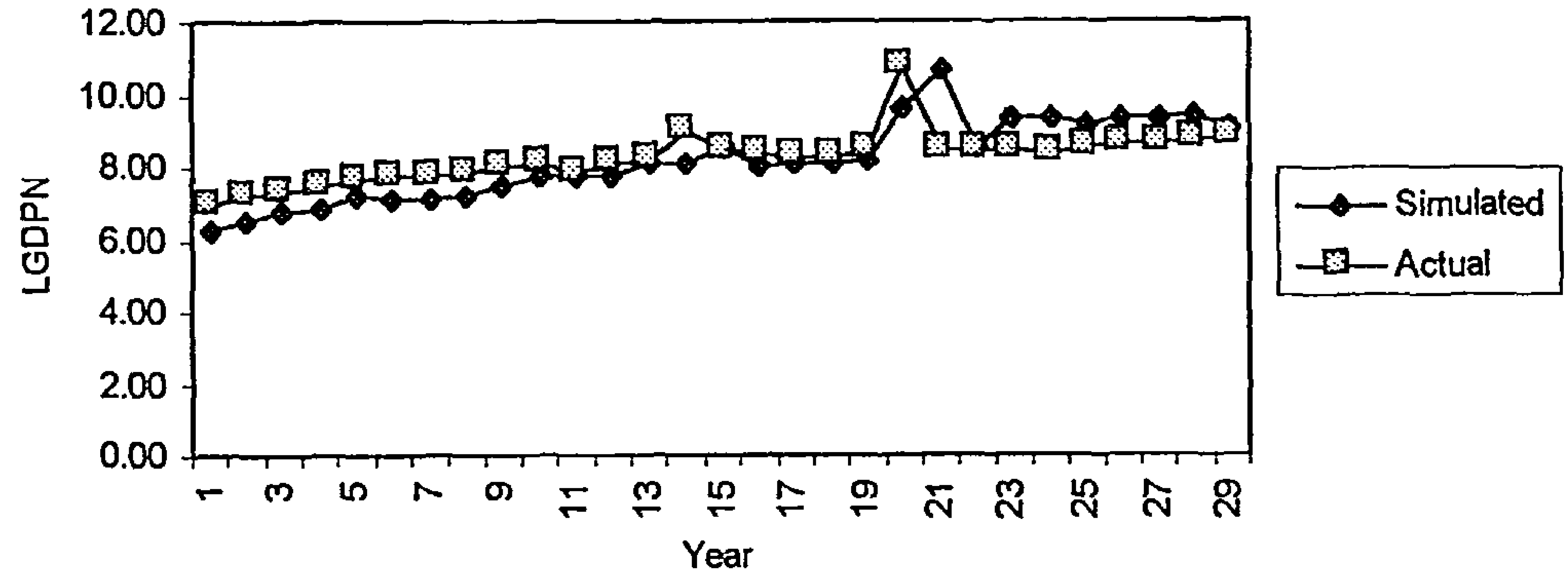


Figure 7.8 Simulated and Shocked LVOEX 1964-1992 of the Static Model

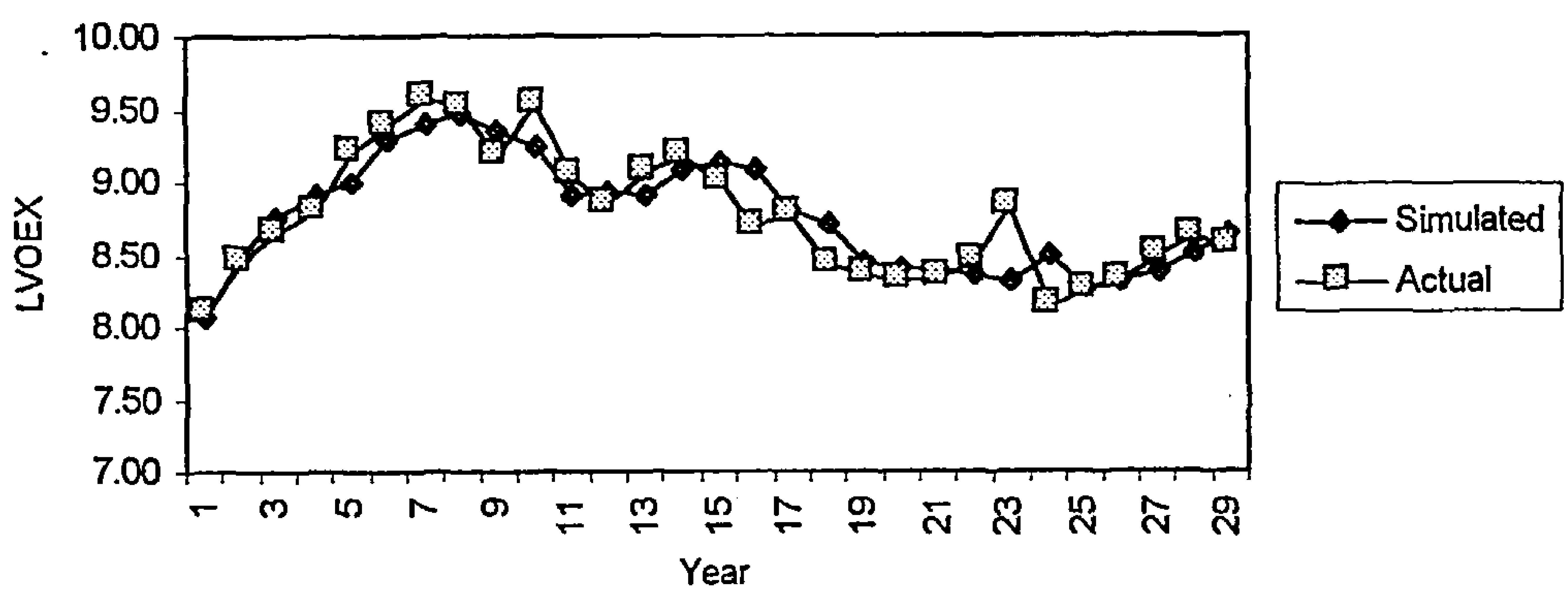


Figure 7.9 Simulated and Historical UTB 1964-1992 of the Static Model

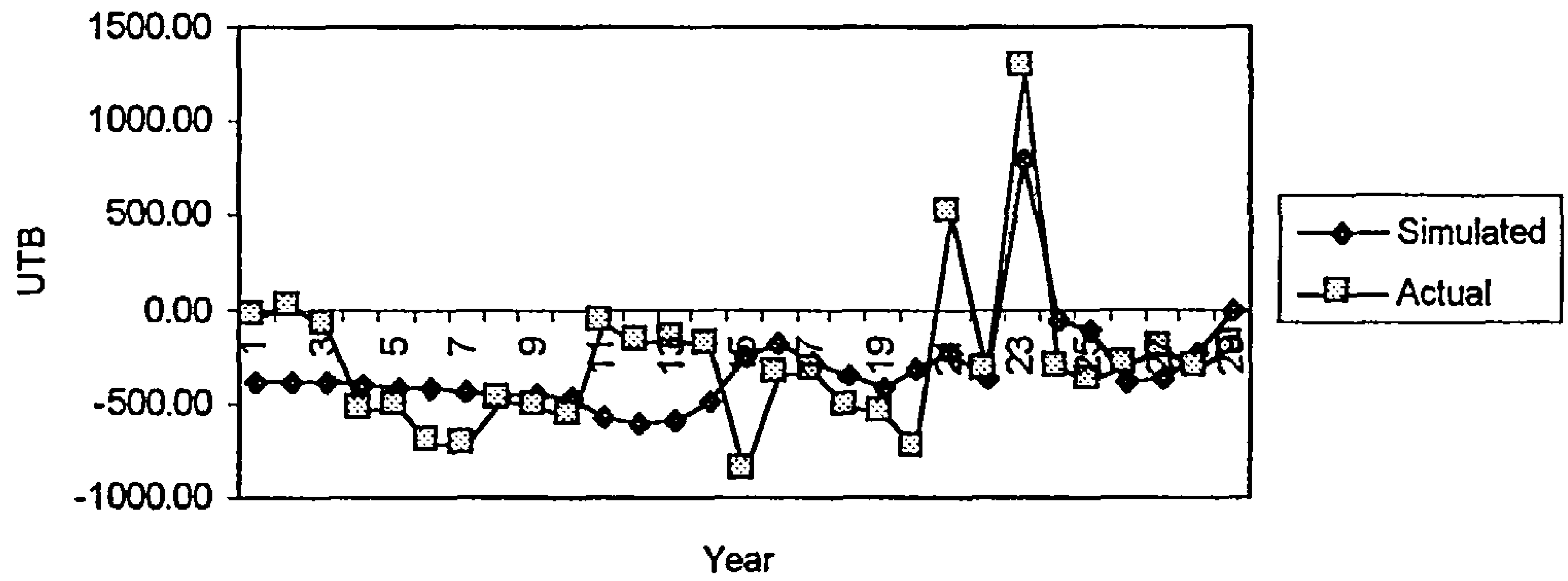


Figure 7.10 Simulated and Historical LTIM 1964-1992 of the Static Model

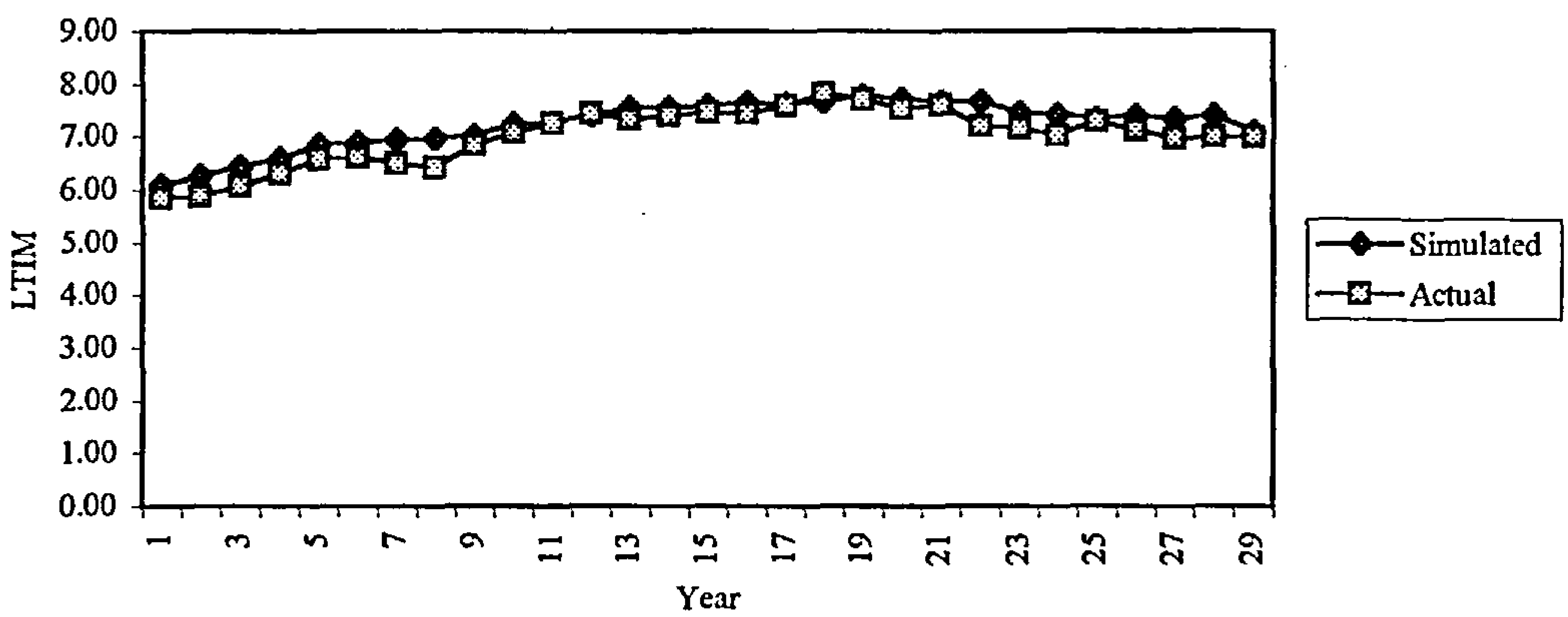


Figure 7.11 Simulated and Historical LSLL 1964-1992 of the Static Model

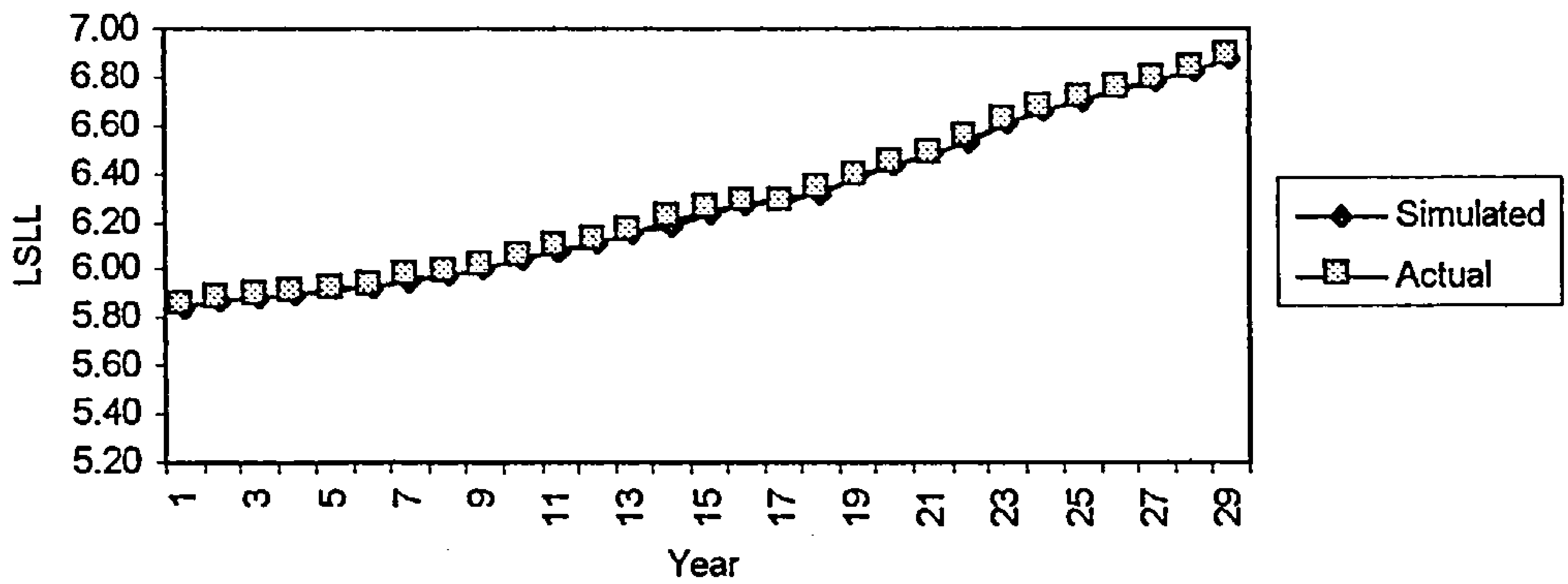
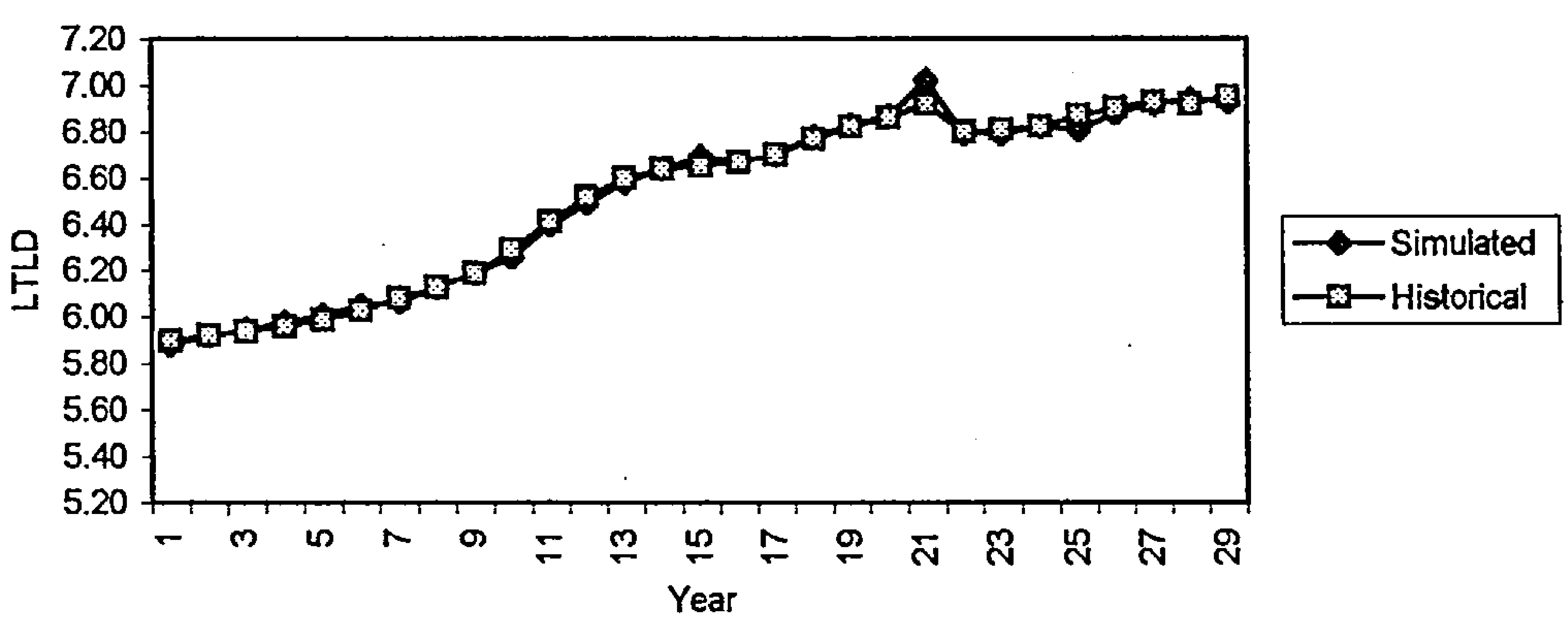


Figure 7.12 Simulated and Historical LTLD 1964-1992 of the Static Model



The measures of how closely the simulated values track their actual values are shown in table 7.1.

The Theil's inequality coefficient (U) is considered as the main criterion to evaluate the model performance. From table 7.1 it can be note that the U results of the model indicate that the model seems to track the historical data quite well. The highest U value is for UTB (real unrequited transfer balance) but for this variable

UD is 0.999, indicating that the forecast errors are random rather than systematic.

Table 7.1

The Accuracy of the Static Simulation of the Model within the Estimation Period

Eq, No.	Endogenous Variable	r	U	UM	UR	UD
5.1	DTXR	0.93	0178	0.000052	0.0527	0.95
5.2	LIDTXR	0.93	0.029	0.00049	0.0179	0.98
5.4	LNOE	0.98	0.028	0.000000	0.00000	1.00
5.5	LDE	0.96	0.044	0.017844	0.60	0.38
5.10	LNMs	0.99	0.0175	0.00058	0.00043	0.999
5.11	LGDPN	0.76	0.086	0.00600	0.601	0.40
5.15	UTB	0.65	0.624	0.005519	0.000153	0.999
5.16	LVOEX	0.90	0.021	0.000026	0.000037	1.00
5.18	LTIM	0.96	0.039	0.0657	0.0511	0.92
5.19	LSLL	0.99	0.0019	0.000104	0.04778	0.95
5.20	LTLD	0.99	0.0040	0.00191	0.00634	0.99

7.3.2-Validation of the Dynamic Model

The dynamic simulation within the sample period is carried out to check the model performance. The historical data provide the initial values of the endogenous variables. In other words, the values of the lagged endogenous variables themselves are generated by the simulation process. This is a more difficult test of the forecasting ability of the model than the static simulation. According to the dynamic simulation results (see also appendix 3, table 2) from table 7.2, the predicted UTB again shows a high level of U, as with the static results in table 7.1. Also, the results show a higher level of UM for all the variables, a higher level of UR for DTXR, LNOE, LNMs, LPI, LGDPN, UTB, and LVOEX, and a lower level of UR for LIDTXR, LDE, and LTIM. The value of UD is lower for all the variables. As expected, the static simulation (see table 7.1) performs better than the dynamic one.

Table 7.2

The Accuracy of the Dynamic Simulation of the Model within the Estimation Period

Eq, No.	Endogenous Variable	r	U	UM	UR	UD
5.1	DTXR	0.82	0.627	0.310	0.515	0.18
5.2	LIDTXR	0.93	0.042	0.550	0.0026	0.45
5.4	LNOE	0.96	0.075	0.618	0.0048	0.38
5.5	LDE	0.94	0.069	0.476	0.260	0.26
5.10	LNMs	0.99	0.334	0.902	0.088	0.01
5.11	LGDPN	0.70	0.118	0.373	0.374	0.25
5.15	UTB	0.35	0.959	0.0297	0.340	0.63
5.16	LVOEX	0.90	0.0212	0.0000191	0.00017	0.999
5.17	LTIM	0.92	0.0625	0.739	0.0312	0.23
5.19	LSLL	0.99	0.00348	0.0774	0.0441	0.88
5.20	LTLD	0.91	0.0837	0.887	0.0369	0.08

Figures 7.13-7.23 present the historical simulations of the dynamic model of the endogenous variables. The poorest tracking is for direct tax revenue (DTXR figure 7.13) and money supply (LNMs-figure 7.17). Otherwise, the conclusion is that the dynamic simulations are generally satisfactory.

Figure 7.13 Simulated and Historical DTXR 1964-1992 for the Dynamic Model

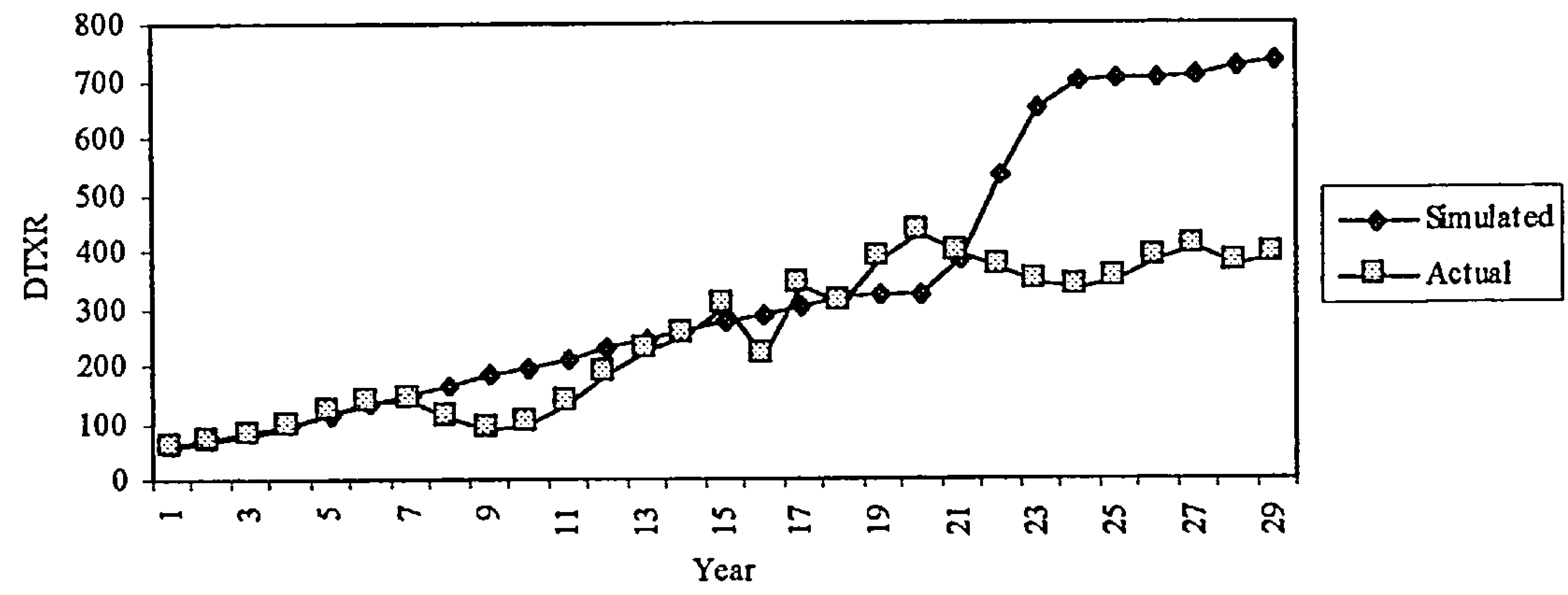


Figure 7.14 Simulated and Historical LIDTXR 1964-1992 for the Dynamic Model

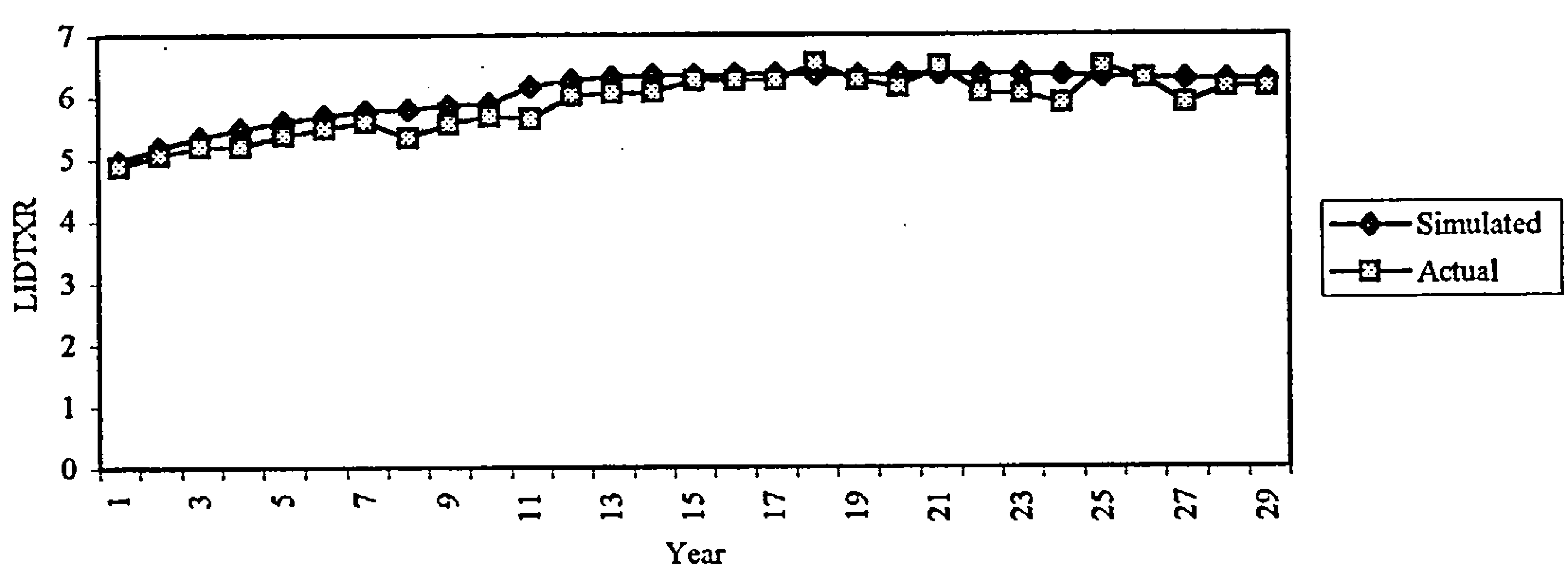


Figure 7.15 Simulated and Historical LNOE 1964-1992 for the Dynamic Model

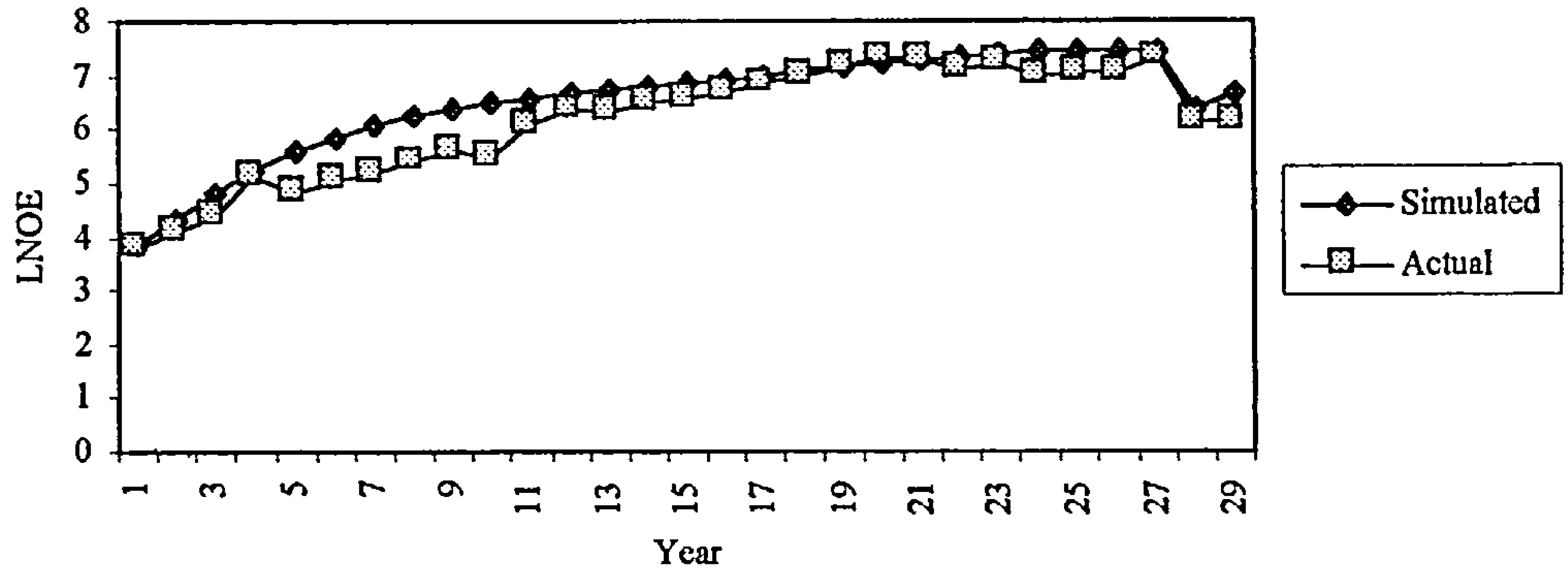


Figure 7.16 Simulated and Historical LDE 1964-1992 for the Dynamic Model

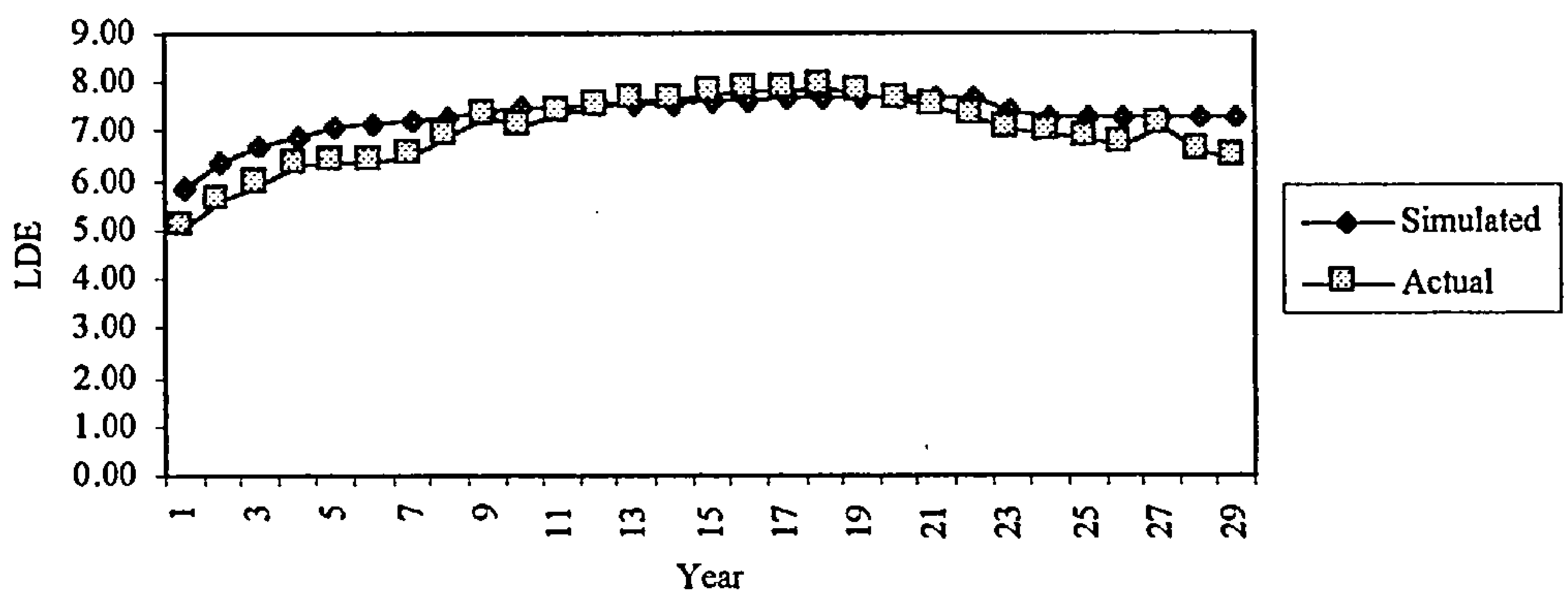


Figure 7.17 Simulated and Historical LNMs 1964-1992 for the Dynamic Model

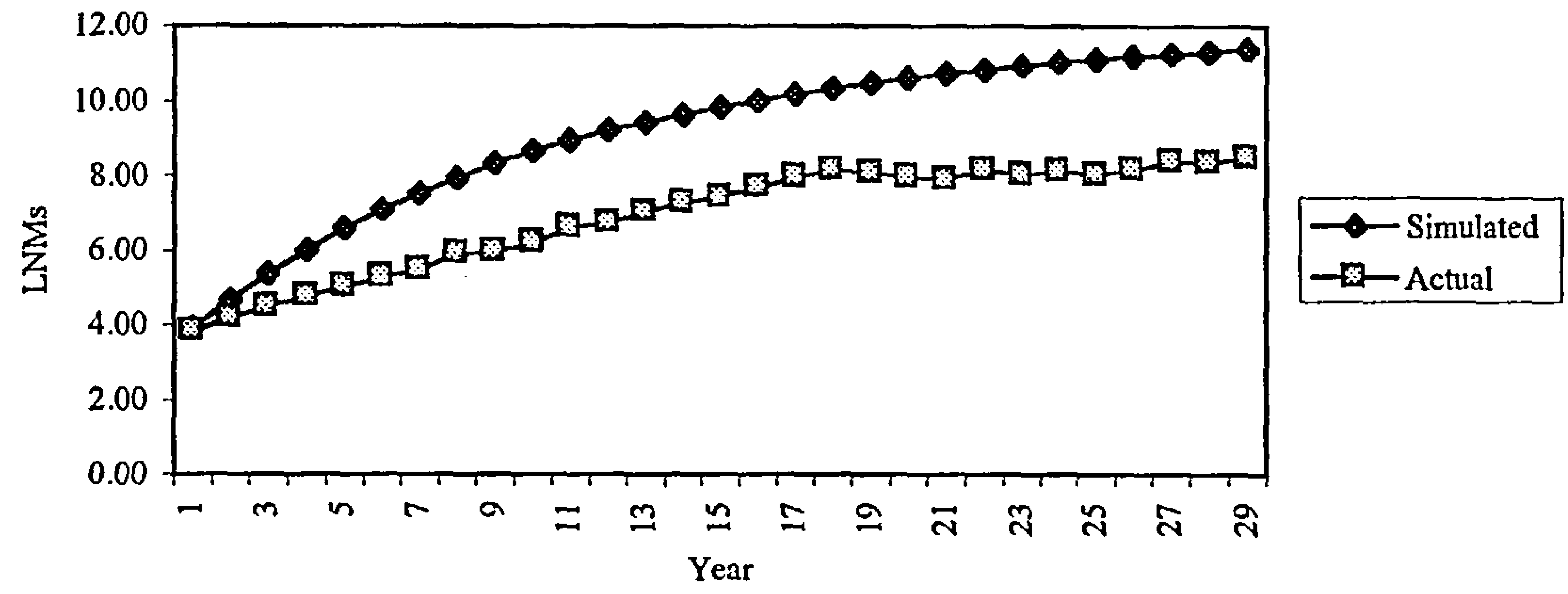


Figure 7.18 Simulated and Historical LGDPN 1964-1992 for the Dynamic Model

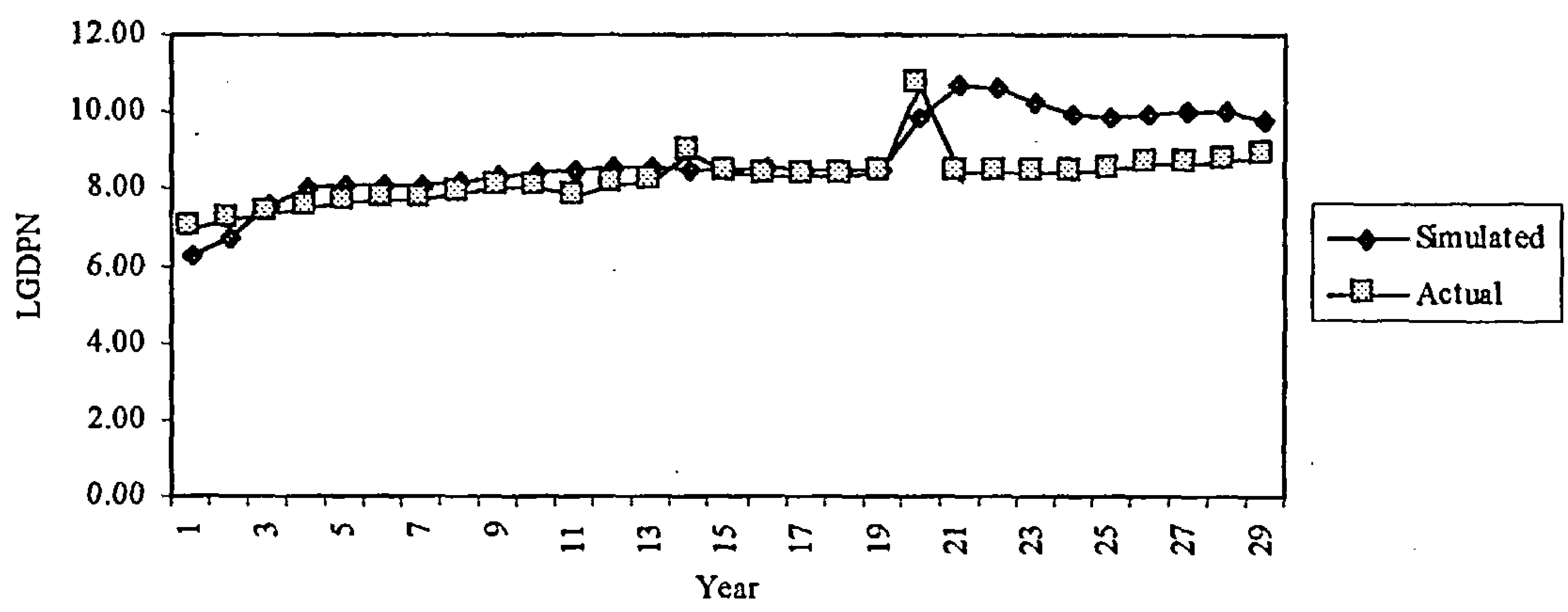


Figure 7.19 Simulated and Historical LVOEX 1964-1992 for the Dynamic Model

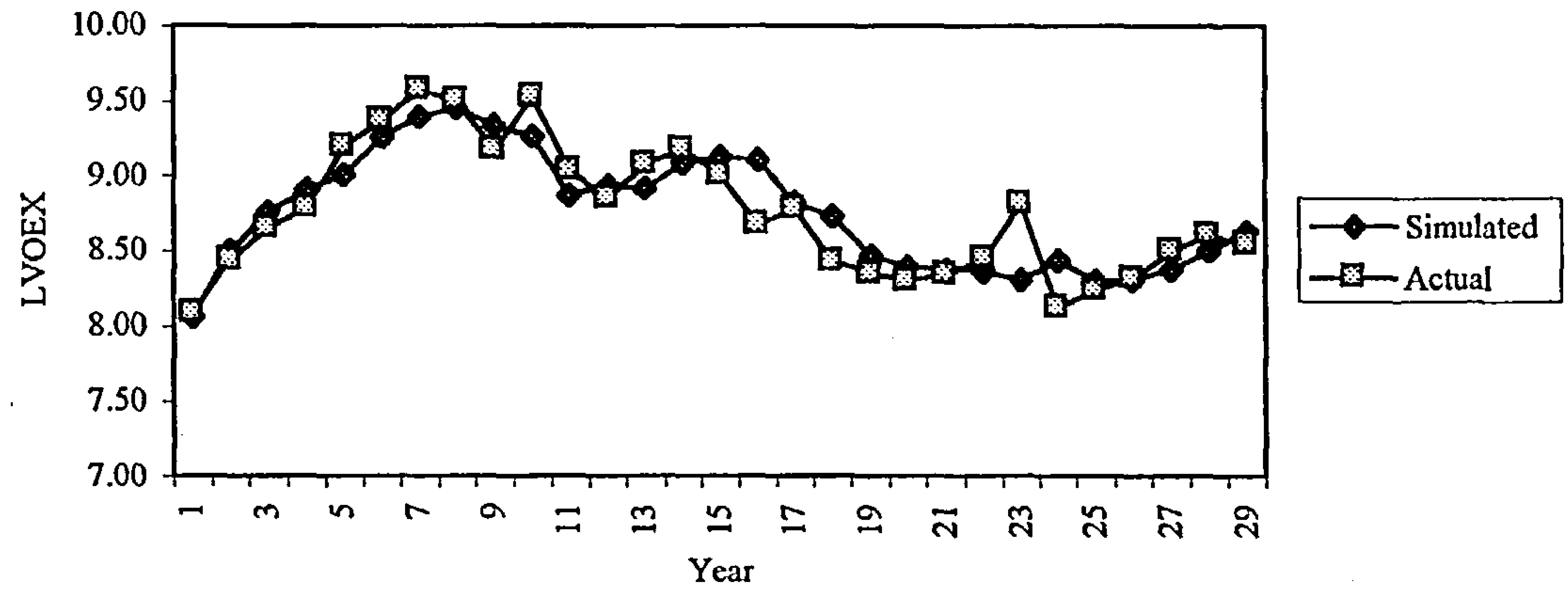


Figure 7.20 Simulated and Historical UTB 1964-1992 for the Dynamic Model

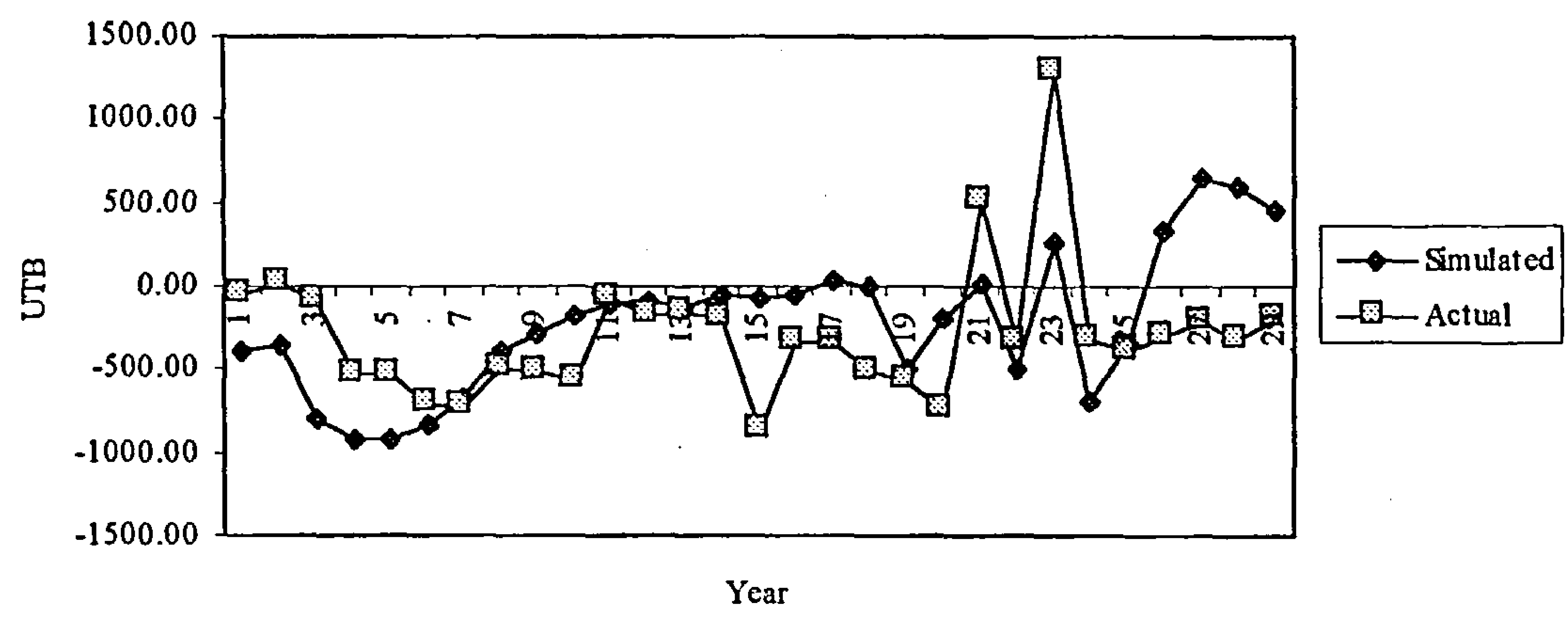


Figure 7.21 Simulated and Historical LTIM 1964-1992 for the Dynamic Model

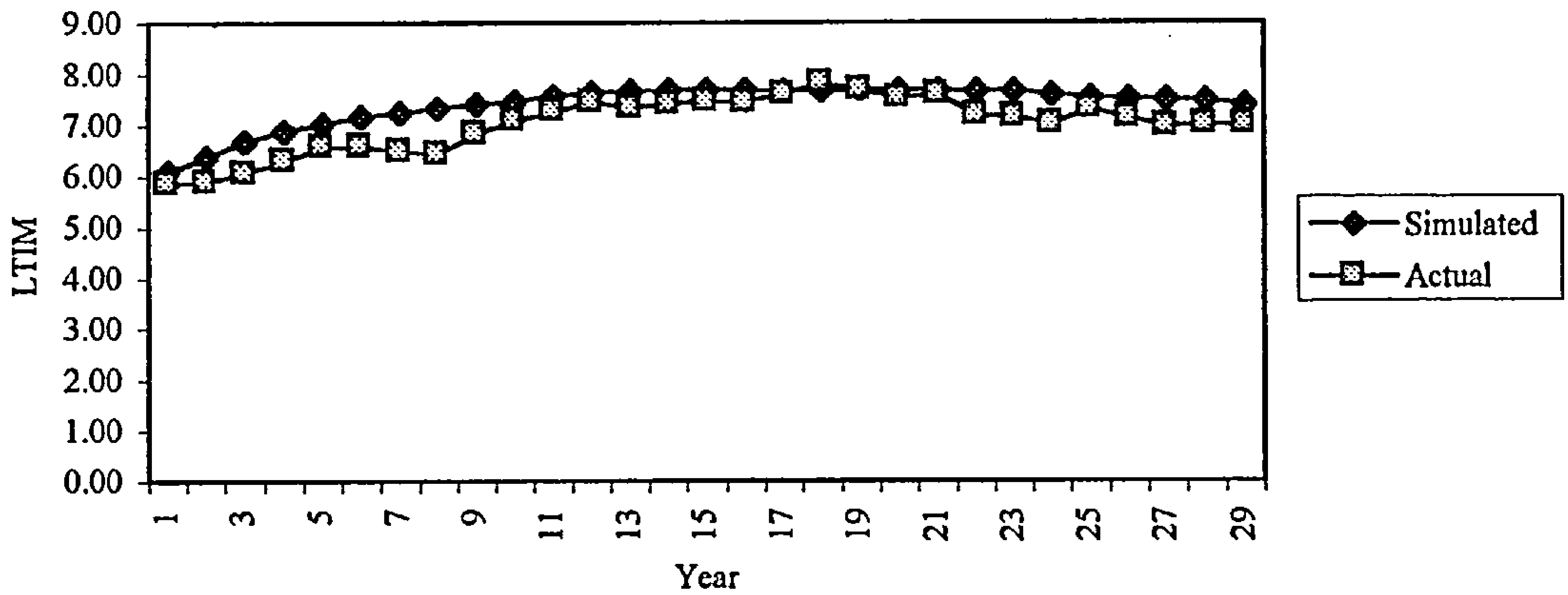
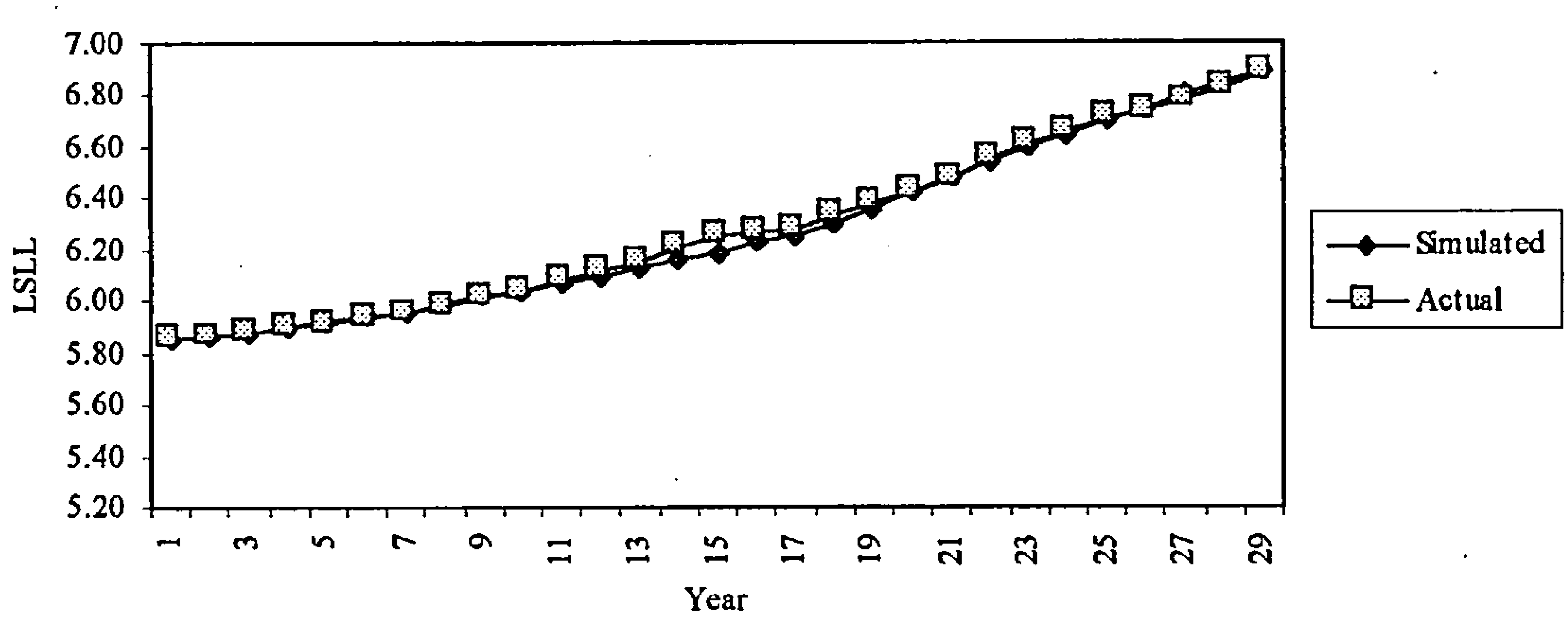
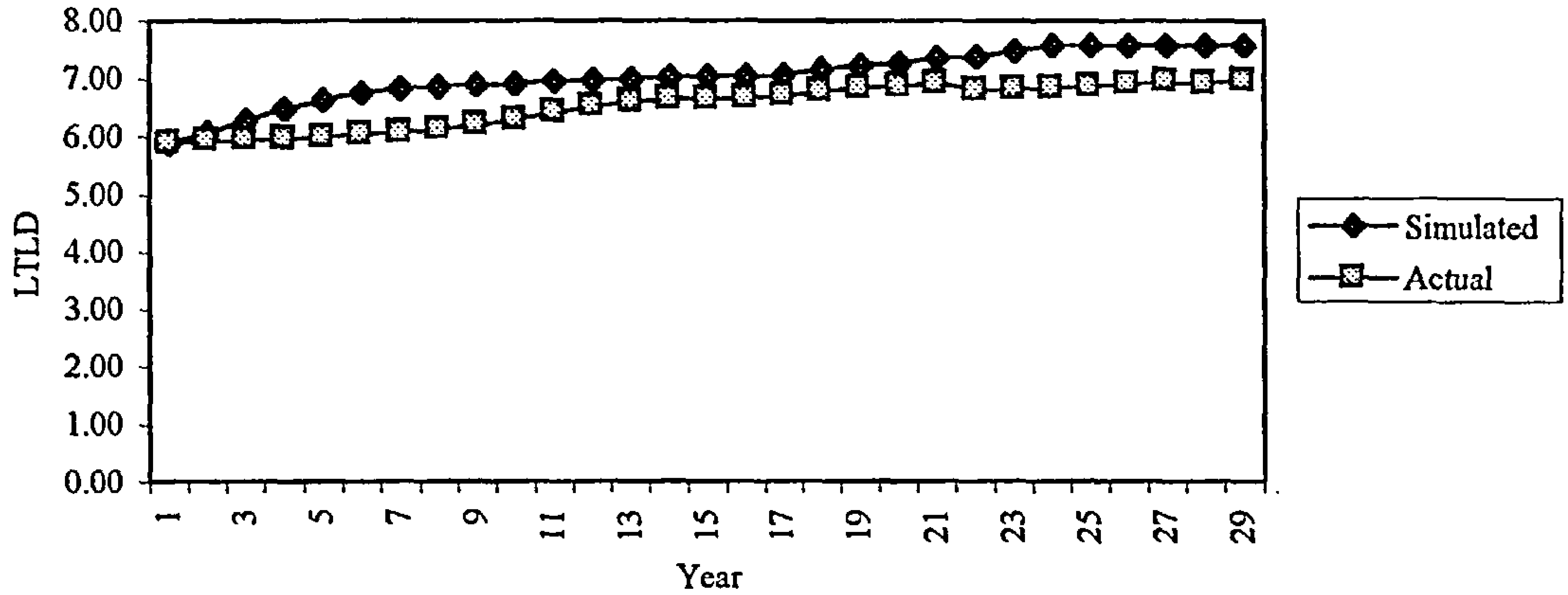


Figure 7.22 Simulated and Historical LSLL 1964-1992 for the Dynamic Model



Fogure 7.23 Simulated and Historical LTLD 1964-1992 for the Dynamic Model



The poor dynamic simulation results for DTXR from 1984 (year 21 in figure 7.13) can be attributed to the fact that GDP (GDP=GDPN+*GDPO)* is the only variable, which effects DTXR. GDPN is estimated in its log form when DTXR in its level. Figure 7.13 show that DTXR takes the same trend as GDPN (see figure 7.18).

The poor dynamic simulation for LNMs can be attributed to problems of the small sample size, and expectation of structural changes because of political changes during the data period.

7.4-Validation by Forecasting

Another test of any econometric model is its ability to produce sensible forecasts beyond the sample period. *Forecasts are required for two basic reasons: the future is uncertain and the full impact of many decisions taken now is not felt until later (Holden, et.al, 1990; 3).* Macro-economic forecasts are helpful for the government for macro-economic policy making. For example, the annual budget requires estimates of future revenue and future expenditure. Also, the government needs to take some view in future values of national output, unemployment, and price level.... etc, in planning the budget (Holden, et.al, 1990). As mentioned in sub-section 7.1.3, two different types of forecast are used in the literature to examine the model's performance over the estimated period, the ex-post and the ex-ante forecasts. The objective is to see how closely each forecasted variable tracks its corresponding data series.

Data availability in most developing countries is one of the biggest problems facing model builders. In this study, data up to 1995 is not available for all variables (see appendix 1 table 2). This means that it is not possible to construct forecasts, which are based on the interactions of the equations in the model. Also, the Libyan economy was under United Nation's sanctions from April 1992 till 1999. As consequences all the economic sectors have been seriously hampered, and it was decided not to proceed to the forecasting stage. Hence, the model can be used for future forecasting when the UN's sanctions are over.

7.5-Conclusion

In this chapter the simulation process, including model evaluation, historical policy analysis, and forecasting was discussed in the first section. Quantitative measures for evaluating forecasting and simulation models were discussed in section 7.2. Validation of the static and dynamic models is discussed in section 7.3. Section 7.4 discusses validation of the model by forecasting.

Figures 7.2-7.12 and the statistical results in table 7.1 using U coefficient indicate that the simulated values of the endogenous variables track their actual values quite well. Because of political events during 1990s, the model does not perform for forecasting outside the estimation period. Hence it is not entirely fair to judge whether the model is able to predict acceptable accurate data or not based on these political circumstances. However, as mentioned above the model simulation results are quite good. Therefore, the model will be adopted in the multiplier analysis in the following chapter.

Chapter Eight

The Multiplier Analysis of the Model

8.0-Introduction

This chapter is concerned with the evaluation of the model by using it for forecasting the future values of Libya's major economic aggregates under different policies for financing government expenditure. The simulation results carried out in the previous chapter were satisfactory and demonstrate that the model fits the historical data for most of the key endogenous variables of the model (see section 7.3 for a more detailed discussion). Models are often built to predict the responses of the endogenous variables to particular changes in the exogenous variables over time. The next test is to examine the multipliers implicit in the model. Multiplier analysis is a technique used to validate the model's forecasting ability, for policy evaluation, and to understand the structure of the model (see Chalien and Hagger, 1983 and Pindyck and Rubinfeld, 1998). *The major interest of economists has been concerned on examining the multiplier effects of government fiscal and monetary policy variables. The numerical values that the multiplier should take are still unsettled (Klein and Young; 66,1980).*

The aims of this study are to investigate the impact of government expenditure (real development expenditure "DE" and real ordinary expenditure "OE") on the growth of the real output of the non-oil sector, and also to find the best way to finance this expenditure. An increase in government expenditure requires a corresponding specification of how this increase is to be financed. Fiscal policy, including increasing real direct tax revenue "DTXR" and real indirect tax revenue "IDTXR", and monetary policy, including increasing real public debt (PD), and increasing money supply (Ms) will be evaluated as alternative ways of financing this expenditure. However, government policy is expected to react to external influences. Lucas (1976) pointed out *that the coefficients in the equations of standard econometric models depend on the existing policy regime, and any change in that regime will alter these coefficients (Holden et.al; 1991:94).* Here, for a small change in policy, and because of the lack of sophistication of the population, the Lucas (1976) critique is not relevant.

The rest of this chapter will be organised as follows. Section one is introduces the definition and the measurement of the multipliers. Section two tests the impact of government expenditure on the growth of the output of the non-oil sector. The fiscal and monetary policies mentioned above will be evaluated to see the effects of alternative modes of financing Libya's government expenditure in section 8.3. Section 8.4 is allocated to present discussion of the empirical results. Finally, section 8.5 will summaries the main points discussed in this chapter.

8.1-Meaning and Measurement of the Multipliers

A multiplier is simply the change in the endogenous variable divided by a given change in relevant exogenous variable. In this regard, three different types of multipliers are considered: impact multipliers, intermediate multipliers, and long-run multipliers.

(i)The impact multipliers refer to the current period effects of a change in an exogenous variable. Suppose that there are two variables Y and X. Consider the reduced form for Y:

$$Y_t = a_1 + a_2X_t + a_3Y_{t-1} + a_4X_{t-1} + U_t \qquad (8.1)$$

Abstracting from the error term and differencing (8.1) gives

$$\Delta Y_t = a_2\Delta X_t + a_3\Delta Y_{t-1} + a_4\Delta X_{t-1} \qquad (8.2)$$

Suppose X and Y are constant (so $\Delta X_{t-1} = 0 = \Delta Y_{t-1}$). Hence, if X_t is increased by 1, $\Delta X_t = 1$, and equation (8.2) gives the immediate effect on Y:

$\Delta Y_t = a_2 (1) + a_3 (0) + a_4 (0) = a_2$ (the impact multiplier of a unit increase in X).

(ii) The dynamic multipliers (the intermediate multipliers) are any period -to-period change in Y_t resulting from changes in the exogenous variables. Suppose the model is in equilibrium. If X increases by 1, then $\Delta X_1 = 1$. From (8.2) the impact (first period) multiplier is $\Delta Y_1 = a_2$ as above. The second period multiplier, from (8.2), assuming that $\Delta X_2 = 0$, so that the change in X was once-and-for-all rather than an increase each period, is

$\Delta Y_2 = a_2\Delta X_2 + a_3\Delta Y_1 + a_4\Delta X_1$

$= a_2 (0) + a_3a_2 + a_4(1) = a_3a_2 + a_4$

The impact multiplier differs from the dynamic multiplier because the latter includes the effects of ΔY_1 and ΔX_1. The third period multiplier, from (8.2) assuming that $\Delta X_3 = \Delta X_2 = 0$, is

$\Delta Y_3 = a_2\Delta X_3 + a_3\Delta Y_2 + a_4\Delta X_2$

$= a_2 (0) + a_3[a_3a_2 + a_4] + a_4(0) = a_3[a_3a_2 + a_4]$

Other dynamic multipliers can be found by the same method. If the change in X had been an increase of 1 in each period, in the above equations $\Delta X_2 = \Delta X_3 = ... = 1$, and the multipliers would be, for period 2, $a_2 (1) + a_3a_2 + a_4 (1)$, and for period 3, $a_2 (1) + a_3[a_2 + a_3a_2 + a_4] + a_4(1)$ etc. *(iii) The long-run multipliers* give the total effect of a change in the exogenous variable and are the sum of all the dynamic multipliers. Consider equation (8.2) and let $\Delta Y_t = \Delta Y_{t-1} = \Delta Y$, and $\Delta X_t = \Delta X_{t-1} = \Delta X$ be the long-run rates of increase of Y and X, (8.2) becomes

$\Delta Y = a_2\Delta X + a_3\Delta Y + a_4\Delta X$ or $\Delta Y = (a_2 + a_4)\Delta X/(1-a_3)$ so that the long-run multiplier or long-run effect of a permanent increase in X by 1 is $(a_2 + a_4)/(1-a_3)$. If $\Delta X = 0$, so that there is no permanent increase in X, $\Delta Y = 0$, and Y is unchanged (Chalien and Hagger, 1983 and Pindyck and Rubinfeld, 1998).

The above multipliers provide information about the response of a particular endogenous variable of a linear model to a shock in the form of a unit maintained increase in a specified exogenous variable. Information about the response of an endogenous variable to changes in exogenous variables in the case of non-linear models such as the present one is also interesting. However, in the case of non-linear models the formula for the various multipliers cannot be easily obtained by analytic methods. The alternative method is to use an appropriate simulation experiment. In general, system simulation comprises two runs of the solution of the model over the same time period (the simulation period). The first is called the control run the second is the shocked run. The difference between the two is that in the case of the shocked run a shock is introduced into the system. The shock often takes the form of a change in the time path of one or more exogenous variables or may take the form of a change in one or more parameters of the model or replacing one of the equations of the system by another (Challen and Hagger, 1983 and Pindyck and Rubinfeld, 1998). Information on the response of the model to the postulated shock can be obtained by comparing the solution values of the endogenous variables which are generated in the shocked run with the solution values of the endogenous variables which are generated in the control run. *However, if the model is stable, it is expected that the dynamic multipliers are diminishing and converge to zero. Therefore, these multipliers are considered another check on the stability of the model (Baryun; 1980,239).*

8.2-The Impact of Government Expenditure on the Growth of the Non-Oil Sector

The impact of government expenditure on the growth of the non-oil sector (GDPN) now is investigated. Government expenditure is dis-aggregated into development expenditure (DE) and ordinary expenditure (OE). The model provides a framework for the analysis of economic growth. The effects of a change in the components of the total public sector budget expenditure (TPSBE) can be evaluated by examining the percentage deviation of the actual and the simulated time paths of the endogenous variables of the model. *However, the impact and long-run multipliers (total multipliers) are mostly utilised in empirical studies (Baryun, 1980; 239).* Therefore, these two multipliers will be obtained. The next two sub-sections will present and discuss the effects of a change in DE, and OE from a 10 percent increase in GDPN.

8.2.1-The Impact of a Change in Development Expenditure

The first component of total public sector budget expenditure (TPSBE) is development expenditure (DE). DE is an endogenous variable (see equation 5.5). To investigate the impact of DE on GDPN the model is re-simulated with the government raising the level of DE beyond the level associated with the equation for the entire observation period.

In this experiment a 10 percent increase in development expenditure (DE) is considered. This increase in DE will effect directly nominal ordinary expenditure

(NOE) (see equation 5.4, section 5.10), which have nominal development expenditure (NDE) as an independent variable. The 10 percent increase in DE also will generate an equivalent increase in total public sector budget expenditure (TPSBE) identity (see identity 5.7, section 5.10). Also, the change in NOE caused by the increase of DE will be passed on to the TPSBE (see identity 5.7, section 5.10). Since TPSBE, which is effected directly by the increase in DE, and indirectly by the change in NOE, is an independent variable in other equations and identities; these equations and identities will be effected indirectly by the shock introduced in DE.

The direct and indirect changes in TPSBE will affect the budget deficit identity (see identity 5.8, section 5.10). Again, the change in TPSBE will be passed on to the output of the non-oil sector (GDPN) (see equation 5.11, section 5.10), in turn this will affect the gross domestic product (GDP) (see identity 5.12, section 5.10). TPSBE is an independent variable in total imports (TIM) equation (see equation 5.17 section 5.10). The total change in TPSBE resulting from the initial increase in DE by 10 percent and the indirect change from ordinary expenditure (OE) will pass on to the TIM. TIM is an independent variable in the indirect tax revenue (IDTXR) (see equation 5.2, section 5.10). The change in TIM resulting from the total increase in TPSBE will pass on to the IDTXR offsetting to some extent the increase in TPSBE. Finally, the change in GDP will pass on to the total labour demand (TLD) (see equation 5.20, section 5.10). Chart 8.1 illustrates the impact of changing DE.

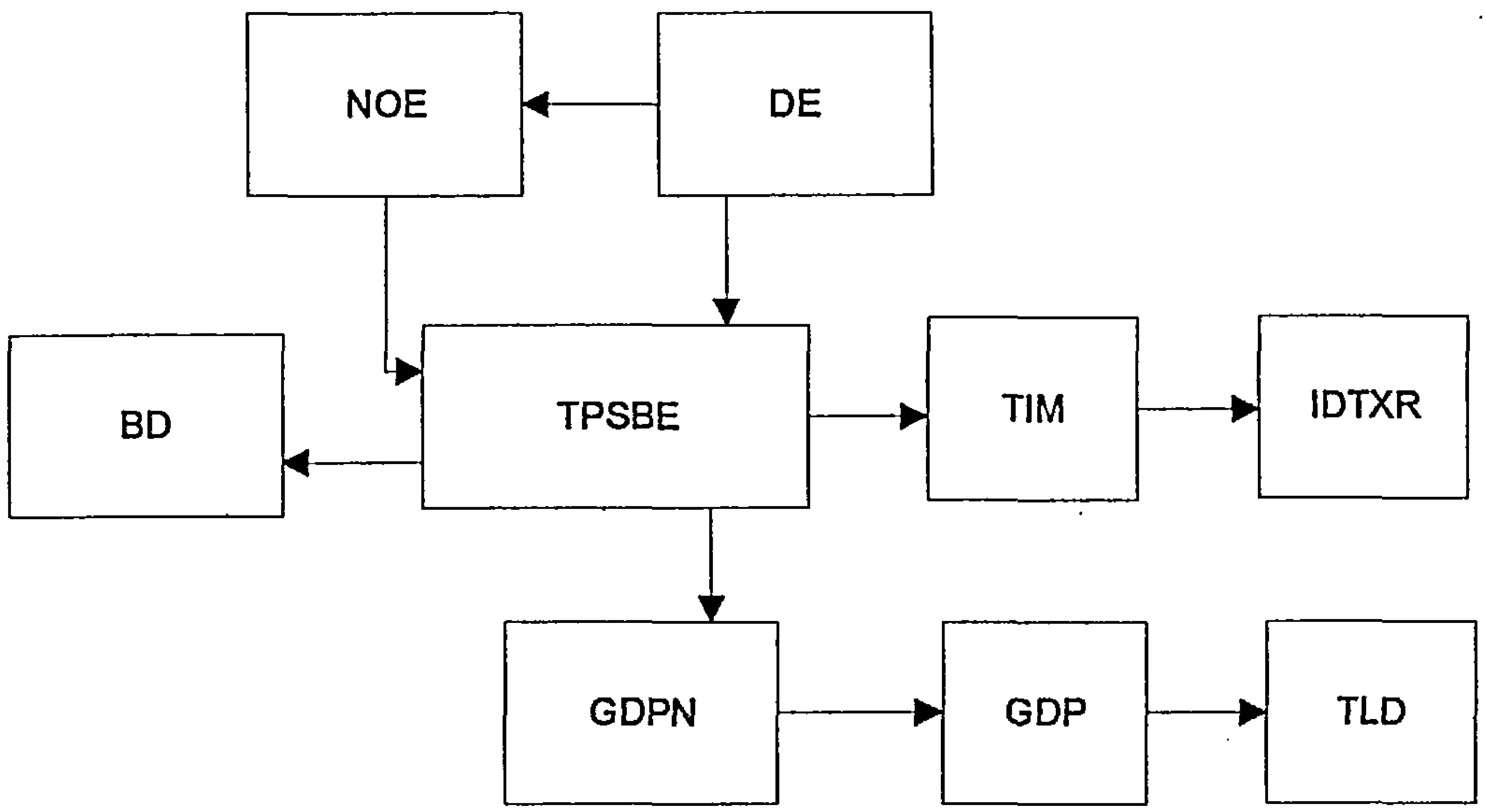


Chart 8.1. The impact of a change in development expenditure

8.2.2-The Impact of a Change in Ordinary Expenditure

The second component of total public sector budget expenditure is ordinary expenditure (OE). NOE is an endogenous variable in this model (see equation 5.4). As in the above case the model is re-simulated with the government raising the level of NOE beyond the level associated with the equation for the entire observation period. The 10 percent increase in NOE will generate a 10 percent increase in TPSBE. This is the direct affect (see identity 5.7, section 5.10). The direct change in TPSBE will affect the budget deficit identity (see identity 5.8, section 5.10). TPSBE is an independent variable in GDPN and TIM equations. Therefore, the direct effect on TPSBE will be passed on to GDPN and TIM (see equations 5.11, and 5.17, section 5.10). The indirect affect of the initial 10 percent change in NOE through TPSBE will follow the same path of the change in DE as analysis in the previous section. Chart 8.2 illustrates the impact of changing NOE.

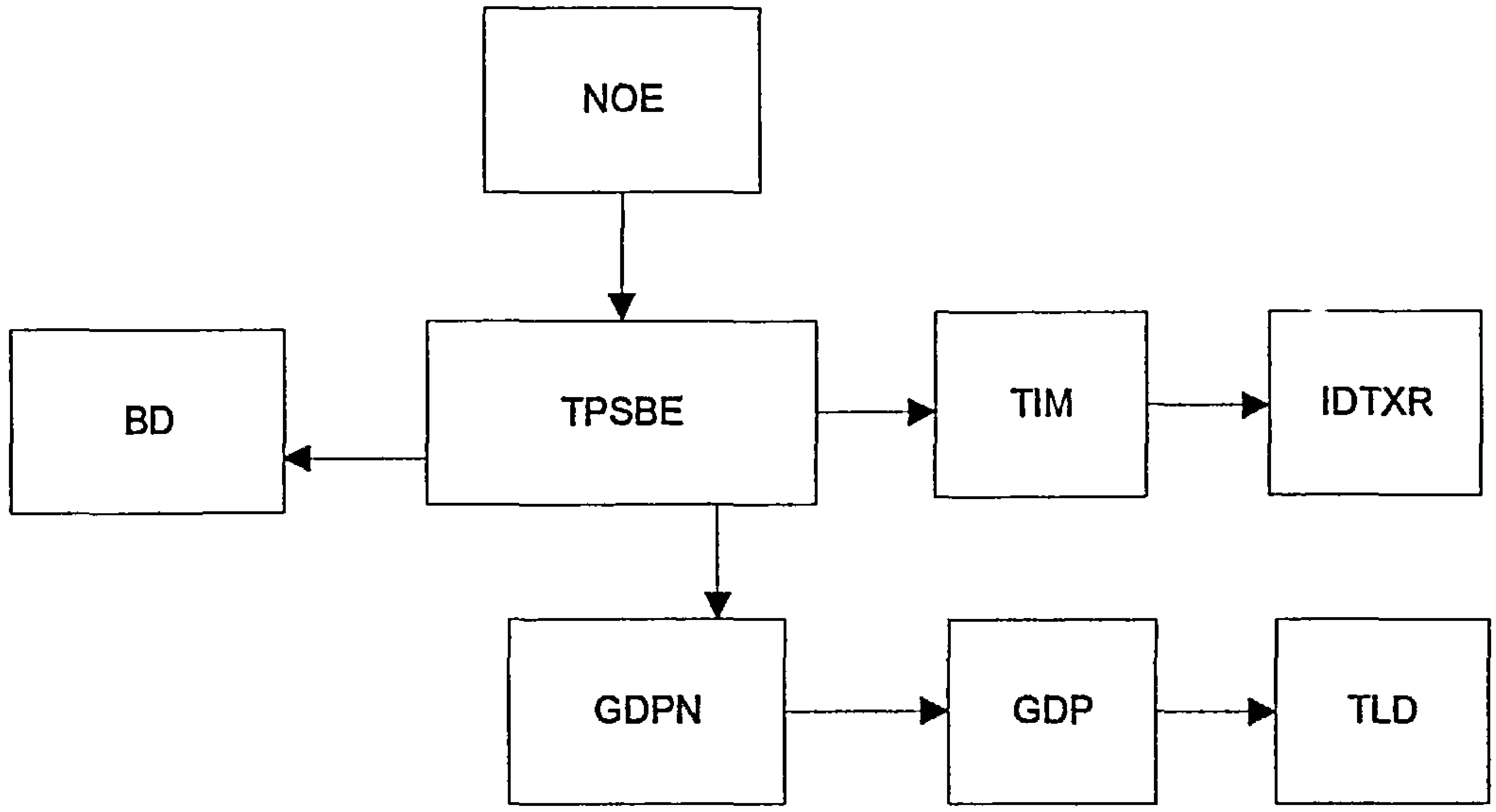


Chart 8.2. The impact of a change in ordinary expenditure

8.3-Different Modes of Financing Libyan Government Expenditure

As mentioned before Libyan planners did not face any problems financing the government spending through the 1960s and 1970s. By 1980 difficulties arose because of the world recession, decreasing oil prices, and the socialist thinking that dominated the Libyan economy after 1978 which put pressure on the government to finance and produce all goods and services (see sub-section 2.2.4.1.2).

In the economic literature two sorts of sources to finance the government deficit are discussed. These are external and internal sources. Each has different impacts on inflation, the balance of payments, output, prices, employment etc. (Jha, 1994). In the case of Libya, foreign loans have not been used to finance the public sector budget deficit. Instead, it was financed mainly through the expansion of domestic credit to the public sector (public debt "PD") (see sub-section 2.2.2.3).

The complete model of the Libyan economy built and estimated in chapters five and six is now used to explore the consequences of various economic policy changes. Usually, standard fiscal and monetary instruments are examined and model's responses to these changes are discussed. The fiscal and monetary policy variables in the model consist of: (i) fiscal policy including changes in direct and indirect taxes (ii) monetary policy instruments including domestic credit to the public sector "public debt" (PD), and increasing the money supply (Ms). The external loans will be examined to investigate their effect on different variables if used to fund government expenditure. As a result of the USA ban on importing Libyan oil since 1981, the world recession, and the collapse of oil prices from 1982 the government faced financial problems for funding government expenditure (see sections 1.0 and 1.1). Therefore, 1981 is chosen for introducing the shocks to the different financial modes that can be used to fund Libyan government expenditure. The next three sections discuss the model's response to changes in policy variables. This change will be via the intercept of the equation under consideration. However, in all cases, the effect of the shock is not confined to the first period, since it takes up to three periods for the effect of the shock to show up in employment sector (total labour demand "TLD" and demand for foreign labour "DFL".

8.3.1-Fiscal Policy

The public sector budget constraint discussed in section 5.5 shows that the fiscal deficit can be financed in three ways: (i) by increasing real tax revenues, (ii) by borrowing domestically from the LCB (PD), or (iii) by increasing money supply (Ms). The two fiscal policies mentioned above will be used to explore their effect on GDPN, TLD, DFL, and TIM when they are used to finance the change of the components of TPSBE.

8.3.1.1-Change in Development Expenditure Financed by Increasing the Direct Tax Revenue

In this experiment the 10 percent increase in development expenditure (DE) is financed by an equivalent increase in the direct tax revenue each year in 1981-1992. From table 8.1 the initial impact on real output of the non-oil sector (GDPN) is an increase of 0.67 % and converges to 0.0 in the long-run from the base simulation path.

Table 8.1

The Effect of a 263.56 MLD* Increase in Development Expenditure (DE) in 1981

		Mode of Financing the Increase in DE		
GDPN		Period	DTXR	IDTXR
		1981-1992	%	%
Impact Multiplier			0.667	0.660
Long-RunMultiplier			0.002	0.036
TLD				
		1981-1992	DTXR	IDTXR
Impact Multiplier			0.026	0.024
Long-Run Multiplier			0.006	0.003
DFL				
		1981-1992	DTXR	IDTXR
Impact Multiplier			0.026	0.024
Long-Run Multiplier			0.006	0.003
TIM				
		1981-1992	DTXR	IDTXR
Impact Multiplier			0.196	0.196
Long-Run Multiplier			0.000	0.000

* MLD is Million Libyan Dinar

Increasing development expenditure means improving existing firms or establishing new projects. This will create new jobs. Therefore, total labour demand (TLD) will be increased. Table 8.1 shows that using DTXR to fund any expansion of DE will result an increase in TLD as an initial impact only by 0.026 and in the long-run will be increased by 0.01 from the base run path.

As mentioned before the Libyan economy is assumed to be full employment, also, the Libyan economy relies on the external labour market. Hence, the demand for foreign labour is elastic. Therefore, the increase of TLD leads to an increase in the demand for foreign labour (DFL). Table 8.1 indicates that DFL will increase by the same as in TLD in both the first and long-run effect when DTXR is used to fund the increase in DE. Since a significant part of DE is allocated to import capital and raw material goods, total imports (TIM) are increasing. From table 8.1 the impact multiplier from increasing DE funding by an equivalent increase in DTXR will raise TIM by 0.196 in the first period and converge to 0.00 in the long-run.

8.3.1.2-Change in Development Expenditure Financed by Increasing the Indirect Tax Revenue

In this case the increase in DE is financed by an equivalent increase in the indirect tax revenue (IDTXR). Because a great part of DE is allocated to fund capital and raw material goods it is expected that this increase in DE will have a positive effect in GDPN growth. Table 8.1 shows that GDPN increased by 0.66 in 1982 and by 0.036 in the long-run, from the base simulation path.

In general, using IDTXR as a financial method to fund DE expansion has the same impact in the initial and long-run periods on TLD, DFL, and TIM as when DTXR is used (see table 8.1).

8.3.1.3-Change in Ordinary Expenditure Financed by Increasing the Direct Tax Revenue

The second component of total public sector budget expenditure (TPSBE) is ordinary expenditure (OE). As mentioned in section 5.5.2, OE comprises wages and salary outlay, administration expenditure, and other government consumption. In this experiment the increase of OE by 10 percent is financed by an equivalent increase in the direct tax revenue each year. Table 8.2 shows a higher increase for the impact (0.83) and the long-run effect (0.06) of GDPN from the simulation path. The results in table 8.2 indicate that the impact and long-run multipliers are the same for TLD and DFL, being only 0.039 in the initial period and 0.02 in long-run. TIM will be increased by 0.24 and 0.01 in the first and long-run respectively.

Table 8.2

The Effect of a105 MLD* Increase in Ordinary Expenditure (OE)

in 1981

		Mode of Financing the Increase in OE		
GDPN		Period	DTXR	IDTXR
		1981-1992	%	%
Impact Multiplier			0.829	0.822
Long-Run Multiplier			0.061	0.026
TLD				
		1981-1992	DTXR	IDTXR
Impact Multiplier			0.039	0.036
Long-Run Multiplier			0.021	0.017
DFL				
		1981-1992	DTXR	IDTXR
Impact Multiplier			0.039	0.036
Long-Run Multiplier			0.021	0.017
TIM				
		1981-1992	DTXR	IDTXR
Impact Multiplier			0.244	0.244
Long-Run Multiplier			0.007	0.007

*MLD is Million Dinar

8.3.1.4-*Change in Ordinary Expenditure Financed by Increasing the Indirect Tax Revenue*

In this experiment the increase in ordinary expenditure (OE) by 10 percent is financed by an equivalent increase in the indirect tax revenue (IDTXR). Table 8.2 Shows that IDTXR has a little lower effect on GDPN compared with DTXR in the first and long-run impact multiplier from the base simulation path when is used to fund the 10 percent increase in OE. IDTXR has the same effect on TLD and DFL when it used as a financial method as DTXR in the initial (0.04) and the long-run (0.02) from the base simulation path. IDTXR has the same effect on TIM as using DTXR to fund the 10% increase in OE 0.24 in first period and only 0.01 in long-run.

8.3.2-Monetary Policy

Turning to monetary policy, from the discussion in the previous section it is clear that the Libyan government can finance its fiscal deficit by using only two monetary policies. These are borrowing domestically from the Libyan Central Bank (LCB) "PD", and increasing the money supply (Ms). In this section the results of policy simulations of the deviation of monetary instruments from the base simulation trends are presented. Experiments will be carried out to investigate the effects of the monetary policy on GDPN, TLD, DFL, and TIM when they are used to finance the change of development expenditure (DE), and ordinary expenditure (OE).

8.3.2.1- Change in Development Expenditure Financed by Increasing Public Debt

In this experiment the 10 percent increase in development expenditure (DE) is financed by an equivalent increase in public debt (PD) borrowing from the LCB each year in 1981-1992. From table 8.3 the initial impact on the real output of the non-oil sector (GDPN) is an increase of 0.67 in the first period, converging to 0.00 in the long-run from the base simulation path.

Table 8.3

The Effect of a 263.56 MLD* Increase in Development Expenditure (DE) in 1981

Mode of Financing the Increase in DE			
GDPN	Period	PD	Ms
	1981-1992	%	%
Impact Multiplier		0.667	0.667
Long-Run Multiplier		0.002	0.002
TLD			
	1981-1992	PD	Ms
Impact Multiplier		0.026	0.026
Long-Run Multiplier		0.006	0.006
DFL			
	1981-1992	PD	Ms
Impact Multiplier		0.026	0.026
Long-Run Multiplier		0.006	0.006
TIM			
	1981-1992	PD	Ms
Impact Multiplier		0.196	0.196
Long-Run Multiplier		0.000	0.000

* MLD is Million Libyan Dinar

Increasing DE expenditure will increase TLD to run the new projects. Table 8.3 illustrates that the impact multipliers of TLD in 1982 of using public debt (PD) to fund the expansion of DE is 0.026, this will decrease in the long-run to 0.01. Also, the demand of foreign labour will increase as a result of increasing DE expenditure. From table 8.3 the initial impact of increasing DE on DFL when PD is used as a financial method is as the same as the increase in TLD in first and long-run.

Again, increasing DE will increase total imports (TIM) to supply the existing and the new projects with capital and raw material goods. The initial impact of using PD to fund the higher DE is increases TIM by 0.196 and will converge to 0.00 in the long-run.

8.3.2.2-Change in Development Expenditure Financed by Increasing the Money Supply.

In this case the increase in DE by 10 percent is financed by an equivalent increase in the money supply (Ms). Table 8.3 shows that GDPN, TLD, DFL, and TIM increased by the same amount as when PD is used to fund the increase in DE.

8.3.2.3-Change in Ordinary Expenditure Financed by Increasing Public Debt

The second component of total public sector budget expenditure is ordinary expenditure (OE). In this experiment the increase of OE by 10 percent is financed by an equivalent increase in public debt (PD) each year. Table 8.4 shows that the impact multiplier is 0.829 and the long-run multiplier is .061 for GDPN.

Table 8.4

The Effect of a 105 MLD* Increase in Ordinary Expenditure (OE) in 1981

Mode of Financing the Increase in OE			
GDPN	Period	PD	Ms
	1981-1992	%	%
Impact Multiplier		0.829	0.829
Long-Run Multiplier		0.061	0.061
TLD			
	1981-1992	PD	Ms
Impact Multiplier		0.039	0.039
Long-Run Multiplier		0.021	0.021
DFL			
	1981-1992	PD	Ms
Impact Multiplier		0.039	0.039
Long-Run Multiplier		0.021	0.021
TIM			
	1981-1992	PD	Ms
Impact Multiplier		0.244	0.244
Long-Run Multiplier		0.007	0.007

*MLD is Miliion Libyan Dinar

Using public debt to fund the expansion of the OE has a low effect (0.039) on TLD in the first period and in the long-run (0.02). Also, it has the same effect in the first period (1982) and in the long-run for DFL.

Using PD to fund the 10 percent increase in OE has an effect in the first period (0.24) on TIM which decreased to 0.01 in the long run.

8.3.2.4-Change in Ordinary Expenditure Financed by Increasing the Money Supply

In this experiment an equivalent increase in money supply is considered as a policy to fund an increase in OE. Using this policy has the same impact and long-run multipliers on the four variable under-consideration (GDPN, TLD, DFL, and TIM) as using PD to fund the 10 percent increase in OE.

8.3.3-External Loans

As mentioned before external loans have never been used as a method to fund Libyan government expenditure. However, foreign loans have impacts on the price level, output, employment etc. This section aims to investigate the effect of external loans on these macroeconomic variables under-consideration if this financial method were adopted by the Libyan government to fund its financial problems since 1981. The next two sub-sections discus the effect of increasing DE and OE on GDPN, TLD, DFL, and TIM if foreign loans are used finance them.

8.3.3.1-Change in Development Expenditure Financed by External Loans

In this case increasing DE by 10 percent is financed by external loans (EXL)*. As mentioned above DE has a positive effect on most of the variables. Table 8.5 shows that the first impact (1982) of using EXL is to increase GDPN by 0.67 and this converges to 0.00 in the long-run.

* Borrowing from abroad requires repayment but that this would be outside the time period of this model and there is no allowance for this fact in this simulation.

Table 8.5

The Effect a 263.56 MLD* Increase in Development Expenditure (DE) in 1981

Mode of Financing the Increase in DE		
GDPN	Period	EXL
	1981-1992	%
Impact Multiplier		0.668
Long-Run Multiplier		0.00
TLD		
	1981-1992	EXL
Impact Multiplier		0.043
Long-Run Multiplier		0.014
DFL		
	1981-1992	EXL
Impact Multiplier		0.043
Long-Run Multiplier		0.014
TIM		
	1981-1992	EXL
Impact Multiplier		0.196
Long-Run Multiplier		0.001

*MLD is Million Libyan Dinar

The other positive effect is to increase employment. From table 8.5 TLD and DFL will increase by 0.043 as initial impact and by 0.014 in the long-run. Also, using EXL to fund the increase in DE will increase TIM in the first period by 0.196 and in the long-run will converge to 0.00.

8.3.3.2-Change in Ordinary Expenditure Financed by External Loans

The effect of using EXL to fund the expansion of OE is shown in table 8.6. The results indicate that the initial impact of GDPN is 0.829 and 0.156 in the long-run from the simulation path.

Table 8.6

The Effect of a 105 MLD* Increase in Ordinary Expenditure (OE) in 1981

Mode of Financing the Increase in DE		
GDPN	Period	EXL
	1981-1992	%
Impact Multiplier		0.829
Long-Run Multiplier		0.156
TLD		
	1981-1992	EXL
Impact Multiplier		0.059
Long-Run Multiplier		0.045
DFL		
	1981-1992	EXL
Impact Multiplier		0.059
Long-Run Multiplier		0.045
TIM		
	1981-1992	EXL
Impact Multiplier		0.244
Long-Run Multiplier		0.017

*MLD is Million Libyan Dinar

Also, table 8.6 shows the effect of EXL in the labour market. TLD and DFL are increased by 0.059 in the initial period and 0.045 in the long-run from the simulation path.

The results in table 8.6 show that external loans will increase TIM by 0.24 in the first period and by 0.02 in the long-run when used to finance the increase of OE.

8.4-Empirical Results Discussion

The analysis in this chapter is focusing on the period 1981-1992. The results in tables 8.1-8.6 indicate increasing OE is more beneficial for the economy than DE. This can be attributed to the fact that the development plan 1981-1985 was not totally implemented. This is because of the financial problems faced the Libyan government in the early 1980s, caused by decreasing oil revenue the main source of the income for the government. In addition no development plans have been implemented from 1986. Also, as mentioned before most of OE is used to fund wages and salaries, but since wages and salaries have been fixed from 1981, Libyan workers have the feeling that their income is low. Hence, increasing their salaries will motivate them to increasing their output. Also increasing OE will lead to creating jobs in the public sector institutions, which will lead to increased output of the economy.

Turning to the financial methods, direct tax (DTXR) financing of the increase in DE and OE has a more positive effect on GDPN growth, TLD, DFL, and TIM than indirect tax (IDTXR) financing (see tables 8.1 and 8.2). This result arises from the fact that GDP is an independent variable in DTXR equation in the model so, that when GDP increases, DTXR increases. Also, the financial problems mentioned above put pressure on the government to reduce its imports. Since total import (TIM) is the main factor determining IDTXR, TIM decreased during 1981-1992 leading to a decrease in IDTXR. This can explain why IDTXR multipliers are lower than DTXR multipliers.

On the other hand, using the monetary instruments "public debt (PD) or money supply (Ms)" to fund any expansion in DE or OE has the same effect in the first and long-run on the growth of GDPN, TLD, DFL, and TIM (see tables 8.3 and 8.4). This is because in Libya, as in most developing countries, borrowing from the private sector has not been used as a tool to finance the public sector-borrowing requirement due to a lack of relevant institutional arrangements. Thus, borrowing from the private sector has not been considered to be a policy option. Instead, the government borrows from its central bank. Therefore, public debt is another method of creating money. Hence, increasing any of the public debt or the money supply has the same impact on the economic variables under consideration.

External loans (EXL) have the same effect on GDPN and TIM (see tables 8.5 and 8.6) as the monetary tools "public debt (PD) and the money supply (Ms)" (see tables 8.3 and 8.4). The explanation is that EXL is in foreign currency, which affects the net foreign assets. In the present model net foreign assets (FAN) is the only factor affecting the money supply. Hence, increasing FAN has the same effect as increasing the money supply. Also, EXL has a little more positive effect on the employment sector than using the other policies. This is because Libyan economy relies on the external labour market and EXL increases the government's ability to pay the foreign workers their high salaries in hard currency.

Finally, in an open economy, any increase in spending is partly dissipated in purchases of foreign goods, which creates additional income for foreigners rather than for the domestic economy. This illustrates a general result that international trade lowers the numerical value of the multiplier. Since the Libyan economy depends heavily on the external market to supply its needs of capital, raw materials and consumption goods and services as well as foreign labour, the values of the multipliers in tables 8.1-8.6 are less than one.

8.5-Conclusions

In this chapter the meaning and measurement of the multiplier have been presented in section 8.1. The working mechanisms of the two variables development expenditure (DE) and ordinary expenditure (OE) were discussed in section 8.2. The effectiveness of different modes of financing the change of the previous two variables on the real output of the non-oil sector (GDPN), total labour demand (TLD), demand of foreign labour (DFL), and total imports (TIM) were discussed in section 8.3. The government controls the price level during 1962-1992; therefore, the effect of different financial methods of financing DE and OE on price level was not investigated.

Fiscal policy, such as increasing the rate of direct and indirect tax, is examined to investigate the most appropriate policy available to the Libyan government to fund any expansion of the components of total public sector budget expenditure (DE, and OE). For long periods during the study period the government fixed the exchange rate. Therefore, two monetary instruments are available to be used by the government to fund any expansion of its expenditure. These are borrowing from the Libyan

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Chapter Nine

The Implications of the Study

9.0-Introduction

This study provides considerable knowledge about the structure of the Libyan economy in 1962-1992 and about the impact of fiscal and monetary policies both in the short-run and in the long-run. The survey of Libya's economic development in 1950-1992 (see chapter 2) suggests that (1) before the discovery of oil in the late of 1950s Libya was one of the poorest countries in the world; (2) from 1962, as a result of producing and exporting oil, the Libyan economy changed from primitive agriculture economy to petroleum one; (3) from 1962 the government turned to planning as a way of enabling the economy to grow; (4) the government budget deficit has been financed by borrowing domestically from the central bank (public debt); (5) the economy relies on the external labour market to fill the gap between total labour demand and the supply of Libyan labour.

The rest of this chapter is divided into three sections. A summary of the theoretical model is presented in section one. The methodology adopted of this study and empirical results will be discussed in section two. Suggestions on using and improving the model by further research will be introduced in the final section.

9.1-The Model

The model that emerges in the present study, on the basis of observations on the Libyan economy, theoretical considerations and the literature review, is designed to investigate, first, the impact of government expenditure on economic growth of the non-oil sector, and second, to find the most appropriate tool that can be used by the Libyan government to finance this expenditure and the impact of this on employment and imports. To achieve these ends a small macro-econometric model has been built using annual data for the period 1962-1992. Since public sector expenditure is the source of investment, the model was built to capture this feature of the economy. The model consists of five parts with public finances linked to the monetary sector, the real sector, the foreign trade and the balance of payments, and the labour market. The model contains 21 relations, of which 11 are behavioural equations, and 10 are identities. There are a total of 41 variables, of which 21 are endogenous. In general the equations are in real terms and include logarithms of the variables (denoted by L). However, an exception is for ordinary expenditure (5.4), which is in nominal terms. Furthermore, the equation for direct tax revenue (5.1) and unrequited transfer balance (5.15) are in level form. Also, theoretically the money supply equation (5.10) is in nominal form (see chapter five).

9.2-The Results

The Johansen methodology of co-integration for the long-run behaviour and error-correction models for short-run behaviour was adopted.

One of the aims of the study is to investigate the impact of government expenditure (TPSBE) on the growth of the output of the non-oil sector (GDPN). It was found that total public sector expenditure has big effect on GDPN. A change in TPSBE by one percent will lead to GDPN increasing by more than 0.65 percent in the long-run (see equation 6.5.12-CV). This supports the view that government intervention is helpful for economic growth, in particular where a big push is needed for a LDC to overcome its retarded state. The Error Correction Model (ECM) for each behavioural equation of the model was estimated to give the short-run dynamic relationship. However, most of the short-run dynamic model equations have only the ECM term. This means that the causal variables have no effect in the short-run and a significant effect in the long-run. This is might be because that the short-run effects are concealed by the annual data. The coefficient of the error correction term, in all the error correction equations is highly significant. This provides additional evidence of co-integration (see chapter six).

It is important to test how the model functions as a complete system in simulation, prediction, and policy evaluation. Hence, the model was used for simulation .The Theil's inequality coefficient (U) is considered as the main criterion to evaluate the model performance. The U results (see table 7.1) and the static simulation results (see figures 7.2-7.13 and appendix 3, table 1) indicate that the simulated values of the endogenous variables track their actual values quite well. Also, a dynamic simulation was carried out (see table 7.2, figures 7.14-7.25, and appendix 3, table 2). In general the static simulation performs better than the dynamic one. Another validation of any econometric model is its ability to produce sensible forecasts beyond the sample period. However, the effects of the United Nation's sanctions during 1992-1999 mean that any such forecasts are likely to be misleading.

Fiscal and monetary policies and external loans are examined to investigate the most appropriate policy available to the Libyan government to fund any expansion of the components of total public sector budget expenditure (DE, and OE). The results in tables 8.1-8.6 indicate that monetary instruments "public debt (PD) or money supply (Ms)" or direct tax revenue (DTXR) are the most appropriate instruments for the government to use to fund any expansion of DE and OE. This is because of their high positive effect on economic variables under consideration compared with the other available financing methods (see chapter eight).

9.3-Suggestions for Further Research

In this regard it is useful to mention some suggestions concerning future studies of government expenditure and growth in Libya:

1- The first suggestion is related to the data problems. Most of the short-run dynamic model equations (in this study) have only the ECM term. This means that the causal variables have no effect in the short-run and a significant effect in the long-run. This might be because that the short-run effects are concealed by the annual data. However, a quarterly or half year unit observation is preferable with the short term and when should these become available the model could be re-estimated.

2- Dis-aggregation of DE and OE by sectors would enable the impact of DE or/and OE on the growth of particular sectors to be examined.

3- As mentioned in chapter two, in the late 1980s and early 1990s the government permitted the private sector to take part in different economic activities without transferring any foreign currency to finance their importation of commodities. The result was a black market for foreign exchange transactions. The economic role of this parallel market for foreign exchange in Libya is ambiguous and requires investigation. The assets traded in informal markets, their current prices, and expected future paths of their prices can be expected to affect the current decisions of private agents.

4- Since the Libyan economy relies on foreign labour, dis-aggregation of foreign labour data by sectors would seem to be worth investigation to see the effect of foreign labour on growth in each sector. Also, Libyan planners could then determine which sector needs an improved quantity and quality of Libyan labour.

5-The switch to a market economy (no price controls etc) from 1990 has had a liberalisation affect on the economy. It would be interesting to apply this model after the estimation period of this study when the data become available, and compare the results with these obtained in the present study.

Appendix 1-Historical Data of the Model.

Table 1.1
The Historical Data of The Model 1962-1992
Nominal Terms Continued

Year	BAOR	BD	BOP	CAB	DE	DFL	DTXR
1962	14	-10.19	1.7	-10	15.91	16	6.6
1963	38.5	-29.37	6.88	6.28	16.73	16.5	8.2
1964	75.3	-46.54	18.76	12.96	25.46	17.1	9.6
1965	125.4	-66.1	27.82	27.82	44.5	19.1	11.7
1966	178	-79.04	33.81	20.01	69.36	21.9	13.9
1967	224.1	-10.39	15.98	19.08	107.41	25.6	17.6
1968	352.7	-181.53	55.37	64.57	122.57	31.2	24.7
1969	415.1	-226.43	169.2	202.3	122.47	39.4	28.3
1970	484	-254.3	344.24	377.44	146.9	50	30
1971	629	-242.2	500.7	519.7	257.6	64	27.6
1972	164.8	407.5	162.8	96.1	397.3	81	24
1973	106.2	410.4	-206.77	40.13	410.1	118.4	32.6
1974	195.1	891.8	917.36	931.96	881.9	169.8	75.9
1975	331.3	735.6	-61.54	205.56	944.1	223	99
1976	115	1190.7	2446.97	2736.17	1187.2	262.6	126.5
1977	122	1313.6	956.97	1274.57	1280.4	266.2	152.1
1978	168	1371.9	171.41	595.91	1371.3	252.3	175.4
1979	214	1862.6	1701.42	2152.52	1862.6	259.4	160
1980	565	1987.4	2967.15	3494.75	2451.6	279.8	339.2
1981	170	2838.2	608.79	644.99	2872.8	311.3	336.3
1982	380	2503.9	192.78	326.88	2465.9	329.6	398.1
1983	2520	178.7	60.62	144.32	2096.3	333.1	441.4
1984	2125	184.7	1035.69	997.086	1834.7	369	391.9
1985	1846	-209.1	1526.76	1614.97	1407.6	195	352.8
1986	1074	419.9	280.54	1180.24	1081.1	166	328.1
1987	1029.7	103.5	-39.48	-151.58	993	132.4	317
1988	898	-29.5	231.61	115.71	875.3	142.3	329.8
1989	1181.5	-452	614.52	147.82	760.9	152.7	357
1990	1600	-270	1517.1	1247.4	1100	139.2	375
1991	2230	-2320.2	810.05	816.25	640	85.3	343
1992	1267	-1520.5	1220.34	1116.54	574	77	353

Table 1.1
The Historical Data of The Model 1962-1992
Nominal Terms Continued

Year	GDP	GDPN	*GDPO*	IDTXR	MS	FAN	OE
1962	155.5	117.5	38	17.6	29.1	32.05	26
1963	235.3	135.7	99.6	19.1	35.7	38.93	32.9
1964	364.6	168.9	195.7	21.4	46.48	57.69	45
1965	492.1	222	270.1	27.3	66.78	85.51	61.3
1966	634.9	278.8	356.1	33.4	90.86	119.32	82.7
1967	747.8	345.3	402.5	35.5	116.74	135.3	166.4
1968	1072.6	424	648.6	46.3	150.12	190.67	125.9
1969	1223	675.3	547.7	52.7	201.86	359.87	158.8
1970	1288.3	475.7	812.6	59.5	241.08	704.11	176.6
1971	1586.5	663.8	922.7	55.2	364.47	1204.81	230.2
1972	1753	832.4	920.6	73.3	392.74	1367.61	263.9
1973	2182.3	1050.5	1131.8	99.2	490.97	1160.84	234.5
1974	3792	1402	2390	165	753.84	2078.196	432
1975	3674.3	1713.2	1961.1	219.9	844.43	2016.66	573.2
1976	4768.1	2018.1	2750	242.9	1139.37	4463.63	564
1977	5612.7	2336.8	3275.9	264.2	1443.76	5420.59	669.3
1978	5496.1	2677.4	2808.7	307.3	1687.81	5592	695
1979	7603	3057.7	4545.3	393.3	2223.61	7293.42	770
1980	10553.8	4028.1	6525.7	522.9	2856.83	10260.57	950
1981	8798.8	4395.5	4403.3	753.6	3512.1	10869.37	1050
1982	8932.4	4696.6	4235.8	552.2	3252.8	11062.14	1255
1983	8511.7	4688.1	3823.6	488.0	2894.4	11122.77	1520.4
1984	7804.7	4594.9	3209.8	654.3	2711.3	12158.45	1440.2
1985	7852.1	4351.7	3500.4	413.9	3492.2	13685.21	1182.1
1986	6767.5	4361.3	2406.2	401.9	3041.4	13965.74	1332.9
1987	5933.2	4221.6	1711.6	348.4	3438.6	13926.27	1075
1988	6170.6	4643.4	1527.2	617.7	3032.7	14157.87	1125
1989	7094.7	5179.2	1915.5	506.8	3521.5	14772.39	1170
1990	7749.6	5008.8	2740.8	334.5	4452.3	16289.49	1490
1991	8440.2	5657	2783.2	434.5	4292.8	17099.53	454.8
1992	8774.4	6294	2480.4	425.2	4987.2	18319.87	458.5

Table 1.1
The Historical Data of The Model 1962-1992
Nominal Terms Continued

Year	SLL	TB	TIM	TLD	TPSBE	TPSBR	UTB
1962	340	-22.9	73.39	356	41.91	52.1	-2.3
1963	344	34.58	85.32	360.5	49.63	79	-1.6
1964	348.2	117.06	104.38	365.3	70.46	117	-3.1
1965	353.1	170.02	137.79	372.2	105.8	171.9	1
1966	358.3	213.11	144.69	380.2	152.06	231.1	-5.5
1967	363.7	249.88	170.14	389.3	273.81	284.2	-34
1968	369.3	436.67	230.22	400.5	248.47	430	-35.4
1969	375.2	532.1	241.30	414.6	281.27	507.7	-46.2
1970	388.5	658.24	164.29	438.5	323.5	577.8	-42.7
1971	395	762.1	198.00	459	487.8	730	-35.1
1972	407	415.9	343.20	488	661.2	253.7	-39.9
1973	419.7	655.43	539.94	538.1	644.6	234.2	-49.9
1974	437.4	1627.56	817.84	607.2	1313.9	422.1	-21.8
1975	454.1	969.06	1106.86	677.1	1517.3	781.7	-50.3
1976	470.1	1879.07	950.84	732.7	1751.2	560.5	-52.1
1977	498.8	2264.97	1117.13	765	1949.7	636.1	-66.6
1978	520.4	1570.41	1362.57	772.7	2066.3	694.4	-310.9
1979	529.6	3189.52	1572.42	789	2632.6	770	-277
1980	533	4483.05	2055.93	812.8	3401.6	1414.2	-335.8
1981	560.1	1879.69	2481.41	871.4	3922.8	1084.6	-487.4
1982	588.4	1595.78	2124.32	918	3720.9	1217	-495.7
1983	617.4	1587.42	1784.78	950.5	3616.7	3438	-621.9
1984	647	1423.09	1841.71	1016	3274.9	3090.2	392.8
1985	700	2431.16	1110.69	895	2589.7	2798.8	-256.5
1986	739	1115.64	1315.67	905	2414	1994.1	463
1987	780.2	385.72	1278.08	912.6	2068	1964.5	-155
1988	820.8	-69.9	1685.40	963.1	2000.3	2029.8	-152.6
1989	842.5	704.22	1474.99	995.2	1930.9	2382.9	-146.1
1990	879.4	1703.6	1510.90	1018.6	2590	2860	-136.2
1991	927.2	1505.15	1505.46	1012.5	1094.8	3415	-160
1992	967.9	1468.24	1512.99	1044.9	1032.5	2553	-96

Table 1.1
The Historical Data of The Model 1962-1992
Nominal Terms

Continued

Year	VOOEX	Dpo	D_{74}	D_{80}	D_{81}	D_{83}	D_{ade}
1962	47	0	0	0	0	0	0
1963	116.9	0	0	0	0	0	0
1964	216.4	0	0	0	0	0	0
1965	280.3	0	0	0	0	0	0
1966	353.4	0	0	0	0	0	0
1967	415.7	0	0	0	0	0	0
1968	664.3	0	0	0	0	0	0
1969	771.3	0	0	0	0	0	0
1970	852.5	0	0	0	0	0	0
1971	956.9	0	0	0	0	0	0
1972	755.1	0	0	0	0	0	0
1973	1194.5	0	0	0	0	0	0
1974	2444.4	1	1	0	0	0	0
1975	2015.9	0	1	0	0	0	0
1976	2827.7	0	1	0	0	0	0
1977	3378.4	0	1	0	0	0	0
1978	2929.3	0	1	0	0	0	0
1979	4759.3	0	1	0	0	0	0
1980	6486.4	1	1	0	0	0	0
1981	4359.8	1	1	0	1	0	0
1982	3718	1	1	1	1	0	0
1983	3370.7	1	1	1	1	1	0
1984	3262.3	1	1	1	1	1	0
1985	3592.2	1	1	1	1	1	0
1986	2428.7	1	1	1	1	1	1
1987	1663.6	1	1	1	1	1	1
1988	1496.7	1	1	1	1	1	1
1989	1969.2	1	1	1	1	1	1
1990	3034.5	1	1	1	1	1	1
1991	2843.1	1	1	1	1	1	1
1992	2634.8	1	1	1	1	1	1

Table 1.1
The Historical Data of The Model 1962-1992
Nominal Terms Continued

Year	*CBC*	*KAB*	*EON*	*OEXN*	*OPR*
1962	16.21	2.3	9.4	3.5	65.5
1963	20.6	-1.6	2.2	3	167.5
1964	23.597	-3.1	8.9	5.04	313.9
1965	35.417	-0.8	0.8	4.14	445.3
1966	47.458	8.9	4.9	4.4	550.5
1967	54.44	2.7	-5.8	4.32	632.6
1968	73.66	3.1	-12.3	2.59	951.3
1969	92.93	-9.8	-23.3	2.1	1134.4
1970	96.198	3.1	-36.3	3.74	1208.8
1971	107.61	0.1	-19.1	3.2	1003.6
1972	148.03	74.5	-7.8	4	905.5
1973	240.896	58.1	-305	0.871	793.9
1974	448.55	-41.4	26.8	1	555.3
1975	641.903	-190.1	-77	1.9	540.1
1976	739.41	-242.7	-46.5	2.2	707.3
1977	853.21	-299.2	-18.4	3.7	753.1
1978	925.959	-373.3	-51.2	3.68	724.4
1979	1040.41	-409	-42.1	2.64	763.5
1980	1321.21	-463.8	-63.8	2.8	669.8
1981	2167.68	-81.6	45.4	1.3	444.5
1982	2161.996	-167.4	33.3	2.1	414.6
1983	2208.14	-35.4	-48.3	1.5	403.3
1984	2153.68	86.2	-47.6	2.5	390.9
1985	2033.00	-36.5	-51.7	53.4	365.4
1986	2031.6	-853.7	-46	2.6	454.1
1987	2157.5	148.1	-36	0.2	355
1988	2316.5	1.3	114.6	118.8	367.1
1989	2441.9	436.6	30.1	210	412.4
1990	2533.3	284.9	-15.2	180	494.7
1991	2615.8	15.5	-21.7	167.5	601.9
1992	2812.3	94.4	9.4	255.5	565.3

Table 1.1
The Historical Data of The Model 1962-1992
Nominal Terms

Year	*OTXR*	PD	*SIB*	*POPL*
1962	13.9	0	15.2	1401.60
1963	13.2	0	-26.7	1455.20
1964	10.7	0	-101	1521.80
1965	7.5	0	-143.2	1563.00
1966	5.8	0	-187.6	1616.60
1967	7	0	-196.8	1672.00
1968	6.3	0	-336.7	1729.30
1969	11.6	0	-283.6	1788.60
1970	4.3	0	-238.1	1849.90
1971	18.6	0.57	-207.3	1913.20
1972	27.3	4	-279.9	1978.80
1973	31.3	198.34	-565.4	2046.60
1974	25.6	277.02	-673.8	2131.50
1975	191.8	554.22	-713.2	2221.20
1976	144	511.51	909.2	2314.80
1977	180	319.4	-923.8	2412.30
1978	110	1032.5	-663.6	2513.90
1979	153.7	1035	-760	2619.80
1980	202	320	-652.5	2730.10
1981	317.3	1170	-747.3	2845.10
1982	241.7	1803.65	-773.2	2965.00
1983	257.9	910.3	-821.2	3089.80
1984	273.9	621.36	-818.8	3220.00
1985	393.5	829.8	-559.7	3355.60
1986	401.3	686.4	-398.4	3496.90
1987	426.5	650.8	-382.3	3644.20
1988	503.1	3155.1	338.2	3797.70
1989	557.3	3775.8	-410.3	3957.70
1990	585	4216.2	-320	4124.30
1991	600	4382.4	-528.9	4298.10
1992	620	4431.4	-255.7	4479.20

Table 1.1
The Historical Data of The Model 1962-1992
Prices Indexes At 1980 Prices

Year	*PI*	*OPI*	*TEXPI*	*GDPPI*	*TIMPI*
1962	30.55	6.87	0.78	13.70	29.37
1963	32.83	6.67	1.85	15.10	31.21
1964	35.11	6.59	3.41	16.30	30.20
1965	38.03	6.05	4.38	17.00	31.54
1966	45.33	6.17	5.51	18.50	33.56
1967	48.24	6.33	6.46	19.50	31.04
1968	49.12	6.72	10.26	21.10	32.19
1969	56.46	6.58	11.90	21.50	32.85
1970	53.86	5.83	13.00	21.70	29.70
1971	52.56	7.14	14.81	26.20	32.40
1972	53.41	7.78	14.90	27.80	36.80
1973	47.44	8.72	18.42	33.40	44.90
1974	50.14	28.91	37.64	58.00	57.41
1975	53.02	28.96	31.16	53.23	61.81
1976	57.83	32.30	43.56	56.30	62.61
1977	65.38	34.99	52.04	60.70	67.89
1978	73.28	35.85	45.13	58.00	78.79
1979	90.20	81.06	73.28	74.30	91.21
1980	100.00	100.00	100.00	100.00	100.00
1981	110.88	94.89	67.25	109.00	99.50
1982	124.16	88.06	62.56	104.00	96.20
1983	137.32	83.45	56.36	103.00	94.42
1984	154.46	77.92	50.91	99.00	92.01
1985	168.57	76.42	56.21	96.00	92.01
1986	174.12	36.02	37.49	95.00	103.42
1987	181.71	49.24	25.70	95.00	112.59
1988	187.39	39.54	24.97	94.00	113.81
1989	189.82	48.07	33.63	93.00	119.39
1990	206.18	61.82	49.57	92.00	143.39
1991	230.37	51.71	46.41	92.00	137.99
1992	257.41	51.21	44.51	91.00	130.35

Table 2
Historical data available for the model variables up to 1995
Nominal Terms

Year	BAOR	BD	BOP	CAB	DE	DFL	DTXR
1993	1119.77		-417.70	-417.7	507.31*		
1994	704.34		-68.90	-68.9	318.9*		
1995	1459.67		659.80	659.8	660.9*		
Year	GDP	GDPN	*GDPO*	IDTXR	TIM	TLD	TPSBE
1993	9287.50	6768.00	2519.50		1714.8		
1994	9913.50	7354.00	2559.50		1402.9		
1995	10582.50	7907.50	2675.00		1716.8		
Year	MS	FAN	OE	SLL	TB	D80	D81
1993	4948.1	18662.67			904.1	1	1
1994	5132.6	19749.87			1279	1	1
1995	5237.2	20828.07			1386.7	1	1
Year	TPSBR	UTB	VOOEX	Dpo	D74	*EON*	*OEXN*
1993		-90	2327.90	1	1	-63	291
1994		-87	2289.00	1	1	61	392.9
1995		-78.3	"2681.3	1	1	18.6	422.2
Year	D83	Dade	Dm81	*CBC*	*KAB*	*WS*	*POPL*
1993	1	1	1	3094.2	-45.8		4700.00
1994	1	1	1	3337	144.8		4898.00
1995	1	1	1	3587.8	-31.9		
Year	*OP*	*OPR*	*OTXR*	*PD*	*SIB*		
1993	5.20	518.40	0.00	3626.90	-362.50		
1994	5.76	508.80	0.00	4617.80	-310.60		
1995	6.65	510.60	0.00	5667.10	-216.90		
Year	PI	*OPI*	*TEXPI*	*GDPPI*	*TIMPI*		
1993	^323.3	45.35					
1994		43.15					
1995							

Appendix 2 – Co-integration Tests.

Table 1

Cointegration with unrestricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
DTXR GDP
List of I(0) variables included in the VAR:
D_{81}
List of eigenvalues in descending order:
.51761 .0032357

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	21.1412	14.8800	12.9800
r<= 1	r = 2	.093987	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR

Cointegration LR Test Based on Trace of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
DTXR GDP
List of I(0) variables included in the VAR:
D_{81}
List of eigenvalues in descending order:
.51761 .0032357

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	21.2352	17.8600	15.7500
r<= 1	r = 2	.093987	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR

Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
DTXR GDP
List of I(0) variables included in the VAR:
D_{81}
List of eigenvalues in descending order:
.51761 .0032357

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-382.1381	-390.1381	-395.6073	-391.8510
r = 1	-371.5675	-382.5675	-390.0876	-384.9227
r = 2	-371.5205	-383.5205	-391.7242	-386.0898

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 2

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

30 observations from 1963 to 1992. Order of VAR = 1.
List of variables included in the cointegrating vector:
LIDTXR LTIM
List of I(0) variables included in the VAR:
D_{74}
List of eigenvalues in descending order:
.41813 .018673

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	16.2451	14.8800	12.9800
r<= 1	r = 2	.56547	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

30 observations from 1963 to 1992. Order of VAR = 1.
List of variables included in the cointegrating vector:
LIDTXR LTIM
List of I(0) variables included in the VAR:
D_{74}
List of eigenvalues in descending order:
.41813 .018673

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	16.8106	17.8600	15.7500
r<= 1	r = 2	.56547	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

30 observations from 1963 to 1992. Order of VAR = 1.
List of variables included in the cointegrating vector:
LIDTXR LTIM
List of I(0) variables included in the VAR:
D_{74}
List of eigenvalues in descending order:
.41813 .018673

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	26.4077	22.4077	19.6053	21.5111
r = 1	34.5302	27.5302	22.6260	25.9613
r = 2	34.8130	26.8130	21.2082	25.0199

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 3

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LNOE LNDE
List of eigenvalues in descending order:
.50322 .14280

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	20.2887	14.8800	12.9800
r<= 1	r = 2	4.4685	8.0700	6.5000

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LNOE LNDE
List of eigenvalues in descending order:
.50322 .14280

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	24.7573	17.8600	15.7500
r<= 1	r = 2	4.4685	8.0700	6.5000

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LNOE LNDE
List of eigenvalues in descending order:
.50322 .14280

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-.77210	-6.7721	-10.8740	-8.0568
r = 1	9.3723	.37227	-5.7806	-1.5547
r = 2	11.6065	1.6065	-5.2299	-.53456

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 4

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

30 observations from 1963 to 1992. Order of VAR = 1.
List of variables included in the cointegrating vector:
LDE LFAN
List of I(0) variables included in the VAR:
D_{ade}
List of eigenvalues in descending order:
.36012 .23306

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	13.3942	14.8800	12.9800
r<= 1	r = 2	7.9604	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

30 observations from 1963 to 1992. Order of VAR = 1.
List of variables included in the cointegrating vector:
LDE LFAN
List of I(0) variables included in the VAR:
D_{ade}
List of eigenvalues in descending order:
.36012 .23306

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	21.3546	17.8600	15.7500
r<= 1	r = 2	7.9604	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

30 observations from 1963 to 1992. Order of VAR = 1.
List of variables included in the cointegrating vector:
LDE LFAN
List of I(0) variables included in the VAR:
D_{ade}
List of eigenvalues in descending order:
.36012 .23306

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-6.0887	-10.0887	-12.8911	-10.9852
r = 1	.60845	-6.3915	-11.2957	-7.9604
r = 2	4.5886	-3.4114	-9.0161	-5.2044

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 5

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LNMs LNFAN
List of eigenvalues in descending order:
.34971 .23874

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	12.4796	14.8800	12.9800
r<= 1	r = 2	7.9105	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LNMs LNFAN
List of eigenvalues in descending order:
.34971 .23874

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	20.3901	17.8600	15.7500
r<= 1	r = 2	7.9105	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LNMs LNFAN
List of eigenvalues in descending order:
.34971 .23874

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	21.5644	15.5644	11.4625	14.2798
r = 1	27.8042	18.8042	12.6514	16.8772
r = 2	31.7594	21.7594	14.9230	19.6183

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 6

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

20 observations from 1973 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LGDPN LTPSBE LPD
List of I(0) variables included in the VAR:
D_{83}
List of eigenvalues in descending order:
.71591 .15498 .0000

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	25.1690	18.0600	15.9800
r<= 1	r = 2	3.3679	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

20 observations from 1973 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LGDPN LTPSBE LPD
List of I(0) variables included in the VAR:
D_{83}
List of eigenvalues in descending order:
.71591 .15498 .0000

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	28.5369	23.3200	20.7500
r<= 1	r = 2	3.3679	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

20 observations from 1973 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LGDPN LTPSBE LPD
List of I(0) variables included in the VAR:
D_{83}
List of eigenvalues in descending order:
.71591 .15498 .0000

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-10.5668	-20.5668	-25.5455	-21.5387
r = 1	2.0177	-11.9823	-18.9525	-13.3430
r = 2	3.7016	-12.2984	-20.2642	-13.8534

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 7
Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
UTB DFL
List of eigenvalues in descending order:
.43162 .10473

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	16.3842	14.8800	12.9800
r<= 1	r = 2	3.2083	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
UTB DFL
List of eigenvalues in descending order:
.43162 .10473

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	19.5925	17.8600	15.7500
r<= 1	r = 2	3.2083	8.0700	6.5000

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
UTB DFL
List of eigenvalues in descending order:
.43162 .10473

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-358.6424	-364.6424	-368.7443	-365.9271
r = 1	-350.4503	-359.4503	-365.6032	-361.3773
r = 2	-348.8462	-358.8462	-365.6826	-360.9873

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 8
Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LVOEX *LOPR*
List of I(1) exogenous variables included in the VAR:
LOPR
List of I(0) variables included in the VAR:
D_{PO}
List of eigenvalues in descending order:
.30078 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	10.3759	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LVOEX *LOPR*
List of I(1) exogenous variables included in the VAR:
LOPR
List of I(0) variables included in the VAR:
DPO
List of eigenvalues in descending order:
.30078 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	10.3759	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LVOEX *LOPR*
List of I(1) exogenous variables included in the VAR:
LOPR
List of I(0) variables included in the VAR:
DPO
List of eigenvalues in descending order:
.30078 0.00

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	2.6282	-1.3718	-4.1064	-2.2282
r = 1	7.8162	1.8162	-2.2857	.53153

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 9

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

30 observations from 1963 to 1992. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LTIM LTPSBE *LCBC*
List of I(1) exogenous variables included in the VAR:
LCBC
List of eigenvalues in descending order:
.53682 .27638 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	23.0891	18.0600	15.9800
r<= 1	r = 2	9.7046	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

30 observations from 1963 to 1992. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LTIM LTPSBE *LCBC*
List of I(1) exogenous variables included in the VAR:
LCBC
List of eigenvalues in descending order:
.53682 .27638 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	32.7937	23.3200	20.7500
r<= 1	r = 2	9.7046	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

30 observations from 1963 to 1992. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LTIM LTPSBE *LCBC*
List of I(1) exogenous variables included in the VAR:
LCBC
List of eigenvalues in descending order:
.53682 .27638 0.00

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	11.8640	9.8640	8.4628	9.4157
r = 1	23.4086	17.4086	13.2050	16.0638
r = 2	28.2608	20.2608	14.6561	18.4678

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 10

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LSLL *LPOPL*
List of I(1) exogenous variables included in the VAR:
LPOPL
List of I(0) variables included in the VAR:
D_{80}
List of eigenvalues in descending order:
.25967 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	8.7191	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LSLL *LPOPL*
List of I(1) exogenous variables included in the VAR:
LPOPL
List of I(0) variables included in the VAR:
D80
List of eigenvalues in descending order:
.25967 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	8.7191	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

29 observations from 1964 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LSLL *LPOPL*
List of I(1) exogenous variables included in the VAR:
LPOPL
List of I(0) variables included in the VAR:
D80
List of eigenvalues in descending order:
.25967 0.00

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	85.5514	81.5514	78.8168	80.6950
r = 1	89.9110	83.9110	79.8091	82.6264

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Table 11

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

****

20 observations from 1973 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LTLD LGDP LPD
List of I(0) variables included in the VAR:
D_{81}
List of eigenvalues in descending order:
.66843 .39603 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	22.0781	18.0600	15.9800
r<= 1	r = 2	10.0847	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

****

20 observations from 1973 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LTLD LGDP LPD
List of I(0) variables included in the VAR:
D_{81}
List of eigenvalues in descending order:
.66843 .39603 0.00

****

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	32.1628	23.3200	20.7500
r<= 1	r = 2	10.0847	11.4700	9.5300

****

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

****

20 observations from 1973 to 1992. Order of VAR = 2.
List of variables included in the cointegrating vector:
LTLD LGDP LPD
List of I(0) variables included in the VAR:
D_{81}
List of eigenvalues in descending order:
.66843 .39603 0.00

****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	51.0211	41.0211	36.0425	40.0492
r = 1	62.0602	48.0602	41.0900	46.6995
r = 2	67.1025	51.1025	43.1367	49.5475

****

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

Appendix 3-Simulation Results.

Table 1

Simulation Results of the Static Model

Continued

Year	DTXR		LIDTXR		LNOE		LDE	
	Simulated	Actual	Simulated	Actual	Simulated	Actual	Simulated	Actual
1964	62.599	58.90	4.97	4.88	3.82	3.81	5.82	5.05
1965	69.628	68.82	5.07	5.07	4.11	4.12	6.01	5.57
1966	80.88	75.14	5.14	5.20	4.41	4.42	6.28	5.93
1967	88.518	90.26	5.23	5.20	4.70	5.11	6.46	6.31
1968	103.213	117.06	5.33	5.39	5.27	4.84	6.62	6.36
1969	131.441	131.63	5.47	5.50	5.09	4.07	6.69	6.34
1970	142.556	138.25	5.51	5.61	5.26	5.17	6.79	6.52
1971	153.209	105.34	5.50	5.35	5.36	5.44	6.99	6.89
1972	125.288	86.33	5.40	5.57	5.63	5.58	7.19	7.26
1973	109.898	97.6	5.62	5.69	5.80	5.46	7.33	7.11
1974	120.559	130.86	5.98	5.65	5.71	6.07	7.22	7.33
1975	149.283	185.99	6.04	6.02	6.26	6.35	7.19	7.48
1976	198.350	224.69	6.19	6.07	6.49	6.34	7.24	7.65
1977	238.148	250.58	6.16	6.08	6.51	6.51	7.42	7.65
1978	278.999	302.41	6.19	6.27	6.64	6.54	7.44	7.77
1979	309.274	215.34	6.26	6.27	6.68	6.65	7.49	7.83
1980	237.270	339.20	6.25	6.26	6.80	6.86	7.41	7.80
1981	345.492	308.53	6.31	6.54	6.99	6.97	7.43	7.88
1982	308.900	382.79	6.46	6.27	7.09	7.13	7.47	7.77
1983	375.107	428.54	6.35	6.16	7.20	7.33	7.45	7.62
1984	465.600	395.86	6.26	6.49	7.32	7.27	7.41	7.52
1985	383.514	367.50	6.36	6.07	7.26	7.08	7.40	7.29
1986	360.240	345.37	6.10	6.05	7.08	7.20	7.05	7.04
1987	336.833	333.68	6.09	5.90	7.13	6.98	7.09	6.95
1988	323.286	350.85	6.01	6.49	6.96	7.03	7.00	6.84
1989	339.286	383.87	6.25	6.30	6.97	7.06	7.00	6.71
1990	372.127	407.61	6.13	5.90	6.98	7.31	7.93	7.09
1991	395.858	372.83	5.98	6.16	6.12	6.12	7.04	6.54
1992	268.894	387.91	6.05	6.15	6.26	6.13	6.89	6.45

Table 1						Continued
Year	LNMs		LGDPN		LVOEX	
	Simulated	Actual	Simulated	Actual	Simulated	Actual
1964	3.94	3.84	6.34	6.94	8.06	8.09
1965	4.19	4.20	6.55	7.17	8.50	8.44
1966	4.53	4.51	6.82	7.32	8.75	8.65
1967	4.82	4.76	6.95	7.48	8.90	8.79
1968	5.04	5.01	7.27	7.61	9.00	9.20
1969	5.28	5.31	7.19	7.69	9.28	9.37
1970	5.57	5.49	7.24	7.69	9.41	9.59
1971	5.76	5.89	7.28	7.84	9.47	9.50
1972	6.15	5.97	7.46	8.00	9.35	9.18
1973	6.22	6.20	7.72	8.05	9.25	9.53
1974	6.40	6.63	7.75	7.79	8.90	9.04
1975	6.81	6.74	7.67	8.08	8.94	8.85
1976	6.91	7.04	8.10	8.18	8.91	7.08
1977	7.21	7.28	8.09	8.94	9.09	9.18
1978	7.42	7.43	8.49	8.44	9.14	9.01
1979	7.56	7.71	7.98	8.32	9.09	8.68
1980	7.81	7.96	8.10	8.30	8.79	8.78
1981	8.05	8.16	8.06	8.30	8.72	8.43
1982	8.23	8.09	8.15	8.42	8.44	8.35
1983	8.16	7.97	9.57	10.72	8.39	8.30
1984	8.06	7.91	10.89	8.44	8.37	8.34
1985	8.01	8.16	8.48	8.42	8.35	8.46
1986	8.24	8.02	9.31	8.43	8.32	8.82
1987	8.12	8.14	9.29	8.40	8.49	8.13
1988	8.23	8.02	9.18	8.51	8.27	8.24
1989	8.12	8.17	9.31	8.62	8.30	8.32
1990	8.25	8.40	9.34	8.60	8.38	8.50
1991	8.46	8.36	9.44	8.72	8.51	8.61
1992	8.43	8.51	9.06	8.84	8.64	8.55

Table 1								
Year	UTB		LTIM		LSLL		LTLD	
	Simulated	Actual	Simulated	Actual	Simulated	Actual	Simulated	Actual
1964	-379.82	-47.01	5.71	5.85	5.85	5.85	5.90	5.90
1965	-380.98	16.52	5.91	5.89	5.87	5.87	5.94	5.92
1966	-386.00	-89.17	6.12	6.07	5.88	5.88	5.98	5.94
1967	-393.42	-537.45	6.31	6.31	5.90	5.90	6.00	5.96
1968	-414.33	-526.68	6.52	6.57	5.92	5.91	6.03	5.99
1969	-422.35	-702.46	6.63	6.60	5.93	5.93	6.07	6.03
1970	-440.42	-732.20	6.64	6.50	5.95	5.96	6.10	6.08
1971	-450.09	-491.81	6.67	6.42	5.98	5.98	6.16	6.13
1972	-453.29	-513.14	6.79	6.84	6.01	6.01	6.18	6.19
1973	-462.43	-572.26	7.06	7.09	6.04	6.04	6.26	6.29
1974	-569.10	-75.41	7.11	7.26	6.07	6.08	6.34	6.41
1975	-605.49	-173.66	7.27	7.44	6.11	6.12	6.48	6.52
1976	-588.02	-161.32	7.39	7.33	6.15	6.15	6.57	6.60
1977	-478.48	-190.34	7.42	7.41	6.18	6.21	6.63	6.64
1978	-252.90	-867.20	7.44	7.46	6.24	6.25	6.68	6.65
1979	-178.80	-341.72	7.50	7.45	6.28	6.27	6.67	6.67
1980	-284.82	-335.80	7.51	7.60	6.30	6.28	6.69	6.70
1981	-355.06	-513.65	7.56	7.82	6.31	6.33	6.77	6.77
1982	-411.98	-562.92	7.67	7.70	6.39	6.38	6.82	6.82
1983	-320.39	-745.25	7.59	7.54	6.44	6.43	6.86	6.86
1984	-233.10	504.09	7.48	7.60	6.49	6.47	7.02	6.92
1985	-364.23	-335.63	7.46	7.19	6.53	6.55	6.78	6.80
1986	805.46	1285.48	7.24	7.15	6.61	6.61	6.78	6.81
1987	-53.05	-314.81	7.14	7.03	6.66	6.66	6.81	6.82
1988	-107.64	-385.89	7.07	7.30	6.71	6.71	6.80	6.87
1989	-375.67	-303.93	7.12	7.12	6.76	6.74	6.88	6.90
1990	-369.21	-220.33	7.02	6.96	6.79	6.78	6.91	6.93
1991	-225.13	-309.43	7.10	6.99	6.83	6.83	6.93	6.92
1992	-9.65	-187.47	6.91	6.99	6.88	6.88	6.93	6.95

Table 2

Simulation Results of the Dynamic Model

Continued

Year	DTXR		LIDTXR		LNOE		LDE	
	Simulated	Actual	Simulated	Actual	Simulated	Actual	Simulated	Actual
1964	62.90	58.90	4.97	4.88	3.82	3.81	5.82	5.05
1965	70.99	68.82	5.04	5.07	4.28	4.12	6.41	5.57
1966	80.96	75.14	5.22	5.20	4.68	4.42	6.75	5.93
1967	95.42	90.26	5.40	5.20	5.00	5.11	6.95	6.31
1968	113.23	117.06	5.54	5.39	5.27	4.84	7.08	6.36
1969	133.72	131.63	5.62	5.50	5.49	4.07	7.15	6.34
1970	148.69	138.25	5.68	5.61	5.68	5.17	7.24	6.52
1971	166.41	105.34	5.72	5.35	5.85	5.44	7.33	6.89
1972	182.14	86.33	5.75	5.57	6.01	5.58	7.42	7.26
1973	196.99	97.60	5.78	5.69	6.17	5.46	7.50	7.11
1974	211.98	130.86	6.05	5.65	6.34	6.07	7.52	7.33
1975	229.68	185.99	6.14	6.02	6.52	6.35	7.55	7.48
1976	243.81	224.69	6.18	6.07	6.71	6.34	7.57	7.65
1977	260.79	250.58	6.21	6.08	6.90	6.51	7.61	7.65
1978	277.30	302.41	6.22	6.27	7.08	6.54	7.63	7.77
1979	289.23	215.34	6.23	6.27	7.26	6.65	7.66	7.83
1980	304.82	339.20	6.24	6.26	7.44	6.86	7.68	7.80
1981	319.70	308.53	6.25	6.54	7.61	6.97	7.70	7.88
1982	322.39	382.79	6.25	6.27	7.77	7.13	7.72	7.77
1983	325.04	428.54	6.27	6.16	7.92	7.33	7.73	7.62
1984	383.77	395.86	6.28	6.49	8.07	7.27	7.74	7.52
1985	531.60	367.50	6.28	6.07	8.20	7.08	7.74	7.29
1986	650.14	345.37	6.28	6.05	8.33	7.20	7.45	7.04
1987	695.50	333.68	6.28	5.90	8.40	6.98	7.35	6.95
1988	701.94	350.85	6.23	6.49	8.46	7.03	7.32	6.84
1989	701.15	383.87	6.20	6.30	8.53	7.06	7.31	6.71
1990	707.59	407.61	6.20	5.90	8.59	7.31	7.32	7.09
1991	722.55	372.83	6.17	6.16	7.58	6.12	7.33	6.54
1992	735.51	387.91	6.17	6.15	7.94	6.13	7.34	6.45

Table 2						Continued
Year	LNMs		LGDPN		LVOEX	
	Simulated	Actual	Simulated	Actual	Simulated	Actual
1964.00	3.94	3.84	6.26	6.94	8.06	8.09
1965.00	4.67	4.20	6.83	7.17	8.50	8.44
1966.00	5.33	4.51	7.73	7.32	8.76	8.65
1967.00	5.92	4.76	8.25	7.48	8.91	8.79
1968.00	6.45	5.01	8.34	7.61	9.01	9.20
1969.00	6.91	5.31	8.26	7.69	9.26	9.37
1970.00	7.34	5.49	8.22	7.69	9.40	9.59
1971.00	7.74	5.89	8.27	7.84	9.45	9.50
1972.00	8.11	5.97	8.34	8.00	9.34	9.18
1973.00	8.46	6.20	8.39	8.05	9.27	9.53
1974.00	8.78	6.63	8.40	7.79	8.87	9.04
1975.00	9.08	6.74	8.37	8.08	8.93	8.85
1976.00	9.36	7.04	8.33	8.18	8.92	7.08
1977.00	9.64	7.28	8.32	8.94	9.08	9.18
1978.00	9.90	7.43	8.32	8.44	9.13	9.01
1979.00	10.14	7.71	8.34	8.32	9.11	8.68
1980.00	10.37	7.96	8.35	8.30	8.32	8.78
1981.00	10.59	8.16	8.36	8.30	8.73	8.43
1982.00	10.80	8.09	8.37	8.42	8.47	8.35
1983.00	10.99	7.97	9.71	10.72	8.40	8.30
1984.00	11.17	7.91	10.53	8.44	8.38	8.34
1985.00	11.34	8.16	10.47	8.42	8.36	8.46
1986.00	11.50	8.02	10.10	8.43	8.31	8.82
1987.00	11.64	8.14	9.76	8.40	8.44	8.13
1988.00	11.78	8.02	9.66	8.51	8.31	8.24
1989.00	11.90	8.17	9.71	8.62	8.31	8.32
1990.00	12.03	8.40	9.78	8.60	8.38	8.50
1991.00	12.14	8.36	9.80	8.72	8.50	8.61
1992.00	12.26	8.51	9.74	8.84	8.63	8.55

Table 2								
Year	UTB		LTIM		LSLL		LTLD	
	Simulated	Actual	Simulated	Actual	Simulated	Actual	Simulated	Actual
1964.00	-379.82	-47.01	5.71	5.85	5.85	5.85	5.88	5.90
1965.00	-350.81	16.52	6.14	5.89	5.86	5.87	6.07	5.92
1966.00	-785.98	-89.17	6.50	6.07	5.88	5.88	6.28	5.94
1967.00	-920.31	-537.45	6.73	6.31	5.90	5.90	6.48	5.96
1968.00	-947.13	-526.68	6.88	6.57	5.92	5.91	6.65	5.99
1969.00	-869.43	-702.46	6.98	6.60	5.94	5.93	6.77	6.03
1970.00	-704.81	-732.20	7.05	6.50	5.96	5.96	6.84	6.08
1971.00	-395.44	-491.81	7.10	6.42	5.99	5.98	6.88	6.13
1972.00	-250.54	-513.14	7.15	6.84	6.02	6.01	6.91	6.19
1973.00	-121.91	-572.26	7.22	7.09	6.04	6.04	6.93	6.29
1974.00	-57.50	-75.41	7.29	7.26	6.07	6.08	6.94	6.41
1975.00	-41.44	-173.66	7.34	7.44	6.10	6.12	6.96	6.52
1976.00	-64.61	-161.32	7.38	7.33	6.13	6.15	6.97	6.60
1977.00	-0.72	-190.34	7.40	7.41	6.16	6.21	6.99	6.64
1978.00	-31.84	-867.20	7.43	7.46	6.19	6.25	7.01	6.65
1979.00	-37.99	-341.72	7.44	7.45	6.23	6.27	7.02	6.67
1980.00	22.67	-335.80	7.45	7.60	6.26	6.28	7.03	6.70
1981.00	-22.74	-513.65	7.47	7.82	6.30	6.33	7.12	6.77
1982.00	-516.97	-562.92	7.50	7.70	6.36	6.38	7.19	6.82
1983.00	-216.00	-745.25	7.51	7.54	6.43	6.43	7.22	6.86
1984.00	-10.48	504.09	7.51	7.60	6.48	6.47	7.32	6.92
1985.00	-472.96	-335.63	7.51	7.19	6.54	6.55	7.32	6.80
1986.00	277.74	1285.48	7.50	7.15	6.60	6.61	7.44	6.81
1987.00	-669.10	-314.81	7.40	7.03	6.65	6.66	7.51	6.82
1988.00	-343.13	-385.89	7.33	7.30	6.70	6.71	7.53	6.87
1989.00	327.65	-303.93	7.30	7.12	6.75	6.74	7.51	6.90
1990.00	650.49	-220.33	7.29	6.96	6.80	6.78	7.50	6.93
1991.00	592.82	-309.43	7.28	6.99	6.85	6.83	7.50	6.92
1992.00	422.07	-187.47	7.28	6.99	6.90	6.88	7.51	6.95

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