AN ANALYSIS OF THE EFFECTS OF THE OIL INDUSTRY ON ECONOMIC DEVELOPMENT IN NIGERIA

by

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ABSTRACT

This thesis examines the direct and indirect effects of the oil industry on economic development in Nigeria between 1960 and 1995. Three main empirical issues are addressed. Firstly, the thesis questions the relevance of orthodox models of Dutch Disease to Nigeria by testing the effects of variables such as the real price of oil and government real investment expenditures in the oil sector on sectoral output, and investment and labour demand. Secondly, the effect of a smaller oil sector on the economy in general and on the manufacturing sector in particular is analysed. Thirdly, the effects of the balance of payments on the economy under both a fixed and a floating exchange rate system are examined. This study is in two parts.

Part I which comprises Chapters One to Four provides the background and descriptive accounts of the thesis. Chapter One is an introductory chapter. In Chapter Two, a description of the Nigerian economy and macroeconomic policy developments from 1960 to 1995 is provided. In Chapter Three, a critical examination of the oil sector is carried out including an account of the direct physical and environmental effects. Chapter Four provides a theoretical and empirical overview of the literature on Dutch Disease and related macroeconomic sectoral models.

Part II comprises the core empirical chapters. In Chapter Five, a dynamic multi sectoral Dutch Disease macroeconomic model is developed. In this chapter, three variants are considered, a world price model, an exogenous exchange rate model and a balance of payments constrained growth rate model. The chapter also discusses a number of econometric issues in the context of simultaneous equation models. In Chapter Six, the model is estimated and parameter estimates examined. In Chapter Seven, a critical examination of the Nigerian manufacturing sector is carried out which is based on the estimated Dutch Disease macro model under both a floating and a fixed exchange rate system and on a constructed traded goods index. An account of Nigeria's industrial policy developments since 1960 is also given. In Chapter Eight, the model is used for examining the effects of the balance of payments on the Nigerian economy under a floating exchange rate system. In this chapter, various theoretical models of exchange rate determination are used to calculate the Nigerian Naira exchange rate. A detailed account of exchange rate and related macroeconomic policy developments in Nigeria since 1914 is contained in an appendix. The summary and conclusions of the study are contained in Chapter Nine.

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CHAPTER 1

INTRODUCTION

1.1 Background to and Objectives of the Thesis

This thesis examines the impact of the oil industry on the economy of Nigeria between 1960 and 1995. Oil has been the mainstay of Nigeria's economy and foreign trade over the last twenty five years or so. During the oil boom period of the 1970s and early 1980s, the huge earnings from the oil sector were mainly invested in infrastructure and services. The period witnessed the expansion of the non-traded sectors and the concurrent decline of the traded sectors, particularly the agricultural sector. This disproportionate effect on the economy which results from a natural resource boom is described as the 'Dutch Disease', although the term itself more directly refers to the decline in manufacturing output as the exchange rate appreciates. Throughout the boom period, Nigeria maintained an unrealistically high exchange rate value for its domestic currency, the Naira, which is believed to have hurt its traditional export sectors and placed the balance of payments under pressure whilst at the same time significantly increasing the role of the government in the economy given that it was the main beneficiary of revenues derived from the oil sector.

It is against this background, that three main empirical issues are therefore addressed with respect to the Nigerian economy in this study. Firstly, the thesis questions the relevance of orthodox models of Dutch Disease to Nigeria by testing the effects of variables such as the real price of oil and government real investment expenditure in the oil sector on sectoral output, and on the demand for capital and labour demand in both traded and non-traded sectors. Secondly, the effect of a smaller oil sector on the economy in general and on the manufacturing sector in particular is examined. The performance of the manufacturing sector is further addressed by examining both Nigeria's industrial policy developments since independence and a constructed traded goods index which traces trends in the manufacturing sector over time. Thirdly, the effects of the balance of payments on the Nigerian economy under a regime of both fixed and floating exchange rate systems are examined.

The main objective of the thesis is therefore to develop an adequate macroeconomic model for Nigeria to test the various hypotheses which subsequently can then be used as a framework for conducting various macroeconomic policy shocks in an oil dominated economy in which the government plays a large and crucial role. The thesis is considered particularly important for the manufacturing sector because it examines whether the presumed damaging effects of oil related developments on the sector can be traced to the standard Dutch Disease type economic effects or whether other structural/socio political effects outside of the model itself have been contributory factors.

1.2 Contributions and Significance of the Thesis

The Dutch Disease has been explained by a large number of theoretical models and a number of empirical studies which have tended to estimate reduced form equations, the estimates of which are not conclusive. This thesis differs from previous studies in a number of ways. Firstly, to the best of our knowledge, it is a first attempt of an explicit simultaneous equation model for Nigeria or closely related economies that combines a set of output supply and demand equations, and equations for capital and labour at a disaggregated sectoral level.

Secondly, and again to the best of our knowledge, it is a first attempt at explicitly investigating the resource movement and spending effects, which are the main effects of traditional models of the Dutch Disease, by analysing in detail the employment of resources using an autoregressive instrumental variable ECM model of capital stock and employment of labour at the sectoral level. It is concluded that the standard resource movement effect is difficult to detect in Nigeria, but that government expenditure in the oil sector results in a moderate to important resource movement effect.

Thirdly, the model is sufficiently dynamic in that for the factor equations it combines features of both the short and the long run in which sectoral output and prices are determined endogenously so that the demand for the capital stock and labour demand functions at the sectoral level are better understood.

Fourthly, the model differs from previous studies in that it adds considerable flexibility to existing Dutch Disease models by considering several variants to the basic model such as versions with world prices, a balance of payments constrained growth rate model and an exogenous exchange rate model, the latter two being so flexible that they can be respecified under alternate assumptions about the exogeneity or endogeneity of the exchange rate and balance of payments variables. It is suggested that a resource boom allows a country to reduce its balance of payments constraint and grow more quickly.

Finally, the thesis differs from previous studies in that it contains an explicit empirical account of the nature of manufacturing in a typical oil exporting less developed country mainly through the use of the estimated Dutch Disease macro model and to an extent through the study of the constructed manufacturing index.

The study utilises a 23-year set of national accounts and external sector data to construct a comprehensive sectoral data set which are then used in addressing the issues mentioned above. Given that a lot of effort was spent in obtaining this data to test the theoretical models properly, the thesis is significant because it is expected to contribute towards a better understanding of our knowledge of sectoral macroeconomic models in general and Dutch Disease models in particular.

Specifically, our results are expected to provide further evidence of the need for the modification of standard optimising Dutch Disease models to take into account the unique features of natural resource producing developing countries, including Nigeria. From a methodological perspective, the thesis will indicate whether the traditional Dutch Disease analysis should continue to be relied upon as the appropriate framework for investigating the role of the oil sector *per se* in transmitting oil related macroeconomic impulses to the rest of the economy in general and in particular to the manufacturing sector.

1.3 Organisation of Thesis

After this introductory chapter which sets the background to the study, the rest of the thesis is broadly organised into two parts and comprises eight chapters. Part I which comprises Chapters Two to Four provides a description of the Nigerian economy, a critical examination of the oil sector, and finally a review of the relevant theoretical and empirical literatures.

Part II comprises the core empirical chapters. In Chapters Five and Six, a Dutch Disease macroeconomic model is developed and estimated. Chapter Seven contains a critical section on the Nigerian manufacturing sector which relies in part on the estimated model and on an indexation methodology. In Chapter Eight, the model is used for examining the effects of the balance of payments on the economy. The summary and conclusions of the study are contained in Chapter Nine. A more detailed synopsis of each chapter is now given below.

Chapter Two reviews the Nigerian economy since her independence in 1960. This chapter traces events in the early development period between 1960 and 1972, a period dominated by the agricultural sector with relatively high but stable growth. The chapter gives an account of the social upheavals during the period which culminated in the civil war and offers an opinion as to whether it had its roots in the emerging oil sector. The chapter then examines the period between 1973 to 1985 which witnessed the years of oil boom and busts. The impacts on both traded and non-traded sectors are examined. Other developments in the real sector of the economy, particularly the growing public sector, the vexed issue of revenue allocation and the balance of payments are also examined. The impact of the international oil and debt crises from about 1982 which resulted in the introduction of the structural adjustment programme in Nigeria in 1986 and the third phase of policy changes are reviewed. Finally, the impact of the liberalised foreign exchange market and other structural changes on traded and non-traded sectors are examined.

Chapter Three gives a descriptive account of the oil sector in Nigeria. The domestic operational aspects of the industry and Nigeria's international obligations as a member of the OPEC are examined. This descriptive account is considered vital in order to place the empirical analyses and deductions from our estimated Dutch Disease macro model in a firm context. In the second half of the chapter, the direct physical and environmental effects due to oil production in Nigeria are examined. This chapter therefore provides a relevant and quantitative history of the oil industry induced environmental and physical effects arising from water, land and air pollution. Given the political sensitivity of environmental issues and limited environmental data in Nigeria which are only just becoming publicly available, any objective and meaningful application of existing environmental valuation techniques to the oil industry becomes very difficult. As such, this chapter provides only a descriptive account of the physical and environmental effects of the oil sector and does not carry out any empirical investigations.

Chapter Four reviews the theory and empirical literature of the Dutch Disease starting with studies of what is generally known in the literature as the 'Core Models' or the 'Australian Models' typified by Corden and Neary (1982) and Gregory (1976) and then provides an account of those models that have grown out of the core models. The chapter presents the evidence which show that certain modifications of the assumptions implicit in the early models bring about other effects in developing countries beside the core 'resource movement' and 'spending effect'. The chapter examines the limited empirical studies by Fardmanesh (1991a), Benjamin et al (1989), Struthers (1990) and Kamas (1986), amongst others, which justify the modification of the core models for developing countries. The chapter concludes by reviewing the literature on related macroeconomic sectoral models which are not necessarily linked to the Dutch Disease but nonetheless have certain useful features which are incorporated in the model developed for Nigeria.

In Chapter Five, a Dutch Disease Model of the Nigerian economy that is capable of econometric estimation is developed. A dynamic multi sectoral model is used to analyse the relationship between sectoral output supply and demand, and the employment and use of factors. In this chapter, an overall economic interpretation of the dynamic model is given after which detailed econometric specifications of the equations are derived, presented and discussed. Three variants are considered, a model with simple world prices, an exogenous exchange rate model and a balance of payments constrained growth rate model. The chapter then goes on to discuss several important econometric issues within the context of simultaneous equation models such as identification, instrumentation, and the estimation and diagnostic test procedures employed. Finally, the chapter concludes by discussing some of the problems of the data employed for the study and the reasons why a five sector approach was considered more appropriate than the traditional three sector approach used in typical models of Dutch Disease.

Chapter Six reports and discusses the regression results of the different structural equations of the estimated Dutch Disease model for Nigeria. The parameter estimates and statistical diagnostic test results from 2SLS and in some cases 3SLS estimation procedures are presented and discussed.

The impacts of macroeconomic policy shocks are examined by subjecting the model to policy simulations. In Chapter Seven, the performance of the manufacturing sector is examined by using the estimated macro model to analyse the effects of a smaller oil sector on manufacturing under both a fixed and a floating exchange system and by constructing an indexation methodology which traces developments in the industrial sectors between 1960 and 1995. An account of Nigeria's industrial policy objectives and developments between 1960 and 1995 is also given.

Chapter Eight simulates the long run effects on the Nigerian economy of imposing alternative balance of payments constraints under a floating exchange rate system. This exercise is useful not only in predicting what the exchange rate value in Nigeria would be given such constraints but the effects on traded sectors, particularly the manufacturing sector. The chapter also uses various theoretical models of exchange rate determination to calculate the Nigerian Naira exchange rate. A detailed account of exchange rate and related macroeconomic policy developments in Nigeria since 1914 is contained in an appendix to the chapter.

Chapter Nine is the concluding chapter which summarises the main findings from the thesis and offers some policy recommendations based on the results from the study.

CHAPTER 2

THE NIGERIAN ECONOMY, OIL PRODUCTION AND MACROECONOMIC POLICY DEVELOPMENTS: 1960 TO 1995

2.1. Introduction

This chapter gives an account of the economy of Nigeria over the period 1960 to 1995. In doing so, particular emphasis is placed on examining the performances of individual sectors and their responses to various macroeconomic policy developments since 1960, the year in which Nigeria gained her political independence. This chapter provides the necessary descriptive background of the Nigerian economy which subsequent chapters will use in analysing the effects of the oil industry on economic development in Nigeria.

In carrying out this account, a three period framework is used over the entire 1960 to 1995 time-frame: the early development years of high and stable growth covering the period 1960 - 1972; the period of the oil boom and the consequent dramatic rise in both public and private sector economic activities, 1973 - 1985; and the period of structural adjustment and macroeconomic policy reversals, 1986 - 1995, following the sharp decline in the price of oil.

In section 2.2, events in the first period are examined, a period during which Nigeria was predominantly an agricultural economy and was considered to be one of the world's poorest countries with a per capita income of just over $100 (World Bank Trends, 1992). This period was also important because of the dislocation of the economy, which arose from social and political tensions, and eventually the outbreak of civil war, factors which may have had their roots in the emerging and strategically important oil sector.

The second period, 1973-1985, which is examined in section 2.3, was characterised by dramatic increases and equally spectacular falls in the price of oil. During this period, rising oil prices increased the value of exports to a peak of about $26 billion by 1980 and per capita income to over $1000 (World Bank Trends, 1992). However, earnings from the oil boom started a process of massive public investment in the economy. Nigeria's development strategy centred around using the resources generated by the oil industry for productive investment in other key sectors of the economy and for the development of physical infrastructure. The period therefore witnessed the decline of the traditional export (agricultural) sector, a modest expansion of the manufacturing sector and a rise in the non-traded industrial and services sector. Throughout the boom and shortly after, Nigeria maintained an unrealistically high exchange rate value for its currency hurting its non-oil export sectors and putting pressure on the balance of payments as she was able to maintain trade deficits against the proceeds of future oil sales. However, towards the end of the sub-period, it became clear that the continued trend of unstable and downward real oil prices, ineffective sectoral policies and rising population had impacted negatively on Nigeria's efforts towards sustained economic development. Nigeria's ability to meet its medium to long term diversification objectives of shifting resources to other non-oil traded sectors and relying less on oil exports were severely curtailed.

It was against this background that during the third period, 1986-1995, the economic fortunes of Nigeria dipped and, as a result, the government was forced to introduce radical structural changes and effect various macroeconomic policies, sometimes conflicting, in support of structural reform. In section 2.3, these structural changes, characterised by the introduction of the Structural Adjustment Programme (SAP) in 1986, are examined. During this period, the emphasis was on liberalising the economy, shifting the provision of goods and services from the public to the private sector and revitalising the ailing non-oil traded sectors.

2.2 The Development Period and the Agrarian Economy: 1960 - 1972

Nigeria is Africa's largest oil producer, accounting for about 8.5% of OPEC production. Nigeria is the regions's most populous nation, with a population estimated in 1988 at 117 million, with a current growth rate of 3.2% per annum (World Bank Trends, 1992). Although during the period 1960-72 Nigeria in per capita income terms was considered poor, the country was generally regarded as potentially rich given her rich endowment of natural and human resources. (National Development Plan, 1962-1968).

TABLE 2.1: MACROECONOMIC (OUTPUT) INDICATORS IN %s (1960-1995)

	1960-1972	**1973-1979**	**1980-1985**	**1986-1989**	**1990-1995**
Sectoral Share of (Nominal) GDP/Real Sectoral Growth:					
Agriculture	54.0%/2.29%	25.7%/-1.91%	31.8%/-2.77%	36.9%/7.88%	32.3%/2.14%
Manufacturing	6.0%/3.93%	5.8%/7.89%	6.6%/-3.72%	7.4%/8.44%	5.7%/2.14%
Oil	5.8%/41.7%	24.3%/6.04%	23.4%/-7.38%	22.5%/3.85%	35.9%/3.58%
Non-Traded Industrials	6.9%/5.3%	9.1%/5.57%	5.2%/-3.97%	2.6%/-1.54%	1.6%/3.46%
Services	17.0%/2.94%	29.3%/7.11%	27.5%/-2.18%	25.3%/7.94%	21.8%/5.20%
Government Producers	10.3%/9.85%	5.8%/1.52%	5.5%/-8.92%	5.3%/4.97%	2.7%/0.50%
Real GDP Growth:	11.97%	4.57%	-4.87%	5.56%	2.95%

Sources: (i) Own calculations from National Accounts of Nigeria, various issues.

Note: (i) It is important to note that data for 1960-72 are not completely reliable because of the disruption of the civil war during the period. For example, offical statistics show that the oil sector in real terms grew by -22%, -48% and over 200% in 1967, 1968 and 1969 respectively which appears doubtful.

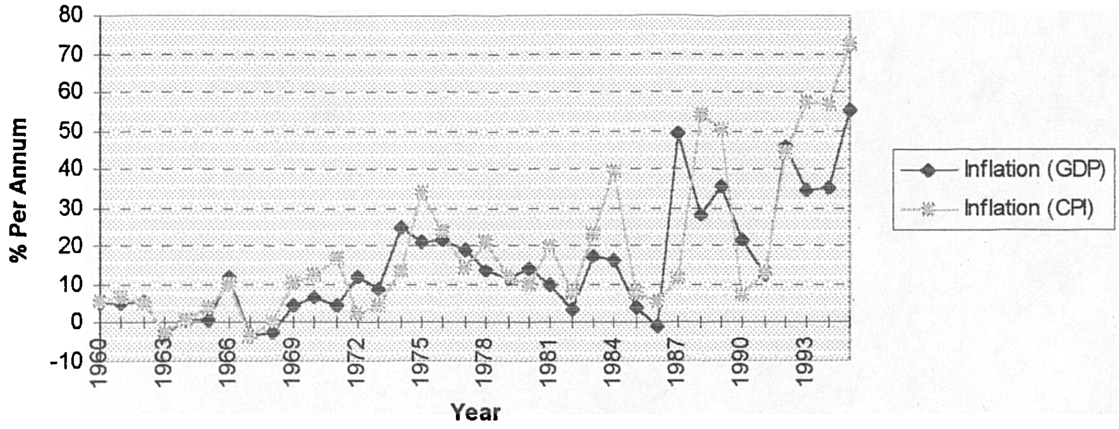
The growth of the economy as reflected by the growth of Gross Domestic Product (GDP) was quite high averaging approximately 12% in real terms during the period 1960 to 1972 (see Table 2.1). Prices for Nigeria's exports rose rapidly and demand was strong. Imports also rose quite significantly, although the value of exports exceeded the value of imports and thus permitted a healthy surplus on the current account and the accumulation of foreign reserves (National Development Plan, 1962-1968).

Although the proportion of the GDP devoted to private consumption was quite high at about 85% (National Development Plan, 1962 - 68), the objective of increasing private sector savings tended to be offset by rising government consumption which had become necessary to support the expanding economy. In general, the growth of the Nigerian economy during this period occurred under a generally favourable international economic climate although the civil war between 1966-70 and its aftermath slowed to some extent the country's pace of development.

2.2.1 *Macroeconomic Policies during the Early Development Period*

When Nigeria gained its independence in 1960, it inherited institutions and processes that reflected its colonial ties (World Bank Trends, 1996; Gelb, 1988), and which therefore formed the initial basis for the economic and political decision making processes that remained in place for much of the period 1960 - 1972.

Figure 2.1: Main Price Indicators (1960-1995)



Source: IMF, International Financial Statistics, 1996.

The objectives of fiscal policy during the period were designed to raise enough revenue for the government, increase national savings, investment and capital formation and maintain a healthy balance of payments position (National Development Plan, 1970-74). By the mid 1960s, the major instruments of policy increasingly became reliant on quantitative restrictions and administrative controls. In particular, a process of stringent but selective import restrictions were in place for much of the years between 1967 and 1969, with the Exchange Control Act, which came into force in 1962, extended in all its aspects by 1968 largely as a means of averting the impending crisis in the balance of payment situation. The deteriorating balance of payments may have been partly due to the net outflow of capital, largely the result of the steep rise in external spending for the armed forces associated with the civil war, and the loss of reserves due to the speculative outflow associated with the devaluation of Sterling in 1967 (National Development Plan, 1962-68).

In an era of relatively low inflation (Figure 2.1), the monetary measures largely focused around the provision of cheap money to finance both public and private capital investments. The measures were also directed at restraining consumption expenditure to improve the balance of payments and prevent a deterioration of the external reserve position of the country. In 1969, a radical Banking Decree was promulgated aimed at achieving tighter control of banking operations, promoting greater operational efficiency and stimulating quicker response by the banking system to monetary policy changes (National Development Plan, 1962-68).

The industrial policy of the government as reflected in the National Development Plan, 1970-74 was aimed at stimulating the establishment and growth of industries that impacted directly and indirectly on economic growth whilst enabling Nigerians to take an active role in the ownership, management and direction of such establishments. New institutions were created and exiting ones reconstructed. In particular, the Investment Company of Nigeria (ICON) was reconstructed in 1964 into the Nigerian Industrial Development Bank (NIDB) with adequate set of fiscal incentives aimed at achieving the government's industrial objectives[1].

2.2.2 *Developments in the Traded and Non-traded Sectors*

The most significant feature of the early development period 1960 to 1972 was the rapid growth of virtually all the traded and non-traded sectors (Table 2.1). Being essentially an agrarian economy, overall growth of the economy during the early part of this period tended to reflect the growth of the agricultural sector. Agriculture alone accounted for about 54% of total GDP thus reflecting its enormous importance in the development of the economy (Table 2.1). The agricultural sector's share of exports and domestic demand in the economy was high with averages of over 80% and 55% respectively during the early part of the period (Central Bank of Nigeria Annual Report, various issues), although over the entire period the growth of output in the sector was moderate averaging slightly over 2% (Table 2.1).

However, throughout most of the period, traditional agricultural practices remained the norm, while the cumbersome system of land tenure and other factors such as the war and drought

[1] A detailed account of industrial policy and the manufacturing sector is provided in Chapter Seven.

(Struthers, 1990) constrained the rapid growth of the sector. Going into the 1970s, the onerous task of modernising the sector required a massive infusion of public resources, the development of adequate infra structural networks, better access to credit and the enhancement of storage, management and irrigation techniques (National Development Plan, 1962-68).

By comparison, the industrial sectors, mainly manufacturing and oil, were still in their infancy contributing modestly to overall growth. The growth of the manufacturing sector in real terms and as a proportion of GDP was less than spectacular (Table 2.1). Interestingly, the greatest impediment to rapid industrial development during the period as stated in the National Development Plan (1962-68) was considered to be the lack of the inflow of skilled labour rather than the inflow of capital.

During the early development period, 1960-72, the non-traded industrial sectors as a whole grew about 5% with the construction and utilities sub-sectors achieving growth rates of about 6% and 4% respectively. The services sector's contribution to GDP as a whole averaged about 17% with growth rates of about 3% (see Table 2.1).

2.2.3 Political Developments and the Impact on Economic Planning

It has been suggested that when Nigeria gained its independence in 1960, it may also have inherited ethnic and regional tensions[2] that mirrored the colonial design of its borders and constituencies (World Bank Trends, 1996; Gelb 1988; Lubeck, 1992). By the mid 1960s, a series of constitutional crises, which had plagued the country since shortly after independence, led to the establishment of a military regime in 1966 and eventually the outbreak of civil war in 1967.

The outbreak of the civil war which may have had its roots in the emerging and important oil sector (Gelb, 1988), brought about a decline in output and general economic activity. Internally, the major objectives of fiscal and monetary policies were to finance the war and to improve the external reserves position. Additionally, the creation in 1967 of twelve new states

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[2] Between 1960 and 1967, the four regions in Nigeria were the Northern, Eastern, Western and Midwestern regions.

from the four old regions increased the pressure for public funds.

Pearson (1970) and Gelb (1988) strongly suggest that ethnic pressures and the regional structure which Nigeria inherited after independence played a role in precipitating the war once oil was found. During the 1950s and early 1960s when the Northern and Western regions produced almost all of Nigeria's major agriculture exports the principle of derivation was applied. The principle was that revenue collected by the federal government was allocated to the regions in accordance with how much revenue each region had generated. During this period, limited knowledge of the true extent of Nigeria's oil reserves and the potential impact of future oil production meant that oil was not in the forefront of economic and political planning. This changed with the announcement in 1965 by the Prime Minister and Federal Minister of Finance of the positive impact of oil production on Nigeria's balance of payments. Consequently, once oil was found in commercial quantities in the Eastern and the delta areas of the Midwestern regions, the Northern and Western regions abandoned the principle of derivation and favoured a process where power and control of federal funds was more centralised. Thus, rising oil revenues and political developments, especially with regard to an equitable and fair revenue allocation[3], dramatically changed the context in which national economic planning and development was conducted in Nigeria.

2.3 *The Oil Boom and Bust Period: 1973 - 1985*

2.3.1 *Macroeconomic Policies and the Impact on Sectors*

The period 1973 - 1985 followed against the backdrop of the pre-oil boom years of relatively stable economic growth and the programme of post-war reconstruction and development. The primary objective of economic planning and development in Nigeria as contained in successive National Development Plans, (1970-74; 1975-80 and 1981-85) was the achievement of rapid increase in the nation's productive capacity with a view to improving the standards of living of its people.

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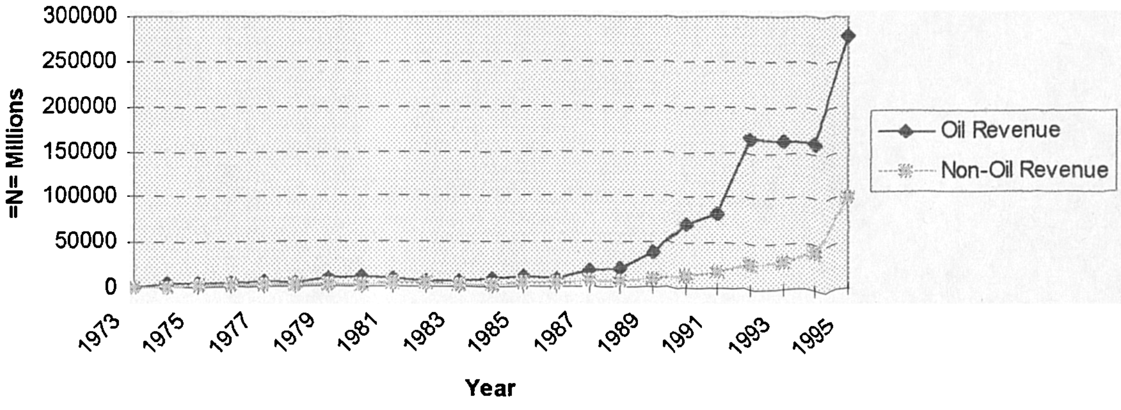
[3] A full account of revenue allocation is contained in section 2.3.2.

Figure 2.2: Oil Revenue versus Non-Oil Revenue (1973-1995)



Source: Central Bank of Nigeria, Statistical Bulletin, 1995.

The quadrupling of oil prices in the 1970s, which brought about a generalised depression in the economies of several other non-oil exporting African countries, allowed Nigeria to meet its development objectives to an extent. Nigeria was able to rapidly move away from an agrarian economy to one reliant on production and exports of crude oil. Nigeria's oil revenue expanded from \$7.55 billion in 1975 to \$15.5 billion in 1979 and \$25.3 billion in 1980 (United Nations, 1993), and during the period 1973 to 1985 oil revenues began to outstrip non-oil revenues (Figure 2.2). During this period, per capita income was relatively high although rapid population growth and the fall in oil revenues later in the period particularly between 1982 and 1985 resulted in sharp declines in aggregate per capita income (Figure 2.3).

In the immediate aftermath of the rise in oil prices in 1973, the nation embarked on a number of ambitious projects and wage demands soared following the large increase in public sector wages granted by the Udoji civil service awards in 1975 (Gelb, 1988). The instruments for achieving price stability in the face of inflationary pressure were vested in a Productivity, Prices and Incomes Board and a Unified Civil Service Grading and Pay System. (National Development Plan, 1981-85). During this period, a number of infra structural projects were completed, although, sadly, the increased economic activity and particularly the growth of the public sector was occasioned by a general increase in the incidence of corruption (Faruqee, 1994) which at the time was easily absorbed with high oil prices and revenues (World Bank Trends, 1996).

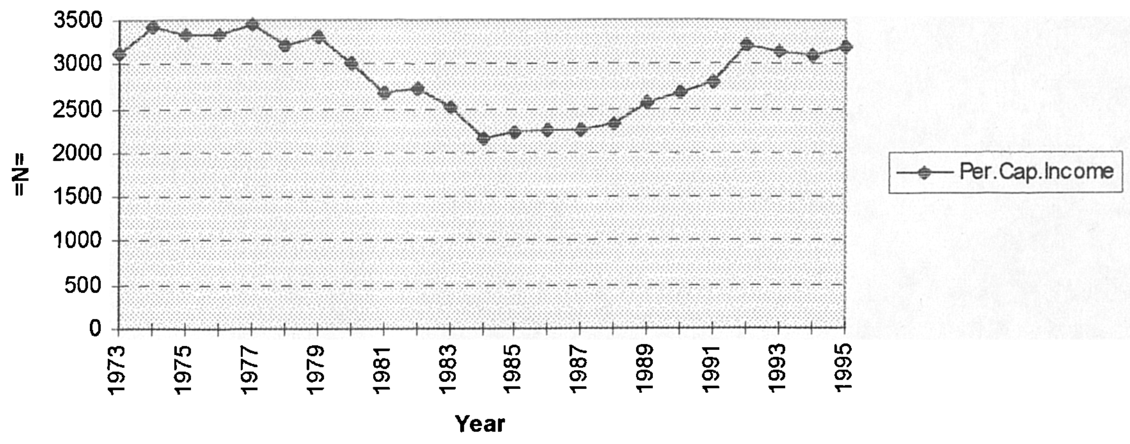
TABLE 2.2: TRADED SECTORS SHARES OF EXPORTS AND IMPORTS (1960-95)

	% Share of Exports						% Share of Imports			Total
	Nigeria			Indonesia			Nigeria			
YEAR	Agric-ulture	Manuf-acture	Oil	Agric-ulture	Manuf-acture	Oil	Agric-ulture	Manuf-acture	Oil	
1960	95.00	1.00	4.00	na	na	na	14.00	85.00	1.00	100
1965	74.43	3.10	22.47	na	na	na	14.00	85.00	1.00	100
1970	40.46	1.43	58.11	50.10	1.20	38.50	11.20	85.63	3.18	100
1975	6.62	0.52	92.86	20.50	1.20	74.80	12.42	84.89	2.70	100
1976	5.13	0.56	94.32	24.90	1.40	70.30	12.51	84.09	3.40	100
1977	7.51	0.72	91.77	26.60	1.80	67.20	14.82	83.38	1.81	100
1978	7.70	1.39	90.92	26.00	1.90	63.90	16.45	81.63	1.93	100
1979	4.71	0.75	94.55	27.90	3.10	56.90	19.99	77.72	2.29	100
1980	6.05	0.88	93.07	21.80	2.40	58.70	16.99	81.01	2.00	100
1981	2.69	0.54	96.77	11.80	2.90	72.20	18.11	80.69	1.20	100
1982	2.31	0.59	97.10	10.60	4.30	69.40	19.97	78.89	1.14	100
1988	7.55	2.33	90.12	23.50	28.70	27.70	12.55	86.49	0.96	100
1989	5.20	1.50	93.30	22.45	27.87	26.98	11.00	88.16	0.84	100
1990	4.70	1.59	93.71	20.17	26.93	33.66	11.70	87.70	0.60	100
1991	3.59	1.21	95.20	na	na	na	11.30	88.10	0.60	100
1992	1.51	0.90	97.58	na	na	na	12.50	87.10	0.40	100
1993	2.50	1.30	96.20	na	na	na	12.10	87.40	0.50	100
1994	2.30	1.00	96.70	na	na	na	10.80	88.70	0.50	100
1995	2.20	1.10	97.30	na	na	na	17.10	81.60	1.30	100

Sources: (i) Own calculations for Nigeria from data provided by Central Bank of Nigeria, Economic & Financial Review, various issues. (ii) For Indonesia, culled from Harvie C and Thaha A (1994), Oil Production and Macroeconomic Adjustment in the Indonesian Economy, Applied Economics, 16 (4), page 257.

Notes: Exports for the Indonesian economy do not round up to 100% because of contributions from the gas and other sectors.

Figure 2.3: Aggregate Per Capita Income (1973-1995)



Source: (i) Federal Office of Statistics, National Accounts of Nigeria, various issues.

During the period of the oil boom, the agricultural sector went into virtual decline with its share of exports from a peak of about 95% in 1960 plummeting to 40% in 1970 and about 5% by 1976 (Table 2.2). In 1974, and for the first time since independence, Nigeria moved from being a net exporter of food to a net importer of food. Many local producers abandoned the farms and migration from the rural to the urban cities increased (Balabkins, 1988; Struthers, 1990). With the oil boom, agricultural production and exports collapsed, productivity fell (Figure 2.4) and the relative attractiveness and incomes of the sector declined (World Bank, 1983).

Although it is generally believed that the overvalued exchange rate and increased spending on construction related activities and services boosted the prices of non-traded goods and therefore provided disincentives to the traded sector (World Bank Trends, 1992), the oil boom may have brought about an expansion of the manufacturing sector (see the evidence in Chapter Four). This expansion may have been largely the result of trade protection which rendered the sector semi-nontradeable. Indeed, the flow of relatively cheap imported inputs, allowed by the high exchange rate, (Struthers, 1990), enabled the manufacturing sector to grow rapidly during the period, especially, between 1973-79 (Table 2.1). However, the sector's contribution to overall GDP was still very low at about 6% during the period (Table 2.1). The rapid increase in the prices of domestically produced goods and spiralling wages, particularly in the public sector, hindered the international competitiveness of the manufacturing sector as a whole (World Bank, 1983).

TABLE 2.3: SELECTED EXTERNAL INDICATORS FOR NIGERIA (1973-95)

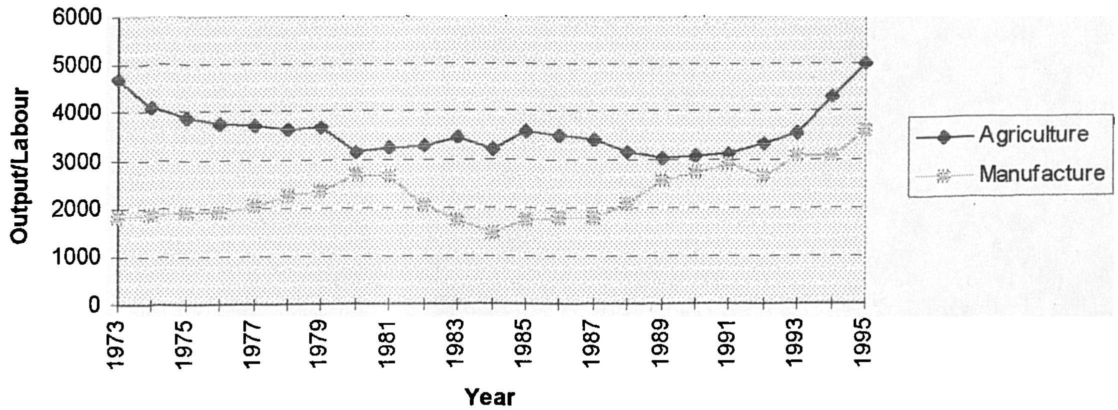
YEAR	Current Account (%GDP)	Total Debt (%GDP)	Debt Service (%Export)	Interest Payments (%Export)	Net Factor Income (=N= Mls)	Foreign Reserves (=N= Mls)	Net Flow of FDI (=N= Mls)
1970	-4.96	7.64	7.16	2.09	-332	104.6	121.6
1973	8.52	6.47	6.08	1.01	-621	241.0	192.6
1974	21.56	4.10	1.91	0.42	-435	3112.5	48.3
1975	3.91	3.07	2.96	0.49	-220	3380.1	475.4
1976	-5.17	1.99	3.66	0.40	-350	3057.6	46.3
1977	-2.01	6.04	1.04	0.39	-207	2521.0	197.6
1978	-3.69	8.97	1.29	0.57	-174	1249.1	331.8
1979	6.23	8.78	2.17	1.43	-416	3043.2	289.9
1980	9.44	9.52	4.1	3.3	-1090	5445.6	467.0
1981	-4.90	14.63	9.1	5.9	-910	2424.8	137.8
1982	-5.02	16.60	16.2	9.7	-1162	1026.5	1624.9
1983	1.89	23.34	23.6	13.0	-974	781.7	556.7
1984	7.56	22.23	33.6	15.7	-1599	1143.8	534.8
1985	7.28	23.87	38.7	12.8	-1623	1641.1	329.7
1986	3.48	64.08	28.6	11.8	-5380	3587.4	2499.6
1987	-6.85	119.2	14.2	7.6	-11182	4643.3	680
1988	-3.56	101.81	29.6	20.4	-12740	3272.7	1345.6
1989	3.23	108.39	22.1	15.4	-17619	13457.1	-439.4
1990	10.12	114.80	23.6	13.1	-22013	34953.1	-464.3
1991	6.52	112.80	26.6	17.8	-24500	44249.6	1808.0
1992	9.27	107.10	29.4	13.2	-16031.2	13992.5	8269.2
1993	-2.45	118.90	13.0	na	-20707.8	67245.6	32994.4
1994	-5.65	102.5	19.6	na	-17976.9	134912	3907.2
1995	-9.08	na	na	na	-18444.6	161332	na

Sources: (i) Own calculations from:

(a) Central Bank of Nigeria, Statistical Bulletin, 1995 (b) IMF Balance of Payments Statistics, 1996

(c) World Bank, World Debt Tables, various issues.

Figure 2.4: Labour Productivity Indicators for the Non-Oil Traded Sectors (1973-1995)



Sources: (i) Federal Office of Statistics, National Accounts of Nigeria, various issues.

(ii) Federal Office of Statistics, Economic and Social Statistics Bulletin, various issues

By contrast, the rise in oil prices which brought about a boom in the non-traded sectors of the economy, particularly in the construction industry, shifted resources, mainly labour, from the agricultural sector (World Bank, 1983). Nigeria gradually lost its comparative advantage in low productivity agriculture (World Bank, 1983) even as aggregate per capita incomes associated with the oil boom steadily rose (see Figure 2.6). At the same time, the share of the services sector in overall GDP increased rapidly averaging close to about 28% during the period (Table 2.1).

By 1978, there was a glut in the world oil markets and the first indication of a recession emerged. The production of oil fell from 2.10 million barrels a day to 1.55 million between 1977 and 1978 (Central Bank of Nigeria Statistical Bulletin, 1995). Nigeria's high level of imports could no longer be sustained as eventually the balance of payments on the current account moved into a deficit of $1.01 billion in 1977 and $3.76 billion in 1978, and its public debt rose by about 62% to $5.09 billion by early 1978 accounting for about 9% of GDP (see Table 2.3). A number of short term measures, as contained in the budget statement of 1979, which included curbing certain imports, raising tariffs, cutting public expenditures and a tightening of the money supply were introduced to deal with the problem. The recession was short-lived because of the disruption of Iran's oil supply in 1979 and the consequent increase in the price of oil from about $15 in 1978 to about $39 by 1980.

The short term relief once again saw Nigeria embark on a massive spending programme especially with the election of a new civilian government in October 1979. Nigeria's imports skyrocketed from =N=9.1 billion in 1980 to =N=13.2 billion in 1981[4]. Its debt rose significantly (Table 2.3) as she was able to borrow against the proceeds of future oil sales projected to rise to $40 by 1985. Indeed, the 4th National Development Plan (1981-85), which was prepared in 1980, was based on this presumption that world oil markets would once again be highly favourable and as such the plan contained an ambitious expenditure program. Nigeria appeared not to be financially constrained as she signed up as one of the thirteen member countries that lent to the IMF's Supplementary Financing Facility set up in 1979 to enhance the role of the Special Drawing Rights (SDRs) as an international reserve asset (Central Bank of Nigeria Annual Report, 1979). The civilian government embarked on an ambitious agricultural green revolution programme and a massive plan to modernise the industrial sectors and provide the necessary infrastructure in support of its plan. At the same time, several billions of Naira was committed towards the development of a new federal capital at Abuja.

Unfortunately, the price of oil collapsed from a high of about $44 in 1981 to $28 in 1985 and about $14 in 1986 and the ensuing crisis that emerged was considerably more severe than the 1977/78 crisis. As a consequence, by 1981 the current account balance which showed a deficit of about $5.5 billion, accounting for about 5% of GDP, was increasingly financed out of foreign exchange reserves and external borrowing (Table 2.3). By 1982, foreign reserves had declined to about =N=1 billion or about one-fifth the level at the end of 1980. The country's budget deficit increased as revenues fell far short of planned expenditure. Foreign exchange earnings fell from a peak of about $26 billion in 1980 to $12 billion by 1982 and GDP in real terms fell in 1983 (Central Bank of Nigeria Statistical Bulletin, 1995). Since oil revenues accounted for more than 80% of total government revenues (Central Bank of Nigeria Statistical Bulletin, 1995), public finances came under severe pressure and expenditures programmes both at the federal and state levels were increasingly carried out by deficit financing.

[4] The Naira (=N=) is the Nigerian currency.

The ensuing crisis quickly spread to all sectors of the economy, both public and private. Unemployment rose as large numbers of workers were laid off mostly in the industrial sectors, and social tensions quickly spread as migrants from neighbouring countries were expelled. Many small manufacturing companies collapsed in the wake of the crisis unable to sustain production because of shortage of raw materials. Inflation quickly rose because of the supply gap and the country's debt crisis worsened. As the problems deepened the agricultural sector went into further decline, the construction boom ended and the provision of social public services were severely curtailed (Central Bank of Nigeria Annual report, various issues).

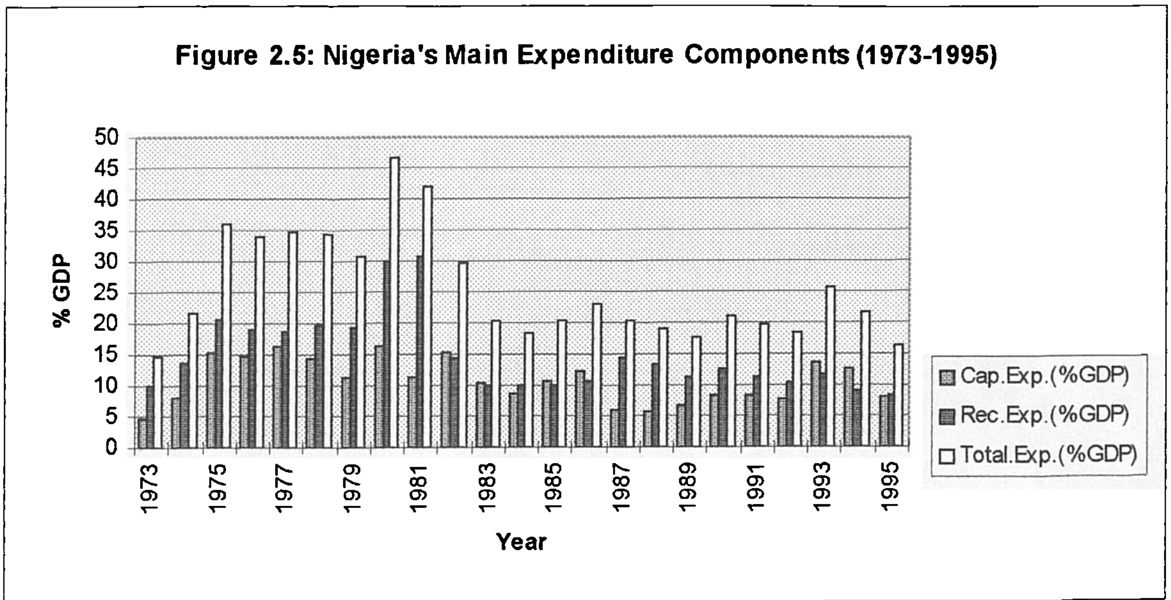
For the agricultural sector, in spite of various incentives such as the provision of loans, the encouragement of foreign participation through generous subsidies, tax relief, etc, and infra structural programmes introduced by successive regimes in support of the sector, not much was achieved in terms of real growth of output during the period (Table 2.1). The failure of these incentives suggested that institutional problems existed bordering on technological difficulties as characterised by many less developed countries (World Bank, 1983) and the cumbersome procedures for acquiring both land (Onosode, 1993) and credit facilities (Balogun and Otu, 1991) in Nigeria.

For the manufacturing sector, it is doubtful the extent to which incentives such as a more favourable tax regime served in promoting manufacturing investment given that many enterprises, by default, enjoyed tax reliefs because of the ineffective tax administration system in Nigeria (Onosode, 1993). Incentives by way of gradual easing of import bottlenecks and duties and particularly the encouragement of the use of locally sourced raw materials served to stimulate industrial output and growth during the period.

In 1982, the Government introduced an Economic Stabilisation Act, which came fully into force by 1984, largely to restore balance of payments equilibrium by stemming the tide of imports and enforcing more stringent exchange control measures (Saheli-Isfahani, 1989). Included as one of the main objectives in this package of austerity measures was the Government's intention to achieve a system of prioritisation of capital expenditures and a more judicious allocation of scarce resources.

Towards the end of 1986, Nigeria had no other option but to carry out a comprehensive restructuring of the entire economy rather than the ad hoc measures she had embarked on when the first signs of decline emerged in 1978. It was against this backdrop that the SAP was launched in 1986, a package that was considered to be the most comprehensive and revolutionary set of policy measures adopted since Nigeria attained independence in 1960.

2.3.2 Revenue Allocation, Public Sector Expenditures and the Issue of Crowding Out



Source: Central Bank of Nigeria, Statistical Bulletin, 1995.

Historically, the share of investment by the public sector has been large consuming a major part of financial resources (World Bank, 1983) although during the period 1973 to 1985 recurrent expenditures were generally twice as large as capital expenditures (Figure 2.5)[5]. An aftermath of the oil boom was the significant increase in the size of the Civil Service both in terms of employment and the use of public funds for the provision of basic infrastructure like roads, electricity and water and social services like education and health (Figures 2.6a and 2.6b).

[5] Nigeria's sectoral spending plans and development objectives have generally been set out in a series of national development and rolling plans and influenced by the annual budgets and the revenue allocation formula. Since independence, four National Development Plans, the 1962-68 (1st Plan); 1970-74 (2nd Plan); 1975-80 (3rd Plan); 1981-85 (4th Plan) and two Rolling Plans 1990-92 and 1993-95 have been prepared.

Figure 2.6a: % Average Share of Federal Government Capital Expenditure (1973-1985)

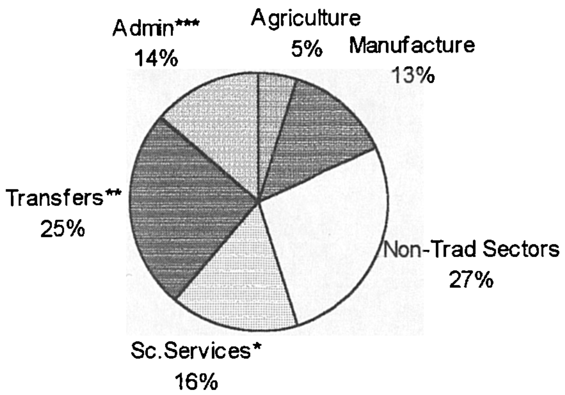
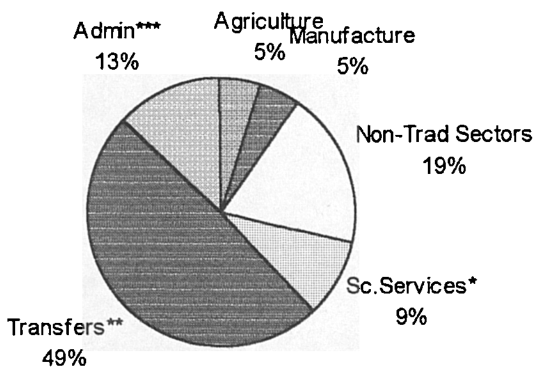


Figure 2.6b: % Average Share of Federal Government Capital Expenditure (1986-1995)



Source: Central Bank of Nigeria, Statistical Bulletin, 1995.

Notes: (i) * (Social Services): includes Education and Health

(ii) ** (Transfers): includes Petroleum Trust Fund (PTF) and Capital Repayments

(iii) *** (Administration): includes Defence and Internal Security.

Being the major beneficiary of oil revenues in Nigeria through its petroleum profit taxes, rents and royalties, the manner in which the government spends the extra revenues has a major potential effect on the performance of sectors (Jazayeri, 1986; Struthers, 1990; Harvie and Thaha, 1994). In Nigeria, this relationship is not always altogether very clear (World Bank, 1983) neither are the factors that impact on a particular sector's performance. For example, Struthers (1990), has observed that the decline in agricultural output in the 1980s may have been the result of any or all of three factors, namely, the low levels of government investment, the high exchange rate or price disincentives to farmers - the latter stemming from low producer prices for agricultural output set by marketing boards which bore no relationship to international prices (also Oshikoya, 1990). Indeed, Gelb (1988) has suggested that as far back as the 1950s and early 1960s, Nigeria's leaders had little inclination to invest in agriculture because of their views on development (which centred on growth, modernisation and indigenisation[6]) and the political pressures from various ethnic and regional groups.

Inevitably, the complications and political tensions arising from the use of an equitable revenue sharing formula for the three tiers of government[7] has plagued the country for a number of years. Since 1976, various technical committees and commissions have been set up to examine the vexed issue of revenue allocation. Though many workable recommendations were proposed over the years, many states were still faced with inadequate resources to complete capital projects and meet on-going recurrent expenditures, and most resorted to borrowing on a large scale (World Bank, 1983).

Capital investment expenditures in the manufacturing sector were mainly concentrated in critical sub-sectors such as petroleum products, steel, cement and paper and pulp sub-sectors, with varying degrees of foreign technical assistance in the form of joint ventures, although the development of the steel sub-sector tended to dominate the government's public expenditure

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[6] Indigenisation refers to the transfer of ownership of companies from foreigners to domestic residents.

[7] The three levels of government are the federal, state and local governments. Because of the difficulty of obtaining data for state and local governments (see for example, Struthers, 1990), especially at the sectoral level, this study focuses on economic activities at the federal level. Although the state and local governments expenditures cannot be directly controlled by the federal government, their spending profiles usually reflect those at the federal level, and strict guidelines are set by the federal authorities as to how much debt is accumulated for public expenditures.

programme for many years (World Bank, 1983).The main problems in the manufacturing sector outside pure financial and economic considerations have mainly been political factors which have affected the implementation and location of projects, and limited private sector participation, mainly foreign, in these critical sub-sectors. This naturally has increased the burden on the government's share of project financing.

The government's capital investment expenditures in the oil sector are mainly in the form of its joint venture exploration and development program (JVE&DP) and its own exploration (seismic data acquisition, exploration drilling) through the state owned Nigerian National Petroleum Corporation (NNPC)[8]. Funding for the government's JVE&DP are typically not part of the federal government's capital investment program. Funding for capital expenditures in the JVE&DP is from oil sales revenues after which they are then later shared among the different tiers of government. This strategy has the potential of crowding out investments in other parts of the economy as different sectors compete for limited public funds.

2.3.3 The Debt Crisis: 1982

When oil prices and revenues fell in the early 1980s, the government for a while sustained its spending programmes rather than cutting them, and resorted to external borrowing to finance its expenditure programmes. With the rise in international interest rates, the foreign debt accumulated and substantial arrears on the current account emerged (Table 2.3). However, for much of the 1970s and early 1980s, Nigeria faced a dilemma in deciding on the optimal level of public debt. This dilemma was succinctly expressed by the World Bank (1983) which stated that the problem Nigeria faced was in:

"...choosing levels of foreign borrowing that allowed for the realisation of gains from international capital markets without prejudicing future credit worthiness and not borrowing thereby missing out on the opportunities for increasing incomes and growth."

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[8] A detailed and full account of the origins, history and operational aspects of the oil industry is considered in Chapter Three.

Some authors have suggested that because governments were overly optimistic about future mineral revenues from an oil boom, they were encouraged to borrow against future expected windfalls that did not materialise, (for example Gelb, 1988). This situation tended to precipitate a process of tardy diversification which inhibited long-run growth (Auty, 1993, 1994) and exploded into a debt crisis. Table 2.3 gives an indication of the huge accumulation of debt following the first oil price rise. The debt which stood at $567 million in 1970 grew to an astonishing $30.1 billion by 1987, with a debt service to GDP ratio of over 100% (World Debt Tables, various issues).

Nigeria's debt problem was compounded in the late 1980s by the unrealistically high exchange rate value for the Naira, the decline in foreign exchange earnings, its low savings propensity and the structure of the loans themselves. For much of the 1970s, when Nigeria was considered to be under borrowed relative to other middle-income developing countries (Gelb, 1988), its total debt outstanding consisted of soft long-term loans from multilateral agencies like the IBRD and from other bilateral agreements. However, from about the mid 1980s onwards, the debt as a proportion of GDP rose dramatically (Table 2.3), with about 75% of its medium to long term debt owed to private creditors (Ezeala-Harrison, 1993).

From about 1982, Nigeria attempted to manage her external indebtedness through a package of debt re-scheduling, various debt conversion schemes and the injection of new lending with international financial institutions and multilateral credit agencies for on-going core projects that were considered of vital interest to the economy. However, by the mid 1980s, Nigeria's credibility on international capital markets sharply deteriorated, (Gelb, 1988), negotiations with the IMF broke down as a result of the latter's stringent conditionalities and, as a consequence, her debt and trade arrears continued to mount. As a result, reserves sharply declined and the current account recorded persistent deficits. These events leading up to 1986 paved much of the way for the "home grown" structural adjustment programme.

2.4 *The Period of Macroeconomic Policy Changes and Structural Adjustment: 1986 - 1995*

2.4.1 *The Structural Adjustment Programme (SAP): 1986*

After the 1973 - 1985 period of spectacular oil price rises and declines, an unrealistically high exchange rate value of the Naira and a regime that relied on administrative and quantitative controls, the government embarked on a programme of structural reform. From about the mid 1980s, Nigeria increasingly resorted to counter-trade policies partly to supplement dwindling foreign exchange earnings from oil and partly, as suggested by Soremekun (1995), to circumvent OPEC quota and IMF conditionalities contained under the SAP. The SAP which is a medium to long term programme is generally regarded as the culmination of efforts dating back to the early 1980s when a package of austerity measures was announced following the plunge in oil prices from a high of about $44 in 1981 to a little over $14 by 1986 (Ayodele, 1985; Central Bank of Nigeria Statistical Bulletin, 1995).

Nigeria for much of the years prior to 1986 resisted a loan package that was offered by the IMF because of its stringent and unacceptable conditionalities. When in 1986 Nigeria announced a comprehensive reform package of its own formally known as the Structural Adjustment Programme (SAP), it ironically contained a number of changes which the IMF had required. The centrepiece of SAP was a move to market determined prices. Since its introduction in 1986, the SAP has led to much debate. The programme has been examined both in the context of the economic effects for example, Onimode, (1991); Olukoshi, (1994) and Faruqee, (1994) and the social and political costs of its adoption, Osaghae, (1995). The key macroeconomic objectives in the SAP were:

- the reduction of the fiscal deficit and tighter monetary policy
- a rationalisation of public expenditure programmes
- a programme of privatisation of government establishments
- a regime of trade liberalisation and deregulated financial markets, including interest rates
- a system of floating exchange rates.

While the rise in inflation, as reflected by the consumer price index, from modest levels of about 5% prior to 1986 to about 10% in 1987 and over 50% in 1989 (see Figure 2.1) may have been attributed to the deregulation of the exchange rate under SAP, other developments such as the government's fiscal indiscipline, expansionary monetary policies and liberalised interest rates contributed to the increase in the general price level. In particular, the departure from a fixed interest rate regime prior to SAP which resulted in positive and rising real interest rates may have had adverse consequences on investment in the real sectors. The result of raising interest rates was inflationary because of the continued high financial cost to the manufacturing sector.

Furthermore, inflation and social tensions were fuelled with the government's continued deregulation of the economy, through privatisation, and significantly more importantly, through its decision to reduce oil subsidies in 1986 and implement other measures that were essentially part of the IMF's original conditionalities. The rationale behind the removal of oil subsidies was to release much needed public funds for development in other areas, and to reduce the incidence of smuggling of petroleum products across Nigeria's borders given the huge price differentials between domestic prices and prices in other countries, particularly, neighbouring African countries (Soremekun, 1995). By late 1994, domestic fuel prices had risen by 300% (World Bank Trends, 1996) bringing retail prices more in line with international levels.

The government's determination to curb excess liquidity and inflation therefore required a more disciplined fiscal stance, a slow-down in money growth and tighter guidelines with regard to the allocation of credit. These measures resulted in a decline in the rate of inflation to about 10% by the end of 1990 (Figure 2.1). However by 1991, fiscal indiscipline and public resource mismanagement gradually crept in with the temporary upsurge in oil prices in 1991 following the Gulf crisis. Nigeria once again began recording large overall fiscal deficits reaching a record high of about 10% of GDP by 1995 (see Table 2.3). Because of the government's determination to finance the deficit, monetary policy became lax from the tighter stance in the early days of SAP, the result being an increase in the money supply and inflation causing pressure on an already beleaguered exchange rate. For example between 1990 to 1993, the money supply grew on average 45% and inflation, 38% (World Bank Trends, 1996).

Internally, the overall average unemployment rate was steady at about 5.1% between

1986-92 (United Nations, Yearbook of Labour Statistics, 1994), although this figure is far from conclusive in view of the growth of informal employment, especially in the agricultural and services sectors, and therefore the unaccounted and consequent rise in "hidden unemployment", or "underemployment".

Externally, the net flow of foreign direct investments into the country during the period 1986 to 1995 was inconsistent whilst the debt burden continued to increase (see Table 2.3). For example, the inflow of total foreign direct investment which stood at about =N=1.77 billion in 1986 rose to about =N=2.31 billion in 1987 but then plunged to about =N=700 million in 1990-91. However, the inflow of foreign direct investments were mainly in the form of reinvestment of profits by foreign investors (National Rolling Plan, 1993-95). Therefore, it is doubtful whether the use of interest rate and exchange rate policies to induce foreign investments whilst concurrently stemming capital outflows were effective (see Table 2.3). With regards to its debt profile during the period, the external debt stood at about $19.7 billion in 1986 and about $33.5 billion in 1991 (World Debt Tables, various issues) and any hope of reversing the trend still largely hinged on the successful negotiation of debt rescheduling agreements with Nigeria's international creditors.

2.4.2 Exchange Rate Policies and the Management of Nigeria's External Reserves (the Second-tier Foreign Exchange Market)

Three major indicators that may have impacted on the pattern of development in several oil producing developing countries were the appreciating exchange rate, sectoral relative prices (Looney, 1990, 1991) and the impact of the balance of payments[9]. Increased oil revenues need not lead to exchange rate appreciation if, for example, the extra foreign exchange earnings are accumulated at home or invested abroad (see Forsyth and Kay, 1980; Thirlwall and Gibson, 1992 and Eastwood and Venables, 1982 for possible explanations). This was a strategy adopted by some oil-producing developing countries, notably Kuwait and Saudi Arabia (Enders and Herberg, 1983), a policy that not only avoided the inevitable problem of their economies expanding beyond their short-run absorptive capacities given the resources available to them at the time, but also

[9] For a very good account of exchange rate effects on sectoral prices see Ajakaiye D O and Ojowu O (1994).

ameliorated the full impact of the recession following the collapse of oil prices. Alternatively, the increase in domestic prices engendered by an oil boom which may reduce a country's international competitiveness, may be counteracted by devaluations. The latter strategy was adopted early on by countries like Indonesia and Mexico with the devaluation of the Indonesian rupiah and the Mexican peso in 1978 and 1982 respectively. In Indonesia in particular, the non-oil traded sector accounted for about 51% of total exports, with the agricultural sector alone, whose decline started from about 1973 with the rise in oil prices, strongly recovering to account for about 20% of total exports by 1990 (See Table 2.2). Similarly, manufacturing exports, which accounted for only about 3% of total exports in 1973, had by 1990 accounted for about 27% of total exports (Table 2.2).

For much of the 1970s and 1980s, Nigeria neither invested abroad nor devalued its currency. In her case, a fixed exchange rate policy and consequent overvalued currency was maintained throughout the period, largely the result of the country's industrialisation perspective of a strategy of import substitution encouraged by relatively large and cheap imports of intermediate manufacturing inputs[10]. The exchange rate was not determined through the market in any sense, but was largely managed through official reserve intervention.

When the price of oil started to decline in the early 1980s, the government resorted to stringent quantitative measures by rationing of foreign exchange and a cumbersome import licensing system designed to protect dwindling foreign reserves. The system was administratively costly and subject to abuse because of the possibility of the existence of discretion in granting applications (Bienen and Gersovitz, 1981). These measures proved to be unsustainable in the long term, thus paving the way for market reform and ultimately structural adjustment.

Thus, the most important single policy measure contained in the Structural Adjustment Programme (SAP) designed to make the economy more price responsive, more market oriented and therefore move away from the bureaucracy of government control was the introduction of the Second Tier Foreign Exchange Market (SFEM) in 1986, later replaced by a unified Foreign

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[10] In Chapter Seven, a detailed account of industrialisation and the impact of various macroeconomic policy effects under the assumption of both a floating and a fixed exchange rate system is given.

Exchange Market (FEM) in 1987. Since the introduction of the deregulated foreign exchange market, the Naira has been largely determined by the forces of demand and supply, with three markets, the official, autonomous and black markets operating in parallel. The rationale behind reducing the substantial over-valuation of the Naira was to make Nigeria more internationally competitive, although the general perception was that the Naira had become considerably undervalued as it had been overvalued before the introduction of the deregulated foreign exchange market (Onosode, 1993).[11]

Between 1986 and 1995, the economy witnessed several policy changes in the foreign exchange and related money markets. To establish firm guidelines for the operation of the autonomous FEM, the inflow of foreign investment and the repatriation of investment income, the Exchange Control Act of 1962 and the Nigerian Enterprises Promotion Decree of 1977/1988 were replaced by the Foreign Currencies and Capital Investment Monitoring Decree and Nigerian Investment Promotion Decree respectively in 1995. Ironically, at about the same time, two major macroeconomic policy u-turns on the exchange and interest rates were effected. The fixed exchange rate regime was re-introduced ostensibly to provide an anchor for domestic prices. As a result, the inflow of autonomous foreign exchange sharply declined, whilst demand rose far above official foreign reserves. After having a regime of liberalised interest rates for some time, the government re-introduced a cap on interest rates, with an upper limit of 21% on bank lending rates and a lower limit on 13.5% on deposit rates (Federal Republic of Nigeria, Press Briefing, 1995). The obvious effect was the introduction of financial distortions to the system and the removal of an important monetary instrument from the Central Bank (World Bank Trends, 1992).

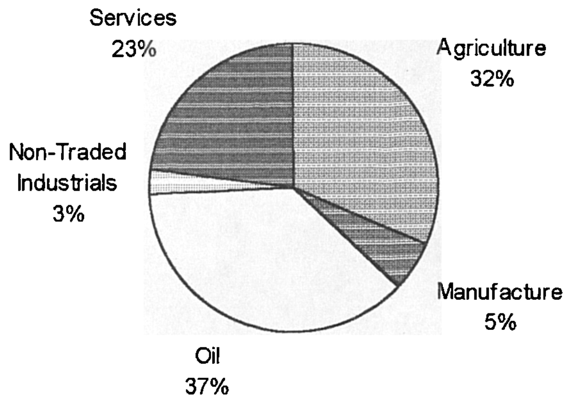
2.4.3 Sectoral Performances under SAP and the Period of Macroeconomic Policy Changes

During the period 1986-95 the economy as a whole recorded on average a positive rate of growth of about 5.4%, a marked departure from the negative downward trend in GDP between 1981-85 (see Table 2.1) and well above the negative growth rates for the entire sub-saharan region as a whole (United Nations, 1993). However, the continued depreciation of the exchange

[11] In Chapter Eight, a full account of exchange rate policy developments since Nigeria attained independence is given. More importantly, in this chapter, the Nigerian Naira Exchange Rate is valued using a number of alternative theoretical models of exchange rate determination.

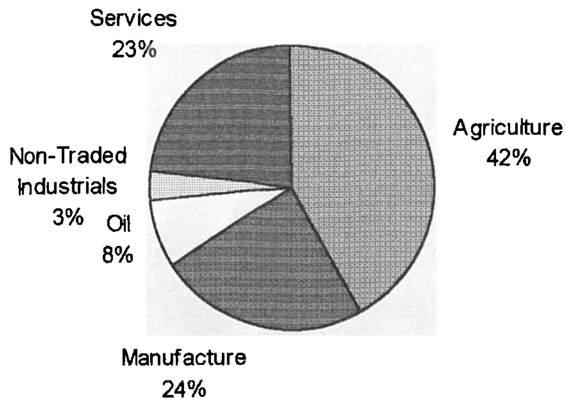
rate resulted in higher domestic prices (Struthers, 1990) whilst not dramatically stimulating either agricultural or industrial production in real terms. During this period, domestic production in both these sectors was low relative to the oil sector whilst by contrast domestic demand remained relatively high (Figures 2.7 and 2.8), a situation that prevailed in the early 1970s to mid 1980s which was the era of a fixed exchange rate system.

Figure 2.7: % Average Share of Total Supply by Sector (1973-1995)



Source: Federal Office of Statistics, National Accounts of Nigeria, various issues.

Figure 2.8: % Average Share of Total Demand by Sector (1973-1995)



Source: Federal Office of Statistics, National Accounts of Nigeria, various issues.

However, although not dramatic, a reason for the upward trend in overall GDP during the period was the generally more favourable conditions for the agriculture sector arising from the deregulation of agricultural prices, the introduction of the FEM, generous levels of subsidies, favourable weather conditions and the priority given to the implementation of a number of key agriculture-related public sector programmes. Agriculture, which had declined on average by 2% between 1980 to 1986, grew by about 5% between 1987 and 1992 (see Table 2.1). However one cash crop, cocoa, accounted for over 65% of non-oil exports in 1988 (Central Bank of Nigeria Annual Report, 1989), and the dramatic rise was more the result of price rather than quantitative increases.

Despite these modest achievements, it is believed that the performance of the agricultural sector post SAP was generally poor (Osaghae, 1995). The flow of private investment in the agricultural sector remained sluggish. Furthermore, even though the agricultural sector employed about two-thirds of the labour force, its contribution to GDP and exports was just over 37% between 1986 and 1989 and less than 7% between 1988 and 1990 respectively (see Tables 2.1 and 2.2 respectively).

A major institutional reason for the poor agricultural performance was the failure of the Directorate of Food, Roads and Rural Infrastructure (DFRRI)[12], and the state-run Agricultural Development Programmes (ADPs), which were the main instruments for the implementation of Nigeria's agricultural policy during the period. Although much of the funding for the ADPs were by way of international multilateral agencies like the World Bank and the European Community (Central Bank of Nigeria Annual Reports, various issues), their performance in terms of management, tighter project monitoring and increased efficiency of output was generally very poor. However, even though productivity remained very low, increased use of irrigation and improved technology suggested that there was considerable scope for higher output (World Bank Trends, 1996).

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[12] DFRRI was created by the military government of General Ibrahim Babangida in 1986 to improve and co-ordinate rural development. It is generally acknowledged that DFRRI has fallen well below expectations in spite of being funded with about 20% of Nigeria's total agricultural allocation in successive budget provisions since 1988. The non-performance of DFRRI stems from allegations of financial impropriety and poor management to its immensely massive mandate of providing physical and social services and infrastructure which it found incapable of meeting.

In response to various policy measures to deregulate the economy, the manufacturing sector remained sluggish. Although the index of industrial production rose by about 6.90% on average between 1987-92 compared to the negative growth of -2.4% during 1982-86 (National Rolling Plan, 1993-95), the sector still accounted for less than 5% of GDP at 1990 prices. The small share of the sector in overall GDP was well below the target level of between 12% and 15% as envisaged under the SAP. The percentage of manufacturing to non-oil exports also remained low at 3% while imports continued to remain high at about 85% of total imports (see Table 2.3)[13].

During the period, the government continued to be an active participant in the oil sector[14]. To provide a measure of macroeconomic policy stabilisation, in 1994 a Petroleum Trust Fund (PTF) which was funded from revenue accruing from the adjustment of the prices of petroleum products following the rise in oil prices that accompanied the Gulf Crisis in 1991 was established. It is recognised that the PTF has become increasingly important in influencing the direction of macroeconomic policy formulation in Nigeria (Federal Republic of Nigeria Press Briefing, 1995). As has been the case in some natural resource exporting developing countries like Chile (see Auty and Warhurst, 1993), such a scheme may have had the potential of providing a measure of macroeconomic stabilisation by limiting the extent to which public funds arising from windfalls were spent for short-term political advantage. On the positive side, the development of significant industries like Petrochemicals and the Liquefied Natural Gas (LNG) project have been carried out in recent times with greater resolve. However, several changes to the target dates for production and export of liquefied gas has undermined confidence in the LNG project to replace oil as Nigeria's main foreign exchange earner in the near future.

During the period 1986 to 1995, the non-traded industrials and services sectors expanded, accounting for over 25% of GDP (see Table 2.1). Growth in the non-traded industrials sector remained strong although the construction sub-sector's performance was curtailed by the government's tight financial stance. However, the most phenomenal performance during the period, especially in the immediate aftermath of the introduction of SAP, was in the services

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13 In Chapter Seven, these issues which impact on industrial development are examined in depth, especially against the backdrop of the macroeconometric model developed for Nigeria.

14 In the next chapter, a full account of the domestic and international aspects of the oil sector is presented.

sector, particularly the financial services sub-sector. On average, the financial services subsector recorded annual growth rates of about 32% between 1988 and 1991 (Central Bank of Nigeria, various issues). This was clearly the result of deregulated domestic and particularly foreign exchange markets which increased competition, fostered rationalisation processes in banks and brought about radical changes in the operations and strategies of the banks (National Rolling Plan, 1993-95). However, since late 1993, the financial services sub-sector has generally been on the decline. By 1995, a significant number of banks had become insolvent and a strategy to merge, reconstruct or liquidate some or all of such banks was been considered (Federal Republic of Nigeria Press Briefing, 1995). Measures were also been worked out late in 1995 to re-purchase privatised shares in previously owned government banks or partially nationalise them with a view towards returning some credibility to the beleaguered financial system.

2.5 Conclusion

This chapter has used a three-period framework to analytically examine the Nigerian economy and macroeconomic policy developments from 1960 to 1995. During the first period, 1960-72, agriculture was the mainstay of the economy. In spite of political upheavals, the period witnessed a steady growth rate, low inflation, a relatively healthy balance of payments, emerging industrials sectors, and relatively low levels of public sector investments.

The second period, 1973-85, which was characterised by occurrences of both spectacular oil price rises and falls, saw agriculture become permanently displaced by the oil sector following the first oil price rise in 1973/74. Inflation steadily climbed as wage demands, particularly in the public sector, rose. Nigeria struggled to keep its development ambitions at pace with revenues and ad hoc policy measures were often introduced to deal with crises at various times during the period.

It was during the third period, 1986-95, that the Nigerian economy underwent radical economic changes characterised by structural adjustment and liberalisation. In general, what was clearly intended to emerge was a more market-oriented and more export-oriented economy with the emphasis on diversification from oil to agricultural and manufacturing production. The opening up of investment opportunities to foreign investors through tax concessions, more favourable guidelines for foreign equity ownership and the repeal of the restrictive Exchange Rate Control Act of 1962, as well as the abolition of price controls in a deregulated market, were introduced to improve the performance of sectors and place the economy on a firmer long-term growth path.

However, in spite of the introduction of these measures, the impact on the real productive sectors of the economy, for example, in agriculture and manufacturing, as evidenced by the in-flow of foreign investments and higher real output growth, was less than encouraging. The reasons stemmed from a combination of political instability, frequent macroeconomic policy reversals, high costs of production following liberalisation and the general absence of a well articulated and consistent set of industrial policy guidelines, the result of which has been an even more dependence on the resources generated by the oil sector. These issues are considered in detail in subsequent chapters.

CHAPTER 3

THE ORIGINS OF THE OIL SECTOR AND A CRITICAL EXAMINATION OF THE INDUSTRY IN NIGERIA

3.1 Introduction

This chapter is entirely a description of the oil industry in Nigeria. The chapter is needed to make comparisons between theory and the conduct of macro economic policy developments in oil rich countries. The chapter starts by discussing and tracing the development of the Nigerian oil industry since the early 1950s and covers the period 1973 to 1995 during which three oil price shocks occurred. The international aspects of the industry are then examined, in particular, the production and pricing policies of the Organisation of Petroleum Exporting Countries (OPEC), of which Nigeria is a member. The chapter gives an account of the difficulties that have been faced by members of the cartel and oil producers in general since the first oil price shock in 1973. An opinion is given as to the desirability of Nigeria's continued membership of OPEC.

In particular, the chapter examines the operational aspects of the industry in Nigeria and provides quantitative indicators especially of the use of resources in production. This is critically important in order to place the later empirical analyses and conclusions from the estimated Dutch Disease macro economic model for Nigeria in a firm context. Furthermore, an examination is carried out of oil related sub sectors, such as the Liquefied Natural Gas Project, the Petrochemicals Industries and the Fertilisers Plant.

Finally, the history of the physical effects of the industry is critically assessed. In doing so, the term sustainable economic development is analysed in an exploratory sense by quantifying the environmental and physical effects of oil production in Nigeria. Given the political sensitivity of environmental issues and limited data, any objective and robust economic analyses of environmental effects are bound to be difficult and imprecise, particularly so in Nigeria where there is insufficient data and no established techniques for valuing the cost of environmental damage. To this extent, this chapter is entirely descriptive of the physical and environmental effects of oil and does not attempt to carry out any empirical analyses of the environmental effects or indeed attempt to develop models based on the concept of sustainable economic development.

3.2 The Discovery and Nature of Crude Oil Production in Nigeria

The world petroleum economy is currently estimated at about $20 trillion (Aina, 1996). The foundations of the oil industry essentially lie with the operations of the so called Seven Sisters of oil companies (Sampson, 1985) going back to the beginning of this century.[1] In the case of Nigeria, the effective exploration of oil began in the 1930s with operations carried out by the multinational oil company, Shell D'Arcy, later to become Shell-BP Petroleum Development Company of Nigeria Limited. However, it was not until 1956 when Shell's first major commercial find was discovered in Oloibiri in the Niger Delta. The first exports of Nigerian oil of about 1.8 million barrels were in 1958 and were valued at about =N= 176 million (Ayodele, 1985)[2]. The country's first oil terminal, where crude oil is stored for exports or for processing in local refineries, was built by Shell at Bonny in 1961.

For much of the period between 1930 to 1960, Shell-BP had a virtual monopoly of the entire oil resources of Nigeria. Such was the level of control by Shell-BP that the legislation relating to oil leases and licences in Nigeria stated among other things that:

> ..."No lease or licence shall be granted except to a British subject or to a British company, and having its principal place of business, within Her Majesty's dominions, the Chairman, Managing Director, (if any), and the majority of the other directors of which are British subjects".

It was not until about 1957 that the monopoly was broken when, the American multinational firm, Mobil, started prospecting for oil in Nigeria[3]. However, between 1958 and 1964 the production of crude oil increased modestly. By 1966, the last year in which production was unaffected by the interruption of the civil war, output was about 19 million tons and exports

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[1] Standard Oil of New Jersey (later Exxon), Shell, British Petroleum, Standard Oil of California, Gulf, Texaco and Companies Franchise des Petrole.

[2] =N= is the unit of the Nigerian currency the Naira.

[3] The early players in the Nigerian oil scene during the 1960s were Shell-BP, Mobil, Gulf (now Chevron), Safrap (now ELF), Texas Overseas (now Texaco) and Agip.

were valued at about =N=185 million (Pearson, 1970)[4]. During this period, the main external market was the United Kingdom, accounting for about 40% of total exports. (Pearson, 1970). After the end of the civil war in 1969, production increased, and by 1970 production had reached about 1 million barrels per day (bpd). Thereafter, production steadily increased throughout the 1970s, reaching a peak of about 2.3 million bpd in 1979 (Central Bank of Nigeria Statistical Bulletin, 1995), with exports accounting for about 95% of total production. A major development during the 1970s was the nationalization of the Shell-BP in 1979 consequent upon the company's links with the then apartheid government of South Africa. Production declined during much of the early 1980s reaching a low of about 1.25 million bpd in 1983, with exports plunging to about 1.07 million bpd valued at about =N=8 billion. Production remained low throughout the rest of the 1980s, but steadily climbed going into the 1990s.

At present, several multinational and indigenous oil companies prospect for oil in Nigeria and production is currently estimated at about 2 million bpd from over 150 oil fields and about 1500 oil wells. (DPR, 1992). At these levels of production, Nigeria ranks amongst the top fifteen oil producers in the world, all of whom account for over 80% of total world output (Table 3.1). The Nigerian oil industry has therefore grown tremendously since the early 1930s and from NNPC accounts, about 3,000 wells have been used for appraisal development, and an additional 525 wells for exploration between 1956 and 1992 most of which are mainly located in the Niger Delta region.

Although other basins in Nigeria are believed to contain substantial quantities of petroleum reserves, (Imevbore, 1979; NDES, 1997), over 90% of Nigeria's oil production is from the Niger Delta, both on and offshore, with the former accounting for about 74% of oil fields. Several accounts of the geology of the Niger Delta have been given in various reports (World Bank, 1995; NDES, 1997), but most importantly, the basin is considered to be one of the largest wetlands in the world covering an area of about 70,000 square kilometres, with a high concentration of bio diversity and both renewable and non-renewable natural resources including hydrocarbons.

[4] Converted to Nigerian Naira (=N=) based on the post colonial exchange rate of =N=2 to the £=N=1.

TABLE 3.1: % SHARES OF WORLD'S TOP 15 OIL PRODUCERS (1970-95)

Country:	1970-1975	1974-1975	1976-1977	1978-1979	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995
Canada	2.94	2.82	2.25	2.19	2.48	2.45	2.46	2.64	2.73	2.49	2.67	2.95
China	2.57	3.15	2.83	2.88	3.26	3.91	3.58	4.85	4.69	4.63	4.69	4.90
Indonesia*	2.07	2.46	2.70	2.62	2.74	2.41	2.57	2.09	2.06	2.29	2.25	2.17
Iran*	9.58	10.4	9.81	6.88	2.39	4.54	3.47	4.15	4.38	5.49	5.72	5.87
Iraq*	3.36	3.90	4.04	4.90	3.02	1.98	2.51	4.26	4.73	1.99	0.88	1.20
Kuwait*	6.28	4.25	3.49	3.76	2.40	1.77	2.08	1.75	2.45	1.14	1.76	3.28
Mexico	1.09	0.82	1.59	2.17	3.74	5.08	4.41	4.72	4.31	4.34	4.44	4.28
Nigeria*	3.21	3.71	3.52	3.41	3.20	2.37	2.79	2.39	2.45	3.01	3.05	3.01
Norway	0.15	0.06	0.47	0.62	0.82	1.16	1.39	1.86	2.24	2.94	3.51	4.41
Saudi Arabia*	11.6	14.2	15.1	14.9	17.0	10.3	13.6	7.18	8.69	12.1	13.9	13.1
U.A.E.*	3.31	3.08	3.34	2.98	2.76	2.25	2.52	2.56	2.87	3.69	3.78	3.59
United Kingdom	0.02	0.01	0.85	2.11	2.89	4.13	3.51	3.72	3.48	2.99	3.14	3.95
United States	18.4	17.2	13.9	14.1	14.4	16.3	15.6	15.1	13.5	12.3	11.9	11.2
U.S.S.R.	14.5	17.9	16.0	16.4	21.8	23.1	22.4	22.5	21.1	18.1	15.0	11.4
Venezuela*	6.79	4.88	3.85	3.67	3.69	3.46	3.57	2.85	2.85	3.67	3.91	3.88
Other OPEC**	8.55	6.17	6.94	6.68	5.93	6.50	6.20	4.05	4.38	5.35	5.40	4.15

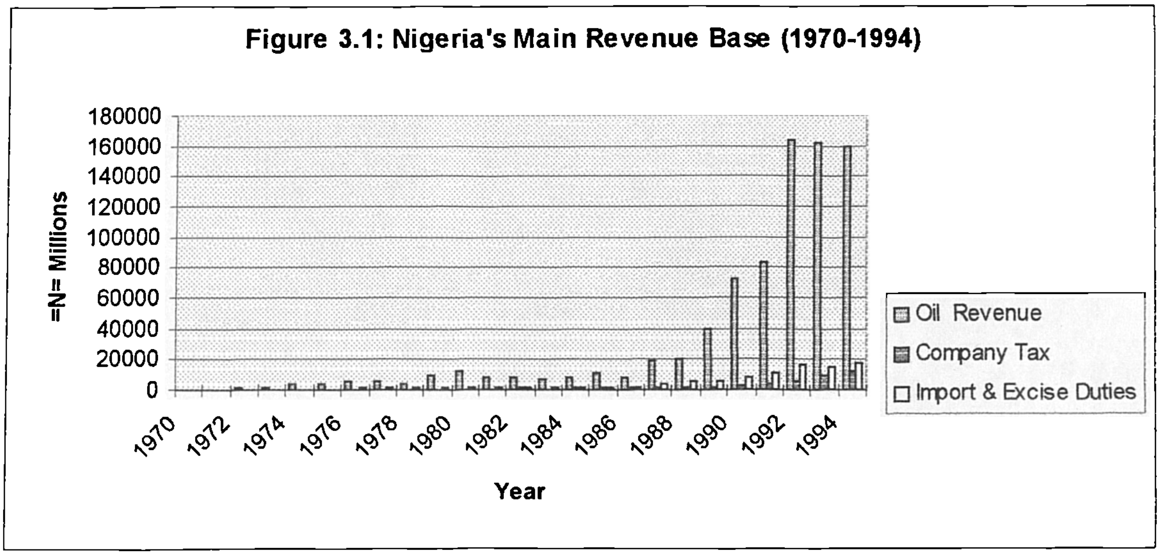
Source: (i) Own calculations from (a) OPEC Annual Statistical Bulletin, various issues (b) OPEC Annual Reports, various issues.

Notes: (i) * means a member of OPEC

(ii) ** denotes other OPEC countries which as at 1993 were: Ecuador, Qatar, Algeria, Gabon and Libya.

The growth of the Nigerian oil industry and the premium that she has enjoyed on its crude oil has been facilitated by two important natural advantages. Firstly, the high quality of its reference crude, bonny light, with its low sulphur content and light gravity (specific gravity of 0.3% for API (American Gravity Institute) 34.6°crude oil), (Pearson 1970), makes extraction and refining relatively easy. In addition to this, Pearson reports that the high fuel yield and blending properties made Nigerian crude particularly attractive to Western European and American markets. However, the low kerosine yield made it unattractive to the West African market, although the relative unimportance of this market is evident from the observation that exports to this region has never exceeded 0.5% in the last several decades (DPR, 1992)[5].

Secondly, Nigeria's close proximity to markets in North America and Western Europe is important for two reasons. Firstly, transportation costs are low. Nigeria is almost equi-distant form both Europe and North America. Secondly, and perhaps more importantly, Nigeria is geographically insulated from the more politically turbulent and sensitive areas of the Middle East.



Source: Central Bank of Nigeria Statistical Bulletin, 1995.

To date, oil continues to dominate Nigeria's economy and foreign trade accounting for a large portion of the revenue base (Figure 3.1). Domestically, demand for oil remained high relative to other sources of energy. For example, between 1979 and 1981, the percentage share of petroleum products in total domestic energy demand was about 75% (Ojo, 1984),with coal, hydro electric power and gas accounting for only about 1%, 9% and 15% respectively. On the supply side, for the period 1973 to 1995, the share of oil production in total energy production was overwhelming, peaking at around 98% in the early to mid 1980s. These numbers are markedly different from estimates for world energy production by the World Bank (1992) which indicated that in 1987, for example, the share of other sources of energy, like biomass, nuclear energy, hydropower, natural gas and coal collectively accounted for about 77%. Furthermore,

5 DPR: Department of Petroleum Resources, Ministry of Petroleum Resources.

the oil sector in Nigeria also accounts for about 80% of government revenues and over 95% of foreign exchange receipts (Central Bank of Nigeria Annual Report, various issues). However, the Nigerian government's effective operational participation in the oil industry has been limited to downstream activities like refining and marketing, whilst upstream oil production activities are still largely dominated by foreign oil companies.

3.2.1 OPEC: Production Sharing Arrangements and the Determination of Pricing Policies

In 1965, the Organisation of Petroleum Exporting Countries (OPEC), generally regarded as the world's most famous cartel, was established. Nigeria joined the organisation as the eleventh member in 1971. However, long before Nigeria joined the organisation, OPEC terms were imposed on the multinational oil companies operating in the country. This meant that from about 1967, the Nigerian government sought terms equal to the most favoured terms enjoyed by other oil exporting countries in Africa and the Middle East. These terms largely involved procedures that sought to establish a fair price for exported oil and the manner in which petroleum taxes and royalties were accounted for (Pearson, 1970).

TABLE 3.2: AVERAGE YEARLY SPOT/POSTED PRICES FOR NIGERIA'S BONNY LIGHT CRUDE ($ PER BARREL) FOR 1972-95

Year	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
Price	3.316	4.649	14.661	12.944	13.775	15.231	14.816	21.560
Year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Price	39.233	42.695	35.25	29.98	29.16	28.25	14.93	18.55
Year	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Price	14.42	18.42	24.14	20.46	19.84	17.50	16.17	16.60

Sources: (i) 1972-1981: Ayodele, A S (1985), The Conflict in the Growth of the Nigerian Petroleum Industry and the Environmental Quality. Socio-Economic Planning Sciences, Vol.19, No.5, pp. 297.
(ii) 1982-1995: Central Bank of Nigeria, Statistical Bulletin, 1995.

Shortly after joining OPEC, the first oil price shock, which occurred in 1973-74 following the Arab-Israeli war, resulted in a three-fold increase in the international prices of oil, including Nigeria's bonny light (Table 3.2). Nigeria, like most other OPEC countries, again benefitted from the increase in the price of oil in 1979-80 following the Iran and Iraq war and the unusually high world demand for oil during that period.

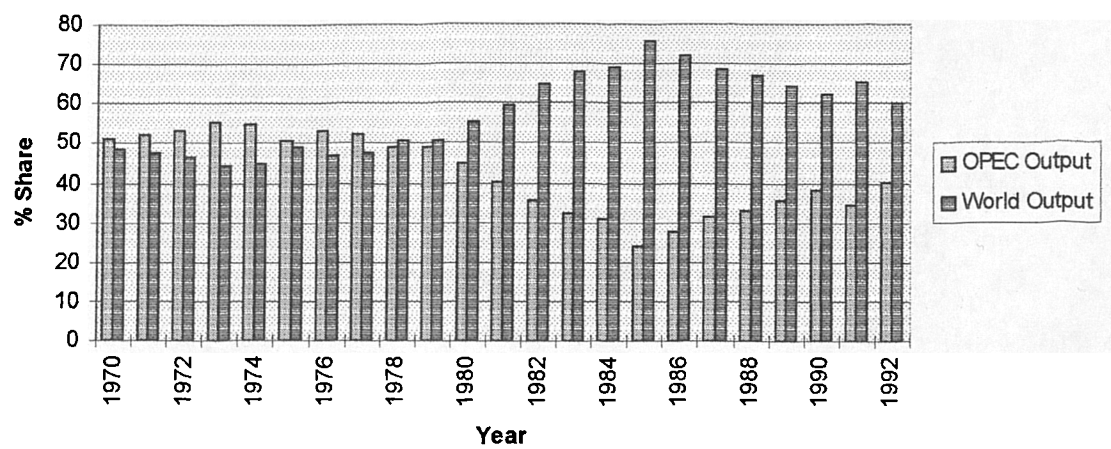
For much of the 1970s, OPEC had considerable influence over oil prices, although the determination of future oil prices by the organisation was regarded as a quite complex affair. Marquez (1984) argued that since oil prices reflected inter temporal dynamics, both the exhaustible nature of oil on the one hand and the dynamics of adjustments to higher prices on the other were important considerations. In practice, for individual OPEC countries, the main concern has always been to maximise revenues. This may arise from either an increase in price given a restriction in supply or higher sales volumes given lower prices.

For OPEC as a group, it becomes critical to understand the dynamics of both the price and income elasticities of the world demand for oil. In other words, a tradeoff for OPEC as a group exists between increasing revenues by exploiting the direct price elasticity of oil demand and losing revenues because of the feedback effects of oil prices on real income (Marquez, 1984). In addition, during the 1970s and 1980s, the accelerated development and relatively cheaper methods of developing substitutes for oil, such as nuclear and solar energy, ultimately impacted on world oil demand and OPEC's long term growth objectives.

For a period during the 1980s, OPEC's share of the world oil market declined (Figure 3.2) largely as a result of the rise of new non-OPEC oil-producing countries, like the United Kingdom and Mexico and countries in parts of Eastern Europe, and a slackening of world demand. Over the entire period 1973 to 1995, oil prices reached their lowest level in 1988 following the near collapse of OPEC. OPEC countries received a brief respite in 1990/91 with the third oil price shock which occurred following the Gulf conflict involving Iraq, one of its largest member states and since then the restriction on Iraq's oil exports.

Whilst governments are continually concerned about balanced budgets in the face of ever growing domestic expenditure needs (see Chapter Two), the willingness of a major country to act as swing producer, in the case of OPEC this being Saudi Arabia, by periodically absorbing the impacts of higher quotas of smaller member countries becomes vital. Nigeria has been able to negotiate higher quotas, though sometimes modest, when faced with pressing national commitments or financial crisis. Over the years, Nigeria's ability to press for higher quotas declined, largely the result of Saudi Arabia's unwillingness to continue to act as swing producer, and with her role severely undermined, the organisation was on the brink of near collapse in 1986. The glut in the oil market during the mid to late 1980s exerted downward pressure on prices and revenues. With budget deficits, countries were forced to produce more to meet the shortfalls, exacerbating the oversupply situation and exerting even more downward pressure on oil prices.

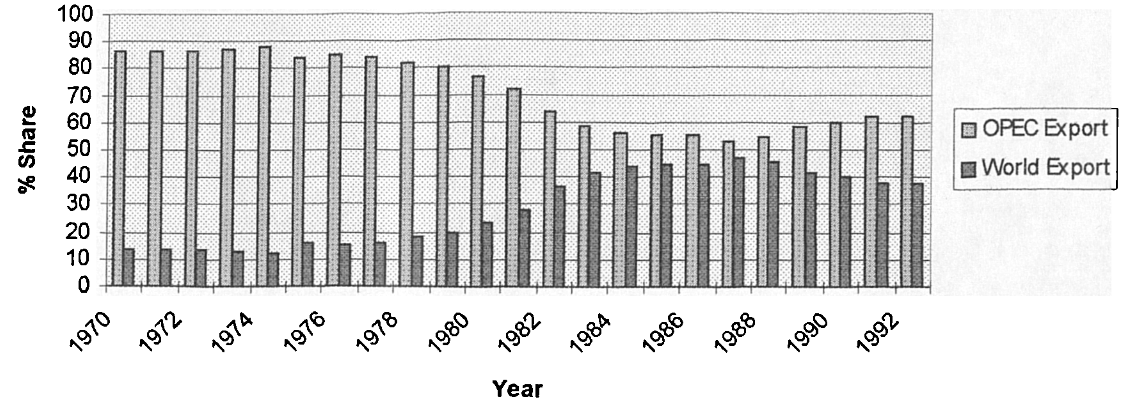
Figure 3.2: OPEC vis-a-vis World Output (1970-1992)



Source: Department of Petroleum Resources, 1985, 1992.

More recently therefore, the ability of OPEC to influence prices and world market conditions has considerably declined. This situation is demonstrated by the fact, as reported by the United Nations (1995), that in spite of the embargo on Iraqi oil and reduced oil exports from the former Soviet Union, oil prices have remained low since the third oil price shock in 1990/91. This suggests that oil prices are increasingly being determined by fundamental market conditions rather than by OPEC.

Figure 3.3: OPEC vis-a-vis World Exports (1970-1992)



Source: Department of Petroleum Resources, 1985, 1992

The reasons for the diminution in OPEC's influence from about the mid 1980s stemmed from a variety of supply and demand factors. Technological advances have led to reductions in exploration and development costs, improved efficiency, and productivity, and these have impacted on supply conditions through the discovery of yet more oil fields (United Nations, 1995). For Nigeria in particular, the emergence of high quality crude oil from the North Sea and other fields from the mid 1970s onwards, the development of alternative energy sources and technological improvements in refinery and extraction processes have reduced the competitiveness and market premium hitherto enjoyed by Nigerian Bonny crude.

However, the continued importance of OPEC should not be dismissed out of hand. As Figure 3.2 and Figure 3.3 show, total non-OPEC production and exports have declined since 1986, largely the result of the fall in production in the former Soviet Union and the United States, the two largest oil producers in the world. As a result, the share of OPEC in world oil production and exports has steadily increased since 1987 in spite of lower prices. As at 1994, world demand still remained high with about 64% of this demand or consumption of 68 million barrels per day coming from developed market economies (United Nations, 1995). Furthermore, OPEC commands about 77% of total world oil reserves, estimated at the end of 1994 to be of the order of about 1,000 billion barrels (United Nations, 1995), with Nigeria's oil reserves estimated at 20 billion barrels.

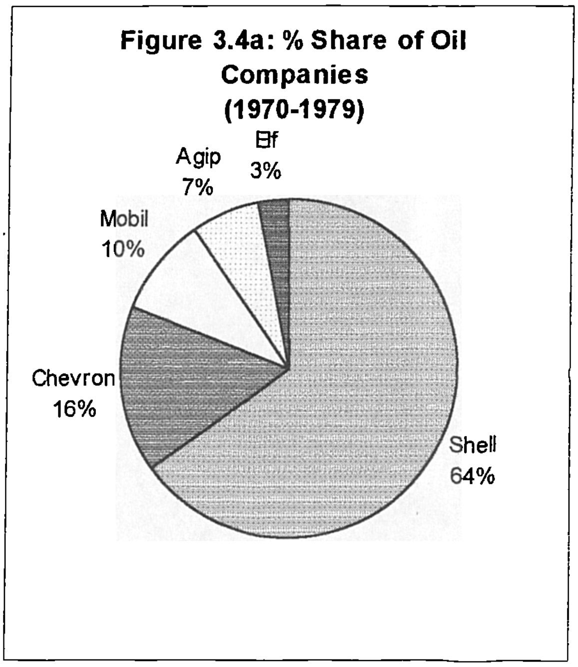
In recent times, the debate on Nigeria's continued membership of OPEC has been muted, probably largely the result of domestic political and fundamental economic issues taking priority. To date, only one country, Ecuador, has opted out of the organisation. Given the instabilities in the international oil market, low prices and the gradual erosion of Nigeria's natural comparative advantages, it seems likely that Nigeria will remain in OPEC for some time to come.

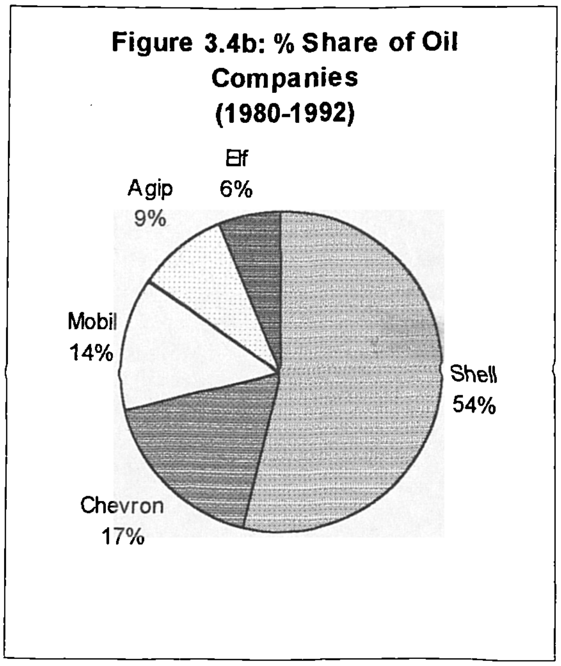
In future, Nigeria's depletion policy, given its national commitments would continue to play an increasingly important role. Depletion policy would be expected to depend on expected real oil prices and the discount rate used in maximising the present value of profits from current production. In many developed oil producing countries this 'rule of thumb' has increasingly been of important significance since the heady days of spectacular oil price increases and declines. For example, the Bank of England in 1980 proposed that the rule that ought to have been followed by the United Kingdom was to postpone more production the faster the real oil price was expected to rise and advance production the higher the discount rate, other things being equal. In Nigeria, it is not evident that adherence to such a rule is being followed. National priorities and the need to advance industrial and general economic development (Balabkins, 1988; Egbon, 1989), and given the production constraint that she faces as an OPEC member, have guided the path to which oil resources are extracted and depleted. With oil reserves estimated at about 20 billion barrels of oil and at production levels of between 1.8 to 2 million barrels a day, oil is likely to continue to play a major role in the Nigerian economy well into the year 2030.

3.3 Operational Aspects of the Oil Sector and Oil-Related Industries in Nigeria

The main policy objective of the government and the Nigerian National Petroleum Corporation (NNPC) is to ensure the maintenance of existing proven recoverable oil reserves as world market conditions permit in partnership with operating multinational oil companies. In Nigeria, six major international oil exploration and production companies namely, Shell, Chevron, Mobil, Agip, Elf and Texaco, account for the management of some 98% of the oil reserves and operating assets in Nigeria (Shell, 1996). As at 1996, Shell was the largest (see also Figures 3.4a and 3.4b) in terms of daily oil production and the number of production oil fields and wells. Shell operated a joint venture on behalf of the NNPC, which holds 55%, Shell (30%), Elf (10%) and Agip (5%). Since 1973, joint venture participation agreements have fluctuated between 80%

ownership for the government and 20% for the foreign partners. Presently, no oil is produced by the NNPC other than as part of a joint venture.





Source: Department of Petroleum Resources, 1985, 1992.

The Nigerian government itself became a major participant in the oil industry in 1971 when, through the state-owned Nigerian National Oil Corporation (NNOC), later merged in 1977 with the Ministry of Petroleum Resources to become the Nigerian National Petroleum Corporation (NNPC), it acquired equity interests in the operations of the multinational oil companies. Significantly, in 1969, a Petroleum Decree was promulgated the aim of which was to vest ownership and control of the oil industry in the government. Through the NNPC therefore, the government's objective was to engage in all aspects of petroleum development in Nigeria and eventually to control and manage the oil industry.

The Petroleum Decree of 1969 compelled, amongst other things, all multinational oil companies (MOCs) to fill all non-professional staff positions with Nigerians and, at the end of one decade of an oil company's operation in the country, to ensure that at least 75% of its workforce be in management and professional positions, of which at least 60% must be filled by Nigerians. (Kalu, 1994).

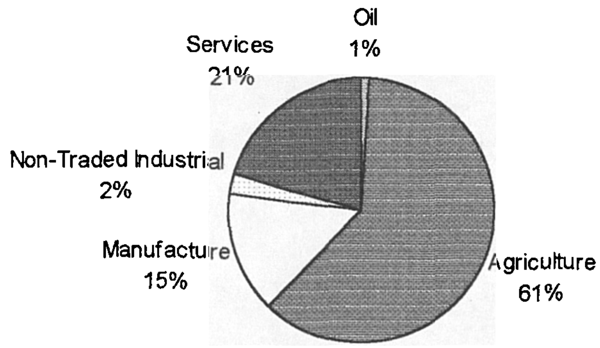
Throughout the 1970s and 1980s, several structural changes, aimed at improving operational efficiency, occurred within the oil industry characterised by the re-establishment in 1985 of the Ministry of Petroleum Resources (Oshikoya, 1990). In 1986, the Department of Petroleum Resources under this Ministry took over the regulatory duties of the NNPC. The Ministry is responsible for supervising and regulating the Nigerian oil industry, including the NNPC and its subsidiaries, for fixing the pricing of crude oil and petroleum products and for licensing and matters as they relate to the development of oil related industries such as natural gas, petrochemicals and refining (Price Waterhouse, 1994).

Presently, the government, through the NNPC, is responsible for the exploration and exploitation of crude oil through the operation of the joint venture agreements. The NNPC therefore manages all aspects of the industry. The scope covers exploration, production, refining, transportation, and the distribution of crude oil, natural gas and petroleum products whether for exports or domestic use. The NNPC also is responsible for supervising the operations of all foreign and indigenous oil and oil servicing companies as well as ensuring that environmental standards are adhered to (Price Waterhouse, 1994).

It is generally recognised that the oil industry is a sophisticated and complex industry requiring capital-intensive technological processes both in terms of physical equipment and machinery and human knowledge and skill (Atsegbua, 1993). A number of economic, financial, technical and even political factors have therefore tended to influence the operations of the multinationals in Nigeria. The financial arrangements in the industry include joint venture agreements with respect to profit sharing and operational costs and legislation regarding depreciation allowances for the multinationals.

The government through the NNPC is responsible for 60% of operating costs and capital expenditure largely through the joint venture arrangements, although government participation through production sharing contracts and service contracts has been on the increase since the late 1970s (Price Waterhouse, 1994). The memorandum of understanding between the government and the multinationals in the joint venture arrangements generally provides that the latter shall realise after tax income of not less than a certain amount for technical costs and as a profit margin[6]. Therefore, the government's pricing and marketing policies which are aimed at maximising oil revenues (Soremekun, 1995) have potential impacts on the operations and efficiency of the multinational oil companies. The latter contend that recent pricing has adversely affected their efficiency while government has maintained that the multinationals escalate operating costs which reduces the maximum benefit that the country derives from its oil resources (Post Express Wired, 1998). In addition, oil marketers have canvassed for a review to obtain a higher price to them as operating costs for each litre of petrol sold. Kalu and Lambo (1994) have examined this issue. Using a goal programming approach to investigate operational efficiency, they conclude that pricing policies need to be such that the multinationals are compensated in terms of return on capital.

Figure 3.5: % Share of Employment by Sector (1973-1995)



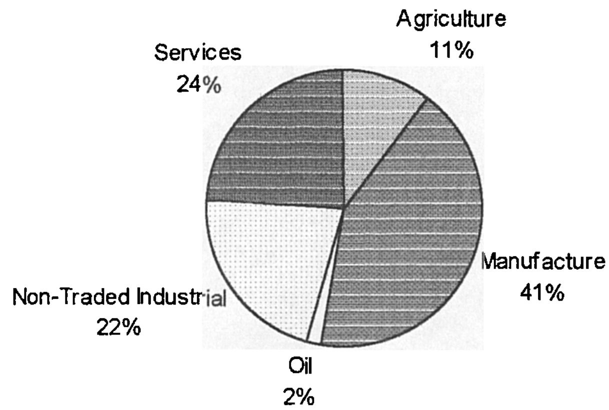
Source: Federal Office of Statistics of Nigeria, Economic and Social Statistics Bulletin, various issues

From the foregoing, although it might appear that the Nigerian government has considerable leeway in determining its oil revenue base, it is not altogether evident that effective control of technological processes and the determination of the optimal mix of operating resources lie in the hands of Nigerians. Indeed, the opposite appears to be the case. For example,

[6] As at 1995, the realised after tax income was $2 per barrel and another $2 per barrel for profit margin with a guaranteed profit of just over $1 per barrel.

although it is generally recognised that a substantial proportion of staff in the multinationals are Nigerians (Shell, 1996)[7], some occupying important management positions, the key management roles and strategic decision making are performed largely by foreigners (Ayodele, 1985; Atsegbua, 1993). Ayodele contends that Nigerians are not in effective control positions in the industry, and as such the control of the technology of oil production is still largely determined by foreigners. Indeed, the local technical infrastructure is very low and this has impeded the process of technological transfer and development. Atsegbua (1993) suggests that the transfer of petroleum technology to Nigeria directly conflicts with the interests of the multinationals since it becomes less profitable to them once the monopoly on technological control is broken.

Figure 3.6: % Share of Domestic Loans & Advances by Sector (1970-1994)



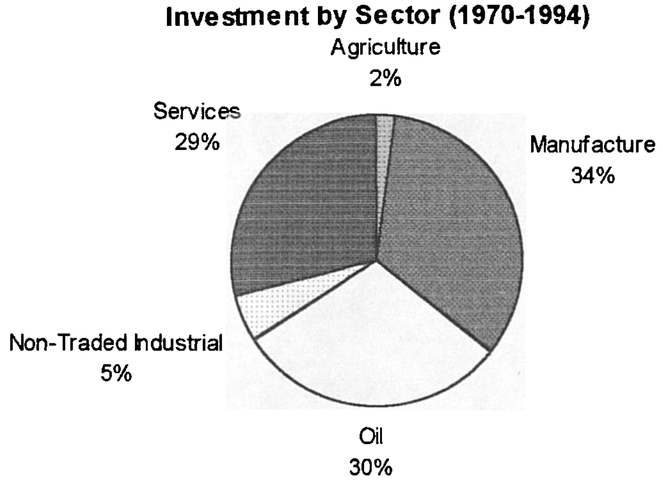
Source: Central Bank of Nigeria Statistical Bulletin, 1995.

Oil production therefore relies heavily on imported capital goods and critical manpower and only much less on domestic resources. The oil sector's contribution to overall employment in Nigeria is negligible (Figure 3.5). It also appears that the sector does not engage much in financing its operations in the domestic market for loans and advances (Figure 3.6). By contrast, the oil sector has a disproportionately large share of foreign direct investments and the capital

[7] Shell is the country's biggest operating multinational. About 95% of its 5000 staff and a majority of its 8000 contract staff are Nigerians (Shell Report, 1996).

stock financed out of such investments relative to the agricultural and non-traded industrials sectors (Figure 3.7 and Figure 3.8). Even if foreign companies engaged in a deliberate policy of retaining profits to finance future operations rather than repatriating these profits, the effect is still largely the same as one where the supply of finance for investments comes from overseas. Indeed, the picture that can be painted is a sector that does not use many domestic resources in production (Saheli-Isfahani, 1989) such that the backward and forward linkages with the rest of the economy are very low indicating a rentier economy whose rent accrues entirely as foreign exchange (Oshikoya, 1990). By contrast, countries such as Norway and Algeria, (the latter, a developing African country like Nigeria) through their state-owned oil companies, Statoil and Sonatrach respectively, control and operate all aspects of their oil industries and have succeeded in wresting technological control from the private multinationals, generating important spillover effects along the way (Atsegbua, 1993).

Figure 3.7: % Share of Foreign Direct Investment by Sector (1970-1994)



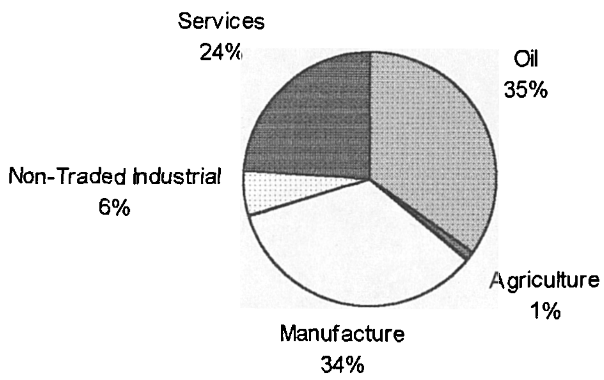
Source: Central Bank of Nigeria Statistical Bulletin, 1995

To ameliorate some of the problems mentioned above and to increase investments in the oil sector, the Nigerian government has recently encouraged local private sector participation through the "farm out"[8] of marginal fields previously licensed to the large multinational

[8] This is a technical term used in the industry to describe the decree issued by the Nigerian government in 1995 which mandated the multinationals to transfer low ranking marginal fields in their portfolio to local companies.

companies. Indigenous participation in upstream production activities has largely been facilitated by partnerships between local investors and foreign technical and financial partners. However, several reports (for example, Soremekun, 1995) indicate that indigenous private sector participation in the oil industry is still low, the major constraints being the lack of adequate capital and technological know how.

Figure 3.8: % Share of Capital Stock from Foreign Direct Investment by Sector (1970-1994)



Source: Central Bank of Nigeria Statistical Bulletin, 1995

The development of downstream activities, which has progressed alongside upstream production activities, is where effective government control, participation and influence is relatively strong, in particular in refining and marketing. Nigeria's refining capacity is about 2.5 million barrels per day from four operating refineries (Oshikoya, 1990). However, capacity utilisation rates for Nigeria's four operating refineries has remained low for much of the 1990s largely as a result of inadequate foreign exchange to purchase raw materials and spare parts, frequent breakdowns of equipment and prolonged period of plant closures as a result of industrial unrest and strikes. With the continued trend of unstable oil prices, Nigeria was forced to enter, in principle, into a number of arrangements that impacted on downstream activities. One involved the government acquiring equity interests in the refining and distribution networks of countries that purchased its oil (Price Waterhouse, 1994). The government, through the NNPC, exports crude oil to offshore refineries which sell and distribute the refined petroleum products. Another arrangement involved the leasing of unused or spare domestic refining capacity (Federal Republic of Nigeria, Annual Budget Statement, 1994). The advantage of these measures is that overall operational efficiency is improved by integrating downstream and upstream activities whilst generating much needed revenue in an unstable oil market.

The development of significant oil related industries, like the Liquefied Natural Gas (LNG) project, Petrochemicals plants, the Fertiliser Plants and the Condensates Project, has progressed with relative degrees of success[9]. In addition to its large reserves of crude oil, Nigeria is also endowed with huge deposits of natural gas. Indeed, the NDES (1997) describes the Niger Delta as a gas province with some oil in it. Nigeria's gas reserves are estimated at about 150 trillion standard cubic feet (150 SCF) of gas making it the 10th largest reserve in the world (Post Express Wired, 1998). Although survey reports (NDES, 1997)[10] indicate that independent gas fields exist in parts of the Niger Delta, about half of Nigeria's gas is associated with oil so that the problem of gas flaring has been a recurring problem.

The government's main objective in the gas sub-sector is to harness Nigeria's huge gas reserves to meet domestic and international demand. At present, Nigeria's most ambitious plan to commercially utilize its huge gas reserves has been through the development of a Liquefied Natural Gas (LNG) plant. However, international market opportunities for Nigeria's LNG had long been recognised since the 1960s (see Schaztl, 1969). Unfortunately, several delays to the project have occurred over the years, largely as a result of a combination of political and economic factors. In recent times, the urgent need for Nigeria to diversify its export base has assumed heightened significance especially in light of rapidly declining oil prices. The economic viability and foreign exchange earnings potential of the LNG project is such that the government has pursued the take off and development of the project very vigorously since the late 1980s to early 1990s. Indeed, considerable progress has been made in securing buyers and formalising joint venture agreements. Recently, the project was made more attractive to foreign investors (World

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9 The economic impact of oil and industrial policy developments as they pertain to these industries and the manufacturing sector in general are examined fully in Chapter Seven.

10 NDES: Niger Delta Environmental Survey (1997).

Bank Trends, 1996), largely as a result of government agreeing to a minority holding in the joint venture. Government's equity interest in the project has therefore been reduced to a minority holding of 49% from the 60% agreed to in the Framework Agreement of prospective partners in 1985 (World Bank Trends, 1996).

Nigeria also possesses substantial reserves of condensates and minerals such as coal, tin, iron ore and uranium. Whilst exports and revenues of condensates grew by about 50% and 30% respectively in 1994 over the figures in 1993 (CBN Annual Report, 1995), its contribution to total export revenues still remained low at less than 3%. Likewise, the contributions of minerals to overall output of the extraction and mining sector has been negligible over the last twenty- five years or so.

Since independence, the Nigerian oil industry has grown by leaps and bounds. In recent times, in spite of social and political upheavals arising from both the uncertainty with regards to the country's scheduled return to civilian rule and agitations from minority groups[11] in regions from which the bulk of the country's oil wealth is derived who have felt increasingly marginalised, Nigeria's oil production and exports have only been marginally affected (World Bank Trends, 1996). However, the disruptions have resulted in prolonged scarcities of domestic fuel supplies and has had a substantial impact on commercial activities in general. In recent years, Nigeria has been forced to process up to 0.5 million barrels per day of crude oil abroad to meet domestic requirements because of underutilisation of refining capacity brought about in part by civil unrest. A slower depletion policy if oil prices are expected to rise will be a profitable investment strategy, the reverse also being true (Forsyth and Kay, 1980), although the form of the investment is important in deriving maximum benefits. In the medium to long term therefore, it is hoped that increased investments in the oil sector would assist in the process of capital accumulation, in raising oil reserves to the targeted level of 30 billion barrels, and ultimately in accelerating the process of technological transfer in the industry.

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[11] For a poignant account of the effect of ethnic differences and the Ogoni uprising on economic development in Nigeria, see Osaghae E (1995).

3.4 Relevant History of the Physical and Environmental Effects of the Oil Industry

Clearly, there are links between economic activity and environmental degradation, such that it is now common place for the measurement of economic development to include some index of sustainability. The term sustainable development has many definitions. Its basic premise is that it recognises that economic growth cannot be sustained indefinitely without taking cognisance of the impacts to the environment and the social (eco)system as a whole. The most accepted definition is that provided by the World Commission on Environment and Development (1987) and this defines sustainable development as:

> ".....development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs."

This basic definition has provided the initial foundations for sustainable macroeconomic policy decision making (Barbier, 1987; Lee and Goodland, 1989; Girma, 1992; Goldin and Winters, 1994), for the development of theoretical and valuation methods (Pearce et al, 1990; Howarth and Norgaard, 1992; Barbier and Markandya, 1990; Winpenny, 1991; Common, et al, 1993), and for formally carrying out tests of sustainability (Stern, 1995 ; Pearce and Atkinson, 1995), among others.

All the different notions of economic sustainability are not necessarily compatible. For example, Barbier (1987) has argued that the primary concern of sustainable development would seem to be to ensure that the poor have access to sustainable and secure livelihoods. Pearce et al, 1990 consider sustainable development "as a situation in which the development vector does not decrease over time with respect to each single period of time (strong sustainability), or with respect to the trend measured as present value of development benefits (weak sustainability). The difficulty is that "the elements of the development vector (income, health, education, access to resources, income distribution, freedom, etc) and the time horizon applied are subject to ethical debate and practical decision". The crucial element of sustainable development in meeting these sets of conditions for development, would be the constancy of the natural capital stock (Pearce et al, 1990), which, whether measured in physical terms or in terms of economic value, should not decrease over time.

The implications for sustainability are therefore many and varied - ranging from the exploitation and use of natural resources (agricultural land, fisheries, forestry, oil), to poverty, income distribution, population and economic and social development.

From the perspective of the environment in general, Nigeria has started to integrate the environment into economic development planning at all levels of government (FEPA, 1992; Agunbiade, 1991). With regards to the oil sector in particular, it is obvious from the accounts in Sections 3.2 and 3.3 that the nature of crude oil production is complex and sophisticated such that the physical and environmental effects are bound to be extensive and far-reaching. Indeed, several accounts have been provided that point to the environmental effects of oil-related activities on the economy, the environment and human life (for example, Luigi and Millanese, 1979; Imevbore, 1979; Odu, 1981; Okogu, 1991; World Bank, 1995). Two government organisations, the Federal Environment Protection Agency (FEPA) and in particular, the Department of Petroleum Resources (DPR) of the Ministry of Petroleum Resources are empowered with administrating environmental standards in the oil industry, although these are supported by an array of organisations such as Clean Nigeria Associates, the NDES and multinational-specific contingency teams.

Given that almost all of Nigeria's oil is produced in one region, the Niger-Delta, the impact of oil related activities on the environment of this region is widespread and substantial (World Bank, 1995). All aspects of the industry - exploration, production, refining, marketing and transportation - constitute a source of pollution to the environment (Imevbore, 1979; Aina, 1996; NDES, 1997). In Nigeria, there are mixed reports as to the scale of environmental problems due to oil production. World Bank estimates indicate that oil pollution by itself is only of moderate priority when compared to other major environmental problems in the region brought about by human and other industrial activities. This account is corroborated by preliminary phase one reports of the NDES[12] (1997), which indicates that many industrial and human activities impact on major environmental problems in the oil producing areas of the Niger Delta.

[12]The first ever attempt to systematically gather environmental data, in an effort to determine the impact of oil and other industrial production on the environment of the Niger-Delta, was initiated in May 1995 with the establishment of the Niger-Delta Environmental Survey (NDES). The group is primarily funded by Shell, with members drawn from industry, international environmental organisations, academia, the World Bank and community groups. The full results from the survey are not expected until about the middle of 1999.

Contrary views (Oyefolu and Awobajo, 1979; Okogu, 1991; comments in the national and international media) have variously been expressed. Okogu has reported that the decline in agricultural productivity and output in Nigeria can be directly linked to environmental effects of oil production, specifically through oil spills and land degradation, rather than indirectly via the appreciating exchange rate, given rising oil revenues, as emphasised by the theoretical models reviewed in Chapter Four.

In general, the nature of environmental problems in Nigeria, particularly in the Niger-Delta, are of three types, land resource degradation, renewable resource degradation and environmental pollution (World Bank, 1995). The third type is primarily due to oil production. Although the most obvious and widely reported of these physical effects is oil spills, which are generally known to be considerably damaging, they do not constitute the only source of oil pollution from the industry, others being flared gas, discharged effluents and degraded land due to machines, heavy equipment and pipelines.

The worst oil spills in world history were the Exxon Valdez spill off the coast of Alaska in 1989 (Okogu, 1991) in which about 260,000 barrels were released and the Ixtoc spill in 1979/80 in the Gulf of Mexico in which about 3.3 million barrels was spilled, although the former ranks as the costliest in history given that clean up costs have been about $3 billion excluding litigation costs (Odogwu, 1991). The largest case of an oil spill in Nigeria was recorded in 1979 when about 700,000 barrels of oil was spilled (Table 3.3). Within the last two decades, over 4,500 spills have been recorded, which translates to about 2.3 million barrels of crude oil that have been spilled into the environment (Table 3.3).

TABLE 3.3: MAJOR ENVIRONMENTAL INDICATORS FOR THE NIGERIAN PETROLEUM INDUSTRY (1975 TO 1995)

Year	Crude Oil Production (in barrels)	Number of Oil Spills	Quantity of Oil Spills (in barrels)	Quantity Lost to Environment (in barrels)	Gas Production (M m³)	Gas Flared (M m³)	% Flared
1975	660,148,000	16	na	3,544	18,656	18,333	98%
1976	758,058,000	128	26.157	19,021	21,276	20,617	97%
1977	766,055,000	104	32,879	31,176	21,924	20,952	96%
1978	696,324,000	154	489,294	97.849	21,306	19,440	89%
1979	845,463,000	157	694,117	630,635	27,618	26,073	94%
1980	760,117,000	241	600,511	558,094	24,885	22,904	92%
1981	525,291,000	238	42,722	37,252	17,202	14,162	82%
1982	470,638,000	257	42,841	40,669	14,830	11,940	81%
1983	450.961.000	173	48,351	41,995	15,207	11.948	79%
1984	507,487,000	151	40,209	38,564	16,251	12,817	79%
1985	547,088,000	187	11,876	10,157	18,426	14.846	81%
1986	535,929,000	155	12,905	12.358	17,900	13,917	78%
1987	483,269,000	129	31,866	25,757	15,580	12,291	79%
1988	529,602,000	208	9,172	7,207	20.212	14,737	73%
1989	625,908,000	228	5,956	3,803	26,300	18,730	71%
1990	660,559,000	166	14.150	12,057	28,163	21,820	77%
1991	689,850,000	258	108,367	105,912	31.587	25,934	82%
1992	711,340,000	378	51,187	49.711	32.465	24,588	76%
1993	691,400,000	453	8,105	6,632	33,445	25,406	76%
1994	696,790,000	495	35,123	32,787	na	na	na
1995	715,400,000	417	32,787	60,568	na	na	na
Total	15,535.671.000	4,541	2,329,567	1,850,222	502,382	429.536	-

Sources: (i) Oil Production Data: CBN Statistical Bulletin, 1995

(ii) Oil Spills Data (a) 1972-1975: Imevbore, A M A The Petroleum Industry and the Environment of the Niger Delta. Proceedings of a seminar sponsored by the Federal Ministry of Housing and Environment and the Nigerian National Petroleum Corporation (1979). (b)1976-1995: NDES, Phase One Report, 1997.

(iii) Data on Gas Flaring: NDES, 1997

TABLE 3.4: % OF GAS FLARING FOR OPEC, WORLD AND A SELECTED NUMBER OF MAJOR OPEC COUNTRIES

Year	Algeria	Saudi Arabia	Iran	Opec Average	World Average
1980	22.37%	72.03%	47.16%	43%	40%
1994	4.0%	20.0%	19.0%	18%	4.8%

Source: Culled from (i) Ojo, A T (1984), Energy Policy, March, Vol. 12, No.1, pp 26. (ii) NDES, 1997.

Presently, about 80% of the oil-associated gas produced in Nigeria is flared, with an estimated economic loss valued in excess of $4.4 billion (Oshikoya, 1990), not to mention the adverse environmental and health implications (NDES, 1997), the practice has resulted in. Various reports indicate that gas flaring in Nigeria is higher than in any other country in the world. The percentage of gas flared in Nigeria, which is estimated on average at about 95%, is well over the OPEC average of 43% and the world average of 40% (Table 3.4). Indeed, it has been reported (Aina, 1996) that the wasted heat and energy from gas flaring in 1986 alone was equivalent to the entire electrical power generated by the country's electricity authority. In an effort to reduce the incidence of gas flaring, the government has at various times imposed stiff penalties to companies to curtail the practice. Ultimately, the long term solution rests on the successful development of the proposed liquefied natural gas project.

3.5 Conclusion

This chapter has expanded on the general overview of the Nigerian economy presented in Chapter Two by giving a thorough sector-specific account of the oil industry in Nigeria. The international aspects of the industry were examined, particularly the impact that OPEC has had on the world oil market in the last three decades or so. The main conclusion drawn was that although the influence of the cartel has considerably declined in recent times due to a number of supply and demand oriented factors, it still plays an important role in the international oil market, commanding over three quarters of proven world oil reserves.

Most importantly, the domestic operational aspects of the sector were examined and the phenomenal growth of the industry within a short space of time attributed to natural comparative advantages and the active involvement of operating multinational companies. However, the stark reality observed was that in spite of the active involvement of the Nigerian government in the industry, effective technological and operational control is still largely foreign determined. Indeed, the picture that emerged is a sector that uses little domestic resources relative to other traded and non-traded sectors. These issues are taken up in detail in the empirical analyses of subsequent chapters. Furthermore, although for decades a lot of effort had gone into the development of oil-related sub sectors, the surprising observation was that they do not significantly contribute to mining output and exports, a situation that is in stark contrast to other developing oil exporting countries like Algeria.

Finally, an examination was carried out of the perceived impacts of the physical effects of the industry on other sectors, on environmental quality and on general economic life. The environmental quantitative indicators presented clearly revealed that Nigeria lags behind several other oil exporting countries both in terms of the extent of the environmental effects and the institutional mechanisms in place to deal with such effects. Specifically, although information on the exact extent of these physical effects on output of other sectors is mixed, the two main mechanisms that appear to be at work are those that stem from the direct environmental effects and those linked to pure but indirect economic factors. The latter is the focus of the next chapter and this is examined using a number of theoretical and empirical models.

CHAPTER 4

A THEORETICAL AND EMPIRICAL OVERVIEW OF THE LITERATURE

4.1 *Introduction*

In the last two decades or so, Dutch Disease models have been used as one possible explanation of the structural difficulties experienced by countries as a result of a natural resource boom. The phenomenon, also sometimes referred to as 'de-industrialisation', directly refers to the fall in manufacturing output and the concurrent rise in non-traded output. This chapter provides a review of the Dutch Disease and related macroeconomic sectoral literature.

The chapter starts by examining the core models of Dutch Disease which have investigated the effects of an oil boom on the allocation of resources and income distribution (Corden and Neary, 1982; Corden, 1984; Enders and Herberg, 1983; Edwards and Aoki, 1983; van Wijnbergen, 1984), on sectoral structural changes (Forsyth and Kay, 1980; Kaldor, 1981), and on the transmission of oil shocks to the economy (Harberger, 1983 and Bruno and Sachs, 1982), amongst others. These studies, which are particularly suited for developed oil exporting countries, have been largely influenced by earlier theoretical models of the Dutch Disease or the so called 'Australian Models' of the 1970's pioneered by Gregory (1976) and Snape (1977).

The chapter then examines theoretical extensions of the core models which have been developed by Benjamin et al 1989; Fardmanesh, 1991b; Long, 1983 and Davis, 1995 to suit certain features of natural resource exporting developing countries including Nigeria. Following this, the empirical evidence provided by Fardmanesh, 1991a; Struthers 1990; Kamas 1986; Gelb, 1988; Auty, 1993; Richards, 1994 and Looney, 1990, 1991 are examined.

The chapter concludes by briefly reviewing multi-sectoral trade and growth models. Although many of these multi sectoral models are not necessarily linked to the Dutch Disease, the review is necessary because the proposed Dutch Disease model for Nigeria inevitably draws on the wider literature on multi sectoral models.

4.2 The Dutch Disease, Output, Relative Prices and Factor Incomes

4.2.1 The Dutch Disease: Some Theoretical Definitions and Interpretations

The 'Dutch Disease' is a term that has been used to analyse the extent to which a boom in a particular natural resource exporting sector affects the rest of the economy. The booming sector is usually of an extractive kind - for example, minerals in Australia, natural gas in the Netherlands or oil in the UK and many oil exporting developing countries including Nigeria - with the lagging sectors being the traditional export sector, for example, the manufacturing or agricultural sector.

The term itself however was first coined by the Economist (1977) to describe the experiences of the Netherlands in the 1970s. Since then, different studies have focused on different mechanisms of change and this is usually reflected in the varying interpretations and definitions of the term. Harberger (1983), for example, defines the Disease as:

> ".....an increase in the price (or production) of a commodity export (oil) that results in a real appreciation of the exchange rate, and in a loss of competitiveness of the traditional (non-oil) tradeable goods sector."

Whereas, Yokohama (1989) emphasises the concurrent growth of other non-traded sectors by defining the Disease as:

> "A phenomenon of deindustrialization characterised by a relative shrinkage of domestic manufacturing industry, and a relative expansion of service industries".

Corden and Neary (1982), are concerned with the medium to long term effects of the Dutch Disease on growth, resource allocation and factor income distribution across sectors. Other interpretations of the term have at various times emphasised the world price effects (Fardmanesh, 1991a, 1991b), the wealth effects (Enders and Herberg, 1983; Bruno and Sachs, 1982) and the exchange rate (Forsyth and Kay, 1980).

The Dutch Disease is a problem common to both developed and developing countries. However, the consequences depend on the relative strengths of the perceived Dutch Disease effects, the structure of the particular economy and government macroeconomic policies, particularly with regard to its investment and overall expenditure programmes. When applied to explain the adverse effects on Dutch manufacturing of natural gas discoveries in the 1970s, the focus was essentially on the appreciation of the real exchange rate as being the primary mechanism of change. For developed countries in particular with both significant manufacturing and oil industries, the commonly held view was that the discovery of oil and rise in oil prices may have brought about major macroeconomic adjustments in the structure of their economies and the link to the idea of deindustrialization takes on added significance. When applied to developing countries however, the analysis of the Dutch Disease is viewed differently because of the lack of a significant and comparable manufacturing sector (Odifa, 1988). In these countries, quite often, it is the traditional agricultural sector that is placed under pressure from increased oil revenues.

In the review of the theoretical and empirical literature that follows, the terms Dutch Disease and deindustrialization will inevitably be used interchangeably. The latter term in general will refer to the squeeze on the manufacturing sector when viewed in the context of developed natural resource exporting countries, and to the agricultural sector when extended to deal with the experiences of less developed countries. However, the focus will be on examining the mechanisms that result in different sectoral responses given a rise in the price of the natural resource oil and given other changes that arise from macroeconomic policies closely associated with the oil sector.

4.3 The Core Models

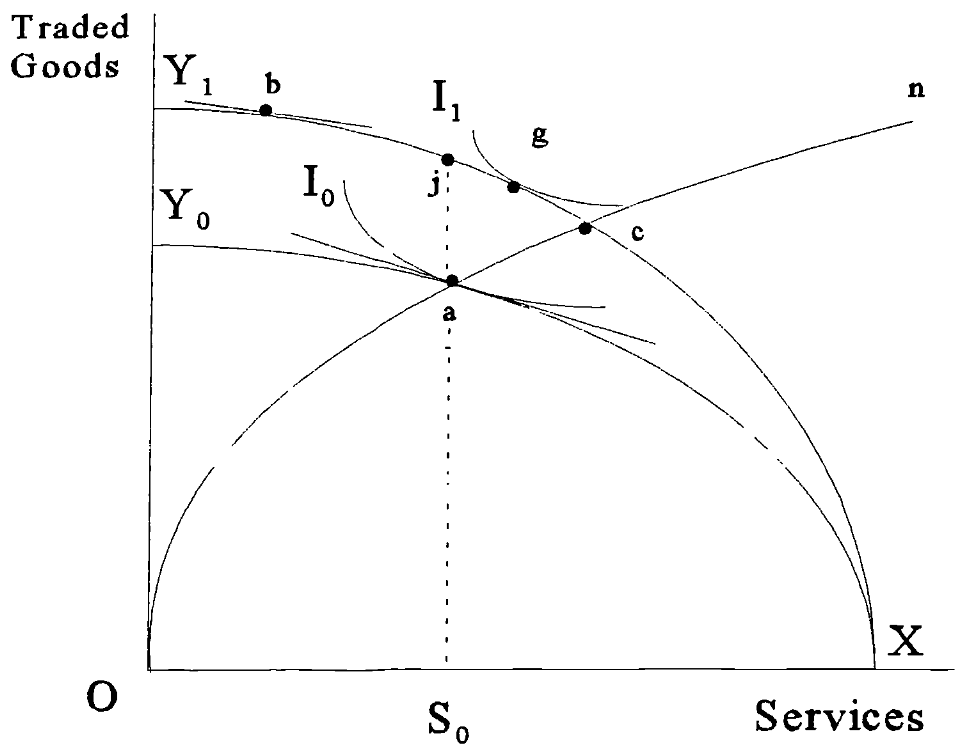
In the core models of Dutch Disease, two effects are usually identified with a rise in natural resource revenues, namely a resource movement effect and a spending effect. Whilst some authors have recognised only the spending effect (for example, Gregory, 1976; van Wijnbergen, 1984; Neary and Wijnbergen, 1984), the majority of studies have recognised both the resource movement and spending effects (for example, Snape, 1977; Corden and Neary, 1982; Corden, 1984; Enders and Herberg, 1983; Long, 1983; Drudi, 1987; Edwards and Aoki, 1983 and Eastwood and Venables, 1982).

In a seminal paper by Corden and Neary (1982) of a small open economy model, the impact of an oil boom on the distribution of income and the size and profitability of the non-oil traded and non-traded sectors is examined. In their model, it must be emphasised from the outset that for countries that are net exporters of oil, the effects of a rise in the world price of oil are similar to the effects arising from a discovery of oil. The model consists of two tradeable goods whose prices are determined in the world market and one non-traded good whose price is determined domestically given a flexible product market. All goods are for final consumption only and a once and for all Hicks-neutral improvement in technology is considered. The model does not consider monetary factors and the emphasis is on real variables, so that only relative prices are determined which in this case is expressed in terms of the given prices of traded goods. The overall trade account is balanced, so that national spending and output are always equal and international capital flows are precluded in the model. The terms of trade between the traded goods are fixed. However, this is not the case between traded and non-traded goods, so that relative prices between them and hence the real exchange rate can change. Prices in the factor markets are perfectly flexible and with a flexible real wage, the economy is always at full employment equilibrium.

In the model of Corden and Neary (1982), the discovery of the new and profitable oil sector gives rise to two effects; a resource movement effect and a spending effect. The resource movement effect is caused by the boom in the oil sector raising the marginal revenue products of the mobile factors employed there, and so drawing resources out of the lagging export and non-traded sectors. This leads to various adjustments in the economy including the appreciation of the exchange rate. The resource movement effect causes resources to be drawn out of the other sectors without the need for an appreciation and so this effect leads to *direct de-industrialisation*.

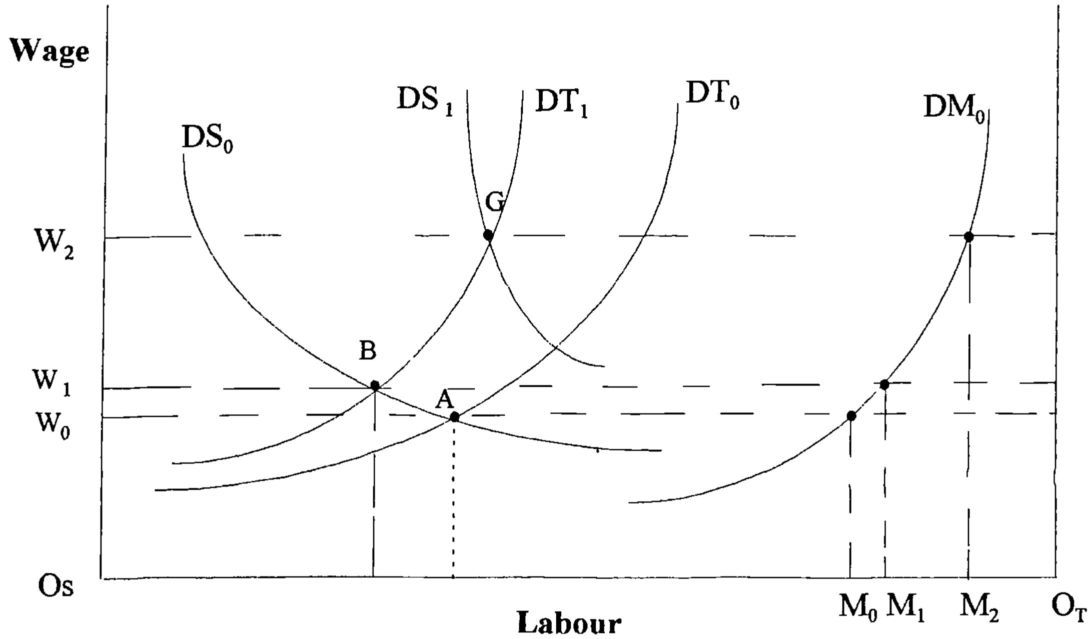
In the model of Corden and Neary, the spending effect takes the form of increased spending on both traded and non-traded goods as oil revenues rise. Given that traded goods prices are fixed at the world level, the additional demand for non-traded goods leads to a rise in the price relative to the price of traded goods. The result is an appreciation of the real exchange rate, defined as the relative price of non-traded to traded goods, which causes mobile resources to be drawn out of the booming oil and non-oil traded sectors into the non-traded sectors and as a consequence leads to *indirect deindustrialization*. Both effects are formally analysed in some detail with the aid of Figure 4.1 and Figure 4.2.

Figure 4.1: Effect of an Oil Boom on Sectoral Output, Corden and Neary, 1982.



Using the model of Salter (1959) in Figure 4.1 and a comparative statics approach, Corden and Neary show that the extent of the resource movement effect and spending effect depends on the assumptions about the degree of inter sectoral factor mobility. In the short-run version of the model, labour is the only mobile factor of production. XY_0 and XY_1 are the production possibilities curves with an initial equilibrium in the market, before the discovery of oil, at point a. Traded goods consisting of oil and manufacturing output are measured on the vertical axis and non-traded goods, assumed to be services, measured on the horizontal axis. OY_0 and OX therefore represent the production and consumption of tradeables and non-tradeables respectively. The indifference curves, I_0 and I_1 are used to depict aggregate demands ignoring the fact that changes in the distribution of income will cause them to shift. The slope of the tangential line common to the two curves at point a represents the initial real exchange rate which is measured by the initial price of services to traded goods.

Figure 4.2: Effect of an Oil Boom on the Labour Market, Corden and Neary, 1982.



From Figure 4.2, the initial equilibrium position in the labour market before the discovery of oil is at point A. The wage rate is measured on the vertical axis while the economy's total labour (fixed) supply is measured on the horizontal axis. The demand for labour in the services and manufacturing sectors are denoted by DS_0 and DM_0 respectively. The aggregate labour demand for the traded goods sector which includes the oil sector is denoted by DT_0. The diagram shows that the demand for labour in each sector is negatively related to the wage rate.

The resource movement effect causes the oil sector's labour demand schedule to shift upwards and this raises the demand for labour in the oil sector at a given wage rate. The outwards shift from DT_0 to DT_1 results in a new equilibrium at B. The wage rate is increased to W_1 at a constant real exchange rate which causes labour to move out of both the manufacturing and services sectors to the oil sector. The effect of this is a fall in employment in manufacturing from O_TM_0 to O_TM_1 so that the resource movement effect leads to direct deindustrialization. Going back to Figure 4.1, the boom does not change the maximum output of services OX, but increases maximum traded output from OY_0 to OY_1 so that the production possibilities curve XY_0 shifts outwards to XY_1. The outward shift of the curve XY_0 represents the size of the oil boom and the vertical difference between XY_0 and XY_1 can be regarded as a measure of the growth in foreign exchange earnings generated by the oil sector. The movement of labour out of the services sector induced by the resource movement effect leads to a fall in the output of services so that point b lies to the left of point a in Figure 4.1. This leads to various adjustments in the economy including the real exchange rate.

In considering the resource movement effect on its own, Corden and Neary assume that the income elasticity of demand for services is zero. Therefore at the initial real exchange rate there is an excess demand for services due to the resource movement effect which leads to a real appreciation to restore equilibrium in the market for services. Because of the rise in the price of services which must occur to eliminate the excess demand, demand switches from services and dampens the fall in the output of services induced by the resource movement effect. However, the fall cannot be reversed so that the output of services is lower than the initial equilibrium at a and lies between b and j.

To consider the spending effect on its own, Corden and Neary assume that the energy sector does not use any labour. Therefore, at the initial exchange rate, the boom shifts the production possibilities curve outwards so that point b lies above point a in Figure 4.1. If the demand for services rises with income, that is assuming services are normal goods, there is once again an excess demand for services at the initial real exchange rate so that a real appreciation must occur. The output of services increases and the new equilibrium lies somewhere between points j and c which is higher than the initial equilibrium position at a.

The spending effect is therefore the result of increased spending on all goods as national incomes rise due to an oil boom. The increased spending on services increases their price and therefore leads to a real appreciation. The services sector will need more factors of production to meet the increased demand for this output. On the other hand, with the price of traded goods fixed at the world level, the increased demand and hence spending on the non-oil traded goods sectors can be met by imports. Indeed, even though profitability in the energy sector rises due to the resource movement effect, it is quite possible that overall profitability in the sector may fall because of the spending effect, given that the price of oil is fixed at the world level and is exogenously determined. "The factor specific to the energy sector fails to benefit from the spending effect, because the price of energy is fixed at the world level". (Corden and Neary, op. cit., pp. 832).

Therefore in Corden and Neary, in the short run, the overall impact on the economy of the two effects is real appreciation with the final equilibrium in Figure 4.1 at point g which has a higher relative price of services than the initial equilibrium at point a. The resource movement effect tends to lower the output of services while the spending effect tends to raise it and there is no mechanism in this theoretical model to determine which will dominate. Figure 4.1 however is drawn such that point g is to the right of j which indicates that the spending effect dominates the resource movement effect. The effect on the manufacturing sector is unambiguous: direct deindustrialization due to the resource movement effect which does not require an appreciation of the exchange rate and indirect deindustrialization due to both the spending effect and the resource movement effect. The final labour equilibrium position for the manufacturing sector in Figure 4.2 is therefore at O_TM_2 which is lower than the initial equilibrium at $O_T M_0$. Although Corden and Neary define a real appreciation as a rise in the relative price of non-traded to traded goods *whatever the cause* (italics for emphasis), real appreciation can occur either through simple exchange rate appreciation or with a fixed exchange rate and inflation in the non-traded goods prices but no change in traded goods prices.

In Corden and Neary, in the long run however, the two effects depend on underlying assumptions about the degree of capital mobility across sectors. If capital is mobile between the manufacturing and services sectors, the extent of sectoral changes in the economy arising from the resource movement effect will depend on the relative capital intensities of these sectors. To consider the resource movement effect on its own, we again assume that the income elasticity of the demand for services is zero. At the initial wage rate, the boom raises the oil sector's demand for labour and reduces the amount available for the manufacturing and services sectors. If manufacturing is capital intensive relative to services, its output falls in absolute terms but rises relative to services while that of labour intensive services falls. Given the relative and absolute fall in the output of services, the wage rises and the price of services rises. The fall in the output of services is associated with a relative rise in the output of manufacturing. The resource movement effect therefore gives rise to *pro-industrialization* and raises the return to capital in manufacturing relative to services. However, if manufacturing is relatively labour intensive, the resource movement effect leads to a rise in the wage rate, but in this case the output of services rises and the price of services falls (a real depreciation). In this case, the output of labour-intensive manufacturing falls leading to a normal case of deindustrialization.

In the long run, the spending effect on its own increases the demand for services which are non-tradeable. This results in an increase in the output and price of services and a fall in manufacturing output irrespective of the relative sectoral factor intensities. The higher price of services is associated with a higher wage only if services are relatively labour-intensive. Hence, the spending effect results in a normal case of deindustrialization irrespective of factor intensities.

The long run effect when capital is perfectly mobile across all three sectors reveals some ambiguities in the results of Corden and Neary. Changes in both factor and output prices solely depend on the resource movement effect, specifically, the relative factor intensities between oil and manufacturing on the one hand and manufacturing and services on the other. By contrast, quantitative changes in output depend on both the spending and resource movement effects, the latter depending on several possible configurations of relative factor intensities across sectors. In general, the resource movement effect leads to deindustrialization and increases the output of services, while the spending effect has the tendency of raising the output of both manufacturing and services sectors. However, only when the capital-labour ratio in manufacturing is in between the oil and services sectors is deindustrialization the inevitable outcome.

In concluding, some observations and problems with Corden's and Neary's are explained. Firstly, it appears that provided that there is a resource movement effect and a spending effect, there must be deindustrialization in Corden and Neary's model in the sense of a fall in manufacturing output, employment and profitability. However, in reality, many booms may have a small resource effects because of low labour intensity of boom related sectors. In addition, the resource effect is dampened if the levels of both capital and labour are supplied from abroad, which is particularly true in the case of many oil exporting developing countries where the levels of domestic technological and managerial expertise are relatively very low. Dutch Disease models are very abstract and do not relate well to actual facts about resource movements.

Secondly, many of the underlying assumptions about the product and factor markets in

Corden and Neary's model are not very realistic when viewed in the context of oil exporting developing countries. In other words, the efficiency of markets, which is crucial to Corden and Neary's argument, appears to be in doubt in these countries. Indeed, in the next section, the models which are presented are generally adapted to oil exporting less developed countries through the relaxation of one or more of the assumptions implicit in Corden and Neary's study.

Thirdly and quite importantly, Corden and Neary's model in spirit is private sector driven, hence the very important role that the government plays in determining factor incomes distribution and the direction and magnitude of both public and private capital investments is ignored. In the model of Corden and Neary no distinction is made between public and private expenditures. Indeed, as argued later on in this study, an explicit recognition of public sector investment and expenditure decisions is required, failure of which could have immense consequences for the direction and magnitude of both the spending effect and the resource movement effect, if indeed present.

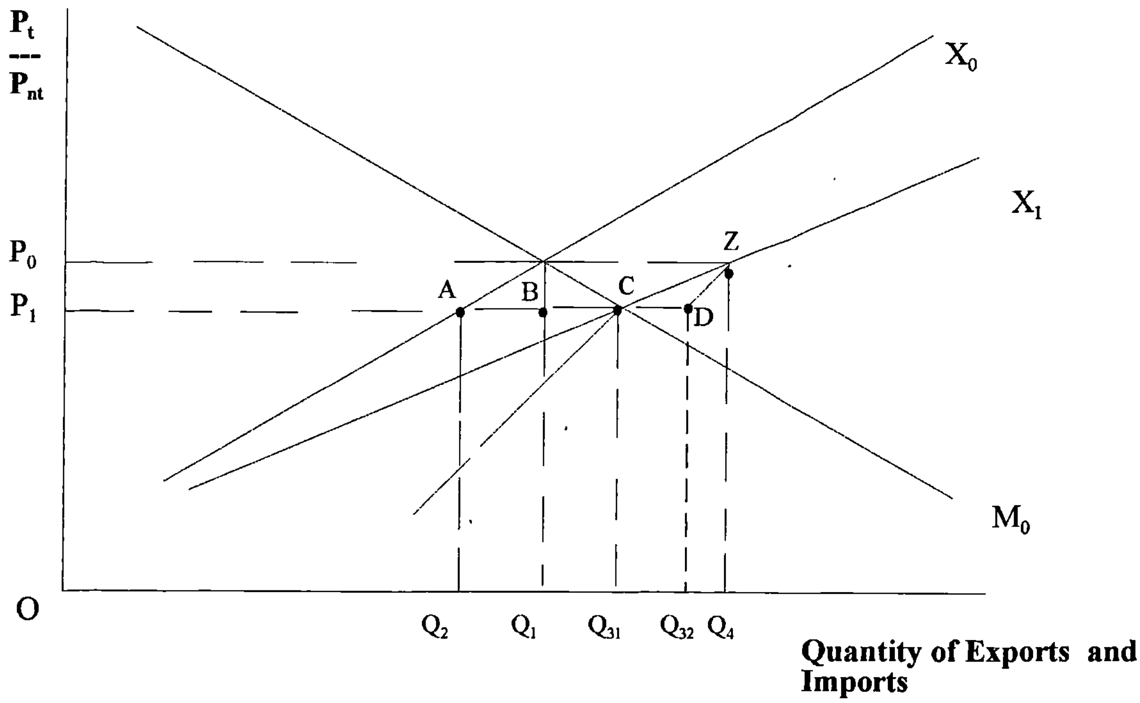
Fourthly, Corden and Neary's three sector approach, which has been used in some other studies (for example Lawler, 1987), is inadequate for two reasons. First, the responses of traded agriculture (labour and land intensive, diminishing returns) and traded manufacturing (capital intensive, increasing returns) are bound to be different. Second, in reality, the relative price of traded goods are not always fixed; the relative price of agriculture and manufacturing may change through a process that is described later in this chapter as the world price effect.

Finally, from an external point of view, in Corden and Neary's model, the balance of trade in manufacturing must deteriorate (assuming manufacturing is not protected) since output falls and the additional home demand is met by imports, although this needs not be so if tariffs and other protectionist policies are effected.

Gregory (1976) specifically addresses the effect of the resource boom on imports, exports and the non-oil trade balance. In his model of the Dutch Disease, often described as the Australian model, Gregory analysed the impact of an expanding mineral sector using the Australian economy as a basis. Gregory's model is important for two reasons. Firstly, it shows how a balance of payments deficit may arise and be financed on the basis of future oil production (Atkinson and

Hall, 1983). Secondly, it explicitly models an exchange rate determination process.

Figure 4.3: Exports, Imports and Relative Prices, Gregory, 1976.



Gregory's model consists of two sectors, a traded and a non-traded sector and two factors of production, capital and labour. The price of the traded good (P_t) is determined in the world markets. The emergence of a booming mineral sector affects the relative price of traded to non-traded goods (P_t/P_{nt}) which leads to pressures to reduce this price ratio. Therefore,

$$(4.1) \quad (P_t/P_{nt}) \quad = \quad ER \quad * \quad (P_w/P_{nt})$$

where ER is the exchange rate defined as the domestic price of foreign currency and P_w is the world price of traded goods measured in a foreign currency. Gregory assumes that all changes in this price ratio are caused by exchange rate changes so that relative price changes can be equated with depreciations or appreciations of the domestic currency.

The effects of a mineral export boom is depicted in Figure 4.3. The curves X_0 and M_0 represent exports and imports of traditional tradeables at various price ratios before the discovery of a natural resource, while the curve X_1 represents the sum of all traded goods. The horizontal distance between X_0 and X_1 is a measure of the quantity of mineral exports at any given relative price. The discovery of a natural resource disturbs the balance of payments equilibrium (P_0) and the supply of exports schedule shifts from X_0 and X_1. The expansion of the mineral sector therefore results in increased exports and creates a surplus on the balance of payments. If import demand remains constant, P_t/P_{nt} will fall to P_1 so that a new equilibrium is achieved. The mechanism of change is the appreciation of the exchange rate, i.e. a fall in ER or domestic inflation which could cause the price of non-traded goods to rise.

In Gregory's model, this price reduction has a number of important effects on the economy. First, the quantity of traditional exports supplied falls from Q_1 to Q_2. Second, the fall in the price of imports induces an increase in the quantity of imports demanded from Q_1 to Q_{31} and a concurrent decline of the non-oil traded sectors. Finally, the new mineral export sector moves from Q_{32} to Q_{31} which indicates that the booming sector is also adversely affected by the new price ratio, P_1. Therefore the distance between Q_{32} to Q_{31} (C and D) is a measure of the under-realisation of expectations of the new export sector based on the difference between the higher old price ratio, P_0 and lower new price ratio P_1. In general, the adjustments each sector would have to undertake had prices remained at P_0 will depend on the extent of mineral discoveries, the price elasticity of supply of mineral exports, the price elasticity of demand and supply of imports and the price elasticity of demand and supply of traditional exports.

Gregory goes on to argue that a policy of devaluation of the domestic currency to restore the old price ratio to P_0 is not as effective as the introduction of across the board tariffs on sectors. However, he shows that tariffs that are more sector specific affect both the new price ratio P_1 and the adjustments that have to be made by each sector. The effect of an introduction of tariffs is to reduce the demand for imports and move the curve M_0 downwards to the left. The introduction of a tariff reduces the quantity of non-oil imports which improves the balance of trade in manufacturing.

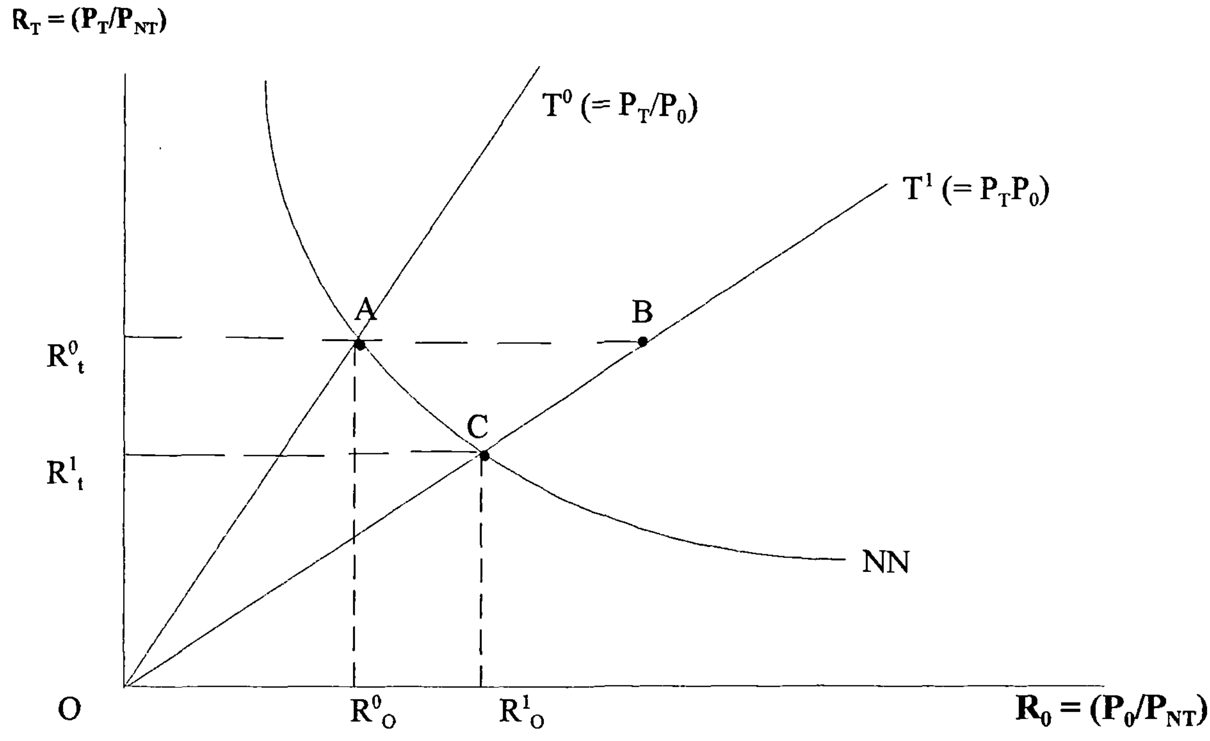
Gregory's conclusion that devaluation as an instrument of policy is ineffective while a policy geared towards imposing sector specific tariffs is more effective has received some support, in particular in Enders and Herberg's (1983) study of the consequences of a natural resource boom on prices, real income, employment and sectoral structural changes in the Norwegian economy. Tariffs on imported goods raise the domestic price of manufactures whilst leaving unaffected the world price. According to Enders and Herberg, this induces firms to increase domestic output, which raises national income and essentially leads to an improvement in the balance of trade. On the other hand, they argue that a policy of devaluation is merely transient, given that the non-oil traded sectors cannot sustain the initial (short run) expansion in output and employment. For Enders and Herberg the effects of a natural resource boom on the economy are the same as those arising from price effects. So in the tradition of Corden and Neary, no distinction is made between oil price discoveries and rises in the price of oil.

In examining the effects of macroeconomic policies and the incentives that give rise to Dutch Disease type effects, Enders and Herberg focus on the labour market and hence distinguish between the short, medium and long run effects. Essentially, Enders and Herberg state that:

> "Our distinction between the three consecutive equilibria implies that we assume that, following any disturbance, initially only the price of services, the wage rate, the output of manufacturing and services as well as income Y change, that after some time wealth attains the level of desired wealth and that finally sectoral employments in manufacturing and services adjust and unemployment ceases to exist".

Enders and Herberg focus on three effects namely, an income effect, a wealth effect and a labour movement effect are very similar to Corden and Neary's (1982), spending and resource movement effects. Short-run and medium-run equilibria are obtained via the spending effect while the resource (labour) movement effect results in the long-run equilibrium, the adjustments arising via the labour market as the laid off workers move from the shrinking manufacturing sector to the services sectors. This phenomenon of unemployment being regarded as an adjustment cost in an economy experiencing an oil boom has received some theoretical support, most notably by Eastwood and Venables (1982), while the long run implications on the real sectors of the economy have been investigated by Edwards and Aoki (1983).

Figure 4.4: Equilibrium Situation in the Non-tradeables Market, Edwards and Aoki, 1983.



According to Edwards and Aoki (1983), the long-run real phenomenon in a non-monetary economy of an increase in the price of oil is for an equilibrium reduction in the price of non-oil tradeables both in terms of non-tradeable and additionally in terms of oil. This sets up incentives for resources to move out of the traditional non-oil traded sectors. In this model, it is assumed that the government owns the oil and that the factors of production employed in the oil sector are sector specific. In the short-run labour is quite mobile, while capital is mobile between all sectors in the long-run. The exchange rate is fixed[1] so that changes in the real exchange rate takes place through changes in the nominal price of non-traded goods.

In Edwards and Aoki, the excess demand for non-tradeables is assumed to depend on prices and income which is expected to be equal to zero in equilibrium, and can be expressed as:

[1] Most of the studies already reviewed assume a flexible exchange rate system. However the extension of Edwards and Aoki's model to deal with the case of flexible rates does not affect their main findings.

(4.2) $$N_T - N_T\,(R_T, Y) - 0$$

(4.3) $$\frac{\partial N_T}{\partial R_T} > 0 \ , \ \frac{\partial N_T}{\partial Y} > 0 \ ,$$

where R_T is the relative price of traded to non-traded goods (P_T / P_{NT}), and Y is real income in terms of tradeables. The expected positive sign on the derivative of N_T with respect to R_T underlies the assumption of gross substitutability between non-traded and traded goods. When Y is expressed in terms of non-traded goods in equation (4.2), the expression becomes:

(4.4) $$Y - Q^{S}_{NT} + R_T Q^{S}_{T} + R_O Q^{S}_{O}$$

where Q^S_{NT}, Q^S_T and Q^S_O are the supplies of non-tradeables, traditional tradeables and oil respectively, and R_O is the relative price of oil in terms of non-traded goods. Because of the existence of cartels such as OPEC, the supply of oil is held fixed. The price index denoted by P_I, depends on the nominal prices of non-tradeable (P_{NT}) to tradeable (P_T). If the assumption of gross substitutability is maintained, it is possible to analyse the effect of an increase in the price of oil on the relative price of traditional tradeables with respect to non-tradeables. The equilibrium that emerges in the market for non-traded goods as a result can be depicted in Figure 4.4. The NN schedule shows the combination of R_T and R_O that are compatible with equilibrium in the non-traded goods market and its slope is given by:

(4.5) $$\frac{\partial R_T}{\partial P_O} = - \frac{(\partial N_T / \partial Y) Q^{S}_{O}}{[(\partial N_T / \partial R_T) + (\partial N_T / \partial Y) Q^{S}_{T}} \quad < \quad 0$$

The ray OT^0 measures the relative price of both tradeable goods - traditional tradeables to oil (P_T/P_O) with the initial equilibrium position at A, and the initial equilibrium relative price being equal to R^0_T and R^0_O.

An exogenous increase in the price of oil will rotate the OT^0 ray to OT^1 in Figure 4.4. If the nominal price of non-traded goods was constant the new equilibrium will be at B with a constant relative price of traditional tradeables to non-tradeables. However, there is an excess demand for non-tradeable at point B (as reflected in the negative slope of the NN schedule) which will require an increase in the relative price of these goods both with respect to the price of oil and the price of traditional tradeables. Therefore the final equilibrium will be attained at point C. The effect of an increase in the price of oil has been to decrease the relative price of traditional tradeables with respect to oil and with respect to non-tradeables. The reduction encourages resources to move out of the traditional tradeable sector into the other sectors of the economy, an effect that has already been previously described as the *deindustrialization* effect of an export boom for the more advanced economies and the d*eagriculturisation* effect for less developed countries. This effect has been suggested by Odifa (1988) as triggering the process of migration towards the urban centres in Nigeria, with the likelihood of rising unemployment in the absence of adequate structural absorption possibilities engendered by the resource movement effect.

Whilst the analysis by Corden and Neary (1982), Enders and Herberg (1983), Gregory (1976) and Edwards and Aoki (1983) have employed formal macroeconomic dynamics in models that appear to be of general applicability to many developed oil exporting countries like Norway and Australia, Forsyth and Kay (1980) and others have addressed the issue of structural change associated with the Dutch Disease for the UK economy in particular.

Forsyth and Kay (1980) adopt a comparative statics approach to the study of the Dutch Disease by carrying out an examination of two hypothetical states of the UK economy. In other words, they describe what would have happened to the United Kingdom had oil not been discovered in the North Sea Oil and examine the impact on sectoral output and the balance of payments. From the perspective of the balance of payments, they claim that the improvement in the UK current account (ex-ante) was associated with the increase in output of oil which is either exported or substituted for costly oil imports. The kernel of their argument strongly suggests that that there were ways by which Britain can benefit from North Sea due to its self sufficiency in oil, these being the contraction of the manufacturing sector and the increase in spending on imported goods[2]. The market's mechanism for bringing about this change is the appreciation of the exchange rate. One can link the idea of the oil sector supplanting manufacturing to the idea that the wealth generated from the oil sector supplanted sensible agricultural development in developing countries. In essence, Forsyth and Kay point out that the rise in the exchange rate was a beneficial mechanism for bringing about structural readjustments in the United Kingdom economy[3]. The result is an exchange of oil for traded goods and the redeployment of resources released from these sectors into the non-traded sectors. They essentially conclude that North Sea Oil added value to the United Kingdom output. They emphasise that there is no mechanism for deriving any benefit from oil which does not in the short or long run require this structural change. The decline in the UK manufacturing sector must occur in absolute terms rather than relative terms.

Although Forsyth and Kay's (1980) study is analytically sound given their descriptive methodology, a number of problems arise from their study. In general, the comparative static approach and the set of assumptions implicit in Forsyth and Kay's analysis tends to weaken their conclusions. If the UK economy were allowed to grow at the same time as oil was introduced then the decline in the manufacturing sector might have been a relative and not an absolute one. (Atkinson and Hall, 1983). Therefore, the development of a natural resource whether exported or replacing existing imports might likely lead to a relative decline in the domestic production of tradeable goods, particularly manufacturing. Secondly, the assumption implicit in Forsyth and Kay's and Gregory's (1976) analyses that government policy remains unchanged is rather implausible. Atkinson and Hall argue that fiscal and exchange rate policies could be used to bring about near full employment and cause the exchange rate to fall without creating a balance of payments problem. However, they concede that such a course of action could have inflationary consequences through rising import prices given the low exchange rate and rising demand given the higher level of income. As the Bank of England forcefully argued deindustrialization was not

[2] The effects of North Sea Oil on the UK economy are however disputed. See for example, Bank of England, 1980, 1982 ; Rhys, 1980 and Thirlwall and Gibson, 1992.

[3] Structural adjustment in this context is the tendency towards deindustrialization. In Nigeria's case, the recognition that structural adjustment was necessary came after the collapse of oil in the mid to late 1980s. However, this is not unusual. The Bank of England (1982) noted that the UK may have to face the need for structural change as oil fields dry up, or as the resource costs rise in the future.

inevitable. More particularly, the high exchange rate was not necessarily due to developments arising from North Sea Oil, but factors such as asset preferences of oil exporting developing countries and the high interest rates in the United Kingdom. Furthermore, the long run implications of Forsyth and Kay's analysis seemed to suggest that the United Kingdom had fully adjusted to the rise in oil prices. In other words, their structural adjustment process did not fully incorporate the adjustments required relative to past trends (Rhys, 1980).

In concluding this section, in general, the negative effects of resource booms has been on the manufacturing sector and this has been linked to the idea of deindustrialization or Dutch Disease in countries like the UK, Norway and Netherlands which had significant manufacturing industries prior to oil. In the next section, it is argued that in countries that had little or no manufacturing industries prior to a resource boom, the pressure was placed more on the traditional agricultural sector and *deagriculturisation* was the result in these economies.

By relaxing some of the standard assumptions implicit in the core models of Dutch Disease, different sets of results are obtained such that most of the theoretical models reviewed in this section are of less practical applicability to the experiences of the Less Developed Countries (LDCs). In general, given that much of the analyses of Dutch Disease has been on the Developed Countries (DCs), any adoption for a developing country will require certain assumptions which though not necessarily applicable to the conventional analysis will be perfectly legitimate within a developing country framework. The most obvious assumption is that the manufacturing sector can be represented by any other exporting sector such as agriculture. Indeed, the presentations of the extensions to the core models that follow adopt such an approach.

4.4 Extensions of the Core Models: A Theoretical and Empirical Review of the Literature

Much of the literature on Dutch Disease has been concerned with the experiences of the Developed Countries (DCs) and there has been relatively very little work done on the Less Developed Countries (LDCs). The effects of resource discoveries on an open economy have stimulated very wide interest in the economic literature particularly in the Netherlands, Australia and the United Kingdom for some time. More recently, the focus has been on the LDCs particularly in oil exporting countries like Saudi Arabia, Kuwait and Nigeria (Fardmanesh, 1991a, 1991b; Kamas, 1986; Looney, 1990 and 1991; Struthers, 1990 and Richards, 1994). Any meaningful comparative analysis outside the scope of a developing country framework therefore becomes less relevant.

In this section, alternative mechanisms of change arising from the Dutch Disease are discussed. In particular, the limited empirical evidence of the perceived effects in LDC are presented in light of the much discussed macroeconomic effects of resource discoveries and the resultant loss of competitiveness of the traditional export sectors.

4.4.1 Applicability to Less Developed Countries (LDCs) and Evidence of Mechanisms

Contrary to the conclusions of the core models of the Dutch Disease which predict a contraction of the manufacturing sector, some empirical studies have shown that the agricultural sector and not the manufacturing sector contracted in many oil exporting developing countries exporting countries as a result of a resource boom. The account presented in the previous chapter revealed that in Nigeria's case the manufacturing sector performed well during the much of the boom years of the 1970s and early 1980s and what appeared to emerge was the reversal of deindustrialization in ways typical of the Dutch Disease literature. A number of theoretical explanations have been provided to explain this phenomenon and the experiences of Nigeria and other natural resource exporting developing countries. Benjamin et al, (1989) and Fardmanesh, 1991b have modified certain features and assumptions of the core models to explain this trend. Although Corden (1984) and Corden and Neary (1982) did observe in their theoretical papers that some of the non-boom tradeable sub-sectors might expand even though the sector as a whole might contract, these studies have provided the theoretical underpinnings to explain the growth of manufacturing and the concurrent decline of agriculture. These theoretical models have been followed by supporting empirical studies by Fardmanesh, 1991a; Kamas, 1986; Looney, 1990, 1991; Hiliare, 1992 and Richards, 1994, amongst others.

Benjamin et al (1989) have provided an explanation for the expansion of manufacturing, which assumes that manufactures are semi-tradeable goods, by incorporating in their analysis the relaxation of the assumption of perfect substitutability between domestic and imported goods. They show that not all the traded sectors contract as a result of a resource boom. Their general equilibrium model for Cameroun revealed that the agricultural sector contracted while the manufacturing sector expanded, a conclusion that is consistent with those of Fardmanesh and the limited studies of Dutch Disease in developing countries. However, the long run effects from their study is difficult to ascertain given their underlying assumptions about the use of capital and labour.

Fardmanesh (1991a, 1991b), provides an additional explanation of the expansion of the manufacturing sector in LDCs by incorporating into his analysis the idea of a world price effect. Fardmanesh's study of Nigeria and other oil exporting LDCS showed that a spending/income effect and the world price effect, defined as the world price of manufactured goods relative to agricultural products, contracted the agricultural sector and expanded the manufacturing sector. The impact on the non-traded sectors is ambiguous. The spending effect tended to expand output, while the world price effect contracted output under certain plausible circumstances.

The inclusion into the core analysis of Dutch Disease models of the rise in the world price of manufactured goods relative to agricultural products due to oil price increases is a strong factor proposed by Fardmanesh which provides this additional explanation for the expansion of the manufacturing sector. Since developing oil exporting countries are price takers in the world non-oil markets, the domestic relative price and hence profitability of manufactured goods rises in these countries. The rise in manufactured prices is the result of the increase in oil imports and hence production costs of developed countries. Additionally, increased incomes from oil accruing to developing countries increases the demand for manufactured products. This expansion is at the expense of the declining agricultural and possibly the non-traded goods sectors as well. This world price effect impacts on sectoral output through both the supply side and the demand side the importance of which has been underscored by Marquez (1984) in the transmission of oil price effects on the world economy.

For Fardmanesh, on the supply side, the increase in the world price of manufacturing raises the value added and relative profitability of the manufacturing sector in developing oil sector-exporting countries. What this means is that such countries avoid the adverse effects of a shrinking manufacturing base as predicted by the Dutch Disease. The manufacturing sector expands at the expense of the agricultural and non-traded sectors. Fardmanesh claimed that the increased price of oil does not affect the domestic production costs of manufacturing in the oil exporting LDCs because manufacturing is less oil intensive in these countries than in the developed countries. On the demand side, the increase in the world price of manufactured goods worsens the non-oil terms of trade of developing oil-exporting countries since they are net importers of manufactured goods and the resultant decline in national income leads to an excess supply of non traded goods which contracts this sector and expands the manufacturing sector. Based on this theoretical analyses, Fardmanesh (1991a) tests his hypotheses for several oil producing developing countries including Nigeria. The results for Nigeria are presented in Table 4.1.

TABLE 4.1: DUTCH DISEASE AND SECTORAL OUTPUT IN NIGERIA (1970-82), Fardmanesh, 1991.

Sector*	AARGR	Constant	O	P	R^2	F
A	0.83	97.26 (12.58)	-1.36 (-9.26)	-0.33 (-5.78)	0.84	43.40
M	15.33	-24.76 (-7.65)	0.50 (8.17)	0.24 (10.03)	0.87	55.47
N	7.72	27.49 (4.05)	0.86 (6.67)	0.09 (1.80)	0.74	24.71

* A, M and N are the dependent variables and denote the share of agricultural output, manufacturing output and non traded output in non-oil GDP respectively. AARGR denotes sectoral annual real growth rates for the period 1970-82.

The independent variables are O, the ratio of oil revenues to GDP, and P, an index of world relative price of manufactured goods to agricultural products for less developed countries. t-ratios are in parentheses. All the coefficients for the agricultural and manufacturing sectors are significant at the 1% level, while the coefficients for the non traded sector are significant at the 5% level. Fardmanesh's conclusion is that the oil boom contracts the agricultural sector and expands both the manufacturing and non-traded sectors via the increase in oil revenues and the world price of manufacturing.

There are however a number of problems with both the theoretical analyses and the empirical results of Fardmanesh. From a theoretical perspective, Fardmanesh argues that the rise in manufactured prices is the result of the increase in oil imports and hence production costs of developed countries. However for oil discoveries, this may not apply and furthermore oil costs are not necessarily the major cost for many manufactured goods (Darmstadter et al, 1978). Secondly, Fardmanesh claims that the increased price of oil will not affect the domestic production costs of manufacturing in the oil exporting LDCs because manufacturing is less oil intensive in these countries than in the developed countries. On the contrary, one might find that LDCs are more oil intensive than the DCs for manufactured goods. As compared to other energy forms, it requires a less extensive and expensive supply infrastructure.

From the perspective of the empirical results, Fardmanesh's use of reduced form share equations do not show the structural features of the economy. Secondly, the dependent variables should have been absolute sectoral output rather than shares because for example, a growing agricultural sector would lose share if non-oil GDP and other non-traded goods are growing at a faster rate. More importantly, the equations do not take into account the use of resources and the role of the government so that it is doubtful whether the study directly addresses the Dutch Disease.

Unfortunately, a review of the Dutch Disease literature provides little empirical support or lack of support for Benjamin et al (1989) or Fardmanesh's (1991a) studies, especially on the latter which tested important hypotheses for Nigeria. The reason for this is those studies which have examined the Dutch Disease effects on the Nigerian economy have more or less applied partial analyses rather than full macroeconomic or macroeconometric studies. For example, Nyatepee-Coo, 1994 and Salehi-Isfahani, 1989 have simply estimated import demand functions for Nigeria using the Dutch Disease as a theoretical framework, which, though important, does not fully investigate the mechanisms at work. Similarly, Jazayeri's (1986) study, which uses descriptive analysis with the Dutch Disease as a theoretical framework to show the association between sectoral prices and sectoral output growth rates in Nigeria, lacked both content and a rigorous methodology. Several studies of closely related economies to Nigeria have also used descriptive methodologies (for example, Ansari, 1989, Al Sabah, 1988).

However, some evidence of the impact of two important Dutch Disease indicators, namely the exchange rate and sectoral relative prices, on the pattern of development in Nigeria was provided by Struthers (1990). His single sector study of the effect of the real exchange rate on industrial output in Nigeria revealed a positive statistically significant, though small, coefficient which suggested that a high real exchange rate may have benefitted the manufacturing sector prior to 1982. Given the scant evidence on Nigeria, the rest of this section relies on studies that have investigated the effects of the Dutch Disease on closely related economies. In doing so, the review is not necessarily limited to oil producing countries but includes other natural resource producing countries which have similarly experienced Dutch Disease type symptoms .

In Looney's (1991) study of a number of developing oil exporting countries, he finds that the Dutch Disease was particularly strong, most notably in Kuwait, in the years immediately prior to the oil price declines in 1982. He also detects the strong influence of the real exchange rate and relative prices on the economy. Looney shows that between 1973 and 1977, the period characterised by the first OPEC price shock and high oil prices, the real exchange rate of the Kuwaiti currency appreciated by 31%, and following the second oil price shock (1979 -1987), Kuwait actually devalued its currency by 8%. Kuwait's purchase of large amounts of foreign assets enabled the country to devalue the exchange rate and control the domestic rate of inflation, a policy that Nigeria could have followed but failed to do. The interesting result however is that, the devaluation of the Kuwaiti currency did not necessarily result in an expansion of the industrial traded sector, which reinforces the importance of carrying out a rigorous study of individual sectors that takes into account a broad range of factors.

A more detailed account of sector specific effects was contained in a study by Looney (1990). Looney employs OLS to annual data for the period 1965 - 1985 to explain the effects of Dutch Disease type factors on Saudi Arabia traded and non-traded sectoral output. Looney's main results are as follows: For the traded sectors, i.e S1 and S2, the DUTCH variable is significant and has the expected positive sign, indicating that increases in the real exchange rate or an appreciation decreases traded output (See Table 4.2).

TABLE 4.2: IMPACT OF DUTCH DISEASE EFFECTS ON SAUDI ARABIAN SECTORAL OUTPUT IN CONSTANT 1970 PRICES (1965-1985), Looney, 1990.

	Eqn (1)	Eqn (2)	Eqn (3)	Eqn (4)	Eqn (5)
	Sector 1	**Sector 2**	**Sector 3**	**Sector 4**	**Sector 5**
GOVCE	0.06(2.31)	0.53(2.93)			0.05(3.17)
GOVIE				0.10(2.37)	
YNOE	0.07(2.84)			0.08(3.07)	0.05(4.02)
OIL			0.31(6.85)	0.06(3.48)	
INFE	-0.28(7.32)	0.35(2.73)	0.33(9.39)	1.15(7.33)	0.72(6.47)
DUTCH	1.14(5.17)	0.39(2.64)	0.66(3.37)	-1.58(2.51)	-0.13(0.97)
Rho	-0.04	-0.69	0.76	-0.04	0.03
R^2	0.922	0.990	0.939	0.994	0.997
F-statistic	44.07	508.95	82.56	541.21	702.84
Durbin-Watson	2.04	2.05	2.28	2.07	2.05

Source: Looney RE (1990), Oil Revenues and Dutch Disease in Saudi Arabia: Differential Impacts on Sectoral Growth. Canadian Journal of Development Studies, Vol XI, No 1.

Notes: (a) S1: Agriculture; S2: Manufacturing; S3: Mining; S4: Construction; S5: Transport, Storage and Communications.

(b) Independent Variables: GOVCE = Expected Government Consumption; GOVIE =Expected Government Investment; YNOE = Expected non-oil GDP; OIL = Output of the oil sector; INFE = Expected rate of inflation and DUTCH = real Saudi riyal/US $ exchange rate. The figures in brackets are t-statistics.

An important implication from Looney's results is that exchange rate appreciation might have offset any gains in terms of cost reductions associated with lower priced imports of capital inputs and labour. The expected level of government consumption and expected rate of inflation were significant for both traded sectors, although the manufacturing sector was wrongly signed with respect to the latter variable. On the other hand, for the non-traded sectors, exchange rate appreciation did not always have the effect of significantly increasing non-traded output. A strong significant effect across all the non-traded sectors appeared to be the positive influence of government investment on the growth of these sectors.

Besides not examining the effect of relative sectoral prices on output, Looney's study does not explain explicitly the spending effect arising from Dutch Disease on sectors. Sectoral prices are proxied by using expected inflation rather than real sector specific price indices. Looney does not address the problem of possible endogeneity of both product and factor prices neither does he carry out estimates of the determinants of relative prices, even though he points to the fallacy of the theory in addressing the consequences of a boom whilst holding the determinants of relative prices constant. Further, demand is explained by using the expected level of government expenditure as a control variable, but increased spending in a strict Dutch Disease sense is by both private and public agents, so that separate sectoral demand regressions would have been appropriate. Therefore, nothing can be said about the effect of prices on output, demand and the use of factors of production, so that no firm conclusions can be drawn about the extent of the resource movement and spending effects.

Some of the short-comings of Looney's studies are addressed in studies that explain the experiences of other non-oil natural resource exporting countries like Colombia (Kamas, 1986) and Paraguay (Richards, 1994). Whilst the review of the Dutch Disease literature thus far has focused entirely on oil exporting LDCs, the studies by Kamas and Richards on these non-oil exporting LDCs contain results that generally appear to be of some relevance to Nigeria and other oil exporting LDCs.

Although Richards (1994) explicitly accounts for the determinants of sectoral prices, wages and the exchange rate, his results are not indicative of the existence of the Dutch Disease in Paraguay across sectors in any clear sense. Richard confirms that a booming export industry may or may not reduce other traditional lines of export. For example, Richard's result attests to a significant negative effect of booming cotton exports on the traditional exports of food and animal products and to some extent on the exports of forest products. However, he found no evidence to support the Dutch Disease claim with respect to the booming soybeans sector, given the positive and statistically insignificant signs on both traditional lines of exports. Furthermore, he found no significant impact of the cotton sector on both the manufacturing and non-traded sectors. With regards to the distribution of income, which is a recurring concern in the theoretical literature, Richards found no evidence to suggest that the booming export sector activities had worsened real wage or the share of wages in national income.

A number of observations can be made from Richard's study. Firstly, the high price of cotton is associated with a tendency for the relative price of non-traded goods to increase which is symptomatic of Dutch Disease type effects, although, contrary to the theory, it does not lead to a decrease in the real exchange rate (an appreciation). By contrast, an effect that is loosely associated with the Paraguayan balance of payments consistently and significantly affects sectoral output, sectoral prices, the real exchange rate and the real wage. According to Richard, in Paraguay, highly capital intensive booming export sectors, which require little labour appear not to compete directly with traditional export sectors for productive factors so that the resource movement effect is not observed. Richards's conclusion is of direct relevance to the Nigerian oil industry which has been shown to employ very little domestic labour.

Similarly, Kamas' (1986) study of the Colombia coffee export boom provides estimates of the determinants of relative prices and the real exchange rate and their effects on sectoral output and exports. Although not strictly comparable to Richards (1994) or the studies already reviewed, Kamas shows that the relative price of non-traded to traded goods is positively related (though not statistically significant) to the price of coffee and government spending. On the other hand, both factors had a significantly negative effect on the real exchange rate. Furthermore, whilst relative prices affected different sectors in different ways, an expansionary fiscal policy stimulated output in all sectors, while increases in the real exchange rate (a depreciation) expanded output in the most traded sectors and reduced it in the least traded sectors.

However, the statistically insignificant real exchange rate variable in all sectors only weakly confirms the prediction from the theory of Dutch Disease that the real exchange rate has a major effect on the sectoral distribution of output. Furthermore, besides having sometimes reported low Durbin-Watson statistics and low R^2, Kamas does not carry out any statistical procedures to test for or correct for these problems. The limited number of explanatory variables, some of which were wrongly signed and insignificant and the explicit omission of measures of the determinants of the wage casts doubts on the results of Kamas in effectively explaining the precise mechanisms of Dutch Disease effects in LDCs. An attempt is made to provide a summary in Table

4.3 below of all the empirical studies reviewed for the LDCs.

TABLE 4.3: SUMMARY OF STUDIES OF THE MACROECONOMIC EFFECTS OF THE DUTCH DISEASE ON THE TRADED AND NON-TRADED SECTORS

				Macroeconomic Policy Variables:				
Author:	**Estimation Period**	**Method**	**Country Presented**	**Relative Prices**	**Exchange Rate**	**Monetary Policy**	**Fiscal Policy**	**Natural Resource Output**
Fardmanesh	1970-1982	OLS	Nigeria	S_T/NS_{NT}	-	-	-	S_T/S_{NT}
Looney	1965-1985	OLS	Saudi Arabia	S_T/NS_{NT}		S_T/S_{NT}	S_T/S_{NT}	S_T/S_{NT}
Richards	1970-1985	OLS	Paraguay	NS_T/NS_{NT}	-	-	S_T/S_{NT}	-
Kamas	1970-1981	OLS	Colombia	S_T/S_{NT}(WS)	S_T/S_{NT}	S_T/S_{NT}	S_T/S_{NT}	-
Struthers	1970-1982	OLS	Nigeria	-	S_T	-	-	-

Notes: (i) "S", "NS" and "WS" mean Statistically Significant, Not Significant and Weakly Significant respectively.
(ii) subscripts "NT" and "T" denotes non-traded and traded sectors respectively.

In general, the major weaknesses of the studies reviewed for the LDCs including those summarised in Table 4.3 are two-fold. First, the use of a descriptive methodology by several authors makes it difficult to accept their results and, hence, their conclusions cannot be justified either on empirical or theoretical grounds. Secondly, the studies that carried out econometric investigations, particularly those presented in Table 4.3, do not take into account sufficient factors to arrive at any conclusive evidence of the effects of the Dutch Disease. A recurring theme of all the studies was the impact that the Dutch Disease effects had on sectoral (supply) output to the neglect of sectoral demand and factors of production.

However, these empirical results and theoretical studies are still useful in that they form some initial and important set of clues about the nature of the Dutch Disease in Nigeria. Firstly, it appears that the spending effect may be of great importance because of the fact that a large part of the revenues accruing to factors in the booming sector are typically paid in taxes. Secondly, the real exchange rate has been shown to be of importance in explaining sectoral output changes. Thirdly, prices particularly relative prices and the world price of manufactures appear to be a strong factor in explaining the Dutch Disease.

However, any study of the effects of the Dutch Disease both in terms of its direction and magnitude must explicitly model the use and employment of factors, the manner in which the government spends the extra revenues and the effects of the balance of payments. The government's sectoral expenditure and pricing policies will be important in any analysis of the Dutch Disease given its role in influencing demand. The nature of the supply functions is critical to an understanding of relative sectoral factor intensities, use and output. The response of factors of production to exogenous changes generally determines the flows of investment and employment. The balance of payments may also be important because of the constraint that it imposes on demand, sectoral output growth and ultimately economic growth and development.

The proposed model of the Dutch Disease for Nigeria will explicitly take into account these factors in determining the magnitude, direction and mechanisms of the core effects and any additional effects if present. In general, any model within a developing country framework must question the validity or otherwise of the assumptions implicit in core models of the Dutch Disease. It is obvious that in analysing the performance of different sectors in the Nigerian economy, factors that impact on the supply and demand for sectoral output will be just as important as the responsiveness of factors of production to prices and other macroeconomic fiscal incentives.

4.5 Sectoral Macroeconomic Models and Related Literature

The impact of a resource discovery on an economy can be addressed either within an aggregative framework or, more typically, within a disaggregated framework that clearly distinguishes between non-resource traded sectors and the non-traded sectors. Models in the latter category, such as those already reviewed, are concerned with the short, medium and long-run effects of a natural resource on the sectoral distribution of factor incomes, output and employment. Although various theoretical approaches, such as linkage theory, two and three-gap models of growth and theories of export instability (Gelb, 1988), have been used as possible explanations of the effects of natural resource discoveries, the theoretical framework provided by sectoral Dutch Disease macro models has become increasingly important in the last two decades or so.

However, not all sectoral macroeconomic models are necessarily used to examine Dutch

Disease effects. A great deal have been used in studies in the growth and trade literatures, for macroeconomic policy simulations and for macroeconomic development planning. These studies which have clearly been of importance to both Developed Countries (DCs) and the Less Developed Countries (LDCs), including Nigeria, have certain features which can be very useful in building macroeconomic Dutch Disease models. Hence a brief review of sectoral macro models from the growth and trade literatures, and the literature on macroeconomic policy simulations and development planning is given.

It is generally acknowledged that the modern analysis of a closed economy multi sectoral growth model that took into account the complementarity between the agricultural and industrial sectors in the development process began with Lewis (1954). This over the years has been extended by, amongst others, Fei and Ranis, 1964; Todaro, 1969; Jorgenson, 1967; Harrod, 1973 and Thirlwall 1986, with variants developed by Uzawa, 1961 and Turnvosky, 1991, to mention a few.

These closed economy macro sectoral models when opened up to trade allowed for the development of alternative theories of sectoral growth, for example, the foreign exchange availability theory with antecedents in dual and three gap analyses, and models that emphasised external demand constraints. The dual gap model, which has been explored by McKinnon, 1964 and Taylor, 1979 for example, is concerned with the shortage of foreign exchange in the presence of relatively inelastic import requirements (Dutt, 1990) or simply, when economies have strict foreign exchange controls (Pesaran, 1984). The demand constrained models on the other hand, view sectoral development and ultimately growth as being largely determined by export demand (Ram, 1985 and Moschos, 1989) and the constraints imposed by the balance of payments (for example, Thirlwall and Hussain, 1982; Thirlwall and Gibson, 1992 and McCombie and Thirlwall, 1994).

For the purposes of macroeconomic development planning, several macro models have been used to examine the effects of macroeconomic policy shocks on the economy (Barker et al, 1980; Neary and Purvis, 1981; Bond and Knobl, 1982; Lee et al, 1992; Pesaran et al, 1993; Runstler, 1994; Siebe, 1995 and Ajaikaiye and Ojowu, 1994, for example), and for development planning in LDCs (for example, Akhiakpor, 1989 and Ndlovu, 1994). Many of these studies will clearly be of importance in developing a Dutch Disease macro model for Nigeria because they distinguish between sector-specific and aggregate economic shocks, in most cases arising from the oil industry.

Although this thesis is concerned with sectoral macroeconomic models that primarily stem from the Dutch Disease literature rather than those linked to the growth and trade literature or the literature on macroeconomic policy simulations, the Dutch Disease model developed for Nigeria in subsequent chapters inevitably straddles across most strands of the broader literature reviewed. It has been necessary to adopt such an approach because of the relatively scant empirical (and theoretical) studies of Dutch Disease for Nigeria and the fact that there are commonalities across many macroeconomic sectoral models irrespective of the theory to which they are particularly affiliated.

4.6 Conclusions

This chapter has provided a comprehensive review of the theory and empirical literature of Dutch Disease and a brief review of related macroeconomic multi sectoral models. In particular, the results from several studies of natural resource exporting developing countries were presented and the extent and causes of the Disease investigated.

On a general note, the evidence presented was mixed, largely the result of inadequate theoretical models and the lack of robust econometric studies that took into account the realities, and, particularly, the peculiar nature of oil exporting developing countries like Nigeria. The seminal contribution by Corden and Neary (1982) provided the theoretical starting point, and the conclusion drawn was that their model and the bulk of the other core theoretical models reviewed were clearly of more relevance to oil exporting developed countries with sophisticated and well functioning capital and labour markets.

The review of the theoretical and empirical extensions of the core models revealed that they were more suited to the needs of Nigeria and hence could be useful in providing the initial foundations for the development of a Dutch Disease model for Nigeria. However, a major weakness of most of the studies was that they failed to determine the exact nature and the extent of the mechanisms at work which resulted in the absolute and relative decline of the exposed traded sector, in particular, the agricultural sector. This was largely the result of naive econometric specifications, specifically with regard to oil price and quantity variables, insufficient disaggregation of the economy and/or a focus on particular aspects of the Dutch Disease that were really more the result rather than the root causes of the disease. Therefore, a thorough examination of the structural changes *within* and *across* all sectors of the economy, which may or may not have their origins in the perceived disruption brought about by the oil boom, must be conducted in order to arrive at firm conclusions of the harmful or otherwise effects of the Dutch Disease. The chapter noted that the proposed Dutch Disease macro model for Nigeria will inevitably draw on the wider literature on macroeconomic sectoral models, partly the result of inadequate studies of Dutch Disease and partly because of the importance of these models themselves.

The next chapter therefore attempts to build a more robust Dutch Disease macro model for Nigeria than has previously been done. The originality of the model stems from the use of sectoral structural equations, rather than reduced form equations, that are sufficiently disaggregated so that the structural features of the Nigerian economy can be better studied. The model uses sufficient sectoral data to test the theoretical models properly to show the price, income, resource movement and balance of payments effects of the Dutch Disease.

In particular, the important role of the government in influencing the magnitude and direction of the Disease and the relative size of sectors is emphasised. Although some of the studies reviewed showed that in the absence of government the decline of some sectors, such as manufacturing, may be inevitable if a country is to gain from oil, in Nigeria's case, one might be inclined to conclude that sectoral declines to a great extent might result from failure of government policies rather than inevitable factors directly due to oil, given that the government is the main beneficiary of oil revenues that accrue to the country.

CHAPTER 5

A STRUCTURAL MULTI-SECTORAL DUTCH DISEASE MACRO MODEL FOR NIGERIA

5.1 Introduction

In this chapter, a Dutch Disease Model of the Nigerian economy that is capable of econometric estimation is built. The Dutch Disease model for Nigeria is based on the view that economic decisions are based upon prices and that dynamic effects are often important. Using first principles of economics, the proposed model for Nigeria draws on both the theoretical and empirical literature of Dutch Disease and multi sectoral macroeconomic models. The main objective is to explore in a lot more detail than has previously been done the extent of and actual mechanisms implicit in theoretical and empirical models of Dutch Disease using Nigeria as one particular example.

In Section 5.2 the economics and interpretation of the dynamic multi sectoral Dutch Disease model is explained. The rationale behind the specification of each equation is discussed and how the model as a whole works. In Chapter Six, there is further discussion of the dynamic specifications. The first equations discussed are those for the domestic supply of and demand for sectoral output. By examining the supply-side, inferences can be drawn about the resource movement effect, while the examination of the demand-side sheds light on the spending effect. Then the resource movement effects are further analysed by examining and formulating sectoral capital and labour demand and supply functions which draw on a number of theoretical and empirical approaches based on neoclassical and to some extent on accelerator type models. In doing so, the critical role of government in influencing sectoral capital demand is emphasised and discussed. In the standard version of the model, world prices are fixed. The model is built such that in subsequent chapters the standard world price version allows for the investigation of the classic Dutch Disease effects. An additional effect is investigated that refers to the ability of a country to run balance of payments deficits when enjoying a resource boom. With regard to the determination of the balance of payments, two variants are considered: one where the exchange rate is exogenous with the balance of payments being endogenous and vice-versa.

In Section 5.3, the econometric issues of the model are discussed. In this section, the econometric issues of identification, instrumentation, sample size and the estimation procedures are addressed in the context of simultaneous equation models. In addition, the methodology for the evaluation of the results of the estimated model in Chapter Six is formally presented and discussed.

Finally, Section 5.4 discusses some problems in the data used in this study and the rationale behind the adoption of a five-sector framework for this study, while section 5.5 concludes the chapter.

5.2. *Oil Production, Sectoral Output and Demand Responses, the Employment of Factors of Production and the External Sector: An Integrated Multi-Sectoral Macro Model*

5.2.1 *An Overview of the Multi Sectoral Macroeconomic Model*

The sub-section gives an economic interpretation of the sectoral model that is estimated in Chapter Six. This interpretation is at a broad level, and the important model equations are discussed and explained in greater detail in later sections of this chapter. The present discussion ignores all issues of dynamics and econometric specifications, which are taken up later on.

The model considers five sectors: Agriculture (A), manufacturing (M), Oil (O), Non-Traded Industrials (N) and Services (S). The first three sectors produce tradeable goods and the latter two produce non-tradeable goods. The choice of sectors was determined by the availability of suitable data and is discussed in greater detail in section 5.4. Each sector is assumed to use two factors of production, labour and capital. The variable factor of production is always labour and is assumed to be intersectorally mobile both in the short and the long runs. Capital is fixed in the short run and is therefore sector-specific and intersectorally immobile. In the long run, the capital stock can be altered through depreciation and net new investment and, therefore, becomes mobile between sectors.

The basic equations of the model are listed below and refer to three variants of the model namely: infinite elasticities of export demand and import supply model (the World Price model);

the Exogenous Exchange Rate model; and the Balance of Payments Constrained model.

Following Corden and Neary (1982), Fardmanesh (1991a, 1991b) and others, monetary considerations are ignored in general so as to highlight the structural effects of the boom in the oil sector. The focus will be on the implications for relative prices and real variables rather than nominal variables.

A key to all variable names is given after the equations. Variables in bold represent vectors. The subscript j represents, A: Agriculture sector, M: Manufacturing sector, O: Oil sector, N: Non-Traded Industrial sector and S: the Services sector.

Formal Specification of the Macroeconomic Dutch Disease Model for Nigeria

Behavioural Equations:

(5.1) $S_j \quad = \quad f_j\,(\mathbf{PS}, \ \mathbf{PL}, \ DK_j)$ $\qquad$ (j = A, M, N, S)

$$\frac{\partial S_j}{\partial PS_j} > 0, \ \frac{\partial S_j}{\partial PL_j} < 0, \ \frac{\partial S_j}{\partial DK_j} > 0$$

(5.2) $S_O \quad = \quad$ fixed politically by OPEC

(5.3) $(D/POP)_j \quad = \quad g_j\,(\mathbf{PD}_j, \ Y/POP)$ $\qquad$ (j = A, M, O, N, S)

$$\frac{\partial (D/POP)_j}{\partial PD_j} < 0, \ \frac{\partial (D/POP)_j}{\partial (Y/POP)} > 0$$

(5.4) $DK_j = h_j(S_j, \mathbf{PS}, \mathbf{PL}, RIR)$ $(j = A, M, O, N, S)$

$$\frac{\partial DK_j}{\partial S_j} > 0, \ \frac{\partial DK_j}{\partial PS_j} > 0, \ \frac{\partial DK_j}{\partial PL_j} > 0, \ \frac{\partial DK_j}{\partial RIR} < 0$$

(5.5) $\sum SK_j = m_j(RIR, Y)$ $(j = A, M, O, N, S)$

$$\frac{\partial(\sum SK)_j}{\partial RIR} > 0, \ \frac{\partial(\sum SK)_j}{\partial Y} > 0$$

(5.6) $DL_j = n_j(S_j, \mathbf{PS}, \mathbf{PL}, RIR)$ $(j = A, M, O, N, S)$

$$\frac{\partial DL_j}{\partial S_j} > 0, \ \frac{\partial DL_j}{\partial PS_j} > 0, \ \frac{\partial DL_j}{\partial PL_j} < 0, \ \frac{\partial DL_j}{\partial RIR} > 0$$

(5.7) $(SL/WPOP)_j = o_j(\mathbf{WL})$ $(j = A, M, O, N, S)$

$$\frac{\partial(SL/WPOP)_j}{\partial WL_j} > 0$$

Identities:

(5.8) $PS_j = WP_j * ER * (1 + TFF_j/IM_j)$ $(j = A, M, O)$

(5.9) $PD_j = PS_j * (1 + NT_j)$ $(j = A, M, O, N, S)$

(5.10) $Y = \dfrac{\sum S_j + NFI}{POP}$ $(j = A, M, O, S, N, G)$

where G is the government services sector.

(5.11) $S_j = D_j + NX_j$ $(j = A, M, O)$

Market Clearing Conditions:

(5.12) $S_j = D_j$ $(j = N, S)$

(5.13) $\sum SK_j = \sum (\Delta DK_j + \delta_j DK_j)$ $(j = A, M, O, N, S)$

(5.14) $SL_j = DL_j$ $(j = A, M, O, N, S)$

(5.15) $\sum S_j * PS_j - \sum D_j * PS_j = BP$ $(j = A, M, O)$

Key to the Macroeconomic Variables:

S	-	Output Supply
D	-	Output Demand
DK	-	Capital Demand
SK	-	Capital Supply
DL	-	Labour Demand
SL	-	Labour Supply
PS	-	Output Supply Prices
PD	-	Output Demand Prices
PL	-	Labour Demand Wage
WL	-	Labour Supply Wage
RIR	-	Interest Rate
Y	-	National Income
NX	-	Net Exports
WP	-	World Prices
NT	-	Net Taxes
TFF	-	Tariffs
NFI	-	Net Factor Income
BP	-	Balance of Payments
ER	-	Exchange Rate
GEX1	-	General Government Expenditure excluding Investments
GEX2	-	Government Investment Expenditure in the Oil Sector
POP	-	Population
WPOP	-	Working Age Population

The simplest model is the exogenous exchange rate model with world prices. There are five supply and demand equations in which prices, income and capital variables have standard effects. The quantity and price of oil is determined by OPEC, so there is no standard supply equation for the oil sector. The Naira prices of tradeable goods (agricultural, manufacturing and oil) are determined by world prices and the fixed exchange rate. Differences between supply and demand prices are given by the net tax identity equations in (5.9).

The demand and supply for capital equations follow the normal specification, with new investment being mobile between sectors. Similarly, the labour demand and supply equations are of a standard specification. Oil demand equations for capital and labour are specified as although quantity and the price of oil are determined by OPEC, the method of production may depend on the relative prices of factors.

Prices for the non-tradeable goods are determined by the equality of supply and demand in the two sectors implied in our equation (5.12). The prices of capital and labour are also determined by our market clearing conditions in equations (5.13) and (5.14) above. Finally, with the exchange rate being exogenous, the balance of payments is endogenous and is determined by the final equation (5.15) in the list above.

In the Balance of Payments constrained model, the key difference with other variants of models is that the exchange rate is endogenous and is determined so as to give the exogenously determined level of balance of payments. This balance of payments constraint is not necessarily zero.

5.2.2 The Supply and the Demand for Disaggregated Sectoral Output

In this sub-section, the equations for the supply and the demand for sectoral output which were presented as part of our economic interpretation of the entire model at a broad level is considered in detail. For these equations, the formal derivations are given and the econometric specifications presented. In each final econometric specification presented, although the dynamics are included, the theoretical explanation and rationale for the incorporation of dynamics are fully considered in Chapter Six.

Starting with the ith firm,

$$(5.16)\quad S_j^{\,i} = f_j^{\,i}(DL_j^{\,i},\ DK_j^{\,i})$$

Profits can be defined as:

$$(5.17)\ \Pi = PS_j^{\,i}\ f_j^{\,i}(DL_j^{\,i},\ DK_j^{\,i})\ -\ (PL_j DL_j^{\,i}\ +\ RIR\ DK_j^{\,i})$$

In the short run, we have (assuming price taking of PS_j and PL_j)

$$(5.18)\ PS_j \frac{\partial f_j^{\,i}}{\partial DL_j^{\,i}}\ (DL_j^{\,i}, DK_j^{\,i})\ =\ PL_j$$

Solving for DL_j^i

$$(5.19)\ DL_j^{\,i} = DL_j^{\,i}\ (PL_j^{\,i},\ PS_j^{\,i},\ DK_j^{\,i})$$

$$(5.20)\ \Rightarrow\ S_j^{\,i} = f_j^{\,i}\ (DL_j^{\,i}\ (PL_j^{\,i},\ PS_j^{\,i},\ DK_j^{\,i}),\ DK_j^{\,i})$$

Aggregation gives,

$$(5.21)\ S_j = \sum_i S_j^{\,i} = \sum_i f_j^{\,i}(DL_j^{\,i}(PL_j,\ PS_j,\ DK_j^{\,i}),\ DK_j^{\,i})$$

In the aggregate, this can be given by the first order approximation

(5.22) $\ln S_j \quad = \quad a_0 + a_1 \ln PS_j + a_2 \ln PL_j + a_3 \ln DK_j + \mu$

This approximation also allows for any elasticity effects from the PS_j and the PL_j variables due to aggregation and any effects due to non-price taking behaviour. In the econometric work, a lagged dependent variable and other price variables were specified, but were found to be statistically insignificant and the above specification was retained. In the original specification, the price of oil is also included in all sectoral supply equations to reflect the resource effect. The statistical significance and quantitative importance of this effect is tested for.

Demand for the five sectors is explicitly specified as:

(5.23) $\ln (D/POP)_j \quad = \quad \ln b_0 + b_1 \ln (D/POP)_{j\ -1} + b_2 \ln PD_j + b_3 \ln (Y/POP) + \epsilon$

The lagged dependent variable is specified to capture dynamic demand effects. The theoretical rationale for adopting this particular dynamic specification is fully discussed in Chapter Six.

National income is a major determinant of sectoral demand in any country, and this is no less the case for Nigeria. The inclusion of the income variable in the specification is consistent with theoretical and empirical studies on demand functions, and this is no less so for Nigeria (see for example, Nyatepee-Coo, 1994). Aggregate national income is (Y) defined as:

(5.24) $Y \quad = \quad S_A + S_M + S_O + S_N + S_S + S_G + NFI$

where the variables are as defined previously, and S_G is output from producers of government services. The national income variable and the sectoral demand variables are normalised for population to control for the rapid rate of growth of population in Nigeria between 1973 and 1995.

Turning to the prices in the world price model, Nigeria is relatively small (the small country assumption), and the prices of all traded goods - agricultural, manufacturing and oil - are exogenously determined. Their foreign currency prices WP_A, WP_M and WP_O respectively can be assumed to be exogenously determined on the world markets. Using the standard world price version of the model, and in the absence of trade impediments, their home currency prices become:

(5.25) $PS_A = ER * WP_A$

(5.26) $PS_M = ER * WP_M$

(5.27) $PS_O = ER * WP_O$

where ER is the exchange rate, i.e the domestic price of foreign currency. However, the model takes into account the effects of tariffs (TFF_j) so that equations (5.25) to (5.27) are modified and become:

(5.28) $PS_A = ER * WP_A * (1 + TFF_A/IM_A)$

(5.29) $PS_M = ER * WP_M * (1 + TFF_M/IM_M)$

(5.30) $PS_O = ER * WP_O * (1 + TFF_O/IM_O)$

On the other hand, the prices of the non-traded industrials sector, PS_N, and the services sector, PS_S are determined by domestic supply and demand conditions. The sectoral demand prices (PD_j) are derived from these supply prices (PS_j) as shown in the net tax identities below:

(5.31) $PD_j \;=\; PS_j * (1 + NT_j)$

where NT_j, is sectoral net taxes (taxes less subsidies). So in the final demand specifications, the inclusion of the vector of sectoral demand prices in the demand equations is aimed at capturing the own price effect on demand and the complementary or substitution/cross price effect of other sector prices on a particular sector's demand. These prices are important in the spending effects of the Dutch Disease after relative price changes.

In the original demand specifications, a general government expenditure variable normalised for population (GEX1/POP) was included among the explanatory variables as a way of trying to represent total demand of private and public sectors for the five traded and non-traded sectors. The statistical significance and importance of this effect is tested for and the results presented in the next chapter.

In concluding this section, the nature of output and demand relationships for the oil sector is discussed. Although the sector competes for resources so that factor demand and supply equations for both capital and labour can be specified, the level of production, S_O is politically (exogenously) determined. This is the reason why an output equation for the oil sector was not included amongst the sectoral supply specifications. The price of oil (PS_O) is also politically (exogenously) determined. Both S_O and PS_O are determined by a complex system of OPEC pricing and production sharing arrangements. These political arrangements would take into account the absorptive capacity of each particular country, potential reserves, future availability of alternative energy sources and a host of other considerations.[1]

The idea of the level of oil production being determined externally or by the domestic government have been incorporated in previous studies, for example Enders and Herberg (1983). The boom may be represented by an increase in the price of oil (PS_O), an increase in oil production (S_O) or revenues ($S_O PS_O$) (Corden and Neary, 1982; Enders and Herberg, 1983). However a sectoral demand equation is specified for the oil sector. The assumption in most theoretical models of Dutch Disease is that, as oil is discovered, the total output is exported (Enders and Herberg, 1983) and countries can sell all that it produces. This model differs from previous models in that it includes explicitly a domestic demand function for oil amongst the other demand specifications, although this demand is not great relative to supply.

[1] Chapter Three contains an account of the oil sector including the nature of the production and pricing arrangements of the Organisation of Petroleum Exporting Countries (OPEC), of which Nigeria is a member.

5.2.3 The Demand for the Capital Stock and the Supply of Capital Functions

The specifications of our demand for and supply of capital equations are based upon neoclassical and accelerator-type analyses and have similarities to models of capital demand in studies by McKay et al, 1983; Catinat, 1987; El Hodiri, 1987; Kohli, 1990; Sakr, 1994; Newman, et al, 1995 and Khatiri and Thirtle, 1996, amongst others.[2]

In the neoclassical theory[3] of capital demand the objective of an optimising firm is to maximise the present discounted value of net cash flows subject to constraints as specified in the production function. The neoclassical model is typically supply oriented in which perfect competition is assumed in all markets. Capital demand becomes a function of the relative prices of factor inputs, the cost of capital and anticipated earnings.

In the accelerator model where Keynesian type unemployment exists (Catinat et al, 1987), demand is emphasised, that is, firms face a sales constraint, although they are not constrained in either the capital or labour markets. A change in output induces a change in the capital stock, so that investment becomes a function of the change in output. The sum of depreciation and the difference between the desired and realized capital stock is a measure of investment. The change in the capital stock can therefore be modelled as a function of the change in output with lags incorporated where necessary.

Returning to the profit function,

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[2] Other models of capital demand such as the profits model and Tobin's q model have been proposed (1969). In the profits model, capital demand is a function of profits. In Tobin's q model, capital demand is a function of q, that is, the difference between the market value of new additional capital goods (stock market value of firm) and the replacement costs of these physical assets. Although one can intuitively see a connection between the profitability idea and Tobin's q, indeed the modified neoclassical capital demand theory with adjustment costs and Tobin's *q* theory are in fact equivalent (Hayashi, 1982). Furthermore, although in an extended model of capital demand, Catinat et al (1987) included profits, with a less than perfect capital market in Nigeria, the theoretical justification for including a profit variable in our capital demand equations becomes less desirable for reasons outlined in Carruth et al (1998).

[3] The econometric investigation of neoclassical theory of capital demand was originally put forward by Jorgenson (1963).

$$(5.32)\ \Pi = PS_j^{\,i}\ f_j^{\,i}(DL_j^{\,i},\ DK_j^{\,i}) - (PL_j DL_j^{\,i} + RIR\ DK_j^{\,i})$$

Differentiating with respect to DK_j^i gives (assuming price taking behaviour)

$$(5.33)\ PS_j \frac{\partial f_j^{\,i}}{\partial DK_j^{\,i}}\ (DL_j^{\,i}, DK_j^{\,i}) = RIR$$

Solving for DK_j^i based on above gives a function of DL_j^i, RIRi, and PS_j

Remembering that DL_j^i is a function of PL_j^i, RIR and PS_j

$$(5.34)\ DK_j^{\,i} = DK_j^{\,i}(PS_j,\ PL_j,\ RIR)$$

As demand increases across time, one would expect that the demand for capital to increase even with fixed PS_j, PL_j and RIR. To allow for this effect in aggregation, the demand for capital is made a function of total output

$$(5.35)\ \sum DK_j^{\,i} = DK_j^{\,i}(PS_j,\ PL_j,\ RIR,\ S_j)$$

In the long-run, when capital is allowed to vary and is intersectorally mobile, capital is allowed to depreciate at a constant rate δ. With a constant rate of depreciation over time and no new investment,

$$(5.36)\quad \frac{\partial DK_j}{\partial t} = -\delta_j \, DK_j$$

where δ_j is the $_j$th sector's rate of depreciation. Gross capital stock is

$$(5.37)\quad \sum (DK_j^{\,i}(PS_j,\ PL_j,\ RIR,\ S_j) + \delta_j DK_j)$$

Equilibrium in the market for capital goods services is then summed up in equation (5.38) below (total gross savings = total gross investment):

$$(5.38)\quad \sum SK_j \quad = \quad \sum (\Delta DK j \; + \; \delta_j \, DK_j)$$

As the capital demand is a highly dynamic process, the aggregate econometric specification chosen to represent the demand for capital from equation (5.37) above is shown as an error correction model:

$$(5.39)\ \Delta \ln DK_j = c_0 + c_1 \ln DK_{j\ -1} + c_2 \ln S_{j\ -1} + c_3 \ln PS_{j\ -1} + c_4 \ln PL_{j\ -1} + c_5 \ln GEX2_{\ -1}$$

$$+ c_6 \ln RIR_{\ -1} + c_7 \, \Delta \ln S_j + c_8 \, \Delta \ln PS_j + c_9 \, \Delta \ln PL_j + c_{10} \, \Delta \ln GEX2 + c_{11} \, \Delta \ln RIR + \eta$$

where Δ represents the first difference operator. In the original specification, the price of oil variable is included in all the sectoral capital demand equations to reflect the resource movement effect. The statistical significance and quantitative importance of this effect is then tested for.

In presenting these econometric specifications for the capital demand equations, two important issues with respect to the real interest rate variable (RIR) and to the government investment in the oil sector variable (GEX2) are considered. With respect to the former, because of data limitations on sectoral cost of capital price series, the sectoral own price of capital is proxied by the real rate of interest. Therefore, from Equation (5.38) above, it is the real interest rate that brings about equilibrium in the market for capital goods services. Indeed, it is not always the case that a capital demand function with a cost of capital variable outperforms that with a simple real interest rate variable (Carruth et al, 1998). Furthermore, given the complexity of constructing a price of capital series (see Clark, 1979 for example), its inclusion, given the Nigerian data constraints, becomes difficult. However, although our tested models use the real interest rate as the major indicator of the cost of funds, it is not always clear what the effects of the interest rate are on capital demand. McKinnon (1973) and Shaw (1973) suggest that the accumulation of domestic real money balances are an important determinant of capital demand in less developed countries which implies a positive relationship between interest rates and capital demand[4]. However, this is in sharp contrast to the overwhelming evidence of a negative relationship between interest rates and capital demand via increases in the cost of capital (Greene and Villanueva, 1991; Bernanke, 1983 and Kaskarelis, 1993, for example), which normally follows from neoclassical capital demand type models.

From the foregoing, our capital demand equations can essentially be regarded as based on neoclassical theory. However, a crucial modification of the theory stems from the inclusion of a public sector expenditure variable (GEX2) in the specifications for the capital demand equations. This variable, which is defined as the summed level of government investments in the oil sector, is included in the capital demand equations to examine the importance of the public sector crowding out effects on sectoral capital demand. This crucial variable which is tested with the price of oil variable in the capital demand equations to determine and draw inferences about the nature of the resource movement effect is examined further in the next sub-section.

For the capital supply equation, the supply of capital is largely determined by individuals preferences and because it is also a dynamic process, the econometric specification is given by:

$$(5.40)\ \ln \Sigma SK_j = d_0 + d_1 \ln \Sigma SK_{j\,-1} + d_2 \ln RIR + d_3 \ln Y + \xi$$

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[4] This financial repressionist idea which is thought to occur in many less developed countries has been tested by Looney (1995) and was found to hold true for Pakistan.

Following our stated methodology, the exact nature of the dynamics for both the capital demand and the capital supply equations is fully considered in Chapter Six. In these equations, apart from the real interest rate (RIR) variable, monetary and financial variables are not considered and the focus will be on the implications for relative prices and real variables rather than nominal variables.

5.2.3.1 Capital Demand and the Role of the Public Sector

Investment by the government in the oil sector crowds out public investment in other sectors and also may crowd out private investment in other sectors. Although the idea of integrating theories of capital demand is widely applicable to developed economies with well functioning financial markets and reliable data (Kaskerelis, 1993), the idea of integration, if suitably modified, can be applied to less developed countries. The most important modification of the theories of capital demand functions with regard to developing countries, is the explicit inclusion of the role government in influencing capital demand. Government or public investment is not explicitly represented in the accelerator component of capital demand for less developed countries, although, for developed countries, it works its way mainly through aggregate demand (Catinat, et al, 1987). This modification has been applied in empirical studies by Sunderarajan and Thakur (1980); Tun Wai and Wong (1982), Blejer and Khan (1984); Greene and Villanueva (1991) and Looney, 1992 in varying degrees.

Even though at the empirical level, any application of the neoclassical model to developing countries would have to include, in addition to the real interest rate, the public sector investment rate as a major factor affecting capital demand, (Blejer and Khan, 1984), at the theoretical level its inclusion is ambiguous (Greene and Villanueva, 1991). Indeed, public investment may be complementary to or a substitute for private capital demand. Higher public capital accumulation crowds out private capital demand by raising the national investment rate above the level chosen by rational agents, although the increase in public capital stock could equally crowd in private capital demand by raising the returns to private capital.

Government investment, which is important in establishing linkages between sectors, may therefore create positive or negative effects depending on the nature of its investment. In an economy in which resources may not be fully employed, positive effects or crowding in effects are created because government investment effectively raises demand directly through raising incomes or indirectly through the multiplier effect (Tun Wai and Wong, 1982), which can encourage capital demand. Secondly, specific forms of government investment, for example, in infrastructure or sectoral research and development activities, reduces costs, increases profitability and the demand for capital.

On the other hand, government investment may create negative effects and crowd out capital demand in other sectors of the economy. Such crowding out may occur either directly or indirectly. Direct crowding out may occur if there is competition for scarce physical and financial resources, at least in the short run, (Sunderarajan and Thakur, 1980), especially in countries where the government is the major recipient of large natural resource revenues. Indirect crowding out may occur through higher interest rates or higher inflation, given debt financed deficits[5], and higher taxes which are required to finance government expenditure thus discouraging capital demand elsewhere in the economy.

Because most of these empirical studies concentrate mainly on the relationship between aggregate government investment, on the one hand, and other forms of capital demand, for example, aggregate private capital demand, on the other hand, the impact of specific forms of government investments on other sectors of the economy in both developing and developed countries has been generally unexplored. The implication is that, significant crowding out or crowding in effects are lost which, if recognised, would have provided useful signals for policy makers in the conduct of sectoral and macroeconomic policy formulation.

In the Dutch Disease model developed for Nigeria, our *a priori* expectation is that the public sector variable may crowd out both public and private capital demand in other sectors of the economy directly via the competition for resources hypothesis and, to some extent, indirectly, via the real interest rate mechanism. In Dutch Disease models, the impact of government's fiscal policies on the distribution of oil tax revenues to other sectors of the economy and on the size of

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[5] Friedman, B M. 1978, argues however that debt financed deficits need not crowd out capital demand but may even crowd in some.

Dutch Disease effects is important (Bruno and Sachs, 1982), particularly in countries such as Nigeria with a dominant oil sector (Jazayeri, 1986; Gelb, 1988 and Struthers, 1990). In the tested model, the public sector is explicitly recognised and, following Sunderarajan and Thakur (1980), Aschauer, (1989), and others, government investment is treated as exogenous.

5.2.4 The Demand for Labour and the Supply of Labour Functions

The theoretical rationale for including demand for labour functions in the Dutch Disease model for Nigeria stems from similar arguments to those for the capital demand equations, capital and labour being the two most important factors of production. In the short run, labour demand functions may differ depending upon assumptions about the degree of substitution between capital and labour and whether the former includes depreciation in gross investment. In the previous section, the starting point for determining both the labour demand and the capital demand equations was the underlying production function. In the short run, labour is the only variable factor of production, whilst the long-run version of the model allows for variability in both labour and capital.

Going back to the equation (5.19),

$$(5.41)\quad DL_j^{\,i} = DL_j^{\,i}(PL_j,\ PS_j,\ DK_j^{\,i})$$

By aggregating,

$$(5.42)\quad DL_j = \sum_i DL_j^{\,i}(PL_j,\ PS_j,\ DK_j^{\,i})$$

Substituting for DK_j^i gives:

$$(5.43)\quad DL_j = \sum_i DL_j^{\,i}(PL_j,\ PS_j,\ DK_j^{\,i}\ (PS_j,\ PL_j,\ RIR,\ S_j))$$

$$(5.44)\quad DL_j = DL_j(PL_j,\ PS_j,\ RIR,\ S_j)$$

Allowing for dynamic effects, an error correction model of labour demand is specified such that:

$$(5.45)\quad \Delta \ln DL_j = e_0 + e_1 \ln DL_{j\ -1} + e_2 \ln S_{j\ -1} + e_3 \ln PS_{j\ -1} + e_4 \ln PL_{j\ -1} + e_5 \ln RIR_{\ -1} + e_6 \Delta \ln S_j$$

$$+ e_7 \Delta \ln PS_j + e_8 \Delta \ln PL_j + e_9 \Delta \ln RIR + \Phi$$

Although not strictly comparable to our sectoral labour demand specifications, a comprehensive survey of demand for labour functions in Challen and Hagger (1992), and other studies (for example, Mangan and Stokes, 1984; Hamermesh, 1986; Nickell, 1984 and Lee et al 1990), have used labour demand equations including output, output price and the real wage as well as the price of capital proxied by the real interest rate. For the tested model, features of both the neoclassical and accelerator-type ideas are thus seen to be incorporated. Obviously, the real wage is an important determinant of employment and is included in the model. Nefti (1978) (cited in Sargent, 1978) provides evidence for Granger causality flowing from wages to employment and a strong negative influence of real wages on employment. The determination of sectoral market clearing wages in our model departs from the Scandinavian tradition (Hoel, 1981; Enders and Herberg, 1983), where the assumption is made that centralised bargaining leads to a uniform nominal wage rate. Capital demand through the real interest rate is included as an indication of the substitution of capital for labour. The output variable effectively specifies labour intensity in production and incorporates features of the accelerator models.

With regards to the supply of labour, the vast majority of models of labour supply decisions (for example, Pencavel and Holmlund, 1988; Killingsworth, 1987; O'Leary, 1991 and Lacroix and Fortin, 1992) have employed panel and survey data at the individual level to test their models. The sectoral Dutch Disease model developed for Nigeria obviously does not use panel or individual survey data but data at the sectoral level. Under a neoclassical framework, the decisions regarding the supply of labour will result from a process of maximisation of a utility function subject to a budget constraint (Leoni, 1994 and Lacroix and Fortin, 1992). The interaction of the supply and the demand curves for labour will determine sectoral wage rates so that equilibrium in the labour market is determined by the sectoral real wage rates which are treated as endogenous. The labour supply equations in the Dutch Disease model for Nigeria are not explicitly derived, but the assumption is made that supply decisions simply reflect preferences and, as such, individuals supply of labour depends on the own sectoral real wage rate as well as the real wage rates in other sectors. The latter effect was found to be statistically and quantitatively unimportant in the econometric investigation. Allowing for dynamic effects, the labour supply equations are specified as:

(5.46) $\ln (SL/WPOP)_j = f_0 + f_1 \ln (SL/WPOP)_{j\ -1} + f_2 \ln WL_j + \upsilon$

5.2.5 The Traded Goods Sectors: the Role of the Balance of Payments and the Exchange Rate

In the Dutch Disease model for Nigeria, the identities in equation (5.11) above suggests that residuals are treated as exports or imports in the traded goods sectors. This implies that from the output equations of (5.1) and (5.2) above,

(5.47) $S_j \quad = \quad S_{dmj}$ (domestic supply) + EX_j (export supply) $\quad (_j = A, M, O)$

The EX_j component of total sectoral output (S_j) represents the residuals which are exported by Nigerian producers to foreign markets. Similarly, the demand equations of (5.3) above implies that,

(5.48) $D_j \quad = \quad D_{dmj}$ (domestic demand) + IM_j (import demand) $\quad (_j = A, M, O)$

The IM_j component of total sectoral demand (D_j) represents the residuals which are imported by Nigerian consumers from foreign markets. In this model, a distinction is not made between an import demand and a pure domestic demand function neither is there any distinction between an export supply and a pure domestic supply function. In other words, in our model if domestic demand exceeds domestic output this demand is met by imports while excess supply of output can be exported under conditions given above. Therefore,

$$(5.49)\quad S_A = D_A + NX_A$$

$$(5.50)\quad S_M = D_M + NX_M$$

$$(5.51)\quad S_O = D_O + NX_O$$

where NE_A, NE_M and NE_O are net exports of the agricultural, manufacturing and oil sectors respectively. This net exports variable (NX_j), which represents the difference between supply and demand in each sector, will vary by sector depending on underlying assumptions about the exchange rate and the balance of payments.

Given that both the balance of payments and the exchange rate have played a crucial role in Nigeria's macroeconomic policy development over the last thirty five years or so, an explanation of how both variables enter into the Dutch Disease macro model for Nigeria is important. In studies of Dutch Disease models, a number of authors have utilised econometric analyses to determine the exchange rate for several developing countries (Kamas, 1986; Richards, 1994) and for Nigeria in particular (Odifa, 1988).The theory of the Dutch Disease as contained in these and other studies reviewed in Chapter Four implied that the exchange rate will rise as a result of a new natural resource which enhances the country's foreign exchange earnings[6]. As was the case in many oil exporting developing countries, the large inflow of foreign exchange and consequent balance of payments surpluses caused the domestic currency to appreciate[7]. For others, particularly those with fixed exchange rate systems, it was possible to maintain a strong domestic currency whilst simultaneously having the ability to run balance of payments deficits

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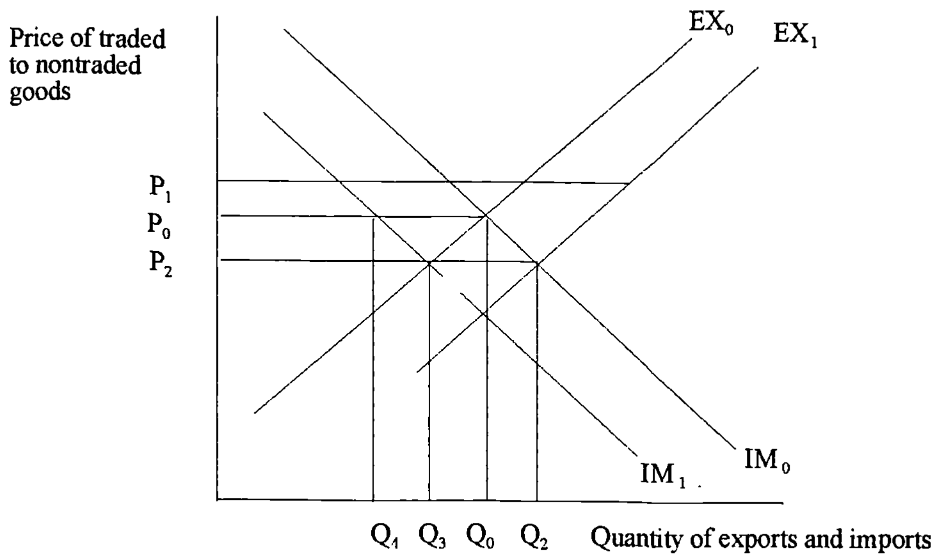
[6] The nominal exchange rate is defined as the price of one currency in terms of another. In this study, the exchange rate is defined as the Naira price in terms of the United States dollar. Therefore, a fall in the exchange rate implies a high value of the Naira, or an appreciation while a rise in the exchange rate implies a low value of the Naira or a depreciation.

[7] In Chapter Four, it was argued that increased oil revenues need not necessarily lead to exchange rate appreciation. This was shown to be the case in some oil-producing developing countries, notably Kuwait and Saudi Arabia, which adopted strategies that prevented excessive exchange rate appreciation, for example, by investing abroad.

based on the proceeds from future sales of oil. Oil therefore had the potential of raising the value of Nigeria's currency, the Naira, whilst at the same time enabling the country to maintain balance of payments deficits on the current account.

Figure 5.1: Mechanism of Exchange Rate Adjustment.



In the Dutch Disease model developed for Nigeria, the exchange rate can be endogenous with the balance of payments exogenous and vice versa. In theory, in a model in which the exchange rate is endogenous, the exchange rate moves flexibly to maintain equilibrium on the balance of payments. The mechanism of exchange rate adjustment is shown in Figure 5.1 where the EX_j and the IM_j curves represent composite traded goods export supply and import demand schedules respectively. In theory, at P_0 the economy has attained balance of payments equilibrium with the intersection of the EX_0 and IM_0 schedules.

However, an increase in oil exports for example shifts the supply curve from EX_0 to EX_1. Assuming imports IM_0 remain constant, the horizontal distance EX_1 - EX_0 will be a representation of the increase in exports at a given exchange rate. As a result of this movement, a new equilibrium is established at P_2Q_2 where both total exports and imports are larger. At the new relative price ratio, the Naira value of dollar is larger, or the Naira price smaller, representing an appreciation, although for reasons stated earlier this need not be the case. Non-oil exports falls to q_3 given the oil resource and the new price ratio at P_2. Therefore, a fall in the exchange rate (an appreciation) causes a decline in non-oil exports and a rise in the level of imports. However, in Nigeria's case, the persistent surpluses and deficits on the current account for much of the period between 1973 and 1995 suggested that the exchange rate was not necessarily the mechanism for attaining balance of payments equilibrium, rather it was, in theory, the 'policy' of imposing balance of payments constraints.

By contrast, with a fixed exchange rate system, as was the case in Nigeria for much of the period between 1973 and 1995, the exchange rate was fixed by the government, which meant that oil price rises and falls per se had little effect on the value of the currency. Rather, the vast sum of capital and foreign reserves which accrued to the country from the sale of oil abroad enabled the Nigerian authorities to support the Naira and maintain an unrealistically high exchange rate value for the Naira. With a fixed exchange rate system, the exchange rate can no longer act to restore balance of payments equilibrium. In such a case, the exchange rate is largely exogenous and the balance of payments becomes endogenous.

$$(5.52) \quad \sum S_j * PS_j - \sum D_j * PS_j = BP \qquad (j = A, M, O)$$

With a fixed exchange rate system and world determined prices of traded goods, the implication is that, in a strict sense, the mechanism of adjustment in the Dutch Disease process will be via an increase in the price of the nontraded sectors (Struthers, 1990). By contrast, the main mechanism of the theory in a floating exchange rate system will be via the appreciation of the nominal exchange rate. Given that several variants of the standard Dutch Disease model are developed in this study, the extent of Dutch Disease type effects may well depend not only on the assumptions about the exchange rate and the balance of payments, but indeed on other crucial exogenous factors such as government investment expenditure in the oil sector. Therefore, the main conclusion that can be drawn from the above account is that the exchange rate may or may not be exogenous and that there may be an additional balance of payments effect that allows resource rich countries to run balance of payments deficits.

Summary of Perspectives to Modelling a Dutch Disease Model for Nigeria

It is clear from the analyses of Section 5.2 that a Dutch Disease macro model for Nigeria can be developed based loosely on neoclassical foundations but that allows for many important practical issues such as government expenditure and balance of payments effects. In line with studies of Dutch Disease models and multi sectoral macroeconomic models, as well as studies of capital and labour demand functions, both types of factors of production, that is, capital and labour, have by and large been assumed to be homogeneous at the sectoral level. In this study, each sector produces a single homogenous product and specific factors of production are aggregated at the sector level. All sectoral output are final consumption goods, either for the domestic market or for exports. In our model, if home demand exceeds domestic production, this demand is met by imports. The exchange rate and the balance of payments enter into the model either as exogenous or endogenous variables. The balance of payments surpluses and deficits maintained by Nigeria on its current account suggests that she was not faced with significant balance of payments constraints. Such constraints therefore cannot realistically be assumed to determine the exchange rate.

The system of equations can then be estimated as a complete Dutch Disease macro model for Nigeria. The estimated model will be concerned with both the short and long-run effects of oil on output, the allocation of resources and the balance of payments. In the next section, the econometric rationale for determining the adequacy of the estimates from the model is discussed. The parameter estimates and the results of the econometric diagnostics from the estimated model are discussed in the next chapter, while in Chapters Seven and Eight the model is solved to conduct various macroeconomic policy shocks. The objective is to investigate the extent of the resource movement and the spending effects which are generally associated with traditional models of the Dutch Disease, and other effects if present.

5.3 Macroeconometric Rationale and Justification of the Dutch Disease Model for Nigeria

It is a known fact that most economic variables are jointly dependent. Therefore, single structural equation models belong to a wider system of equations or relationships. By estimating such models in isolation, very important aspects of the true relationship will be lost. This is particularly true of supply and demand type models of product and factor markets and market equilibrium models.

From Table 5.1 below, the complete model is comprised of 25 behavioural equations and 26 identities and market clearing conditions. The total number of variables in the model are 107 consisting of 51 endogenous variables and 56 predetermined variables. 19 of the predetermined variables are exogenous and 37 are lagged endogenous and exogenous variables. Where monetary values are used, all variables are expressed in Naira (the unit of the Nigerian currency) or the United States dollar ($) and are stated in real terms, ie at 1990 constant prices. In Section 5.2, *a priori* sign of the parameters of each behavioural equation was given below each equation. The behavioural equations specified were expressed in log-linear form the advantages of which are well documented in the econometrics literature. Therefore, all the variables used in the behavioural equations presented in Section 5.2 were preceded by the prefix ln.

In many cases, the dynamics relating to the behavioural equations were based on a partial adjustment or an error correction process. With lagged variables, the important short and long run properties in the model that are related to the theory can be derived and analysed. The advantages include the fact that the model will be able to capture the disequilibrium aspects of the economy within a dynamic structure and the speed of adjustments of the variables can be deduced which will throw light on the structure of the time lags involved (Fair and Jaffe, 1972; Gourieroux, Laffont and Monfort, 1980; Greene, 1997). These issues relating to the dynamics of the model are considered in a lot more detail in the next chapter.

For the system to be complete, the number of equations in the model which consists of behavioural equations, equilibrium conditions and identities must be equal to the number of endogenous variables. Only complete systems can be solved. Generally, as Greene (1997) points out, it is not possible to estimate the structural parameters of an incomplete system. There are 51 endogenous variables and 51 equations, so that the model is mathematically complete. There are enough equations in the model so that the endogenous variables are potentially uniquely determined. Following the formal specification of the model, the system of equations can then be identified and estimated using the appropriate econometric techniques, which the rest of this Chapter describes.

TABLE 5.1: MACROECONOMIC VARIABLES FOR THE DUTCH DISEASE MODEL

Total Number of Macroeconomic Variables	Endogenous (LHS)	Endogenous (RHS)	Exogenous/ Predetermined
Output Supply (S_j) (5 Lags)	4 S_j	-	1 S_O
Output Demand (D_j) (5 Lags)	5 D_j	-	-
Demand Capital (DK_j) (5 Lags)	5 DK_j	-	-
Supply Capital (SK) (1 Lag)	1 SK	-	-
Demand Labour (DL_j) (5 Lags)	5 DL_j	-	-
Supply Labour (SLj) (5 Lags)	5 SL_j	-	-
Prices Supply (PS_j) (4 Lags)	-	5 PS_j	-
Prices Demand (PD_j)	-	5 PD_j	-
Prices of Labour Demand (PL_j) (5 Lags)	-	5 PL_j	-
Prices of Labour Supply (WL_j)	-	5 WL_j	-
Interest Rate (RIR) (1 Lag)	-	1 RIR	-
National Income (Y)	-	1 Y	-
Net Exports (NX_j)	-	3 NX_j	-
World Prices (WP_j)	-	-	3 WP_j
Net Taxes (NT_j)	-	-	5 NT_j
Tariffs (TFF_j)	-	-	3 TFF_j
Net Factor Income (NFI)	-	-	1 NFI
Balance of Payments (BP) & Exchange Rate (ER)	-	1 BP or 1 ER	1 ER or 1 BP
General Government Variable (GEX1)	-	-	1 GEX1
Government Investment Variable (GEX2) (1 Lag)	-	-	1 GEX2
Producers of Government Services (S_G)			1 S_G
Population (POP)	-	-	1 POP
Working Age Population (WPOP)	-	-	1 WPOP
37 Lagged Variables from above list	-	-	37 Lagged Variables
TOTAL NUMBER OF VARIABLES = 107	**TOTAL = 25**	**TOTAL = 26**	**TOTAL = 56**

No of Endogenous Variables (51) = No of Equations (51)

Note: (i) The Balance of Payments variable and the Exchange Rate variable are the same, that is, they can either be treated as endogenous or exogenous variables depending on which variant of the standard model is used.

5.3.1 Identification

Identification precedes estimation (Greene, 1997 and Pesaran 1986). This sub-section deals with identification while the next section discusses the estimation procedures. Identification is the process of trying to find the values of the parameters of an equation or system of equations. In economics, if more than one theory is consistent with the same data, then these are said to be observationally equivalent and since there is no way of distinguishing between them, the underlying structure is said to be unidentified (Greene, 1997). The identification problem refers to the structural behavioural equations and not the identities since these do not require measurement. The identities are included as additional equations in the model.

A model may be exactly identified or over identified. The nature of the identification will determine what estimation method is appropriate. The two criteria for determining the identification state of a relationship are the rank and order conditions. The order conditions for the identification of a behavioural equation are:

(i) $E = G - 1$ (then the equation is exactly identified and estimation by Indirect 2SLS is possible).
(ii) $E > G - 1$ (then the equation is over identified and estimation by 2SLS is possible).

where E is the number of variables excluded from that equation, i.e the total number of variables in the model minus the number of variables in the equation in question, and G is the number of equations in the model.

The order condition is only a counting rule which ensures a necessary but not a sufficient condition for identification. It assumes that our equations have at least one solution, but it does not ensure that it has only one solution. The sufficient condition for uniqueness is the rank condition, but this is specific to linear models and is for simple equations and therefore in our case is clearly not relevant. As Greene (1997) has pointed out, it is generally unusual for a model to pass the order and not the rank condition. For large models which have many exogenous and predetermined variables, the rank condition is usually passed trivially, and only the order condition need be verified. A useful rule of thumb for checking the rank and order conditions of a model is that if every equation has its own predetermined variable the entire model is identified. Each equation was individually checked to ensure that the order condition for identification was met[8].

(A) ORDER CONDITION:

1. (a) *Output Supply Equations*:

   E (107 - 4 = 103) > G - 1 (51 - 1 = 50) meaning each supply equation is identified.

   (b) *Output Demand Equations*:

   E (107 - 4 = 103) > G - 1 (51 - 1 = 50) meaning each demand equation is identified.

2. (a) *Capital Demand Equations*:

   E (107 - 12 = 95) > G - 1 (51 - 1 = 50) meaning each capital demand equation is identified.

   (b) *Capital Supply Equation*:

   E (107 - 4 = 103) > G - 1 (51- 1 = 50) meaning the capital supply equation is identified.

3. (a) *Labour Demand Equations*:

   E (107 - 10 = 97) > G - 1 (51 - 1 = 50) meaning each labour demand equation is identified.

   (b) *Labour Supply Equations*:

   E (107 - 3 = 104) > G - 1 (51 - 1 = 50) meaning each labour supply equation is identified.

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[8] The results reported here are standardised for the general case only. Those equations which included additional variables in their final specification (for example, the demand for output equations) were also checked and easily passed the order condition for identification.

All the behavioural equations in the model satisfy the order condition for identifiability. In all cases, the behavioural equations were over identified, i.e E > G - 1 and the rank condition is met trivially.

5.3.2 The Validity of the Instruments used for Estimation

The use of economic instruments is aimed at eliminating the bias and inconsistency of single equation ordinary least squares estimates. The recognition of the presence of endogenous variables in a model and instrumentation of these have important feedback mechanisms. Failing to take account of these can lead to large upward biases in subsequent simulation exercises (Newman et al, 1995). The problem in the application of the instrumental variable method for both 2SLS and 3SLS methods of estimation is in identifying an adequate number of admissible instruments. With a system of simultaneous equations, determining instruments availability must be conducted before any estimation can be carried out.

A variable that may have been considered truly exogenous may not be and any assumptions of a one way causation between the dependent variable and the independent variables may lead to wrong inferences. Godfrey (1988) has shown that in simultaneous equation models, the standard Granger tests for causality are not helpful in checking the assumption that a variable is predetermined (or exogenous) rather than endogenous, and so do not provide tests of the validity of instruments. Godfrey therefore states that "Granger causality tests are not relevant to the problem of validating estimation and hypothesis testing conditional upon a sub-set of variables".

In our case, the model of the Dutch Disease to be estimated may be considered large when compared to the size of the sample. There are only 23 observations for the years 1973 to 1995 and the number of exogenous and predetermined variables far exceed 23. In such a situation, it has therefore not been possible to use all the exogenous variables as instruments when employing 2SLS and 3SLS methods of estimation. This problem is referred to as the undersized sample problem or the degrees of freedom problem (Klein, 1973; Challen and Hagger, 1983).

Two common methods of dealing with this problem are the principal components method which goes back to the work of Kloek and Mennes (1960) and the truncated 2SLS approach originally due to Fischer (1965)[9]. The former method substitutes the predetermined variables by linear combinations or principal components with the weights chosen in such a way that they are pair-wise uncorrelated but account for the variation in the original variables. Klein (1969) on the other hand suggested that if the principal components method is applied, the performance of dynamic simulation exercises will determine the number of principal components to use (and by implication the number of instruments).

Fischer suggests a process of regressing each right hand side endogenous variable on sub-sets of instruments, checking the R^2, removing an instrument and repeating the whole procedure after which a decision can be made about the retaining the instrument if dropping it causes the R^2 to drop significantly. The method uses the economic theory behind the model in choosing subsets of the predetermined variables as instruments. That is, it deletes those predetermined variables from the list of instruments used in the first stage regression that are considered unimportant. Although both methods require some degree of arbitrariness in choosing the number of predetermined variables as instruments or the number of principal components in the first stage regression (see Klein, 1969), the principal components method has been criticised by some authors (see, for example, Maddala, 1971).

Therefore, formal tests for both the admissibility of valid instruments and for exogeneity[10] of the variables were carried out for each structural equation before employing the appropriate estimation procedures. The Sargan test was used to test for the validity of instruments and the Hausman tests for exogeneity of the variables (Greene, 1997; Kennedy, 1993). In section 5.3.4, the Sargan and Hausman tests are formally explained together with the other tests employed for this study.

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[9] For a full discussion see for example Challen DW and Hagger AJ (1983).

[10] As Pesaran and Smith (1985) point out, systems such as vector-autoregressive systems (VAR) which involve a large number of observations, do not require the classification of variables into endogenous and exogenous variables and so may avoid the difficulty involved in exogeneity assumptions necessary for the identification and estimation of macroeconomic models.

This study adopted the truncated 2SLS approach by using subsets of the predetermined variables as instruments in the first stage regression. To determine which instruments were to be included in the subsets for the purposes of two and three stage least squares estimations, a number of steps were carried out. Firstly, the McCarthy rule (1971) was adhered to as strictly as possible. The rule states that the exogenous regressors for all the endogenous variables in a given structural equation must be the same, and they must include explicitly the exogenous variables included in that structural equation. The instruments considered for first stage regressions included all exogenous variables and all other predetermined variables which consisted of lagged values of both exogenous variables as well as lagged values of endogenous variables.

5.3.3 The Estimation Procedures

Following Catinat, et al, 1987 and others, two broad principles were followed in econometric estimations. Firstly, in most cases, identical specifications were given within groups of equations irrespective of the particular sector concerned, although it is recognised that the performances of different sectors are not necessarily always determined by the same set of factors. For example, taking the sectoral output equations specified in sub-section 5.2.1, each sector's output is made a function of its own price, the real wage and the capital stock. Secondly, in order to ensure comparability of results, these variables used in the sectoral output equations (and other variables within blocks of equations in the entire model) were measured in exactly the same manner.

In virtually all the studies reviewed in Chapter Four, two broad estimation methods were used, namely the Autoregressive Least Squares (ARLS) method and the Autoregressive Instrumental Variables (ARIV) methods. The first class of estimators include standard Ordinary Least Squares (OLS) techniques. The second class of estimators include the Two Stage Least Squares (2SLS) and Three Stage Least Squares (3SLS) techniques.

The OLS estimator allows each equation to be estimated separately. OLS estimates of the structural parameters are biased and not consistent because of the correlation between the disturbances and the endogenous variables included in the behavioural equation which leads to simultaneous equation bias (Greene, 1997). The use of 2SLS and 3SLS estimation techniques becomes imperative to allow for the simultaneity between price and quantity variables. The OLS estimator has been employed solely for the purpose of prior experimentation with 2SLS and 3SLS estimators and is not reported or used for further work in later chapters.

For over identified equations, the 2SLS estimator, originally proposed by Fair (1970) for equations with lagged dependent variables, is the appropriate estimator. Estimation of the system is one equation at a time. A disadvantage of this estimator is that it neglects information contained in other equations, hence the limited information nature of estimation. 2SLS however has the advantage of being computationally easy to use. Another advantage of the 2SLS equation by equation estimator, is that it will to a large extent confine any specification error in any part of the model to the particular equation in which it appears (Greene, 1997). 2SLS eliminates the problem of simultaneous equation bias which originates from the inclusion of endogenous variables in the right hand side of our behavioural equations. By removing the random elements associated with the disturbance term from the endogenous explanatory variables, consistent estimates can be obtained from the application of OLS to behavioural equations.

The 2SLS method consists of using the fitted values of Y_j (endogenous variables) from a regression of Y_j on all of the instruments or the $X_{j's}$ (exogenous variables). The 2SLS estimates is obtained by OLS regression of y_j (the dependent variable) on the Y_j and X_j. The name therefore stems from these two regressions in the procedure. That is, in the first stage, each endogenous explanatory variable that appears on the right hand side of the behavioural equation is regressed on all predetermined variables and their predicted values obtained. In the second stage, each of the right hand endogenous variable is replaced by their predicted values and ordinary least squares applied to the transformed equations to obtain the estimates of the structural parameters of the behavioural equations.

The three stage least squares (3SLS) estimator originally proposed by Zellner and Theil (1962) is obtained by first regressing all the variables on the right hand side (RHS) of each behavioural equation on the variables in the list of instruments and retaining their predicted values. The equations in the model are estimated jointly, with each endogenous variable that appears on the RHS of a behavioural equation being replaced by the predicted values. For such systems, there must be the same number of observations for all the equations. The advantage of the 3SLS is that from a efficient estimation point of view it outperforms the 2SLS, which in turn outperforms OLS. The 3SLS has been suggested as bringing gains in efficiency as a result of joint estimation (Greene, 1997). However, a major disadvantage of the procedure is that any specification error in any one part of the model will be propagated throughout the system. Therefore, the finite-sample variation of the estimated covariance matrix in both the 3SLS and SURE[11] models is transmitted throughout the system, and it may well turn out that the finite-sample variation of 3SLS/SURE may well be as large or larger than that of 2SLS[12].

With only 23 observations, the entire model consisting 107 variables and 51 equations is quite large when compared to the number of observations available. With a large number of instruments, 3SLS estimates for the entire model which includes our sectoral supply and demand equations and the equations for factors of production is not possible. In order to carry out 3SLS, the entire model was split into blocks and estimated. This treatment of undersized samples in econometrics is dealt with in detail by Klein (1973) and was explained in the previous section.

The model was estimated by the use of the LIMDEP, version 7 program. The equations were estimated by employing the 2SLS procedure, although in some cases, such as for the capital and labour demand equations, the 3SLS procedure was additionally employed and compared to the 2SLS estimates. All the equations incorporated a correction for first order serial correlation, and adequate diagnostics tests were carried out. The methods generated efficient estimates for simultaneous equation models with and without lagged dependent variables. Details of these procedures captioned under the title methodology for the evaluation of estimation results are presented in the next sub-section.

5.3.4 Methodology for the Evaluation of Estimation Results

This section describes the methodology for the evaluation of estimated results which will be presented in Chapter Six. The application of diagnostic criteria to a model and the pre-testing

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11 SURE (Seemingly Unrelated Regressions) is also a joint systems estimator.

12 The role of Monte-Carlo studies in ranking econometric techniques for the purpose of choosing the right one is well documented n the literature. See for example, Cragg (1967) and Judge et al (1985).

of data, where applicable, are important features of model development. The pre-tests generally involve checking whether the data series are stationary, the rejection of which can lead to wrong inferences from estimations or spurious regressions. The methodology for formal testing methods and the application of statistical diagnostics to evaluate the estimated results from our model were carried out in two ways. The first involved the examination of the estimates of individual coefficients and the goodness of fit of the regression equations such as the signs and magnitudes of the coefficients and the elasticities, the t-ratios, the standard error of the regression (SER), the Durbin-Watson statistic where applicable, the F-statistic and the R^2. Secondly, formal test procedures were carried out and reported for serial correlation (the Hatanaka procedure), for the validity of instruments (Sargan test), for the exogeneity of the variables (Hausman test), for the functional form of the model (Reset *j*-test), and for the structural stability of the model (Cusum and Cusum^2). In addition, where applicable, the WALD restriction tests for formally testing the joint significance of variables was carried out.

A). Formal Testing Methods, Diagnostics Criteria and the Pre-testing of Data

1. Serial Correlation and Multi-collinearity

Both serial correlation and multi-collinearity are considered to be the two most important problems associated with an econometric model. Multi-collinearity which is often associated with the identification state of a model, occurs when the explanatory variables of an equation are correlated so that it does not allow the precise analysis of their individual effects (Koutsoyiannis, 1978). When the variables are perfectly correlated, that is the correlation coefficient is equal to unity for these variables, then it is not be possible to get separate estimates for their coefficients. Multi-collinearity can be regarded as a failure of the data and not the assumptions of the model. Because there is some degree of interconnection amongst most economic time series data and given the problems of data which are fully discussed in the next section, the problem of collinearity among the variables cannot be completely avoided.

To test for the presence of serial correlation, which is considered a far more serious problem in time series econometrics studies, it is common practice to report the Durbin-Watson statistics. In small samples, the Durbin-Watson statistic is regarded as a useful device (Beggs, 1988). The Durbin-Watson statistic and the autocorrelation statistic are checked and reported as a first test for the presence of serial correlation. However, because the model includes lagged dependent variables, the Durbin-Watson statistic to test for serial correlation is not strictly valid (Maddala, 1989).

To deal adequately with the problem of serial correlation therefore, two alternative approaches were considered, i.e, whether to interpret low DW statistic as evidence of model mis-specification or allow for it in some way. In this study, the latter approach was taken which takes the view that not much can be done to avoid misspecification, especially, given the nature and availability of the data. Previous Dutch Disease models for Nigeria have applied 2SLS with a correction for first order serial correlation in this way (Nyatepee-Coo, 1994). Therefore, in all equations, the model incorporated *rho* in two ways depending on whether 2SLS or 3SLS estimation procedure was used.

For the 2SLS estimates, this study employed the Hatanaka procedure. Hatanaka has derived an efficient estimator for models with lagged dependent variables which is asymptotically equivalent to maximum likelihood. When economic models contain lagged endogenous variables and autoregressive errors serious estimation difficulties arise (Fomby and Guilkey, 1983). Several techniques such as the Hatanaka estimator, Wallis two-step estimator and the Maximum Likelihhod estimator were considered as possible ways of dealing with the problem of serial correlation in models that have lagged dependent variables. Whilst the relative merits of each of these estimators is mixed, the Hatanaka procedure, in particular, has been found to be asymptotically efficient (see for example Greene, 1997; Hatanaka, 1974; Hatanaka, 1976; Fomby and Guilkey, 1983, Hall and Rossana, 1991) and for practical purposes, is well supported by several econometric packages including LIMDEP.

The basic model for the Hatanaka procedure is:

(1) $y_t = \beta' x_t + \gamma y_{t-1} + \epsilon_t$

(2) $\epsilon_t = \rho \epsilon_{t-1} + u_t$

The procedure uses instrumental variables to estimate β,γ from which ρ (*rho*) is constructed by autocorrelation of the residuals using the actual values and not the predictions.

$$(3)\quad \rho \quad = \quad \frac{\sum e_t e_{t-1}}{\sum e_t^2}$$

where $e_t \quad = \quad y_t - b_{iv}'x_t + c_{iv}y_{t-1}$

A Cochrane-Orcutt transformation to do generalised least squares based on the original data, and an additional regressor ϵ_{t-1}, is then performed. The efficient estimate of ρ is the original estimate of ρ plus the coefficient on the lagged residual.

For the 3SLS estimates the Hatanaka procedure is not available in LIMDEP. Hence, the study employed a general Prais and Winsten algorithm to produce values for *rho*. With 2SLS, the procedure can be quite straight forward. However, with the 3SLS estimator, LIMDEP does not allow for first order autocorrelation. The Seemingly Unrelated Regressions (SURE) method was therefore used for all joint system estimations. Each right hand side endogenous variable was regressed on all instruments and their fitted values retained. Thereafter, the SURE procedure is identical to the 3SLS procedure. That is, using SURE, the behavioural equations were then estimated jointly. The left hand side dependent variables in all equations in the list were regressed on the right hand side fitted values, the exogenous variables and the predetermined variables with a correction then made for first order autocorrelation. The procedure iterated to the default value of one as it is known that iterated 3SLS does not bring gains in efficiency and does not produce a maximum likelihood estimator (Greene, 1997).

2. *Testing the Validity of Instruments and Exogeneity of Variables*

Because each equation can have different sets of instruments, a formal test for the validity of instruments chosen using the truncated 2SLS approach (see sub-section 5.3.2 for details of this approach) had to be carried out. To test for the validity of chosen instruments, the Sargan test procedure was applied. The result of this procedure is that a statistically insignificant test statistic would be an indication that the null hypothesis, which states that the chosen variables are valid instruments, should be accepted (not rejected).

To test for the exogeneity of variables, various testing procedures were considered (Hausman, 1978 and Nakamura and Nakamura, 1981). Hausman shows that with two estimators b_0 and b_1, of the parameter vector β, under the null hypothesis, H_0, of no measurement error, both b_0, the least squares estimator and b_1, the instrumental variable (IV) estimator are consistent estimators of β, although least squares is efficient whereas the IV estimator is inefficient. Under the alternative hypothesis, H_1, only b_1, is consistent.

The test statistic for the Hausman procedure is:

$$H = (\mathbf{b}_{IV} - \mathbf{b}_{OLS})' * (\mathbf{V}_{IV} - \mathbf{V}_{OLS})^{-1} * (\mathbf{b}_{IV} - \mathbf{b}_{OLS}) \sim \chi_2(k)$$

where k = the number of parameters.

This test which is regarded as a general test (Kennedy, 1993) can be applied to test for the exogeneity of variables (Beggs, 1988; Greene, 1997) after having carried out the Sargan test for the validity of instruments. The OLS estimates are consistent under exogeneity but inconsistent when endogeneity is present. The IV estimators are consistent in both situations. Therefore under exogeneity, the two sets of coefficient estimates are asymptotically equal, but they are not equal in the absence of exogeneity (Beggs, 1988).

3. Tests of Stability and Structural Change of the Model

Several methods have been proposed for testing that a model is stable or has not undergone any structural change (see for example, Gujurati, 1970; Beggs, 1988). A stability test can either be conducted on the dependent variable and each of its determinants in turn or, as more commonly used, on the general relationship between the dependent variable and the independent variables taken together (Catinat et al, 1987). Formal procedures for testing the stability of a model based on the latter approach are the cumulative sum of the recursive residuals (Cusum), the cumulative sum of the recursive residual squared (Cusum^2) and Quandt's likelihood ratio tests.

Both the Cusum and the Cusum^2 tests are useful tests for the constancy of the regression coefficients over time. A clear advantage of these tests over other testing methods such as the Quandt likelihood ratio tests is that they provide a very useful graphical interface of the constancy of the coefficients over time as well as being computationally easy to use. To test for the structural stability of the model over time, this study employs the Cusum and Cusum^2 test procedures of parameter constancy.

4. Testing for the Functional Form of the Model

Several tests for formally testing that a model is of the correct functional form have been proposed in the literature (for example, Ramsey's Reset test, White's test, Davidson and Mackinnon tests)[13]. The tests are generally categorised into two groups, namely, non-specific alternatives and specific non-nested alternatives. Of the latter group of tests, the best known is the Davidson and Mackinnon *j* test (Beggs, 1988). For this study, the Davidson and Mackinnon (1981) procedure is used to test the linear specification against the alternative log-linear form. The hypotheses are:

H_0: $y = \boldsymbol{\beta}'\mathbf{x} + \epsilon_0$ against

H_1: $\ln y = \sum \beta_k \ln x + \epsilon_1$

A conventional t-test based on a statistically insignificant coefficient on the added variable (the difference between the predictions from the models) is a confirmation that the model is correctly specified in the log-linear form against the alternative linear specification (Greene, 1997; Beggs, 1988; Davidson and Mackinnon, 1981, 1985). In other words, a statistically insignificant test statistic would indicate that under the null hypothesis, the model is of the correct functional form and should be accepted (not rejected).

[13] Beggs (1988) provides a very comprehensive survey of various alternative methods of testing for the functional form.

5. The Dickey-Fuller and Augmented Dickey Fuller Procedures: Pre-testing the Time Series Data

The Dickey-Fuller (DF) procedure tests for the presence of a unit root or non-stationarity in a data series. The augmented Dickey-Fuller (ADF) test is the same as the DF test except that it can accommodate higher-order autoregressive moving average processes in the error term (Greene, 1997). For most economic time series, differencing or detrending is required to achieve stationarity of a data series. A statistically significant test statistic would indicate that under the null hypothesis the variable in levels or in its differenced form is non-stationary (i.e, has a unit root) and should be rejected.

A closely related idea is that of cointegration. Engle and Granger (1987)[14] suggest a two-step process to modelling co-integrated processes. In the first step, the long-run relationship in levels in fitted by least squares and the Dickey-Fuller test applied to the residuals from the regression, and the hypothesis of co-integration tested. A statistically significant test statistic would indicate that under the null hypothesis the residual is non-stationary (i.e, has a unit root) and should be rejected. In the second step, the residuals from the static regression are included as an error correction term in the dynamic, first-differenced regression. These ideas are discussed in detail in Chapter Six where the dynamics of the model are considered and applied to the necessary parts of the model that are estimated in differences and levels.

B). The Examination of Coefficients and the Goodness of Fit Tests

From the classical non-linear regression of the form,

(1) $Y_i \quad = \quad \alpha X_i^{\beta_2} e^{\epsilon_i}$, we obtain the linear model,

(2) $\ln Y_i \quad = \quad \ln \alpha + \beta_2 \ln X_i + \epsilon_i \quad \text{or} \quad y_i \quad = \quad \beta_2 x_i + \epsilon_i$

where ln denotes natural logarithms and the coefficients are the elasticities are given by:

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[14] See Engle and Granger (1987), for a critical analysis of various testing procedures for co-integration.

$$(3) \quad \frac{\partial y_i}{\partial x_i} * \frac{x_i}{y_i} = \frac{\partial \ln y_i}{\partial \ln x_i} = \beta_2$$

In examining the coefficients, inferences therefore about their sign and magnitudes can be drawn based on a combination of economic theory, results of previous empirical studies and intuition. The application of the common t-ratio will be reported in its corrected form, that is, after allowing for serial correlation. The corrected t-ratios are included in brackets below the corresponding coefficient for all the estimation results reported and presented in the tables in the next chapter.

For the goodness of fit tests, standard diagnostics such as the adjusted coefficient of correlation, (R^2), the Durbin-Watson Statistic (DW) where applicable, the F-statistic and the standard error of the regression (SER) are reported or calculated for each equation in the model. The coefficient of multiple correlation (R^2) is a measure of the association between two variables. This is the most commonly used measure of the goodness fit of an equation. The inclusion of an additional explanatory variable in a regression will always improve the R^2 and never reduce it. It is therefore possible to increase the value of the R^2 by adding additional variables to a model. The adjusted R^2 is therefore usually a better measure of goodness of fit, because it corrects for this defect.The adjusted R^2 would better explain how much variation in the dependent variable is explained by variation in the independent variable and these are the ones that are reported. Similarly, the Durbin-Watson statistic where applicable and the F-statistic are reported, while the standard error of the regression (SER) is manually calculated and reported for each equation.

5.4 *<u>Data Issues and Justification for Adopting a Five-Sector Approach</u>*

A lot of effort has been spent in obtaining sufficient data to test the theoretical models properly. The study utilises a 23-year set of national accounts and external sector data to construct a comprehensive sectoral data set which were used to investigate the issues discussed above. Therefore, the importance and availability of data must be mentioned.

The estimated sample period for this study is from 1973-1995. A longer sample period was not possible because the reporting of data on a sectoral basis in Nigeria started only in 1973. This lack of data and problems of their complete reliability, which are well known in developing countries, constituted a constraint to this study. Nonetheless, the sample period included the boom and bust periods in the international oil markets so that meaningful interpretations of Dutch Disease type effects are still possible.

A lot of effort was made to ensure consistent and reliable statistics, given that data sets from various sources have been employed in the conduct of this research. It must be emphasised that even though the quality of economic data in developing countries is usually of some concern, the compilation and reporting of data since 1973 in Nigeria has generally improved. For this research, the most consistent set of macroeconomic data at the sectoral level were from the United Nations, adequately supplemented by data from the Federal Office of Statistics, Nigeria, while aggregate and financial type data were from the International Monetary Fund and the Central Bank of Nigeria.

The main data sources were obtained from (i) International Monetary Fund (electronic and printed) - International Financial Statistics; Government Finance Statistics; Balance of Payments Statistics; Direction of Trade Statistics (ii) World Bank (electronic and printed) - World Tables; World Debt Tables (iii) United Nations - National Account Statistics Yearbooks; Yearbooks of Labour Statistics (iv) Federal Office of Statistics, Nigeria - National Accounts of Nigeria; Economic and Social Statistics Bulletins (v) Central Bank of Nigeria - Statistical Bulletin; Economic and Financial Review. Details of all data sources as well as how the data were used to construct the variables employed in this study are given in an appendix at the end of the chapters.

For this study, the Dutch Disease macro model was classified into three traded and two non-tradeable sectors. The three sector approach commonly adopted in the literature (Corden and Neary, 1982; Lawler, 1987 and others in the theoretical review in Chapter Four) was deemed to be inadequate to examine properly Dutch Disease type effects and other effects arising from a booming oil sector. For example, within the traded sectors as a whole, the responsiveness of manufacturing and agricultural sectors to the high exchange rate induced by Dutch Disease (see, for example, Struthers, 1990), as well as to a host of other macroeconomic policy variables

(Benjamin, et al, 1989; Fardmanesh, 1991b), may well be different.

Because some degree of complementarity exists between non-traded and traded goods (Struthers, 1990), the problem of compiling statistics on a sectoral basis makes it difficult to categorise any economy by sector in any clear sense. Information on sectoral indices for pure traded and pure non-traded goods is almost impossible to obtain and construct (Hay and Morris, 1981; Hiliare, 1992 and Kamas, 1986). For the traded sectors, what is crucial is that goods within sectors are potentially tradeable even though they are not actually traded, for example, non-traded cassava within the traded agricultural sector. For the non-traded sectors, it is often the case that traded elements constitute a significant percentage of sector output in some developing countries, and more so in developed economies like the UK and Norway, although this phenomenon may be unrelated to any natural resource boom. For example, the structure of the United Kingdom economy before and after the discovery of North Sea oil was such that the share of exports and imports in the output of non-traded sectors, particularly in the services sector, was quite high (Forsyth and Kay, 1980).

Therefore, even though it is recognised that non-traded sub-sectors like construction, transportation, financial and services (Gibbs and Hayashi, 1990) are traded, i.e, exported and imported, these are not sectors where supply and demand can easily be equilibrated through net exports (Gelb, 1988). Indeed, information obtained for Nigeria from the United Nations[15] indicated that in 1990, for example, the share of non-traded services in total exports was 0.2% which is minuscule when compared to other developing countries like Mexico, Egypt and Indonesia, which had shares of 18%, 59% and 8% respectively. Therefore, whilst it is recognised that there may be some overlap between traded and non-traded sectors, our classification is consistent with the evidence cited for Nigeria and classifications contained in empirical studies by Gelb (1988), Looney (1991) and Ndlovu (1994), amongst others, and by reporting international organisations such as the World Bank and the United Nations.

[15] United Nations, (1993), Current Trends and Policies in the World Economy, World Economic Survey.

5.5. Conclusion

This chapter has set out in a rigorous form the very important underlying economic and econometric issues that are critical towards building a robust multi-sectoral simultaneous equation Dutch Disease model for Nigeria that is capable of estimation. In doing so, the notion of theoretical encompassing was addressed, which required the incorporation of certain features of the standard neoclassical models of capital demand and other practical issues into the Dutch Disease model for Nigeria. In particular, a crucial modification of the theories was in explicitly recognising the role of the government as a major determinant of investment demand and the distribution of resources. Variants of the Dutch Disease model were considered and addressed including the world price version and versions in which the exchange rate and the balance of payments were treated interchangeably as exogenous and endogenous variables.

The chapter then went on to discuss the econometric issues that were considered necessary for building the Dutch Disease model for Nigeria. This included a discussion of the issue of identification, the validity of instruments used, the various instrumental variable estimation procedures employed and the formal methodology for the evaluation of the results of the estimated model. Finally, a brief account of the problems of the data employed in this study was discussed and the rationale for using a five-sector Dutch Disease model given.

In the next chapter, the appropriateness of the dynamics of the model, the estimation results, the examination of parameter estimates and the results of our evaluation methodology for each regression, as given in this chapter, are presented and discussed.

CHAPTER 6

THE ESTIMATED DUTCH DISEASE MODEL FOR NIGERIA AND THE EXAMINATION OF PARAMETER ESTIMATES

6.1 Introduction

In this chapter, the multi-sectoral Dutch Disease macro model for Nigeria which was developed and specified in the previous chapter is estimated. With the specifications in logarithms, the long and short run elasticities, which capture the effects of a change in one variable holding all other variables constant, can easily be calculated. Throughout this chapter, the estimation results, the statistical diagnostics employed and the implications of the parameter estimates and calculated elasticities for the Nigerian economy against the background of the theory of the Dutch Disease and related multi-sectoral macro models are presented and discussed.

The chapter is also primarily concerned with formally detailing the rationale and the nature of the dynamics of the Dutch Disease Macro model specified in Chapter Five. In general, the dynamic properties must be consistent with the underlying behavioural assumptions of the model. In Section 6.2, a specification where capital is fixed in the short run is employed for the supply of output equations, while for the demand for output equations a standard partial adjustment framework is employed.

With the incorporation of capital and labour demand and supply equations into the model in Sections 6.3 and 6.4, longer term dynamics of the specified Dutch Disease model can therefore be fully considered. Dynamic capital and labour demand functions are modelled using an error correction mechanism, while the capital and labour supply equations are based on the standard partial adjustment framework. In particular, alternative specifications of the capital demand equations using a price of oil variable and a government investment expenditure variable are tested. Section 6.5 contains the conclusions to the chapter.

6.2 Sectoral Output and Demand Responses

The specifications for the supply of output functions which are the behavioural equations to be estimated are written as:

$$(6.1) \quad \ln S_{jt} \quad = \quad \ln a_0 + a_1 \ln PS_{jt} + a_2 \ln PL_{jt} + a_3 \ln DK_{jt} + \mu_{1t}$$

$a_1 > 0, a_2 < 0, a_3 > 0$ $\qquad\qquad$ $(j = A,M,N)$[1]

$$(6.2) \quad \ln S_{St} \quad = \quad \ln a_0 + a_1 \ln PS_{St} + a_2 \ln PL_{St} + a_3 \ln DK_{St} + a_{41}\, IK51_t + a_{42}\, IK52_t$$

$$+ a_{43}\, IK53_t + \mu_{2t}$$

$a_1 > 0, a_2 < 0, a_3 \quad 0, a_{41} \quad < 0, \; a_{42} >< 0, a_{43} >< 0$

where ln denotes logarithms. S_j is real sectoral output, PS_j is real sectoral supply prices, PL_j is the real wage, that is, the nominal wage deflated by the GDP price deflator at factor cost and DK_j is the level of real stock of capital. Following Newman et al (1995) and others, capital stock was deflated by a sector-specific capital goods price index rather than by the overall GDP deflator[2]. Because of possible heterogeneity of the nontraded services sector, some control is made in the specification of equation (6.2) by including as additional variables a number of interactive dummies (IK51, IK52 and IK53). These dummies are defined as the share of each subsector's output in the total output of the services sector interacted with the sector's total stock of capital[3]. Both equations (6.1) and (6.2) indicate that the final specifications in the sectoral supply equations do not include lagged dependent variables. This relationship reflects the dynamics involved in the short and long run production decisions of firms.

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[1] j unless otherwise stated refers to five sectors namely, A: Agriculture; M: Manufacture; O: Oil; N: Non-Traded Industrials and S: Services.

[2] Details of the derivation and calculation of all variables as well as data sources are contained in the technical appendix at the end of this thesis.

[3] The four sub-sectors in the services sector are, Wholesale and Retail Trade (IK51); Transport and Communications (IK52); Finance, Insurance and Real Estate (IK53); and Informal and Social Services (IK54).

In order to form the sectoral demand functions, the partial adjustment approach which is a popular econometric dynamic method mostly used in consumption and money demand functions is adopted here. The approach is used because it is flexible and dynamic[4]. The specification of the equations in logarithmic form allows us to read off the elasticities of dependent variables with respect to each of the explanatory variables quite easily. Additionally, a partial adjustment specification allows for the estimation of long-run and short-run elasticities. Therefore, in the final form, lagged values of sectoral demand are included on the right hand side of each demand equation. The inclusion of a lagged demand variable in the equation has gained wide acceptance in economics both in empirical studies (for example, Nyatepee-Coo, 1994) and on theoretical grounds (Challen and Hagger, 1992). What this means is that demand in any one period is influenced by the demand in the previous period due to a habit formation process.

A long-run sectoral demand function can be defined as:

(6.3) $\Delta\ (D_j POP)_t = \beta\ (D_j/POP)_t^* - (D_j/POP_{t-1})$

(6.4) $(D_j/POP)_t - (D_j/POP)_{t-1} = \beta(D_j/POP)_t^* - (D_j/POP_{t-1})$

The actual change in sectoral demand (D_j/POP_t) from the previously existing level (D_j/POP_{t-1}) is modified by some fraction of the change required to achieve long-run equilibrium. This proportion is achieved by β where $0 < \beta < 1$. In both equations (6.3) and (6.4), the sectoral demand variables on the left hand side (i.e D_{jt}) have been normalised for population (POP).

Sectoral demand depends further on a vector of variables which have been defined as own sectoral demand prices (PD_j), other sectoral demand prices and real per capita income (Y/POP).

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[4] Arize (1987) shows that the adjustment process in such models may be quite restrictive given the fact that it requires the distributed lag pattern to be identical for each explanatory variable. With a large sample a more general form which allows the distributed lags to be different for each regressor may be specified as:

$Y_{xt} = g + a(L)X_1 + b(L)X_2 \ldots\ldots a(L)X_n + et$

where a(L) and b(L) are polynomials in the lag operator L, and L is given by $L_{xt} = Y_{t-1}$.

$$(6.5)\ (D_j/POP)_t{}^* = a_0 + a_1\ PD1_t + a_2\ PD2_t + a_3\ PD3_t\ + a_4\ PD4_t + a_5\ PD5_t + a_6\ Y/POP_t + \epsilon_t$$

By Substituting equation (6.5) in equation (6.3), equation (6.6) is obtained

$$(6.6)\ (D_j/POP)_t = b_0 + b_1\ (D_j/POP)_{t-1} + b_2\ PD_{jt} + b_{31}\ PD_{jt} + b_{32}\ PD_{jt} + \ + b_{33}\ PD_{jt} + b_{34}\ PD_{jt} + b_4\ (Y/POP)_t + \epsilon_t$$

The estimated sectoral output demand equations in logarithmic form are:

$$(6.7)\ \ln (D_j/POP)_t = \ln b_0 + b_1 \ln (D_j/POP)_{t-1} + b_2 \ln PD_{jt} + b_{31} \ln PD_{jt} + b_{32} \ln PD_{jt} + \ + b_{33} \ln PD_{jt} + b_{34} \ln PD_{jt} + b_4 \ln (Y/POP)_t + \epsilon_t$$

$b_1 > 0,\ b_2 < 0,\ b_{31} >< 0,\ b_{32} >< 0,\ b_{33} >< 0,\ b_{34} >< 0,\ b_4 > 0$

where ln denotes natural logarithms.

In other words, once the estimate of the adjustment coefficient (β) is obtained from our regressions results, the long-run elasticities can be easily calculated. Large values of β imply relatively fast adjustment so that the lower the estimate of the coefficient of the lagged dependent variable (i.e b1 in equation (6.7)), the faster equilibrium demand is reached.

The results of our sectoral supply and demand equations which are presented in Tables 6.1 to 6.4 are based on 2SLS[5] estimates using the LIMDEP version 7 program (Greene, 1995)[6]. All variables are in real terms and logarithms unless otherwise stated. The t-ratios after allowing

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[5] As discussed in Chapter Five, with only 23 observations, the entire model compared to the number of observations available is quite large. With a large number of instruments, 3SLS estimation for the entire model including the output supply and demand equations as well as all factors of production is quite difficult. As explained in Chapter Five, in order to carry out 3SLS, the entire model was split rather arbitrarily into mutually orthogonal blocks. Therefore, 3SLS estimates are reported for the purposes of comparison with 2SLS results and are carried out for the capital and labour demand equations only. Subsequent aspects of this study in Chapters Seven and Eight utilize the 2SLS estimates.

[6] It should be noted that using different estimation procedures for various parts of a model is not unusual. For example, Newman et al (1995) use SURE to estimate the output supply and input demand equations and 3SLS to estimate the demand equations in their model.

for serial correlation are in brackets under each coefficient. Throughout this study, the diagnostics are presented under two separate headings. First, the standard regression diagnostics such as the F-Statistic, the adjusted R^2, the Durbin-Watson Statistic where applicable, and the Standard Error of the Regression (SER) are reported. Because each specification allows for serial correlation, the value for *rho* is reported[7]. Secondly, test statistics from formal testing procedures are reported for the functional form of the model (Reset j Statistic), for the validity of the instruments chosen (Sargan Statistic) and for the exogeneity of the variables in the regression (Hausman Statistic). Furthermore, plots of the Cusum^2 values which are used for checking that the model is structurally stable are presented and discussed with the full graphical plots provided in the appendix at the end of the chapter. Other test statistics that relate to certain parts of the model are reported when used. The full estimation period is for 1973 to 1995. However, because the Hatanaka procedure for serial correlation is used throughout, only 21 observations are actually used.

[7] The procedure uses the Prais and Winsten algorithm to produce values for rho. For the 2SLS results, the estimator was allowed to iterate to convergence. As explained in Chapter Five, the 3SLS estimator does not allow for first order serial correlation in LIMDEP. To overcome this problem, the Seemingly Unrelated Regressions (SURE) method was used. Each right hand side endogenous variable was regressed on the list of instruments and their fitted values retained. The estimated equations were then regressed with the fitted values and exogenous variables with a correction made for first order serial correlation which produces values for rho. The procedure iterated to the default value of one as iterated 3SLS does not bring gains in efficiency (Greene, 1997).

Table 6.1: 2SLS Estimates of Output Supply Equations Excluding the Price of Oil Variable

	Eqn (1)	Eqn (2)	Eqn (3)	Eqn (4)
	Agriculture	Manufacture	Non-Trad. Inds.	Services
CONSTANT	3.5151 (2.744)	-2.048 (0.631)	-2.952 (1.948)	-1.744 (0.219)
PS_A	0.0561 (0.994)			
PS_M		0. 0825 (0.311)		
PS_N			0.1340 (0.307)	
PS_S				0.2113 (2.505)
PL_A	-0.321 (3.322)			
PL_M		-0.227 (2.447)		
PL_N			-0.034 (0.737)	
PL_S				-0.354 (5.987)
DK_A	0.9441 (11.577)			
DK_M		1.3401 (2.772)		
DK_N			1.2455 (7.967)	
DK_S				1.3178 (3.134)
IK51				-0.061 (0.955)
IK52				-0.148 (1.391)
IK53				-0.172 (0.773)
Rho	0.0948 (0.402)	0.5732 (2.992)	0.5640 (3.204)	0.0032 (0.012)

n = 21

Standard Regression Diagnostics:				
F-Statistic:	84.62	16.11	39.53	40.52
Adjusted R^2:	0.92	0.73	0.85	0.92
SER:	0.0407	0.1265	0.0707	0.0472
Diagnostics From Formal Test Procedures (Prob = 1-Chi):				
Reset j Statistic:	0.5679	0.1066	0.2820	0.0953
Sargan Statistic.	0.5507	0.9811	0.2209	0.9777
Hausman Statistic	0.1582	0.5903	0.7243	0.3657

Table 6.2: 2SLS Estimates of Output Supply Equations Including the Price of Oil Variable

	Eqn (1)	Eqn (2)	Eqn (3)	Eqn (4)
	Agriculture	Manufacture	Non-Trad. Inds.	Services
CONSTANT	3.5461 (2.677)	-3.742 (0.899)	-2.119 (1.049)	-1.659 (0.114)
PS_A	0.0453 (1.694)			
PS_M		0.1825 (0.776)		
PS_O	-0.0422 (0.425)	0.1813 (1.633)	0.0653 (1.248)	0.1494 (1.017)
PS_N			0.1598 (0.416)	
PS_S				0.2667 (3.012)
PL_A	-0.343 (3.538)			
PL_M		-0.352 (2.597)		
PL_N			-0.029 (0.699)	
PL_S				-0.357 (5.975)
DK_A	0.948 (11.998)			
DK_M		1.4266 (2.676)		
DK_N			1.239 (6.872)	
DK_S				1.3516 (2.684)
IK51				-0.069 (0.992)
IK52				-0.142 (1.183)
IK53				-0.153 (0.724)
Rho	0.0932 (0.393)	0.4336 (1.195)	0.5912 (3.513)	0.0045 (0.009)

n = 21

Standard Regression Diagnostics:				
F-Statistic:	89.86	16.36	28.75	31.59
Adjusted R^2:	0.93	0.75	0.86	0.95
SER	0.0408	0.2324	0.0712	0.0474

An investigation of Tables 6.1 and 6.2 indicates that in terms of the statistical significance, signs and magnitudes of the coefficients as well as standard statistical diagnostics, the 2SLS estimates of the model without and with the price of oil variable (PS3) do not differ considerably[8]. From Table 6.1, which contains the estimates of the equations without the price of oil variable, all the signs are as expected. In a majority of cases, the coefficients of the wage and capital stock variables in all sectors are significant and pass the t-test at the 10 percent and 5 percent levels respectively. The model performed well in terms of the diagnostics although an adjusted R^2 of 0.73 for the manufacturing sector is slightly low relative to other sectors. The value for rho after allowing for serial correlation are acceptable for the agricultural and services sectors, being generally less than 0.1, although the values for rho of 0.57 and 0.56 for the manufacturing and non-traded industrials sectors respectively may be considered relatively high. The statistically insignificant Reset j statistic for all sectors indicates that under the null hypothesis the log-linear specification is superior to the linear specification and should be accepted. The Cusum and Cusum^2 values for all the sectoral output equations confirmed that the model is structurally stable, although a cursory inspection of the Cusum^2 values in Graphs 6.A1 and 6.A2 for the traded agricultural and manufacturing sectors indicates two possible break points, the first occurring around 1984 and the second almost immediately after or at around 1985. In the first case, the departure from zero is trend wise and takes about six years to mature with a sharp increase from about 1980. This trend indicates that the break might have occurred earlier at about the late 1970s. However, the Cusum^2 values do not suggest that the breaks are significant.

From Table 6.1, the wage rate in all sectors have the plausible negative signs and is as expected important quantitatively and statistically significant for the agricultural sector and to some extent the services sectors both of which are relatively labour intensive. For the agricultural sector, the elasticity is 0.321 while that of the services sector is slightly higher at 0.354. This compares generally with a number of studies. Although not strictly comparable to our study, McKay et al's (1983) study of Australian agricultural production revealed a wage coefficient of 0.10, while Khatiri and Thirtle (1996) report a similar and significant long-run elasticity of 0.11.

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8 A dynamic specification of the model which was tested with lagged dependent variables did not reveal large and statistically significant coefficients without and with the inclusion of the price of oil variable. With a restricted profit function in which capital is fixed it is not surprising that the lagged dependent variables are not significant. In general, the statistically insignificant lagged dependent variables suggested a fairly rapid adjustment of output to changes in the real wage, real output prices and the real stock of capital.

Balogun and Otu's (1991) study of agricultural production in Nigeria revealed a significant and higher agricultural wage elasticity of 0.21 in one of their log-linear equations. In general, the wage variables for the sectors are significant with the exception of the relatively more capital intensive nontraded industrials sector whose wage coefficient, though correctly signed, is statistically insignificant and has a very low elasticity of 0.034.

In all sectors, the capital stock variable is highly significant. The extent of scale economies are generally in line with *a priori* expectations regarding the productivity of capital on a sectoral basis. The results reveal very high productivity of capital in the manufacturing and nontraded industrials sectors, the former having a value of 1.34 and the latter 1.25. Again, though not strictly comparable to our study because of the different measures of the capital stock, the quantitatively important and statistically significant capital stock variable in the manufacturing sector is confirmed in Struther's (1990) study of Nigerian manufacturing industry. The services sector also stands out in that the capital variable is quite significant with a value of 1.32 and the sector exhibits returns to scale close to and higher than both capital intensive manufacturing and the nontraded industrials sectors respectively. This is not surprising given the highly heterogenous nature of the sector which includes very highly capital intensive sub-sectors like finance, transport and communications. The negative signs on the interactive dummies immediately suggest that these sub-sectors are either more capital intensive than the informal social services sub-sector or that the degree of economies of scale are much lower in this particular sub-sector or both. For example, with capital fixed, a change in proportions away from this sub-sector results in a fall in the output of services. However, a WALD test of the interactive dummies revealed that they were not particularly jointly significant. The agricultural sector on the other hand exhibits diminishing returns with a value slightly less than 1.This is not unexpected given the land intensive nature of agricultural production in Nigeria and the omission of a land variable from our specification.

With respect to the own sectoral output price variable, all the sectors have the plausible signs but are generally of small magnitude and not significant with the possible exception of the services sector, and to some extent the nontraded industrials sector, where the ability to increase output is greater. For the agricultural sector, the small short-run response of output to changes in prices is not surprising given that the very nature of agricultural production implies that the response in a single period to changes in prices is likely to be limited (Khatiri and Thirtle, 1996).

Indeed, their study revealed statistically insignificant short and long run price elasticities of 0.03 and 0.22 respectively which are very low and in line with our findings. Interestingly, Harvey, 1987 and Thirtle, 1995, (both cited in Khatiri and Thirtle, 1996) report negative relationships between prices and aggregate agricultural output for the UK, while tests of aggregate supply responses for ten European Community countries showed no response for all but two countries. Quite importantly, the findings from these studies strongly indicate that, in general, given the nature and extent of disaggregated set of agricultural sector data, results can differ significantly. With respect to the manufacturing sector, Struthers' (1990) study similarly revealed a small and insignificant own output price variable while in Kamas (1986), the price effect on output turned out to be wrongly signed in some cases. Our results for the manufacturing sector tend to be in line with those of Richards (1994) in that the own output price effects on the manufacturing (and the non-traded industrials) sector are quite small and insignificant. From our results, in general, sectoral output clearly appears not to be very responsive to changes in prices.

Therefore, on the whole, the ability of firms in Nigeria to expand their output in response to price changes induced by policy incentives such as export subsidies and import tariffs, or even a devaluation, may be limited and therefore may not be an effective tool to promote output and exports the consequence being a continued dependence on imports. The low and insignificant price effects from the perspective of the theory of the Dutch Disease is quite important because it casts some doubt on price induced effects which are directly associated with resource shifts caused by resources moving from the traded sector to a booming traded sector like the oil sector in Nigeria. However, these observations are only preliminary because it may well be that our capital stock variables are more responsive to the own output price.

A confirmation of the absence of the direct resource movement effect is based on the results in Table 6.2, where the tested model with the price of oil variable (PS_O) revealed very small coefficients, which were generally close to zero in all sectors and not statistically significant. Richards (1994) also finds no large negative or positive effects of oil output on manufacturing and non-traded output in his study of a developing natural resource booming country. The statistically insignificant oil price variable is indicative of the absence of a simple resource movement effect implicit in theoretical Dutch Disease models. The expected shrinkage of the traded sectors as a result of resources moving out to the more profitable oil sector is not borne out from our findings.

Table 6.3: 2SLS Estimates of Demand Equations without Government Expenditure

	Eqn (1)	Eqn (2)	Eqn (3)	Eqn (4)	Eqn (5)
	Agriculture	Manufacture	Oil	Non-Trad. Inds.	Services
CONSTANT	-0.3438 (0.019)	4.7171 (1.035)	-2.7828 (2.739)	-3.4256 (1.117)	-1.1605 (1.518)
$(D/POP)_A LAG$	0.0739 (0.475)				
$(D/POP)_M LAG$		0.4115 (3.078)			
$(D/POP)_O LAG$			0.6128 (5.343)		
$(D/POP)_N LAG$				0.8369 (5.492)	
$(D/POP)_S LAG$					0.1904 (1.364)
PD_A	-0.1360 (0.862)				0.3237 (3.426)
PD_M	-0.0097 (0.110)	-0.8106 (2.514)		-0.0356 (0.230)	
PD_O			-0.0504 (0.959)		
PD_N	0.0914 (0.785)	0.7540 (2.197)		-0.0503 (0.453)	
PD_S		-0.2420 (1.543)			-0.3239 (5.318)
Y/POP	0.8685 (3.739)	0.6803 (1.936)	0.6298 (3.252)	0.5694 (2.606)	0.8928 (5.329)
Rho	0.9456 (4.627)	0.0747 (0.225)	0.2988 (1.034)	0.5351 (1.812)	0.2688 (0.913)

n = 21

Standard Regression Diagnostics:					
F-Statistic:	13.22	29.12	152.29	61.70	56.83
Adjusted R^2:	0.71	0.88	0.96	0.92	0.92
SER	0.0469	0.1342	0.0537	0.0638	0.0229
Diagnostics From Formal Test Procedures (Prob = 1 - Chi):					
Reset j Statistic:	0.9063	0.6275	0.0826	0.2002	0.1837
Sargan Statistic.	0.2863	0.3035	0.1706	0.7243	0.5092
Hausman Statistic	0.3232	0.3365	0.1681	0.1078	0.3662

Table 6.4: 2SLS Estimates of Output Demand Equations with Government Expenditure

	Eqn (1)	**Eqn (2)**	**Eqn (3)**	**Eqn (4)**	**Eqn (5)**
	Agriculture	**Manufacture**	**Oil**	**Non-Trad. Inds**	**Services**
CONSTANT	-1.0287 (0.392)	3.9679 (0.883)	-3.5467 (3.767)	-5.2539 (1.509)	-2.3892 (2.034)
$(D/POP)_A LAG$	0.1158 (0.703)				
$(D/POP)_M LAG$		0.3479 (2.555)			
$(D/POP)_O LAG$			0.4116 (3.141)		
$(D/POP)_N LAG$				0.7646 (4.989)	
$(D/POP)_S LAG$					0.2124 (1.619)
PD_A	-0.1342 (0.840)				0.3913 (3.958)
PD_M	0.0166 (0.178)	-0.7381 (2.356)		0.1798 (1.027)	
PD_O			-0.0467 (1.034)		
PD_N	0.0948 (0.828)	0.7136 (2.281)		-0.2896 (2.062)	
PD_S		-0.0584 (0.290)			-0.3723 (5.691)
Y/POP	0.9247 (3.857)	0.8558 (1.209)	0.6735 (4.112)	0.7289 (3.816)	0.9203 (5.796)
GEX1/POP	0.0382 (0.768)	0.1832 (1.371)	0.1606 (2.730)	0.2205 (1.802)	0.0467 (1.609)
Rho	0.9285 (4.471)	0.3204 (0.850)	0.1830 (0.598)	0.6236 (2.318)	0.2681 (0.918)

n = 2

Standard Regression Diagnostics:					
F-Statistic:	13.22	29.12	157.38	61.22	43.55
Adjusted R^2:	0.75	0.89	0.97	0.94	0.93
SER	0.0486	0.1282	0.0447	0.0825	0.0239

An investigation of the two different specifications of the output demand equations presented in Tables 6.3 and 6.4 reveal that the demand price and the income variables have the expected signs. From Tables 6.3 and 6.4, the model without the government expenditure variable (GEX1/POP) performed slightly better than the model with this variable in terms of the standard diagnostics and the values for rho.

The results from Table 6.3 indicate that the model performed well in terms of diagnostics with a high R^2 of between 0.71 and 0.96 for all sectors. The low values for rho, except for the agricultural sector, are satisfactory indicating no further misspecification in the equations. This result is confirmed by the rejection of the general specification error based on the results of the Reset *j* test. The structural stability of the model is confirmed by the Cusum^2 values presented in Graphs 6.A5 to 6.A9 for the sectoral output demand equations. The values are well within the upper and lower bounds for the non-traded sectors. Graphs 6.A5 and 6.A6 for the traded agricultural and manufacturing sectors again indicate two crossings of the significance line in 1984 and 1986, which were the years in which both sectors faced severe difficulties prior to the introduction of the structural adjustment programme. The trend wise departures from coefficient constancy for the oil sector (Graph 6.A7) occur rather more haphazardly and are quite well off the significance lines which indicates some degree of structural instability in the sector. This Cusum^2 graph shows a turning point quite visible around 1981 and at about 1992. The structural instability of the sector is probably not surprising given that Nigeria's domestic demand for oil is relatively small (see review in Chapter Two).

Table 6.5: The Long and Short-run Output Demand Elasticities

Variables:	**Income**		**Price**		**Government Spending (from Table 6.4)**	
Elasticities:	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**
Agriculture	0.87	0.94	-0.14	-0.15	0.04	0.05
Manufactures	0.68	1.16	-0.81	-1.37	0.18	0.28
Oil	0.63	1.59	-0.05	-0.13	0.16	0.27
Non-Trad. Inds	0.60	3.49	-0.05	-0.29	0.22	0.92
Services	0.89	1.10	-0.32	-0.40	0.05	0.06

Notes: (i) SR = Short Run = (b'_S: coefficient on the independent variables)

(ii) LR = Long Run = ($b'_S/1 - b_1$).

The results from Table 6.3 indicate that the demand price explains sectoral output demand quite well. The demand price elasticities formally presented in Table 6.5 are somewhat close to Harberger's (1983) hypothesised values of 0.6 and 0.4 for the aggregate traded and non-traded sectors respectively. In our case, the disaggregated set of results in both Table 6.3 and 6.5 indicate that all the demand price variables in all sectors are negative and are mostly significant with the exception of the oil and non-traded industrials sectors. With regards to the oil sector, a possible explanation stems from the fact that most of the output of the sector is exported and prices are fixed at the world level more so than other traded sectors such as manufacturing and agriculture. Furthermore, in Nigeria, domestic prices of petroleum products are regulated by the government, and for much of the estimated period, domestic prices were far below international prices because of the high level of government subsidies. By contrast, the highly significant demand price variable in the manufacturing sector suggests that, contrary to expectations and based on our previous results, the imposition of tariffs, which effectively increases the domestic prices of imported manufactured goods, may be important in effectively reducing import dependence and in effect cushioning the effects of deindustrialization engendered by the Dutch Disease. In some cases, a strong cross price/substitution effect is present, for example, in the nontraded industrials and manufacturing sectors, and less so in the services sector. Given the close relationship between traded and non-traded manufactured goods, the presence of a cross price effect is not surprising. By contrast, a degree of complementary price effect is detected in all sectors, with the exception of the oil sector, although the effect is insignificant in all sectors.

From Table 6.3, the income variable has the expected positive sign and is highly significant in all but the manufacturing sector. Harberger (1983) has suggested that the income elasticity of demand for traded goods and non-traded goods should be somewhere close to 1.25 and 0.83 respectively. As shown in Table 6.5, our estimates are higher in some cases and lower in others. In general, the short run income elasticities of 0.87, 0.68, 0.63, 0.60 and 0.89 for the agriculture, manufacturing, oil, nontraded industrials and services sectors respectively are significantly smaller than their corresponding long run estimates. These relatively high long-run elasticities of between 0.94 and 3.49 are in line with *a priori* expectations of income elasticities, particularly of countries experiencing a large resource boom. As a resource boom increases income, there is a strong spending effect in all the sectors. This is particularly strong in the non-traded industrials sector. The very high income elasticity of 3.49 for this sector appears to reflect public preferences, given that the oil boom in Nigeria was generally associated with booming construction and construction related industries. As an observation, the government expenditure variable (GEX1/POP) which has the expected positive sign for all the sectors (Table 6.4) indicates the positive income-augmenting impact of government spending on sectoral demand. In all but the agricultural sector, the variable is quite significant. This direct positive influence of government expenditure policy on sectoral output has been shown to be important in the economies of developing natural resource exporting countries in studies by Kamas (1986), Richards (1994) and Looney (1990).

Summary of Findings of Supply and Demand Equations

The main conclusions that can be drawn from the output supply and demand estimations are that in the context of the Dutch Disease, the moderate to large income elasticities suggest a strong income (spending) effect which is an important mechanism that leads to pressures of resource reallocation in the economy. The spending effect, which essentially is a demand effect, has the tendency of increasing output in the most non-traded sectors of the economy. Secondly, the price variables appeared not to have had such a strong effect on output as would be expected in a regime of real appreciation induced by a resource boom. The own price elasticities of supply, and in some cases for demand, were found to be very small for virtually all the sectors. As argued, the low supply price elasticities suggest only a weak resource movement effect. The tested model with the oil price variable revealed very small and statistically insignificant coefficients, which indicates that the classic resource movement effect is not as important as most theoretical accounts of Dutch Disease models make out.

These results suggest that the oil sector may be using factors specific to it, mostly sourced from abroad, so that it does not compete directly with other sectors (which themselves may have factors specific to them) for domestic resources in ways suggested by the theory and some empirical accounts of Dutch Disease models. The resource movement effect, which as predicted by the theory is the opposite counterpart to the spending effect, works its way mainly through the supply side of the economy. Therefore, although output is conditioned on capital, there may be a larger resource movement effect in the capital and labour markets. A rigorous study of sectoral capital and labour demand functions which fully shows the relative opportunities of sectoral investment, and by implication the Dutch Disease effects, is required rather than a mere interpretation of the sectoral output prices as some authors, for example, Balogun and Otu (1991)[9], have done in previous studies. Sectoral capital demand will depend on a vector of variables and crucially on the pattern and distribution of government spending, particularly with regards to its investments in the oil sector.

6.3. The Demand for and the Supply of Capital

The results from our sectoral supply and demand equations in Section 6.2 revealed that the resource movement effect may be absent because factors do not typically move into the booming oil sector from other sectors of the economy. However, one may wish to look at the determinants of resource movement, for example, government investment in the oil sector and the possible crowding out effects elsewhere in the economy.

In Chapter Five, the theoretical underpinnings of capital demand functions were analysed and the equations specified with the dynamics although the rationale for their incorporation was not justified either on empirical or theoretical grounds. In this chapter, the nature of the dynamics and the short run and long run effects on sectoral capital demand demand are analysed. In general, a disequilibrium relationship with lagged values of the independent and dependent variables reduces to a relationship specified in levels whenever equilibrium happens to occur.

To examine the employment and use of capital with appropriate dynamics, an Error Correction Model (ECM) of sectoral capital demand is used. Such models have gained wide acceptance in the econometrics literature, notably, Davidson et al (DHSY) (1978), Hendry and von-Ungern Sternberg (HUS) (1981) and Carruth and Henley (1990), amongst others. The model is based on the non-stationarity of the data series, and analyses both in the long and the short-run, the dynamic structure of the relationship.

[9] For a good account of agricultural responses to various policy initiatives see Balogun E D and Otu M F (1991).

Time Series Properties of the Capital Demand Variables

An underlying long-run capital demand equation which can be specified as part of an overall macro model assumes that the time series variables are stationary[10]. If the variables are non-stationary, a straight forward estimation of these equations in levels would yield misleading results. Therefore, before the 2SLS estimates for the capital equations are presented and discussed, the results of the standard Dickey Fuller (DF) tests are investigated. The stationarity of the variables was analysed based on the unit root test and their order of integration (all in logarithmic form) was based on this standard DF test statistic[11]. Table 6.6 shows the DF results which tests for stationarity of the variables involved. As shown in the table, all the variables were found to be stationary after first differences indicating that they are integrated of the order 1, I (1).

A problem that follows from non-stationarity is the issue of co-integration. The stationary first difference series suggests that the variables in levels might have a cointegrated or equilibrium relationship. As Stewart (1991) states, "if time series levels are modelled exclusively in terms of their past behaviour, then such processes often do not satisfy stability conditions". If the variables as already shown are I (1) but not cointegrated, 2SLS might give misleading results. The existence of an equilibrium (cointegrated) relationship between the variables requires a linear combination of the data series to be I (0) or stationary (Thomas, 1993). To establish the existence of an equilibrium relationship, a simple test for cointegration based on the standard DF test on the residuals from the sectoral capital demand equations estimated in levels was carried out.

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[10] See Chapter Five for a full discussion of the economics of the complete Dutch Disease macro model from a theoretical standpoint, as well as related important econometrics issues such as identification, instrumentation and the approach used to deal with the problem of serial correlation.

[11] The Microfit Version 3.0 Program (Pesaran and Pesaran, 1991) was used to carry out the unit root test for the variables and the simple tests for cointegration.

Table 6.6 Testing for Unit Roots for the Capital Demand Variables (1973 - 1995)

Variables	DF Statistic (Levels)	DF Statistic (Differenced)
ln S_A	-1.5040	-4.4070
ln S_M	-1.7882	-3.8231
ln S_O	-1.4051	-4.6226
ln S_N	-1.2817	-3.1674
ln S_S	-1.7581	-3.3504
ln PS_A	-1.6675	-3.2838
ln PS_M	-1.6978	-4.8309
ln PS_O	-2.5922	-5.6474
ln PS_N	-3.7466	-5.2460
ln PS_S	-1.6086	-4.1397
ln PL_A	-1.9823	-5.9595
ln PL_M	-2.6942	-4.5665
ln PL_O	-3.8128	-5.9246
ln PL_N	-2.2863	-4.5883
ln PL_S	-4.9574	-4.2495
ln RIR	-2.6518	-3.9665
ln GEX2	-2.0777	-3.9568
ln DK_A	-0.9915	-4.3164
ln DK_M	-1.9944	-3.6555
ln DK_O	2.1797	-4.5555
ln DK_N	-1.4031	3.7236
ln DK_S	-3.5444	3.8884

H_0: Series are non-stationary; H_1: Series are stationary

(Critical value: 3.6592)

As shown in Table 6.7, the DF test rejects the hypothesis of a unit root in the residual term based on 2SLS regressions of the capital demand equations in levels confirming that it is 1, I (0) and so ensures a stable long-run relationship. It is important to report that previous models of Dutch Disease have not used cointegration techniques. However, with a multivariate model with endogenous right hand side variables and a limited number of observations, the use of sophisticated cointegration techniques, such as the Johanssen method, is not feasible. In this context therefore, modelling the demand for the capital stock as an ECM becomes feasible.

Table 6.7. A Simple Test for Cointegration of the Capital Demand Equations (1973 - 1995)

With Government Investment in the Oil Sector Variable (GEX2)					**With the Price of Oil Variable (PS_O)**			
Eqn (1)	**Eqn (2)**	**Eqn (3)**	**Eqn (4)**	**Eqn (5)**	**Eqn (1)**	**Eqn (2)**	**Eqn (3)**	**Eqn (3)**
Agriculture	Manufacture	Oil	Non.Trad Inds	Services	Agriculture	Manufacture	Non.Trad Inds	Services
-5.7012	-3.7601	-3.7885	3.9457	-7.2057	4.7876	3.2140	3.6164	5.6195

H_0: Residuals are non-stationary; H_1: Residuals are stationary
(critical value: 3.6592)

The Long and Short run Dynamics for the Capital Demand Equations

The use of an instrumental variable error correction model of capital is used to analyse within a dynamic setting the determinants of capital demand, whilst simultaneously allowing for the bias induced by the presence of right hand side endogenous variables which was explained in Chapter Five. In modelling ECMs, two approaches are suggested, the Engle-Granger two step methodology and the Hendry-type general to specific methodology.

Considering a case of an ADL(1,1) model

$$(6.8)\quad Y_t \quad = \quad \beta_1 + \beta_2 X_t + \beta_3 X_{t-1} + \beta_4 Y_{t-1} + u_t;\ t = 1,\ldots\ldots,n$$

Then if a long-run response of Y to a unit change in X is to be equal to 1, then

(6.9) $(\beta_2 + \beta_3)/(1 - \beta_4) = 1 = \beta_2 + \beta_3 + \beta_4 = 1$

If this restriction is imposed on equation 6.9, we obtain

(6.10) $Y_t = \beta_1 + \beta_2 X_t + (1 - \beta_2 - \beta_4)X_{t-1} + \beta_4 Y_{t-1} + u_t$

(6.11a) $Y_t - Y_{t-1} = \beta_1 + \beta_2 (X_t - X_{t-1}) + (\beta_4 - 1)(Y_{t-1} - X_{t-1}) + u_t$

or

(6.11b) $\Delta Y = \beta_1 + \beta_2 \Delta X_t - (1 - \beta_4)(Y_{t-1} - X_{t-1}) + u_t$

Engle and Granger (1987) suggest a two-step approach. First, the existence of a cointegrating relationship among the variables in equation (6.8) is determined based on standard cointegration techniques. If the variables are cointegrated, a stable long-run relationship can be estimated using OLS techniques. Second, the information in the error term of the long-run relationship could be used to create a dynamic error correction model. In other words the idea of a co-integrated series arises when the variables are individually I (1) but where some linear combination is I (0). The cointegrated process says nothing about the form of the lag structure of the short run relationship (Thomas, 1993) because it yields information on long run properties only. If the variables are cointegrated then the short run or disequilibrium relationship between them can be represented by an ECM (Harris, 1995). According to Engle and Granger (1987), this error correction model produces consistent results even when the right hand side variables are not completely exogenous.

Alternatively, using the Hendry general to specific one-step methodology, both the long and the short run elasticities can be estimated together. This procedure has been used in several studies for example, Hoque and Al-Muthari, 1996; Mehra, 1991 and Moser, 1995. Our study employs this methodology and specifies the equations including both levels and differences of the non-stationary variables, so that it is easier to distinguish between the short and the long run in the capital demand equations. Considerable flexibility is achieved using this approach because some variables that are included in the short run part of the model might not be included in the long-run part and vice versa (Mehra). Quite importantly, the small sample bias from this estimator is smaller than it is with the two step procedure (Thomas, 1993). In our case, the ECM is specified in its unrestricted form, that is a long run elasticity of one is not imposed as was the case in Equation (6.9) so that the model generates estimates of elasticities.

The motivation behind the use of the ECM for the modelling of the capital demand equations was therefore influenced by the considerations stated above. Furthermore, it seemed impractical to attempt to use both stocks and flows in the original specification in levels. That is, given that the occurrence of stocks and flows raises dimensionality problems (Hendry, 1986), the attempt to overcome the problem of regressing a stock variable (for example, the sectoral capital stock (DK_j)) on a flow variable (for example the price of oil (PS)), was an important consideration in deciding to adopt an ECM type methodology.

Therefore in the present setting, the utilisation of an instrumental variable unrestricted error correction model of capital demand will be used to analyse the impulse response of sectoral capital demand to stimulus in the right hand side variables within a dynamic setting, whilst allowing for the simultaneity bias induced by the presence of right hand side endogenous variables. This model therefore allows the long-run properties of the variables to obey equilibrium conditions, whilst allowing the short-run properties to have a dynamic specification.

Based on the discussions above, 2SLS is applied directly to the sectoral capital stock equations using the one-step approach where both the long and short run parameters are estimated together. The capital demand equations to be estimated are written as:

(6.12) $\Delta \ln DK_{jt} = c_0 + c_1 \ln DK_{jt-1} + c_2 \ln S_{jt-1} + c_3 \ln PS_{jt-1} + c_4 \ln PL_{jt-1} + c_5 \ln GEX2_{t-1}$

$+ c_6 \ln RIR_{t-1} + c_7 \Delta \ln S_{jt} + c_8 \Delta \ln PS_{jt} + c_9 \Delta \ln PL_{jt} + c_{10} \Delta \ln GEX2_t + c_{11} \Delta \ln RIR_t + \eta_{1t}$

$c_1 < 0,\ c_2 > 0,\ c_3 > 0,\ c_4 > 0,\ c_5 < 0,\ c_6 < 0,\ c_7 > 0\ c_8 > 0,\ c_9 > 0,\ c_{10} < 0,\ c_{11} < 0$

(6.13) $\Delta\ln DK_{St} = c_0 + c_1 \ln DK_{St-1} + c_2 \ln S_{St-1} + c_3 \ln PS_{St-1} + c_4 \ln PL_{St-1} + c_5 \ln GEX2_{t-1}$

$+ c_6 \ln RIR_{t-1} + c_{71}\ IS51_{t-1} + c_{72}\ IS52_{t-1} + c_{73}\ IS53_{t-1} + c_8\ \Delta\ln S_{St} + c_9\ \Delta\ln PS_{St} + c_{10}\ \Delta\ln PL_{St}$

$+ c_{11}\ \Delta\ln GEX2_t + c_{12}\ \Delta\ln RIR_t\ +\ \eta_{2t}$

$c_1 < 0,\ c_2 > 0,\ c_3 > 0,\ c_4 > 0,\ c_5 < 0,\ c_6 < 0,\ c_{71} >< 0,\ c_{72} >< 0,\ c_{73} >< 0,\ c_8 > 0,\ c_9 > 0,$
$c_{10} > 0,\ c_{11} < 0,\ c_{12} < 0$

For the capital supply equations, a standard partial adjustment model was employed. With a lagged dependent variable, the capital supply equation to be estimated is :

(6.14) $\ln\Sigma\ SK_j \quad = \quad d_0 + d_1 \ln \Sigma SK_{jt-1} + d_2 \ln RIR_t + d_3 \ln Y_t + \xi_t$

$d_0 > 0,\ d_0 > 0,\ d_0 > 0$

where DK_j, S_j, PS_j, PL_j and Y are as defined previously, RIR is the real interest rate, GEX2, the level of government's investment in the oil sector, and SK, the total supply of capital. Δ represents the first difference operator. To control for possible heterogeneity and variation in capital in the services sector, a number of interactive dummies were included (IS51, IS52 and IS53). These dummies are defined as the share of each subsector's output in the total output of the services sector interacted with the services sector's total supply of output.

The results of our sectoral capital demand equations are presented in Table 6.8, with each equation tested separately for the price of oil variable (PS_O) and the government investment in the oil sector (GEX2) variable.

Table 6.8: 2SLS Estimates of the Sectoral Capital Demand Equations

	With Government Investments in Oil (GEX2)					With the Price of Oil (PS_O)			
	Eqn 1	Eqn 2	Eqn 3	Eqn 4	Eqn 5	Eqn 1	Eqn 2	Eqn 3	Eqn 4
	Agriculture	Manufacture	Oil	Non-Trad. Inds.	Services	Agriculture	Manufacture	Non-Trad. Inds	Services
Constant	-1.5632 (1.320)	0.9342 (0.778)	0.0300 (0.037)	5.0857 (3.904)	3.8191 (0.905)	-0.4937 (0.190)	-2.3750 (1.047)	3.7659 (1.978)	6.5392 (3.580)
DK_ALAG	-0.6993 (2.358)					-0.7182 (3.729)			
DK_MLAG		-0.3720 (2.003)					-0.3181 (1.246)		
DK_OLAG			-0.2857 (2.588)						
DK_NLAG				-0.9220 (3.902)				-0.5334 (1.998)	
DK_SLAG					-0.8235 (2.798)				-0.9154 (1.142)
S_ALAG	0.79457 (2.287)					0.5673 (2.454)			
S_MLAG		0.2938 (2.628)					0.1377 (1.907)		
S_OLAG			0.2313 (3.676)						
S_NLAG				0.6539 (4.314)				0.2639 (2.700)	
S_SLAG					0.56321 (1.710)				0.4501 (5.363)
PS_ALAG	0.26295 (2.130)					0.3298 (1.656)			
PS_MLAG		0.1239 (2.245)					0.2373 (2.930)		
PS_OLAG						0.2054 (1.113)	-0.0037 (0.023)	-0.1068 (0.306)	0.0399 (0.773)
PS_NLAG				0.0574 (0.056)				0.03222 (0.090)	
PS_SLAG					0.0955 (0.407)				0.2481 (2.238)
PL_ALAG	-0.1973 (1.359)					0.2989 (1.241)			
PL_MLAG		0.0346 (1.519)					-0.0888 (0.550)		
PL_OLAG			-0.0998 (3.122)						
PL_NLAG				-0.1423 (1.913)				-0.0738 (0.232)	
PL_SLAG					0.0228 (0.302)				0.0627 (1.145)
GEX2LAG	-0.1683 (2.609)	-0.1987 (4.139)		-0.1166 (3.586)	-0.0512 (1.136)				
RIRLAG	-0.0003 (0.088)	-0.0063 (2.469)	-0.0109 (2.270)	-0.0029 (1.467)	-0.0036 (0.978)	-0.0007 (0.200)	0.0016 (0.326)	0.0092 (0.814)	-0.0009 (0.401)

IS51LAG					-0.0303 (1.839)				
IS52LAG					-0.0521 (1.457)				
IS53LAG					-0.0757 (0.644)				
ΔS_A	0.36015 (2.978)					0.7156 (2.406)			
ΔS_M		0.3298 (7.440)					0.3524 (3.258)		
ΔS_O			0.2568 (3.154)						
ΔS_N				0.6691 (7.718)				0.7143 (4.078)	
ΔS_S					0.2756 (0.744)				0.1709 (1.411)
ΔPS_A	0.04571 (0.326)					0.0073 (0.048)			
ΔPS_M		0.1261 (2.815)					0.1528 (0.760)		
ΔPS_O						0.5895 (4.124)	-0.2358 (0.836)	-0.0801 (0.331)	0.1096 (1.810)
ΔPS_N				0.0148 (0.258)				0.0232 (0.109)	
ΔPS_S					0.0657 (0.489)				0.1206 (1.831)
ΔPL_A	-0.0781 (0.534)					0.8175 (4.252)			
ΔPL_M		0.1182 (1.326)					-0.2384 (1.009)		
ΔPL_O			-0.0257 (0.472)						
ΔPL_N				-0.04799 (1.193)				0.0926 (0.856)	
ΔPL_S					0.0019 (0.031)				0.1927 (3.289)
ΔGEX2	-0.0218 (2.270)	0.0302 (2.125)		-0.1043 (1.285)	-0.0756 (1.780)				
ΔRIR		-0.0054 (2.450)	-0.0090 (3.323)	-0.1026 (1.216)	-0.0034 (1.314)		0.0013 (0.286)	0.0049 (0.524)	-0.0002 (0.001)
Rho	-0.1051 (0.475)	-0.5372 (1.817)	-0.1356 (0.319)	-0.0472 (0.088)	-0.1064 (0.537)	0.6442 (2.690)	-0.6467 (1.805)	0.1081 (0.223)	-0.6667 (3.221)
Standard Regression Diagnostics and Diagnostics From Formal Test Procedures: (Prob = 1 - Chi)									
F-Statistic	3.79	9.63	2.98	9.74	0.51	2.28	1.75	3.49	4.97
Adj. R^2	0.52	0.29	0.41	0.81	0.52	0.39	0.21	0.58	0.69
SER	0.0330	0.0318	0.0765	0.0194	0.0730	0.0516	0.0837	0.0283	0.0129
Sarg. Stat.	0.1123	0.6307	0.2044	0.7200	0.2428	not used	not used	not used	not used
Haus. Stat	0.08427	0.0014	0.98972	0.8746	0.2150	not used	not used	not used	not used
Reset Stat	0.1856	0.1689	0.2612	0.1529	0.1434	not used	not used	not used	not used

n = 21

For the capital demand equations, in spite of the difficulties usually associated with capital equations (Catinat et al, 1987), the results from the capital demand equations are quite reasonable. From Table 6.8, which contains the results including the government investment expenditure variable (GEX2), our model performed well in terms of *a priori* theoretical assumptions about the Nigerian economy. The model explains quite well sectoral capital demand as a function of output, output price, the real wage, the real interest rate and exogenous developments in the oil sector. The model with the government investment in the oil sector variable outperformed that with the price of oil variable for virtually all the sectors. The inclusion of this variable improved the results in terms of statistical significance of the coefficients and the standard regression diagnostics. The F-statistic, R^2 and the standard error of the regressions (SER) were generally better for all sectors with the possible exception of the services sector.

An check of Tables 6.8 for an indication of the effects of the price of oil on sectoral capital demand reveals some unexpected results. The expected crowding out and crowding in effects on the traded and non-traded sectors respectively given the rise in the price of oil clearly appears not to be borne out. The price of oil variable (PS_O) did not have the expected signs for virtually all the sectors.

According to the theory of the Dutch Disease, an increase in the price of oil would be expected to have a negative effect on the traded goods sector, particularly the traditional (agricultural) exports sector. The sign is positive for the agricultural sector, although it is generally believed (Struthers, 1990; Odifa, 1988) that this sector suffered most from the Dutch Disease. However, the positive sign may be capturing the effect of optimism and subsidies as high oil prices means higher level of subsidies, opening up resources elsewhere for investments in the agricultural sector. A negative sign for the manufacturing sector is contrary to results by Fardmanesh (1991a) and others who have shown that this sector expanded directly as oil prices rose. The services sector is correctly signed but is not significant.

Table 6.9. The Long and Short-run Capital Demand Elasticities

Variables:	Output		Output Price		GEX2		Oil Price	
Elasticities:	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**
Agriculture	0.36	1.14	0.05	0.38	-0.02	-0.24	0.59	0.29
Manufacture	0.33	0.79	0.13	0.33	0.03	-0.53	-0.24	-0.01
Oil	0.26	0.81	-	-	-	-	-	-
Non-Trad. Inds	0.67	0.71	0.01	0.06	-0.10	-0.13	-0.08	-0.20
Services	0.28	0.68	0.07	0.12	-0.08	-0.06	0.11	0.04

Notes: (i) GEX2 = Government Investment in the Oil Sector

(ii) SR = Short Run

(iii) LR = Long Run.

A further investigation of Table 6.8 based on the government investment expenditure version of the model (i.e with GEX2), and the corresponding estimated elasticities presented in Table 6.9, shows that the output variable (S_j) is highly significant which indicates that capital responds to output in all sectors fairly consistently both in the short and long run. The influence of the output variable is therefore statistically significant and quantitatively important in all cases, a result that is line with estimates from Catinat et al (1987). Similarly, Sundararajan and Thakur (1980) found output to be the most significant determinant of the capital stock. An investigation of the results from Tables 6.8 and 6.9 indicates the strong and significant effect of the output variable, with large t-ratios and high short and long run output elasticities, particularly for the traded manufacturing and the nontraded industrials sectors. For the agricultural sector, the short and long run output elasticities of 0.36 and 1.14 respectively indicate that as output increases, this sector only just uses proportionately more capital in the long run. In general, for all the sectors, the size of scale economies of between 0.88 and 1.46 from the capital equations compares quite well with estimates from our output supply equations estimated previously.

With respect to the output price variable (PS_j), the demand for capital equations responds more strongly to changes in prices in the long run than in the short run. This is generally in accordance with the Le Chatelier-Samuelson principle, that output and price elasticities are larger in the long run than in the short run[12]. An investigation of Tables 6.8 and 6.9 indicates that the short-run output price elasticities are generally quite small and not significant for the services and non-traded industrials sectors, while for traded agriculture and manufacturing sector, the elasticities were relatively larger and quite significant. In the long run, however, the output price variables for all the sectors are quite large and significant, particularly for the manufacturing and services sectors. The long-run price elasticities of 0.38, 0.33 and 0.12 for the agricultural, manufacturing and services sectors respectively are generally consistent with *a priori* expectations of price variables with respect to the capital stock. Given that capital is quite responsive to the output price and output itself is conditioned on capital there may be a larger resource effect than our previous supply equations showed. However, the effect is not direct in the classic sense of the Dutch Disease resource movement effect given that the oil price effects were quite small.

The degree of factor substitution between capital and labour in each sector depicts different stories. The coefficients on the wage variables (PL_j) are quite small and not always significant. In a number of cases, a negative coefficient is reported. For the oil sector, typically regarded as an 'enclave sector' given that much of its resources are thought to come from abroad, the negative and significant real wage may indicate that the sector substitutes oil wells for capital and labour so that as the price of labour increases, the use of capital falls. For the non-traded industrial sector, the negative wage coefficient may be interpreted as the substitution, for example, of the quality of land for capital and labour so that as the price of labour increases the sector uses less capital. It is important to note that the output variable allows for opposite effects and therefore one might think that capital and labour are substitutes with opposite signs so that there should be no presumption as to what direction the real wage or other factor prices may go. In general, the negative coefficient tends to indicate that as labour costs go up output effect dominates substitution effect, which is likely in those industries which use little labour. The variation of factor prices to capital demand was shown by Sundararajan and Thakur (1980) who found that the rental-wage ratio had a strong negative influence on capital demand in India but had no significant influence in Korea. Indeed, the effect of wages on capital demand may change

[12] Hoel and Vislie (1983) however have theoretical demonstrated that when price uncertainty is introduced into a model of a competitive firm, the Le Chatelier-Samuleson principle may not hold.

depending on the relative likelihood of demand and supply constraints (Bhaskar, 1992), such that the factor substitution is not clear cut in any way.

With respect to the own price of capital (proxied by the real interest rate), our results are generally in the spirit of standard neoclassical ideas, in that, the real interest rate variable (RIR) is shown to be negatively, though not significantly, related to capital demand. In all but the traded manufacturing sector and to some extent the non-traded industrials sector, the coefficient is small and insignificant. This result is perhaps not surprising if we recall from Chapter Three the fact that the manufacturing sector accounts for a large share of the domestic market for loans and advances, while the oil sector, by contrast, accounts for less than 1%. The manufacturing and non-traded industrials sectors are therefore likely to be more sensitive to changes in the real interest rate since much of their productive investments are typically sourced from the domestic capital markets rather than from abroad as is the case in the oil sector.

Clearly, at the sectoral level, interest rates are shown not to be positively related to capital demand as was the case in a number of developing countries investigated in the empirical accounts of previous chapters. From our results, the main conclusion that can be made is that in general, the statistically insignificant and small real interest rate variable is probably not capturing the true cost of capital. The observed interest rate may not be reflecting the scarcity of capital because capital markets in developing countries such as Nigeria are still relatively small and not very sophisticated. Our findings of a negligible effect of interest rates on the capital stock, and by contrast, a high and significant effect of output appears consistent with findings by Clark (1979) in his comprehensive review of leading econometric models of the determinants of the capital stock.

Our government investment expenditure in the oil sector variable (GEX2) itself had the expected negative signs and was highly significant for the agricultural, manufacturing and non-traded sectors, and marginally significant for the services sector. On empirical grounds, this seems to justify the modification of the standard neo-classical models of capital demand to account explicitly for the role of government as a major determinant of the capital stock.

From Table 6.9, the generally negative short-run government investment elasticities are quite small varying from between -0.02 to -0.10. In the short run, a 10% increase in government spending induces a crowding out effect of about 1% in the most affected sector this being the non-traded industrials sector. However, our estimates of the corresponding long-run elasticities revealed much higher values of -0.24, -0.53, -0.13 and -0.06 for the agricultural, traded manufacturing, non-traded industrials and services sectors respectively.

A surprising finding from our results is with respect to the manufacturing sector given that the estimated short run coefficient is positive while the long run coefficient is negative. The positive sign on the short run government investment variable (GEX2) may be an indication of the favourable boost to domestic manufacturing production as a result of increased government spending on locally produced industrial inputs. The negative crowding out effect on the manufacturing sector begins to occur only over the long run.

In general, the negative substitution effect, induced by government investments in the oil sector which essentially means that less funds are available for investments in other sectors of the economy, is felt in all sectors. Increased investments by the government in the oil sector crowds out the demand for capital in other sectors, particularly traded agriculture and manufacturing, via the competition for public funds hypothesis, although this effect is more pronounced in the long run than in the short run. Although our theoretical and empirical accounts from previous chapters noted that the nature and extent of crowding out will depend on the specific type of public investment in question, (for example, Blejer and Khan, 1984), clearly in our case, government investment expenditures results in a competitive (crowding out) effect rather than a complementary (crowding in) effect. In some cases, this direct crowding out effect is augmented by an indirect crowding out effect from higher real interest rates which are induced by expansionary fiscal policies such as the increase in government investment spending in the oil sector itself. Although it has already been noted that a consistently negative real interest rate variable lends credence to mainstream neoclassical type ideas, the lack of statistical significance suggests that the main crowding mechanism in our model is via the direct (competitive) hypotheses rather than indirectly through the feedback effects of expansionary fiscal policies (or contractionary monetary policies) on the interest rate.

Table 6.10: 2SLS Estimates of Total Capital Supply Equation

	Independent Variables:					**Diagnostics:**		
	Constant	SKTLAG	RIR	Y	Rho	F-statistic	Adjusted R^2	SER
Eqn 1	-3.7015 (0.350)	0.4261 (0.848)	0.1814 (0.672)	0.7221 (0.546)	0.2598 (0.482)	3.33	0.25	0.3253

n = 21

The results from our capital supply equation further reveals the insignificance of the real interest rate (RIR) on domestic conditions, particularly savings, in terms of both the magnitudes and direction of the short and long run elasticities. From Table 6.10, the derived short and long run interest rate elasticities of 0.18 and 0.32 respectively are considered quite small, although the positive sign of the coefficient is consistent with earlier findings which attest to the positive effect of the real interest rate on savings. By contrast, a size effect as proxied by national income (Y) was found to have a large, though not significant, effect on domestic savings. The increase in the short run income elasticity from 0.72 to a high long run value of about 1.26 indicates that the scope for savings in Nigeria increases with the general growth of the economy.

Before going on to discuss the labour demand and supply equations, the results from 3SLS estimates of the capital demand equations with the government investment variable (GEX2) are presented in Table 6.11, solely for the purpose of comparison with the 2SLS estimates. The major observation that can be made is that there is a marked improvement in the statistical significance of the coefficients for most of the variables when the 3SLS estimator is employed. However, because of the problems in transferring systematic errors in estimation using this estimator, 3SLS results are generally not presented and are not used for estimating the elasticities or as a basis for subsequent work in later parts of this study.

Table 6.11: 3SLS Estimates of Capital Demand Equations using the Government Expenditure Variable (GEX2)

	Eqn 1	Eqn 2	Eqn 3	Eqn 4	Eqn 5
	Agriculture	Manufacture	Oil	Non-Trad. Inds.	Services
CONSTANT	-2.3976 (2.562)	-0.3042 (1.898)	0.6115 (0.941)	5.0438 (9.538)	4.8070 (4.195)
DK_ALAG	-0.7872 (4.046)				
DK_MLAG		-0.6547 (4.669)			
DK_OLAG			-0.2688 (3.160)		
DK_NLAG				-0.9259 (8.328)	
DK_SLAG					-0.9853 (9.169)
S_ALAG	0.7952 (4.481)				
S_MLAG		0.4735 (4.530)			
S_OLAG			0.2612 (4.730)		
S_NLAG				0.5451 (7.287)	
S_SLAG					0.5029 (6.139)
PS_ALAG	0.3654 (2.237)				
PS_MLAG		0.0843 (2.016)			
PS_OLAG					
PS_NLAG				0.7695 (5.926)	
PS_SLAG					0.1930 (3.133)
PL_ALAG	-0.4070 (3.075)				
PL_MLAG		0.0628 (2.067)			
PL_OLAG			-0.1037 (3.898)		
PL_NLAG				-0.0904(2.267)	
PL_SLAG					0.0823 (2.046)
GEX2LAG	-0.0592 (2.928)	-0.0665 (4.312)		-0.0396 (6.118)	-0.0547 (3.341)
RIRLAG	-0.0067 (0.025)	-0.0064 (2.049)	-0.0068 (2.817)	-0.0056 (2.854)	
IS51LAG					0.1514 (2.672)
IS52LAG					0.0610 (1.154)
IS53LAG					0.0919 (1.260)

ΔS_A	0.7059 (2.401)				
ΔS_M		0.2369 (3.498)			
ΔS_O			0.2239 (4.312)		
ΔS_N				0.7141 (7.959)	
ΔS_S					0.3741 (3.737)
ΔPS_A	0.3848 (0.243)				
ΔPS_M		0.1144 (2.687)			
ΔPS_O					
ΔPS_N				0.4064 (5.656)	
ΔPS_S					0.2388 (4.026)
ΔPL_A	-0.0781 (0.585)				
ΔPL_M		0.0533 (1.167)			
ΔPL_O			-0.0033 (0.110)		
ΔPL_N				-0.0568 (0.989)	
ΔPL_S					-0.1428 (4.220)
ΔGEX2	-0.0130 (0.768)	0.0453 (3.458)		-0.2459 (3.984)	-0.2630 (3.081)
ΔRIR		-0.0073 (2.734)	0.0052 (3.191)	-0.0068 (3.158)	0.0035 (3.194)
Rho	-0.2978	-0.1516	0.1206	-0.234	-0.3938

n = 21

Standard Regression Diagnostics:					
Adjusted R^2	0.47	0.63	0.53	0.86	0.73
SER	0.0341	0.0205	0.0568	0.0194	0.0163

6.4. Labour Supply and Demand

To pre-test the time series nature of the data for the labour demand equations, a Dickey -Fuller (DF) test procedure similar to the one used in testing the variables included in the capital demand equations was carried out on the additional DL_{jt} variables, other variables being the same as those used in the capital demand equations. The DL_{jt} variables were generally stationary after first differences as Table 6.12 shows.

Table 6.12: Testing for unit roots for the Labour Demand Variables (1973 - 1995)

Variables	ADF Statistic (Levels)	ADF Statistic (Differenced)
$\ln DL_A$	-1.3117	-3.7005
$\ln DL_M$	-0.6082	-4.3614
$\ln DL_O$	-1.9881	-4.6388
$\ln DL_N$	-1.1585	-2.0608
$\ln DL_S$	-2.5057	-3.8275

H_0: Series are non-stationary; H_1: Series are stationary. (Critical value: 3.6592).

The DF test for the residual term from the estimates of the labour demand equations in levels rejected the hypothesis of a unit root for all the equations (Table 6.13). The labour demand equations were modelled as an ECM in its unrestricted form.

Table 6.13: A Test for Cointegration for the Labour Demand Equations (1973 - 1995)

Eqn (1)	Eqn (2)	Eqn (3)	Eqn (4)	Eqn (5)
Agriculture	**Manufacture**	**Oil**	**Non-Trad. Inds**	**Services**
3.5556	3.1837	3.9681	3.2341	5.9627

H_0: Residuals are non-stationary; H_1: Residuals are stationary. (Critical value: 3.6592).

The demand for labour in each sector depends negatively on the sectoral real wage. The real wage is calculated as the nominal wage deflated by the GDP deflator at factor cost. With an ECM type specification similar to the capital demand equations, the labour demand equations to be estimated are:

(6.15) $\Delta\ln DL_{jt} = e_0 + e_1 \ln DL_{jt-1} + e_2 \ln S_{jt-1} + e_3 \ln PS_{jt-1} + e_4 \ln PL_{jt-1} + e_5 \ln RIR_{t-1} + e_6 \Delta\ln S_{jt}$

$+ e_7 \Delta\ln PS_{jt} + e_8 \Delta\ln PL_{jt} + e_9 \Delta\ln RIR_t + \phi_{1t}$

$e_1 < 0,\ e_2 > 0,\ e_3 > 0,\ e_4 < 0,\ e_5 > 0,\ e_6 > 0,\ e_7 > 0,\ e_8 < 0,\ e_9 > 0$

(6.16) $\Delta\ln DL_{St} = e_0 + e_1 \ln DL_{St-1} + e_2 \ln S_{St-1} + e_3 \ln PS_{St-1} + e_4 \ln PL_{St-1} + e_5 \ln RIR_{t-1} + e_{61}\, IS1_{t-1}$

$+ e_{62}\, IS2_{t-1} + e_{63}\, IS3_{t-1} + e_7 \Delta\ln S_{St} + e_8 \Delta\ln PS_{St} + e_9 \Delta\ln PL_{St} + e_{10} \Delta\ln RIR_t + \phi_{2t}$

$e_1 < 0,\ e_2 > 0,\ e_3 \quad 0,\ e_4 < 0,\ e_5 > 0,\ e_{61} >< 0,\ e_{62} >< 0,\ e_{63} >< 0,\ e_7 > 0,\ e_8 > 0,\ e_9 < 0,\ e_{10} > 0$

The labour supply equations to be estimated which employ a partial adjustment approach are:

(6.17) $\ln (SL_j/POP)_t = f_0 + f_1 \ln (SL_j/POP)_{t-1} + f_2 \ln WL_{jt} + f_{31} \ln WL_{jt} + f_{32} \ln WL_{jt} + f_{33} \ln WL_{jt}$
$+ f_{33} \ln WL_{jt} + v_t$

$f_1 < 0, f_2 > 0, f_{31} \quad < 0, f_{32} >< 0, f_{33} >< 0, f_{34} >< 0$

where the variables are as defined previously, DL_{jt}, is the sectoral labour demand, SL_{jt}, is sectoral labour supply, WPOP, the working age population and WL_j, sectoral wages deflated by the GDP deflator at market prices. The results from our specifications reported here for the labour supply equations only use the own wage variable for the traded sectors, as a complete or partial specification of the wage variables was econometrically tested and the other wage variables rejected.

Table 6.14: 2SLS Estimates of the Labour Demand Equations

	Eqn 1	Eqn 2	Eqn 3	Eqn 4	Eqn 5
	Agriculture	Manufacture	Oil	Non-Trad. Inds	Services
Constant	2.956 (0.735)	-1.476 (1.117)	0.643 (0.698)	-0.888 (1.187)	4.302 (7.031)
DL_ALAG	-0.299 (0.546)				
DL_MLAG		-0.600 (5.155)			
DL_OLAG			-0.298 (1.211)		
DL_NLAG				-0.207 (1.622)	
DL_SLAG					-0.997 (5.258)
S_ALAG	0.310 (1.765)				
S_MLAG		0.148 (2.080)			
S_OLAG			0.122 (0.944)		
S_NLAG				0.109 (1.089)	
S_SLAG					0.896 (3.608)
PS_ALAG	0.142 (0.592)				
PS_MLAG		0.129 (1.941)			
PS_NLAG				0.021 (0.142)	
PS_SLAG					0.540 (2.864)
PL_ALAG	-0.192 (1.107)				
PL_MLAG		-0.074 (1.187)			
PL_OLAG			-0.016 (0.433)		
PL_NLAG				-0.103 (1.065)	
PL_SLAG					-0.083 (1.488)
RIRLAG	-0.013 (0.770)	0.005 (1.509)	0.008 (1.264)	0.002 (0.688)	0.013 (1.080)
IS51LAG					-0.126 (1.988)
IS52LAG					0.277 (2.534)
IS53LAG					-0.192 (2.055)
ΔS_A	0.437 (0.557)				
ΔS_M		0.122 (1.697)			
ΔS_O			0.246 (1.561)		
ΔS_N				0.470 (3.687)	

ΔS_S					0.150 (1.905)
ΔPS_A	0.963 (1.142)				
ΔPS_M		0.158 (1.659)			
ΔPS_N				0.066 (0.868)	
ΔPS_S					0.568 (2.910)
ΔPL_A	-1.103 (1.147)				
ΔPL_M		-0.436 (4.115)			
ΔPL_O			-0.339 (2.051)		
ΔPL_N				-0.029 (0.668)	
ΔPL_S					-0.217 (2.425)
ΔRIR		0.002 (0.590)	0.014 (0.289)	-0.022 (0.597)	0.003 (1.123)
Rho	-0.093 (0.240)	-0.747 (2.904)	-0.798 (3.186)	0.450 (1.432)	-0.954 (3.203)

n= 21

Standard Regression Diagnostics:					
F-Statistic	4.16	3.63	1.43	7.66	1.49
Adjusted R^2	0.57	0.54	0.33	0.73	0.23
SER	0.0579	0.0330	0.0504	0.0329	0.0371
Diagnostics From Formal Test Procedures (Prob = 1- Chi):					
Reset j Statistic:	0.1218	0.5112	0.0821	0.1059	0.5957
Sargan Statistic.	0.7041	0.5310	0.985	0.8930	0.5256
Hausman Statistic	0.9992	0.3549	0.8559	0.9955	0.1027

From Table 6.14, the labour demand equations performed quite well, although in terms of the statistical significance of the coefficients and the standard statistical diagnostics, the equations did not perform quite as well as the capital demand equations. For all but the non-traded industrials and agricultural sectors, the value for rho was quite high with t-ratios of close to 3 in some cases. However, the Reset j statistic and the Cusum^2 values presented in Graphs 6.A16 to A6.20 were satisfactory which confirmed that the log-linear specification was correct and the model was structurally stable.

Table 6.15: The Long and Short-run Labour Demand Elasticities

Variables:	**Output**		**Output Price**		**Real Wage**	
Elasticities:	**SR**	**LR**	**SR**	**LR**	**SR**	**LR**
Agriculture	0.44	1.04	0.96	0.47	-1.10	-0.64
Manufacture	0.12	0.25	0.16	0.22	-0.44	-0.12
Oil	0.25	0.41	-	-	-0.34	-0.05
Non-Trad. Inds.	0.47	0.53	0.07	0.10	-0.03	-0.49
Services	0.15	0.89	0.57	0.54	-0.22	-0.08

Notes: (i) SR = Short Run (ii) LR = Long Run.

An investigation of the full set of results for the labour demand equations in both Table 6.14 and the corresponding long and short run elasticities in Table 6.15 reveals that the signs are as expected on the own output price.[13] The coefficients on the output price (PS_j) variables were moderately statistically significant with short run elasticities generally between 0.07 and 0.96 and corresponding long run elasticities generally between 0.10 and 0.54 for the sectors. In particular, the agricultural sector revealed relatively higher short and long run elasticities of 0.96 and 0.47 respectively. Although not strictly comparable to our study, McKay et al (1983) revealed a

[13] An earlier tested model with a price of oil variable (PS_O) did not improve the results. The variable was statistically insignificant for the agricultural, non-traded and services sectors, but moderately significant for the manufacturing sector. This is probably not surprising given that the sector more likely shares a common pool of labour with the oil sector given the relatively high degree of foreign involvement in both sectors.

similarly high short run price elasticity of 1.05 for certain agricultural sub-sectors in Australia which accounted for quite a high percentage of total agricultural output.

From Table 6.15, the output variable (S_j) is seen to be quite important with short run elasticities of between 0.15 for the services sector to 0.47 for the non-traded industrials sector. In the long run, the coefficients are also very significant with much higher elasticities of between 0.25 for the manufacturing sector and 1.04 for the agricultural sector, although in the latter case, some over-adjustment might have occurred. The importance of this output variable is shown in Lee et al (1990) who report high short and long run output elasticities of 0.47 and 1.5 respectively for UK manufacturing employment. McKay (1983) reports a short run output elasticity of 0.50 for agricultural employment in Australia, while Nickell's (1984) OLS estimates of manufacturing employment in the UK revealed lower though highly significant output effects which confirmed the strong influence of output on labour demand.

In general, the effect of an increase in the real wage on employment, which several empirical studies have shown to be ambiguous raising it in some cases and reducing it in others (for example, Bhaskar, 1992), or not having any effect at all (Kraft, 1989), is negative in all sectors in Nigeria. In Nigeria, the theoretical possibility of efficiency wage effects reversing the standard results of a negative wage relationship (Fitzroy and Funke, 1994) may therefore not arise. An inspection of Table 6.14 indeed indicates that the real wage variables (PL_j) have the expected negative signs and are relatively significant in the manufacturing, non-traded industrials and services sectors with relatively high short and long run elasticities as seen in Table 6.15.

In the agricultural sector, the short run wage elasticity of -1.10 indicates a high degree of short run over adjustment and may be the result of a large short run output effect increasing the use of labour when the price of labour falls. As labour is the major part of total factor costs, a large output effect might be expected through the low agricultural demand price elasticities in Table 6.5 which should be noted. With a long run wage elasticity of -0.64, the output effect in the long run may have a smaller effect on labour demand as capital is substituted for labour.

With respect to the manufacturing sector, the statistically significant wage variable is consistent with studies of labour employment in other countries (Lee et al, 1990; Nickell, 1984), although given the different methodologies and the level of aggregation, a comparison with our results is not strictly valid. However, as has been emphasised throughout this study, such comparisons cannot be avoided given the limited and extremely scanty empirical studies of macroeconomic Dutch Disease models in Nigeria which adopt an aggregation and methodological approach similar to that in this study. For labour demand functions in particular, the nature of aggregation takes on added significance. For example, with disaggregated industry level data Lee et al (1990) found that only a few sectors had insignificant responses of employment to the real wage and to output, while at a more aggregate level, employment responded quite strongly to the wage and output. Therefore, in Nigeria, it is plausible that in the 'core' services sub-sectors such as retail trade and social services which are relatively more labour intensive, the responsiveness of labour demand to the wage would probably have been more pronounced.

In general, the evidence across sectors in Nigeria seems to strongly suggest that the real wage has a strong influence on labour demand. The short and long run wage elasticities of -0.39 and -0.11 reported by Lee et al (1990) and Nickell (1984) respectively in their studies of UK manufacturing employment, and Khatiri and Thirtle's (1996) short and long run wage elasticities of -0.4 and -0.5 with respect to UK agricultural employment compares quite well with our estimates for the manufacturing and agricultural sectors given in Table 6.15.

Given that an important mechanism in the theory of Dutch Disease is the influence of the real wage on output, the actual circumstances in Nigeria for labour demand and supply become crucial. In theoretical models, a competitive and flexible labour market as well as full employment conditions are usually assumed. In Nigeria, it is not evident that there is a labour market which meets most of the conditions implicit in theoretical Dutch Disease models and models of labour demand. In Nigeria, wages in the civil service are largely fixed and the private sector is often encouraged to exercise restraints on wage demands. Wages in the oil and manufacturing sectors, which employ relatively larger numbers of foreign workers, are usually set on a contractual basis. Although nominal wages have generally increased, the real wage has been declining because of high inflation particularly from about the early to mid 1990s. With wage inflexibility and less than competitive labour market and full employment conditions, Dutch Disease effects may not be present. Before going on to examine the supply of labour equations, 3SLS estimates for the labour demand equations are given in Table 6.16 for presentational purposes only.

Table 6.16: 3SLS Estimates of Labour Demand Equations

	Eqn 1	Eqn 2	Eqn 3	Eqn 4	Eqn 5
	Agriculture	Manufacture	Oil	Non-Trad. Inds	Services
Constant	2.2063 (2.177)	-1.1766 (1.553)	1.3238 (1.592)	-1.8713 (4.757)	5.7865 (1.250)
$DL_A LAG$	-0.3641 (2.310)				
$DL_M LAG$		-0.5191 (5.360)			
$DL_O LAG$			-0.7237 (4.165)		
$DL_N LAG$				-0.1048 (3.098)	
$DL_S LAG$					-0.6367 (3.945)
$S_A LAG$	0.1352 (2.177)				
$S_M LAG$		0.1107 (2.415)			
$S_O LAG$			0.3037 (3.154)		
$S_N LAG$				0.2396 (4.049)	
$S_S LAG$					0.1855 (0.756)
$PS_A LAG$	0.0538 (0.862)				
$PS_M LAG$		0.1122 (2.580)			
$PS_N LAG$				0.2775 (3.683)	
$PS_S LAG$					0.0726 (0.179)
$PL_A LAG$	-0.0383 (0.754)				
$PL_M LAG$		-0.0731 (1.871)			
$PL_O LAG$			-0.0771 (1.871)		
$PL_N LAG$				-0.1896 (3.157)	
$PL_S LAG$					-0.0889 (0.867)
RIRLAG	0.0003 (0.080)	0.0008 (0.302)	0.0050 (1.156)	0.0027 (0.725)	0.0043 (0.707)
IS51LAG					-0.0945 (2.224)
IS52LAG					-0.3860 (1.279)
IS53LAG					
ΔS_A	0.0423 (0.239)				
ΔS_M		0.1129 (1.219)			
ΔS_O			0.2050 (3.106)		
ΔS_N				0.5016 (5.847)	
ΔS_S					0.2318 (0.675)

ΔPS_A	0.1082 (0.903)				
ΔPS_M		0.0209 (0.412)			
ΔPS_N				0.1119 (1.903)	
ΔPS_S					-0.3865 (2.567)
ΔPL_A	-0.0395 (0.375)				
ΔPL_M		-0.3570 (5.962)			
ΔPL_O			0.0110 (0.303)		
ΔPL_N				-0.0214 (0.545)	
ΔPL_S					-0.3956 (2.456)
ΔRIR		0.0013 (0.670)	0.0030 (1.278)	0.0030 (1.123)	0.0042 (0.959)
Rho	-0.0439	-0.3150	0.1262	-0.3150	-0.2074

n = 21

Standard Regression Diagnostics:					
Adjusted R^2:	0.62	0.59	0.35	0.73	0.58
SER	0.0546	0.0317	0.0513	0.0317	0.0306

Table 6.17: 2SLS Estimates of Model with Labour Supply Equations

	Eqn 1	Eqn 2	Eqn 3	Eqn 4	Eqn 5
	Agriculture	Manufacture	Oil	Non-Trad. Inds.	Services
Constant	-0.239 (0.597)	-3.390 (3.422)	-2.086 (1.592)	0.5101 (1.640)	-1.005 (2.111)
$(SL/POP)_A$LAG	0.8936 (9.507)				
$(SL/POP)_M$LAG		0.5544 (3.261)			
$(SL/POP)_O$LAG			0.945 (10.130)		
$(SL/POP)_N$LAG				0.725 (15.781)	
$(SL/POP)_S$LAG					0.3763 (1.906)
WL_A	0.0259 (0.350)			-0.5091 (9.543)	-0.2601 (2.010)
WL_M		0.3622 (3.710)			
WL_O			0.1225 (1.320)		
WL_N				0.1769 (9.401)	-0.2111 (2.561)
WL_S					0.4371 (2.797)
Rho	-0.222 (1.092)	0.1885 (0.863)	-0.067 (0.298)	-0.233 (1.070)	0.0058 (0.026)

n=21

Standard Regression Diagnostics:					
F-Statistic	106.59	87.94	45.88	310.26	5.04
Adjusted R^2	0.91	0.89	0.82	0.98	0.45
SER	0.0441	0.0522	0.0488	0.0334	0.0447
Diagnostics From Formal Test Procedures (Prob. Values):					
Reset j Statistic:	0.5303	0.1540	0.1646	0.9090	0.6561
Sargan Statistic.	0.3535	0.6649	0.3410	0.3125	0.2498
Hausman Statistic	0.1949	0.0993	0.0032	0.2857	0.5258

With regard to the supply of labour in our model, the own wage variables are clearly very important in most of the sectors. Our results from Table 6.17 show that the real wage variables have the expected positive effect on supply of labour decisions in all sectors with moderately significant short run elasticities of between 0.03 to 0.44 and moderate to high long run elasticities of between 0.18 to 2.24. The wage variables are particularly statistically significant in the manufacturing, non-traded industrials and services sectors, marginally significant in the oil sector and not significant in the agricultural sector. For the oil sector, this result is not surprising given the contractual nature of foreign and domestic employment and the nature of wage claims within the sector. For the agricultural sector, this may be explained by the fact that there tends to be a high level of disguised unemployment given that many small farms which form a large part of the agricultural sector employ labour from within family units and the poor statistical data at the farm gate level. Indeed, a closer investigation of our results indicates that a very high percentage of the labour demand and supply coefficients for the sector are generally not statistically significant.

After much investigation, other sectoral wage variables which were initially included in each sector's labour supply equation to test for possible substitution/cross price effects, were dropped as they added very little in terms of their explanatory power, priors about the signs and sizes of the coefficients and, in general, the need for improved regression diagnostics. As would be expected from supply of labour decisions, it was reasonable to have in the final specification just the own wage for the traded agricultural, manufacturing and oil sectors. With the inclusion of other wages for the non-traded industrials and services sectors, small to moderate substitution effects were detected. In terms of the overall performance of the labour supply equations, the standard regression diagnostics such as the F-statistic, the R^2, the SER and the value for rho, as well as the test procedures for model stability and functional form were satisfactory.

6.5 Conclusion

In this chapter, a dynamic multi-sectoral Dutch Disease macro model for Nigeria which integrated output supply and demand equations as well as capital and labour demand and supply equations was estimated. In general, the model performed well in terms of *a priori* expectations of the magnitude and direction of the estimated elasticities, the statistical significance of the coefficients, the standard regression diagnostics and the formal test procedures employed.

Based on the evidence from estimates from our model, the theoretical aspects of the Dutch Disease were shown not to be wholly applicable to the experiences of a developing country like

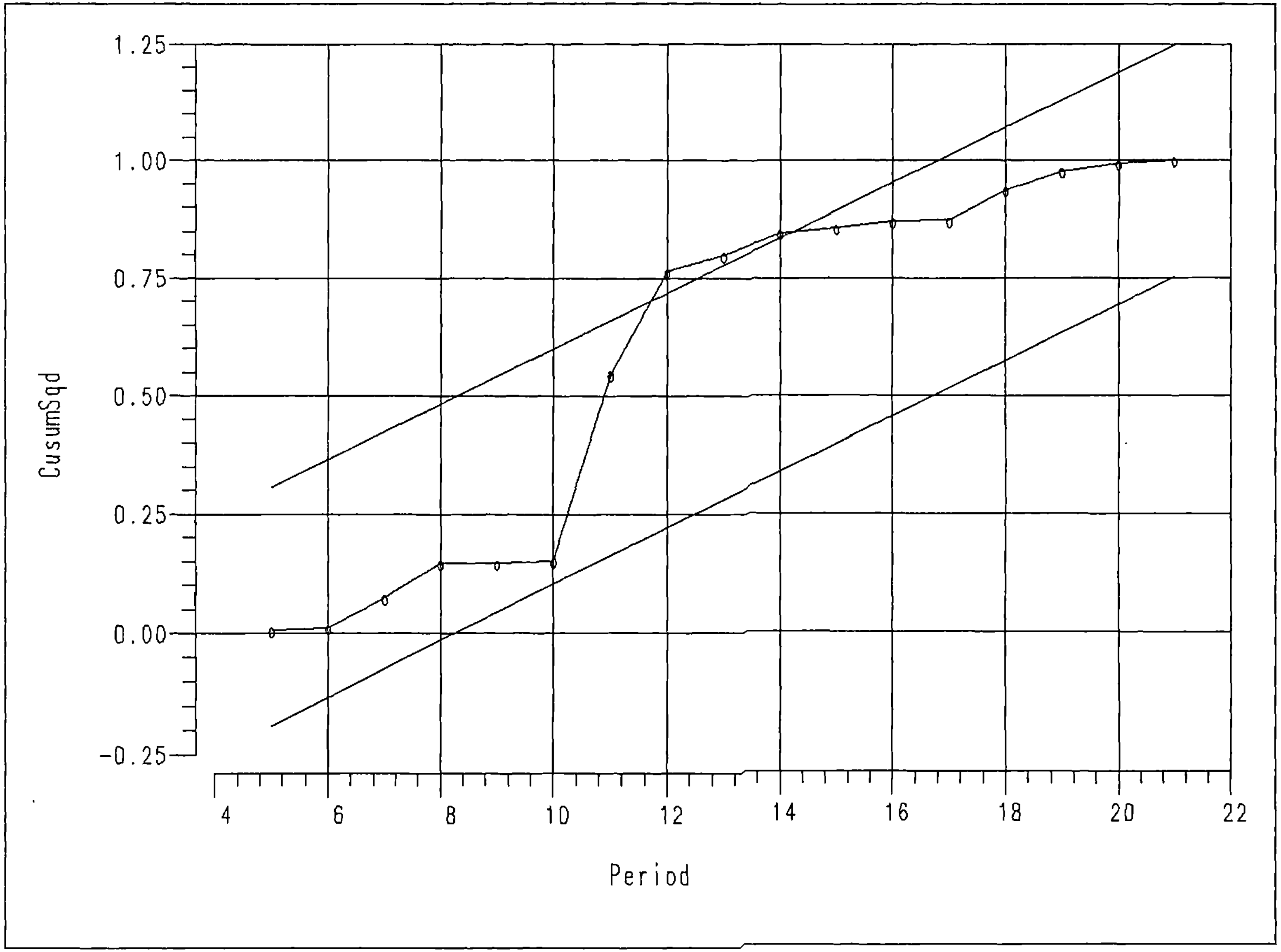
Nigeria with its less than competitive capital and labour markets, and an 'enclave like' oil sector which typically employs resources specific to it. As such, the incentives and domestic conditions for inducing Dutch Disease effects which are generally emphasised by the theoretical models are clearly not applicable to Nigeria. In particular, whilst pointing to a strong income effect, our results revealed the absence of the classic Dutch Disease 'resource movement effect'; rather a 'resource constraint effect,' attributable to the use of limited public resources by competing sectors, was detected. Alternative specifications of the model with and without the price of oil variable directly confirmed this result.

On a general note though, the results obtained underscore the importance of using sectoral data to explain macroeconomic activity in general and sectoral behaviour in particular, an approach that has been strongly advocated by Lee et al, (1992), Pesaran et al, (1993), and Caporale (1997), amongst others. Such an approach, in essence, forms the basis for Chapters Seven and Eight in that the estimated Dutch Disease model is used to examine the effects of sector-specific and aggregate level activity arising from oil related shocks, the balance of payments and government investment expenditures, under a regime of both fixed and flexible exchange rate systems.

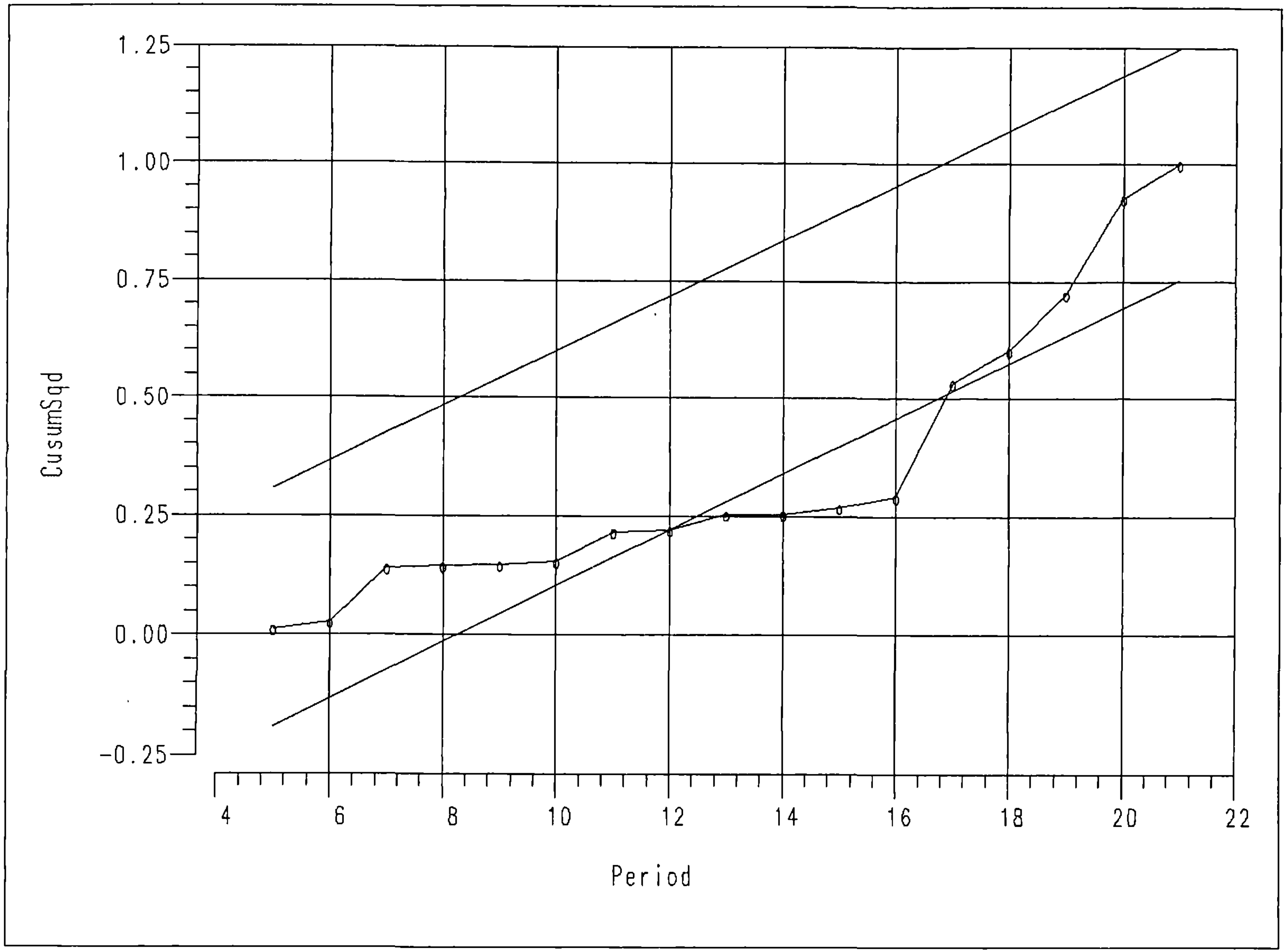
Appendix 6.1: Page

LIST OF GRAPHS FOR THE CUSUM^2 VALUES

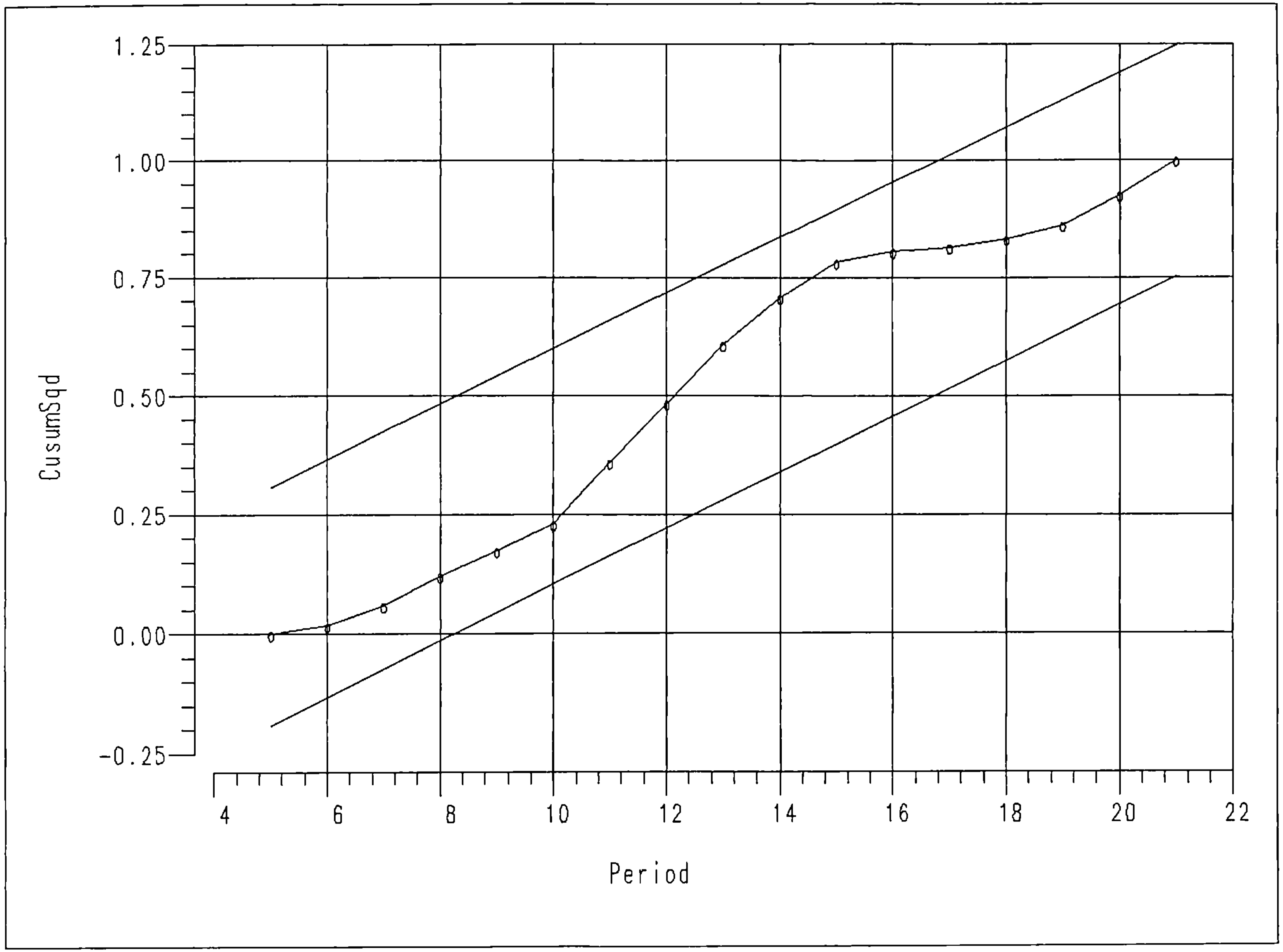
6.A1 ***SUPPLY OF OUTPUT*** ***(AGRICULTURE)***



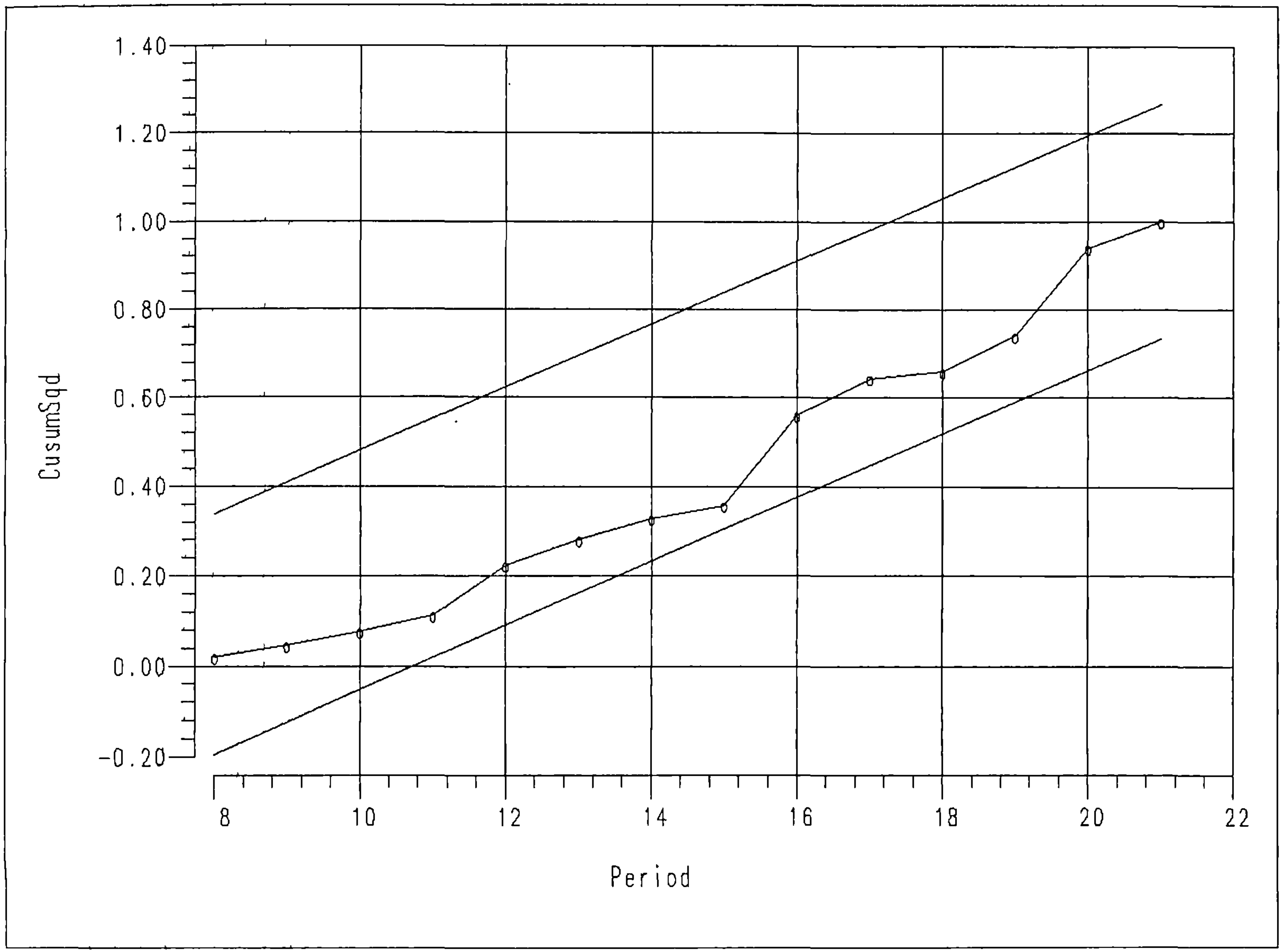
6.A2 SUPPLY OF OUTPUT (MANUFACTURE)



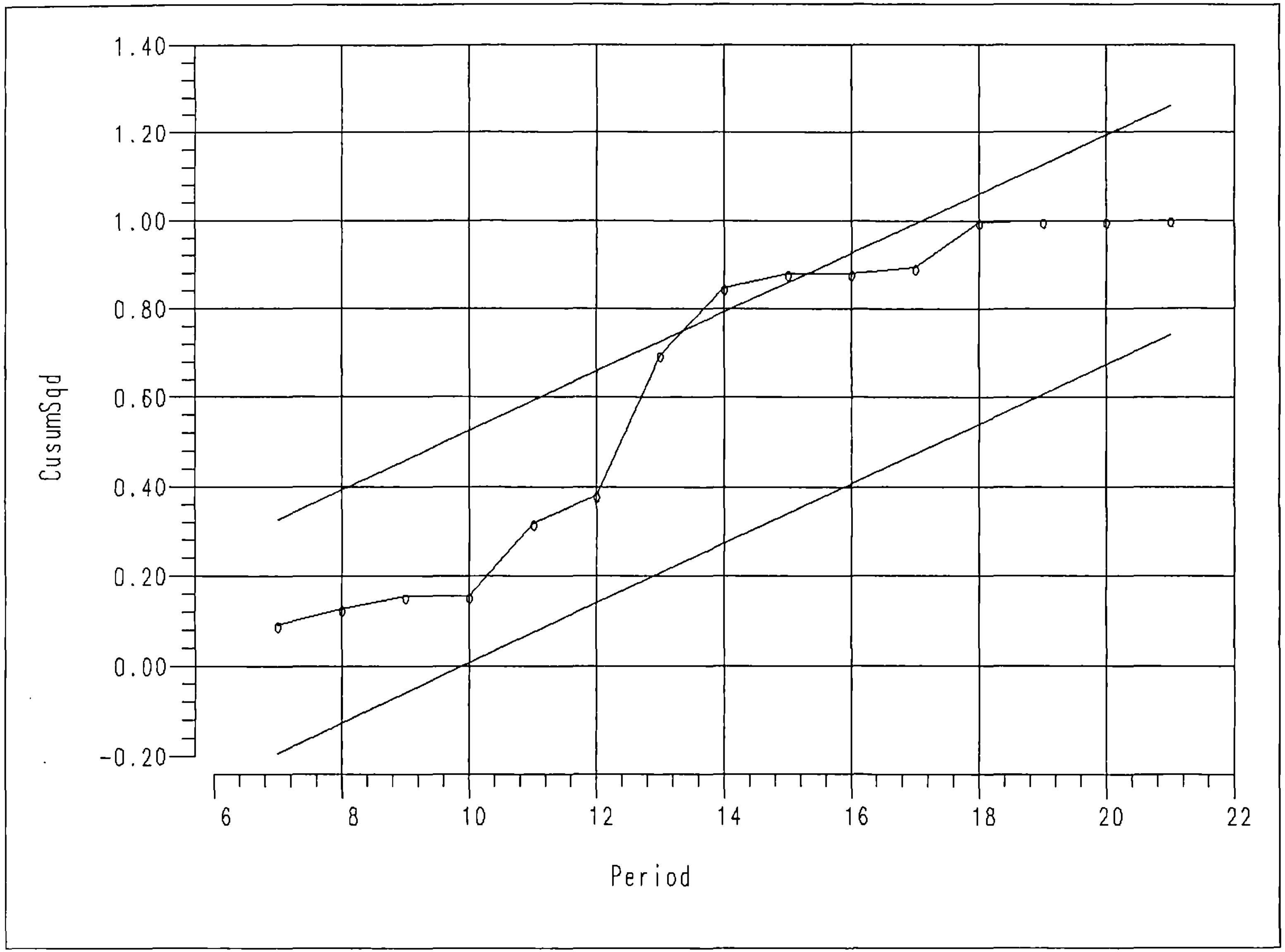
6.A3 SUPPLY OF OUTPUT (NON-TRADED INDUSTRIALS)



6.A4 SUPPLY OF OUTPUT (SERVICES)



6.A5 DEMAND FOR OUTPUT (AGRICULTURE)



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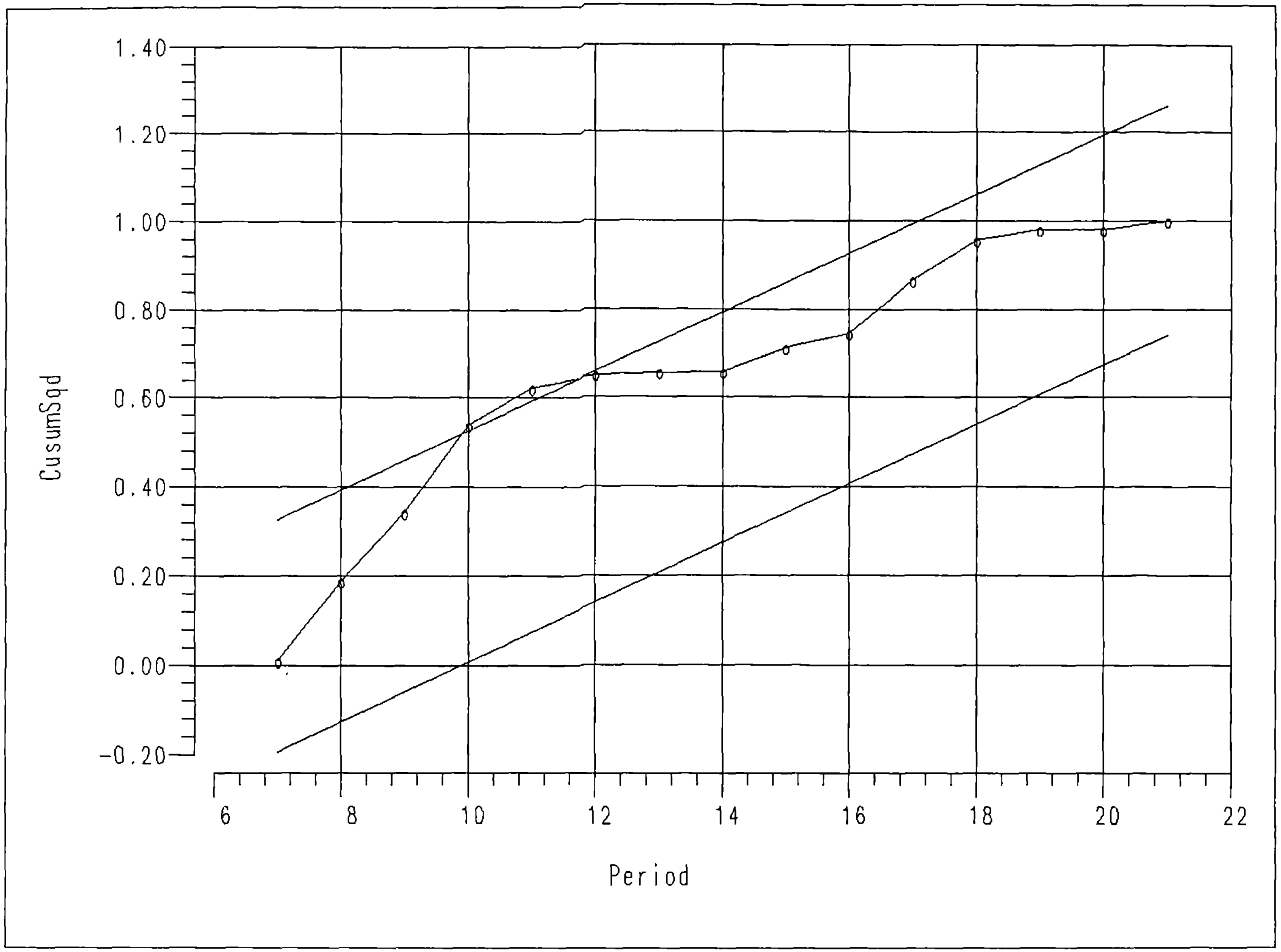

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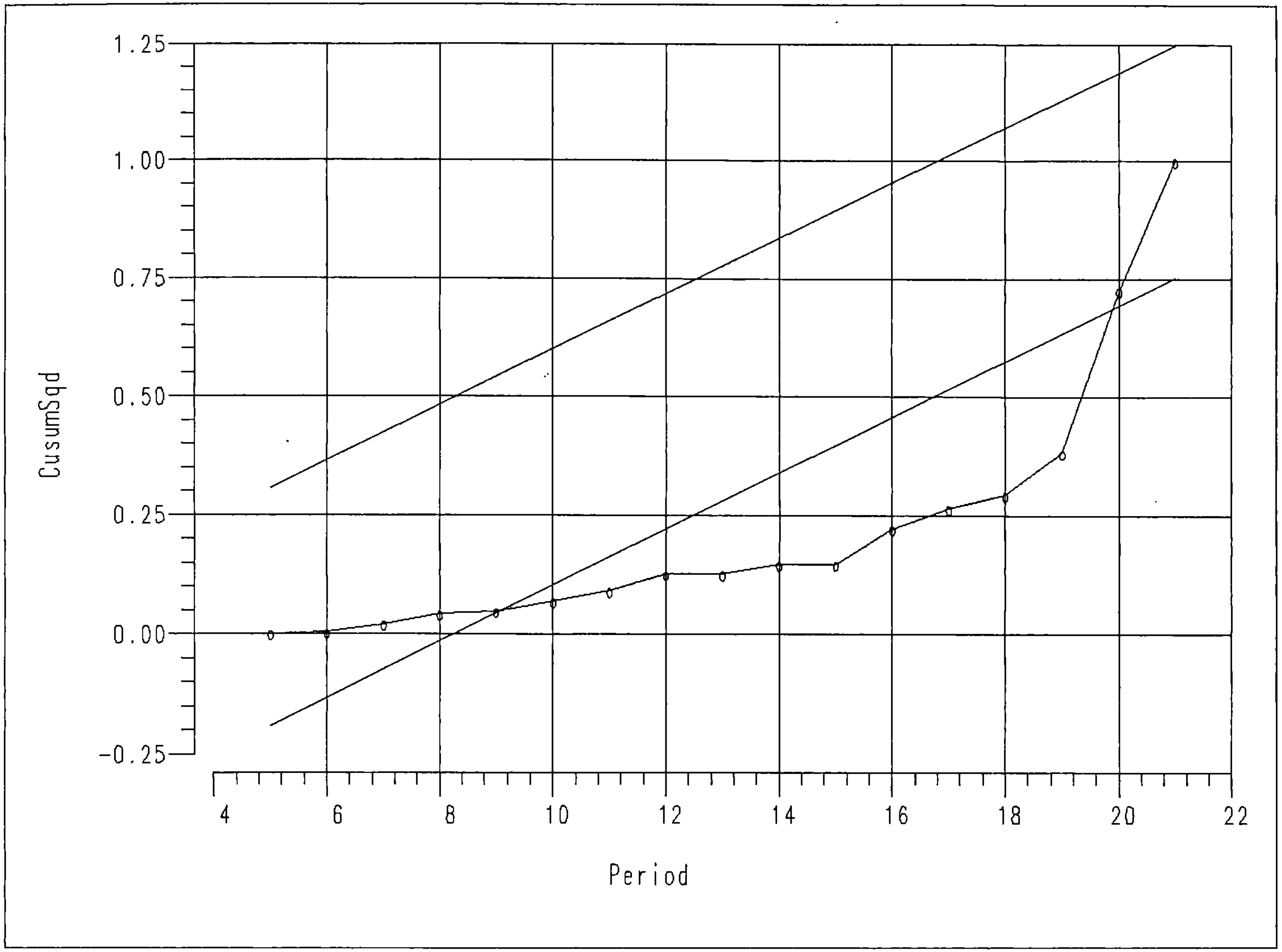
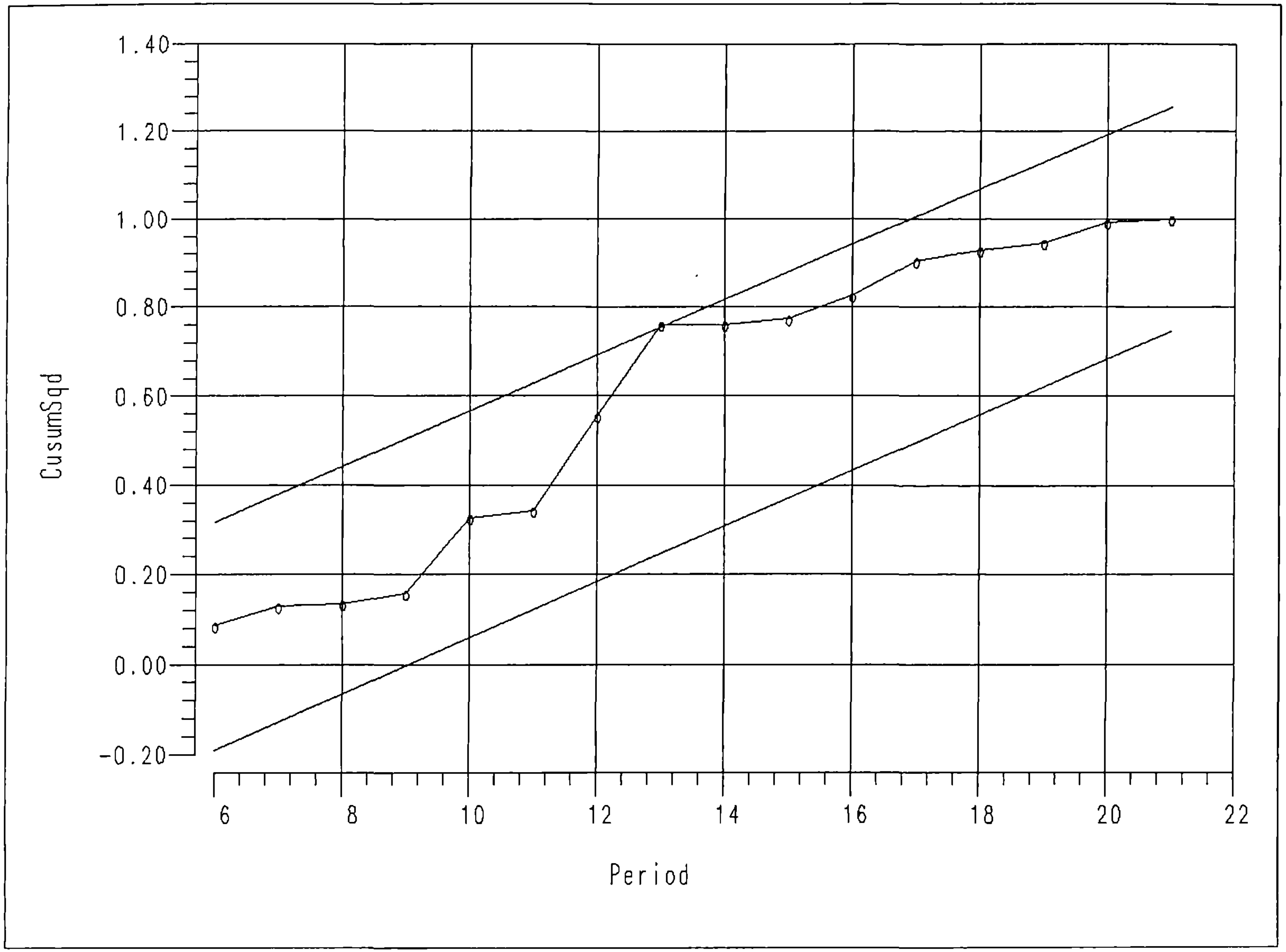
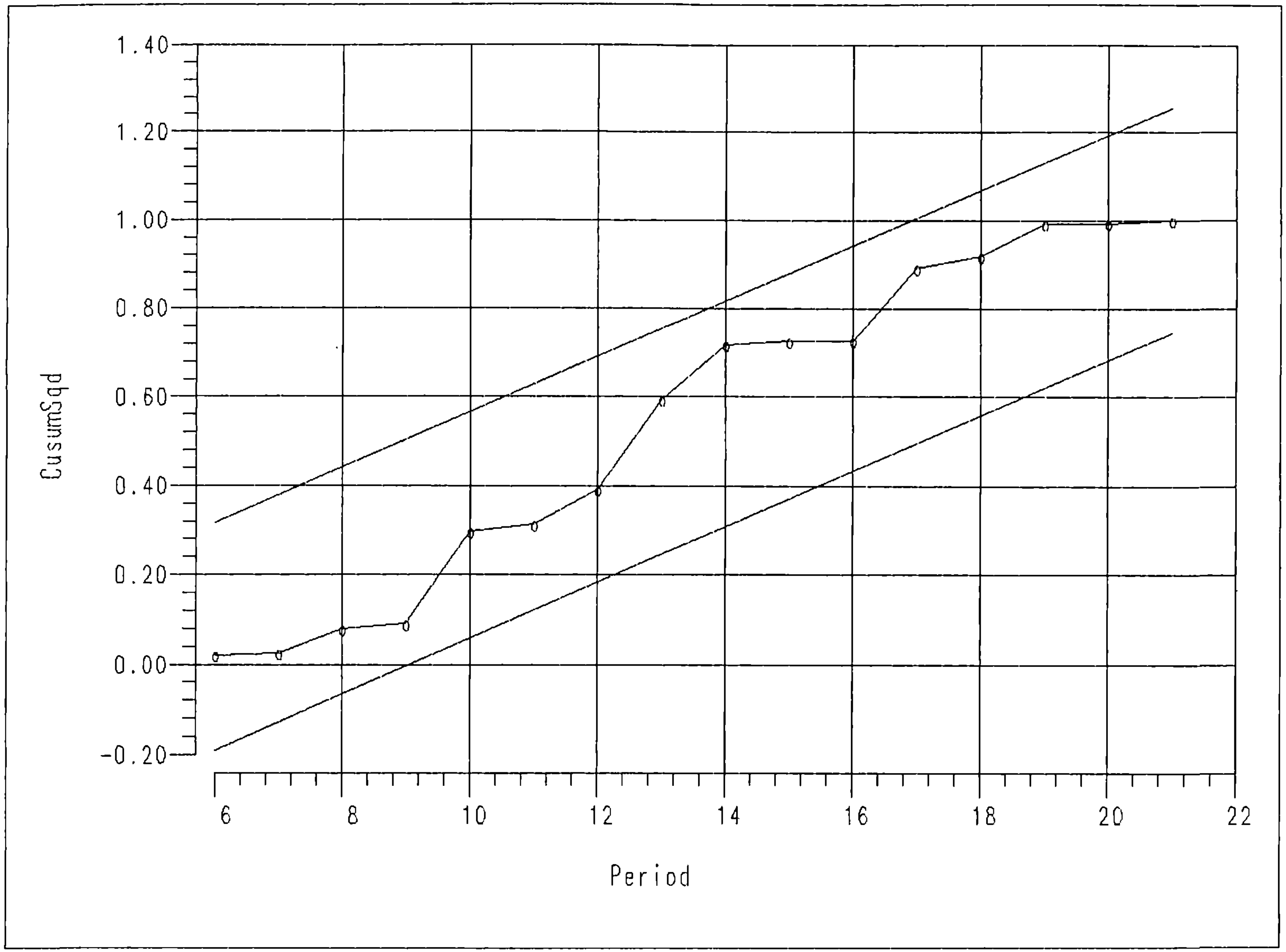


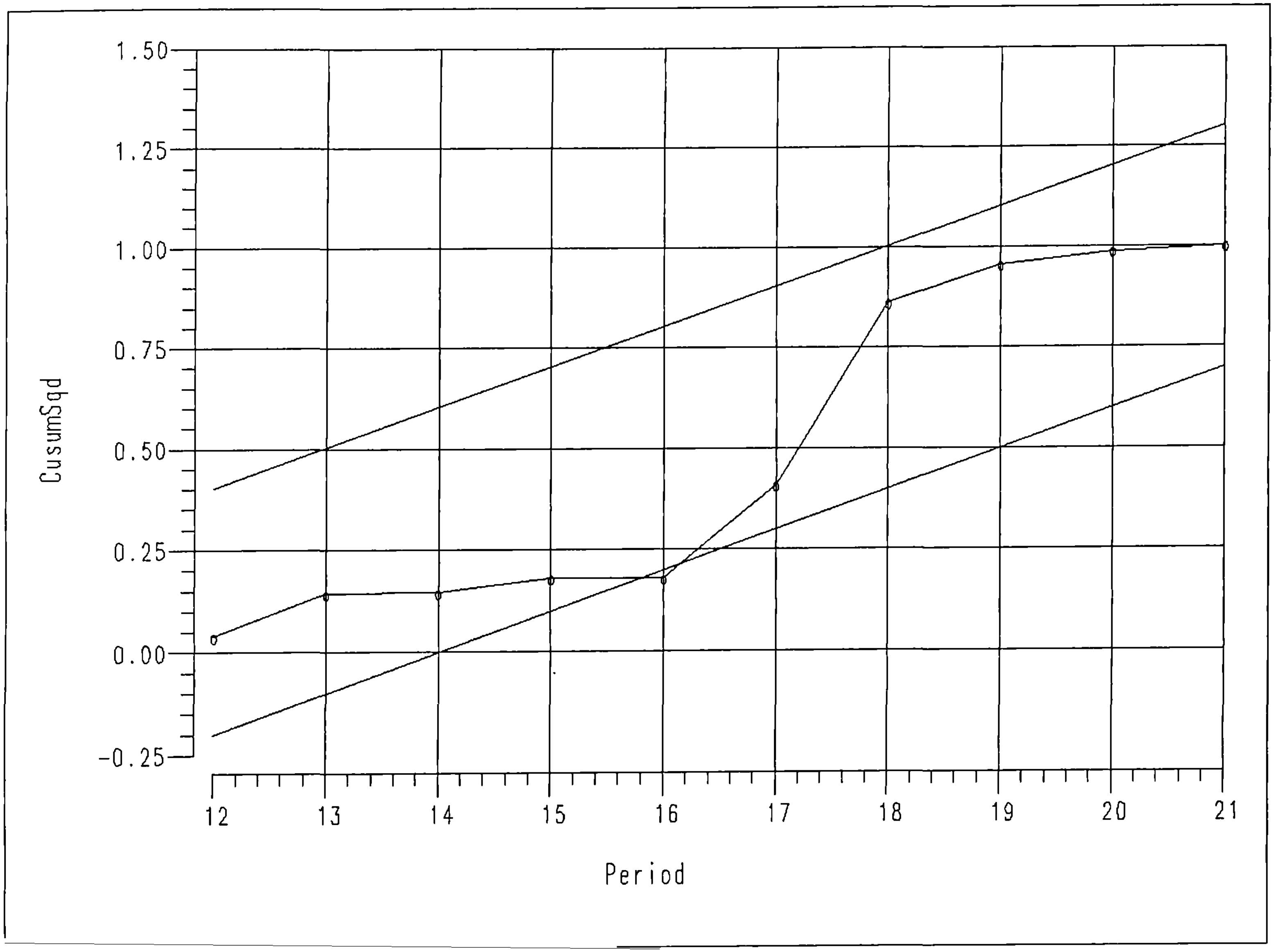
6.A8 DEMAND FOR OUTPUT (NON-TRADED INDUSTRIALS)



6.A9 DEMAND FOR OUTPUT (SERVICES)



6.A10 DEMAND FOR CAPITAL (AGRICULTURE)



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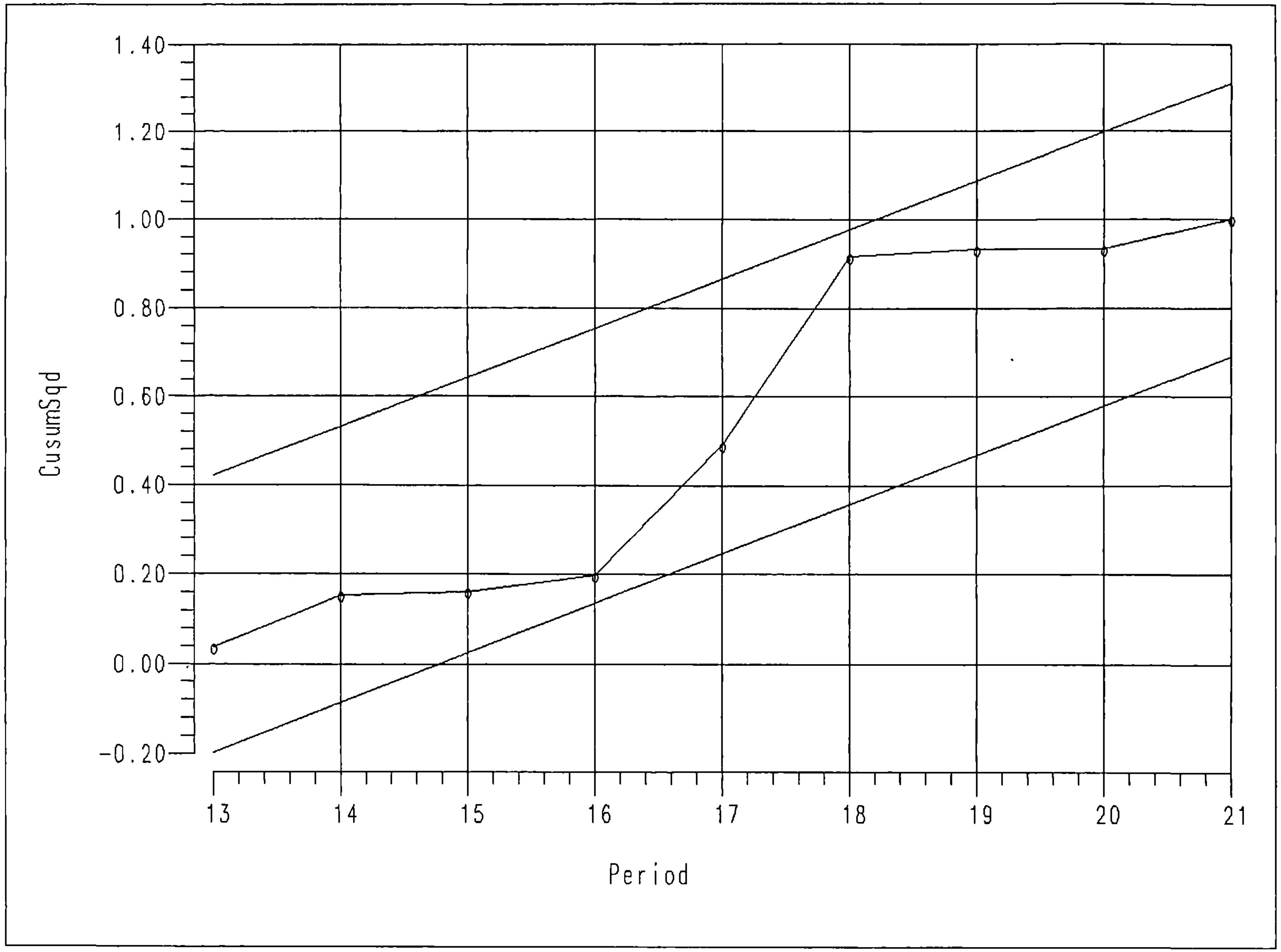

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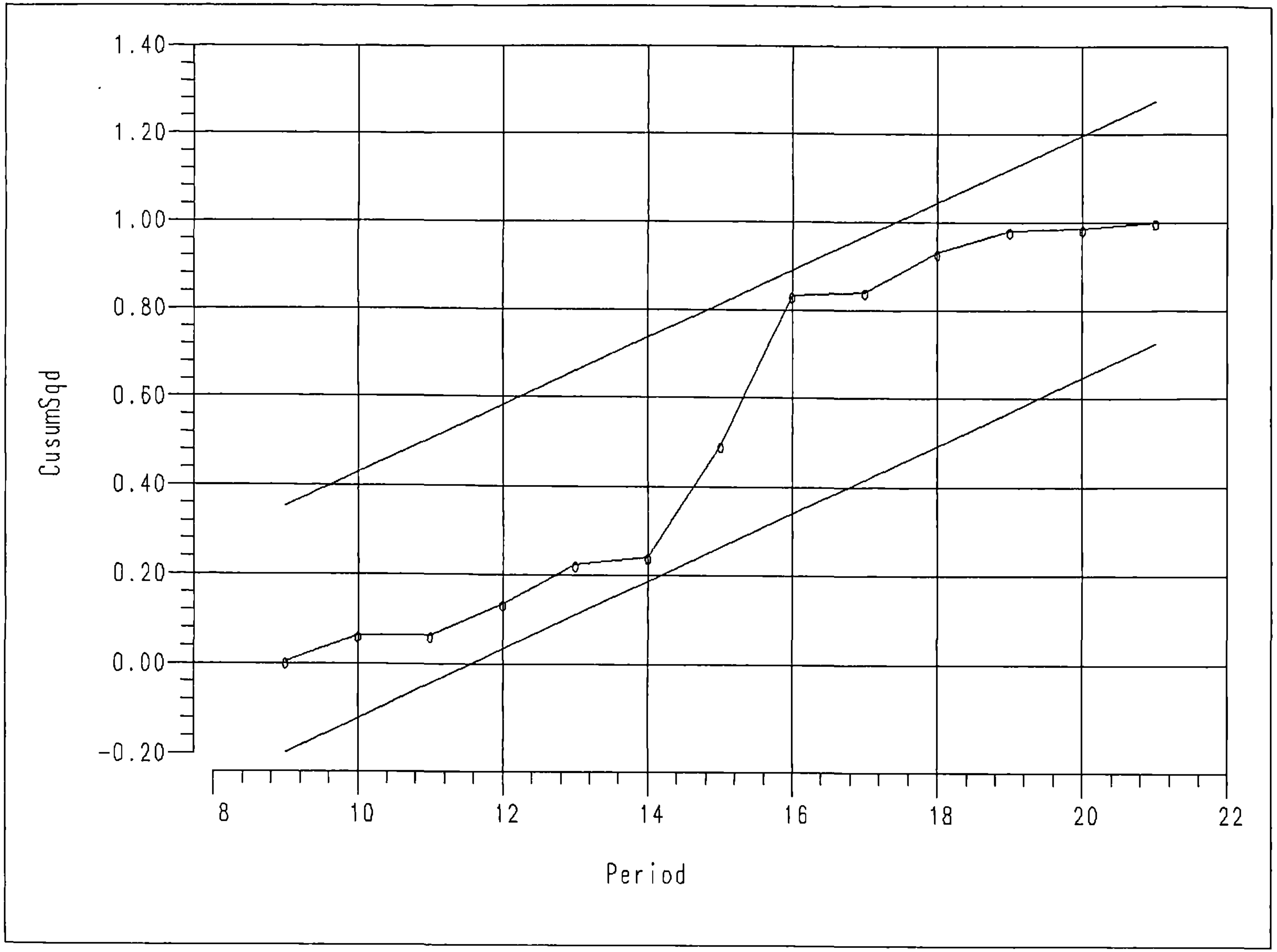
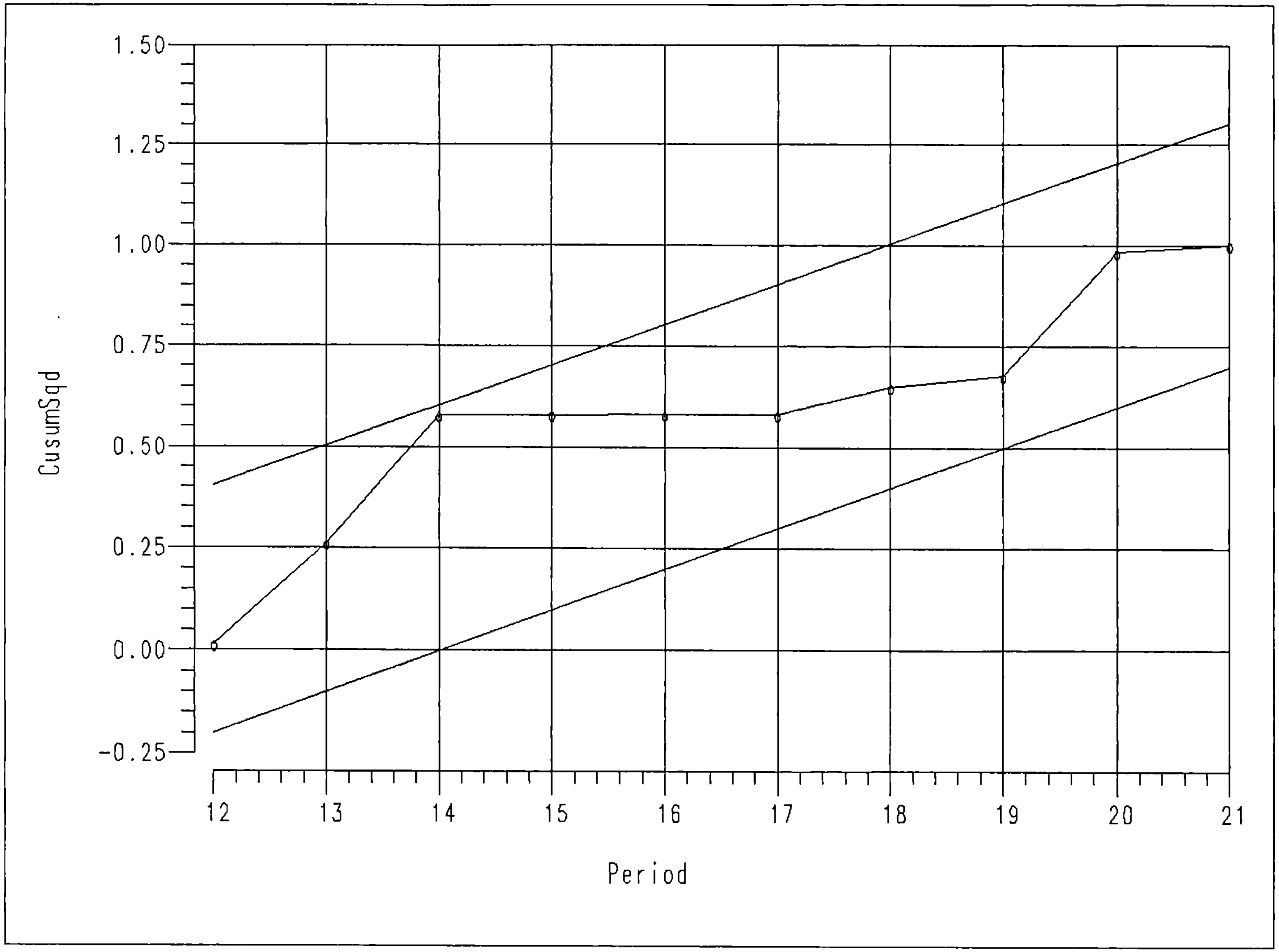


6.A13 DEMAND FOR CAPITAL (NON-TRADED INDUSTRIALS)



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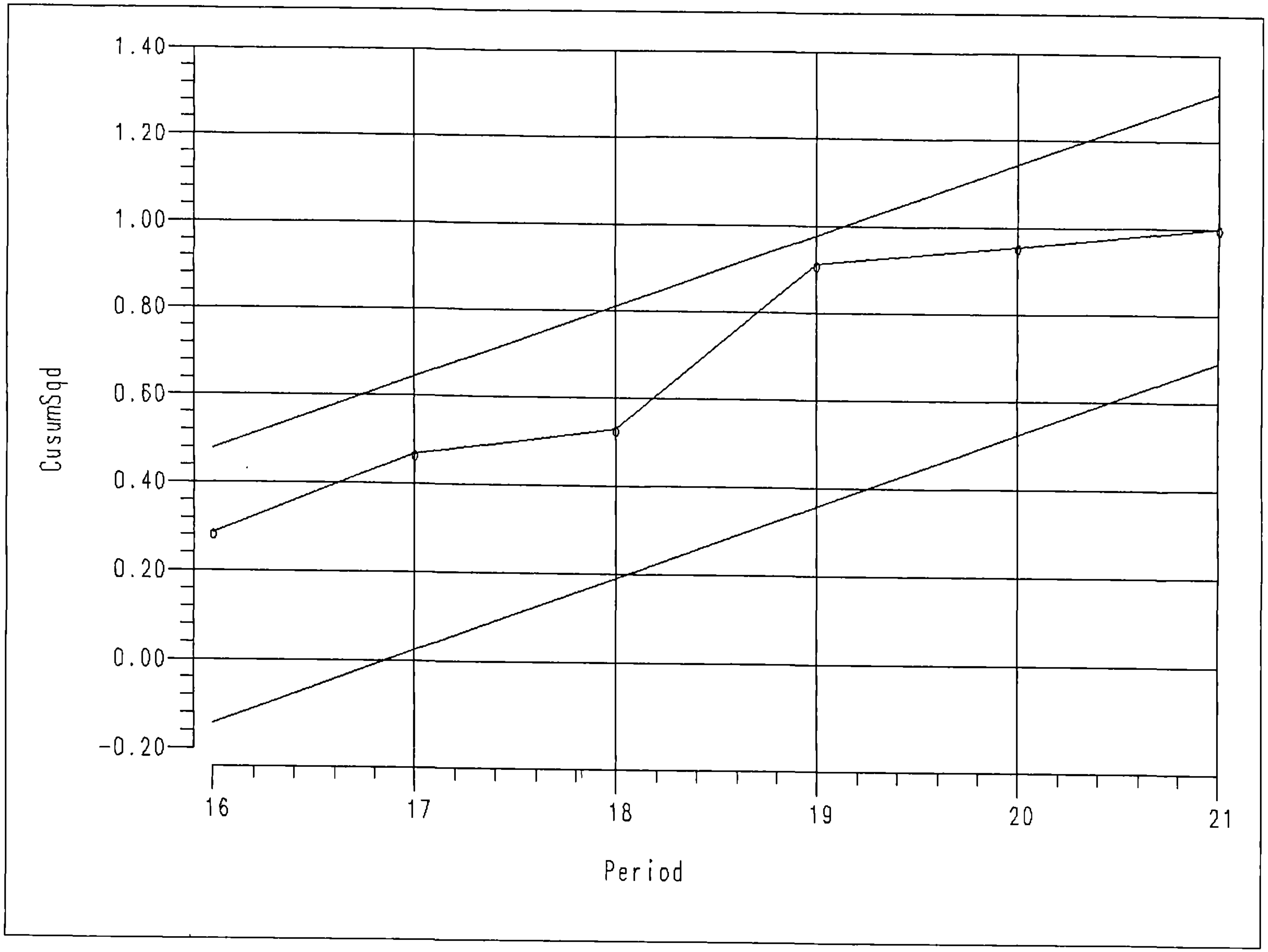
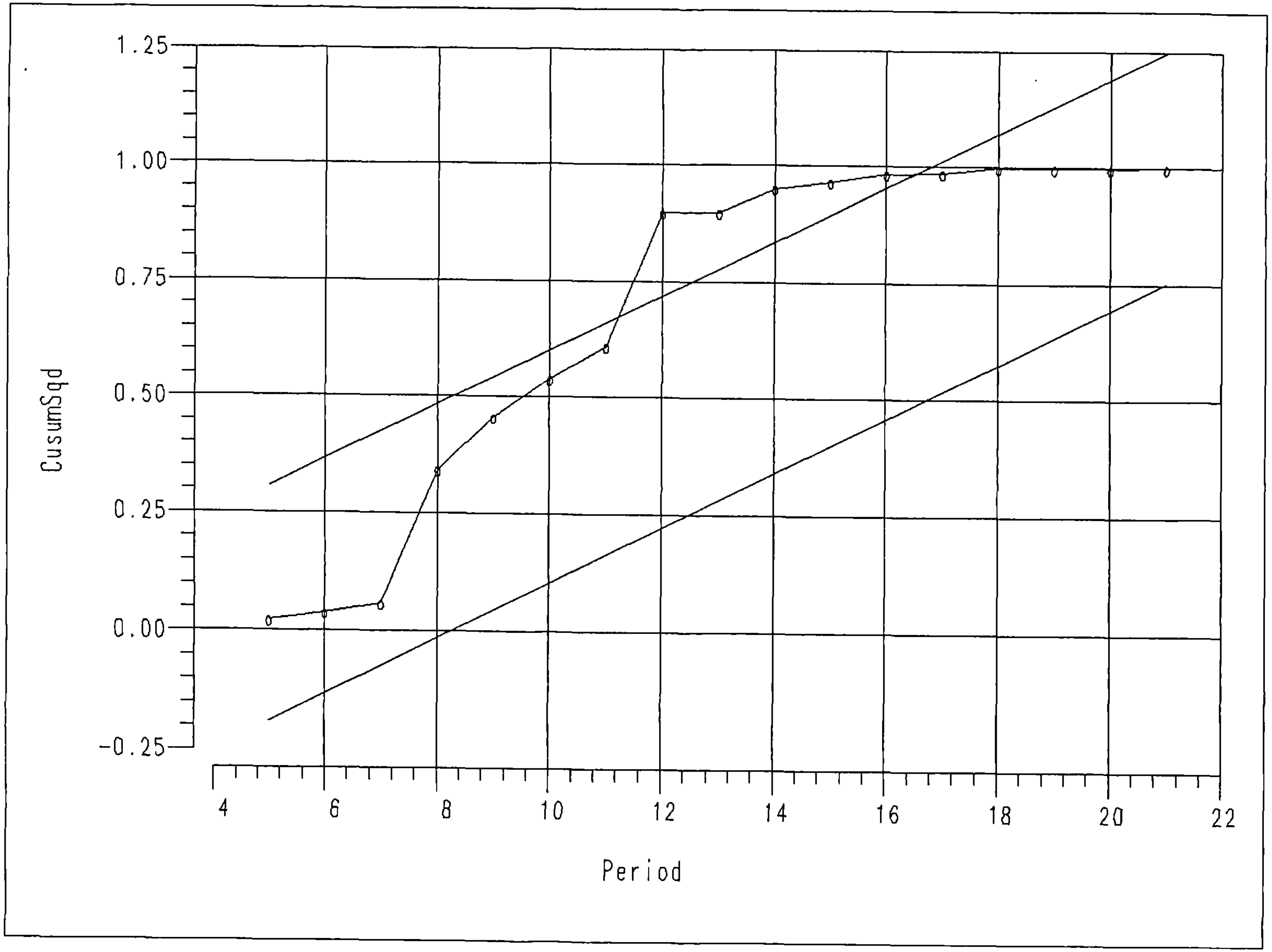


6.A15 SUPPLY OF CAPITAL



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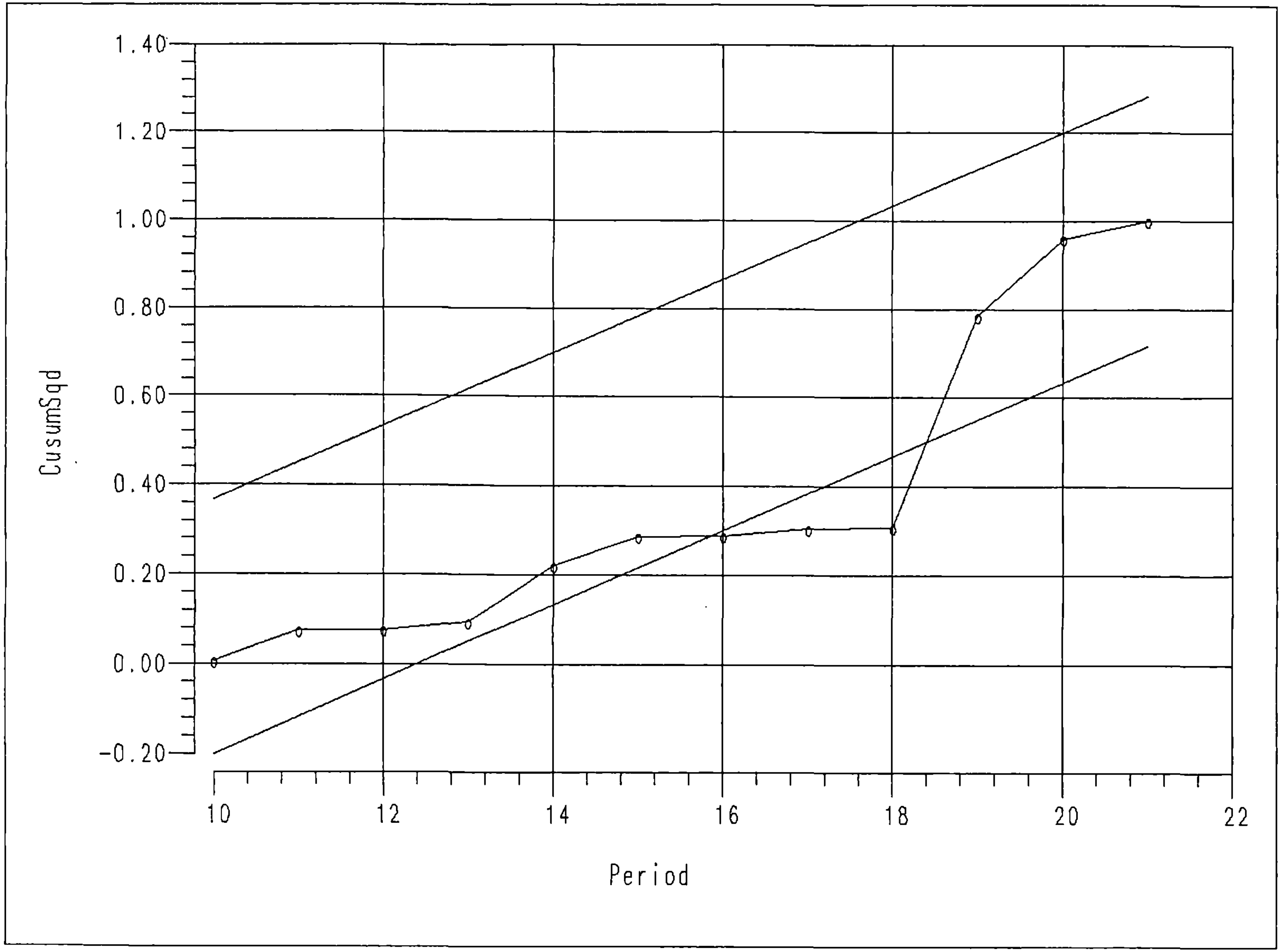
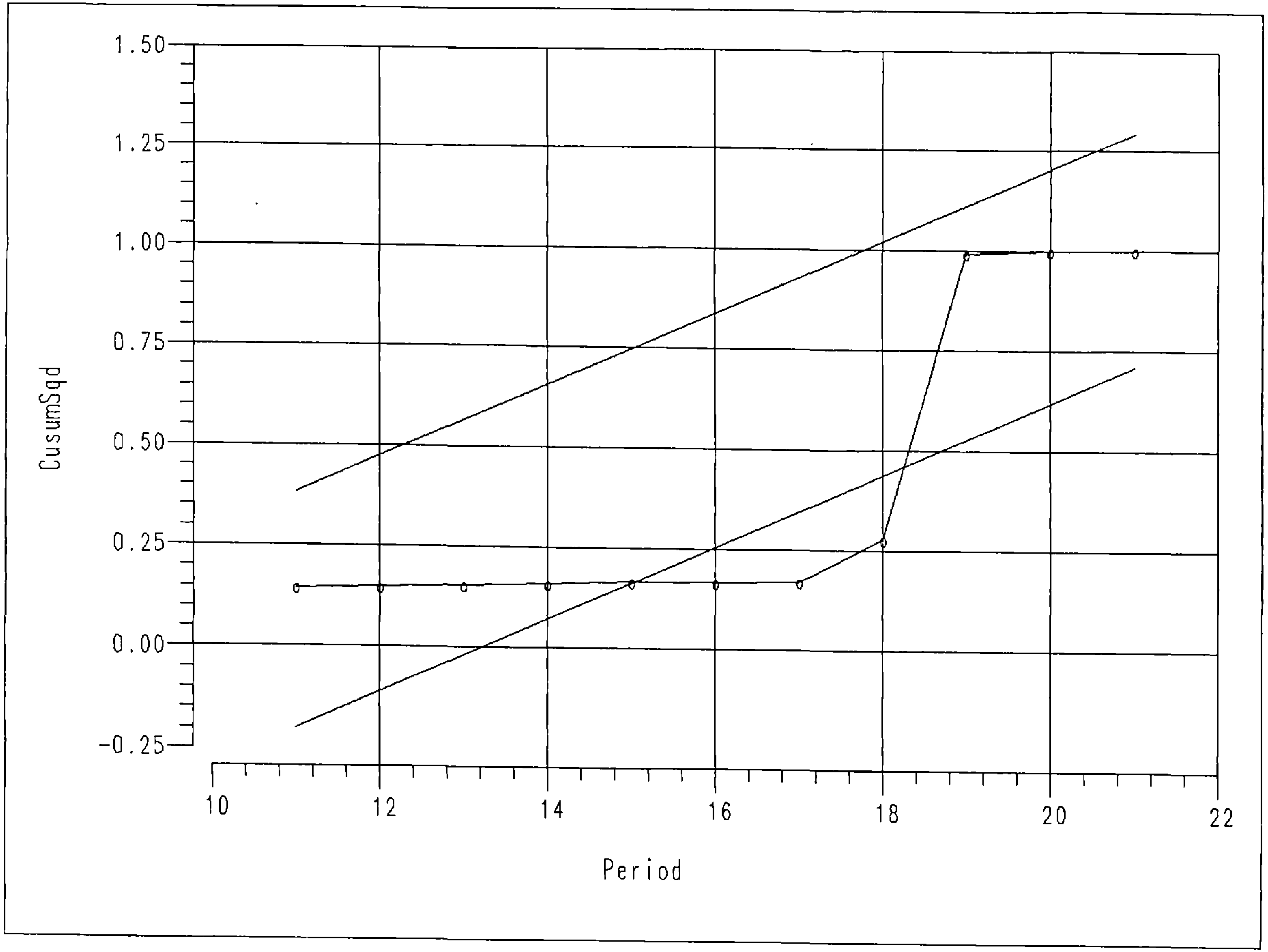
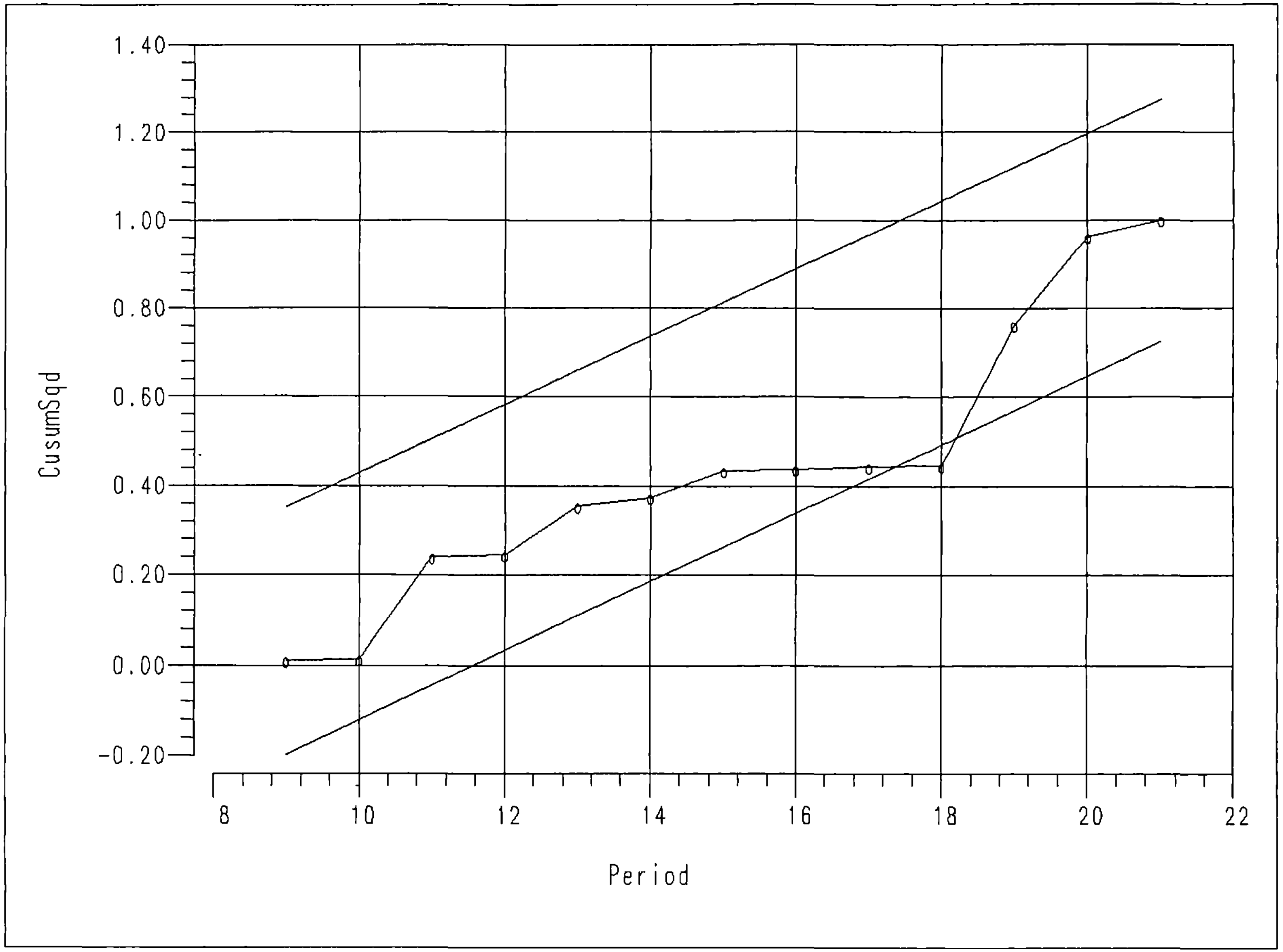


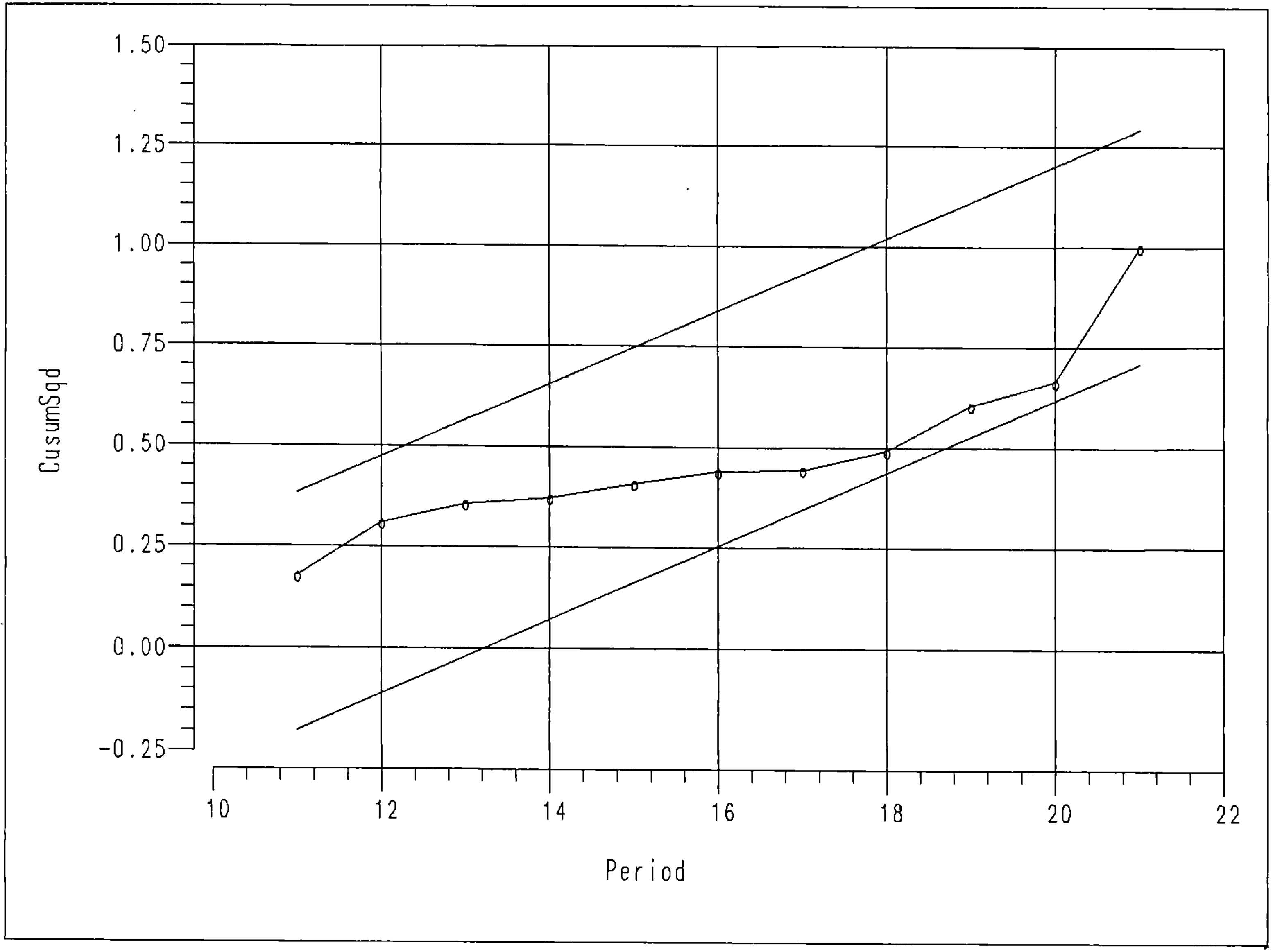
6.A17 DEMAND FOR LABOUR (MANUFACTURE)



6.A18 DEMAND FOR LABOUR (OIL)



6.A19 DEMAND FOR LABOUR (NON-TRADED INDUSTRIALS)



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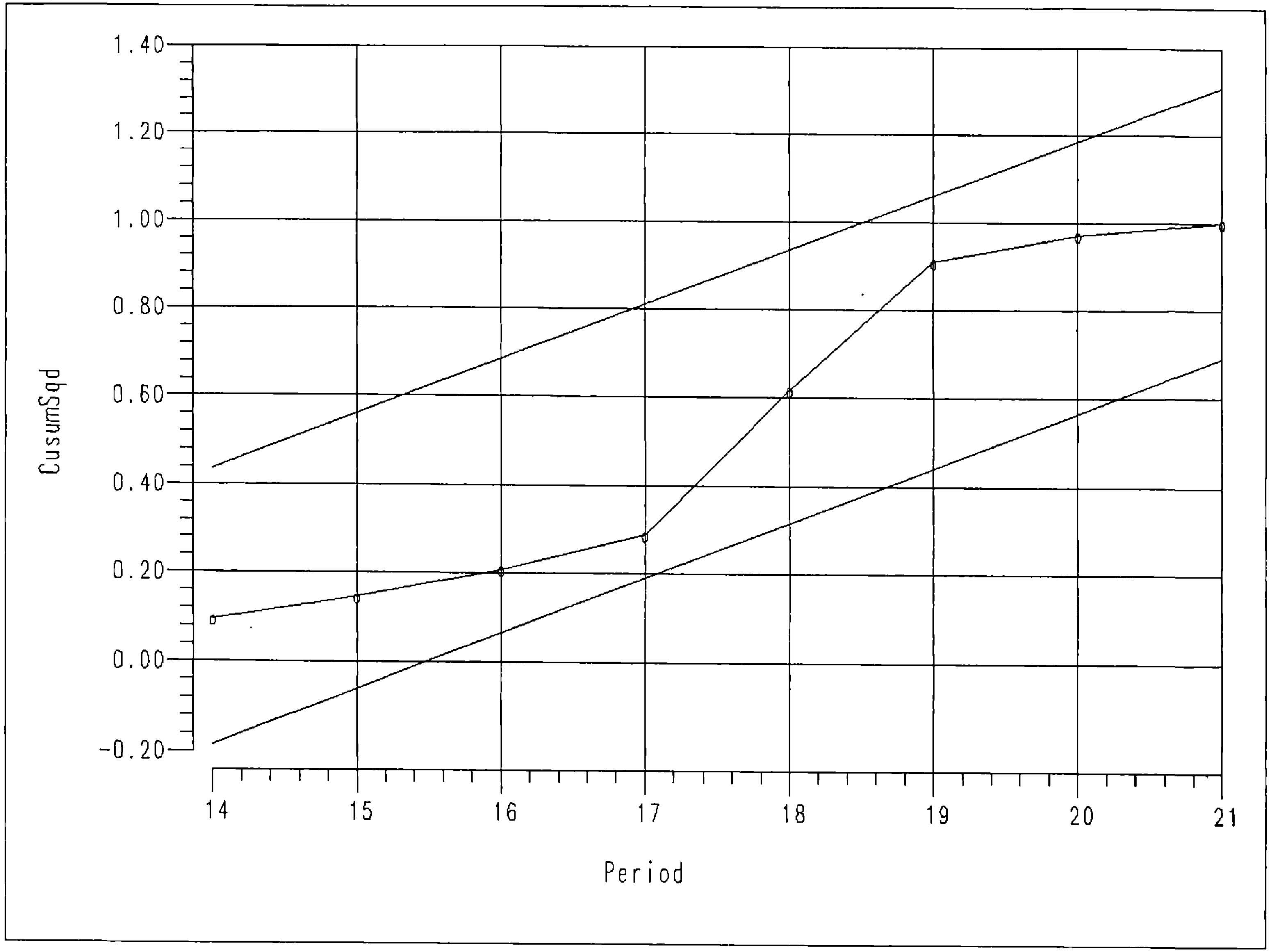
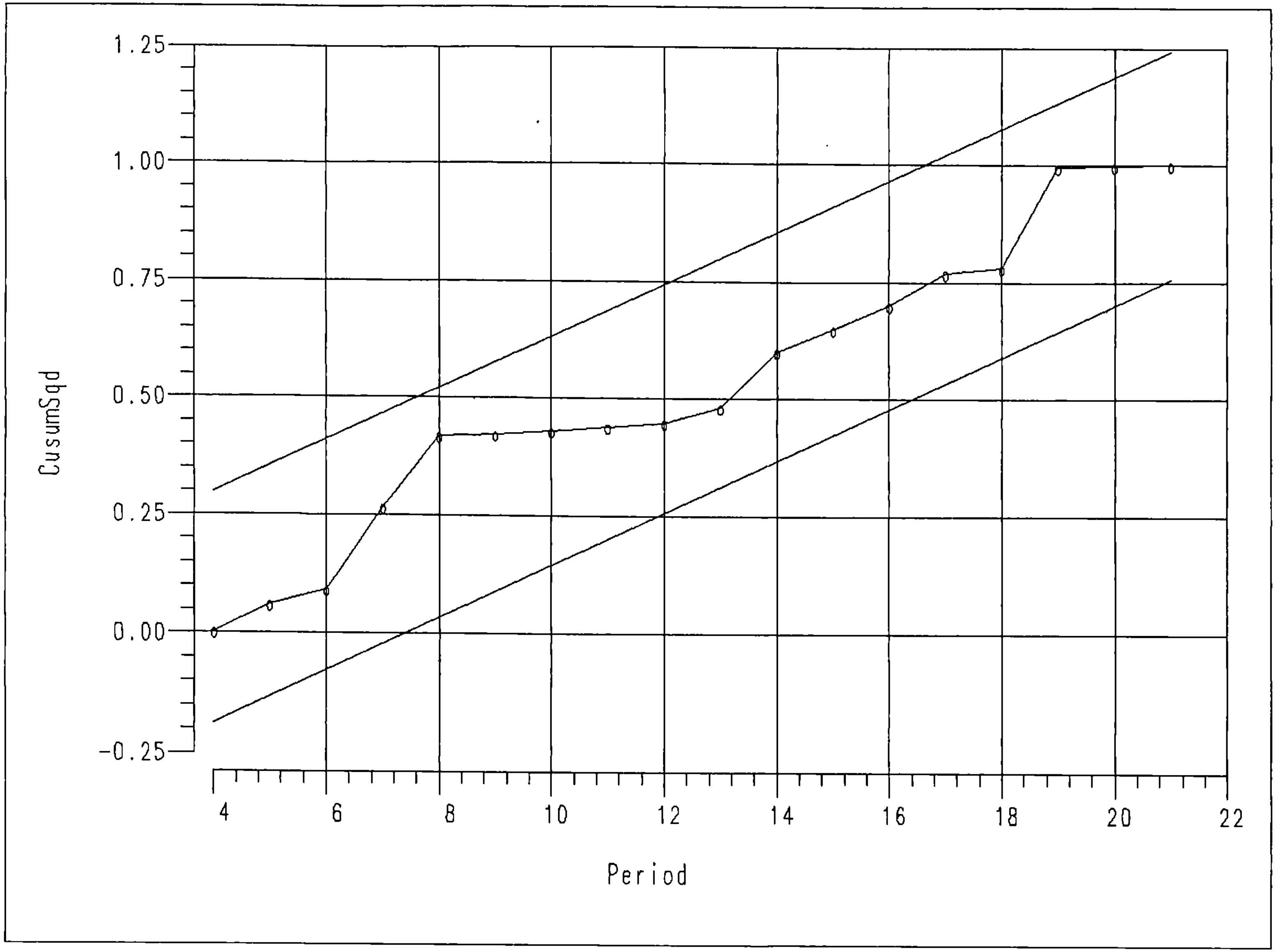


6.A21 SUPPLY OF LABOUR (AGRICULTURE)



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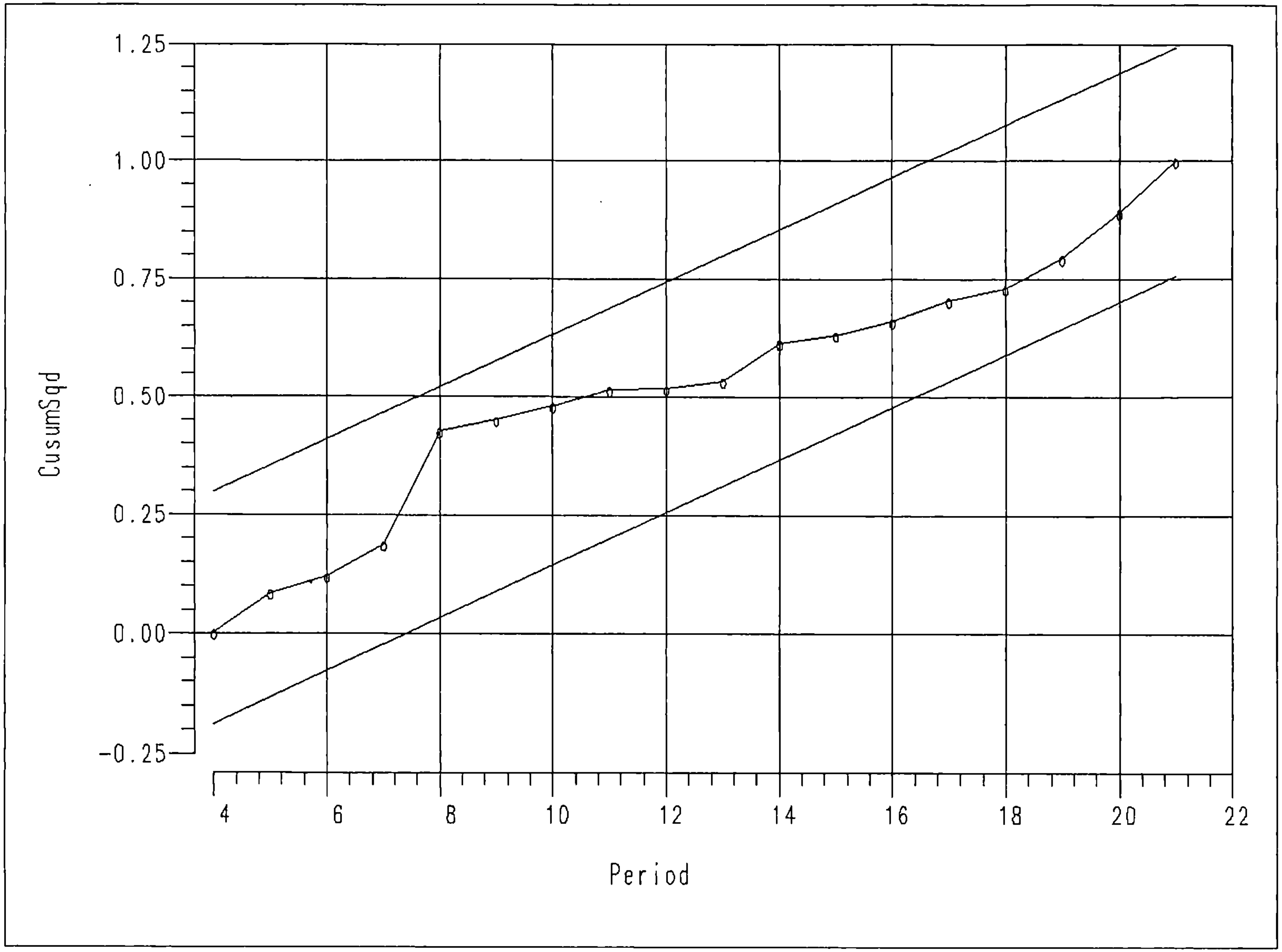

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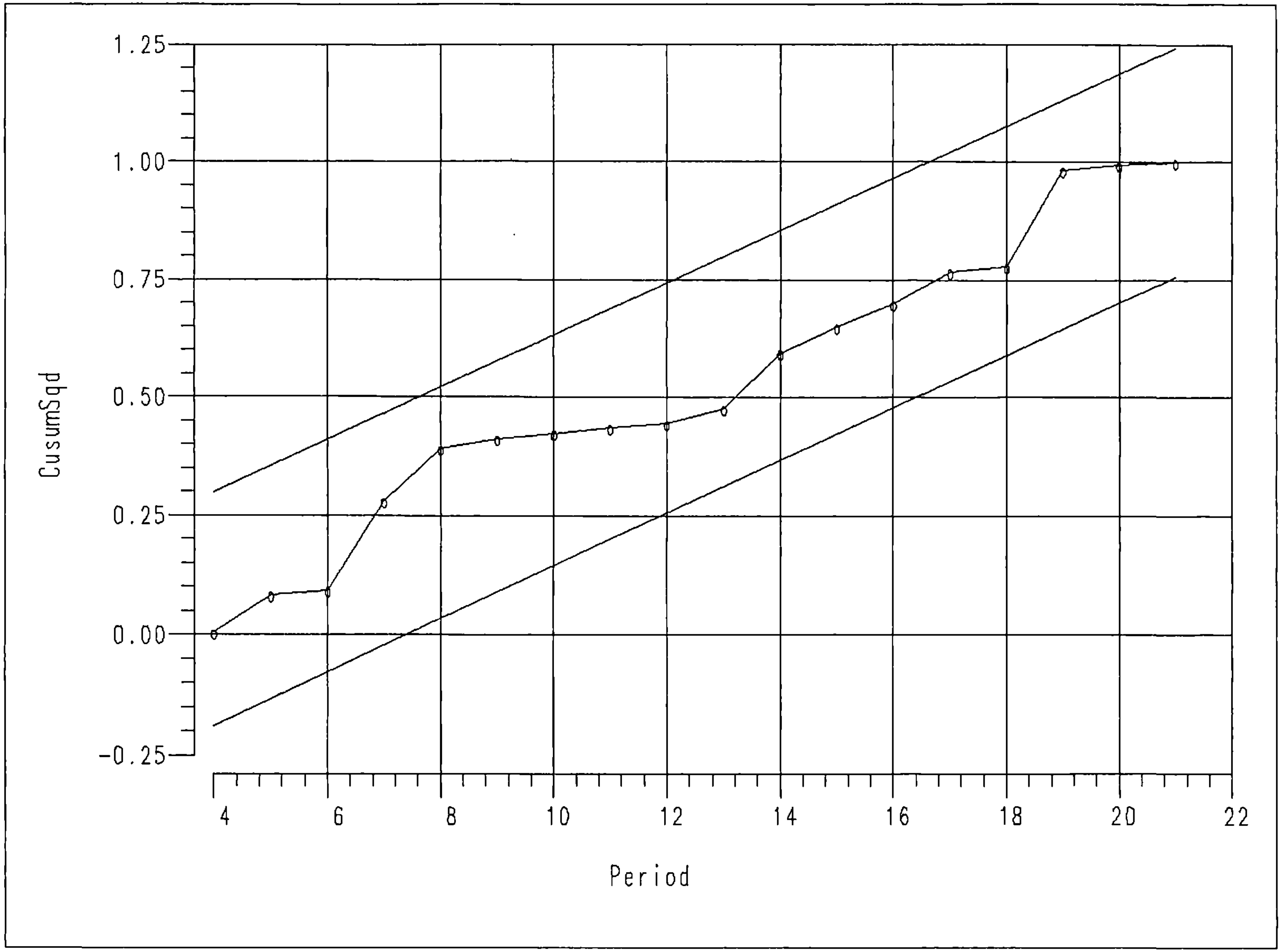
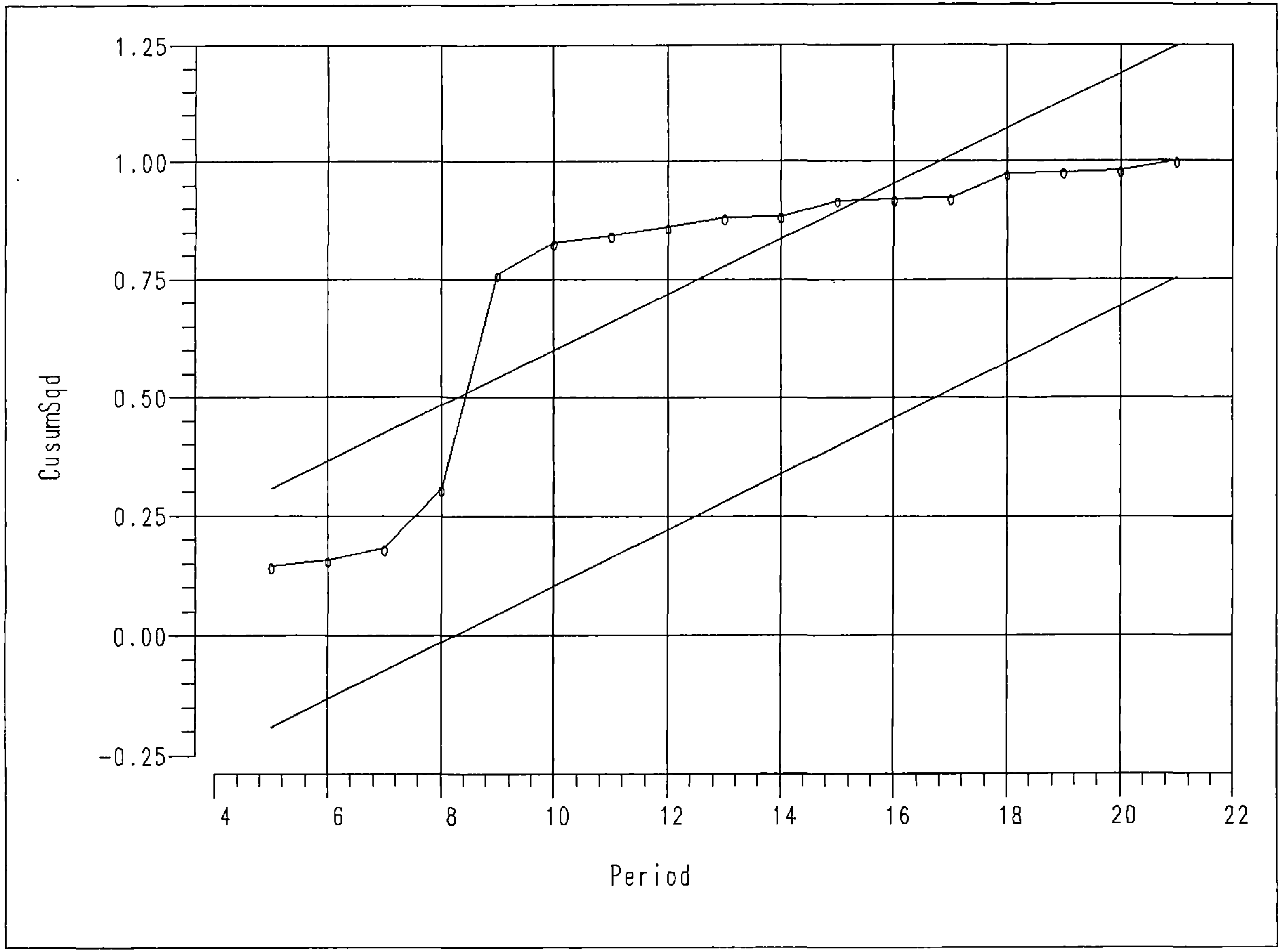
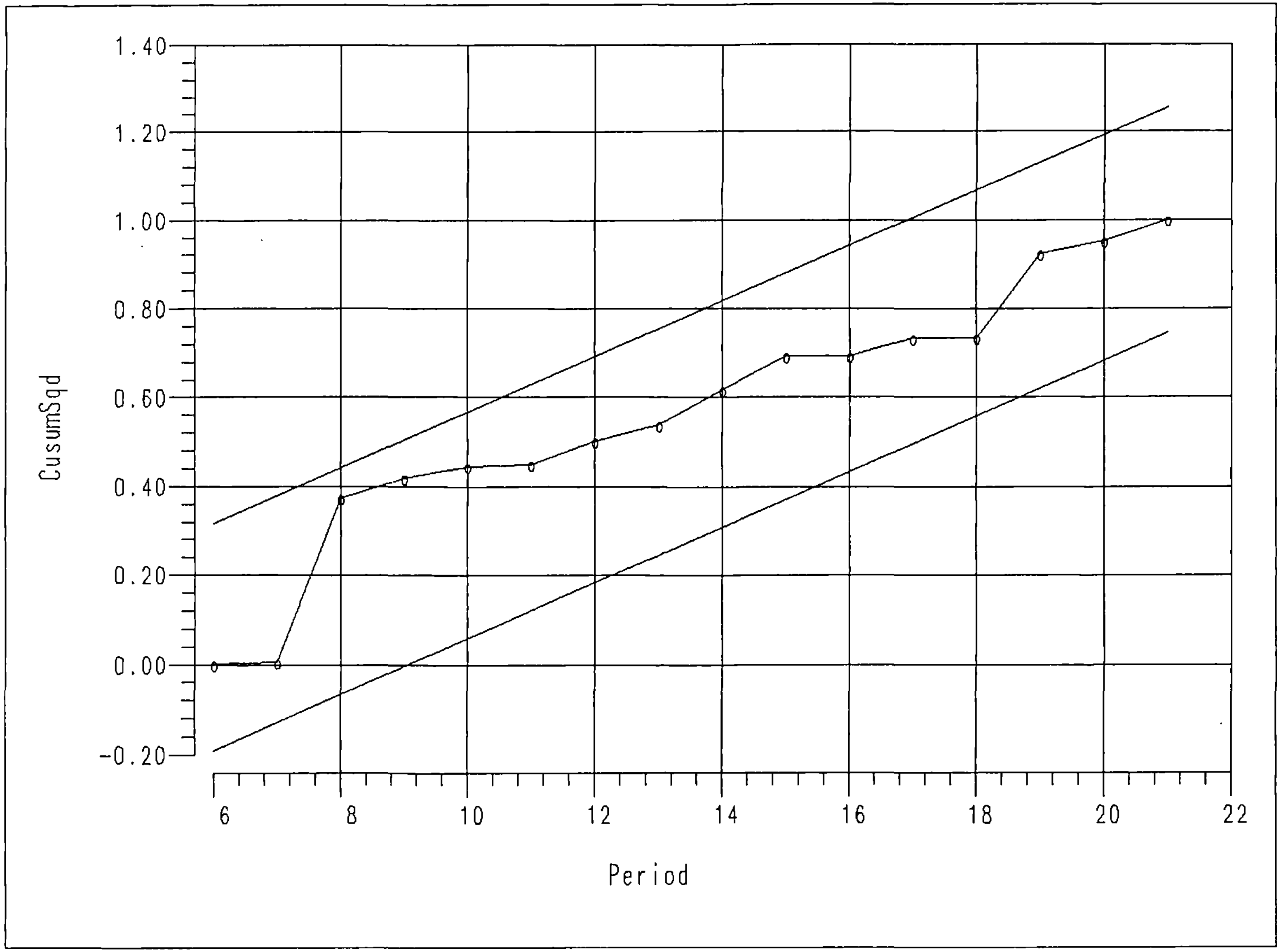


6.A24 SUPPLY OF LABOUR (NON-TRADED INDUSTRIALS)



6.A25 SUPPLY OF LABOUR (SERVICES)



CHAPTER 7

INDUSTRIAL POLICY IN NIGERIA AND AN EVALUATION OF THE PERFORMANCE OF THE MANUFACTURING SECTOR USING THE DUTCH DISEASE MACRO MODEL AND AN INDEXATION METHODOLOGY

7.1 Introduction

In this chapter, the estimated Dutch Disease macro model is used to investigate the effect of the oil industry on the size and performance of traded and non-traded sectors, in particular, the traded manufacturing sector. Previous chapters have dealt with the theoretical mechanisms of the Dutch Disease while our empirical results from Chapter Six strongly suggested that in Nigeria the classic Dutch Disease resource movement effect is absent, while both an income effect, which is generally in line with predictions from other theoretical and empirical models, and a crowding out/resource constraint effect linked to government's investment in the oil sector were present. In this chapter, an additional effect attributable to the balance of payments, which has largely been ignored in theoretical and empirical models of Dutch Disease, is also examined.

In this Chapter, a critical examination of the manufacturing sector is carried out. In spite of huge oil revenues, the share of the manufacturing sector to overall GDP in Nigeria is one of the lowest in the world (World Bank Report, 1992, 1995). Therefore, an important starting point in investigating the reasons behind the relatively small share of manufacturing in the Nigerian economy is a critical appraisal of Nigeria's industrial policies since 1960, and this is carried out in Section 7.2. Indeed, the picture that emerges is a capital intensive industrial sector characterised by high production costs, a very high level of import content in manufacturing output and periodic reversals in government industrial policies and programmes.

In Section 7.3, the long run solutions for the world price model under both a floating and a fixed exchange rate system are given. In this section, a brief overview of the nature of simulation systems is given before the long run equilibrium values are obtained which are subsequently used as the benchmark for the simulations in the next section.

In Section 7.4, the estimated Dutch Disease model is used to simulate the effects of a smaller oil sector on the manufacturing sector both under a floating and a fixed exchange rate system. In other words, the model is used to give an indication of the structure of the Nigerian economy, particularly the manufacturing sector, without oil.

Finally, in Section 7.5, an indexation methodology is used to construct a manufacturing index which is then subsequently utilised to provide further evidence of the Dutch Disease in the manufacturing sector, while Section 7.6 concludes the chapter.

7.2 *Industrial Policy and the Growth of the Manufacturing Sector in Nigeria: 1960 - 1965*

Nigeria at independence in 1960 was characterised by a small number of industries mainly concentrated in the agricultural sector. Given Nigeria's colonial ties with Britain, in the early 1960s, the industrial scene, not surprisingly, was dominated by British trading companies, with management roles taken up by a small cohort of trained Nigerians (Egbon, 1989). The major import substitution industries during the early industrial development period were mainly consumer goods. During this period, the proportion of gross profit and salaries repatriated by foreign firms was very high while the level of domestic participation in the ownership and management of industries was very low (Oshikoya, 1990).

In the First National Development Plan of Nigeria, 1962 - 1968, the development objectives of Nigeria's industrialisation programmes were to stimulate the establishment and growth of industries, promote economic growth and secure and improve the standards of living of its people. The plan called for reduction in the dependence of the country on foreign influences through reducing the dependence on foreign trade and imported goods and increasing local participation in the ownership and management of industries. Given that a major constraint to industrial development in the period was inadequate levels of skilled labour (National Development Plan of Nigeria, 1962 - 1968), a concerted effort was made towards the replacement of imports of non-consumer durable goods produced using low skilled labour and little capital.

However, following the devastating effects of the civil war between 1967 and 1969, Nigeria's industrial scene did not actually take off until the early 1970s. By 1973, the government's growing influence on industrial development was effected through the provision of industrial incentives such as income tax exemptions for pioneer status industries, generous capital allowances, a tariff regime that sought to protect local industries and direct government investments (Egbon, 1989). The import substitution industrialisation strategy in the 1970s was aimed at promoting growth and economic diversification whilst reducing the dependence of the economy on the agricultural sector, which at the time was still the country's principal earner of foreign exchange.

By 1973/74, Nigeria's efforts at industrialisation was given a major boost with the discovery of oil, the three fold increase in oil prices and the consequent huge foreign exchange earnings from the export of the commodity that accrued to the government. At about this time, domestic participation in the ownership and management structures of industries gradually increased, particularly after the promulgation of the Nigerian Enterprises Promotion Decrees in 1972, and later in 1977, whose aim was to wrest control from foreigners and increase indigenous participation (Oshikoya, 1990).

By the late 1970s to early 1980s, the government's industrial strategy of import-substitution fuelled by huge oil revenues gradually shifted emphasis towards more capital intensive industries such as iron and steel, petroleum refineries and vehicle assembly (Bienen and Gersovitz, 1981 and Oshikoya, 1990). These subsectors, whose finance were generally considered beyond the financial capacity of the private sector, were primarily financed by heavy government investments (World Bank, 1983). During this period, although the pursuit of the import substitution strategy at that stage of Nigeria's development was clearly aimed at reducing the country's long term dependence on imports it created the opposite effect. Indeed, it raised the problem of economic dependence (Egbon, 1989), given that a large component of intermediate inputs and raw materials were imported, even when the final production was locally produced, such that there was little domestic value added (Balabkins, 1988) and few forward and backward linkages. Although the term 'self-reliance' constantly re-echoed in successive national development and rolling plans, Nigeria was anything but self-reliant in manufacturing and industrial production. With regard to the import substitution strategy, Egbon (1989) stated:

"A policy of import substitution industrialisation becomes increasingly difficult to follow beyond the consumer goods phase because with each successive import substitution activity through the intermediate and capital goods phases, the capital intensity of import substitution projects rises, resulting in a longer import content of investment"

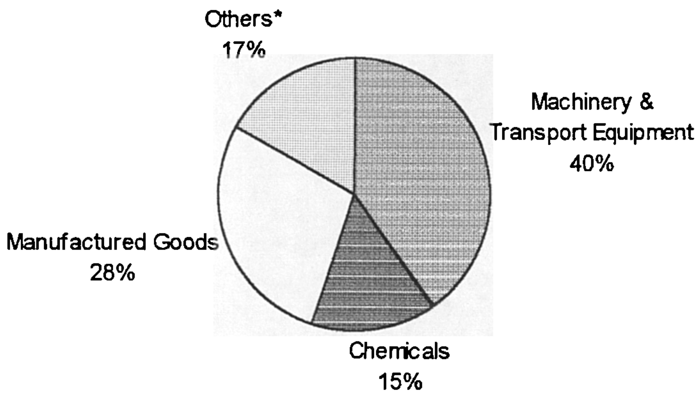
TABLE 7.1: KEY PERFORMANCE INDICATORS FOR THE MANUFACTURING SUB-SECTORS (ANNUAL % GROWTH RATES) FOR 1970 - 1995

Year	Real Value of Output	Operational (Wage) Costs	Total Employment	Investment Expenditure	Profitability	Foreign Direct Investment
1970	7.42	n.a.	n.a.	n.a.	n.a.	n.a
1975	5.17	11.72	2.74	7.46	28.77	-2.71
1979	7.32	-4.96	3.11	-26.49	8.21	11.01
1980	17.24	-7.48	3.63	15.22	15.50	7.23
1981	10.55	9.52	4.61	15.58	11.66	13.42
1982	-19.66	-6.56	5.09	-24.19	6.29	12.71
1983	-17.75	-14.97	4.38	-17.11	3.47	10.60
1984	-18.83	-12.24	3.15	-12.03	-22.49	0.88
1985	6.15	-18.53	3.08	8.40	22.56	8.01
1986	-32.37	-1.24	2.89	-9.02	-1.83	23.36
1987	44.79	-1.53	-2.27	32.95	41.62	11.11
1988	4.47	-2.06	-4.98	-6.20	-3.47	16.48
1989	7.35	-1.64	-7.87	-11.6	-25.26	48.65
1990	9.63	-0.18	0.19	23.81	2.59	17.25
1991	11.79	-2.81	3.07	16.72	15.30	37.13
1992	-0.195	13.48	-7.68	-13.46	-0.46	12.12
1993	-3.65	11.73	-13.43	-56.94	17.08	32.21
1994	-3.275	22.17	-1.86	-45.56	29.86	9.12
1995	-1.432	-5.47	1.48	-10.65	12.56	n.a

Sources: Computed from various publications from the Central Bank of Nigeria, Federal Office of Statistics of Nigeria, Federal Ministry of National Planning and the Federal Ministry of Employment, Labour and Productivity.

The implication of continued import dependence was that capital intensive industrialisation remained relatively high, and as such the Nigerian manufacturing base was still highly dependent on imported capital and technological equipment (see Figure 7.1) as well as on foreign management skill and knowledge. The further pursuit of the import substitution industrialisation had caused more inefficient use of resources, increased foreign exchange constraints and costs, and created balance of payments difficulties (Egbon, 1989).

Figure 7.1: % Average Distribution of Imports by S.I.T.C. Sections (1973 - 1995)



Source: Central Bank of Nigeria, Statistical Bulletin, 1995.

Note: (i) * (Others): includes Food, Mineral Fuels and Miscellaneous Transactions.

By the mid 1980s, the manufacturing sector was still characterised by high import content of industrial output. However, following the plunge in oil prices in 1986, the sector began witnessing low levels of both foreign investments (see Table 7.1) and capacity utilization and industrial progress severely declined as oil revenues declined sharply and the balance of payments rapidly deteriorated. The government's return on capital on the portfolio of core industrial projects in which it had invested heavily continued to be low and with rapidly declining oil revenues many of these industrial projects proved unsustainable and turned out to be "White

Elephant" projects (Manufacturers Association of Nigeria, 1989).[1] The situation was not helped by unwise decisions concerning project location. In Nigeria, the location of industries was often based on 'federal character' and the need for various parts of the country to share in government investments (Bienen and Gersovitz, 1981) rather than the need to minimise the costs of production of manufactured goods by directly exploiting natural comparative advantages.[2]

By the late 1980s, the government of Nigeria increasingly recognised the need for industrial and structural reform. Nigeria finally introduced a Structural Adjustment Programme (SAP) in 1986 after being under pressure from international lending agencies like the World Bank which tended to be biased in favour of agriculture and agro-allied industrial sectors rather than the highly protected, import and capital intensive industries (Lubeck, 1992) which had characterised the country's industrial scene. The lending agencies, in general, favoured more liberalised policies although this often directly conflicted with the interests of the multinationals which often demanded conditions conducive to it, including effective protection, before undertaking investments (Stein, 1992). After a number of ad hoc measures between 1983 and 1985 in support of the industrial sectors, the SAP by contrast was a comprehensive package of reform whose industrial aim was to liberalise controls to induce greater foreign and local private sector investments, encourage the development and use of local raw materials and local technology in production, and promote more export oriented industries.

Thus the year 1986 can be regarded as a significant year in Nigeria's industrial and economic history given the significant impact of trade, financial and foreign exchange market liberalisation policies under the SAP on the performance of the industrial sectors, particularly the manufacturing sector. The SAP and the foreign exchange squeeze forced industries to look inwards and reduce import dependence by sourcing their raw materials requirements locally

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[1] The urgency of project rationalisation became evident when in 1984 the federal government appointed a projects review committee to appraise and review all federal government projects worth =N=30 million (thirty million Naira) and above.

[2] The location of the oil refineries and the rolling mills hundreds of miles from the oil fields and the steel plants to achieve a balanced federal spread and ethnic equity are prime examples. Using the latter case as an illustration, Nigerian manufacturers over the years have been forced to use more expensive local steel because of government's restrictions on importation of foreign steel, and as a result, the high costs of domestic steel has imposed additional burdens on Nigerian manufacturers which use this input in competition with foreign firms which export goods to Nigeria made with foreign made steel (Bienen and Gersovitz, 1981).

(Manufacturers Association of Nigeria, 1989). Indeed, those industrial sub-sectors that performed well after the introduction of the SAP were those which utilised local raw materials, like wood, beverages and textiles (National Rolling Plan, 1993-95 and Table 7.2).

TABLE 7.2: INDEX OF PRODUCTION IN MANUFACTURING SUB-SECTORS FOR 1970 - 1995 (1985 = 100)

Year	Sugar Confec-tionery	Soft Drinks	Beer & Stout	Cotton	Synthe-tic Fabrics	Paints	Refined Petro-leum	Cement	Vehicle Assem-bly	Soap & Deter-gent	Total*
1970	336.3	6.8	13.1	108.5	n.a	47.4	21.4	17.7	8.8	39.7	24.1
1975	578.7	28.6	36.5	131.7	179.6	85.6	74.2	87.6	22.5	99.8	43.9
1980	234.1	65.4	123.6	233.9	369.6	177.9	177.3	48.4	208.9	251.9	102.4
1985	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1990	93.7	364.4	97.8	118.0	1501	62.7	108.8	88.7	24.1	153.0	162.9
1995	59.9	153.2	103.3	89.6	799.3	118.1	117.9	93.2	11.7	167.6	136.3

Source: Central Bank of Nigeria Statistical Bulletin, 1995

Note: (i) * Total includes Foot Wear, Roofing Sheet and Radio & T.V sub-sectors which are reported here.

From about the late 1980s to early 1990s, the deregulation of interest and exchange rates under the SAP generally led to higher costs of production for many manufacturing industries given high costs of imported raw materials, cost of capital and labour. The deregulation of the banking sector under the liberalisation programme which resulted in very high interest rates of between 60% and 80% was a major disincentive to manufacturers and small and medium scale industries (Osaghae, 1995).The overall effect of trade and exchange rate policies on manufacturing has been mixed and the expected large in-flow of foreign investments has not been realised. The level of capacity utilisation of about 39% per annum between 1986 to 1991 (National Rolling Plan, 1993 - 95) may be considered low by world standards. The shortage of technical equipment and other inputs, falling demand arising from declining purchasing power, reduced revenues in the face of increased competition that directly results from tariff reductions, and the weak linkages among industrial sub-sectors casts serious doubt on the success of IMF/World Bank induced liberalisation type policies (Stein, 1992).[3]

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[3] Indeed, as at the time of writing, two major policy u-turns on interest rates and the exchange rate had been effected. Both the interest and the exchange rate are now fixed, and there are plans by the government to re-purchase

In spite of the numerous investment and monetary incentives[4] in support of the industrial sectors, the obvious advantages of Nigeria with its potentially huge market, amiable natural topology and entrepreneurial ingenuity of its people, the manufacturing sector is yet to take off in ways expected of a major oil exporting country that has earned hundreds of billions of dollars from oil receipts since independence.

Failure on the path of the industrial sectors, more often than not has been associated with the lack of a clear industrial policy guideline[5], although frequent government u-turns, poor management and implementation, and a cumbersome state administrative system (World Bank Trends, 1992, 1996) have been contributory factors. Pure economic supply side factors such as high production costs arising from the continued depreciation of the Nigerian Naira and shortages of imported machinery, spare parts and raw materials in the face of dwindling foreign exchange earnings, and demand factors linked to declining consumer purchasing power have resulted in less than spectacular increases in domestic and foreign investments and have in general constrained the performance and overall growth of the sector.

7.3 *The Long-run Solution of the Dutch Disease World Price Model under both a Floating and a Fixed Exchange Rate System*

An economic simulation is a solution to a simultaneous set of differenced equations (Pindyck and Rubinfeld, 1998). Even if all the individual equations fit the data well and are statistically significant as was generally the case from our results in Chapter Six, simulations are necessary because the model as a whole will have a dynamic structure that is more complex than any of the individual equations within it (Ege, 1988). It is generally recognised that in building

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its shares in previously privatised banks. The consequence of these developments is the re-regulation of the Nigerian economy.

[4] The main state-owned financial institutions for promoting government's industrial policies are the Nigerian Industrial Development Bank (NIDB), the Nigerian Bank for Commerce and Industry (NBCI), the Nigerian Agricultural and Co-operative Bank (NACB) and the Federal Mortgage Bank (FMB).

[5] For several decades after independence, Nigeria did not have a formal and consistent set of industrial policy guidelines, although the annual budget statements and the periodic National Development and Rolling Plans, which generally informed the path of and direction of industrial development, were faithfully prepared but not properly executed.

models, compromises sometimes have to be made because equations which do not have good statistical fits turn out to be useful for simulation exercises (Pindyck and Rubinfeld, 1998) and this is no less the case in models of the Nigerian economy (Oshikoya, 1990). Before presenting and discussing the results of our simulation runs, a brief description is given of the key features of a system simulation and how the long run equilibrium solution values used as the benchmark values in both Chapters Seven and Eight were obtained.

Firstly, simulations are generally of two types, namely, static and dynamic simulations. Simulations are described as static if historical values of the lagged endogenous variables are used in successive solutions of the system simulation. Most often, a dynamic simulation is performed in which case the lagged variables are those generated by the model itself. The simulations carry forward the dynamic solution of the whole system from given initial conditions (Klein, 1969). In such situations, the values of endogenous variables are generated within the system from solutions at earlier time periods. The advantage of a dynamic simulation is that it indicates whether the model is stable and provides a better measure of fit of the model (Pindyck and Rubinfeld, 1998), while the disadvantage is that errors can accumulate (Sundararajan and Thukur, 1980).

In the present simulations, all predetermined variables, that is both the lagged endogenous and exogenous variables, are given starting values from the actual 1993 values. Because of the presence of lags in the model, these 1993 values are not really at their actual equilibrium values. Because of these lagged variables, a simulation model should be allowed to run for many periods to obtain the long run values. As a result, our model was run over a period of sixty five years to establish the long run values, that is, the model was run long enough for the dynamics to work out. This was checked by looking at successive changes in the values of the endogenous variables across the entire period.

Secondly, in simulations, residuals can be treated in two ways. The first, which is used in an overwhelming majority of system simulations (Klein, 1969; Challen and Hagger, 1983; Pindyck and Rubinfeld, 1998), including this study, simply sets all residuals to zero. The alternative approach, though this is very rarely used, are stochastic simulations in which artificial time series are generated for each residual in much the same manner as the values for the random disturbances in a Monte Carlo experiment are created.

Thirdly, a simulation consists of a control run, in which benchmark values are obtained, and a shocked run. The difference between the runs is that in the case of the shocked run, some form of shock is introduced into the system. The size of the shock is optional, but is generally kept as a constant percentage of the simulation period mean historical value of the exogenous variable in question (Challen and Hagger, 1983).[6] The shocked run may be of four types:- Firstly, it may take the form of a change in the time path of a single exogenous variable. Secondly, the shock may take the form of simultaneous changes in several variables. Thirdly, the shock could involve a change in one or more parameters of the system. Finally, the shock may involve replacing one of the equations of the system by another. In this chapter, the second type of shock is used while in the next chapter the first type is used. In both situations, a comparison of the long run equilibrium solution values of the endogenous variables from the control run (the benchmark) and the shocked runs gives very useful information on the response of the system to the shock.

Finally, for the results presented in the next section, the Gauss-Siedel method of model solution in TSP version 4.3 program is used. The advantages of this method of solution are that its use of computer storage is considerable less when compared to other methods of model solution, convergence is relatively easier and the solution is suitable for large economic models which are non-linear (Hall, 1994). To solve the model, the equations were normalised, that is, each of our fifty-one endogenous variables specified in Chapter Five appeared once and only once on the left hand side of an equation. This normalisation procedure is quite common and has been used for the solution of very large economic models (see for example, Barker et al, 1980). All model equations have to be specified including the identities in the model that neither contain parameters to be estimated nor disturbances but are necessary to complete the model such that the number of equations and the number of endogenous variables in the model are equal.[7]

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6 Multipliers are calculated by dividing the difference between the appropriate shocked run value and the control or benchmark value by the shock size. See Challen and Hagger (1983) for a detailed account of why this method is extensively used to eliminate the problem of the impact of trending of the exogenous variable on the control run values of the endogenous values.

7 For the simulations, TSP treats the identities and structural equations identically so that in solving the models, the errors for both identities and structural equations are kept as small as possible.

7.4 *Analysis of the Effects of a Non-Oil Dutch Disease Macro-Model on the Manufacturing Sector Under both a Floating and a Fixed Exchange Rate System*

The estimated Dutch Disease model is both multi sectoral and dynamic. Models that are dynamic and multi sectoral are very useful for investigating the effects of macroeconomic policy changes on individual sectors of the economy. The bulk of Dutch Disease models have not accorded a role for government so that important macroeconomic consequences of oil and oil related shocks have not been fully accounted for.

Those limited studies (for example, Harvie and Thaha, 1994) which have conducted policy simulations involving shocks to oil production in conjunction with exogenous changes to government macroeconomic policies have not considered government expenditure shocks directly linked to the oil sector. Our results from Chapter Six implied that oil related shocks may not have a direct effect on sectoral output and investment decisions, rather it is the manner in which the government decides to spend the extra revenues domestically that have direct and permanent impact on sectors. In this chapter, the effects of sector specific government expenditure policies on the Nigerian economy are examined.

Although the next chapter considers the effects of the balance of payments on its own and in detail under a floating exchange rate system, considering oil related shocks in this chapter under a floating and a fixed exchange system is important because both the exogenous exchange rate effect and the exogenous balance of payments effect can be detected in conjunction with these shocks. The former effect is important given that it is more closely related to the realities of the Nigerian situation because a fixed exchange rate regime was in place for much of the estimation period while the latter effect is important because of the constraints it may impose on the growth of the economy. Both effects are considered in turn for the world price version of our estimated Dutch Disease model. Therefore, in this chapter, the long run effects of changes to three key exogenous variables under both a floating and a fixed exchange rate system for the world price model are analysed.

The three adapted exogenous variables considered are:

Oil production (S_O) is allowed to fall by 50%

Government investment in the oil sector (GEX2) falls by 50%

Output of government services (S_G) falls by 50%.

The first effect is interesting because the reduction in the oil sector mimics a situation where Nigeria might have been without oil. The second is considered important because the ability of the government to spend out of oil revenues (GEX2) will clearly depend on the size of the oil sector (S_O). Given that oil revenues account for over 90% of government revenues with other taxes[8] and revenues sources quite negligible, a simple rule, *pari passu*, between the size of the oil industry and government expenditure in the oil sector is followed. Similarly, the third case is plausible given that the ability of the government to provide educational and health services (S_G) depends on oil production (S_O). A simple rule is also followed that allows production in the government sector to fall proportionately by the fall in oil production.

These three cases are considered simultaneously for the world price model under both a fixed and a floating exchange rate regime.[9] In general, the higher the percentage change, the more effective each case is with respect to the particular endogenous variable of interest in each sector. The results of the runs with respect to major macroeconomic variables are presented in Tables 7.3 and Table 7.4. The former is for the case where the exchange rate is endogenous[10] and the balance

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[8] Taxes are used here in a rather loose way to mean income (corporation, personal) taxes, ad valorem taxes and customs and excise taxes. Technically, government revenues from the oil sector are derived largely from petroleum taxes.

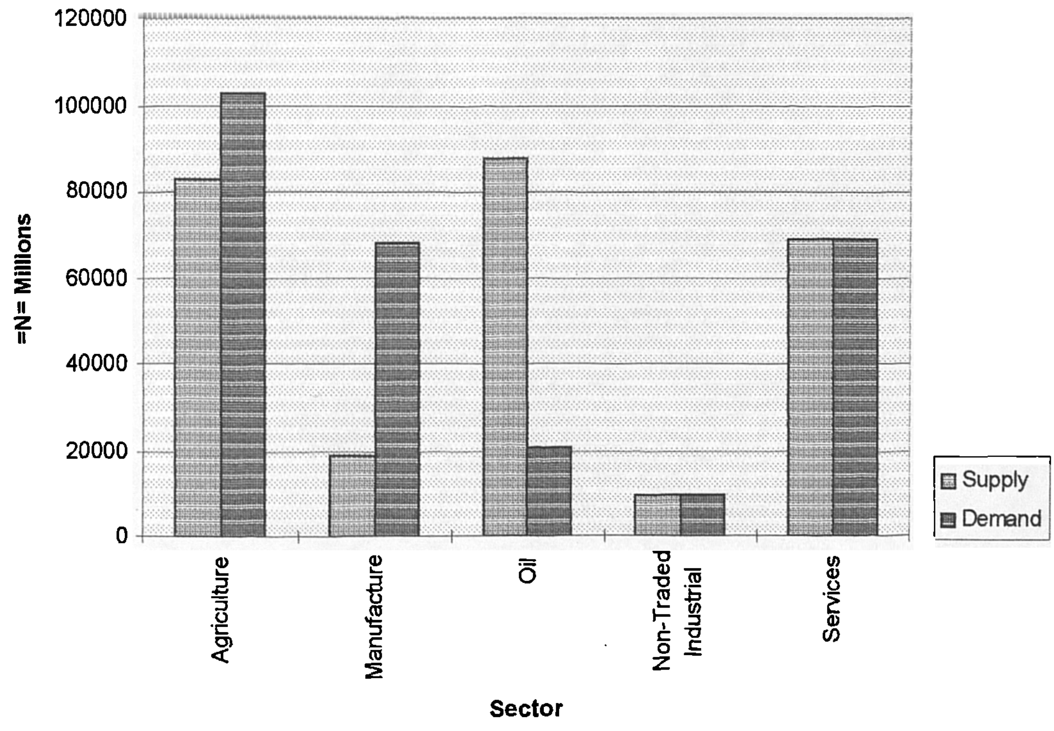
[9] It is recognised that a fourth simultaneous case that may arise as a result of the fall in oil production is a fall in net factor income. But data limitations on the export and import of gross factor incomes made it very difficult to establish precisely by how much net factor income will actually fall and so this case was not considered.

[10] In models of exchange rate determination such as those that will be examined in Chapter Eight as well as models like the current balance model or the Mundell-Fleming model, the exchange rate is flexible and assumed to be endogenous. In the current balance model, the exchange rate is determined by the current account. However, in the latter models like the Mundell Fleming model, the exchange rate is largely determined by the capital account. With flexible exchange rates, the deficit (surplus) on the current account is offset by a surplus (deficit) on the capital account. This of course assumes that there is a very high degree of capital mobility, that domestic and foreign assets are perfect substitutes and the condition that foreign and domestic interest rates are equal holds. Clearly in Nigeria's case, these assumptions are not very realistic given controls on capital movements and the observation made in Chapter Two that foreign investments have been largely unresponsive to the manipulation of domestic interest and exchange rates.

of payments is exogenous (fixed), while the latter is the reverse case where the exchange rate becomes exogenous (fixed) and the balance of payments is endogenous. Because of the huge volume of numbers generated from the simulation runs the discussion that follows places emphasis on interpreting the effects on the sectoral output and demand variables, particularly for the traded agricultural and manufacturing sectors, and in providing an overall and meaningful economic interpretation for the model as a whole under both the floating and the fixed exchange rate systems. However, in interpreting the results, it is important for the reader to bear in mind that the relative effectiveness of the runs is influenced by the initial starting conditions.

For the models, the long run equilibrium benchmark values under the floating and the fixed exchange rate system are shown in Figures 7.2 and 7.3. The benchmark values for the model under the floating exchange rate system (first column of numbers in Table 7.3) and the corresponding plots (Figure 7.2) will be the same as those used in the next chapter when the balance of payments effect is considered on its own.

Figure 7.2: World Price Model with Floating Exchange Rates (Benchmark Values for Supply and Demand Variables)



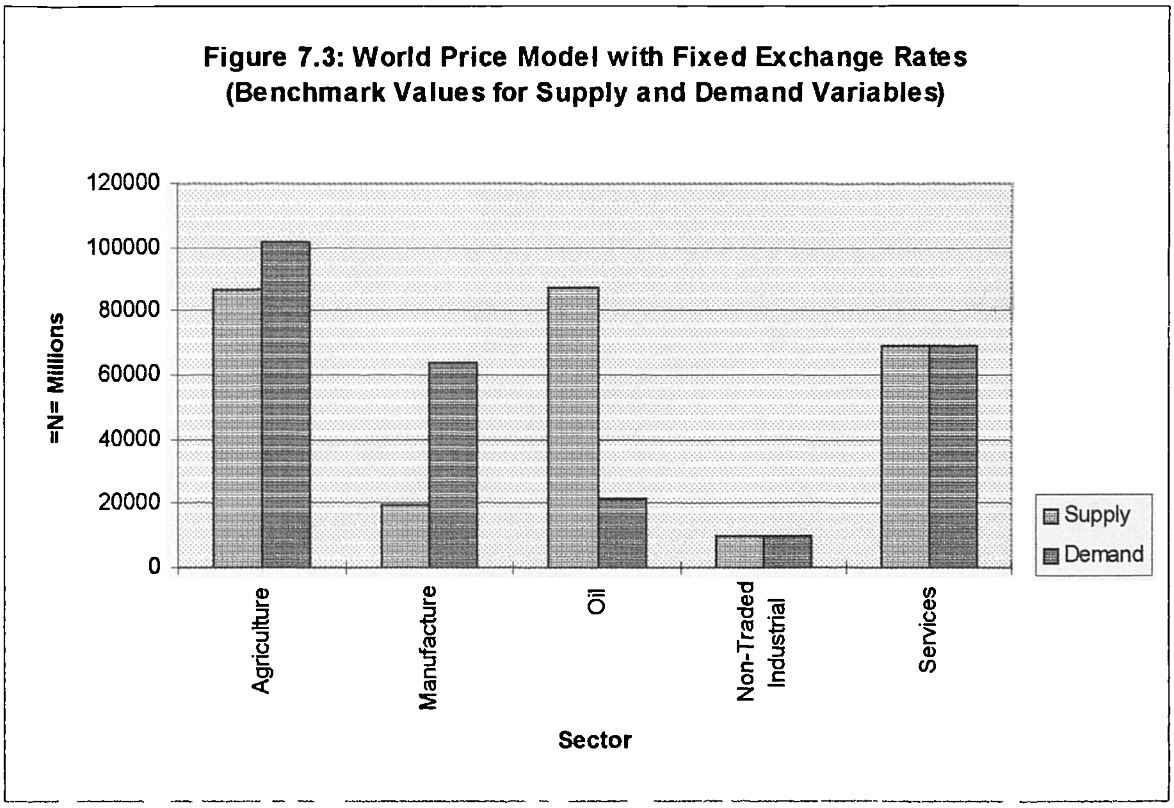


Figure 7.3: World Price Model with Fixed Exchange Rates
(Benchmark Values for Supply and Demand Variables)
120000
100000
80000
60000
40000
20000
0
=N= Millions
Agriculture
Manufacture
Oil
Non-Traded Industrial
Services
Sector
Supply
Demand

The results in Tables 7.3 for the world price model under a floating exchange rate system show that a smaller oil sector with simultaneous reductions in government investments in the oil sector and output from producers of government services significantly affects sectoral output, sectoral demand, income, net exports of the traded sectors, as well as the demand and the supply of factors of production.

The reduction in the size of the oil sector increases output of the traded sectors. The direct effects are seen to be acting through the crowding out effect of government investment spending in the oil sector which directly affects the capital stock. This reverse Dutch Disease type effect stimulates output in the traded agricultural and manufacturing sector. Therefore, the impact on traded output in this world price model, though not significant in the short run, is very significant in the long run where the ability to adjust the stock of capital increases. With a reduction in the balance of payments deficit which imposes a tighter constraint (third column of numbers in Table 7.3), output in the traded sectors only slightly increases relative to the situation where a less constraining long run balance of payments constraint was imposed (second column of numbers).

The depreciation of the exchange rate consequent upon the relatively large fall in oil production, increases the Naira equivalent of foreign currency, increases the incentive to supply more traded goods and increases non-oil traded output. With the 1993 long run balance of payments constraint imposed, output in traded agriculture and manufacturing increases by about 10% and 14% respectively given the shock to oil production and simultaneous related shocks to the economy. For the non-traded industrials and services sectors, where supply equals demand output falls by about 14% and 8% respectively consequent upon the large fall in income.

TABLE 7.3: WORLD PRICE MODEL WITH A FLOATING EXCHANGE RATE

Variable:	Variable Name:	Sector:	Benchmark Values:	WPFLER* (% Change)	WPFLER ** (% Change)
S1	Supply of Output	Agriculture	82839.22	10.57	12.69
S2	Supply of Output	Manufacture	19007.05	14.71	16.80
S3	Supply of Output	Oil	87590.66	-50.00	-50.00
S4	Supply of Output	Non-Trad Ind	68813.32	-14.69	-14.49
S5	Supply of Output	Services	9721.99	-9.76	-9.56
D1	Demand for Output	Agriculture	102800.9	-14.86	-16.92
D2	Demand for Output	Manufacture	67984.55	-17.38	-19.26
D3	Demand for Output	Oil	20867.54	-16.60	-18.67
D4	Demand for Output	Non-Trad Ind	9721.99	-14.69	-14.49
D5	Demand for Output	Services	68813.32	-9.76	-9.56
DK1	Demand for Capital	Agriculture	24794.21	11.92	13.93
DK2	Demand for Capital	Manufacture	18934.24	15.94	17.98
DK3	Demand for Capital	Oil	25881.05	-18.61	-19.04
DK4	Demand for Capital	Non-Trad Ind	50446.10	-15.42	-15.18
DK5	Demand for Capital	Services	9871.99	-9.96	-9.74
DL1	Demand for Labour	Agriculture	22.80	3.32	3.91
DL2	Demand for Labour	Manufacture	4.96	5.95	6.90
DL3	Demand for Labour	Oil	0.1182	-21.42	-21.82
DL4	Demand for Labour	Non-Trad Ind	7.76	-5.00	-4.80
DL5	Demand for Labour	Services	0.9314	-2.79	-2.69
SK	Supply of Capital	-	16845.72	-30.82	-24.72
SL1	Supply of Labour	Agriculture	22.80	3.32	3.91
SL2	Supply of Labour	Manufacture	4.96	5.95	6.90
SL3	Supply of Labour	Oil	0.1182	-21.42	-21.82
SL4	Supply of Labour	Non-Trad Ind	0.9314	-5.00	-4.80
SL5	Supply of Labour	Services	7.76	-2.79	-2.69
NX1	Net Exports	Agriculture	-19961.72	126.57	129.88
NX2	Net Exports	Manufacture	-48977.50	30.67	32.14
NX3	Net Exports	Oil	66723.12	-60.67	-60.35
Y	Real Income	-	326893.8	-25.10	-24.39
PS1	Supply Price	Agriculture	113.85	10.51	13.11
PS2	Supply Price	Manufacture	114.76	10.51	13.11
PS3	Supply Price	Oil	104.30	10.51	13.11
PS4	Supply Price	Non-Trad Ind	120.94	-12.83	-12.61
PS5	Supply Price	Services	87.93	-8.83	-8.81
PL1	Wage - Demand	Agriculture	339.19	2.05	2.90
PL2	Wage - Demand	Manufacture	640.69	4.03	4.67
PL3	Wage - Demand	Oil	3468.03	-9.97	-10.04
PL4	Wage - Demand	Non-Trad Ind	1060.62	-4.54	-4.30
PL5	Wage - Demand	Services	1998.93	-2.04	-1.94
ER	Exchange Rate	-	21.78	10.51	13.11
RIR	Real Interest Rate	-	2.26	-58.54	-36.37

* World Price Model with a Floating Exchange Rate (Using 1993 Balance of Payments as Constraint)

** World Price Model with a Floating Exchange Rate (Using Half of 1993 Balance of Payments as Constraint)

TABLE 7.4: WORLD PRICE MODEL WITH A FIXED EXCHANGE RATE			
Variable:	Variable Name:	Sector:	Benchmark Values:	WPMFXER* (% Change)
S1	Supply of Output	Agriculture	83550.46	10.86
S2	Supply of Output	Manufacture	19799.01	12.52
S3	Supply of Output	Oil	87590.66	-50.00
S4	Supply of Output	Non-Trad Ind	9768.51	-14.72
S5	Supply of Output	Services	68847.03	-9.53
D1	Demand for Output	Agriculture	104992	-12.74
D2	Demand for Output	Manufacture	67911.07	-18.04
D3	Demand for Output	Oil	21665.51	-16.78
D4	Demand for Output	Non-Trad Ind	9768.51	-9.53
D5	Demand for Output	Services	68847.03	-14.72
DK1	Demand for Capital	Agriculture	25523.45	11.07
DK2	Demand for Capital	Manufacture	19723.16	13.54
DK3	Demand for Capital	Oil	26129.90	-18.83
DK4	Demand for Capital	Non-Trad Ind	9881.40	-10.67
DK5	Demand for Capital	Services	50470.82	-6.67
DL1	Demand for Labour	Agriculture	22.80	3.06
DL2	Demand for Labour	Manufacture	4.96	4.38
DL3	Demand for Labour	Oil	0.1181	-20.98
DL4	Demand for Labour	Non-Trad Ind	0.9311	-4.88
DL5	Demand for Labour	Services	7.76	-2.66
SK	Supply of Capital	-	18851.76	-22.03
SL1	Supply of Labour	Agriculture	22.80	3.06
SL2	Supply of Labour	Manufacture	4.96	4.38
SL3	Supply of Labour	Oil	0.1181	-20.98
SL4	Supply of Labour	Non-Trad Ind	0.9311	-2.66
SL5	Supply of Labour	Services	7.76	-4.88
NX1	Net Exports	Agriculture	-21441.50	104.40
NX2	Net Exports	Manufacture	-48112.06	30.78
NX3	Net Exports	Oil	65925.15	-60.92
Y	Real Income	-	328477.2	-23.97
PS1	Supply Price	Agriculture	115.36	0.00
PS2	Supply Price	Manufacture	116.28	0.00
PS3	Supply Price	Oil	105.68	0.00
PS4	Supply Price	Non-Trad Ind	89.33	-12.61
PS5	Supply Price	Services	122.57	-8.66
PL1	Wage - Demand	Agriculture	340.86	2.34
PL2	Wage - Demand	Manufacture	641.96	2.06
PL3	Wage - Demand	Oil	3464.60	-11.83
PL4	Wage - Demand	Non-Trad Ind	1999.92	-4.49
PL5	Wage - Demand	Services	1057.46	-2.00
BOP	Balance of Payments	-	-3628.41	-75.49
RIR	Real Interest Rate	-	4.12	-24.46

* World Price Model with a Fixed Exchange Rate

In these models, the increase in sectoral demand prices which reduces demand is reinforced by the fall in income which further depresses demand. Sectoral demand in all sectors falls, consequent upon the fall in national income, in ways typical of traditional models of Dutch Disease. Our results from Tables 7.3 show that given the fall in national income, demand falls by between 10% to 20% in the five traded and nontraded sectors. The relatively large fall in demand for manufactured goods relative to other sectors reflects the strong substitution/cross-price effect in this sector. The complementarity effect between manufactured goods and services is relatively large but this effect is more than offset by the substitution/cross price and income effects so that demand for manufactured goods falls. The increase in production of both traded agricultural and manufacturing sectors is offset by the fall in oil production, output of government services and output of the non-traded sectors so that overall national income falls.

For the traded sectors as a whole, the current account is in a deficit. However, not all the individual traded sectors are in a deficit. From an initial deficit, net exports in the agricultural sector rises and the sector moves into an overall surplus. For the manufacturing sector, net exports also rise though not large enough to generate a manufacturing surplus.

From the perspective of the use of factors of production, the results from Table 7.3 for the model under a floating exchange rate system indicate that consequent upon the increase in output in the traded sectors, the demand for capital in these sectors rise. With capital being variable in the long run, investment is output generating in the long run. The fall in government investment in the oil sector (GEX2) results in higher investments in the non-oil traded sector, higher sectoral output and increased employment in these sectors. If this shock to the economy occurred without other simultaneous shocks, we would expect overall national income to increase. The increase in income would stimulate imports which would increase government non-oil tax revenues and the feed-back effect could actually increase government investment expenditures. In Nigeria, this is unlikely to be the case and the transmission mechanism is broken because of the government's ineffective tax administration system which is directly responsible for the relatively low levels of non-oil tax revenues. More importantly, because of the simultaneous decline in exogenous oil production and the output of government services, income actually falls. Although the demand for capital in the non-oil traded sectors rise, the supply of capital in the economy as a whole falls, savings become less attractive, and the real interest rate falls.

Because labour is also an important factor of production, the demand for labour in the non-oil traded sectors rise. The rise in the demand for labour exerts an upward pressure on wages which induces an increase in the supply of labour to these sectors. For the oil sector, the demand for both capital and labour falls consequent upon the fall in output. The fall in the real interest rate is not large enough to induce a rise in the demand for capital in the oil sector. The fall in the demand for labour in the sector results in a fall in the price of labour, but because the substitution effect is very small, so that the demand for capital in the sector does not rise.

Thus, the simultaneous shocks to the economy results in external and internal adjustments. Externally, the fall in the exchange rate (depreciation) increases the competitiveness of Nigerian exports and reduces imports thus maintaining the balance of payments. With respect to the balance of payments, a resource boom allows the country to reduce the constraint imposed by the balance of payments and therefore allows it to grow more quickly. At the height of the oil boom in the 1970s and early 1980s when Nigeria was considered credit worthy and under borrowed relative to other less developed countries, the country's huge oil resources may have allowed her to enjoy significant arrears on the trade account. Thus an important mechanism which arises is the ability of a country to run substantial deficits during a resource boom which represents an additional Dutch Disease effect, an effect that has generally been unexplored in the literature on Dutch Disease.

However, from our results, these balance of payments effects, which can be seen from our model under a floating exchange rate system (third column of numbers in Table 7.3), are seen to be small. With an increase in the balance of payments constraint, a demand constraint is imposed. In the model, to reduce the deficit the exchange rate further depreciates, imports become more expensive and net exports rise. Output in the traded sectors rises relative to the situation where a less tight balance of payments constraint existed.

Internally, relative to the benchmark, the simultaneous shocks to the economy increases prices and wages in the traded sectors, particularly in the manufacturing sector, bringing about pressure for the reallocation of resources in the domestic economy. With a reduction in the balance of payments deficit, our results indicate relative wage and price increases in the non-oil traded manufacturing and agricultural sectors.

Turning to the model under a fixed exchange rate system, the results from Tables 7.4 indicate that the effects of our policy shocks on the economy in general and on the manufacturing sector in particular are similar to those obtained for the model under a floating exchange rate system, the key difference arising from relative price changes in the traded sectors which are small and the balance of payments actually created which is comparatively large, given that a constraint does not exist. In this world price model, the price effect is not detected because both the exchange rate and the world price of traded goods are fixed as the results in Table 7.4 indicate. With the balance of payments endogenous, our results indicate that significant deficits on the current account emerges in this exogenous exchange rate version of the world price model. Although the deficits may ultimately not be sustainable, our results show that this phenomenon is not unexpected because with a fixed exchange rate, which is set by the government, the balance of payments simply emerges. Thus, the main observation for the model under a fixed exchange rate system is that the decline in oil production and government investments in the oil sector increases production in the traded sectors with no exchange rate effects and contracts production in the non-traded goods sectors.

The scenarios just described for our models can be contrasted with a hypothetical scenario in which the country reverses to the pre-oil shock economy that is represented by the long-run benchmark values in Tables 7.3 and 7.4. Following a Forsyth and Kay (1980) line of argument, Nigeria once again attains self sufficiency in oil production. The resultant high revenues from oil exports partially insulates the country from the full effects that would have been required for adjustments on an extensive scale. With domestic absorption and structural adjustment inextricably linked, the right investment decisions, whether domestic or overseas, become crucial (Forsyth and Kay). In Nigeria where there are weak co-ordinated structural networks, any attempt at raising domestic absorption levels in line with rising oil revenues would inevitably create additional adjustment problems (Odifa, 1988).

In concluding, some important observations are made about the manufacturing sector and the balance of payments with respect to exogenous changes to oil production. For the manufacturing sector, our results strongly indicate that if the theoretical explanation of the deindustrialization process is accepted on its face value which is that the rise in the exchange rate value of the Naira (an appreciation) consequent upon the rise in oil revenues increases domestic absorption of agricultural and manufactured imports and thus contracts domestic agricultural and manufacturing production (the Dutch Disease), then clearly the reverse must be the case if oil revenues decline. Our simulations have attempted to show this. That is, a fall in oil production and consequent rise in the exchange rate (a depreciation) will result in domestic absorption of agricultural and manufactured imports becoming more expensive which will shift consumption towards domestic goods thus expanding production and output in these traded sectors. Our results showed that this was indeed the case although the mechanisms were not in ways typified by the core models of Dutch Disease. For the manufacturing sector in particular, there is little dispute that the sector grew relatively fast in Nigeria in the face of rising oil revenues given that the sector was effectively highly protected which rendered it semi-non tradeable. If the manufacturing sector is to expand further, it is more likely through the potential crowding in effect of reductions in government investment expenditures in other sectors, like oil, which impacts directly on the capital stock and manufacturing output.

The Nigerian government's control of the income generated from oil allows it to decide whether the additional resources are to be consumed or invested, and in the latter case the form, nature and extent of the investments. When viewed against the background of the rest of the chapter which has examined the manufacturing sector and industrial policy developments in Nigeria, the role of the government becomes particularly crucial. The manufacturing sector may have more direct forward and backward linkages to the rest of the economy than the oil or other sectors. In Nigeria, where the oil sector employs factors specific to it, it may well be that the manufacturing sector on the other hand generates more direct positive externalities on other sectors such as the agricultural and services sectors. Because these other sectors are labour intensive and tend to be characterised by diminishing returns and surplus labour, a healthy and growing manufacturing sector is linked to productivity growth in these sectors because manufacturing expansion draws labour resources and raises the average product in these sectors whilst raising its own stock of capital (Thirlwall and Gibson, 1992). Industrial expansion therefore generates resources and does not diminish the output of other sectors, in a way that these other sectors by their very nature, would find hard to emulate (Thirlwall and Gibson, 1992). Therefore, for these potential linkages to be fully exploited in Nigeria the crowding out effects of government investment expenditure, which our results have shown to be detrimental to the traded sectors, must be taken into consideration.

With regard to the balance of payments and oil production, for much of the 1970s and 1980s, the structure of the Nigerian economy was such that it combined self sufficiency in oil production, a high exchange rate and occasional balance of payments deficits. However, balance of payments deficits need not arise necessarily from direct oil related developments. Balance of payments deficits may arise from supply and non price factors, an issue that is considered in detail in the next chapter. Here we argue that balance of payments deficits may also persist because of expectations. As Forsyth and Kay (1980) point out, if the expectation now is that a country would increase oil production in future which will cause the exchange rate to rise (appreciate), then people would buy their domestic currency now in anticipation of exchange rate gains. So even if in the extreme there was no oil production now the foreign exchange market and the exchange rate would incorporate this *oil premium*. The result would be a balance of payments deficit at current levels of oil production. Our model does not incorporate expectations in this sense because, although there is the suspicion that speculation on the Naira and illegal profiteering through unauthorised access to official sources of foreign currency have occurred in the past in Nigeria, (Balabkins, 1988), there is not enough empirical evidence to warrant its inclusion.

What has clearly emerged from the results in this section is the reverse of a situation where the discovery of substantial quantities of oil contracts the traded sectors while concurrently expanding the non-traded sectors. Our models have mimicked a situation where Nigeria might have been without oil. With no oil, in order to earn the foreign exchange to pay for oil imports to facilitate its industrial and agriculture objectives, Nigeria would have had to export more leading to pressures for readjustment within the economy. In effect, the country would have to reallocate and divert resources to the non-oil traded sectors, increasing output and net exports in these sectors. Our results show that this was indeed the case in the agricultural and manufacturing sectors which employed more resources for use in production, and increased output and net exports consequent upon the large fall in oil production.

To the extent that oil production in Nigeria is highly capital intensive and predominantly financed by foreign firms, the impact of this sector on the performance of other sectors arises through income or financial resource distribution rather than directly through the movement of domestic resources or factors of production from other sectors to the oil sector. On the demand side, the income effect is very strong. On the supply side, the crowding out effect of government spending is very strong. As such, our results indicate the presence of a strong income or demand effect and a resource constraint effect while the resource movement effect is not evident. The transmission of the effects of oil related shocks on the Nigerian economy under both the fixed and flexible exchange rate regimes is thus seen to be via the income and crowding out effect.

7.4 An Indexation Methodology and the Examination of Dutch Disease Effects

A quick alternative to measuring the extent of the Dutch Disease and assessing the impact of oil production on the Nigerian economy, and in particular the manufacturing sector, over time, is through the application of an indexation methodology based on Chenery and Syrquin (1975), Syrquin (1988) and Gelb (1988). By constructing an index along the lines suggested by Gelb, the shortfall in the share of tradeables in the non-oil economy relative to normal levels as defined by Chenery and Syrquin (1975) and Syrquin (1988) can be measured. Changes in the index indicate the direction in which the share of tradeables is evolving relative to a normal pattern.

To analyse sectoral Dutch Disease effects effectively, Gelb divides the economy into five sectors; the booming sector, agriculture, manufacturing, non-traded industrials (represented only by the construction sub-sector) and the services sector. Using this methodology, the objective of Gelb is to isolate those changes primarily due to the Dutch Disease from the changes in the "standard norm" owing to increased real per capita income which is represented by non-boom output per capita.[11] Gelb's constructed Dutch Disease index for a number of developing oil exporting countries including Nigeria showed the presence of the Dutch Disease, that is, it showed the contraction of the traded sectors and a shift towards the non-traded sectors. The

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[11] Dutch Disease models that involve sectoral shares either for the purpose of constructing indexes or for use in econometric estimations that contain share equations typically exclude the booming sector from the analyses. Some examples are those by Sakr (1996) who used the Gelb methodology to construct a Dutch Disease index for Egypt, and Nyatepee-Coo (1994) and Fardmanesh (1991b) both of whom carry out econometric estimations with some form of share equations or variables. The reason for this is that the share of a growing tradeable sector will fall if the booming sector and GDP are growing at a faster rate.

weakness of Gelb's 1988 study is that it constructed a general Dutch Disease index for the traded sector as a whole so that it failed to capture trends in individual traded agricultural and manufacturing sectors and therefore the uniqueness of each sector. Secondly, the methodology itself does not show the mechanisms that result in Dutch Disease effects. On the other hand, a great merit of the indexation methodology is that it provides snap shots of the presence of the Dutch Disease which can conveniently be traced over time.

This study easily resolves the two weaknesses mentioned above. Firstly, a disaggregated Dutch Disease index is constructed and reported for both the manufacturing and agricultural sectors. Secondly, the objective of this sub-section is not really to use the index to show Dutch Disease mechanisms *per se* but to use the disaggregated indices to trace sectoral developments over time against the background of the empirical analyses and results of earlier chapters which have dealt extensively with the mechanisms in precise ways.

The equations below were used by Syrquin (1988) and Chenery and Syrquin (1975) as the basic regressions for measuring a number of cross-country characteristics[12] and processes:

$$X_1 = \alpha_1 + \beta_1 \ln Y$$

$$X_2 = \alpha_2 + \beta_1 \ln Y + \beta_2 (\ln Y)^2 + \gamma_1 \ln N + \gamma_2 (\ln N)^2 + \sum \delta_j T_j$$

where X_1 and X_2 = the dependent variable which is defined in general as a country-specific characteristic individually measured as a % of GDP[13]

Y = per capita income

N = population in millions

T_i = time period ($j = 1, 2, 3, 4$), that is, 4 five year periods are used as dummy variables in measuring T which correspond to 1950 - 54,

[12] The samples used in both Syrquin (1988) and Chenery and Syrquin (1975) consisted of a large number of developing and developed countries.

[13] Several cross country characteristics were used such as sectoral shares, investment, expenditure, government revenue, exports and imports as a % of GDP, as well as demographic and distributional variables amongst others.

1955 - 59, 1960 - 64 and 1965 - 69.

The production pattern is then summarised by the index of production (PO) below:

$$PO = P - \hat{P} = (V_P - V_M) - (\hat{V}_P - \hat{V}_M)$$

$\hat{P}$ *is the value predicted for the country's size/income given 7.1/7.2*

P *is the actual bias ;* V *is value added*

A positive value indicates a bias towards primary production or a lag in manufacturing (deindustrialization) while a negative sign suggests manufacturing orientation (industrialisation).

This chapter concludes by quantifying the Dutch Disease for Nigeria by using and expanding on the indexation methodology originally proposed by Gelb (1988) and based on Syrquin (1988) and Chenery and Syrquin (1975). Separate indices for manufacturing and the agricultural sectors are constructed and reported. A general Dutch Disease index along the lines of Gelb is also constructed and reported. The index and incremental index constructed for the manufacturing sector are used to strengthen and support the findings in earlier chapters and the implications for industrial policy are assessed. The indexation methodology "provides a basis for associating identifiable development strategies such as import-substitution or export-based growth with characteristic deviations from the average patterns" (Chenery and Syrquin, 1975). The Dutch Disease index for Nigeria is calculated from the period 1960 to 1995. The standard shares of the traded sectors in non-oil real GDP are calculated for the traded sectors and these are then applied to the actual observed growth of GDP in Nigeria. The Dutch Disease index is defined as:

$$DD = (SAGR_{SS} + SMAN_{SS}) - (SAGR_{AS} + SMAN_{AS})$$

where DD is the Dutch Disease index; SAGR and SMAN are the shares of agriculture and manufacturing respectively in non-oil real GDP; and the subscripts $_{SS}$ and $_{AS}$ indicate the standardised and actual shares respectively.

TABLE 7.5: DUTCH DISEASE INDICES FOR NIGERIA FOR 1960 TO 1995

	INDICES			INCREMENTAL INDICES		
Year	Agriculture	Manufacture	General	Agriculture	Manufacture	General
1960	2.3037	-0.1434	2.1603	2.3037	-0.1434	2.1603
1961	1.9531	-0.1463	1.8068	-0.1522	-0.0201	-0.1636
1962	1.5955	-0.1183	1.4772	-0.1831	0.1914	-0.1824
1963	-1.2384	0.1118	-1.1266	-1.7762	1.9451	-1.7626
1964	-0.9488	0.2786	-0.6702	0.2338	1.4928	0.4051
1965	-0.8751	0.2505	-0.6246	0.0777	-0.1010	0.0680
1966	-1.0734	0.1933	-0.8801	-0.2266	-0.2283	-0.4090
1967	0.3202	-0.5600	-0.2397	1.2983	-3.8966	0.7276
1968	-2.0368	0.1336	-1.9031	-7.3602	1.2387	-6.9389
1969	-2.2619	-0.3160	-2.5778	-0.1105	-3.3645	-0.3545
1970	-0.3816	0.0853	-0.2963	0.8313	1.2700	0.8851
1971	-1.7357	0.4542	-1.2815	-3.5486	4.3226	-3.3257
1972	-2.5180	0.1292	-2.3888	-0.4507	-0.7156	-0.8640
1973	-2.7197	0.0798	-2.6399	-0.0801	-0.3823	-0.1051
1974	1.7527	-0.1127	-1.6400	1.6445	-2.4130	0.3788
1975	3.5334	0.0325	3.5659	1.0160	1.2881	3.1744
1976	4.5672	-0.2542	4.3131	0.2926	-8.8255	0.2095
1977	3.2689	-0.3235	2.9454	-0.2843	-0.2729	-0.3171
1978	-2.4218	0.4551	-1.9667	-1.7409	2.4068	-1.6677
1979	-1.1359	0.1580	-0.9779	0.5310	0.6530	0.5028
1980	0.2950	-0.9370	-0.6419	1.2597	-6.9319	0.3436
1981	2.5843	-1.3063	1.2780	7.7600	-0.3942	2.9908
1982	1.7508	0.1171	1.8679	-0.3225	1.0897	0.4616
1983	1.5225	0.7644	2.2869	-0.1304	5.5259	0.2243
1984	3.8013	0.2193	4.0206	1.4967	-0.7131	0.7581
1985	-1.7107	-0.0552	-1.7660	-1.4500	-1.2518	-1.4392
1986	4.6855	0.4846	-4.2009	3.7389	9.7754	-1.3788
1987	1.7645	0.0332	1.7978	-0.6234	-0.9315	1.4279
1988	1.5062	-0.2800	1.2262	-0.1464	-9.4312	-0.3179
1989	0.3356	0.1744	0.5100	-0.7772	1.6229	-0.5840
1990	0.1817	0.1584	0.3401	-0.4585	0.0918	-0.3331
1991	-0.3744	-0.2952	-0.6695	-3.0600	-2.8633	-2.9684
1992	-0.4902	-0.0013	-0.4915	-0.3093	0.9957	0.2660
1993	-0.4264	0.0096	-0.4167	0.1301	8.5854	0.1520
1994	-1.0291	0.0352	-0.9939	-1.4135	-2.6550	-1.3848
1995	-1.4680	-0.0545	-1.5225	-0.4265	2.5457	-0.5319

The results from Table 7.7 shows in general a negative index for the manufacturing sector which tends to indicate a fairly strong sector relative to the normal level and the general absence of the Dutch Disease. The improvement in the index from about 0.45 in 1971 to about -0.32 in 1977 indicates a gradual industrialization process, with the deterioration in the index in 1978 coinciding with the crisis in the oil market in that year. In general, throughout the 1970s and very early 1980s the index reveals a fairly healthy manufacturing sector, at least from the perspective of the Dutch Disease, with the trend becoming quite pronounced in 1976 and 1980 where the incremental indices peaked at about -8.82 and -6.93 respectively which occurred during the periods of the two oil booms. This trend towards gradual industrialisation seemed to coincide with the country's industrialisation strategy of import substitution through cheap imports allowed by the fixed and high exchange rate value for the Nigerian Naira and import restrictions via quantitative quotas, tariffs and outright bans. However, although negative, the relatively small values indicates that these measures may not have been completely successful.

The positive values between 1982 and 1987 indicates a gradual shrinking of the manufacturing sector and therefore some symptoms of the Dutch Disease. This coincided with the downturn in the economy following the collapse in the oil market and consequent foreign exchange shortages which impeded manufacturing production. However, since 1988 and going into the 1990s the index generally improves with the implementation of more market based policies contained under the structural adjustment programme. In general, it appears that the reverse of the Dutch Disease has been the case for the manufacturing sector, with manufacturing production and general industrial activity reflecting trends in the oil sector.

By contrast, unlike the manufacturing sector, the index for the agricultural sector shows a sustained deterioration from about the early 1970s up to the mid 1980s with a brief recovery in 1978 when the oil market temporarily slumped. This trend suggests that the agricultural sector was probably the least favoured sector during the period of import substitution industrialisation. The decline in the relative size of the agricultural sector, mirrored by the increasing and large positive index, indicates the presence of the Dutch Disease. This deterioration of the agricultural sector or 'deagriculturisation' occurred in spite of efforts by successive governments in support of the sector through improved irrigation, tax reliefs and generous subsidies. The conclusion that can be drawn is that the problems of the sector may have been the result of unstable and unsustained surges in government investments, unfavourable agricultural policies and institutional difficulties linked to farming techniques. In general, the trend in the agricultural index strongly reflects the trend in the overall 'general' index so that for the traded sector as a whole there is evidence of the Dutch Disease and a trend towards a decline brought about by factors which have been investigated throughout this study and will be summed up in the conclusion chapter.

7.5 Conclusion

This chapter has examined the growth and performance of the traded and non-traded sectors in Nigeria. Given Nigeria's diversification objective of relying less on the oil sector and transforming the country to an industrial state, the manufacturing sector in particular was critically analysed and the performance of the sector examined in three ways. Firstly, a descriptive account of the sector was given by assessing Nigeria's industrial policy objectives and developments since 1960. The import substitution policy which was clearly aimed at creating incentives for the production of goods by restricting import competition created a situation where manufacturing production required large and relatively scarce amounts of skilled labour and capital. As a result, although the sector achieved higher than average growth rates between 1960 and 1995, its growth was negatively affected by Nigeria's import substitution strategy of industrialisation.

Next, our Dutch Disease macro model was simulated to examine the long run direct effects of oil related developments on the Nigerian economy particularly the manufacturing sector. The conclusion arrived at was that the influence of the oil sector in Nigeria has been quite significant. A fall in oil production stimulated output in the traded sectors which indicates that the manufacturing sector would have grown even with a smaller oil sector in Nigeria. The results in this chapter confirmed those obtained in Chapter Six which showed no strong evidence of the presence of the classic Dutch Disease effects in the traded sectors; rather Dutch Disease type effects were evident acting through three channels: an income effect, a crowding out/resource constraint effect and to some extent a balance of payments effect.

Finally, a Dutch Disease index constructed for the manufacturing sector confirmed earlier findings which pointed to the growth of the sector though not significantly and the general absence of the Dutch Disease in the sector at least relative to the traded agricultural sector.

Appendix 7.1: <u>Normalisation Solutions for the Dutch Disease World Price Model under Alternative Exchange Rate Systems</u>

```
GENR D1 = DA1/POP ; GENR D2 = DA2/POP ; GENR D3 = DA3/POP ; GENR D4 =
DA4/POP ; GENR D5 = DA5/POP ; GENR NT1 = (PD1/PS1)-1 ; GENR NT2 = (PD2/PS2)-1
; GENR NT3 = (PD3/PS3)-1 ; GENR NT4 = (PD4/PS4)-1 ; GENR NT5 = (PD5/PS5)-1 ; GENR
NT1 = (PD1/PS1)-1 ; GENR NT2 = (PD2/PS2)-1 ; GENR NT3 = (PD3/PS3)-1 ;GENR NT4 =
(PD4/PS4)-1 ; GENR NT5 = (PD5/PS5)-1 ; ? GENR SL1 = SAL1*WPOP ; GENR SL2 =
SAL2*WPOP ; GENR SL3 = SAL3*WPOP ; ? GENR SL4 = SAL4*WPOP ; GENR SL5 =
SAL5*WPOP ;
? SET NT1 = -0.00187 ; SET NT2 = 0.06293 ; SET NT3 = 0.02625 ;
? SET NT4 = 0.00028 ; SET NT5 = -0.00684 ;
? -0.00205 (nt1) ; 0.202253 (nt2) ; 0.00419 (nt3) ;
? SET NFI = -20906 ;
 SET DPTN1 = 0.12 ;
 SET DPTN2 = 0.11 ;
 SET DPTN3 = 0.11 ;
 SET DPTN4 = 0.08 ;
 SET DPTN5 = 0.10 ;
 SET SKCONS = -3.7015 ;
 SET SKRIR = 0.18141 ;
 SET SKLAG = 0.42607 ;
 SET SKGNP = 0.72213 ;
 SET LAMBDA = 0.998612 ;
? IDENTITIES FOR THE MODEL
IDENT PS1ID PS1 = WP1*ER ;
IDENT PS2ID PS2 = WP2*ER ;
IDENT PS3ID PS3 = WP3*ER ;
IDENT PS4ID PS4 = exp((log(D4*POP) - A40 - A42*log(PL4) - A43*log(DK4))/A41) ;
? IDENT PS4ID PS4 = exp(((B40-A40)/A41) - ((A42/A41)*log(PL4))
? - ((A43/A41)*log(DK4)) + ((B42/A41)*log(PD4)) + ((B43/A41)*log(PD2))
? + ((B44/A41)*log(Y)) + ((B41/A41)*log(D4(-1))) + log(POP)/A41) ;
IDENT PS5ID PS5 = exp((log(D5*POP) - A50 - A52*log(PL5) - A53*log(DK5)
- A54*(USS52*log(DK5)) - A55*(USS53*log(DK5)) - A56*(USS54*log(DK5)))/A51) ;
? IDENT PS5ID PS5 = exp(((B50-A50)/A51) - ((A52/A51)*log(PL5))
? - ((A54/A51)*(USS52*log(DK5)))
? - ((A55/A51)*(USS53*log(DK5))) - ((A56/A51)*(USS54*log(DK5)))
? - ((A53/A51)*log(DK5)) + ((B52/A51)*log(PD5)) + ((B53/A51)*log(PD1))
? + ((B54/A51)*log(Y)) + ((B51/A51)*log(D5(-1))) + log(POP)/A51) ;
? IDENT PS5ID PS5 = exp(((B50-A50)/A51)
? - ((A54/A51)*(USS52*log(DK5)))
? - ((A55/A51)*(USS53*log(DK5))) - ((A56/A51)*(USS54*log(DK5)))
? - ((A53/A51)*log(DK5)) + ((B52/A51)*log(PD5)) + ((B53/A51)*log(PD1))
? + ((B54/A51)*log(Y)) + ((B51/A51)*log(D5(-1))) + log(POP)/A51) ;
 IDENT PD1ID PD1 = PS1*(1+(NT1)) ;
 IDENT PD2ID PD2 = PS2*(1+(NT2)) ;
```

```
IDENT PD3ID PD3 = PS3*(1+(NT3)) ;
IDENT PD4ID PD4 = PS4*(1+(NT4)) ;
IDENT PD5ID PD5 = PS5*(1+(NT5)) ;
IDENT WL1ID WL1 = PL1*LAMBDA ;
IDENT WL2ID WL2 = PL2*LAMBDA ;
IDENT WL3ID WL3 = PL3*LAMBDA ;
IDENT WL4ID WL4 = PL4*LAMBDA ;
IDENT WL5ID WL5 = PL5*LAMBDA ;
IDENT PL1ID PL1 = exp((log(DL1/WPOP) - F10 - F11*log(SL1(-1)/WPOP(-1)))/F12) ;
? IDENT PL1ID PL1 = ((F10-E10)/(E18-F12)) - ((E12-E16)/(E18-F12)*S1(-1))
? - ((E13-E17)/(E18-F12)*PS1(-1)) - ((E15-E19)/(E18-F12)*RIR(-1))
? - ((E14-E18)/(E18-F12)*PL1(-1)) - ((E16)/(E18-F12)*S2)
? - ((E17)/(E18-F12)*PS2) - ((E19)/(E18-F12)*RIR)
? + ((F11-(E11+1))/(E18-F12))*SL1(-1) ;
IDENT PL2ID PL2 = exp((log(DL2/WPOP) - F20 - F21*log(SL2(-1)/WPOP(-1)))/F22) ;
? IDENT PL2ID PL2 = exp(((F20-E20)/(E28-F22)) - ((E22-E26)/(E28-F22)*log(S2(-1)))
? - ((E23-E27)/(E28-F22)*log(PS2(-1))) - ((E25-E29)/(E28-F22)*log(RIR(-1)))
? - ((E24-E28)/(E28-F22)*log(PL2(-1))) - ((E26)/(E28-F22)*log(S2))
? - ((E27)/(E28-F22)*log(PS2)) - ((E29)/(E28-F22)*log(RIR))
? + ((F21-(E21+1))/(E28-F22))*log(SL2(-1))) ;
IDENT PL3ID PL3 = exp((log(DL3/WPOP) - F30 - F31*log(SL3(-1)/WPOP(-1)))/F32) ;
? IDENT PL3ID PL3 = ((F30-E30)/(E35-F32)) - ((E32-E34)/(E35-F32)*S3(-1))
? - ((E34-E36)/(E35-F32)*RIR(-1)) - ((E33-E35)/(E35-F32)*PL3(-1))
? - ((E36)/(E35-F32)*S3) - ((E36)/(E35-F32)*RIR)
? + ((F31-(E31+1))/(E35-F32))*SL3(-1) ;
IDENT PL4ID PL4 = exp((log(DL4/WPOP) - F40 - F41*log(SL4(-1)/WPOP(-1))
- F43*log(PL1))/F42) ;
? IDENT PL4ID PL4 = ((F40-E40)/(E48-F42)) - ((E42-E46)/(E48-F42)*S4(-1))
? - ((E43-E47)/(E48-F42)*PS4(-1)) - ((E45)/(E48-F42)*RIR(-1))
? - ((E44-E48)/(E48-F42)*PL4(-1)) - ((E46)/(E48-F42)*S4)
? - ((E47)/(E48-F42)*PS4) + PL1 + ((F41-(E41+1))/(E48-F42))*SL4(-1) ;
IDENT PL5ID PL5 = exp((log(DL5/WPOP) - F50 - F51*log(SL5(-1)/WPOP(-1))
- F53*log(PL1) - F54*log(PL4))/F52) ;
? IDENT PL5ID PL5 = ((F50-E50)/(E511-F52)) - ((E22-E26)/(E511-F52)*S5(-1))
? - ((E23-E27)/(E511-F52)*PS5(-1)) - ((E25-E29)/(E511-F52)*RIR(-1))
? - ((E24-E28)/(E511-F52)*PL5(-1)) - ((E56)/(E511-F52))*(USS52*S5)
? - ((E57)/(E511-F52))*(USS53*S5) - ((E58)/(E511-F52))*(USS54*S5)
? - ((E59)/(E511-F52)*S5) - ((E510)/(E511-F52)*PS5)
? - ((E511)/(E511-F52)*RIR) + PL1 + PL4 + ((F51-(E51+1))/(E511-F52))*SL5(-1) ;
IDENT YID Y = (S1+S2+S3+S4+S5+S6+NFI)/POP ;
IDENT RIRID RIR = (exp(-SKCONS)*SK*(SK(-1)**(-SKLAG))*(Y**(-SKGNP)))
**(1/SKRIR) ;
IDENT SKID SK = (((DK1-DK1(-1)) + (DPTN1*DK1)) + ((DK2-DK2(-1)) + (DPTN2*DK2))
+ ((DK3-DK3(-1)) + (DPTN3*DK3)) + ((DK4-DK4(-1)) + (DPTN4*DK4))
+ ((DK5-DK5(-1)) + (DPTN5*DK5))) ;
IDENT NX1ID NX1 = S1 - (D1*POP) ;
? nx1 = ex1 - im1 ;
```

```
IDENT NX2ID NX2 = S2 - (D2*POP) ;
? nx2 = ex2 - im2 ;
IDENT NX3ID NX3 = S3 - (D3*POP) ;
? nx3 = ex3 - im3 ;
? IDENT ERID ER = BOP/((S1*WP1)+(S2*WP2)+(S3*WP3))-(((D1*POP)*WP1) +
? ((D2*POP)*WP2) + ((D3*POP)*WP3)) ;
IDENT BOPID BOP = ((S1-(D1*POP))*ER) + ((S2-(D2*POP))*ER)
+ ((S3-(D3*POP))*ER) ;
? EQUATIONS FOR THE MODEL
FRML S1EQ S1 = exp(A10 + A11*log(PS1) + A12*log(PL1) + A13*log(DK1)) ;
FRML S2EQ S2 = exp(A20 + A21*log(PS2) + A22*log(PL2) + A23*log(DK2)) ;
FRML S4EQ S4 = exp(A40 + A41*log(PS4) + A42*log(PL4) + A43*log(DK4)) ;
FRML S5EQ S5 = exp(A50 + A51*log(PS5) + A52*log(PL5) + A53*log(DK5)
+ A54*(USS51*log(DK5)) + A55*(USS52*log(DK5)) + A56*(USS53*log(DK5))) ;
?
FRML D1EQ D1 = exp(B10 + B11*log(D1(-1)) + B12*log(PD1) + B13*log(PD2)
+ B14*log(PD4) + B15*log(Y)) ;
FRML D2EQ D2 = exp(B20 + B21*log(D2(-1)) + B22*log(PD2) + B23*log(PD4)
+ B24*log(PD5) + B25*log(Y)) ;
FRML D3EQ D3 = exp(B30 + B31*log(D3(-1)) + B32*log(PD3) + B33*log(Y)) ;
FRML D4EQ D4 = exp(B40 + B41*log(D4(-1)) + B42*log(PD4) + B43*log(PD2)
+ B44*log(Y)) ;
FRML D5EQ D5 = exp(B50 + B51*log(D5(-1)) + B52*log(PD5) + B53*log(PD1)
+ B54*log(Y)) ;
?
FRML DK1EQ DK1 = exp(C10 + (C11+1)*log(DK1(-1)) + (C12-C17)*log(S1(-1))
+ (C13-C18)*log(PS1(-1)) + (C14-C19)*log(PL1(-1)) + (C15-C110)*log(GEX2(-1))
+ C16*log(RIR(-1)) + C17*log(S1) + C18*log(PS1) + C19*log(PL1)
+ C110*log(GEX2)) ;
FRML DK2EQ DK2 = exp(C20 + (C21+1)*log(DK2(-1)) + (C22-C27)*log(S2(-1))
+ (C23-C28)*log(PS2(-1)) + (C24-C29)*log(PL2(-1)) + (C25-C210)*log(GEX2(-1))
+ (C26-C211)*log(RIR(-1)) + C27*log(S2) + C28*log(PS2) + C29*log(PL2)
+ C210*log(GEX2) + C211*log(RIR)) ;
FRML DK3EQ DK3 = exp(C30 + (C31+1)*log(DK3(-1)) + (C32-C35)*log(S3(-1))
+ (C33-C36)*log(PL3(-1)) + (C34-C37)*log(RIR(-1)) + C35*log(S3)
+ C36*log(PL3) + C37*log(RIR)) ;
FRML DK4EQ DK4 = exp(C40 + (C41+1)*log(DK4(-1)) + (C42-C47)*log(S4(-1))
+ (C43-C48)*log(PS4(-1)) + (C44-C49)*log(PL4(-1)) + (C45-C410)*log(GEX2(-1))
+ C46*log(RIR(-1)) + C47*log(S4) + C48*log(PS4) + C49*log(PL4)
+ C410*log(GEX2)) ;
FRML DK5EQ DK5 = exp(C50 + (C51+1)*log(DK5(-1)) + (C52-C510)*log(S5(-1))
+ (C53-C511)*log(PS5(-1)) + (C54-C512)*log(PL5(-1))
+ (C55-C513)*log(GEX2(-1)) + (C56-C514)*log(RIR(-1)) + C57*(USS51*log(S5))
+ C58*(USS52*log(S5)) + C59*(USS53*log(S5)) + C510*log(S5) + C511*log(PS5)
+ C512*log(PL5) + C513*log(GEX2) + C514*log(RIR)) ;
?
FRML DL1EQ DL1 = exp(E10 + (E11+1)*log(DL1(-1)) + (E12-E16)*log(S1(-1))
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+ (E13-E17)*log(PS1(-1)) + (E14-E18)*log(PL1(-1)) + (E15-E19)*log(RIR(-1))
+ E16*log(S1) + E17*log(PS1) + E18*log(PL1) + E19*log(RIR)) ;
FRML DL2EQ DL2 = exp(E20 + (E21+1)*log(DL2(-1)) + (E22-E26)*log(S2(-1))
+ (E23-E27)*log(PS2(-1)) + (E24-E28)*log(PL2(-1)) + (E25-E29)*log(RIR(-1))
+ E26*log(S2) + E27*log(PS2) + E28*log(PL2) + E29*log(RIR)) ;
FRML DL3EQ DL3 = exp(E30 + (E31+1)*log(DL3(-1)) + (E32-E35)*log(S3(-1))
+ (E33-E36)*log(PL3(-1)) + (E34-E37)*log(RIR(-1)) + E35*log(S3)
+ E36*log(PL3) + E37*log(RIR)) ;
FRML DL4EQ DL4 = exp(E40 + (E41+1)*log(DL4(-1)) + (E42-E46)*log(S4(-1))
+ (E43-E47)*log(PS4(-1)) + (E44-E48)*log(PL4(-1)) + E45*log(RIR(-1))
+ E46*log(S4) + E47*log(PS4) + E48*log(PL4)) ;
FRML DL5EQ DL5 = exp(E50 + (E51+1)*log(DL5(-1)) + (E52-E59)*log(S5(-1))
+ (E53-E510)*log(PS5(-1)) + (E54-E511)*log(PL5(-1)) + (E55-E512)*log(RIR(-1))
+ E56*(USS51*log(S5)) + E57*(USS52*log(S5)) + E58*(USS53*log(S5))
+ E59*log(S5) + E510*log(PS5) + E511*log(PL5) + E512*log(RIR)) ;
FRML SL1EQ SL1 = exp(F10 + F11*log(SL1(-1)/WPOP(-1)) + F12*log(WL1))*WPOP ;
FRML SL2EQ SL2 = exp(F20 + F21*log(SL2(-1)/WPOP(-1)) + F22*log(WL2))*WPOP ;
FRML SL3EQ SL3 = exp(F30 + F31*log(SL3(-1)/WPOP(-1)) + F32*log(WL3))*WPOP ;
FRML SL4EQ SL4 = exp(F40 + F41*log(SL4(-1)/WPOP(-1)) + F42*log(WL4)
+ F43*log(WL1))*WPOP ;
FRML SL5EQ SL5 = exp(F50 + F51*log(SL5(-1)/WPOP(-1)) + F52*log(WL5)
+ F53*log(WL1) + F54*log(WL4))*WPOP ;
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CHAPTER 8

THE BALANCE OF PAYMENTS AND THE DUTCH DISEASE MACRO MODEL UNDER A REGIME OF FLOATING EXCHANGE RATES

8.1 Introduction

This chapter is primarily concerned with analysing in more detail than previous chapters the effects of the balance of payments on the economy of Nigeria using the Dutch Disease macro model developed in Chapter Five and estimated in Chapter Six. In this chapter, simulations are carried out based on the 2SLS estimates. In this chapter the economy is assumed to operate under a floating exchange rate system with the exchange rate endogenous and the balance of payments an exogenous constraint. Given this assumption of a floating exchange rate system, the chapter starts by first examining in Section 8.2 exchange rate and balance of payments developments, as well as other key related macroeconomic policy developments, in Nigeria over the last thirty five years or so. A detailed chronological list of these developments since 1914 is contained in an appendix to this chapter. More importantly, in this section, various models of exchange rate determination are used to calculate the Nigerian Naira exchange rate. This section is important in that it provides the background as it relates to the exchange rate and the balance of payments for the simulation exercises which are conducted under the assumption of a floating exchange rate system.

In Section 8.3 therefore, simulations exercises are carried out on the world price model using alternative balance of payments constraints. In carrying out these exercises, the crucial assumption implicit in the models is that the exchange rate is endogenous and the balance of payments constraint is exogenous and not necessarily zero. This distinction was explained in previous chapters, although in the last chapter it was also the case that the exchange rate was assumed to be exogenous and the balance of payments endogenous in which case the model operated under a fixed exchange rate system. In this section, the long run effects of imposing alternative balance of payments constraints on sectors in particular and the Nigerian economy in general are examined, while Section 8.4 concludes the chapter.

8.2 *Exchange Rate Developments in Nigeria and the Measurement of the Nigerian Naira Exchange Rate using Alternative Theoretical Models*

It was noted in Chapter Two, that the Second-Tier Foreign Exchange Market (SFEM) was the single most important macroeconomic policy development contained under the Structural Adjustment Programme (SAP) introduced in Nigeria in 1986. The objective of SFEM was to loosen the reins of government in the management and determination of the exchange rate and thus move the economy to a more market based approach.

From various Central Bank of Nigeria accounts, prior to the introduction of SFEM in September 1986, the determination of the fixed Naira exchange rate was influenced by a combination of external and internal factors (see Appendix 8.1 for a detailed chronological account of exchange rate and related macroeconomic policy developments in Nigeria since 1914). Externally, fluctuations of the two main trading currencies namely the US dollar and pound sterling and trends in the currencies of Nigeria's key trading partners played an important role in the exchange rate value of the Naira. Internally, the key determinants were the stock of external reserves outstanding.

For much of the 1970s and early to mid 1980s, the management of the exchange rate value of the Naira was carried out firstly to reflect the government's fundamental economic condition of the country as mirrored by the balance of payments position and secondly to respond to exchange rate developments in the international foreign exchange markets (Central Bank of Nigeria Annual Report, 1985). During this period, the high exchange rate value of the Naira was easily maintained by the government because of the large inflow of foreign reserves made possible by high oil revenues and the strict quantitative and exchange rate controls that were in force. Although it was clear that the substantial overvaluation of the currency made Nigeria internationally uncompetitive, which was reflected in the 1970s through the current account deficits, the government resisted any move towards devaluation of the currency given its strategy of industrialisation fuelled by cheap imports.[1] During the period, the Nigerian government from

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[1] Chapter Seven contained a detailed account of industrialisation and industrial policy developments in Nigeria.

time to time simply carried out "structural devaluations" which were necessary not for reasons of trade but because some of the major trading currencies tied to the overvalued US dollar were included in the import-weighted basket of currencies for the determination of the Naira. For example, between 1976 to 1985 the Naira was structurally devalued against the US dollar by about 6.03% per annum on average.

Consequent upon the deregulation of the foreign exchange market in 1986, the Naira exchange rate has continued to be determined largely by market forces, although considerable differences between the three markets, (namely, the official, the autonomous and the black markets) still persist. The official market, which is largely funded by official foreign exchange receipts (the Central Bank), sells to the banks only through auctioned bids (see Appendix 8.1) while the autonomous sells to the private sector for purchases of any kind.

Since the deregulation of the foreign exchange market, two key indicators are often used to appraise the success of exchange rate deregulation. The first is the extent of devaluation of the Naira. Relative to the average structural and administrative devaluation of the Naira of 6.03% per annum between 1976 and 1985, the devaluation of the currency between 1986 and 1995 has been considerable. The second, and as a direct consequence of devaluation, is a measure of the disparities between the three parallel markets. This naturally raises the question of the equilibrium Naira exchange rate at any point in time and how over/under valuation of the currency can be measured. The exchange rate calculated from various models of exchange rate determination are presented in Tables 8.1 and 8.2.

TABLE 8.1: CALCULATION OF THE EXCHANGE RATE USING THE PPP THEORY

(1)	(2)	(3)	(4)	(5)	(6)	(7)
YEAR	Official Rate US $ per =N=	Nigerian CPI	United- States CPI	PPP Measure	Equilibrium Exchange Rate	Over/Under Valuation (%)
1973	1.52	4.4	34	1.00	1.52	0.00
1974	1.58	5.0	37.8	0.98	1.49	6.59
1976	1.59	8.3	43.6	0.68	1.03	54.37
1977	1.55	9.5	46.4	0.63	0.96	61.40
1978	1.57	11.5	49.9	0.56	0.85	84.53
1979	1.65	12.9	55.6	0.56	0.85	95.31
1980	1.83	14.2	63.1	0.58	0.87	109.18
1981	1.64	17.1	69.6	0.53	0.81	102.47
1983	1.38	22.7	76.2	0.43	0.65	112.31
1984	1.30	31.7	79.5	0.32	0.49	164.33
1985	1.12	34.1	82.4	0.31	0.48	135.36
1986	0.49	36.0	83.9	0.30	0.46	7.95
1987	0.25	40.1	87.0	0.28	0.43	-41.64
1989	0.14	93.1	94.9	0.13	0.20	-32.27
1990	0.12	100	100	0.13	0.20	-36.74
1991	0.10	113	104.2	0.12	0.18	-44.35
1992	0.06	163.4	107.4	0.09	0.14	-57.14
1993	0.04	256.8	110.6	0.06	0.09	-55.55
1994	0.05	403.3	113.4	0.04	0.06	-16.66
1995	0.05	696.9	116.6	0.02	0.03	66.66

Calculations: (i) Column 5 = $\dfrac{\text{Column 4}}{\text{Column 3}} * \dfrac{\text{Column 3 (1973)}}{\text{Column 4 (1973)}}$

(ii) Column 6 = Column 2 (1973) * Column 5

(iii) In Column (7), a positive sign means over valuation; a negative sign means undervaluation.

Data Sources: (i) International Monetary Fund, International Financial Statistics.

(ii) Central Bank of Nigeria Statistical Bulletin, 1995.

In the absence of exchange rate controls, the value of the Nigerian Naira exchange rate can be estimated through the application of the theory of Purchasing Power Parity (PPP) and the parallel black market rate so that market disparities and the extent of over or under valuation of the currency can be formally measured. The PPP theory relates the exchange rate to the relative price levels in two countries (Bienen and Gersovitz, 1981). Taking the United States and the US dollar as the reference country and currency respectively, an increase in the Nigerian price level means that the number of dollars per Naira will fall (a depreciation of the Naira), since the Naira buys fewer goods. Conversely, a relative increase in the price level in the US means that the number of dollars per Naira rises (an appreciation of the Naira). Thus, the PPP measure in Table 8.1 attempts to predict movements in the Naira exchange rate relative to its 1973 level.[2]

From Table 8.1, between 1973 and 1985, the equilibrium exchange rate or the exchange rate predicted by the PPP theory was between 1.52 and 0.48. In other words, PPP theory predicts a decline in the Naira exchange rate. However, during this period, the exchange rate actually appreciated so that by 1985 the Naira exchange rate was overvalued by about 135%. Since 1986, the reverse has been the case where the introduction of the deregulated foreign exchange market has resulted in official Naira exchange rate being much lower than the equilibrium exchange rate and thus being considerably undervalued.

[2] As Bienen and Gersovitz (1981) argue, it is important to understand that the assumption is made that in 1973, the actual equilibrium rate was equal to the actual rate. Furthermore, although it can be argued that the 1973 rate itself may have been overvalued and thus may not reflect the free rate, the extent of overvaluation is difficult to deduce from the PPP theory, and this is a short coming of the theory contained in Bienen and Gersovitz. Even if the 1973 rate was lowered by about 30%, the PPP indicator still predicts that the Naira was overvalued between 1974 and 1986 and undervalued thereafter.

TABLE 8.2: CALCULATION OF BLACK MARKET EXCHANGE RATE PREMIUM

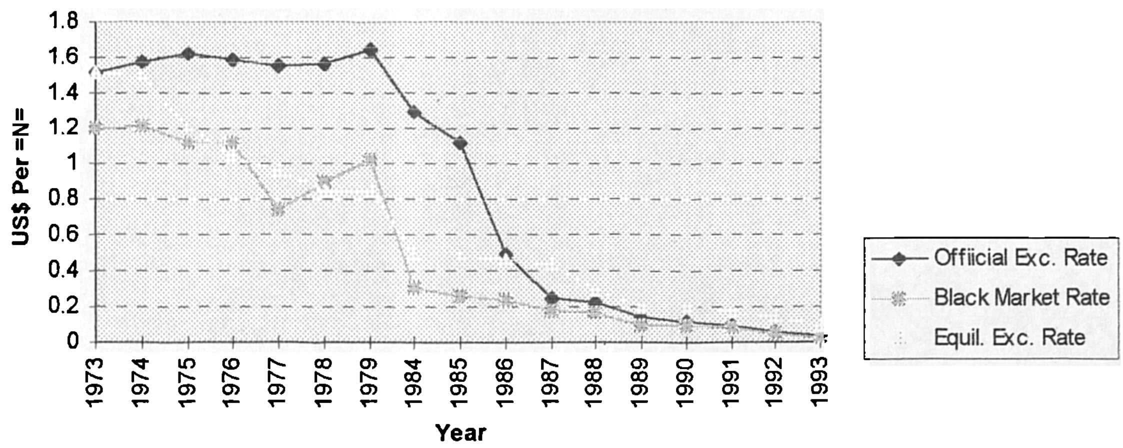
YEAR	Official Rate ($ per Naira)	Black Market Rate ($ per Naira)	Black Market Premium (%)
1973	1.52	1.2	26.65
1974	1.58	1.21	30.97
1975	1.62	1.12	44.94
1976	1.59	1.12	42.40
1977	1.55	0.74	109.51
1978	1.57	0.9	74.98
1979	1.65	1.02	62.32
1980	1.83	na	na
1984	1.30	0.31	320.57
1985	1.12	0.26	330.22
1986	0.49	0.24	106.17
1987	0.25	0.18	38.34
1988	0.22	0.17	29.65
1989	0.14	0.09	50.86
1990	0.12	0.10	24.40
1991	0.10	0.08	26.15
1992	0.06	0.046	30.43
1993	0.04	0.027	48.15

Data Sources: (i) Olisadebe (1991)

(ii) Central Bank of Nigeria Economic and Financial Review, various issues.

Using the parallel black market rate, a similar result is obtained. From Table 8.2, the black market rate declined between 1974 and 1985 so that during this period the difference between the two markets rates widened. From Tables 8.1 and 8.2, both the rate predicted by the PPP theory and the black market rate declined together fairly evenly from 1973 up to 1983, although considerable differences existed in 1984 and 1985, where the black market rate was on average about two and a half times that predicted by the PPP theory.

Figure 8.1: Exchange Rate Indicators for Nigeria: 1973-1993



Sources: (i) Central Bank of Nigeria Statistical Bulletin, 1995

(ii) Central Bank of Nigeria Economic and Financial Review, various issues.

(iii) Olisadebe (1991).

However, since 1986, the black market premium has considerably narrowed and from Figure 8.1 some convergence is clearly noticeable between the official rate, the rate predicted by the PPP theory (the equilibrium exchange rate) and the parallel black market rate, which points to a degree of success of measures under policies of exchange rate deregulation. What is clearly of more importance are the effects on the economy, particularly the traded manufacturing sector, of exchange rate and other liberalisation policies of the government after 1986 and its import substitution strategy of industrialisation through cheap imports prior to 1986, issues that were considered in detail in the last chapter.

8.3 *Analysis of the Effects of the Balance of Payments on the Nigerian Economy using the Dutch Disease Macro Model*

In this section two policy simulations with respect to the balance of payments are carried out as follows;

Case I: A balance of payments constraint of 50% of 1993 long run benchmark value is imposed.

Case II: A balance of payments constraint of 25% of 1993 long run benchmark value is imposed.

These two cases are each simulated separately for the world price model under the assumption of a floating exchange rate. As per the previous chapter, the emphasis is on interpreting the effects on major macroeconomic variables with respect to each policy case and in providing meaningful economic interpretations for the model as a whole. As was pointed out in the previous chapter, it is important to bear in mind that in interpreting the results the relative effectiveness of the policy cases is largely influenced by the initial starting conditions. The plots and values of the long run equilibrium benchmark solutions are the same as those shown in Figure 7.2 and presented in Table 7.3 in the previous chapter which showed that the economy initially maintains a balance of payments deficit on the current account.

The balance of payments constraints in these models are not 'policy' variables in the strict sense of the word and should not be seen in the same sense as exogenous policy variables in typical simulation exercises. Running a balance of payments deficit is simply something that the Nigerian government was able to do because of a resource boom. A resource boom could allow the country to run higher balance of payments deficits which allows it to grow more quickly. Therefore, such a resource boom allows a country to reduce its balance of payments constraints and this represents an additional Dutch Disease effect. With a reduction in the balance of payments constraint, a demand constraint is ultimately removed. However, in our model exercises, by reducing the balance of payments deficit the exchange rate must depreciate to make imports more expensive, thereby imposing a constraint on demand, and exports more attractive and net exports in the traded non-oil sectors should rise. With a depreciation, the domestic Naira equivalent of foreign currency rises and output in the traded sectors rise relative to the situation where a higher balance of payments deficit or a less constraining demand constraint existed.

TABLE 8.3: WORLD PRICE MODEL WITH A FLOATING EXCHANGE RATE

Variable:	Variable Name:	Sector:	Benchmark Values:	WPFLER* (% Change)	WPFLER ** (% Change)
S1	Supply of Output	Agriculture	82839.22	3.18	4.19
S2	Supply of Output	Manufacture	19007.05	4.47	5.56
S3	Supply of Output	Oil	87590.66	0.00	0.00
S4	Supply of Output	Non-Trad Ind	68813.32	0.68	0.89
S5	Supply of Output	Services	9721.99	0.58	0.78
D1	Demand for Output	Agriculture	102800.9	-1.99	-2.36
D2	Demand for Output	Manufacture	67984.55	-2.78	-3.35
D3	Demand for Output	Oil	20867.54	-2.11	-2.59
D4	Demand for Output	Non-Trad Ind	68813.32	0.68	0.89
D5	Demand for Output	Services	9721.99	0.58	0.78
DK1	Demand for Capital	Agriculture	24794.21	2.16	2.59
DK2	Demand for Capital	Manufacture	18934.24	2.74	3.27
DK3	Demand for Capital	Oil	25881.05	-1.12	-1.21
DK4	Demand for Capital	Non-Trad Ind	50446.10	0.49	0.59
DK5	Demand for Capital	Services	9871.99	0.42	0.47
DL1	Demand for Labour	Agriculture	22.80	0.95	1.27
DL2	Demand for Labour	Manufacture	4.96	1.48	1.67
DL3	Demand for Labour	Oil	0.1182	1.06	1.33
DL4	Demand for Labour	Non-Trad Ind	7.76	0.20	0.29
DL5	Demand for Labour	Services	0.9314	0.18	0.25
SK	Supply of Capital	-	16845.72	7.03	7.77
SL1	Supply of Labour	Agriculture	22.80	0.95	1.27
SL2	Supply of Labour	Manufacture	4.96	1.48	1.67
SL3	Supply of Labour	Oil	0.1182	1.06	1.33
SL4	Supply of Labour	Non-Trad Ind	7.76	0.20	0.29
SL5	Supply of Labour	Services	0.9314	0.18	0.25
NX1	Net Exports	Agriculture	-19961.72	21.71	24.76
NX2	Net Exports	Manufacture	-48977.50	3.30	4.28
NX3	Net Exports	Oil	66723.12	0.55	0.71
Y	Real Income	-	326893.8	1.75	1.92
PS1	Supply Price	Agriculture	113.85	15.60	18.92
PS2	Supply Price	Manufacture	114.76	15.60	18.92
PS3	Supply Price	Oil	104.30	15.60	18.92
PS4	Supply Price	Non-Trad Ind	120.94	1.60	1.89
PS5	Supply Price	Services	87.93	1.51	1.79
PL1	Wage - Demand	Agriculture	339.19	0.57	0.70
PL2	Wage - Demand	Manufacture	640.69	0.88	1.13
PL3	Wage - Demand	Oil	3468.03	0.35	0.44
PL4	Wage - Demand	Non-Trad Ind	1060.62	0.13	0.17
PL5	Wage - Demand	Services	1998.93	0.10	0.13
ER	Exchange Rate	-	21.78	15.60	18.92
RIR	Real Interest Rate	-	2.26	41.19	46.09

* World Price Model with a Floating Exchange Rate (Using 1/2 of 1993 Balance of Payments as Constraint)

** World Price Model with a Floating Exchange Rate (Using 1/4 of 1993 Balance of Payments as Constraint)

From Table 8.3, it can be seen that to reduce the deficit, the exchange rate would have to depreciate to make imports more expensive. The increase in the demand constraint or the reduction in the initial balance of payments deficit from its 1993 level results in a fall in demand and imports of traded goods and an increase in output in the traded sectors. Output of traded agricultural and manufacturing sectors rise but not by very large amounts. The tightening of the balance of payments constraint aimed at reducing the deficit has constrained demand and resulted in the country growing less quickly. The mechanism that brings about this change in our world price model with an exogenous balance of payments constraint is that the price of traded goods significantly rises which contracts demand and stimulates the supply of traded output, although this change is not large. Dutch Disease type effects are therefore present through price effects induced by the balance of payments and consequently the exchange rate, although as already noted these effects are small. For example, output of both agricultural and manufacturing rise by less than five percent and income by about two percent when the balance of payments deficit of fifty percent of the 1993 long run benchmark value is imposed and by even smaller amounts when the deficit is lowered further which when compared to the benchmark value are quite small.

The price changes, which are caused by the deprecation of the exchange rate by about 15% which arises because of the need to reduce imports and the balance of payments deficit, increases the Naira equivalent of foreign currency which increases the incentive to supply traded goods and therefore increases non-oil traded output. Our results reveal that output in the traded agriculture and manufacturing sectors increase on average in the world price model by 3%when 50% of the 1993 long run balance of payments deficit is imposed, and by about 4% when the balance of payments deficit is further reduced by 25%, although it is important here to note again that the results are influenced by the initial starting conditions.

However, as a consequence, output of non-oil traded sectors increases and for the non-traded industrials and services sectors, both of which are subjected to domestic supply and demand conditions, output is marginally affected. Thus, for the economy as a whole, the depreciation of the exchange rate increases the competitiveness of the non-oil traded sectors, increases output in these sectors but constrains the overall growth of demand in the economy.

Our results show that sectoral demand in the traded sectors fall consequent upon the rise in demand prices. With less imports because of the lower trade deficit, the pressure is on domestic prices which rise and dampens demand. Specifically, with the balance of payments at 50% of the 1993 long run value, demand in the agricultural and manufacturing sector fall on average by about 2% and 3% respectively, and marginally rises in the non-traded sectors. The slightly more than expected fall in demand for manufactured goods relative to agricultural goods is a reflection of the substitution/cross-price effect in this sector. Although this cross price effect between manufacturing and non-traded industrials is small in absolute terms, it is quite large relative to other sectors, for example the agricultural sector, and demand in the manufacturing sector falls by more than the fall in the other traded sector. The complementarity effect, although small, is observed between manufactured goods and services, and therefore this relatively insignificant price effect is not likely to result in a large increase in the demand for manufactures given the fall in the demand price for services. In the non-oil traded sectors, the increase in sectoral demand prices is large enough, at least relative to the modest increase in income, to reduce demand for traded goods, although this effect is small. In our model, the balance of payments therefore serves to act as a constraint on demand.

In theory therefore, for countries wishing to grow faster, raising the balance of payments equilibrium growth rate through a combination of export incentives and import disincentives may have the potential of expanding demand without producing balance of payments difficulties (Thirlwall and Gibson, 1992). Within limits, demand can subsequently generate its own supply by encouraging investment, rasing productivity growth and reducing under-employment.

From Table 8.3, net exports in the agricultural and manufacturing sectors rise, although by significantly different amounts, and the overall deficit on the current account is maintained at the respective levels of the balance of payments constraints targeted and imposed. It is important to note here that what is specific to a sector need not necessarily be the case for the economy as a whole. In theory, a depreciation causes exports to rise by increasing the domestic price which encourages firms to produce for exports given the increase in the profitability of exports. However, demand effects must be considered and net exports may rise or fall in the economy with individual traded sectors responding in either way. Our results clearly indicate that the traded sectors respond to shocks in different ways, a point that has been emphasised in previous chapters and has been strongly advocated by Lee et al (1992) and Pesaran et al (1993), amongst others.

From the perspective of the Dutch Disease literature (see for example, Corden and Neary, 1982), even though trade is balanced overall, trade in any of the traded sectors need not balance, a feature that was shown quite prominently in the previous chapter.

From the point of view of the use of factors of production by sector, from Tables 8.3, the increase in output of the traded sector means that the demand for capital in both sectors rises. In the capital market, because there is an overall higher level of supply of capital in the economy, savings becomes more attractive and the interest rate rises. Unlike Nigeria, in countries where capital markets are sophisticated and function properly, the importance of the assumption of perfect capital mobility is emphasised. If countries are unable to borrow against the proceeds of future oil sales, then the impact of such sales on the current balance of payments assumes significance (Eastwood and Venables, 1982). In other words, in theory, if a balance of payments constraint exists then the balance of payments is really very significant and from the point of view of the Dutch Disease the impact of the spending effect is likely to be felt more. Correspondingly, in the labour market, the increase in production of the traded sectors means that the demand for labour in these sectors rises and therefore the price of labour rises which causes the supply of labour to rise.

From the perspective of the oil sector in particular, although output is exogenous and politically determined by OPEC[3] and therefore unaffected by the balance of payments constraints imposed, the rise in the real interest rate marginally reduces the demand for capital and marginally increases the demand for labour in the sector. However, because of the substitution effect, the rise in the price of labour consequent upon the rise in the demand for labour decreases the demand for capital in the sector. However, the extent of this substitution effect is very small and capital falls.

These situations just described for our models under a balance of payments constraint can be seen more clearly if contrasted with a theoretical scenario where no balance of payments constraint existed. In the absence of an external constraint, the increase in income, for example, decreases net exports given that imports rise and the country's competitiveness decreases. The current account is in incipient deficit and this is an indication that imports exceed exports, or net

[3] The Organisation of Petroleum Exporting Countries, of which Nigeria is a member.

exports falls. This causes the exchange rate to rise or the domestic currency to depreciate. Given the rise in the exchange rate, imports fall, exports rise and the current account improves such that the overall deficit falls. The result is that the competitiveness of the non-oil traded sectors and the economy as a whole falls, the deficit is eliminated and balance of payments equilibrium is restored.

The key in the scenario just described is that the exchange rate removes balance of payments disequilibrium. In other words, with flexible exchange rates, the exchange rate is the price mechanism that brings about balance of payments equilibrium. Flexible exchange rates are usually seen as a useful mechanism by which the government can be released from the constraints imposed by the balance of payments and a country's growth rate would be that consistent with balance of payments equilibrium on the current account (Thirlwall and Gibson, 1992).

However, in our model where the exchange rate is flexible *but* a policy with respect to the balance of payments constraint is exercised, government intervention will be an important mechanism to bring about balance of payments equilibrium or more appropriately to maintain the balance of payments. The government will be forced to intervene by reducing the demand for imports or raising the interest rates to finance the deficit, both of which are likely to lead to an increase in unemployment or a decrease in the rate of growth (Thirlwall and Gibson, 1992). Clearly in our model, the former option is more appropriate given the point noted earlier that foreign investments and capital flows are largely unresponsive to interest rates in Nigeria so that the capital account is relatively less important than the current account.

Thus, in our models, a 'policy' of imposing a balance of payments constraint on the Nigerian economy expands the traded sectors, and to an extent the non-traded sectors, reduces demand, and has a moderate effect on growth of the economy. Externally, the rise in the exchange rate (depreciation) increases the competitiveness of Nigerian exports and decreases imports so that the balance of payments is maintained at their respective targeted levels. Internally, it increases prices and wages in the traded sectors, mostly in the manufacturing sector, bringing about pressure for the reallocation of resources in the domestic economy.

However, in interpreting these results, two observations must be made with respect to the initial balance of payments position, which on observation is not large in our model. Firstly, the balance of payments is simply an accounting identity. As pointed out by Thirlwall and Gibson (1992), although a balance of payments deficit implies that expenditures exceed income this does not necessarily mean that the deficit is caused by decisions to spend in excess of income. Causation may stem from other exogenous factors which the macroeconomic model does not incorporate like the gradual deterioration in the quality of exports causing output to fall.

Therefore, balance of payments difficulties may originate from the supply side such that short run price adjustments, as our results imply, may not be the appropriate response to deal with these difficulties. Long run price adjustments will be more effective when capital is more responsive to prices and the ability to adjust the stock of capital and ultimately output is considerably increased. The important implication of this is that a devaluation, for example, might not necessarily correct balance of payments difficulties, at least in the short run. The ability of firms in developing countries such as Nigeria to expand output and exports in response to price incentives arising from devaluations, export subsidies or import tariffs may therefore be limited, thereby supporting certain theoretical (for example Goldstein and Khan, 1978; Enders and Herberg, 1983) and empirical (Artus and Sosa, 1978 and Nogues, 1990) accounts. Therefore, devaluation, at least in the short run, is not necessarily an effective policy instrument in improving net exports and ultimately balance of payments difficulties of developing countries such as Nigeria.

Secondly, a balance of payments constraint need not be an overriding consideration for countries wishing to grow quickly. In theory, the ability of a country to finance an ever growing deficit indefinitely may allow it to grow at a rate faster than its balance of payments equilibrium growth rate (Thirlwall and Gibson, 1992). This will depend on the prevailing level of domestic interest rates, which has already been observed as being quite ineffective in Nigeria, in inducing capital inflows. Other factors which are more structural in nature may be more appropriate for improving the performance of the traded sectors, particularly manufacturing, such as the conduciveness of the industrial climate and government expenditure policies which may complement or crowd out traded sectoral investments. These issues were considered in detail in the previous chapter. Alternatively, the improvement of the balance of payments may lie with the ability of the services sector to generate sufficient exports earnings to finance the deficit, although the evidence for Nigeria given in Chapter Five conclusively points to the fact that this is highly unlikely to be the case in the near future.

8.4 *Conclusion*

In this chapter, the properties of our estimated Dutch Disease macro model under a regime of floating exchange rates have been examined with the aid of simulation experiments. To begin our account, an examination of exchange rate and related macroeconomic policy developments in Nigeria was carried out. Various models of exchange rate determination were used to calculate the Nigerian Naira exchange rate. The main conclusion drawn from our calculations was that prior to the introduction of the deregulated foreign exchange market in 1986, the exchange rate was grossly overvalued, although since then, the value of the exchange rate has progressively declined and may be considered to be considerably undervalued.

Following this, dynamic historical simulations, which were designed to capture the effects of the balance of payments on its own on the Nigerian economy under a floating exchange rate system, were carried out. Our results indicated that the effects on the traded sectors were small, and although the growth of demand in these sectors, particularly the manufacturing sector, was somewhat curtailed by a tighter balance of payments constraint, the effect was moderate. Therefore Dutch Disease type effects, though small, were detected acting through the balance of payments which impacted on the exchange rate, sectoral prices of traded sectors and ultimately traded output.

Appendix 8.1: ***Chronology of Exchange Rate Policies and Related National Development Measures in Nigeria: 1914 - 1995***.

Year:	**Date:**	**Exchange Rate Policy and Related National Development Measure:**
1914		After amalgamation, Nigeria brought into Overseas Sterling Area
1947		Nigeria ceased to be a scheduled territory under the United Kingdom Exchange Control Act of 1947. However, still a sterling area.
1960	Oct. 1	Nigeria gains independence. First Civilian government assumes power.
		National and West African Currency Boards notes and coins legal tender. Central Bank on behalf of government floats £=N= 2 million Federation of Nigeria Development loan.
1961	Mar 30	Nigeria joins the International Monetary Fund (IMF) and the International Finance Corporation (IFC).
1962		Exchange Rate Control Act enacted.
1963	Apr 17	Par value of 2.488828 grams of fine gold per Nigerian pound established. £=N=1 to U.S.$ 2.8 established with IMF. Negotiations begin on IMF's Compensatory Financing Facility.
1965		Official Balance of Payments Committee established. Imposition of customs tariffs and ad valorem taxes on a range of imports announced.
1966	Jan.	First military coup; Civilian government ousted.
	Apr 19	Exports of certain foodstuffs prohibited.
	July	Second military coup.
		Customs tariffs on a wide range of imports reduced. Official recognition of the importance of emerging oil sector.
1967	July.	Outbreak of civil war. Trade and general economic activity declines.
1968	March.	'Gold pool' disbanded and a two-tier price system for gold established. Exchange Control Act of 1962 enforced in all its aspects.
		Imports and exports of Nigerian currency and notes prohibited. Sterling and non-sterling countries subject to same regulations and procedures.

1971	Aug 15	Suspension of convertibility of U.S. dollar into gold. Devaluation of U.S. dollar; official price of gold rises.
		World-wide realignment of exchange rates; Important currencies allowed to float within controlled limits vis-a-vis the U.S. dollar.
	Aug 23	Two tier exchange rate market established in Nigeria: (i) For sterling denominated transactions, rate set at £=N= 1 to £1.16, with other currencies other than the US dollar determined by appropriate cross rates. (ii) For dollar denominated transactions, official rate of $US 2.80 applied for government and trade transactions with a floating rate for other transactions.
	Nov 1	Nigerian pound unpegged from sterling. Two-tier abolished.
1972	Jun 23	Sterling area effectively confined to the UK and Republic of Eire.; Nigeria ceases to be a scheduled Territory of the Sterling Area.
1973	Jan 1	The Nigerian Naira (=N=) introduced to replace the Nigerian Pound (£=N=); Exchange rate set at =N= 2.00 to £=N= 1.00.
		Gold Standard abandoned. Naira pegged to the U.S. dollar
1974	April.	Managed float introduced based on the recognition that factors affecting the U.S. dollar were quite different from those affecting the Naira.
	Dec 31	IMF Quota given as SDR (Special Drawing Rights) 135 million.
1975	July.	Third military coup; Third military Head of State assumes power.
1976	Feb 13	Unsuccessful military coup; Fourth military Head of State assumes power.
		Basic Travel Allowance (BTA) per annum remains at =N=1000 and =N= 500 per adult and per child respectively.
1978		Import-weighted basket of exchange rates of seven major trading partners introduced to calculate the Naira exchange rate.
1979	Jan.	Comprehensive Imports Supervision Scheme.
	Feb 23	IMF Supplementary Financing Facility announced.
	Apr 30	Nigeria contributes SDR 220 million to IMF's newly established Supplementary Financing Facility as one of thirteen donor countries.

	Oct 1	First democratically elected civilian government installed.
1980		The Nigerian Naira at its highest value relative to major foreign currencies (=N=0.5464 to $1.00 and =N=1.2647 to £1.00). Remarkable improvement in the balance of payments; Exchange Controls relaxed.
1982	April	Deteriorating balance of payments position; Economic stabilisation measures announced. BTA and Business Travel Allowance (BSTA) per annum reduced to =N=500 for persons above sixteen years and =N=2,500 respectively.
1983	Dec. 30	Civilian government ousted; Fifth military Head of State takes over.
1984	Aug.	BTA reduced to =N=100 per annum; BSTA and foreign exchange for new students on undergraduate courses abroad suspended; Counter trade measures announced.
1985	Aug	Military coup; Sixth military Head of State assumes power.
1986	Sep 26	Economic and Trade liberalisation. Second-tier Foreign Exchange Market (SFEM) introduced.
1987	July	SFEM abolished. Unified Foreign Exchange Market (FEM) established; Weekly biddings changed to fortnightly and Dutch Auction System introduced to stem persistent decline of the Naira exchange rate..
1991		Export Expansion Grant Fund and Duty Drawback Scheme intensified. Export-Import Bank commences operations.
1992	Mar 5	Abolition of Dutch Auction System; Official exchange rate realigned with parallel rate through the establishment of Inter-bank Foreign Exchange Market with Central bank active participant: Naira value falls by 75%. Restriction on capital transfers abolished.
1993		Subsidized funding of pre-SFEM transactions suspended.
		Civilian interim national government established
		Military coup; Seventh Head of State assumes power.
1995		Re-regulation of the Nigerian economy. Interest rates fixed; Naira exchange rate pegged at =N=21 to the U.S. dollar.

Sources: (i) 1914 to 1947: Odifa (1988) (ii) 1960 to 1995: Central Bank of Nigeria Annual Reports, various issues; various national and international media accounts and publications.

CHAPTER 9

SUMMARY AND CONCLUSIONS

9.1 *Summary of Thesis and Main Findings from the Thesis*

This thesis has examined the impact of the oil industry on economic development in Nigeria between 1960 and 1995. The thesis has primarily used the model of the Dutch Disease, popularised by Corden and Neary (1982), as a theoretical basis for testing various hypotheses on the effects of the oil industry and related developments on the Nigerian economy.

The main thrust and focus of the thesis was the examination of the impacts of the oil industry on economic development in Nigeria. A Dutch Disease sectoral macro model was developed and estimated to examine the effects of the exchange rate, the balance of payments, government real expenditures in the oil sector and income distribution effects on sectoral growth and development in Nigeria.

In spite of difficulties at the early stages in obtaining sufficient and consistent data, this thesis has been able to analyse the indirect effects of oil production on economic development through the examination of three main empirical issues. First, the relevance of the model of the Dutch Disease itself to Nigeria was addressed by testing the effects of variables such as the real price of oil and real government expenditure in the oil sector on sector output, and on the demand for both capital and labour. Secondly, the model was used to simulate the effect of a smaller oil sector on the economy, and the manufacturing sector in particular, so that in effect the model was used to indicate whether Nigeria would have been better off without oil than with oil. Thirdly, the model for Nigeria was used to test additional effects such as the effect of the balance of payments constraint on the Nigerian economy under a regime of both floating and fixed exchange rate systems.

To facilitate the discussion the entire thesis was divided into two parts. The first part which comprised Chapters Two to Four provided the bulk of the descriptive accounts of the Nigerian economy, the oil sector and the relevant theoretical and empirical literatures. In the second and empirical part of the thesis which comprised Chapters Five to Eight, a Dutch Disease macroeconomic model was developed, estimated, and subsequently used to examine the effects of various macroeconomic policy shocks on individual sectors and the economy in general. A summary of the chapters is provided below.

Following the introductory chapter, a three-period framework was used to provide a descriptive account of the Nigerian economy from 1960 to 1995 in Chapter Two. In spite of political upheavals and the disruption of the civil war, the period 1960 - 72 was characterised by a steady growth rate and low inflation, a relatively healthy balance of payments, emerging industrials sectors, and relatively low public sector involvement. Following the boom in the oil sector, public sector involvement rose dramatically and inflation steadily climbed as wage demands, particularly in the public sector, rose. Several ambitious projects were embarked upon which had to be curtailed following the crash in the oil market. After several ad hoc policy measures were unsuccessfully introduced to deal with the ensuing crises at various times, a radical structural adjustment programme was introduced in 1986 designed to make the economy more market-oriented and more export-oriented. However, severe political instabilities and conflicting macroeconomic policy undermined the programme.

In Chapter Three, a sector-specific account of the oil industry in Nigeria was given. The domestic operational aspects of the industry and Nigeria's international obligations as a member of the OPEC were examined. The main conclusions drawn were that from an international perspective, the influence of OPEC in the 1990s had considerably declined while domestically, in spite of the active involvement of the Nigerian government in the oil industry, effective technological and operational control was still largely dominated by foreign multinational oil companies such that the sector used little domestic resources relative to other sectors. Finally, the direct physical and environmental effects were examined and where shown to be significantly large relative to other oil exporting developing countries.

In Chapter Four, a review of the theory and empirical literature of Dutch Disease and related macroeconomic multi sectoral models was carried out. The review of the early theoretical and empirical models of the Dutch Disease suggested that the exchange rate will rise as a result of a natural resource boom which enhances the country's foreign exchange earnings, while the competitiveness of the exposed non-oil tradeable sectors will decline as a result of the appreciation of the exchange rate. The chapter ended by concluding that any proposed Dutch Disease macro model for Nigeria will inevitably need to draw on the wider literature on macroeconomic sectoral models partly because most of the studies of Dutch Disease models reviewed were inadequate and partly because of the importance of the sectoral macro models themselves.

In Chapter Five, a dynamic multi sectoral Dutch Disease model that was considered capable of econometric estimation was developed for Nigeria. In this chapter, an economic interpretation of the model as a whole was first given after which detailed econometric specifications for all the equations were presented and discussed. In so doing, the notion of theoretical encompassing was addressed because our Dutch Disease model required the incorporation of certain modified features of standard neoclassical and to an extent accelerator type models of factor demand. In particular, a crucial modification of the theories was in explicitly recognising the role of the government as a major determinant of capital demand. Three variants of the Dutch Disease model were considered, a model with world prices and models in which the exchange rate and the balance of payments were treated interchangeably as exogenous and endogenous variables. The chapter then went on discuss several important econometric issues vital towards building a robust Dutch Disease model for Nigeria such as identification, the validity of instruments used, the various instrumental variable estimation procedures employed and the formal methodology for the evaluation of the results of the estimated model. Finally, a brief account of the problems of the data employed in this study was discussed and the rationale for using a five-sector Dutch Disease model given.

In Chapter Six, the dynamic multi-sectoral Dutch Disease macro model for Nigeria was estimated. The model performed satisfactorily well in terms of *a priori* expectations of the magnitude and direction of the estimated elasticities, the statistical significance of the coefficients, the standard regression diagnostics and the formal test procedures employed. Whilst pointing to a strong income effect, our results revealed the absence of the classic Dutch Disease 'resource movement effect'; rather a 'resource constraint effect,' attributable to the use of limited public resources by competing sectors, was detected. The examination of specific parameter estimates were used in confirming the results.

Firstly, the moderate to large income elasticities suggested a strong income effect. Secondly, the price effects for the supply equations was small for virtually all the sectors. The low domestic supply price elasticities thus suggested only a weak resource movement effect. Thirdly, the inclusion of the oil price variable in the output supply equations revealed small and statistically insignificant coefficients. Furthermore, the price of oil variable was not particularly significant in the capital and labour demand equations. These results and the implausible underlying assumptions implicit in theoretical models of Dutch Disease which emphasise efficient markets and full employment of factors of production strongly suggested that there was little scope for a resource movement effect in Nigeria. Rather, factors responded more to own price effects which may or may not be linked to oil related developments *per se*. Finally, a resource constraint variable defined as the government's investment in the oil sector revealed large and quite significant effects. The explanation given was that in terms of the factor markets, the oil sector operates as an 'enclave' using factors that are specific to it which are mostly supplied from abroad and so does not necessarily draw resources out of other sectors when its output and the demand for factors increases.

In Chapters Seven and Eight the estimated Dutch Disease model was used to examine the effects of sector-specific and aggregate level activity arising from oil related shocks, the balance of payments constraints and government investment expenditures, under a regime of both fixed and flexible exchange rate systems. In Chapter Seven, the growth and performance of the traded manufacturing sector in particular was examined based on the simulated Dutch Disease macro model and on an indexation methodology. A descriptive account of Nigeria's industrial policy objectives and developments since 1960 revealed that the import substitution policy had negatively affected Nigeria's industrialisation objectives. Both the simulated Dutch Disease macro model and the constructed index clearly indicated that the influence of the oil industry on the manufacturing sector in Nigeria had been moderate.

Finally, in Chapter Eight, the results of our simulated models indicated that the effects of the balance of payments constraint on the traded sectors were small to moderate and that a tighter balance of payments constraint was likely to curtail growth to an extent. Thus, in this chapter, a resource boom was seen to allow a country to run balance of payments deficits and this represented an additional Dutch Disease effect which is generally unexplored in the Dutch Disease literature. In this chapter, various models of exchange rate determination were used to calculate the value of the Nigerian Naira exchange rate and our calculations suggested that the currency may be presently undervalued as it may have been overvalued before the introduction of the liberalised foreign exchange market.

9.2 *Conclusions and Policy Recommendations*

On balance, it cannot be said that oil has completely been a curse or a blessing to Nigeria. The agricultural sector clearly weakened as a result of oil. The growth of import-dependent manufacturing sector was modest, at least when viewed in terms of its relatively small share of both oil and non-oil GDP, a development that largely arose from Nigeria's import substitution strategy of industrialisation which did not fully materialise. The sluggish in-flow of private foreign and domestic investments into the manufacturing sector, which was due to the relatively high costs of manufacturing in Nigeria, periodic reversals in government macro-economic industrial policies over the years, and the uncertain political climate exerted high economic and social costs on the country. However, on the positive side, Nigeria did remarkably well in other areas through large scale improvements in its physical infrastructure and the supply of universal education and health services, particularly during the early years of the oil boom, factors which are considered to be critical if the long-run transformation of the weakened agricultural sector (Gelb, 1988) is to materialise.

Clearly enunciated policies which if implemented in good faith are crucial to Nigeria's sustained economic development. Oil income *per se* need not be a curse or blessing to oil exporting countries if only the authorities adopt necessary policy responses to it (Pesaran, 1984). The government's macroeconomic stance on policy issues, like the rate at which oil is depleted, an important decision which the country would be faced with if she decides to opt out of OPEC as has recently been suggested, and the path of spending out of oil revenues, clearly have very important consequences for sectoral distribution of output, and on capital and labour demand. The government's macroeconomic policy stance must be consistent with the inevitable adjustment problems of a dominant oil sector and the theoretical link provided, to an extent, by the Dutch Disease. Three key policy recommendations based on our findings are stressed.

Firstly, government must be more prudent with respect to its capital investment expenditure policies, particularly in the oil sector. Although it is clearly the case that increased investments in the oil sector assists in the process of capital accumulation, and possibly technological transfer in the sector, the beneficial effects on the economy as a whole may be low if the backward and forward linkages of the oil sector with the rest of the economy are not properly managed. Sustained and relatively large increases in government investments in the oil sector may therefore not be desirable for the economy as a whole in the long term.

Secondly, there is the need for clearly enunciated policy linkages *across* and *within* the industrial sub-sectors. The appropriateness of a sound industrial policy in Nigeria is as important as policies such as currency devaluation to stimulate and promote the industrial sector and thus place the country on a firmer long term growth path. By its very nature, the manufacturing sector is likely to have more direct linkages with the rest of the economy and may exert more positive effects than the oil sector which is more highly specialised and uses far less domestic resources.

Thirdly, with respect to the traded sectors as a whole, the general observation is that much more needs to be done to boost agricultural sub-sectors and the manufacturing sector. This can be achieved through a combined strategy of export promotion and import substitution which is less supportive of capital and import intensive industries, and more supportive of labour intensive industries where Nigeria clearly has natural comparative advantages. Furthermore, some degree of government intervention, especially in the development and provision of basic physical infrastructure, will be required.

To date, Nigeria's efforts to diversify the economy have remained largely unfulfilled and in real per capita terms, consumption and income appear no higher in the 1990s than they were in the early 1970s. It should also be noted that only a small fraction of the population have directly benefitted from employment in the oil sector and related industries. Nigeria's liberalisation programme has neither significantly revitalised the non-oil traded sector's output and exports nor, indeed, reduced the dependence of the economy on the resources generated from the oil industry. On the contrary, the liberalisation of the economy has exacerbated social and political tensions, dramatically increased inflation, resulted in balance of payments difficulties and stalled the import substitution industrial strategy of Nigeria.

In the medium term, Nigeria's oil revenues may be seriously negatively affected given the uncertainties in the international oil market, OPEC's rapidly diminishing share of the world oil market and, in general, the substitution away from oil as alternative and cleaner energy sources are increasingly developed. As at the time of writing, oil prices had dropped to its lowest level in history selling for about $10 per barrel. This should serve as a clear indication that in future the country must adopt a more conservative approach to development planning based on oil price projections, but more importantly, on projections from potentially huge alternative revenue sources like the LNG. Unlike the euphoric optimism of the early 1970s and 1980s at the height of the oil boom, a more modest and pragmatic approach to development planning and economic management will be required going into the next century. Failure of Nigeria to consistently support other industries and exports when oil runs out may leave the country with an inadequate base for rapid expansion and industrialisation.

The long term survival of the Nigerian economy and the key to sustainable future prosperity will depend to a very large extent on consistent domestic macroeconomic policies, especially with regards to the exchange rate and public investment expenditure programmes in support of the non-oil traded sectors, stable world economic conditions and domestic political stability in a climate which may be summarised as the emergence of good governance.

DATA APPENDIX

(A) Data Sources

1. Output Supply and Demand (see section on Data Calculation below on how demand was derived from supply):
Source: (a) FOS (National Accounts of Nigeria, various issues) (b) UN (National Accounts Statistics Yearbook, various issues).

2. Sectoral Taxes:
Source: (a) FOS (National Accounts of Nigeria, various issues) (b) UN (National Accounts Statistics Yearbook, various issues).

3. Sectoral Subsidies:
Source: (a) FOS (National Accounts of Nigeria, various issues) (b) UN (National Accounts Statistics Yearbook, various issues).

4. Gross Fixed Capital Formation:
Source: (a) FOS (National Accounts of Nigeria, various issues).

5. Sectoral Depreciation:
Source: (a) FOS (National Accounts of Nigeria, various issues).

6. Sectoral Depreciation Rates (%):
Source: (a) FOS (National Accounts of Nigeria, various issues) (b) FOS (supplementary data)

7. Sectoral Type of Capital Asset (used to construct the weighted Capital Stock Deflator. See section on Data Calculation below on how this weighted deflator was calculated):
Source: (a) CBN (Statistical Bulletin, 1995).

8. Unemployment Data:
Source: (a) UN (Yearbook of Labour Statistics, various issues).

9. Labour Quantity Data:

Source: (a) FOS (Economic and Social Statistics Bulletin, various issues).

10. Sectoral Wages:

Source: (a) FOS (National Accounts of Nigeria, various issues) (b) UN (National Accounts Statistics Yearbook, various issues).

11. Sectoral Exports:

Source: (a) CBN (Statistical Bulletin, 1995) (b) World Bank (World Tables, various issues).

12. Sectoral Imports:

Source: (a) CBN (Statistical Bulletin, 1995) (b) World Bank (World Tables, various issues).

13. Nigerian Interest (Lending) Rate:

Source: (a) IMF (International Financial Statistics, 1996)

14. Net Factor Income:

Source: (a) CBN (Statistical Bulletin, 1995)

15. Government Expenditures:

Source: (a) CBN (Statistical Bulletin, 1995) (b) CBN (Economic and Financial Review, various issues) (c) IMF (Government Finance Statistics Yearbook, 1988) (d) Federal Republic of Nigeria, Annual Budget Statement, various issues.

16. Population:

Source: (a) IMF (International Financial Statistics, 1996)

17. Naira Exchange Rate:

Source: (a) CBN (Statistical Bulletin, 1995)

18. Nigerian Consumer Price Index:

Source: (a) IMF (International Financial Statistics, 1996)

19. GDP Deflator

Source: (a) FOS (National Accounts of Nigeria, various issues) (b) UN (National Accounts Statistics Yearbook, various issues).

20. Nigeria's National Revenue:

Source: (a) CBN (Statistical Bulletin, 1995).

21. Foreign Direct Investment:

Source: (a) CBN (Statistical Bulletin, 1995).

22. Nigeria's Total Debt, Debt Service, Interest Payments

Source: (a) World Bank (World Debt Tables)

23. Nigeria's Foreign Reserves:

Source: (a) CBN (Statistical Bulletin, 1995)

24. Nigerian Oil Sector Data:

Source: (a) DPR (Nigerian Oil Industry Annual Statistical Bulletin, 1985, 1992)

(b) OPEC ((i) Annual Statistical Bulletin, various issues; (ii) Annual Reports, various issues)

(c) NDES (Phase One Report, Volume I).

Note - Abbreviations:

CBN	-	Central Bank of Nigeria
FOS	-	Federal Office of Statistics, Nigeria
UN	-	United Nations
IMF	-	International Monetary Fund
NDES	-	Niger Delta Environmental Survey, Nigeria
DPR	-	Department of Petroleum Resources, Ministry of Petroleum Resources

(B) Data Calculations[4]

(1) Calculation of the Quantity and Price Index for the Output Demand Equations[5]*:*

$$D_j \textit{ at constant market price } = \frac{D_j \textit{ at current market price}}{PD_j}$$

where D_j at current market price = S_j at current factor cost + Net Taxes (taxes less subsidies) + Imports - Exports

and

$$PD_j = PS_j\ (1 + \frac{NetTaxes_j}{D_j \textit{ at current market price}})$$

(2) Calculation of the Nominal Capital Stock for the Estimation Period (1973 to 1995)

Estimates of the capital stock are important to assess government's policy of subsidising investment, the build up of the capital stock itself and the efficiency with which the stock is employed (Thomas, 1979). The most common method of estimating the capital stock is the perpetual inventory method (Armstrong, 1979; Hayashi, 1982; Fadahunsi and Igwe, 1990) and this is given by:

$$DK_t = DK_{t-1} + V_t - S_t,$$

where V_t is Gross Fixed Capital Formation (GFCF), S_t is the gross value of assets scrapped (depreciated assets) over the year t and DK is the capital stock. The method therefore requires

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[4] j denotes A: Agriculture; M: Manufacture; O: Oil; N: Non-Traded Industrials and S: Services. For a key to the names of the variables see page 96, Chapter Five.

[5] See Hiliare A (1992) for a similar derivation of quantity and prices of demand.

an initial estimate of the capital stock in some base year, the time series data for GFCF and data for annual scrapping (depreciation). For most countries, the most serious problem in applying this method is the practical difficulty of obtaining adequate and reliable data on GFCF for different classes of assets (Thomas, 1979) both at the sector and the aggregate levels for a sufficiently long period of time, and this is no less the case for Nigeria (Olaloye, 1991).

Indeed, in Nigeria the only official figure published for gross fixed capital formation (GFCF) or investment by sector was for the year 1973 (Fadahunsi and Igwe, 1990). Therefore, it has not been possible to construct a capital index for Nigeria on a sectoral basis in the common way that directly inputs data on investment from published sources into the capital function. Therefore, for the period 1973 - 1995, the capital stock for Nigeria is calculated by using the depreciation data, which is the only available published data on sectoral capital series. The capital stock is therefore calculated from the expression below:

$$DK_J = \frac{\delta(DK_J)}{\delta_j}$$

$$DK_J = \frac{D_J}{\delta_J}$$

where Dj is capital consumption (depreciation) and δ_j is the rate of average depreciation by sector.

(3) <u>Calculation of the Real Capital Stock for the Estimation Period (1973 to 1995)</u>:

The real capital stock index was obtained by deflating the nominal values calculated from (2) above by a weighted sectoral capital stock deflator given as:

$$w_{ij}\ RE + w_{ij}\ GDP + w_{ij}\ TE$$

where RE; GDP and TE are the Real Estate, Gross Domestic Product and Technical Equipment deflators respectively, and w_{ij} is the share of ith's type of capital asset in total stock of capital financed by foreign direct investment in sector j. $\sum w_{ij} = 1$

(4) Calculation of Gross Savings:

$$\sum SK_j = \sum (\Delta DK_j + \delta_j DK_j)$$

(5) Calculation of Capital Stock Index for the Period 1960: 1972:

For the purpose of comparing the capital stock for the estimation period 1973 to 1995 with what the capital stock prior to 1973 may have been, a capital stock index was constructed for the period 1960 to 1972. The capital stock for this period was not calculated in the same way as that for the estimation period because the reporting of depreciation data on a sectoral basis started in Nigeria from 1973. Hence, using the year 1973 as a base, capital stock values for 1960 to 1972 were derived.

$$\sum (\delta_j DK_j^{72} + \Delta DK_j^{72}) = I^{72}$$

where I is investment or Gross Fixed Capital formation (GFCF)

$$\sum (\delta i + \lambda) DK_j^{72} = I^{72}$$

$$\text{as } \lambda DK_j^{72} = \Delta DK_j^{72}$$

$$DK_j^{72} + \Delta DK_j^{72} = DK_j^{73}$$

$$DK_j^{72} (1 + \lambda) = DK_j^{73}$$

$$DK_j^{72} = \frac{DK_j^{73}}{1 + \lambda}$$

$$\sum (\delta i + \lambda) \frac{DK_j^{73}}{1 + \lambda} = I^{72}$$

$$\sum(\delta i + \lambda)\, DK_j^{73} = (1 + \lambda)\, I^{72}$$

$$\sum \delta i\, DK_j^{73} - I^{72} = -\sum \lambda\, DK_j^{73} + \lambda\, I^{72}$$

$$\frac{[\sum \delta i\, DK_j^{73} - I^{72}]}{-\sum DK_j^{73} + I^{72}} = \lambda^{72}$$

$$DK_j^{72} = \frac{DK_j^{73}}{1 + \lambda^{72}}$$

$$DK_j^{71} = \frac{DK_j^{72}}{(1 + \lambda^{72})(1 + \lambda^{71})} \sim DK_j^{60} = \frac{DK_j^{73}}{(1+\lambda^{72})(1+\lambda^{71})\ldots\ldots.(1+\lambda^{60})}$$

It should be stressed that these derived capital stock values for 1960 to 1972 were used only for historical comparisons with those for the estimation period 1973 to 1995, and were not used for estimations or as part of any empirical exercises in this study.

(6) Calculation of Nominal and Real Wage:

$$PL = \frac{Compensation\ of\ Employees_j}{Employment\ of\ Labour\ j}$$

$$Real\ PL = \frac{PL}{GDP\ Deflator\ at\ factor\ cost}$$

(7) Calculation of theReal Interest Rate:

$$RIR - Interest\ (Lending)\ Rate - Inflation\ rate$$

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