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**MODELLING THE MACROECONOMIC CONSEQUENCES
OF OIL SHOCKS FOR THE INDONESIAN ECONOMY
1973 - 1991**

A thesis submitted in fulfilment of requirements
for the award of degree of
Doctor of Philosophy

from



Department of Economics
THE UNIVERSITY OF WOLLONGONG

by

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AUTHOR'S CERTIFICATION

I certify that the substance of this thesis has not already been submitted for any degree and is not being currently submitted for any other degree.

I certify that any help received in preparing this thesis, and all sources used have been acknowledged in this thesis.

Atifah Thaha

ABSTRACT

This thesis is concerned with developing a dynamic long run macroeconomic model of Indonesia, focussing upon the contribution of oil developments upon that economy's income, investment, wealth, balance of payments, and trade performance. The model incorporates the main characteristics of the oil sector in the Indonesian economy, emphasising the crucial role of government in the distribution of oil production for domestic usage and for export, and the spending of oil generated revenue upon consumption (*routine*) and investment (*development*) (equivalent to a capital transfer to the private sector) expenditure. While focus is placed upon oil developments, the model is sufficiently general for analysing the economic effects arising from non oil shocks and that arising from a wide range of policy options.

A numerical simulation procedure is adopted to identify how the domestic economy is affected by oil related shocks, and how such outcomes can be altered through the adoption of alternative policy responses. The roles of alternative nominal exchange rate policies, combined with different degrees of control over international capital mobility, are also incorporated, in order to capture the impact of such policies upon the domestic economy. This is particularly prevalent in the context of an economy such as Indonesia's, which is engaging in extensive economic liberalisation.

The study indicates that the influence of the oil sector on the Indonesian macroeconomy has been significant over the long run, and that this has been more so from oil price shocks in comparison to that of oil production shocks. A dynamic and long run analysis is adopted in order to identify the most appropriate policy responses in order to moderate the possible Dutch disease effects, and to enhance the benefits arising from such oil shocks.

The major results of this study suggest that adopting a more development-oriented policy (investment) towards additional oil revenue, would moderate the Dutch disease consequences, improve the longer term economic development of the economy, and also smooth the adjustment process. The opposite would be so from stimulating consumption expenditure. Adopting a more export oriented policy towards oil production worsens the Dutch disease consequences, however this would be compensated by a greater accumulation of net foreign asset stocks and vice versa.

It is also found that a flexible exchange rate policy, combined with perfect international capital mobility, is a preferable response to an oil price increase, whilst adopting a flexible exchange rate, together with high degree of control over international capital mobility, is a preferable response to an oil production increase. Hence adopting a more market oriented policy, that leads to a greater role for the private sector and closer integration with the global market economy, is found to be preferable for the case of Indonesia.

TO THE MEMORY OF MY BROTHER AND MOTHER

BUDIMAN THAHA

1940 - 1981

SYAFLAH ABBAS

1908 - 1994

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"In the name of Allah, Most Gracious, Most merciful. Praise be to Allah,
The Cherisher and Sustainer of the Worlds" (Al Qur'an, Surat 1. Ayat 1-2),

I complete this thesis.

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CHAPTER 1

INTRODUCTION

1.1 Background to the Study

Indonesia has been a sizeable producer of oil since the 1950s. However the contribution of oil production to the Indonesian economy was not significant until developments in the 1970s and early 1980s. During this period oil prices increased greatly, which led to a rapid expansion of production that can be described as being an oil boom¹.

Indonesia is a relatively small net oil exporting country. Oil contributed only between 3.23% and 8% of total annual OPEC oil production over the period 1957-1991. However Indonesia is an important marginal producer, with its production able to exert an important influence over the world price of oil. Not surprisingly the contribution of oil to the development of the macroeconomy, now one of the fastest growing in Asia, has been a very important one, and is likely to remain so into the foreseeable future (see Chapter 2 of this thesis).

An oil boom can arise from either an oil price or oil production boom, or from a combination of the two. Both can generate for Indonesia a significant increase not only in revenue to the government, and in real GDP, but also in foreign exchange vital for economic development. The significance of the contribution of oil to the Indonesian

¹The increase in oil production from 43.79 million metric tonnes in 1970 to 66.10 million metric tonnes in 1973 coincided with a substantial increase in the price of oil in 1973-74 (OPEC I), from \$US 3.73 per barrel in 1973 to \$US 11.70 in 1974. From 1974 to 1981 the oil price continuously increased (OPEC II in 1979/1980), then gradually declined thereafter except for 1990.

economy, is further apparent from the fact that budget predictions² are based on the anticipated price of oil. Oil revenue is indeed a major source of income to the government. During the major oil boom period 1973/1974 to 1981/1982, oil revenue contributed between 32.62% and 61.97% of total government revenue. Since 1981/1982 this has declined but still remains the single most important source of government revenue, contributing 28.93% of total revenue by 1991/92.

The government has direct control over oil production, for both domestic use and for export, however both the oil price and oil production are influenced by OPEC agreements, as Indonesia is a member country of this organisation. Hence oil revenue is primarily in the hands of government, having no direct effect upon the private sector. The oil revenue affects the private sector, and hence the domestic economy, only by the way in which the government spends the revenue. Such expenditure is in the form of consumption (*routine*) or investment (*development*) expenditure. Routine expenditure enables the government to carry out, and strengthen, its daily activities, whilst development expenditure, which is equivalent to that of a capital transfer to the private sector, has direct positive effects on domestically produced non-oil goods³.

The oil revenue represents a windfall gain to the government, in so far as the production of oil has required little input of domestic resources, in the form of labour and capital, hence the *resource movement*⁴ effect in the context of Indonesia has been negligible. The primary influence of oil production has thus been *an income effect*, and hence its impact upon expenditure (*spending effect*).

²For details on the importance of the oil sector to the government's budget, see for example "Nota Keuangan" (Budget Statement), 1993.

³This capital transfer could take a variety of forms, including that of a price subsidy on inputs and capital, technology improvement, education and training, research and development, and infrastructure improvements.

⁴For a more detailed discussion of the effects of a resource boom see Corden (1982b), and Chapter 3 of this thesis.

Oil exports have also been a major source of foreign exchange. Such foreign exchange has been important in the financing of imported inputs vital to the development of the economy. During the major oil boom period 1973/1982 oil exports contributed between 50.10% to 76.40% of total export revenue, offsetting sizeable non oil merchandise trade deficits (see Table 2.8 Chapter 2). The latter arose from the importation of capital goods necessary for the development of the economy.

The contribution of oil production to real income (real GDP) has been considerable. From 1973 until 1982, this contribution rose from 12.3% to 19.63%. From 1983 this importance declined - contributing 11.3% to GDP in 1991, in line with the declining oil price and the rapid increase in the manufacturing sector.

Despite the significant contribution of the oil sector to the Indonesian economy, it also has an adverse effect upon non oil traded goods as predicted by the "Booming Sector" or "Dutch Disease" theories. This theory suggests that a boom in one tradeable sector can contribute to a contraction in other non-booming tradeable sectors.

In Indonesia there is strong evidence to suggest that this has happened for non oil traded goods (Harvie and Thaha (1993)) which have traditionally had a strong agricultural base. These have experienced a relative decline in their contribution to both output and exports. A significant structural change in domestic output from agriculture to manufacturing was apparent during the boom period of oil production. Deliberate policy action, to a large extent, initiated this change⁵. The latter has involved the use of the oil revenues to promote the manufacturing sector, as well as implementing protective trade policies for this sector⁶.

⁵For details of agricultural developments in Indonesia see Booth (1988).

⁶For details on the development of the industrial (manufacturing) sector, see for example McCawley (1979) and Hill (1989)

The ways in which the government distributes oil production on domestic usage or for export, and the spending of the oil revenue on consumption and/or investment, are clearly determined politically. These policies will have a major bearing upon the evolution of the macro economy including non oil traded goods. The impact of government spending of these oil revenues and the allocation of the oil production into the domestic economy, however, also depends upon other government policies, such as that towards the exchange rate, interest rate and trade as well as the private sector's response both to the oil revenue and to these other policies.

A major aim of this study, is to develop a model for analysis of the macroeconomic consequences of oil shocks for the Indonesian economy. The model to be developed enables the identification of the ways in which the oil boom has transmitted its effects to the domestic economy, and will enable exploration of the future contribution of oil to the Indonesian economy and the policy implications which flow from this. The model will incorporate the key characteristics of the oil production and revenue, and the way in which the government spends this revenue either for consumption or investment, and the way government allocates oil production either for domestic use or export, as well as government policy towards both the nominal exchange rate and financial markets.

The existing theoretical literature analysing oil related shocks focusses, however, upon cases where the oil revenues primarily accrue to, and expenditure is determined by, the private sector, which also determines the allocation of oil production for export or domestic usage or both. A further feature of such literature is that the assumptions underlying the theory emphasise the existence of a developed economy, and this is clearly not appropriate for a developing economy such as Indonesia.

Such a theoretical analysis may be set within the context of either a static or dynamic framework, and have either a short or long run focus. In regard to the former,

Gregory (1976) conducted an analysis of the effects of a boom in the minerals sector upon Australia's traditional export sector (agriculture). This type of static analysis was also applied to the effects on the UK economy arising from North Sea oil production. Forsyth and Kay (1980) attempted to identify the likely consequences for the UK's traditional export oriented manufacturing sector. Such an approach only compares equilibrium states, giving little insight into likely adjustment processes. The latter is more relevant from a policy perspective. In the early 1980s this deficiency was addressed by Buiter and Purvis (1982), Eastwood and Venables (1982), and Bruno and Sachs (1982) amongst others. Such analyses, which emphasised the dynamic nature of the adjustment process arising from oil related shocks, focussed upon the short to medium term. Later this was extended by Harvie (1993, 1994), Harvie and Gower (1993) and Allen, Srinivasan and Vines (1993) amongst others, who emphasised the long term nature of the dynamic adjustment process. Both approaches will be discussed in this study. Given the policy oriented nature of this study in the context of a growing economy, the adoption of a long run dynamic analysis is regarded as being most appropriate.

There have been several studies analysing the effects of the oil boom on the Indonesian economy, including Pangestu (1986), Gelb (1985, 1986), and Warr (1986, 1991a, 1991b). These existing studies, on the effects of the oil boom for the Indonesian economy, however are inappropriate in six major respects⁷.

Firstly, and most importantly, none of these studies explicitly incorporates the fact that the government has direct control over the use of oil production between that exported and that used domestically; neither do they include government policies on the spending of the oil revenue, which has been a primary influence on the effects of oil related shocks upon the Indonesian economy. These two policies will influence both the adjustment process and the long run equilibrium of the macroeconomic variables.

⁷Warr (1991a), however, does consider the effects of the oil boom on investment and saving on the Indonesian economy. The study however was a partial analysis.

Secondly, these studies give no consideration to an overall analysis of the macroeconomic effects arising from the oil booms⁸. They all focus on Dutch disease consequences for non oil output.

Thirdly, all of these studies adopt a comparative static sectoral approach. By contrast a dynamic analysis that focusses upon the long run and allows for the accumulation of capital stock is more suitable, since such an accumulation makes an important contribution to domestic wealth and economic growth and is partially induced by government capital transfers arising from the oil revenues. Similarly, foreign exchange generated by an increase (decrease) in oil exports may increase (decrease) the foreign asset stock, and thereby have an additional effect upon domestic wealth.

The identification of the possible dynamic adjustment path of the economy to an oil shock, provides information to the government enabling it to choose an optimal policy response to counter these effects. The private sector will equally benefit from such a policy response, enabling Indonesian producers, which are primarily small in size, to be less adversely affected during the adjustment process.

Fourthly, all previous Indonesian studies have assumed that the economy is operating with a fixed exchange rate with no international capital mobility. Indonesia has recently moved from a fixed to a more flexible exchange rate regime, although it is still considerably managed, but the existing studies have not considered these changes. At the same time Indonesia has been moving towards a more open economy, encouraging international capital flows although this capital market is not perfectly open internationally. Allowing such capital flows influences the development of physical capital stocks and non oil output, as well as real income. Most importantly the

⁸See Bevan (1989). Before the 1980s most studies on developing countries focussed upon a sectoral analysis, whereas the macroeconomic problem was of more serious concern.

adjustment path of the economy will differ depending upon which exchange rate regime (Harvie (1993)), as well as the openness of capital flows internationally, is operative. The existing studies make no allowance for such effects.

Fifthly Indonesia, as a member country of OPEC, is subject to production quotas in which the oil price is also set by OPEC. The existing studies by focussing only upon the latter effect, neglect to identify the economic consequences arising from the former. In this study both of these effects will be considered. An increase in oil production will directly affect the government's revenue, whereas an increase in the oil price will also directly affect the general price level.

Finally, none of the existing studies consider the contribution of wealth and permanent income to the adjustment process. The oil shocks will affect the development of both wealth and permanent income through their effects on non oil output and trade.

1.2 Objectives of the Study

Following an extensive review of the contribution of the oil sector to the overall economy, the primary objective of this thesis is to develop a long run and dynamic theoretical macroeconomic model to analyse the effects of oil related shocks such as oil price and oil production increases for the Indonesian economy. The model will explicitly incorporate the characteristics of the oil revenue, as well as the structure of the economy. The study will emphasise the identification of alternative, and appropriate, government policy responses to oil related shocks. In doing so the limitations of existing studies of the Indonesian economy, as discussed above, can be overcome.

A variety of policy responses to the oil related shocks are possible. A major policy response analysed in this study is firstly in regard to decisions relating to the production of oil and its usage, either domestically or for export. The second point of focus is government usage of the oil revenues either for investment, with the objectives

of stimulating production, growth, and exports in certain sectors of economy to achieve developmental objectives, or for consumption. A final policy alternative analysed is in regard to the nominal exchange rate regime and the operation of capital markets.

To compare such outcomes arising from these alternative policies, the study will conduct numerical simulations of the theoretical macroeconomic model for presumed oil related shocks. To conduct such simulations, the parameters of the model are empirically estimated where possible. These simulations enable identification of the adjustment of key macroeconomic variables such as real income, non oil production, physical capital stock, foreign asset stock, non oil trade balance, real exchange rate, inflation rate and wealth amongst others.

The period of analysis will be that from 1973 to 1991, during which time a number of important developments occurred in Indonesia. These include the oil boom and post oil boom periods and the integration of Indonesia into the global economy, as reflected in the movement toward a flexible exchange rate and integration of its financial markets, including interest rates, with global financial markets.

1.3 Methodology

The oil price booms of 1973/1974 (OPEC I) and 1979/1980 (OPEC II) had a significant effect upon the Indonesian economy. Real income grew strongly throughout these periods. This growth, in sectoral terms, was considerably unbalanced. The agricultural sector grew less rapidly than the manufacturing sector. Such a diverging growth performance was a reflection of both diverging export performance and deliberate policy action by government. The former is indicative of the existence of a "Dutch disease" effect in the context of Indonesia. Several studies on the existence of such an effect have already been conducted for Indonesia. These studies, however, have

tended to focus upon the short run and to adopt a comparative static approach emphasising sectoral effects.

In order to conduct a long run dynamic study an appropriate theoretical framework is required, the foundations of which can be found in the original contribution of Dornbusch (1976) and later extended to incorporate oil by Buiter and Miller (1981), Eastwood and Venables (1982), Buiter and Purvis (1982), Neary and Wijnbergen (1984) and most importantly Harvie and Gower (1993) and Harvie (1993, 1994). The above studies enable an analysis of the dynamic adjustment process from an initial equilibrium towards a new equilibrium, arising from an oil related shock to the economy. In each of these studies a deterministic framework is adopted, in which economic agents are assumed to possess rational expectations⁹. This is equivalent to the case of perfect foresight. It assumes financial markets to be in continual equilibrium, whilst non financial markets are subject to sticky price and quantity adjustment. Such stickiness of adjustment of non financial markets can cause economic variables to overshoot or undershoot their equilibrium values, and produce different and interesting adjustment processes. The analysis will emphasise the long run nature of the adjustment process, by inclusion of capital stock accumulation in the product market and foreign asset stock accumulation arising from developments in the current account. The former process is particularly important in the context of a rapidly developing economy such as Indonesia, with its resulting effects upon the economy's potential supply of output. The long run steady state will have a major bearing also upon the dynamic adjustment process over both the short and medium term.

However a number of significant amendments are required to make this framework more applicable to the case of Indonesia. These major changes rest on

⁹Aghaveley and Khan (1977) used the rational expectations assumption in their study of the Indonesian economy over the period 1951-1972.

several factors. Firstly, the oil revenue is in the hands of government, hence government expenditure is endogenous within the model. Secondly, the government spends all the oil revenues to maintain its balanced budget policy. Hence, the way in which it spends the oil revenue will have a major bearing upon the future evolution of the economy. Thirdly, oil exports are assumed to be exogenously determined by the government. This will have a significant effect on the real exchange rate and on developments in the current account. Fourthly, less than perfect capital mobility is assumed. This is because asset markets in Indonesia are not as well developed as in most other developing countries, and therefore domestic and foreign financial assets are not perfect substitutes. In this context, returns on domestic financial assets are equalised continuously, but this can diverge temporarily from those on foreign financial assets out with equilibrium. Fifthly, the analysis will focus upon adjustment under both a fixed and flexible exchange rate system, which is relevant to the recent experience of Indonesia. Sixthly net investment adjusts positively to Tobin's q , hence the accumulation or decumulation of the physical capital stock is based on its marginal market valuation relative to the replacement cost of the capital. Finally, the importance of income, wealth and the current account for the dynamic adjustment process is emphasised.

As well as the review of the contribution of the oil sector and the development of the dynamic macro model for Indonesia, the third major component of the thesis is to estimate the structural parameters of the model by using econometric packages which are later used for simulation purposes. Because of the complexity of the model and because some of the variables, such as the real return to capital and Tobin's q ratio¹⁰, are not well documented for the period of study, it was impossible to estimate all of the variables simultaneously. Hence some of the parameters are estimated using two stage least

¹⁰So far no study of Indonesia has used real returns to capital or Tobin's q in analysing investment behaviour. See also Haque, Lahari and Montiel (1990).

squares (2SLS)¹¹, with the remainder being imposed using, where possible, estimates from existing studies. The study covers the period 1973 to 1991, capturing both the oil boom and post oil boom periods. During this period however the exchange rate system was changed from fixed to flexible, hence the implication of such a change for the effects of oil shocks upon the economy also needs to be identified and evaluated. The parameters of the model were therefore estimated for the period 1973-1983, under the assumption of a fixed exchange rate, and 1983-1991 under the assumption of a flexible exchange rate¹².

The final component, and the main focus, of the thesis is to analyse the effects of oil related shocks upon the Indonesian macroeconomy, and the likely effects arising from alternative policy responses to these. A numerical simulation procedure known as "Saddlepoint" will be utilised in order to derive simulation results from the model. This is a numerical algorithm for computing the solution of rational expectations models, that can be represented by systems of first order linear differential equations with constant coefficients or parameters. It can be viewed as the continuous time analogue of the linear difference model with rational expectations utilised by Blanchard and Khan (1980)¹³. The primary objective of using such a simulation procedure is to identify how well the theoretical framework explains developments that have occurred in the past in Indonesia arising from oil related shocks, as well as to identify appropriate responses to these.

¹¹Bond and Knobl (1983), in their study of the oil boom in U.K., used ordinary least square (OLS) to estimate some of the parameters, two stage least square (2SLS) for others and imposing parameters for the rest.

¹²The Indonesian government announced the change of the nominal exchange rate from fixed to flexible in 1978. However, it was considerably fixed until 1983. From 1983 the nominal exchange rate has gradually moved towards being a flexible exchange rate but still remains substantially managed. For comparative purposes these two fixed and flexible nominal exchange rate policies are emphasised.

¹³ See also Buiter (1982).

1.4 Outline of the Study

In Chapter 2, a historical review of the development of the oil sector in Indonesia, and its contribution to the macroeconomy, is conducted. Particular emphasis is placed upon the contribution of oil revenues to government income, domestic real income (GDP), the current account, and investment at both the national and sectoral levels. Such an emphasis provides an understanding of the significance of the oil sector in the context of the Indonesian economy. The government's responses during the period of the oil booms are identified, such as those in regard to monetary, fiscal, exchange rate and trade policies. Chapter 3 discusses the basic concepts relating to the "Dutch disease" theory. Initially a comparative static analysis is adopted focussing upon the Salter (1957) model. This discussion will be extended to incorporate the effects of government intervention in both the goods and asset markets. The discussion will then be supplemented and supported by several recent studies that have been conducted using a comparative static framework, such as Gregory (1976) for the case of Australia, Forsyth and Kay (1980) for the case of the UK, and Gelb (1985, 1986), and Warr (1986, 1991a, 1991b) for the case of Indonesia. The remainder of this chapter examines the dynamic effects arising from an oil boom, thereby complementing the earlier comparative static discussion. The Dornbusch (1976) type model and its application to an analysis of the economic effects arising from oil related shocks as developed by Buiter and Miller (1981), Eastwood and Venables (1982), Buiter and Purvis (1982), Neary and Wijnbergen (1984), Harvie and Gower (1993), and Harvie (1993) are discussed and analysed at some length.

In Chapter 4 an appropriate theoretical macroeconomic model for Indonesia, incorporating the key characteristics of the Indonesian economy and its oil production, is developed. This draws heavily upon the discussion in the previous chapter, utilising, amending and extending the existing models in order to make them more applicable to the Indonesian situation. The framework developed will be such as to allow for the

existence of both a fixed and flexible exchange rate, combined with different degrees of control on the financial markets.

Chapter 5 consists of two parts. Firstly it presents the results of the parameter values of the model developed in Chapter 4, which are either empirically estimated, where possible, or have been imposed or draw upon the results from earlier studies. Secondly, the model is simulated for the effects of both oil production and oil price shocks upon the dynamic adjustment of the economy, for the fixed exchange rate version of the model combined with a high degree of control of capital markets. This is referred to as the base case. The simulation results obtained are discussed in some detail.

Chapter 6 consists of two parts. Firstly, it presents the results derived for both an oil production and oil price shock incorporating a policy response. The responses focussed upon are more (less) investment for the private sector through the use of a capital transfer, and a more (less) exported oriented policy towards the oil output assuming the nominal exchange rate and operation of capital markets are as that given in Chapter 5. Secondly, it presents the results derived from alternative macroeconomic policy responses, implemented in conjunction with different nominal exchange rate regimes combined with different degrees of control over financial markets. The results obtained from these two different sets of policies are compared, analysed and contrasted to the base case presented in Chapter 5.

Finally Chapter 7 provides a summary of the major conclusions derivable from this study, emphasising in particular the key policy implications for a developing oil abundant economy subject to oil related shocks such as Indonesia. In doing so the reasons for the very successful recent economic development of this country, can be more readily identified. This chapter concludes by making suggestions and recommendations for further study.

CHAPTER 2

OIL DEVELOPMENT AND THE INDONESIAN ECONOMY

2.1 Introduction - A Brief Historical Review

The production of sizeable quantities of oil began in the late 1950s and early 1960s. It increased further in the mid 1970s and, as Figure 2.1 indicates, has remained fairly stable since, with the exception of the years 1977 and more recently 1990. This stability of oil production is a reflection of Indonesia's maintenance of production quotas arising from its membership of OPEC, and suggests that the primary reason for fluctuations in its oil revenues arise from fluctuations in the world price of oil. As Figure 2.2 indicates, this fluctuated quite considerably during the 1970s and 1980s. From the early 1980s the real oil price experienced a sharp downward trend, recovering slightly by 1990.

Whilst Indonesia's production of oil is surpassed by a number of other oil producing economies (see Table 2.1), it is still a major marginal producer in world terms thereby being able to exert an important influence over the world price of oil. It has contributed over the period 1957-1991, between 3 per cent and 8 per cent of total OPEC oil production annually. Its contribution to the evolution and development of the macroeconomy has been an important one, and is likely to remain so into the future.

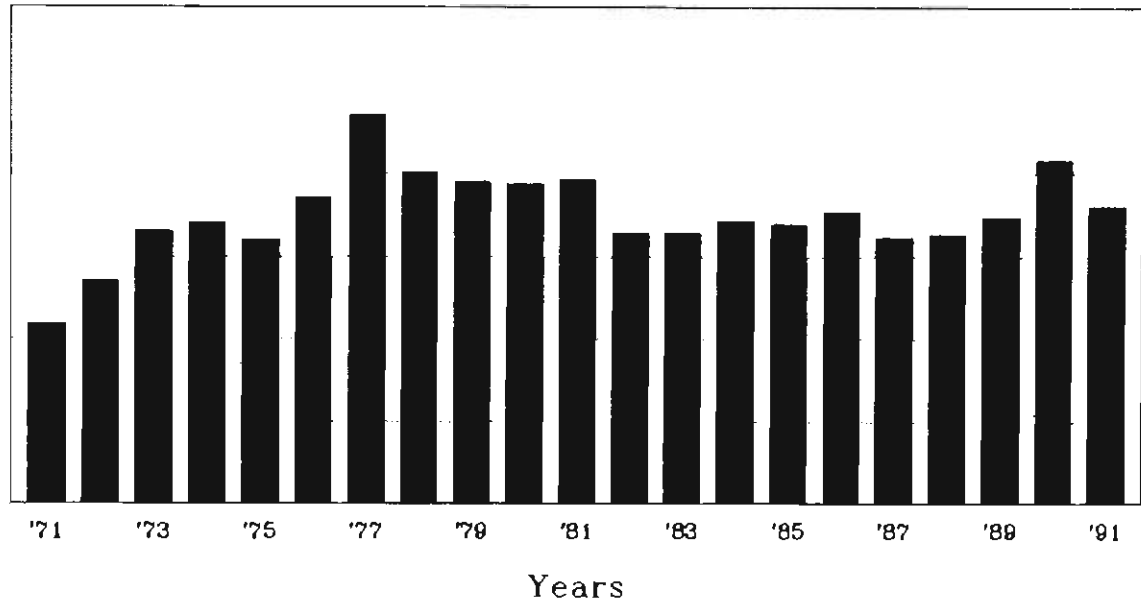
Oil production in Indonesia is best characterised as being highly capital intensive and predominantly financed by overseas firms, with concomitant minimal effects upon domestic financial markets. Correspondingly the requirement for domestic labour has been relatively small. In 1988, for example, only thirteen thousand workers were employed in the mining sector, which includes oil, of which 5% were foreign workers¹⁴. This represented barely 0.02% of Indonesia's total labour force of 72 million. The

¹⁴For details see REPELITA V Sektor Pertambangan (Five Year Development Planning on the Mining Sector) (1990), Departemen Pertambangan (Ministry of Mining).

windfall gains, or economic rents, arising from oil production have generated, using the terminology of Corden and Neary (1982), a strong *spending* or *income effect*, whilst the *investment effect* or *resource movement effect* has been small.

FIGURE 2.1
Oil Production (1971 - 1991)

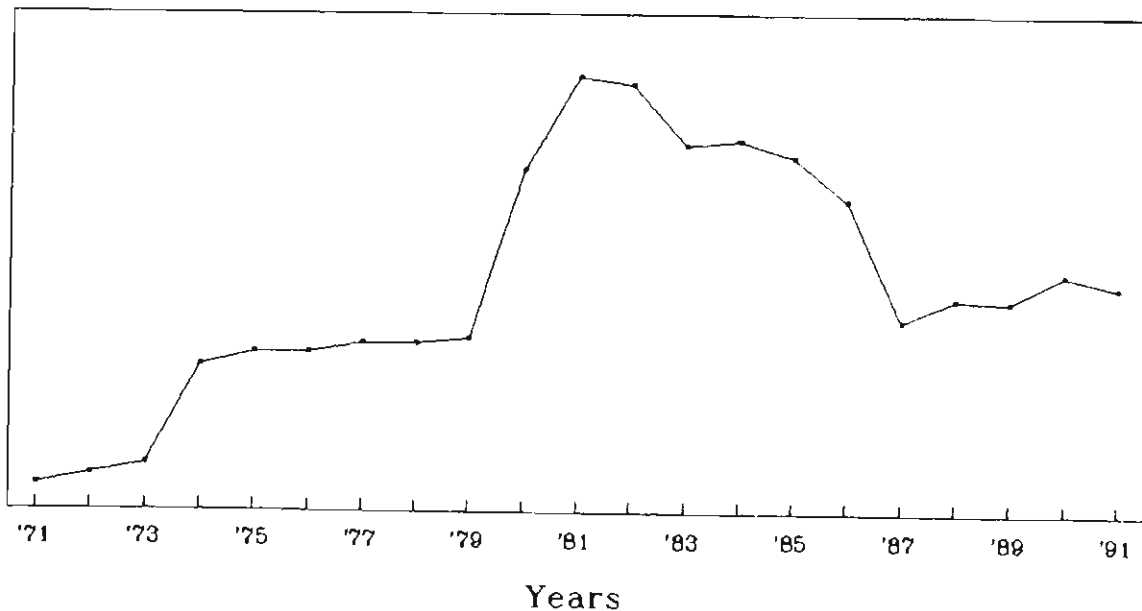
Million metric tons



Source: Montly Bulletin of Statistics, United Nation (UN), Varrous Issues

FIGURE 2.2
Oil Price (1971 - 1991)

\$US/Barrel



Source: Statistik Ekonomi dan Keuangan Indonesia, Bank Indonesia (BI), Central Bank of Indonesia, Various Issues.

TABLE 2.1

Average Oil Production Selected Countries, 1957-1991
(Million Metric Tonnes)

YEAR	INDONESIA	OPEC	SAUDI ARABIA	USA	USSR	MEXICO	UK*	IND/OPEC
1957	15.47	334.71	49.01	353.64	98.35	12.62	0.00	4.62
1963	21.12	539.99	80.98	373.13	206.00	16.43	0.00	3.91
1970	36.62	1134.94	176.86	475.28	353.04	21.50	0.00	3.23
1971	43.79	1230.35	223.51	466.70	377.08	21.41	0.00	3.56
1972	54.08	1332.10	285.58	466.96	401.08	22.16	0.00	4.06
1973	66.10	1223.87	364.34	454.19	429.04	23.26	0.00	5.40
1974	67.98	1505.81	407.92	432.36	459.00	29.70	0.00	4.51
1975	64.14	1353.30	352.39	413.09	491.00	36.46	1.61	4.74
1976	74.20	1523.02	425.81	401.26	520.00	41.34	12.17	4.87
1977	93.95	1689.19	457.08	405.71	545.80	49.28	37.54	5.56
1978	80.48	1602.73	410.33	428.80	572.46	60.83	53.38	5.02
1979	78.07	1524.18	475.97	420.82	585.56	75.46	76.60	5.12
1980	77.63	1332.36	495.72	424.20	603.20	99.94	78.91	5.83
1981	78.66	1126.21	490.80	421.80	608.82	120.20	87.95	6.98
1982	65.86	931.28	324.88	425.59	612.60	142.79	100.31	7.07
1983	65.92	823.51	250.90	427.51	618.00	138.58	110.83	8.00
1984	68.52	795.73	204.18	432.12	612.23	139.94	121.19	3.51
1985	67.76	756.76	158.50	441.36	595.00	135.67	122.50	3.95
1986	71.02	879.30	251.68	428.16	614.75	126.23	121.16	3.54
1987	64.58	865.86	211.13	409.91	na	132.08	117.54	7.46
1988	65.34	1000.18	255.16	410.64	na	130.68	110.77	6.53
1989	69.32	1084.81	252.43	382.68	na	130.67	87.41	6.39
1990	83.52	1173.16	320.38	371.03	na	132.47	88.00	7.12
1991	72.38	1161.98	408.80	373.32	na	139.12	87.23	6.23

Source: Monthly Bulletin of Statistics, United Nation (UN), Various Issues.

2.2 Oil and the Macroeconomy

A number of key macroeconomic variables have been affected by the oil developments just identified, five of which will be given emphasis. These are Government revenue, real GDP, monetary variables (money supply, inflation, interest rate, exchange rate), investment and the balance of payments on current account. There have been a number of extensive studies devoted to a discussion of this issue, such as Arndt and Sundrum (1984), Booth (1988), McCawley (1979), Booth and McCawley (1981), Corden and War (1981), Hill (1986), Sundrum (1988), and Warr (1984, 1986, 1991b).

2.2.1 Government Budget

In Indonesia most of the oil output is produced by foreign companies. However there is an output sharing arrangement whereby around 86% of this goes to the government and 14% to the foreign oil companies¹⁵. Such an arrangement has had a profound impact upon government revenue, as indicated by Table 2.2. In real terms the oil and gas revenue contributed 33% of total Government revenue in 1973/74, over 50% by 1979/80 and 62% at its peak in 1981/82. Since then it has declined, reflecting a weakening of the price of oil on world markets, as well as a slight reduction in oil production. However despite this, the contribution of oil revenue to total government revenue has not fallen below 25% during the 1980s and early 1990s. Other sources of government revenue arise from other taxes, including income, export and import taxes, government enterprise profits, and foreign revenue, which includes foreign borrowing.

To maintain its balanced budget policy, the government spends all of this income in the form of consumption (routine) and development (capital transfer) expenditure. Such capital transfers could take a variety of forms, including that of a price subsidy on inputs and capital, technology improvement, education and training, research and development, and infrastructure improvements. This capital transfer directly enhances the

¹⁵For details see REPELITA V Pertambangan (Five Year Development Planning on the Mining Sector) (1990), Departemen Pertambangan (Ministry of Mining).

production of non oil output. During the period of rapid increase in oil production and oil prices, the share of development to total expenditure increased from 39% in 1973/74 to around 54% in 1983/84 (see Table 2.3). However with the collapse in oil prices in the late 1980s and early 1990s, this share has fallen to around 35%-40% of total government expenditure.

TABLE 2.2

Real Government Revenue

(1980 Price, Billion Rupiah)

Year	Development*	Routine**	Of*** Oil&Gas	Total	The Share (%)	
1	2	3	4	5	6=2/5	7=4/5
1973/1974	632.91	3003.75	1186.35	3636.66	17.40	32.62
1974/1975	535.99	4051.56	2211.41	4587.54	11.68	48.20
1975/1976	949.34	4329.38	2410.04	5278.72	17.98	45.66
1976/1977	1298.18	4813.10	2708.49	6111.28	21.24	44.32
1977/1978	1160.72	5305.93	2924.61	6466.66	17.95	45.23
1978/1979	1459.26	6011.91	3253.48	7471.16	19.53	43.55
1979/1980	1520.53	7372.90	4689.64	8893.44	17.10	52.73
1980/1981	1406.36	9627.70	6608.25	11034.05	12.75	59.89
1981/1982	1488.68	10638.15	7515.33	12126.83	12.28	61.97
1982/1983	1540.91	9863.38	6489.59	11404.29	13.51	56.90
1983/1984	2753.48	10235.96	6751.91	12989.43	21.20	51.98
1984/1985	2265.80	10368.40	6794.72	12634.20	17.93	53.78
1985/1986	2221.70	11973.20	6930.72	14194.90	15.65	48.83
1986/1987	3377.94	9478.46	3721.95	12856.40	26.27	28.95
1987/1988	3312.80	11191.34	5405.07	14504.14	22.84	37.27
1988/1989	4971.88	11446.82	4740.65	16418.70	30.28	28.87
1989/1990	4406.14	13430.09	5258.02	17836.23	24.70	29.48
1990/1991	4909.84	13736.59	4689.77	18646.43	26.33	25.15
1991/1992	4144.29	16556.85	5987.70	20700.34	20.02	28.93

* Government Foreign Borrowing and Loans to support the private sector.

** Domestic revenue including oil & gas.

*** Domestic revenue from oil & gas.

Source: Nota Keuangan dan Rancangan Anggaran Pendapatan Negara Republik Indonesia (Income Statement), Various Issues.

TABLE 2.3
Real Government Expenditure
(1980 Prices, Billion Rupiah)

Year	Development*	Routine**	Out of Debt***	Total	Development*	Routine**	Out Of Debt
1	2	3	4	5	7=2/5	6=3/5	8=4/5
Payments							Payments***
1973/1974	1422.57	2214.09	219.45	3636.66	39.12	60.88	6.03
1974/1975	2240.06	2451.45	170.27	4691.51	47.75	52.25	3.63
1975/1976	2705.31	2573.41	151.59	5278.72	51.25	48.75	2.87
1976/1977	3411.90	2699.38	313.86	6111.28	55.83	44.17	5.14
1977/1978	3241.58	3225.07	342.63	6466.66	50.13	49.87	5.30
1978/1979	3604.66	3866.50	753.23	7471.16	48.25	51.75	10.08
1979/1980	4421.56	4471.88	753.17	8893.44	49.72	50.28	8.47
1980/1981	5573.84	5460.12	738.81	11033.96	50.52	49.48	6.70
1981/1982	6048.78	6078.05	795.38	12126.83	49.88	50.12	6.56
1982/1983	5847.50	5557.03	972.60	11404.53	51.27	48.73	8.53
1983/1984	7023.62	5965.82	1491.21	12989.43	54.07	45.93	11.48
1984/1985	6485.02	6142.67	1808.79	12627.69	51.36	48.64	14.32
1985/1986	6761.88	7432.52	2066.60	14194.40	47.64	52.36	14.56
1986/1987	4893.50	7962.61	2970.33	12856.10	38.06	61.94	23.10
1987/1988	5099.83	9404.48	4413.81	14504.31	35.16	64.84	30.43
1988/1989	6098.60	10319.75	5443.86	16418.36	37.15	62.85	33.16
1989/1990	6466.45	11369.83	5578.91	17836.28	36.25	63.75	31.28
1990/1991	8460.11	13046.80	5825.78	21506.91	39.34	60.66	27.09
1991/1992	8665.22	12035.12	5348.68	20700.34	41.86	58.14	25.84

Source: Nota Keuangan dan Rancangan Anggaran Pendapatan Negara Republik Indonesia
(Income Statement), Various Issues.

* Mostly spend on investment to support private sector
.. Mostly for consumption expenditure
... Foreign debt payments

* Government Foreign Borrowing and Loans to support the private sector.

** Domestic revenue including oil & gas.

*** Domestic revenue from oil & gas.

The way in which the government has distributed this development expenditure by sector is indicated in Table 2.4. The "others" sector classification in general includes services, such as expenditure on education and training, roads and construction, and health and family planning, all of which have benefited from this expenditure¹⁶.

TABLE 2.4
Development Expenditure by Sector
(1980 Prices, Billion Rupiah)

Year	Agriculture	Industry	Mining*	Others	Total
1969/1970 to 1973/1974	268 (21.74)**	85 (7.52)	108 (8.76)	771 (62.53)	1233 (100)
1974/1975 to 1978/1979	1745 (19.12)	686 (7.52)	967 (10.60)	5728 (62.76)	9126 (100)
1979/1980 to 1982/1983	4235 (12.40)	2320 (6.80)	2320 (6.80)	25254 (73.99)	34129 (100)
1983/1984 to 1987/1988	(14.30)	2629 (5.17)	7276 (14.30)	33639 (66.10)	50885 (100)
1988/1989 to 1990/1991	4441 (14.77)	847 (2.82)	3390 (11.28)	21381 (71.13)	30059 (100)

Source: Nota Keuangan dan Rancangan Anggaran Pendapatan Negara Republik Indonesia

* Mostly for non oil & gas (Income Statement), Various Issues.

** Figures in brackets are percentage of total.

The allocation of this development expenditure has been carefully directed away from the agricultural sector. Before the oil boom this sector was the largest beneficiary of government development expenditure, a trend which was reversed during the oil boom. With the collapse in oil prices this distribution was reversed in order to achieve balanced growth, and to generate foreign exchange, as most of agricultural output is in the form of tradeable goods. The industrial sector, which is largely manufacturing, has

¹⁶The government distributed the development expenditure on 18 programs, but there is no distinction between the development expenditure from oil revenue or foreign borrowing. For details of the Government Budget see Nota Keuangan dan Rancangan Pendapatan Negara Republik Indonesia (Government Budget Statement), any year after 1972/1973.

always received the smallest share of the development expenditure. This sector, however, has benefitted from trade policies including both import substitution and export promotion policies throughout the period, and this will be discussed in the last section of this chapter. The services sector has experienced an increase in its share of development expenditure, despite some fluctuations.

2. 2. 2 GDP

A second area of the economy to be affected by oil production is found in developments in GDP. Table 2.5 summarises developments in Indonesia's real GDP over the period 1973-1991, both in total and by major sector. Total real GDP nearly tripled from 1973 to 1984, the period of the oil boom. This raised Indonesia's status from a low income country to a middle income country¹⁷. During the post oil boom period a significant increase in manufacturing output compensated for declining oil revenue, so that real GDP continued to increase although at a lesser rate. At a sectoral level it indicates some of the major changes that have taken place over this period, as is also clear from Figure 2.3.

Indonesia's economy has therefore seen major structural changes over the period 1973-1991. By 1991 the contribution of oil to GDP remained unchanged in comparison to 1973, whilst the contribution of agriculture had halved and that of manufacturing had doubled. Whilst there has been an absolute increase in production by all sectors of the economy¹⁸, the major change has been a decline in the relative significance of agriculture. By international standards this decline has been relatively large, although in absolute terms the Indonesian agricultural sector has been growing and continues to be large (World Bank, 1988, pp 63-82).

¹⁷For development's in Indonesian income see World Development Report, World Bank, particularly 1986, Table 1.1.

¹⁸Gelb (1986) argues that the effects of the oil boom on Indonesian agriculture were much less than in Nigeria, mainly because of better management of the macroeconomic variables.

TABLE 2.5

**Real Domestic Product by Industry of origin
(1980 prices, Billion Rupiah)**

Year 1	Agriculture 2	Mining 3	Oil & Gas* 4	Manufacture 5	Others 6	Total 7
1973	8411.87	2579.43	na	2017.61	7953.71	20962.62
1974	8079.08	5484.63	na	2056.16	9118.72	24738.59
1975	7731.05	4798.45	na	2170.00	9714.69	24414.19
1976	7969.94	4852.85	na	2407.05	10387.09	25616.93
1977	8863.29	5402.44	na	2726.81	11538.77	28531.29
1978	9450.28	6140.85	na	3078.74	13384.42	32054.29
1979	9903.90	7684.47	na	3644.83	14025.45	35258.65
1980	10628.69	10988.49	na	4978.03	16187.37	42782.57
1981	11883.71	11298.43	na	5071.17	18808.54	47061.85
1982	12445.04	9299.29	na	6100.64	19520.10	47365.05
1983	12124.96	11423.69	10711.34	7018.72	24522.20	55089.57
1984	13302.74	11034.20	10369.18	8542.61	25677.52	58557.07
1985	14000.44	8439.55	7825.75	9641.42	28239.99	60321.39
1986	14605.27	6754.94	6167.11	9915.43	29024.03	60299.66
1987	15663.46	9288.98	8596.40	11378.23	30816.77	67147.45
1988	17014.68	8539.73	7734.07	13063.03	32052.04	70669.49
1989	17414.59	10154.16	9090.22	14286.79	35869.61	77725.16
1990	18331.41	11068.08	9354.53	17409.81	38835.26	85644.56
1991	17605.33	12303.23	10211.69	19244.69	41290.44	90443.69

Source: Pendapatan National (National Account), Biro Pusat Statistik (BPS), Various Issues.

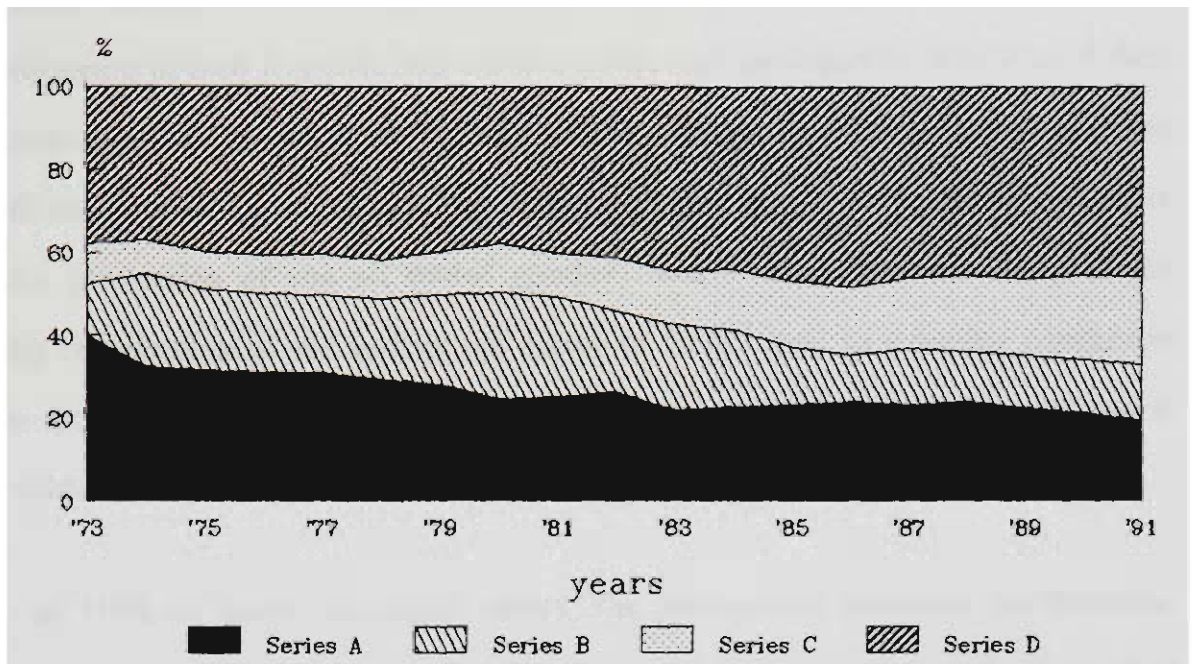
* Up until 1982 oil and gas data was not provided separately, includes in mining

The demise of traditional agricultural exports, arising from this structural development is not surprising. The "Dutch disease" effect suggests that the production of oil, and changes in its price, are likely to have adverse effects on the traditional export sector.

This could occur through price and/or exchange rate effects, as will be discussed in the following section. The manufacturing sector has also been affected by the Dutch disease, but this effect was offset by deliberate policy actions on trade and industrial development.

FIGURE 2.3

**The Sectoral Value Added
(Percentages of GDP, 1973 - 1991)**



Source: Pendapatan National (National Account), Biro Pusat Statistik (BPS), Various Issues.

Series A : Agricultural
 Series B : Mining (mostly Oil)
 Series C : Manufacturing
 Series D: "Others"

2.2.3 Monetary Policy

Developments in the nominal exchange rate are shown in Figure 2.4. From 1971 to 1978, the government adopted a nominal exchange rate fixed against the American dollar. The government spends most of the oil revenue domestically and largely on non oil traded goods¹⁹. To accommodate these increases in government expenditure, and to maintain the fixed exchange rate, the money supply had to increase. The government did not attempt to sterilise such increases in the money supply, resulting in the money supply rising by 30% from 1973 to 1974, as indicated in Figure 2.5. This led to a high domestic inflation rate, as indicated in Figure 2.6. The increase in the inflation rate, whilst the

¹⁹See Pangestu (1986, p. 78).

nominal exchange rate remained fixed, was a reflection of the price of non traded goods increasing. At the same time increased government spending in the domestic economy, and largely on non traded goods, induced further price increases. This caused an appreciation of the real exchange which led to non oil traded goods losing their competitiveness in both domestic and world markets, and subsequently discouraged their production a process known as the "Dutch disease". Pangestu (1986) in her study of the effect of the oil boom on Indonesia, argues that the oil boom had a clearly adverse effect upon the production of non oil traded goods²⁰. Warr²¹ (1991), in his study of the declining contribution of the agricultural sector to GDP, came to a similar conclusion that the Dutch disease effect had occurred in Indonesia, but it was in the agricultural sector whilst the manufacturing sector had not been affected.

In 1978, to assist the export sector, the government devalued the domestic currency by 50%, and at the same time announced a change from a fixed nominal exchange rate system to a flexible exchange rate system. Non oil exports, however, only benefitted for a short time and marginally, due to the high inflation which followed this devaluation. Until 1983, the nominal exchange rate was relatively fixed. Further devaluations became necessary in 1983 and in 1986. These devaluations were partly aimed at helping the export sector, but were mainly designed to help government rupiah revenues and improve international reserves to compensate for declining oil revenue. In general devaluations only benefitted the export sector marginally, because of increases in domestic prices.

From 1973-1983 the Indonesian interest rate was lower than the world interest rate. A combination of low interest rates and high inflation rates caused the real interest

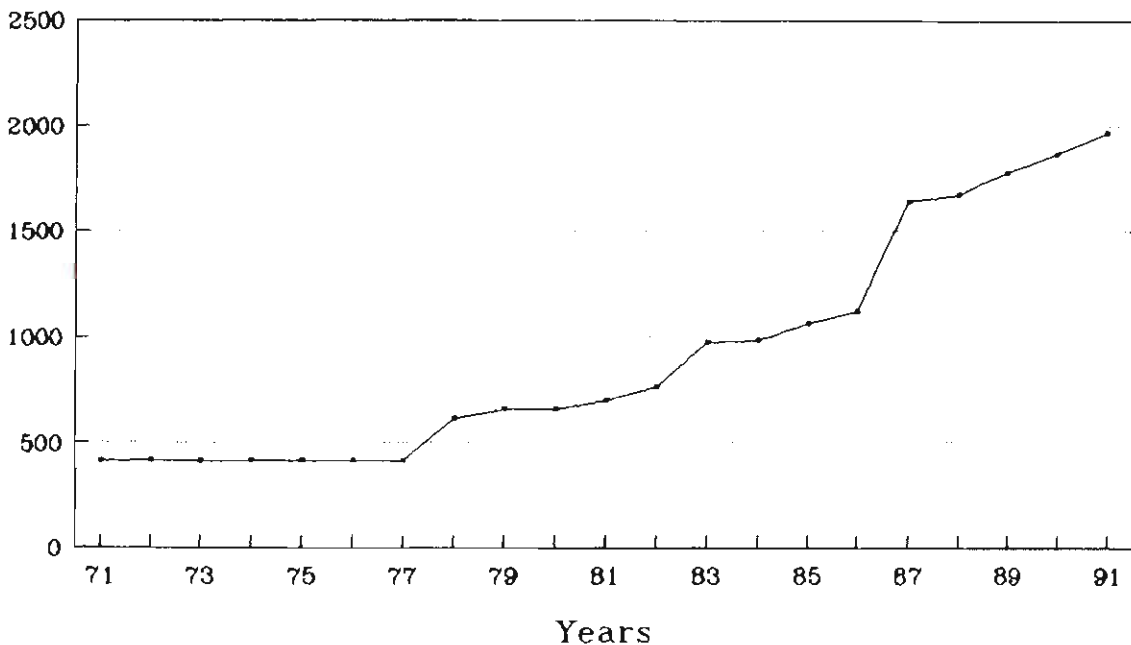
²⁰The disaggregation of domestic non oil output into non oil traded and non traded goods as well as their price is arbitrary as there is no clear definition of the non oil traded and non traded goods. Pangestu included rice as part of non traded goods, whereas Warr (1986) incorporates rice part of non oil traded goods. Note that the price of rice contributed significantly to consumer prices.

²¹Warr(1986) uses the similar definition of the real exchange rate as Pangestu, but different categorization for the non traded and traded goods. He used the price of housing component as the non traded good price, which in fact this price also contain non oil traded goods price.

rate to be negative. Low interest rate policies were designed to encourage domestic production and mostly benefitted industrial and construction sectors, since they had access to formal financial markets. By contrast the agricultural sector benefitted less from these policies, except for the rice sector²². The low interest rate regime also discouraged capital inflow, whilst the relatively high domestic inflation rate also discouraged foreign investment.

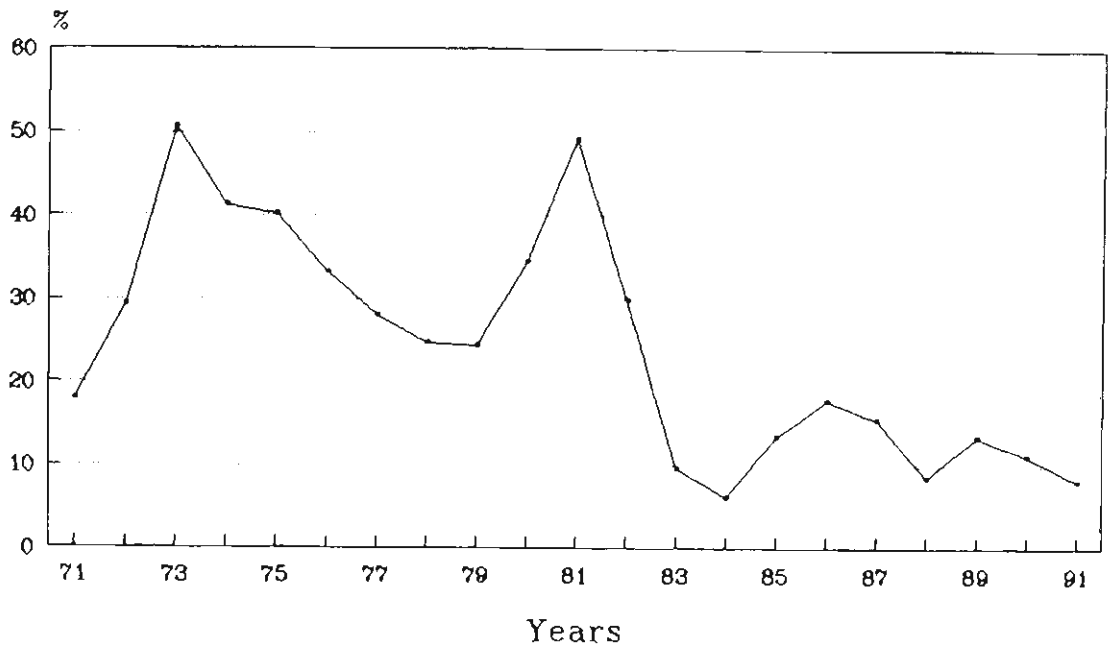
Thus to compensate for declining oil revenue arising from falling oil prices, the government encouraged private sector involvement to increase domestic production and encouraged this by decreasing its controls over the exchange rate, interest rate, and prices as indicated in Figure 2.4, Figure 2.5, Figure 2.6, and Figure 2.7. These policy adjustments started from 1983, but the effects only became significant after 1986 as indicated by increasing exports.

FIGURE 2.4
Exchange Rate (1971 - 1991)



Source: International Financial Statistics (IFS), IMF, Various Issues

²²The rice sub sector, however, receives direct subsidies from government for input price and operating costs, whilst other agriculture mostly benefited through normal banking credit procedures.

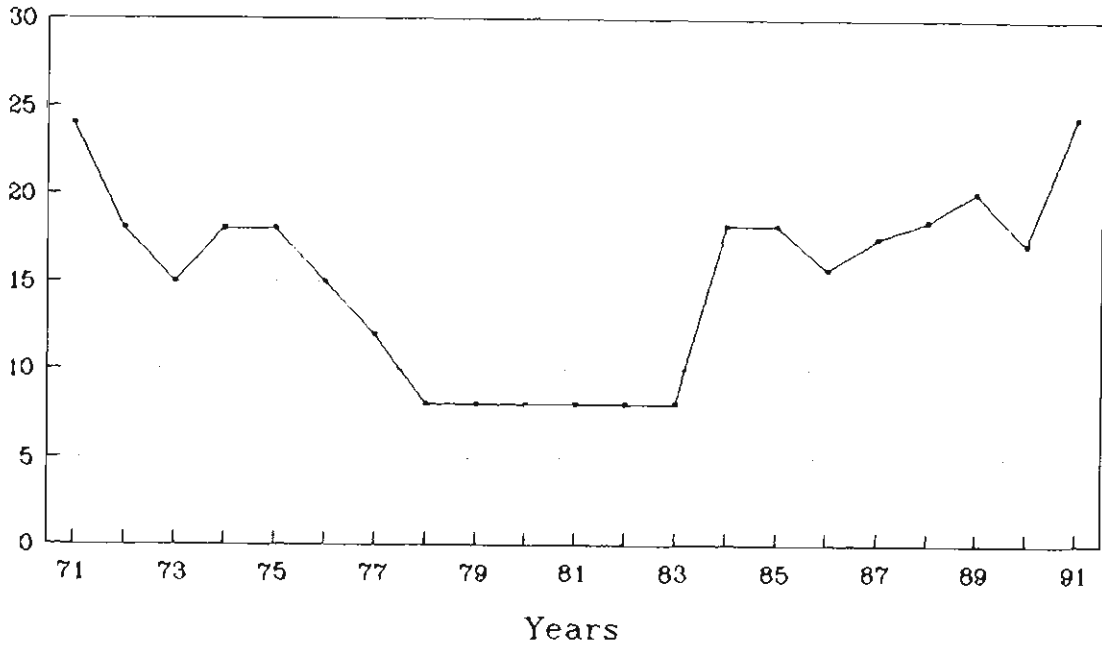
FIGURE 2.5**Change in the Money Supply (1971 - 1991)**

Source: Statistik Ekonomi dan Keuangan Indonesia, Bank Indonesia (BI) Central Bank of Indonesia, Various Issues.

FIGURE 2.6**Inflation Rate (1971 - 1991)**

Source: Statistik Ekonomi dan Keuangan Indonesia, Bank Indonesia (BI), Central Bank of Indonesia, Various Issues.

FIGURE 2.7
Interest Rate (1971 - 1991)



Source: Statistik Ekonomi dan Keuangan Indonesia, Bank Indonesia (BI), Central Bank of Indonesia, Various Issues.

2.2.4 Investment

Gross investment, as measured by fixed capital formation, as a component of GDP rose faster than GDP, as indicated in Table 2.6. In 1973 gross domestic investment was 3589.2 billion rupiahs in real terms, of which the contribution of government, as measured by using government development expenditure, was around 25%²³. This nearly doubled between 1973 and 1983, with the contribution of government to total investment rising to 50% in 1981. Although oil revenues decreased total investment increased to 32,745 billion rupiahs in 1991, but the share of government investment declined to 25%. This rapid growth in investment, regardless of the declining oil revenue, was induced by deliberate policy changes in both the trade and monetary sectors.

²³Fixed capital formation in this context is adopted from the fixed capital formation from expenditure component of GDP (see Pendapatan Nasional (Income Account)), whereas the government contribution to fixed capital formation is estimated by its development expenditure.

TABLE 2.6

Gross Investment (1973 - 1991)

Year	(% of GDP)	(1980 PRICE, Rupiah)
1973	17.89	3589.20
1974	16.78	4151.14
1975	20.34	4965.85
1976	20.72	5307.83
1977	20.13	5743.35
1978	20.53	6430.03
1979	22.06	7778.06
1980	22.19	9493.45
1981	21.38	10061.82
1982	23.00	10893.96
1983	28.68	15799.69
1984	26.19	15336.10
1985	28.05	16920.15
1986	28.27	17052.86
1987	31.36	21057.44
1988	31.49	22437.56
1989	34.75	27009.49
1990	35.23	30172.58
1991	36.21	32749.66

Source: Pendapatan Nasional (National Account), Biro Pusat Statistik (BPS),
Various Issues.

2.2.4 Current Account

The final major impact of oil production and price developments to be discussed, has been upon the current account. Indonesia's oil exports have been a major source of export revenue, and therefore a major source of foreign exchange. This has been very important in stimulating the economic growth of the country, through the financing of imported inputs, technology and services vital to economic development. Table 2.7 identifies developments in the current account over the period 1973-91, broken down to oil trade, non oil trade, the trade balance, services balance and the current account itself.

TABLE 2.7

Current Account
(1980 Prices, Million \$ US)

Year	Oil Trade	Non Oil Trade	Services Traded	Trade Balance	Current Account
1	2	3	4	5=2+3	6=4+5
1973	4857.46	-3362.26	-3408.20	1495.20	-1913.00
1974	11679.44	-3398.44	-4844.68	8281.00	3436.33
1975	9766.26	-5261.53	-15501.10	4504.72	-10996.38
1976	9219.42	-4460.32	-4549.76	4759.11	209.35
1977	9973.88	-3036.72	-5042.69	6937.16	1894.46
1978	10435.89	-3456.27	-8212.98	6979.62	-1233.36
1979	10316.21	-1081.58	-5451.95	9234.62	3782.67
1980	15093.56	-2746.16	-6024.02	12347.40	6323.38
1981	16499.56	-6140.33	-6639.37	10359.23	3719.86
1982	11798.49	-7454.25	-2661.64	4344.24	1682.61
1983	8507.66	-5107.59	-5251.77	3400.07	-1851.70
1984	8678.37	-3462.93	-5001.30	5215.44	214.14
1985	7117.85	-1939.49	-4833.33	5178.36	345.02
1986	4222.40	-1822.57	-3850.55	2399.83	-1450.73
1987	4028.36	-1464.78	-3735.11	2563.58	-1171.53
1988	3370.00	-399.33	-3592.68	2970.68	-622.00
1989	3497.06	-787.07	-3764.07	2709.99	-1054.08
1990	4225.10	-1747.17	-3851.67	2477.93	-1373.75
1991	3417.99	-2114.79	-3688.02	1303.21	-2384.81

Source: Statistik Ekonomi dan Keuangan Indonesia, Bank Indonesia (BI) Central Bank of Indonesia, various Issues.

The 1970s and 1980s saw sizeable surpluses in oil trade, peaking in 1981 at \$16.5 billion (\$US). Since then, with declining oil production and prices, there has been a

steady decline in the oil trade surplus. However despite the declining oil price, it has continually exceeded the non oil trade deficit and contributed to balance of trade surpluses.

The significant non oil trade deficits have mainly arisen from a substantial increase in imports, which has not been offset by a sufficient expansion of exports. The large increases in imports were mainly in raw materials and capital goods, generally in order to support the domestic production of industrial goods. Both import substitution and export goods contain large proportions of imported inputs. Hence, despite a significant increase in manufactured exports, which will be discussed in a later part of this section, this has not led to an improved non oil merchandise trade balance.

The services trade balance has been in persistent deficit throughout this period, arising from both the need to import foreign expertise and from Indonesia's almost negligible export of services.

It has been of a sufficient magnitude to contribute to overall current account deficits on a number of occasions. In fact the current account has been in continual deficit since 1986, reflecting a decline in the oil trade surplus and a persistent services deficit of between \$3.5-4 billion (\$ US) annually.

Table 2.8 identifies export performance by sector over the period 1970-1990. In 1970 agriculture contributed half of Indonesia's exports, compared with 38.5% for oil and manufacturing at only 1.2%. By 1975 oil's contribution to exports had doubled to 75% of total exports, whilst agriculture's contribution declined to 20%, a substantial reversal of roles over a short period of time. By 1981 oil's contribution was still over 70%, although its share declined throughout the remainder of the 1980's. This trend was however reversed in 1990. Thus the declining significance of oil to total exports in the 1980s has been offset by the increased importance of manufactured exports in particular. The agricultural export share also improved with the exception of

1990. Deliberate policy action by government to develop the manufacturing sector, as a result of falling oil revenue from weakening oil prices during the 1980s, has therefore

TABLE 2.8
Exports by Sector (%)

<i>Year</i>	<i>Agriculture</i>	<i>Petroleum</i>	<i>Oil & Gas</i>	<i>Manufacturing</i>	<i>Other</i>	<i>Non-Oil</i>	<i>Total</i>
1	2	3	4	5	6	7=9-4	9
1970	50.10	38.50	38.50	1.20	10.20	61.50	100
1971	54.20	39.10	39.10	1.60	5.10	60.90	100
1972	42.00	51.40	51.40	1.90	4.70	48.60	100
1973	43.60	50.10	50.10	2.80	3.50	49.90	100
1974	24.90	70.20	70.20	2.20	2.70	29.80	100
1975	20.50	74.80	74.80	1.20	3.50	25.20	100
1976	24.90	70.30	70.30	1.40	3.40	29.70	100
1977	26.60	67.20	67.90	1.80	3.70	32.10	100
1978	26.00	63.90	68.60	1.90	3.50	31.40	100
1979	27.90	56.90	65.20	3.10	3.80	34.80	100
1980	21.80	58.70	71.90	2.40	3.90	28.10	100
1981	11.80	72.20	82.10	2.90	3.20	17.90	100
1982	10.60	69.40	82.40	4.30	2.70	17.60	100
1983	12.50	64.10	76.40	7.60	3.50	23.60	100
1984	14.00	57.00	73.30	9.20	3.50	26.70	100
1985	15.90	48.90	68.60	11.20	4.30	31.40	100
1986	21.30	37.20	56.10	18.00	4.60	43.90	100
1987	21.20	35.90	50.10	24.30	4.40	49.90	100
1988	23.50	27.70	41.90	28.70	5.90	58.10	100
1989	22.45	26.98	39.17	27.87	10.51	60.83	100
1990	20.17	33.66	48.86	26.93	4.03	51.14	100

Source: Statistik Ekonomi dan Keuangan Indonesia, Bank Indonesia (BI), Central Bank of Indonesia, Various Issues.

proved to be successful in terms of developing both manufactured goods production, and also export performance through both import substitution and export promotion policies.

Both import substitution and export promotion policies have been directed mainly at promoting industrial goods production. These policies have been pursued through subsidised input prices, either through subsidies on imported inputs, or taxes on exported goods used as inputs in manufacturing, or through imposing tariffs on imported goods, or by imposing export bands, or export taxes on goods which are used for domestic industries. Hill (1986) suggests that before the oil boom, the rate of protection given to the industrial sector was the largest among the ASEAN countries. During the boom, this protection was not increased, although it remained relatively high. Warr (1984) has also suggested that protection given to manufacturing output had gone far beyond the "infant industry" argument. It could be concluded that whatever the degree of protection, protection in one sector or industry is a cost to other sectors or industries.

Declining foreign exchange revenues in line with declining oil revenue forced the government to deregulate some of its trade policies. The government raised tariffs on luxury goods and lowered import subsidies, but maintained tariff exemptions on imported inputs that were not available in the country. As well the government also abolished some export taxes on agricultural products such as palm oil and copra, but in general these adjustments remain favourable toward the manufacturing sector.

2.3 Summary and Conclusions

In conclusion the four main general impacts of oil production in Indonesia have been as follows. First, an increase (decrease) in either oil production or price or both, has increased (decreased) oil revenue. Oil production has remained fairly stable throughout the period from the mid 1970s to 1991. Changes in oil revenues are therefore largely a reflection of changes in the world price of oil. Focus on developments in oil revenue and the macroeconomy are thus particularly pertinent. Secondly, the oil revenues generated from oil production have primarily accrued to the government, enabling it to increase both its consumption and investment expenditure. Domestic resource requirements have

been negligible, hence the spending effect (demand) has been dominated by government policy decisions. Thirdly, oil price developments exert a major influence upon developments in non oil output, the current account, and the accumulation of foreign asset stocks and the real exchange rate will be affected through the nominal exchange rate if this is flexible or the money stock if it is fixed. The current account developments will require further macroeconomic adjustment. Fourthly, there is evidence to support the existence of a Dutch disease effect, which has been particularly apparent for the agricultural sector despite deliberate policy actions in regard to both export promotion and import substitution. This last impact, the Dutch disease effect, will now be examined more closely, in the following chapter.

CHAPTER 3

THE BOOMING SECTOR THEORY

3.1 Introduction

There exists a sizeable literature devoted to discussion of the booming sector theory (see for example Corden (1982a, 1982b), Corden and Warr (1981), Corden and Neary (1982), Forsyth (1982), Eastwood and Venables (1982), Buiters and Purvis (1982), Neary and van Wijnbergen (NW) (1984), and Bevan (1989)). The basic concepts of the theory, however, remain the same. That is, a boom in one tradeable sector, such as oil, contributes towards a contraction of other non-booming tradeable sectors. Such a contraction is also referred to as the Dutch Disease, and arises from the accommodation of revenue from the booming sector into the domestic economy. Overall the welfare of the country can be improved from such an accommodation, as will be discussed in the following section.

Basically there are two effects arising from an oil boom, these being a *resource movement effect* and a *spending effect* (see Corden and Neary (1982)). The resource movement effect occurs if the expansion of the oil sector draws resources from the non oil sector to the oil sector, resulting in a contraction of the non oil sector. This is also referred to as a direct effect. The spending effect arises from additional expenditure generated from the oil boom, which will be strongly influenced by the extent of the economic rents generated from its production. Such additional expenditure can affect relative prices directly, or indirectly via the exchange rate. In either case such a change in relative prices can affect the demand for domestically produced non oil tradeable goods relative to their overseas equivalent, and relative to non traded goods. This will contribute to a change in resource allocation. The movement of these resources from the

non oil sector to the oil sector arising from expansion of the oil sector, or within the non oil sector arising from the spending effect, will primarily depend upon relative factor intensities between these sectors and within the non oil sector itself. The spending and resource movement effects can occur independently or in combination with each other²⁴.

These effects form the basis of what can be referred to as the "core model" for analysing the impact of an oil boom. Such a core model can give a good deal of insight and can be varied or refined in numerous ways, so that none of the outcomes can be regarded as inevitable (Corden, 1982, p.12). It directs attention to the fact that the ways in which an oil boom influences the evolution of the economy, depends upon the way in which the revenue generated is transmitted to the domestic economy and also upon the structure of the economy itself. This study will utilise this core model to provide an understanding of how the oil boom affects an economy, amended where appropriate for analysing the effects of the oil boom for Indonesia.

The economic effects arising from the boom depend upon a number of factors: the size of the boom; the source of the boom, whether from production or price boom or both; the major beneficiary of the boom revenues, whether the government or the private sector; the extent of substitutability amongst goods in both production and consumption; income and price elasticity of goods; factor mobility among sectors; factor intensity in each sector; the groupings of goods²⁵; and existing economy-wide policies relating to monetary, fiscal and trade policies amongst others. Such effects could be examined from a comparative static or dynamic perspective, emphasising the short, medium or long run.

²⁴For a detailed discussion of the spending and investment effects see Corden and Warr (1981)

²⁵ The domestic non oil goods could be grouped as non traded and non oil traded goods as used in this section, but it could also be grouped just as non oil traded goods as used by such as Buiter and Purvis (1983). For further detail see also Corden (1982).

The focus of this chapter is upon contrasting the economic effects arising from an oil boom, where either a comparative static or dynamic approach is adopted. Both of these, however, can be regarded as complementary to the other, although the dynamic framework is more useful if a policy orientation to the oil boom is taken into account.

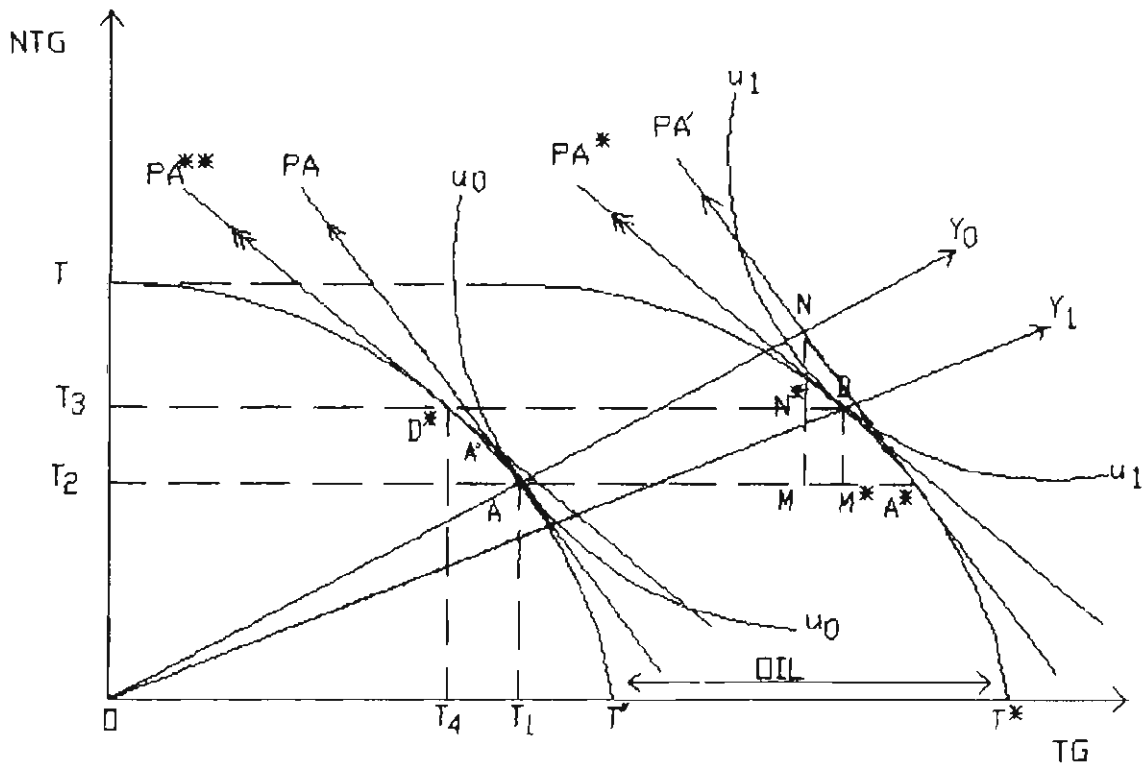
3.2 A Comparative Static Analysis Arising From An Oil Shock

The discussion of this concept will draw on that of Corden (1982a, 1982b), Corden and Neary (1982), Corden and Warr (1981), Forsyth (1982), and Gregory (1976). To analyse, in a more rigorous fashion, the effects previously identified, the study will make use of the diagrammatic analysis developed by Salter (1959) in his analysis of "Internal and External Balance." In this it is assumed that a country produces two composite goods: a tradeable good for which prices are set by world prices, and a non tradeable good the price of which is free to move to equilibrate domestic demand and supply. By definition, traded goods are those goods that can be traded internationally. Non traded goods are those goods that are costly to export, and also those tradeable goods that are subject to binding quotas and price control²⁶. The real exchange rate is therefore, the price of non oil traded goods relative to the price of non traded goods. Other assumptions are that both goods are normal goods, that is increased income leads to increased demand for these goods and pushes prices up. Both goods are substitutes in both production and consumption. That is an increase in the price of one good reduces demand for this good, and increases demand for the other good. On the production side, an increase in the price of one good increases production of this good and reduces production of the other good assuming full employment. To simplify the argument it is assumed that: there are only two inputs available; that capital is fixed in each industry, and that labour is mobile among industries; that neither labour nor capital is mobile internationally; and that there is full employment of these inputs. The oil boom

²⁶For a detailed discussion of traded and non traded goods see Corden (1982).

is assumed to arise from an oil discovery with all production exported. The effects of the boom are analysed with the aid of Figure 3.1.

FIGURE 3.1
Real Effect of an Oil Shock



The horizontal line represents the output of tradeable goods, including oil and non oil tradeable goods, and the vertical line represents the output of non tradeable goods. The schedules TT and U_0 respectively represent the production possibility frontier and society's indifference curves prior to the oil boom. Hence, prior to the oil boom a country will only produce non traded and non oil traded goods domestically. If this assumed domestic demand is equal to domestic supply at point A, then that non oil traded production is OT_1 , and non traded production is OT_2 . The relative price at point A is given by the slope PA, that is at a tangent to both the production possibility frontier and the indifference curve. At point A the economy is in equilibrium, and output or

income is equal to demand or expenditure. The expansion of OY_0 reflects the demand expansion path when relative prices are held constant at PA , and national income increases.

3.2.1 Spending Effects.

It is assumed that producing oil does not use domestic resources, hence it has no investment effects. Therefore an oil boom, such as an oil production (income) boom, is equivalent to a windfall gain to the country, assuming no domestic consumption of oil. An increase in oil production (oil income) shifts the production possibility frontier vertically to the right from TT' to TT^* , while the production possibility frontier for non traded and non oil traded goods remains at TT' . At TT^* total production (income) is at A^* , which is made up of domestic production of non traded goods and non oil traded goods, which remains at A , while AA^* is the oil production.

At the new income A^* and the relative price PA' , which is parallel to PA , the desired spending for non oil output is at point N , moving along the income expansion path OY_0 . The new desired demand N is not an equilibrium point, as producers are willing to produce at point A^* but the consumer wants to consume at point N . At point N , therefore, there is excess demand for non traded goods by NM , as the production of non traded goods remains at point A for the relative price PA , and excess demand for non oil traded goods is AM , which leaves MA^* as a balance of payments surplus.

To restore the equilibrium demand and supply at the TT^* locus the relative price of traded goods to non traded goods has to fall, hence the real exchange rate has to appreciate in order to reduce the excess demand for the non traded good and to get the balance of payments to equilibrium (equal to zero). The real exchange rate appreciation arises either from an increased non traded goods price if the nominal exchange rate is fixed, or a combination of increased non oil traded goods price and appreciation of the

nominal exchange rate if the nominal exchange rate is flexible. At the new relative price, PA^* , the equilibrium is then at point D, along the expansion path OY_1 . Hence an increase in income arising from the oil boom increases demand for non traded goods from M to N, but the appreciation of the real exchange rate lowers demand to N^* resulting in a net increase in demand for non traded goods by MN^* . On the other hand an increase in income arising from the oil boom increases demand for non oil traded goods from A to M, and the appreciation of the real exchange rate increases this further to M^* .

On the production side the appreciation of the real exchange rate tends to draw resources out of the non oil traded sector into the non traded sector, and at the same time reduces profitability in the non oil traded sector relative to the non traded sector²⁷. Hence at the new relative price PA^{**} , which is parallel to PA^* , the domestic production of non traded goods and non oil traded goods moves along the production possibility frontier TT' to point D^* , which is a new equilibrium of non traded and non oil traded production. In this new equilibrium output of non oil traded goods contracts from T_1 to T_4 , and non traded production increases from T_2 to T_3 . To accommodate the increased demand for non oil traded goods, imported non oil goods increase from D^* to D.

The above diagram shows clearly that there are "Dutch disease" effects as indicated by the contraction of non oil traded good output from point T_1 to the point T_4 , arising from the real exchange rate appreciation induced by the oil boom revenue. In aggregate, however, domestic absorption (welfare) improves, as represented by movement of the indifference curve from UU_0 to UU_1 . The magnitude of T_1T_4 and T_2T_3 depends on the slope of the production possibility frontier TT' , the slope of the

²⁷ An increase in the price of non traded goods relative to non oil traded goods will increase the cost of production in both sectors, as the production of non oil traded goods requires non traded goods. However, the price of non traded goods increases while the price of non oil traded goods is unchanged. Therefore producing non oil traded goods is less profitable than producing non oil traded goods, as the price of non traded goods increases whilst the price of non oil traded goods remain unchanged.

indifference curve UU_0 , the relative price of non oil traded to non traded goods and the size of the oil boom²⁸.

3.2.2 The Investment Effects

If the expansion of the oil sector requires domestic resources this will draw resources from the non oil sector to the oil sector, inducing the non oil sector to contract. In the above diagram, the production possibility frontier TT' as well as the T^*T' should shift inward toward the origin. This is also known as a *direct effect*. Assuming there are no spending effects, the effects of this investment effect on non traded and non oil traded goods depends on both factor mobility between the sectors and factor intensity. Both spending and investment effects could occur simultaneously²⁹.

3.2.3 Alternative Effects of the Booming Sector.

The basic assumptions of the above description are: that oil revenues are in the hands of the private sector; all of this revenue will be spent on consumption; that the government does not intervene in the domestic market in either goods or assets markets; and full employment exists. These assumptions imply that the effects of the oil revenue are entirely dependent on how the private sector responds to the revenue within the current state of the economy. The effects would differ if some of these assumptions were modified. The following discussion focuses on the results of government intervention in the domestic economy, the placing of oil revenue in the hands of government, and the existence of surplus labour. That is a shift of oil revenue from the private sector to the public sector, allowing for government intervention and abandoning the full employment assumption.

²⁸For further details see Warr and Cassing (1982), and Jones (1971). The latter is not precisely focused on the booming theory, but focuses on factor mobility which is the foundation for analysing the resource movement effects in booming sector theory. For an empirical analysis see for example Forsyth (1982).

²⁹For further details see Warr and Cassing (1982), and Jones (1971).

Firstly consider the case where all oil revenue is in the hands of the private sector, and the government wants to moderate the effects of the oil boom on non oil traded goods. This can be done, for example, by imposing tariffs on imported goods and/or providing subsidies to exported goods. Imposing tariffs on imported goods increases their price, and induces expansion of non oil traded goods production. Similarly, where the government subsidises the production of non oil traded goods, hence lowering the costs of production, this will also induce an expansion of non oil traded goods production. In the above diagram, domestic production moves from D^* along the TT' toward A , to a point such as A° . The government could also protect particular non oil traded goods. This policy however will increase the burden of the oil boom on the non protected non oil traded goods, and the sector may end up with a less efficient use of the gain from the oil boom. Gregory (1976) analysed the effects of mineral sector growth on traditional exports (agricultural exports) and import competing (manufacturing) goods in Australia. Similar studies have been done by Forsyth (1982) in the case of an oil discovery in the UK and Bruno and Sachs (1982)³⁰. All of them came to the same conclusion as discussed above.

Secondly, if all of the oil revenue is placed in the hands of the government the effects will depend on the governmental response to the use of the revenue. In this case such revenues would therefore have no direct effect upon the private sector. The Government could save or invest all of the revenue overseas with no resulting effects on the domestic economy. In the above diagram, domestic production will remain at A . The other extreme case is if the government spends all the revenue on consumption. In this case the effects will be at point D^* as discussed previously. However, if the government spends some of this oil revenue on consumption and investment, the economy will lie between A and N , whilst the domestic absorption would lie between D and A^* , the effects of which will depend on the distribution of this investment towards non traded and non oil traded goods. At the same time, the government could also intervene in the

³⁰Bruno and Sachs (1982) do not explicitly analyse the agricultural sector.

domestic economy to protect non oil traded goods. The effects of this would favour the protected sectors³¹.

Finally consider the case where there is a labour surplus in the economy, especially unskilled labour, and capital is free to move between industries. Labour is thus not a constraint to the production of domestic goods. The resource movement then occurs due to the movement of capital responding to an increase in oil income.

The above discussion is based on a short run comparative static analysis assuming that both the asset and goods markets will adjust simultaneously. Dornbusch (1976) argued that the asset market would adjust faster than the goods market if there is a shock to the economy. On impact the economy could overshoot or undershoot its long run equilibrium, and then both of these markets will adjust simultaneously and dynamically to the new steady state equilibrium. This issue will be discussed in the following section.

3.3 A Dynamic Analysis of the Economy Arising from Oil Related Shocks

This section will explore the dynamic adjustment processes arising in an economy experiencing an oil related shock, where this shock could be in the form of increased oil production or an increase in its price. The results derived provide an important extension to those derived from the comparative static framework. The dynamic analysis conducted will focus upon the contributions of Eastwood and Venables (EV)(1982), Buiter and Purvis (BP)(1982), Neary and van Wijnbergen (NW)(1984), Harvie and Gower (HG)(1993) and Charles Harvie (CH)(1993). By incorporating oil production each of these represent an extension to the framework developed by Dornbusch (1976). In these analyses a deterministic framework is adopted in which economic agents are assumed to possess rational expectations. This is equivalent to the case of perfect foresight. Financial markets are assumed to be in continual equilibrium whilst non

³¹See for example Corden (1977).

financial markets are subject to stickiness of price, and in the more extended versions quantity adjustment, and can be in disequilibrium throughout the adjustment process.

As is well known in the literature³², such models are characterised by a stable saddlepath property. If there is a shock to the economy non predetermined, or jump, variables are required to put the economy on to this stable saddlepath instantaneously, which will then ultimately take the economy to its new steady state equilibrium. Traditionally financial variables, such as the exchange rate or the interest rate, have taken the role of jump variables, implying that such variables contain information on the required evolution of the economy to steady state. Non financial variables, such as the price level and output, are assumed to be predetermined, or non jump, variables, incapable of adjusting instantaneously. It is the latter assumption, namely presumed sluggishness of adjustment, which contributes to the dynamics of adjustment. If all variables adjusted instantaneously the economy would merely adjust instantaneously to its new equilibrium steady state.

The models identified in this section can be usefully classified as being either short or long run. The EV, NW and BP models can be regarded as being in the former category, whilst the HG and CH models are in the latter category. A major distinction between these is that in the long run models, explicit consideration is given to the accumulation of physical capital stock, and hence emphasises the longer term development of the economy, as well as developments in the current account. Each of these categories of dynamic models are now discussed in turn.

3.3.1 Short Run Models

The key assumptions underlying the short run models are as follows. Firstly the oil revenues are seen as representing a windfall gain to the economy, affecting it through

³²See Buiter and Purvis (1982) for example.

the expenditure generated from these revenues. Secondly the oil revenues accrue primarily to the private sector, with the government benefitting through its taxation policy. Thirdly, the economy is assumed to be a net oil exporter. Fourthly the economy produces a non oil good which can be consumed domestically or exported, and is an imperfect substitute for the overseas equivalent. Fifthly the economy is operating with a perfectly flexible exchange rate, and finally there is assumed to be perfect capital mobility.

The EV and NW models emphasise the role of permanent income in the transmission of the effects of an oil related shock to the economy. Such a change could implicitly arise from an increase in permanent oil output or permanent oil prices, although such a distinction is not explicitly allowed for. This effect upon permanent income can be more usefully described as a wealth effect. Such a wealth effect is allowed for also in the BP model, but in addition oil production and oil price changes can generate an effect upon current income. This income effect arises from the current production of oil, as well as from changes in its price. Hence the BP model is capable of identifying the dynamic adjustment processes arising from oil related shocks affecting permanent oil income, actual oil production and oil price. The approach adopted here is to focus upon the BP model, but also contrasting it with the other two models.

BP Model

$$y = v y_{dno} + (1 - v) y_{do} + (1 - v - \alpha_2) p o^* + (\alpha_1 - v)(e - p n) \quad (1)$$

$$y^p = v y_{dno}^p + (1 - v) y_{so}^p + (1 - v - \alpha_2) p o^* + (\alpha_1 - v)(e - p n) \quad (2)$$

$$y_{dno} = \beta_1 y + \beta_2 y^p + \beta_3 (e - p n) - \beta_4 (r - \dot{p} n) \quad (3)$$

$$p c = \alpha_1 p n + \alpha_2 (e + p o^*) + (1 - \alpha_1 - \alpha_2) e \quad (4)$$

$$\dot{p} n = \phi_1 (y_{dno} - \overline{y_{sno}}) + \dot{m} \quad (5)$$

$$m - pc = \varepsilon_1 y - \varepsilon_2 r + \varepsilon_3 y^p \quad (6)$$

$$e = r - r^* \quad (7)$$

$$c = e - pn \quad (8)$$

$$l = m - pn \quad (9)$$

All variables are in natural logarithmic form except for the domestic and foreign nominal interest rates. The model consists of 9 equations with 9 endogenous variables and 8 exogenous variables. The endogenous variables are; y_{dno} (demand for non oil output), y (real income), y^p (permanent income), e (nominal exchange rate), pc (consumer price level), r (domestic nominal interest rate), c (real exchange rate), l (real money balances), and pn (non oil price level). The exogenous variables are; $ysno$ (natural level of non oil output), y_{dno}^p (permanent non oil output), y_{so} (actual oil production), y_{so}^p (permanent oil production), r^* (world interest rate), m (money stock), p^* (price of the imported non oil good in foreign currency) and po^* (price of oil, in foreign currency). The sign of each parameter represents the partial elasticity of each variable on the right hand side of each equation, with respect to each variable on the left hand side of each equation. Equation 1 identifies total spending (demand) on non oil output. This depends on real income and permanent income, and negatively on the real exchange rate ($e - pn$), defined here as the nominal exchange rate deflated by the domestic price of the non oil good, and negatively upon the real interest rate (the nominal interest rate less the rate of inflation).

Equation 2 shows that real income depends upon non oil output, oil production, the world price of oil expressed in overseas currency and the real exchange rate. The parameter v represents the share of non-oil production in total value added. It is further assumed that v does not change with oil production (see Buiter and Purvis, 1982). If the share of oil output in domestic real income ($1 - v$) is larger than its share in domestic

consumption (α_2), this economy will be an oil exporter which is the case emphasised throughout³³.

Equation 3 identifies the economy's permanent income, derived in a similar fashion to that of real income, consisting of that from non oil and oil production. The actual real exchange rate, world price of non oil output and oil price, and not their permanent equivalents, are used to calculate permanent income (see Buiter and Purvis, 1983). For simplicity the parameter v has the same characteristics as that for the parameter v in equation 2.

Equation 4 identifies the consumer price level, which is a weighted average of the domestic price of the non oil good, the domestic currency cost of oil and the domestic currency cost of the non oil imported good.

The adjustment of the domestic non oil good price is generated by an expectations augmented Phillips curve, as given by equation 5. Such adjustment arises from demand pressure for non oil output relative to its available supply, as given by its natural level of output, and inflationary expectations which are assumed to be based upon the monetary growth rate.

Money market equilibrium is characterised by a conventional LM equation, as in equation 6, in which demand for real money balances (the nominal stock (m) deflated by the consumer price level), depends upon real income, representing a transactions demand, the domestic nominal interest rate and permanent income representing an asset demand for money. This market is assumed to be in continual equilibrium.

Equation 7 shows the uncovered interest parity condition, embodying the assumption of perfect capital mobility and perfect foresight in the foreign exchange market. Equation 7 is also assumed to hold continuously. Finally, equations 8 and 9

³³See Buiter and Purvis (1982) for example.

define two variables which are used extensively throughout, the real exchange rate (c) and real money balances (l) respectively.

From the above model equations the main differences and similarities between the BP, NW and EV models can be identified. These are as follows. Firstly the BP model distinguishes between non oil output and real income, although no such distinction is found in the EV and NW models. Arising from this, equation 2 drops out entirely from the latter two models. Secondly the BP model identifies that oil production contributes to both current and permanent income, whilst the EV and NW models focus only upon its contribution to permanent income. Hence equation 3 simplifies to $y^p = o^p + e + po^* - pc$ in the EV and NW models. Thirdly both BP and NW argue that permanent income affects both the demand for real money balances and non oil output, whereas EV has permanent income only affecting the demand for non oil output ($\epsilon_3 = 0$). The implications arising from these three main distinctions between the BP, NW, and EV models will be discussed further, after discussion of the long run models.

3.3.2 Long Run Models

The long run models for analysing the effects of oil shocks, that is those of HG and CH, are now considered. There are five main extensions to the short run models contained in the long run models. These are the inclusion of the physical capital stock, the current account, a broadening of the components of wealth, emphasis on the supply side of the economy and the inclusion of sticky quantity adjustment.

Both HG and CH argue that in analysing the dynamics of adjustment arising from an oil shock, emphasis should be placed upon the long term nature of that adjustment. Such shocks will have an impact upon capital stock accumulation, and hence investment and the longer term development of the economy, which can only be captured by taking a long term perspective. In addition external equilibrium is required for steady state to be

achieved, since this will have wealth implications and consequently ramifications for the demand for output and financial assets.

The major difference between the HG and CH models is that the former assumes a perfectly flexible nominal exchange rate, whereas the latter assumes that the nominal exchange rate is fixed. Focus is now placed upon the HG model and its differences from the short run models discussed previously. The former model consists of the following equations which are categorised under the following broad headings - goods market, price/wage nexus, asset market, foreign trade sector and definitions:

HG Model

Goods market

$$y = v_{ysno} + (1 - v)y_{so} + (1 - v - \alpha_2)po^* + (\alpha_1 - v)(e - w) \quad (1)$$

$$y^p = v_{ysno^p} + (1 - v)y_{so^p} + (1 - v - \alpha_2)po^* + (\alpha_1 - v)(e - w) \quad (2)$$

$$y_{dno} = \beta_{11}y + \beta_{12}w^e + \beta_{13}(\dot{k} + \beta_{14}k) + \beta_{15}g + \beta_{16}not \quad (3)$$

$$\dot{k} = \Phi q \quad (4)$$

$$y_{sno} = \beta_{21}k - \beta_{22}(w - pc) \quad (5)$$

Prices/wages

$$pc = \alpha_1 w + \alpha_2(e + po^*) + (1 - \alpha_1 - \alpha_2)e \quad (6)$$

$$\dot{w} = \phi_1 + \phi_2(y_{dno} - \overline{y_{sno}}) + \dot{m} \quad (7)$$

$$\pi = \dot{m} \quad (8)$$

Asset Markets

$$m - pc = \varepsilon_{11} y - \varepsilon_{12} r + \varepsilon_{13} w^e \quad (9)$$

$$\dot{e} = r - r^* \quad (10)$$

$$R = \varepsilon_{21} + \varepsilon_{22} y - \varepsilon_{23} k \quad (11)$$

$$\dot{q} = \delta_3^{-1} (q - \delta_1 R + \delta_2 (r - \pi)) \quad (12)$$

$$w^e = \varepsilon_{31}(f + e - pc) + \varepsilon_{32}(m - pc) + \varepsilon_{33}(k + q) + \varepsilon_{34}y^p \quad (13)$$

Foreign sector

$$\begin{aligned} \dot{f} &= \rho_{11} not + \rho_{12} r^* f + \rho_{13} (ot + po^*) \\ &\quad - (1 - \rho_{11} - \rho_{12}) (e - pc) \end{aligned} \quad (14)$$

$$not = \rho_{21}(e + p^* - pc) - \rho_{22}y + \rho_{23}y^* \quad (15)$$

$$ot = -\psi_1 or + \psi_2 (yso - y) \quad (16)$$

Definitions

$$c = e - w \quad (17)$$

$$l = m - w \quad (18)$$

All variables are in natural logarithmic form except for the domestic and foreign interest rates, as for the short run models. The notation utilised here is the same as that used for the short run model. The model consists of 17 endogenous variables and 8 exogenous variables. The endogenous variables are y , y^p , $ysno$, $ydno$, e , pc , r , c , l , as in the short run model, and the rest are w (the nominal wage rate, which is equivalent to that of pn used in the short run models), $ysno$ (non oil output supply), w^e (real wealth of the private sector), k (capital stock), not (non oil trade balance), q (Tobin's q), R (real profit), f (foreign asset stock) and ot (oil trade balance). The exogenous variables are

y_{so} , y_{so}^p , y_{sno}^p , r^* , m , p^* , p_o^* , as in the short run model. The parameter in front of each variable indicates its partial elasticity.

Equilibrium in the model depends upon equilibrium in the goods market, asset market and foreign trade sector. Equilibrium in the goods market is discussed first. Total spending (demand) on non oil output (y_{dno}) is given by equation 1. It depends on real income, domestic gross investment ($\dot{k} + \beta_4 k$), where β_4 is the rate of capital stock depreciation, government expenditure, the non oil trade balance, and domestic private sector real wealth.

Real income is given by equation 2. It is the same as that for the short run model, except that the real exchange rate is emphasised here as being $(e - w)$, that is the nominal exchange rate deflated by the nominal wage rate.

Equation 3 identifies the economy's permanent income, which is the same as in the short run model except for the definition of the real exchange rate $(e - w)$. Equation 4, the investment equation, captures the partial adjustment hypothesis. This partial adjustment arises from costs of adjusting the physical capital stock to the desired capital stock, as in equation 4a:

$$\dot{k} = \phi(k^* - k) \quad 4a$$

with the desired capital stock depending upon its market value as given by equation 4b:

$$k^* = k + q \quad 4b$$

where q is Tobin's q , the ratio of the marginal market valuation of capital relative to the replacement cost of the capital. Substituting 4b into 4a equation 4 can be obtained. Hence net investment adjusts positively to Tobin's q .

The supply of non oil output is endogenously determined, fluctuating in the long run, as well as the short run, as given by equation 5. This relates non oil output supply negatively to real wages but positively to the physical capital stock.

Price and wage developments are given by equations 6 and 7. Emphasis is placed upon the sticky or slow adjustment of nominal wages. Equation 6 identifies the consumer price level, which is a weighted average of nominal wages, the domestic currency cost of the overseas imported non oil good and the domestic currency cost of oil. The adjustment of domestic wages is generated by an expectations augmented Phillips curve, as given by equation 7. Such adjustment arises from three possible sources: developments in productivity, wage fixing or bargaining (ϕ_1); excess demand for labour as measured by current production of non oil output relative to its potential output; and inflationary expectations. Inflationary expectations adjust continually with developments in the monetary growth rate (equation 8).

Asset market equilibrium is given by equations 9 - 13. There are three non money assets in the model (domestic bonds, equities (representing claims to the ownership of the capital stock in the private sector), and foreign bonds). All financial assets are assumed to be perfect substitutes, with arbitrage between them resulting, instantaneously, in the same expected rate of return.

Money market equilibrium is characterised by a conventional LM equation, as in equation 9, incorporating domestic real wealth. Demand for real money balances (the nominal stock m deflated by the consumer price level p_c) depends upon real income, representing a transactions demand, the domestic nominal interest rate and domestic real wealth representing an asset demand for money. This market is assumed to be in continual equilibrium.

Equation (10) embodies the assumption of perfect capital mobility and perfect foresight in the foreign exchange market, and can be interpreted in a similar fashion to that of the short run model equation 7. Real profit, or the return on capital services, is given by equation 11, and is assumed to be an increasing function of real income and, due to diminishing marginal productivity, a decreasing function of the capital stock.

Since domestic financial assets are perfect substitutes, from the perspective of domestic residents, the expected returns on these are assumed to be equated continuously. The expected real return on domestic bonds³⁴ is equivalent to:

$$r - m$$

where m represents inflationary expectations. This is continuously equivalent to the real rate of return on domestic equities. The expected real return on holding equities is given by equation 12a :

$$\dot{q}/q + R/q \quad 12a$$

where q is the value (real) of these equities, and R the real profit stream derived from the capital services. That is, the expected return depends upon the expected capital gain/loss from holding equity capital \dot{q}/q , where $\dot{q} = 0$ in steady state, plus the real profit derived from the capital services R relative to q . Continual and instantaneous arbitrage between domestic bonds and equities implies :

$$\dot{q}/q + R/q = r - m \quad 12b$$

³⁴Possible capital gain/losses on holding the bonds are ignored.

and taking a log linear approximation we can solve for q

$$q = \delta_1 R - \delta_2 (r - m) + \delta_3 \dot{q} \quad 12c$$

or re-arranging, and solving for \dot{q} , we obtain equation 12.

Domestic private sector real wealth is given by equation 13. This consists of real money balances ($m - pc$), the real value of the physical capital stock held by the private sector, consisting of a physical quantity (k) and its market valuation (as given by q), permanent income and the real domestic currency value of domestically held foreign assets (bonds). Domestic bonds are assumed to be inside bonds, that is they are issued and held by agents in the same sector which in this case is the private sector. These bonds, as with equities, are assumed to be held only by domestic residents. The overseas sector consists of the current account (f), the non oil trade balance (not) and actual oil exports (yso).

Developments in the current account are given by equation 14a:

$$\begin{aligned} \dot{f} + e - pc = & \rho_{11} (ot + po^* + e - pc) \\ & + \rho_{12} not + \rho_{13} (r^* f + e - pc) \end{aligned} \quad 14a$$

Rearranging 14a and expressing this in terms of changes in foreign asset (bond) holdings, equation 14 is obtained. This indicates that the accumulation/decumulation of foreign assets, as reflected in the current account balance (\dot{f}), depends upon actual oil exports, the non oil trade balance and real interest earnings on foreign assets ($r^* f$). In long run steady state the current account balance must be zero, otherwise further wealth effects will arise requiring further macroeconomic adjustment.

Equation 15 specifies the non oil trade balance. This depends positively upon the real exchange rate ($e - pc$), negatively upon domestic real income and positively upon world real income (y^*). The oil trade balance, equation 16, depends negatively upon minimum domestic requirements of oil for domestic consumption, and positively upon the ratio of actual oil production to real income. Finally, equations 16 and 17 define two variables used extensively throughout this study.

The CH model is essentially the same as the HG model, except for the assumption that the economy is now operating with a fixed rather than a flexible exchange rate. With the nominal exchange rate fixed, the nominal money stock now becomes an endogenous variable. Hence equation 10 is replaced by equation 10a.

$$e = r - r^* \quad 10$$

$$m = dce + res \quad 10a$$

The money supply depends upon increases in the domestic component of the money supply, described here as domestic credit expansion (dce), which is exogenous, and changes in foreign exchange reserve (res). Developments in foreign exchange reserves depend upon developments in the balance of payments, which are influenced by capital flows, either inflows or outflows, and the current account as in equation 10b.

$$res = r - r^* + f \quad 10b$$

The capital flows depend upon the interest rate differential between the domestic and overseas interest rate ($r - r^*$), whilst the current account position is indicated by the accumulation/decumulation of foreign financial assets. The maintenance of a fixed nominal exchange rate will result in balance of payment surpluses or deficits, and the accumulation/decumulation of foreign exchange reserves. This will impact upon the domestic money supply.

Substituting equation 10b into 10a will give equation 10c.

$$\dot{m} = r - r^* + \dot{f} + dce \quad 10c$$

In the following section, the similarities and differences between the models identified in this section are discussed at greater length.

3.4 The Major Similarities and Differences

Due to the large size of the models identified, it is not possible to derive analytically unambiguous results for all of their steady state properties arising from oil related shocks. In order to overcome this difficulty a numerical simulation procedure can be adopted, enabling a comparison of the adjustment processes arising for each shock in each model.

Harvie (1994) conducted a comparative simulation analysis of the models discussed, by imposing numerical values upon the parameters of the models. To generate such a numerical simulation a program known as "Saddlepoint"³⁵ was utilised. This is a program for solving linear rational expectations models with constant coefficients. It is the continuous time analogue of the solution to linear difference models with rational expectations studied in Blanchard and Khan (1980)³⁶. Before the simulation can be conducted it must be ensured that each model is dynamically stable. That is the control variables must adjust in such a fashion which is consistent with the underlying behavioural assumptions of the model.

Harvie (1994) conducted three oil shock simulation cases, with a 10% increase from base level assumed in each case. The shocks focussed upon were an increase in

³⁵Before the simulation can be conducted it must be ensured that each model is dynamically stable. For details of this see Harvie (1993, p. 14-15), and appendix to Chapter 4.

³⁶See also Austin and Buiter (1982).

permanent oil output (wealth), an increase in oil production and an increase in the price of oil. The analysis emphasised the adjustment of a number of key macroeconomic variables including that of non oil output, real income, inflation, foreign asset stocks, the non oil trade balance and the real exchange rate, and the results were broken down into three periods - the short run, medium run and long run. It can be shown that the parameter values chosen ensure model stability, in that the control variables adjust in such a manner which is consistent with the model's underlying assumptions. The steady state results³⁷ derived for a 10 per cent oil price increase is summarised in Table 3.1.

Table 3.1 shows the directional change from an initial equilibrium to the new steady state, arising from an oil price increase. The results suggest that Dutch disease consequences are possible from these results, as indicated by the appreciation of the real exchange rate, resulting in a relative decline in exportable goods. However such an inference is made without an explicit breakdown of non oil goods into those which are tradeable and those which are non tradeable. In addition it can be observed that overall real income increases, hence there is unlikely to be an absolute decline in the production of any category of goods.

In the EV, NW and BP models, non oil, which is also equivalent to real income, remains unchanged, constrained at the natural level of output. In the HG and CH models non oil output increases, arising primarily from an increase in capacity output induced by the accumulation of physical capital stock. In addition the latter models indicate an increase in real wealth, including an accumulation of foreign asset stocks arising from developments in the current account.

³⁷See Harvie (1994, p.14-15)

TABLE 3.1
A Summary of The Similarities and Differences
Amongst the Models

Variables	Short Run			Long run*	
	EV	NW	BP	CG	CH
l	+	+	+	+	+
c	-	-	-	-	-
y#	?	?	?	+	+
ysno	0	0	+	+	+
w ^e	?	?	?	+	+
k	?	?	?	+	+
not	?	?	?	+	+
f	?	?	?	+	+
g	x	x	x	x	x

+ increase (depreciation)
 - decrease (appreciation)
 ? change is not known, as not explicitly included in the model
 # a distinction between y and ysno/ydno is not made in the EV and NW models, however such a distinction is made in the BP model. The BP model however does not focus upon the difference between non oil output supply and demand. In essence they are assumed to be the same.
 * in steady state, the result is identical for both the fixed and flexible exchange rate regimes.
 x exogenous to the models.

The adjustment process can be summarised as follows. In the short term the magnitude and length of the adjustment process is smaller and faster for the short run models. The incorporation of capital stock and foreign asset stock accumulation, considerably extends the period of time over which the new steady state equilibrium is achieved. In the context of the long run models, the incorporation of a fixed exchange rate suggests that there will be greater volatility during the adjustment process of key macroeconomic variables in comparison to that with a flexible exchange rate³⁸.

³⁸See Harvie (1994).

3.5 Amendments for the Indonesian Economy.

The above models are able to identify the likely economic adjustment processes arising from the major sources of oil related shocks, specifically those arising from actual oil output, permanent oil output and oil price. The framework is able to identify the adjustment of macroeconomic variables, such as domestic non-oil output, real income, wealth, and trade in both oil and non oil output arising from these shocks. During the adjustment process, some economic variables may be better or worse off than in the steady state equilibrium. Knowledge of the possible outcomes during the adjustment process is equally important for government, producers and consumers in optimising the benefits from the oil boom and offsetting its adverse effects as well. These implications are especially important for a developing economy such as Indonesia, as most producers and consumers are small in size.

The long run assumption of the HG and CH studies are of particular relevance to the Indonesian economy, as the government spends some of the oil revenue directly on investment, equal to a capital transfer to the private sector, which will induce capital accumulation in the private sector and thereby affecting capacity output of non oil production. The importance of capital stock accumulation, hence focussing upon the longer term development of the economy, is highly relevant for an economy such as Indonesia which is growing very rapidly.

However all of the models discussed above have been based upon the existence of an already developed economy, so that a number of their underlying assumptions are not appropriate for a developing economy. Hence a number of amendments are required in order to make this basic framework relevant to the study of an economy such as Indonesia. There are four major amendments required for the case of Indonesia. Firstly, unlike those of earlier models, both oil production and its revenue are in the hands of government. Secondly, in Indonesia, both financial and capital markets are highly

controlled by the government. Indonesia has experienced both fixed and flexible nominal exchange rates. The latter, however, more closely resembles that of a managed float. Finally, Indonesia has abundant labour, especially unskilled labour, hence it is not a constraint on domestic production. Such amendments are likely to generate different results, in the process of both economic adjustment towards the long run equilibrium and the long run equilibrium itself. The detail of these amendments will be further discussed, along with the development of the model for the Indonesian economy, in the next chapter.

3.6 Summary and Conclusions

The focus of this chapter, has been upon contrasting and comparing a variety of models in order to analyse the effects arising from oil related developments. This was conducted initially within the context of a comparative static and then a dynamic framework. The objective of this was to identify a useful starting point for the analysis of oil shocks for the Indonesian economy.

Irrespective of whether the framework is comparative static or dynamic, "Dutch disease" effects arising from oil shocks appear in all of them. This is primarily brought about by an appreciation of the real exchange rate, through either an increase in the price of non traded goods, if the nominal exchange rate is fixed, or a combination of an increase in the price of non traded goods and appreciation of the nominal exchange rate if the exchange rate is flexible.

In the static model, as well as in the short dynamic run models such as EV, NW, and BP in steady state, non oil output remains unchanged. In the dynamic long run models, however, non oil output increases. This is induced by allowing for an accumulation of physical capital stock. This is the main contribution of the dynamic long run models over both the static and dynamic short run models. Overall the domestic

economy benefits from oil related shocks, as indicated by increased domestic absorption of both non traded and non oil traded goods in the long run models.

The short and long run dynamic models show the adjustment of the economy towards steady state equilibrium in response to an oil related shock, whilst this is clearly not possible with the static model. During the adjustment process some economic variables may perform better or worse than in the steady state equilibrium. Hence the identification of possible adjustment processes of the economy arising from oil related shocks can be identified and be of benefit both to the government and economic agents, by identifying policies which could be implemented in order to overcome some of the less desirable features of the adjustment process and thereby enhance the benefits from such shocks.

These different models provide significantly different results arising from the effects of oil related shocks on the domestic economy, arising from different assumptions and structures of the models as previously discussed. This suggests that to analyse the economic effects of oil related shocks on a particular country, a careful understanding of the economic structure of that country and also how the oil related shock is transmitted into that economy is required.

The most appropriate model for analysing the economic effects of oil related shocks on Indonesia is a dynamic and long run model. This will both capture the use of the oil revenue on investment, and utilise the rational expectations assumption. Unlike the HG and CH models, the assumptions underlying the asset market, the nominal exchange rate, the capital market, and the labour market need to be amended in order to make such a framework more representative of the Indonesian economy. This is conducted in the following chapter.

CHAPTER 4

THE OIL RELATED MODEL FOR INDONESIA

4.1 Introduction

This chapter is concerned with modelling the macroeconomic consequences of oil related shocks for the Indonesian economy. The model will explicitly incorporate the characteristics of the oil sector, as well as the structure of the Indonesian economy, as discussed in Chapter 1. The model emphasises the long term nature of the dynamic adjustment process, recognising the contribution of the oil boom to the development of the Indonesian economy (see chapters 2 and 3). The economic development emphasised here is that in regard to real income, non oil production which is equivalent to private sector real income, physical capital stock, foreign asset stock, non oil trade balance, real exchange rate, inflation rate, private sector real wealth, and real oil income itself. The basic framework adopted is that developed by CH for the case of a fixed exchange rate and HG for a flexible exchange rate.

The model will focus upon the existence of a fixed exchange rate regime, and a high degree of control over international capital mobility. This is to represent the Indonesian economy during the oil booms of OPEC I (1973/1974) and OPEC II (1979/1980), and is considered as being the base case. This model is capable of incorporating alternative government policy responses toward the allocation of oil production for either domestic usage or export, and the spending of the oil revenue either upon investment or consumption. In the context of the model these represent the two key policy issues directly relating to oil production, having important policy implications for the development of the Indonesian economy as mentioned above. These issues will be discussed in the first part of Chapter 6.

The model is also capable of incorporating different degrees of control over the capital market, along with the adoption of either a fixed or perfectly flexible exchange rate regime. These are highly relevant for Indonesia as its economy is gradually integrated with the global market economy. In the context of the model these represent key policy issues which will be focussed upon, and are discussed further in the second part of Chapter 6.

The arguments and the assumptions underlying the model will be discussed in detail in the following section, and the model itself will be presented in the third part of this chapter. To analyse the macroeconomic effects arising from oil related shocks, the model is simulated by using a numerical algorithm known as "Saddlepoint". The properties and procedure of this simulation will be discussed in the fourth section of this chapter. To generate results for the Indonesian economy, the parameters, for simulation purposes, will be empirically computed or estimated where possible by using Indonesian quarterly data from 1973 to 1991. The method of estimation and the source of the data will be discussed in the fifth section of this chapter. The parameters and the simulation results of the base model will be presented in the next chapter, and the simulation results of the alternative policies will be presented in Chapter 6.

4.2 The Model's Underlying Assumptions

This section will discuss the key assumptions underlying the theoretical model, some of which have already been alluded to previously in Chapter 1. The basic assumptions adopted are as in the CH and HG models, such as: the model is dynamic and focusses upon the long run; economic agents possess rational expectations; the domestic economy produces one composite non oil good which can be consumed domestically and is an imperfect substitute for the imported good³⁹; an oil boom affects the domestic

³⁹Domestically produced non oil goods in reality consist of both non oil traded and non traded goods. However due to limitation of available data, and to reduce the complexity of the model, these two good are combined, as with the other theoretical models, to become a composite non oil good whose price is determined domestically.

economy through the spending it generates. The assumptions are similar to that of the CH and HG models, and will therefore not be discussed further here. There are six main extensions to the CH and HG models. Firstly, oil production and oil revenue generated are primarily under government control. Hence only non oil production takes place primarily in the private sector, producing what is equivalent to private sector real income. This assumption represents a major departure from the existing theoretical models which were discussed in chapter 3. Most importantly this assumption has significant implications for modelling the economic effects of an oil boom on an economy such as Indonesia, as will be discussed in the following section.

In this model the government is assumed to allocate all of oil production for either domestic usage or export, and spend all of the oil revenue⁴⁰ generated. Such expenditure can be on both consumption and investment, with the latter being equivalent to a capital transfer to the private sector⁴¹. These assumptions would lead to different adjustment paths, as well as steady state of the economy, to those of the models identified in Chapter 3.

In addition to a government capital transfer to the private sector, benefits from the oil sector also directly arise from the foreign exchange generated from oil exports and indirectly through the spending of the oil revenue (spending). These will have further implications for the adjustment of non oil output, foreign asset stocks and private sector real wealth.

The second key assumption of the model is that it is set in the context of a dynamic long run framework, as with the CH and HG models. An oil boom generates both physical capital stock accumulation in the non oil sector as well as foreign asset

⁴⁰It is also assumed that there is no income tax. Hence government income is generated solely from the oil sector. This enables focus to be placed upon an analysis of the ways in which government-initiated policies in terms of oil production and revenues, impact upon key macroeconomic variables. It is easy to incorporate government income from other sources such as income tax and foreign borrowing, as discussed in Chapter 2, but this would unnecessarily complicate an already complex model.

⁴¹See footnote 3 to Chapter 1, and Chapter 2.

stock accumulation. The former is partially induced by government capital transfers to the private sector, through development expenditure. This will make an important contribution to enhancing the productive capacity of non oil output, which in the post oil boom period will be essential. The distribution of oil production, as well as the distribution of the oil revenue, is primarily politically determined, and in the context of the model is assumed to be exogenous. These represent two key policy issues which are simulated, and the results compared for varying policy stances regarding oil exports and the distribution of oil revenue between investment and consumption. These alternative policies allow the identification of appropriate policies that would reduce the possible Dutch disease effects, and optimise the benefits from the oil boom. Incorporating these two policy issues, however, does not require modification of the model, except for altering the parameters of the relevant variables and will be discussed in the first part of Chapter 6.

Thirdly the nominal exchange rate is fixed, as in the CH model, however the government controls capital markets. Indonesia's financial markets are in the process of being liberalised, but still have some way to go before full liberalisation is achieved as in most developing countries. This is the third main amendment of the CH model. This imperfect capital mobility, implies that the return on domestic financial assets is not equated continuously with that on foreign assets (bonds). This best represents Indonesia during the oil booms of OPEC I (1973/1974) and OPEC II (1979/1980) which is considered to be the base case.

These assumptions are gradually relaxed with reduced government controls on the capital market, and finally the case of full liberalisation in these markets is also adopted. At the same time the nominal exchange rate regime is changed from fixed to flexible⁴². It is relevant to adopt these assumptions for Indonesia, since its integration with the global market economy means that the government could not isolate the

⁴²Although the government adopted a flexible nominal exchange rate it is still considered as being primarily a managed float. To reduce the complication of the analysis, these two extreme cases were chosen.

domestic economy from developments in the world market. In fact the Indonesian government has engaged in substantial deregulation of the capital markets⁴³. These assumptions allow the identification of appropriate policies in regard to varying the nominal exchange rate regime and capital market controls, that would also reduce the possible Dutch disease effects and hence optimise the benefits from the oil boom. In the context of the model these represent further key policy issues which are simulated, and the results compared to the base case. Unlike policy issues relating to oil production and real oil revenue, to analyse these two policies issues requires modification of the base model as discussed in the second part of Chapter 6.

Fourthly the model assumes a deterministic framework, as with CH, in which economic agents are assumed to possess rational expectations. This is equivalent to the case of perfect foresight. Financial markets are assumed to be in continual equilibrium, whilst non financial markets are subject to sticky quantity adjustment. In the HG and CH models such sticky adjustment can arise from both sticky prices, such as nominal wages, and quantity adjustment. In the context of Indonesia there is labour surplus in the economy, and this is especially true of unskilled labour. Hence labour is not a constraint to domestic non oil production, and the assumption of sticky wage adjustment is not important in the context of Indonesia. Of greater significance is the lack both of capital and technology, and stickiness of adjusting these to increased demand arising from the oil boom (Warr, 1991, David, 1992). The assumption of labour surplus in the economy is related to the supply side of the economy. It assumes that there are two inputs available for the production of non oil output - labour and capital. In this model, however, only the physical capital stock is explicitly modelled, because labour, especially unskilled labour, is available in unlimited quantities and hence is not a constraint to the development of non oil output as previously discussed. Non oil output will then grow proportionally to the accumulation of the physical capital stock⁴⁴.

⁴³The government has lifted controls over the interest rate, but has retained control over other financial markets and variables. For detail see Boediono (1991).

Finally, the oil sector is assumed to generate permanent income, which constitutes an important component of the perceived wealth of the private sector. This could be justified on the basis that whilst the oil sector is controlled by government, the future revenue generated will have major benefits for the private sector.

These assumptions are summarised as follows: the model is dynamic and focusses upon the long run; economic agents possess rational expectations; the oil related shock affects the domestic economy through its spending effects, and hence there is no investment or resource movement effects; both oil production and revenue are in the hands of government and the government spends all the revenue, and this spending will affect the domestic economy indirectly through its effects on the real exchange rate and also directly through capital transfers to the private sector, which will induce the expansion of non oil output, and the accumulation of foreign assets generated from oil export revenue; there is surplus labour in the economy; the domestic economy produces one composite non oil good which can be consumed domestically and is an imperfect substitute for the imported good; and finally, the economy operates under a fixed nominal exchange rate with extensive governmental control over the capital market. The last two assumptions are ultimately abandoned to reflect a gradual movement towards a liberalised economy.

This amendment of assumptions leads to an extensive modification of the modelling of the macroeconomic consequences of oil related shocks for the Indonesian economy, in comparison to that of the CH and HG models. The model is now explicitly developed in the following section.

⁴⁴See for example Taguchi (1993), Malinvaud (1977, 1984), and Khan and Montiel (1989).

4.3 The Model

Four versions of the model for Indonesia are developed here. In the first version of the model the government adopts a fixed nominal exchange rate and exercises substantial control over capital markets. This is regarded as the **base model** as previously discussed. The other three versions of the model are amendments of the base model to allow for the possibility that an equivalent oil boom has occurred in an economy which is more market oriented, with reduced government controls over Indonesian capital markets and at the same time has moved from a fixed to more flexible nominal exchange rate regime.

In the second model, a fixed nominal exchange rate is maintained but allows for an equivalent oil boom occurring in the economy in which there is no government control over the capital market. Hence capital is assumed to be perfectly mobile internationally. In the third model the nominal exchange rate is assumed to be flexible, but the government retains control over Indonesian capital markets as in the base model. The final model to be developed is that for a fully liberalised economy, in which a flexible exchange rate regime is combined with perfect capital mobility. These extended models are capable of identifying appropriate policies, regarding the exchange rate and capital mobility, to reduce possible Dutch disease effects, and hence optimise the potential benefits from the oil boom. Modelling of the base case will be discussed first.

3.1 The Base Case

The model is divided into four sub headings; goods market, asset market, foreign sector and definitions.

Goods markets

$$y = v y_{sno} + (1 - v) y_{so} + (1 - v - \alpha_2) p o^* + (\alpha_1 - v)(e - p n) \quad (1)$$

$$y^p = v y_{sno}^p + (1 - v) y_{so}^p + (1 - v - \alpha_2) p o^* + (\alpha_1 - v)(e - p n) \quad (2)$$

$$y_{dno} = \beta_{11} c p + \beta_{12} i p + \beta_{13} g + \beta_{14} n o x - (1 + \beta_{11} + \beta_{12} + \beta_{13} + \beta_{14}) n o m \quad (3)$$

$$c p = \beta_{21} y_{sno} + \beta_{22} w e \quad (4)$$

$$i p = \dot{k} + \theta k \quad (5)$$

$$\dot{k} = \Phi q \quad (6)$$

$$g = \beta_{31}(y_{so} + p o^* + e - p c) \quad (7)$$

$$g i = \sigma g \quad (8)$$

$$g c = (1 - \sigma) g \quad (9)$$

$$y_{sno} = \beta_{41} + \beta_{42}(p n - p c) + \beta_{43} g i + \beta_{44} k \quad (10)$$

Prices

$$p c = \alpha_1 p n + \alpha_2(e + p o^*) + (1 - \alpha_1 - \alpha_2)(e + p t^*) \quad (11)$$

$$\dot{p} n = \phi_1 + \phi_2(y_{dno} - y_{sno}) + \pi \quad (12)$$

$$\pi = \dot{m} \quad (13)$$

Asset market

$$m = \varepsilon_{11} y_{sno} - \varepsilon_{12} r + \varepsilon_{13} w^e + p c \quad (14)$$

$$w^e = \varepsilon_{21}(f + e - p c) + \varepsilon_{22}(m - p c) + \varepsilon_{23}(k + q) + \varepsilon_{24} y^p \quad (15)$$

$$\dot{m} = \tau(r - r^* + \dot{f}) \quad (16)$$

$$R = \varepsilon_{31} + \varepsilon_{32} y_{sno} - \varepsilon_{33} k \quad (17)$$

$$\dot{q} = \delta_3^{-1}(q - \delta_1 R + \delta_2(r - \pi)) \quad (18)$$

Foreign Sector

$$\dot{f} = \rho_{11} \text{nox} - \rho_{12} \text{nom} + \rho_{13} r^* f + \rho_{14} (\text{ot} + \text{po}^*) - (1 - \rho_{13} - \rho_{14}) (e - \text{pc}) \quad (19)$$

$$\text{nox} = \rho_{21} (e + \text{pt}^* - \text{pn}) + \rho_{22} y^* \quad (20)$$

$$\text{nom} = -\rho_{31} (e + \text{pt}^* - \text{pn}) + \rho_{32} y \quad (21)$$

$$\text{ot} = (1 - \psi) y_{\text{so}} \quad (22)$$

Definitions

$$c = e - \text{pn} \quad (23)$$

$$l = m - \text{pn} \quad (24)$$

A dot (·) above a variable signifies its rate of change.

The model consists of 24 equations, 24 endogenous and 8 exogenous variables. All variables are in natural logarithmic form, except for the domestic and foreign interest rates. The parameter in front of each variable indicates its partial elasticity. Definitions of each variable, some of which are as in the CH model, are presented in Table 4.1 below.

TABLE 4.1
List of Variables

I. Endogenous Variables

y	total real income ¹
yP	total permanent real income
ysno	real non oil output (supply) ²
ydno	real non oil demand
g**	real government revenue (expenditure)
gc#	government consumption
gi#	government investment
cp#	private consumption expenditure
ip	private investment expenditure

pn	price of domestically produced non oil output ³
pc	consumer price index
r	domestic nominal interest rate
m	nominal money supply ⁴
w ^e	private sector real wealth
R	real profit on capital services
k	real physical capital stock in the private sector (non oil)
q	Tobin's q ratio
nom##	real non oil imports
nox##	real non oil exports
ot	physical trade in oil
f	net foreign asset stock in foreign currency
π	inflationary expectation
l	real money balances
c	real exchange rate

II. Exogenous Variables

ysno ^p	real non oil permanent income
yso ^p	permanent oil output
yso	actual oil production
po*	world price of oil (in foreign currency)
pt *	world price of the non oil traded good in foreign currency
e	nominal exchange rate ⁵
r*	world interest rate
y*	world real income

¹Equivalent to the sum of total real private sector income and real oil revenue, which is total domestic production.

²Equivalent to private sector real income.

³Which is equivalent to that of w used in the CH model.

⁴Exogenous if the nominal exchange rate is flexible.

⁵Endogenous if the nominal exchange rate is flexible.

**Exogenous in CH model.

#Not included in CH model.

##Using not (non oil trade balance) instead of nox less nom.

Equilibrium in the model depends upon equilibrium in the goods market, asset market and foreign trade sector. Equilibrium in the goods market will be discussed first.

Real income is given by equation 1 as in the CH model. In the CH model, however, such income accrues to the private sector, whilst in this study only real non oil income goes directly to the private sector with real oil income going directly to the government. This is a major departure from the model presented here and that of the CH model. Real

oil output will directly influence government income as well as its spending as in equations 7, 8, and 9, non oil output supply as in equation 10, and the allocation of oil production as in equation 22. Non oil output will directly influence private sector consumption, the money market and the real return on capital as in equations 4, 14 and 17.

The real exchange rate is emphasised here as being $(e - p_n)$, that is the nominal exchange rate deflated by the domestic non oil good's price. The price of non oil output used here is p_n , this is equivalent to w (nominal wage) used in the CH model. This difference arises from the assumption of a labour surplus in Indonesia, and hence the lack of relevance in this model of the nominal wage. This is a second major difference between this model and that of the CH model.

Equation 2 is also the same as in the CH model, except for the definition of the real exchange rate. However unlike current real income, permanent oil income is assumed to be entirely in the hands of the private sector as mentioned previously, hence permanent oil income directly benefits the private sector of the economy.

Total spending (demand) on non oil output is given by equation 3. It is a log linear approximation of total spending in the form of private consumption, private investment, total government spending and the non oil trade balance consisting of exports less imports. The parameters (β_{ij}) represent the weights of spending in each category.

Unlike the HG model, private sector consumption is explicitly modelled as indicated by equation 4. It is assumed to be positively related to non oil income, representing the private sector's income, and also positively to private sector real wealth. Private sector gross investment is also explicitly modelled, being determined by net investment and depreciation of the capital stock as in equation 5. By substituting equations 4 and 5 into equation 3, equation 3a can be derived, which is as in equation 3

if the CH model except that the non oil trade balance is disaggregated further into exports less imports.

$$\begin{aligned} y_{dno} = & \beta_{11}\beta_{21}ysno + \beta_{11}\beta_{22}we + \beta_{12}(\dot{k} + \phi k) + \beta_{13}g + \beta_{14}nox \\ & - (1 + \beta_{11}\beta_{21} + \beta_{11}\beta_{22} + \beta_{12} + \beta_{13} + \beta_{14})nom \end{aligned} \quad (3a)$$

Net investment is given by equation 6, which captures the partial adjustment hypothesis, as in the CH model and will not be discussed further here.

Equation 7 indicates that real government revenue (g) is endogenously determined, depending positively upon the real domestic currency value of oil production. The government is assumed to spend all of this income on either development expenditure (with a weight of σ), or on routine expenditure (with a weight of $(1-\sigma)$) as identified in equations 8 and 9. Development expenditure will directly influence the production of non oil output as given by equation 10.

The supply (production) of non oil output ($ysno$) is endogenously determined, fluctuating in the long run, as well as in the short run, as given by equation 10. This relates non oil output supply positively to, the price ratio of non oil output, to the consumer price level, government development (investment) expenditure in the form of a capital transfer to the private sector (gi), and the physical capital stock generated by the private sector itself. Unlike the HG model labour input is not explicitly included in the determination of non oil supply, since in Indonesia, as in other developing countries with abundant labour, the labour supply will grow proportionally with the accumulation of capital. β_{51} represents the technology factor.

Price and inflationary expectations developments are given by equations 11, 12 and 13. These are as in the CH model, except that pn is equivalent to w (nominal wages) in the CH model as discussed previously.

Asset market equilibrium is given by equations 14 - 18. There are three non money assets in the model (domestic bonds and equities, the latter representing claims to the ownership of the capital stock in the private sector, and foreign bonds). Domestic financial assets are assumed to be perfect substitutes, with arbitrage between them resulting, instantaneously, in the same expected rate of return. However due to the presumption of imperfect capital mobility, the return on domestic financial assets is not continuously equated with that on foreign assets (bonds). Only gradually will the return on these financial assets be equated. This is a third significant amendment of this model to that of CH.

Money market equilibrium is characterised by a conventional LM equation, as in equation 14, incorporating domestic real wealth. Demand for real money balances (the nominal stock (m) deflated by the consumer price level) depends upon real non oil income, representing a transactions demand in the private sector, the domestic nominal interest rate and domestic real wealth representing an asset demand for money. This market is assumed to be in continual equilibrium, implying that economic agents are satisfied with their portfolio of non money assets held at any point in time. Domestic private sector real wealth is given by equation 15 as in the HG model.

The assumption of a fixed nominal exchange rate combined with imperfect capital mobility is encapsulated by equation 16. The assumption of imperfect capital mobility produces a discrepancy between the return on domestic financial assets and foreign financial assets, which can persist for a prolonged period of time. With a fixed nominal exchange rate, it is incapable of adjusting so as to ensure that expected returns on domestic and foreign financial assets (f) are equalised, and divergences in the returns on domestic and foreign financial assets lead to capital inflows or outflows. These will affect domestic reserves and have an impact upon the domestic money supply, resulting in changes in the consumer price level. These capital inflows or outflows must be such as to

ensure that economic agents are satisfied with the proportion of money in their portfolios.

In this fixed exchange rate case, the money supply is endogenously determined. It depends upon increases in the domestic component of the money supply, described here as domestic credit expansion (dce) and changes in foreign reserve holdings (res), as in equation 16'. dce is exogenously determined by the government. In this study it is assumed for simplicity that the change in this is zero, whilst res is endogenously determined by balance of payment surpluses or deficits which arise from developments in the current account and capital flows as in equation 16". Capital outflows (inflows) depend upon the interest differential between the domestic and overseas nominal interest rate ($r - r^*$), whilst the current account position is indicated by the accumulation (decumulation) of foreign financial assets (f). With the nominal exchange rate assumed to be constant, and hence unable to adjust, there will be balance of payments surpluses or deficits occurring, with a resultant accumulation/decumulation of foreign exchange reserves (res). As mentioned previously, these will have an impact upon the domestic money supply as in equation 16.

Substituting equation 16' to 16", and setting dce to zero, produces equation 16.

$$m = dce + res \quad \text{equation 16'}$$

$$res = \tau(r - r^* + f) \quad \text{equation 16"}$$

$$m = \tau(r - r^* + f) \quad \text{equation 16}$$

where τ represents the degree of capital mobility.

The overseas sector consists of the current account, which can be broken down into the non oil trade balance, consisting of non oil exports less non oil imports, and the oil trade balance.

Developments in the current account are given by equation 19a:

$$\begin{aligned} \dot{f} + e - pc = \rho_{11} \text{nox} - \rho_{12} \text{nom} + \rho_{13} (r^*f + e - pc) \\ + \rho_{14}(\text{ot} + \text{po}^* + e - pc) \end{aligned} \quad 19a$$

where ot represents net exports of oil. Rearranging 19a and expressing this in terms of changes in foreign asset (bond) holdings, equation 19 is obtained. This indicates that the accumulation/decumulation of foreign assets, as reflected in the current account balance (\dot{f}), depends upon the oil trade balance, non oil exports and imports (non oil trade balance) and real interest earnings on domestic holdings of foreign assets (r^*f). In the long run steady state the current account balance must be zero, otherwise further wealth effects will arise requiring further macroeconomic adjustment.

Equation 20 specifies developments in non oil exports, which depends positively upon the real exchange rate and world real income (y^*). Equation 21 specifies that non oil imports depend negatively upon the real exchange rate and positively upon domestic real income. Oil exports, equation 22, are exogenously determined, dependent upon governmental policy, as indicated by the parameter (Ψ), towards the usage of such oil for domestic or export purposes. Equations 21 and 22 are as in the CH model.

4.3.2 Alternative Versions of the Base Model

In this section amendments to the base model are conducted, and this is concerned with altering the nominal exchange rate from a fixed to a flexible exchange rate regime combined with altering the degree of capital mobility as previously mentioned. Three different versions of the base model are considered: (1) a fixed nominal exchange rate combined with perfect international capital mobility; (2) a flexible exchange rate combined with imperfect international capital mobility; and finally (3) a

flexible exchange rate combined with perfect international capital mobility. Modifications to equation 16 in the base model, are shown in the following equations.

$$\dot{m} = \tau(r - r^* + f) \quad (16)$$

$$\dot{m} = (r - r^* + f) \quad (16a)$$

$$\dot{f} = -\tau(r - r^* - e) \quad (16b)$$

$$\dot{e} = (r - r^*) \quad (16c)$$

Equation 16 is used in the base model where the nominal exchange rate is fixed, and τ represents the degree of capital mobility as previously discussed. This parameter value can range from zero to one. For τ equal to zero, means that there is no international capital mobility, whilst for τ equal to one there is perfect international capital mobility. Equation 16a is therefore the relevant equation where a fixed exchange rate regime is operative, combined with the assumption of perfect capital mobility.

The main amendment from a fixed to a flexible exchange rate is in the development of the external sector. The nominal exchange rate is capable of adjusting so that either capital outflows or inflows will have no effect upon foreign exchange reserves. As a result growth of the money stock (\dot{m}) becomes exogenous, and the nominal exchange rate is endogenous. The assumption of imperfect capital mobility produces a discrepancy between the return on domestic financial assets and foreign financial assets, which can persist for a prolonged period of time. Hence a divergence between the domestic and foreign interest rate, after allowing for exchange rate expectations, is eliminated slowly, resulting in a gradual outflow or inflow of foreign assets (bonds). Equation 16b is therefore the relevant equation where the nominal exchange rate is flexible, combined with controlled capital mobility internationally.

For the case of a flexible exchange rate and perfect capital mobility, the three non money assets are assumed to be perfect substitutes. Arbitrage between them implies the

same expected (instantaneous) rate of return. The common expected rate of return must in turn be such that agents are satisfied with the proportion of money in their portfolios. With perfect capital mobility, account needs to be taken of the expected change in the exchange rate. The relevant equation for a flexible exchange rate combined with perfect capital mobility internationally is equation 16c, as in the HG model.

The goods markets and price equations for the flexible exchange rate regime are essentially the same as those for the fixed exchange rate. However, developments in the consumer price level are now a combination of the adjustment of the nominal exchange rate, and the price of non oil domestic goods. As a result an appreciation (depreciation) of the real exchange rate arises from a combination of an appreciation (depreciation) of the nominal exchange rate, and an increase (decrease) in the price of domestic non oil goods.

4.4 Simulation Procedure and Its Properties

To analyse the macroeconomic effects arising from oil related shocks, for both exchange rate versions and varying degrees of capital mobility, the models discussed are simulated by using a numerical algorithm known as "Saddlepoint". The properties of this simulation procedure are outlined in the appendix to this chapter. The simulation will be conducted for both the base case and variants of this, for both oil production and oil price shocks. Hence there will be two sets of simulations conducted for each case.

To generate results which are representative for the Indonesian economy, the parameters of the model will be empirically estimated by using Indonesian data where possible. To focus the analysis upon the effects of alternatives policies, the parameters used in the simulations are the same for both the fixed and flexible nominal exchange rate cases. The source of the data and method of estimation will be discussed in the following section.

4.5 Data Sources and Method of Estimation

4.5.1 Method of Estimation

The models consist of 24 equations, 24 endogenous variables and 8 exogenous variables with constant coefficients, and hence the model is fully determined⁴⁵. However no data is available on the real return to capital and Tobin's q ratio (q), hence the parameters of the model cannot be estimated simultaneously. The parameters of the model, which consist of 48 parameters, will therefore be estimated or computed on an individual equation basis.

The parameters in equations 17 and 18, of which there are six, were derived using results from existing studies and ensure stability of the model. Equations 5, 6, 12 and 16 are adjustment equations containing 4 parameters. These parameters were again derived from existing studies, and are within the range required for model stability⁴⁶.

Equations 1, 2, 3, 7, 8, 9, 11, 13, and 22 are identities and hence the parameters in each equation are log linear approximation, and can be computed by using Indonesian data. These equations consist of 17 parameters. The last two equations are definitions as used in the CH model. The rest of the equations are behavioural equations, which consist of equations 4, 10, 14, 15, 19, 20 and 21 which all together comprise 21 parameters. These equations are over identified and therefore will be estimated by using the Two Stage least Squares (2SLS) method utilising the Shazam package ((see Shazam (1993), p275). The identification and estimation procedures for these behavioural equations will be discussed in the appendix to Chapter 5. The parameters and the simulation results will be presented in Chapter 5.

⁴⁵See Koutsoyiannis (1973, p. 343).

⁴⁶Different adjustment coefficients only affect the adjustment process of each variable toward the equilibrium, but will not affects the long run equilibrium.

4.5.2 Data Sources

The study will cover the period 1973 to 1991, capturing both the oil boom and post oil boom periods. The oil booms of 1973/1974 and 1979/1980 are likely to have caused a structural break during the period of the study. In addition to that during the period of the study the exchange rate system was changed from fixed to more flexible, so that the implications of such a change for the effects of oil shocks upon the economy also needs to be identified and evaluated. The parameters of the model will therefore be computed for the period 1973-1983, 1983-1991 and 1973-1991. The first period was chosen to capture the period of the oil boom where the nominal exchange rate is fixed, whilst the second period was chosen to capture the post oil boom where the nominal exchange rate is flexible whereas the whole period was chosen to represent the period of the study.

The data was largely obtained from international publications such as the International Monetary Fund (IMF), and Indonesian publications such as those by the Bank Indonesia, BI (Central Bank of Indonesia), Biro Pusat Statistik, BPS (Central Bureau of Statistics), Ministry of Finance, and Ministry of Mining. As with many other developing countries, some of the data is not available. In other cases some data may be available but is not always in the form of a consistent time series for relevant variables for Indonesia, or may be difficult or impossible to obtain. Furthermore the data may be available, but not in a form appropriate to the definitions given in this study. In addition to that some material is available on a yearly and six monthly basis, whilst this study will use quarterly data. This quarterly data is required mainly to increase the number of observations, in order to satisfy, for estimation purposes, the required number of degrees of freedom⁴⁷. To overcome this problem the data has been compiled with the objective for achieving as much consistency as possible,

⁴⁷The larger the number of degrees of freedom the smaller the variance of the sample, and the larger the possibility the parameter of the estimation is statistically different from zero, see for example A. Kautsoyiannis (1973, p 90). Notice that for each period of the estimation, the number of observations are only 10 if the data is based on annual observations.

to meet the objectives of the study. The specification of the data is contained in the appendix to Chapter 5.

4.6 Summary and Conclusions.

The focus of this chapter has been upon modelling the macroeconomic effects of an oil boom on the domestic economy. The model explicitly incorporates the fact that the oil production and its revenues are in the hands of government. This is the main departure of this model to the existing models, and has led to an extensive amendment of the models outlined in Chapter 3. The allocation of the oil revenue to either consumption or investment, and the allocation of oil production to either export or domestic usage are politically determined. The economic developments emphasised here relate to that of real income, non oil production which is equivalent to private sector real income, physical capital stock, foreign asset stock, non oil trade balance, real exchange rate, inflation rate, private sector real wealth and real oil income itself.

Government capital transfers contribute to an expansion of the physical capital stock in the non oil sector, enhancing the productive capacity of non oil output. Most importantly, non oil output grows proportionally with developments in the physical capital stock. This arises from the labour surplus in the economy, and hence the labour supply is a non constraint upon economy growth. This is a second main amendment of this model to those outlined in Chapter 3. In this study it is assumed that the domestic economy produces non oil goods, which can be consumed domestically and are imperfect substitutes for imported goods. The price of these good is domestically determined.

The model emphasises the long term nature of the dynamic adjustment process, since the oil shock has long run effects on the Indonesian economy. This arises from allowing for physical capital stock accumulation, especially that induced by government

capital transfers, and developments in the current account balance. The inclusion of developments in the current account captures developments in oil exports and the non oil trade balance, which have a further impact upon developments in private sector real wealth. This is important in order to encourage the involvement of the private sector in the process of developing the economy.

The deterministic framework of the model combined with economic agents possessing rational expectations, is equivalent to the case of perfect foresight. Financial markets are assumed to be in continual equilibrium, whilst non financial markets are subject to sticky price and quantity adjustment.

The model developed is representative of the oil boom period when the nominal exchange rate was fixed, combined with imperfect international capital mobility. This is referred to as the base model. The model was further developed in such a way as to enable the incorporation of alternative government policies, so as to identify and analyse alternative outcomes to that of the base case. These are important for both the government and the private sector in order to offset possible "Dutch disease" effects, and to optimise the potential benefits from oil related shocks during the adjustment process to long run steady state.

In this study two sets of governmental policy responses, in regard to oil related shocks, are emphasised⁴⁸. Firstly that concerned with the allocation of the spending of the oil revenue, and that relating to the allocation of the oil production. These alternative policies do not require an amendment of the base case, only an alteration of some of the parameters of the model. These two key policies will be intensively analysed in the first part of Chapter 6.

Secondly to allow the oil related shocks to occur in an economy operating with either a fixed or flexible exchange rate system, combined with different degrees of international capital mobility. Unlike the first set of policy alternatives, these policy

⁴⁸Other policies include those such as imposing protection on non oil goods.

alternatives require a modification of the base model. A major difference between the fixed and flexible nominal exchange rate regimes is in regard to the development of the money stock. Under a fixed exchange rate regime the money stock is endogenous, whilst under a flexible exchange rate regime the money stock is exogenous. Different degrees of international capital mobility will directly influence developments in financial markets. Under imperfect capital mobility domestic and foreign assets are not perfect substitutes, whilst under perfect capital mobility they are perfect substitutes. The parameters and simulation results for the base model, as well as that for the alternative versions of the model, will be presented in the next chapter.

CHAPTER 5

EMPERICAL RESULTS AND SIMULATION RESULTS FOR THE BASE CASE

5.1 Introduction

This chapter firstly discusses the various ways in which the parameter values of the model were chosen and secondly analyses the simulation of the model under two oil related shocks. Attempts were made to estimate as many of the parameters from the data as possible and where appropriate, three data samples were used to calculate the preferred parameter values. The first is for the period 1973.1 to 1983.1, the oil boom period, where the nominal exchange rate was fixed. The second period is 1983.1 to 1991.4, the post oil boom period, where the nominal exchange rate was flexible. Finally, the parameters are estimated for the whole period of study from 1973.1 to 1991.4. The remaining parameters were imposed by either using values obtained from other studies (where available) or by using a priori beliefs, particularly for the policy adjustment parameters.

The model was then simulated for the base case, that is, where the economy is operating under a fixed nominal exchange rate regime combined with a high degree of control of capital flows out of and into the country. This case represents the Indonesian economy during the oil booms, from 1973 to 1983. During this period, the government adopted a fixed nominal exchange rate policy and at the same time controlled international capital mobility. In addition, this base case represents how the government allocated the oil revenue to both investment and consumption, and the production to both export and domestic usage.

Two simulations were conducted for the base case, namely an increase in oil production and an increase in the price of oil. This enables identification of the effects of the oil shocks in the domestic macroeconomy, both during the adjustment process and in the long run steady state. The conclusions and policy implications of this analysis will be presented at the end of the chapter.

5.2 The Parameters

The model in Chapter 4 consists of 22 equations and 46 parameters. A summary of the chosen parameter values, used in the base case simulation, is presented in Table 5.1.

TABLE 5.1
Parameter Values
(For Simulation)

Equation ^a Value	Parameter	Chosen Parameter
1	2	3
1	v	0.80
2	v	0.80
3	β_{11}	0.76
	β_{12}	0.20
	β_{14}	0.10
	β_{15}	0.20
4	β_{21}	0.65
	β_{22}	0.13
	θ	0.30
6	Φ	0.70
7	β_{31}	1.00
8	σ^b	0.40
9	$(1-\sigma)^c$	0.60
10	β_{41}	0.00
	β_{42}	0.30
	β_{43}	0.30
	β_{44}	0.40
11	α_1	0.60
	α_2	0.10
12	ϕ_1^c	0.00
	ϕ_2	0.70
13	1	1.00

(continued over page)

Table 5.1 (continued)

14	ε_{11}	0.70
	ε_{12}	0.10
	ε_{13}	0.10
15	ε_{21}	0.70
	ε_{22}	0.60
	ε_{23}	0.40
	ε_{24}	0.70
16	τ^b	0.20
17	ε_{31}^c	0.00
	ε_{32}	0.30
	ε_{33}	0.30
18	δ_1	0.50
	δ_2	0.50
	δ_3	0.50
19	ρ_{11}	0.50
	ρ_{13}	0.30
	ρ_{14}	0.50
20	ρ_{21}	0.50
	ρ_{22}	0.20
	ρ_{31}	0.70
	ρ_{32}	0.50
22	ψ^b	0.50

a. Number of each equation of the model, as detailed in Chapter 4.
b. Policy parameters.
c. These parameters are constant terms and so they were set to zero for the simulations.

These equations were grouped into three general categories, "adjustment", "proportional", and "behavioural" equations respectively, which dictated how the simulation parameter values were obtained. Equations 5, 6, 12, 13, and 16 are adjustment equations. The rate of capital stock depreciation in equation 5 is approximated by the value 0.30, as indicated in other studies (see Warr (1991), Taguchi (1993)). In equations 6 and equation 12, the adjustment coefficients have been selected as .70, indicating slow adjustment of the dependent variable⁴⁹. In equation 13 the adjustment coefficient is set to 1.00 forcing the long run money growth rate to return to its base value so that there will be no monetary accommodation. In equations 16 the adjustment coefficient chosen is 0.20,

⁴⁹ The adjustment coefficients range from 0 to 1, the higher the coefficient the faster the adjustment. See Wallis (1973) pp. 38-41.

indicating sizeable government control over international capital mobility. The lower is this coefficient, the greater is the degree of capital control.

For the second category, the simulation required the determination of each right hand side variable's contribution to the left hand side variable. This was done simply by considering the proportionate share of each variable. The calculated shares for the three periods are shown in Table 5.2 for equations 1, 2, 3, 7, 8, 9, 11 and 22 of the model.

TABLE 5.2
Parameter Values
(Proportional Share)

Equation ^a	Parameter	Chosen Parameter Value	Estimated Share		
			1973.1/ 1983.1	1983.1/ 1991.4	1973.1/ 1991.4
1	2	3	4	5	6
1	v	0.80	0.84	0.79	0.86
2	v	0.80	0.84	0.79	0.85
3	β_{11}	0.76	0.76	0.83	0.74
	β_{12}	0.20	0.20	0.12	0.21
	β_{13}	0.20	0.16	0.23	0.15
	β_{14}	0.10	0.11	0.08	0.12
	β_{15}	0.20	0.23	0.26	0.22
7	β_{31}	1.00	1.00	1.00	1.00
8	σ^b	0.40	0.44	0.51	0.43
9	$(1-\sigma)$	0.60	0.56	0.49	0.57
11	α_1	0.60	0.60	0.60	0.60
	α_2	0.60	0.60	0.60	0.60
22	ψ^b	0.50	0.46	0.40	0.49

a. Number of each equation of the model as detailed in Chapter 4.

b. Policy parameters.

The parameters in equations 1 and 2 are calculated as the share of current and permanent oil output to total current and permanent output respectively, as measured by GDP. Equation 3 shows the share of private sector consumption and investment, government total spending, non oil exports and non oil imports to total demand for non oil output.

Equations 7, 8, 9 and 22 comprise the government sector, in which the distribution of each right hand side variable to the left hand side variable are determined by the government according to its policy objectives. The parameter (β_{31}) in equation 7 is set to one, as all oil revenue is in the hands of the government. The parameters σ and ψ represent respectively in equations 8 and 22 the share of government spending on investment and the share of oil production used domestically. The weights used in the consumer price index in equation 11 are approximated by using a consumer expenditure basket⁵⁰. The parameters used in the simulation are shown in column 3. These parameters were basically chosen from the first period, 1973-1983, to represent the actual experience during the oil boom⁵¹.

The third category comprises 9 behavioural equations. Due to there being no data available on the real return to capital and Tobin's q , the parameters in equations 15, 17 and 18 have been imposed⁵². These values were chosen in order to maintain the stability of the model, which proved to be sensitive to them.

The remaining equations, 4, 10, 14, 19, 20 and 21 were estimated using Two-Stage Least Squares (2SLS)⁵³. Several specifications of the equations, which included different exogenous variables were tried in order to generate better results, in particular higher R^2 , and t -statistics. In doing so attempts were made to keep the specifications as simple as possible in order to focus on the effects of the oil boom and to reduce the complexities of the system of equations for simulation purposes, as the larger the number of parameters in the model, the more difficult it is to establish the stability of the model.

⁵⁰ There have been three different baskets of consumer expenditure compiled by the Biro pusat Statistik (BPS), Indonesia (Central Bureau of Statistics); from 1962 to 1978 it consisted of 60 commodities and it was only for Jakarta. From 1978-1988 it consisted of 210 commodities for 22 provinces. The last is from 1988 onward and consists of 260 commodities from all around the country. The figures used in this study were approximated from the consumer basket expenditure 1978-1988.

⁵¹ For simplicity, some of the parameters are marginally scaled up or down. This was done in order to maintain the stability of the model, which proved to be sensitive to these parameter values.

⁵² See for example Harvie (1993), Khan and Montiel (1989), and Boediono (1985).

⁵³ Shazam Version 7, 1993, was used for estimation.

The estimated parameters for equations 19, 20 and 21 were unsatisfactory, having wrong signs, small R^2 , and insignificant t-statistics and they are not reported here. For these equations there were problems in specifying equations which fitted the highly variable data given the very limited dynamic specifications that simulation models allow (see for example Aziz (1989)). For the purposes of simulation the parameters for these equations were therefore adopted from a similar study⁵⁴. These selections were constrained due to the model's sensitivity to these parameter values. The results for the remaining equations 4, 10 and 14 are shown in Table 5.3 for the three periods. Regression details are shown in appendix Table A5.1.

TABLE 5.3
Parameter Values
(Behavioral Equation)

Equation ^a	Parameters	Chosen Parameter Value	Estimated Coefficients Using 2SLS		
			1973.1/ 1983.1	1983.1/ 1991.4	1973.1/ 1991.4
4	β_{21}	0.65	0.61*	0.86*	0.58*
	β_{22}	0.13	0.13*	0.05*	0.12**
10	β_{41}	0.00 ^b	3.39*	3.43*	2.63*
	β_{42}	0.30	0.11	0.15*	0.19
	β_{43}	0.30	0.19*	0.13*	0.16*
	β_{44}	0.40	0.54*	0.23*	0.49*
14	ε_{11}	0.70	0.65*	#	0.48*
	ε_{12}	0.10	0.05	#	0.05
	ε_{13}	0.10	0.16	#	0.25**

a. Equation number.

b. This parameter is a constant and was accordingly set to zero for the simulation.

Not reported here,

*and ** indicate that the estimated coefficients are significantly different from zero at the 5 % and 10 % levels of significance, respectively.

⁵⁴See Harvie (1993).

Equation 4 is the private sector consumption function. Given that the variables are in logs, the income elasticity (β_{21}) is 0.61 for the fixed exchange rate period. This is smaller than for the second period of the study. This indicates that for higher incomes consumption is more responsive to income, as in most developing countries. On the other hand, the wealth elasticity with respect to consumption (β_{22}) is smaller after the period of the oil boom than during the oil boom. This indicates that individuals whose wealth increased during the oil boom, did not increase consumption at the same rate.

Equation 10, gives the non oil output supply function. The relative price elasticity (β_{42}) of 0.11 for the first period, is smaller than those for second and whole periods. This indicates that production is responsive to changes in price, and is more responsive over the whole period of study. Production is however less responsive in the later period to changes in the physical capital stock (β_{44}) and government investment (β_{43}).

Equation 14 shows the demand for real money balances defined as the nominal stock of narrow money deflated by the consumer price index. The real income elasticity (ϵ_{11}) is greater for the period before the oil boom than for the whole period. The wealth elasticity (ϵ_{13}) however is smaller for the period before the oil boom than for the whole period, whereas there is no difference for the insignificant interest rate elasticity (ϵ_{12}), (see Boediono (1985)).

The parameters selected for the simulation are shown in column 3. In choosing the parameters priority was given to the first period, 1973 - 1983, because it represents the actual experience during the oil boom. Some of the parameters, however, had to be taken from other periods and a few had to be imposed in order to maintain the stability of the model. Since β_{41} is a constant it was set to zero. The β_{43} value was chosen as 0.30 (which is above the regression estimate of 0.19) since the endogenous growth literature and associated empirical studies show that due to the presence of externalities, the effects of government investment may be underestimated. Whilst some other values are different to the regression estimates they all lie within their respective 10% confidence intervals

(with one exception β_{44} ⁵⁵). For example $\beta_{42} = 0.30$ for 1973-1983 lies within the 10 % range $(-0.1, 0.39)$, whilst $\varepsilon_{11} = 0.70$, $\varepsilon_{12} = 0.10$ and $\varepsilon_{13} = 0.10$ for 1973-1983 lie in the interval $(0.32, 0.98)$; $(-0.13, 0.18)$; and $(0.03, 0.35)$, respectively for 1973-1983.

Overall, 22 parameters were estimated using Indonesian data (13 were calculated as proportionate shares and 9 were estimated using 2SLS), 6 parameters were set as adjustment coefficients, and 18 were imposed by adapting similar studies results.

5.3 Simulation Results

The simulation results for the base case were derived from the macroeconomic model developed in the previous chapter. In this base case the nominal exchange rate is assumed to be fixed, and the government exercises substantial control over capital mobility out of and into the country. The relevant parameter for the degree of capital mobility is τ , which can range from 0 to 1. If $\tau = 1$ it represents the case of perfect capital mobility, whilst if $\tau = 0$ there is no capital mobility internationally. In the base case, the parameter chosen is $\tau = 0.2$. This parameter value is chosen because during the fixed nominal exchange rate regime period, the government exercised considerable control over international capital mobility.

In the following analysis emphasis is placed upon the adjustment of 9 key variables, which are: the real exchange rate; real oil revenue which is equivalent to government real income; non oil output which is equivalent to private sector real income; physical capital stock; inflation rate; and private sector real wealth. These key variables were chosen because they are important factors in the process of economic development of the country, in regard to economic growth, income distribution and economic stability. Any changes in these variables arising from an oil related shock, will influence the

⁵⁵ β_{44} was chosen as 0.40, being approximately midway between the 2 sub sample values of 0.23 (fixed exchange rate regime) and 0.54 (floating exchange rate regime). However it needs to be acknowledged that it (just) lies outside the 90 % confident interval for the selected sample.

development of other variables and the domestic economy as a whole as discussed in Chapter 4. The simulation is conducted by utilising the parameters in Table 5.1 above. Two simulations are conducted:

- i) An instantaneous and unanticipated 10 percent increase in oil production; and
- ii) An instantaneous and unanticipated 10 percent increase in the price of oil.

The discussion will be divided into an analysis of the long-run steady state properties of the model, and the adjustment process arising from the shock. The steady state properties of the model will be discussed first.

5.3.1 Steady State Properties

A summary of the long run steady state properties of the macroeconomic model focussing upon the variables mentioned previously, for both an oil production and oil price shock, is contained in Table 5.4. The numbers in this table represent an increase (positive sign) or a decrease (negative sign) in percentage points from the base value, for that variable after the shock. In equilibrium q , r , R , pc , pn , and e do not change as there is no monetary accomodation in equilibrium, and they are not presented in this table. These are the only variables for which we can make analytically unambiguous statements as to their steady state values.

TABLE 5.4

Steady State Properties of The Model For The Base Case
(Percentage deviation from baseline)

Variable/ Shock (10% increase in:)	g	c	nox	nom	$ysno$	k	f	w^e
oil production	8.46	-1.92	-0.80	2.86	2.16	2.16	-8.46	-4.55
oil price	2.79	-10.36	-5.05	7.43	2.13	2.13	23.75	16.27

The above results show that the direction of change of the above macroeconomic variables for different sources of shocks is similar, except for the foreign asset stock and private sector wealth. The magnitude of the changes however is not the same, although they are comparable for both non oil output and the capital stock. These similarities and differences mainly arise from differences in the real exchange response to the shocks, and real oil revenue, equivalent to the government's real income, generated from the oil shock. This will be discussed below.

Government Real Income

The simulation indicates that, in steady state, a 10 per cent increase in the oil price leads to an increase in government real income by 2.79 %, whilst it increase by 8.46 % for an increase in oil production. These differences mainly arise from differences in the consumer price level response to the shocks, which influence the development of real oil revenue. Increased oil production and oil prices increase oil revenue equally in nominal terms. An oil price increase, however, will also induce a higher consumer price level. As a result an increase in the price of oil generates government real⁵⁶ income which is smaller than that for the case of an oil production increase.

Developments in government real oil revenue contributes directly to real income⁵⁷, and indirectly through developments in non oil output. The latter is induced by a capital transfer to the private sector, as indicated in equation 10 of the base model in Chapter 4, which further influences the development of the physical capital stock. Most importantly developments in government real income have a significant influence upon the development of the real exchange rate, as will be discussed below.

⁵⁶In this study the real value of a variable is given by its nominal value deflated by the consumer price level.

⁵⁷Real income is a summation of real non oil output and real oil output, as in equation 1 of the base case in Chapter 4.

Real Exchange Rate⁵⁸

The simulation results indicate that for either an increase in oil production or oil price, there will be an appreciation of the real exchange rate. From the simulation, in steady state, a 10 per cent increase in the price of oil leads to an appreciation of the real exchange rate by 10.4 %, whilst it appreciates by only 1.9 % for an increase in oil production. These differences mainly arise from differences in the adjustment of the price of the non oil good, given that the nominal exchange rate is fixed. This will be discussed further below.

Both increased oil production and oil price, increase oil revenue. To maintain its balanced budget policy, the government must spend all of this income thereby increasing demand for both domestic non oil output and the imported good. An increase in demand for domestic non oil output increases its price, resulting in an appreciation of the real exchange rate. An increase in the price of oil will also induce a higher consumer price level⁵⁹. This will induce a higher money stock and will be transmitted to the price of non oil output, resulting in a larger appreciation of the real exchange rate⁶⁰. Developments in the real exchange rate have a significant influence upon developments of the remaining macroeconomic variables, as can be observed in the model for the base case in Chapter 4.

Non Oil Trade

Dutch disease consequences are apparent in both cases, as indicated by the non oil trade deficit, arising from a decrease in non oil exports and an increase in non oil imports. However, the deterioration in non oil exports and non oil imports is larger for

⁵⁸As defined in this study, that is the nominal exchange rate deflated by the price of non oil output ($e - p_n$).

⁵⁹An increase in oil export revenue arises from an increase in either the oil price or oil production, and will have an identical effect upon the the money stock in order to maintain the fixed nominal exchange rate. This will have an identical effect upon the price of non oil output.

⁶⁰See Harvie (1993b), p.16.

the oil price increase case. This arises primarily from the larger appreciation of the real exchange rate for this case, although this is offset by the larger increase in real income for the oil production case.

Non Oil Output (Private Sector Real Income)

In both cases non oil output deviates positively from the baseline and by nearly the same magnitude, regardless of the different appreciation of the real exchange for both cases. This development is significantly influenced by developments in government real income, the physical capital stock and the real exchange rate. Developments in non oil output are directly encouraged by government real capital transfers, which are larger for an oil production than oil price increase. The appreciation of the real exchange rate will also induce the expansion in non oil output as it raises non oil imports which largely consist of capital goods⁶¹, which is larger for an oil price than for an oil production increase. As a result the increase in non oil output is comparable for both cases.

Physical Capital Stock

The private sector physical capital stock accumulates in both cases, and is consistent with a higher level of non oil output. This is partially stimulated by an increase in real profit (not shown here), and partially by an increase in investment which is induced by the government capital transfer to the private sector.

Net Foreign Asset stock

Net foreign asset stocks decumulate by 8.5 per cent for the oil production increase case. Despite an accumulation of net foreign assets from an increase in oil exports, this is offset by deficits in non oil trade and declining foreign interest income. On the other hand for the oil price increase case, net foreign assets accumulate. This is due

⁶¹ Indonesia's imported non oil goods are containt capital goods. For detail see Chapter 2 of this thesis.

to the accumulation of net foreign assets arising from increased oil exports and increased foreign interest income, which offsets the non oil trade deficit.

Private Sector Real Wealth

For the case of an oil production increase, private sector real wealth decreases despite the accumulation of capital stock and increased permanent income. This is due to the sizeable decumulation of net foreign asset stocks as previously identified. On the other hand with an oil price increase, private sector wealth increases significantly. This is due to the sizeable accumulation of net foreign assets, accumulation of physical capital stock and increase in permanent income.

5.3.2 The Adjustment Process

The adjustment process of each of the aforementioned macroeconomic variables, for both an oil price and oil production increase, are now outlined. The adjustment process involved in these cases is presented in Figures 5.1 to 5.9. The vertical axis for each diagram measures the percentage deviation of that variable from its baseline or starting value, while the horizontal axis measures time. These diagrams show an adjustment period arising from a shock lasting 76 periods, since by this time most of the variables have achieved long run steady state except for the physical capital stock and non oil output. These two variables take 90 periods⁶² to reach steady state equilibrium. This indicates that the effects of the oil boom have long run effects. Each diagram contains the two cases, as discussed above.

The figures show that in general the adjustment process of each variable, from different sources of oil shock, show interesting differences, from the beginning right up to the long run steady state. In most cases the adjustment of the aforementioned variables are more volatile, but deviate by less from their base value, for the oil production

⁶²This is not shown here.

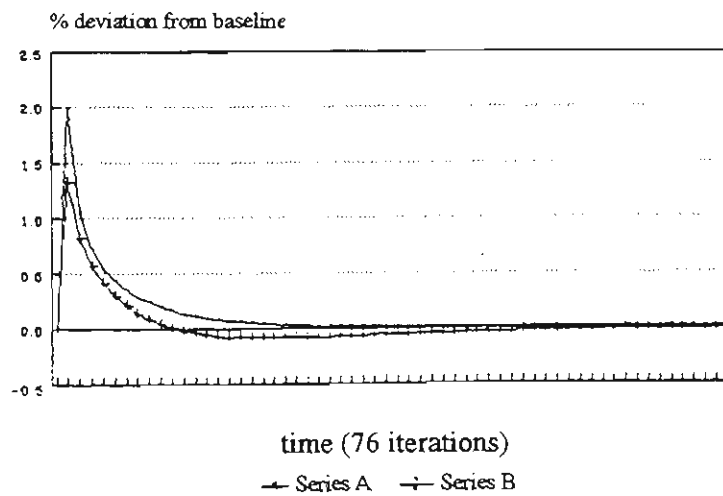
increase than for the oil price increase. The main reason behind this different adjustment process, arises from the real exchange rate response to these oil shocks.

Inflation Rate

Either an oil price or oil production increase raises oil export revenues, which are in foreign currency. The government spends all of the oil revenue to maintain its balanced budget policy. To spend these revenues they have to be converted into domestic currency, and lead to an accumulation of foreign exchange reserve. This causes the money stock to increase in order to maintain the fixed nominal exchange rate policy, resulting in an increase in the inflation rate as shown in Figure 5.1.

FIGURE 5.1

The Base Case*: Inflation (pc)



A: 10 per cent oil price increase

B: 10 per cent oil production increase

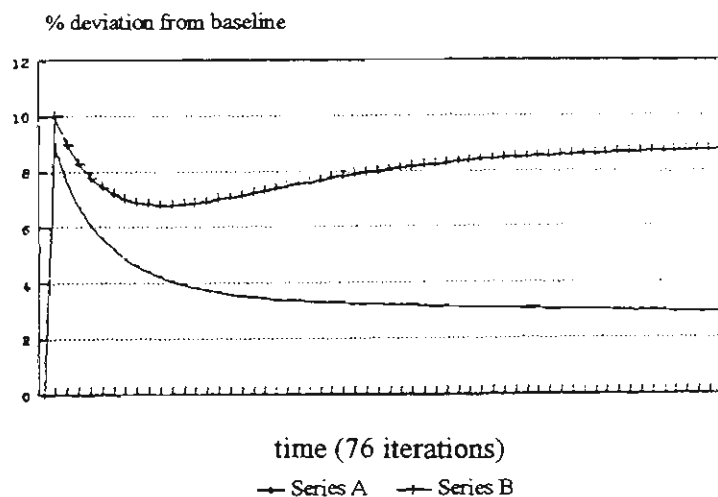
* Fixed Exchange Rate and $\tau = 0.2$

Unlike the case of an oil production increase, an increase in the oil price leads to an increase in the consumer price level. This is because the price of oil directly contributes to the consumer price level, as indicated in Equation 14 of Chapter 4. As a result, the consumer price level increases more for the case of an oil price increase in comparison to an oil production increase initially as shown in Figure 5.1. However the rate of inflation immediately declines for both cases thereafter, due to the non oil trade deficit. For the oil production increase case, inflation deviates below its base level before reaching its long run equilibrium, arising from a decumulation of net foreign assets.

Government Real Income

Initially the government's real income increases in both cases, but increases by more for the oil production than for the oil price increase case due to a smaller inflation rate in the former. Thereafter for both it declines, and continuously so for the oil price increase case, but then improves for the oil production increase case as shown in Figure 5.2.

FIGURE 5.2
The Base Case*: Real Oil Revenue (g)



A: 10 per cent oil price increase

B: 10 per cent oil production increase

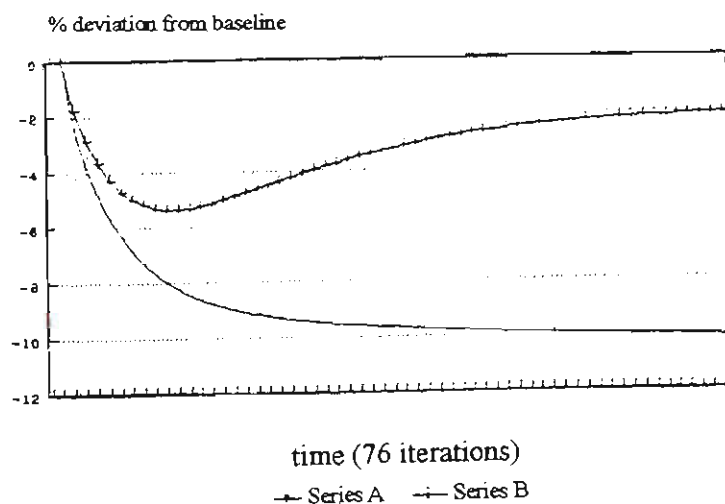
* Fixed Exchange Rate and $\tau = 0.2$

This arises from a declining rate of inflation below its base value before it reaches equilibrium. The larger the increase in government real income, the larger is the capital transfer to the private sector and vice versa. This will have a direct effect upon developments in non oil output, and will also have a further influence upon developments in the physical capital stock and developments in private sector real income itself.

Real Exchange Rate

The simulation results indicate that the real exchange rate does not change on impact arising from the fixed nominal exchange rate and sluggish adjustment of the price of domestic non oil output, as shown in Figure 5.3.

FIGURE 5.3
The Base Case*: Real Exchange Rate (c)



A: 10 per cent oil price increase

B: 10 per cent oil production increase

* Fixed Exchange Rate and $\tau = 0.2$

As the price of domestic non oil output increases, in response to an increase in demand for it, the real exchange rate appreciates. This will be larger for the oil price increase in comparison to that of the oil production increase, as previously discussed. The real exchange rate continuously appreciates towards its long run equilibrium for the oil price increase case. On the other hand for the oil production increase case, the real exchange rate initially appreciates, overshooting its long run rate, then gradually depreciates toward its long run equilibrium. This different development of the real exchange rate mainly arises from a different adjustment of the inflation rate and hence the price of non oil output. For the oil price increase case, the inflation rate remains positive, although decreasing, whilst it is negative for the oil production increase case, as shown in Figure 5.3. The pattern of adjustment for the real exchange rate influences the development of the rest of the aforementioned variables.

Non Oil Trade

Non oil trade deteriorates throughout the adjustment process. This is indicated by a combination of declining non oil exports and increasing non oil imports throughout the adjustment process, as shown in Figure 5.4 and Figure 5.5. The adjustment in non oil exports is strongly influenced by the adjustment of the real exchange rate. On the other hand, the adjustment of non oil imports is influenced by a combination of the real exchange rate and domestic real income.

For the case of an oil price increase, non oil exports asymptotically decrease and non oil imports asymptotically increase towards long run equilibrium. On the other hand for the oil production increase case, non oil exports initially decline, overshooting their long run level, then increase towards the long run equilibrium. Non oil imports show a similar pattern but in the opposite direction. These patterns of adjustment are significantly influenced by the development of the real exchange rate.

FIGURE 5.4
The Base Case*: Non Oil Exports (nox)

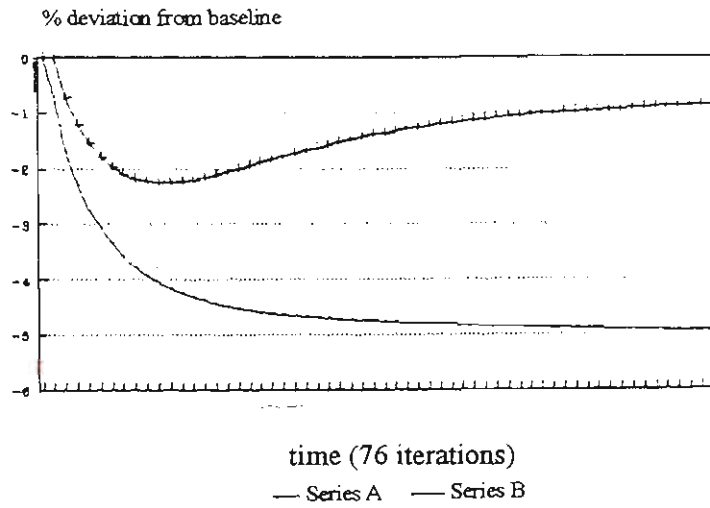
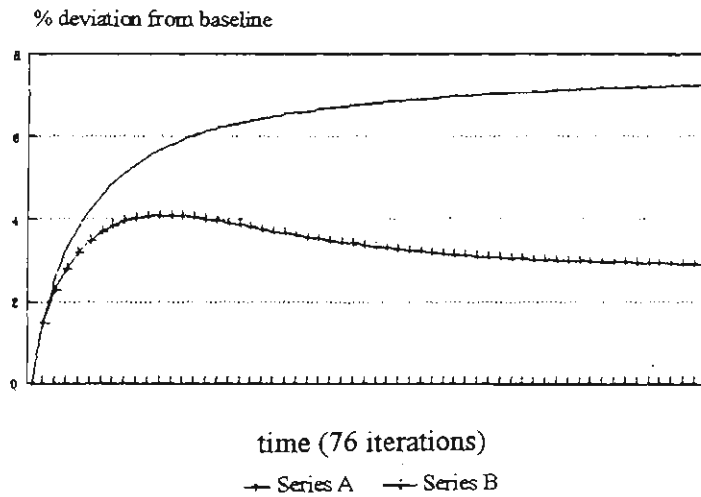


FIGURE 5.5
The Base Case*: Non Oil Imports (nom)



A: 10 per cent oil price increase

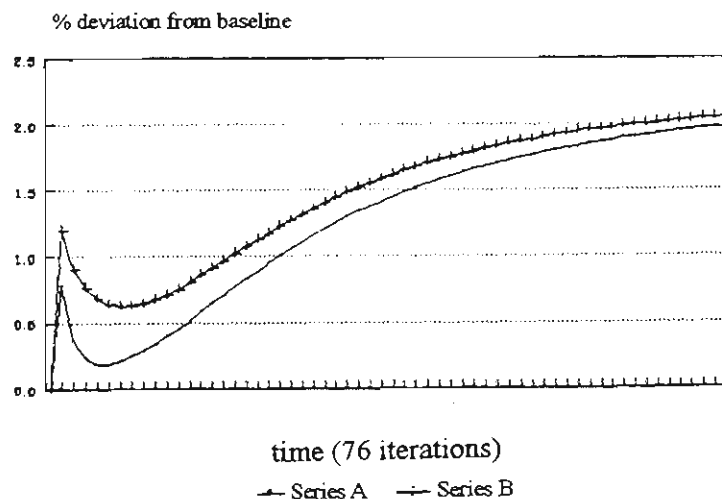
B: 10 per cent oil production increase

* Fixed Exchange Rate and $\tau = 0.2$

Non Oil Output (Private Sector Real Income)

The adjustment path of non oil output is similar for both oil shocks, but the magnitude is larger for the oil production increase case as indicated by Figure 5.6. In both cases non oil output on impact increases, and is larger for the oil production increase case. This is mainly due to the size of the government capital transfer, which is larger for the oil production increase case. The appreciation of the real exchange rate and decumulation of capital stock contributes to declining non oil output, but it remains higher than its base level. Improvements in the physical capital stock improve non oil output, and contribute to a continuous improvement thereafter toward long run equilibrium.

FIGURE 5.6
The Base Case*: Non Oil Output (ysno)



A: 10 per cent oil price increase

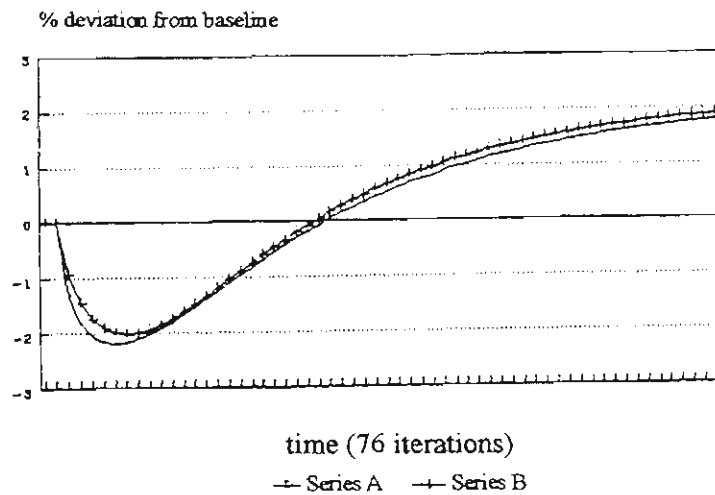
B: 10 per cent oil production increase

* Fixed Exchange Rate and $\tau = 0.2$

Physical Capital Stock

Developments in the physical capital stock are similar for both oil shocks, as shown in Figure 5.7. Initially the physical capital stock decumulates below baseline, but then accumulates sharply towards its long run equilibrium with this being marginally larger for the oil price increase case. The development of the physical capital stock is largely influenced by developments in the real return to capital (Tobin's q)⁶³ and by the development of non oil output.

FIGURE 5.7
The Base Case*: Physical Capital Stock (k)



A: 10 per cent oil price increase

B: 10 per cent oil production increase

* Fixed Exchange Rate and $\tau = 0.2$

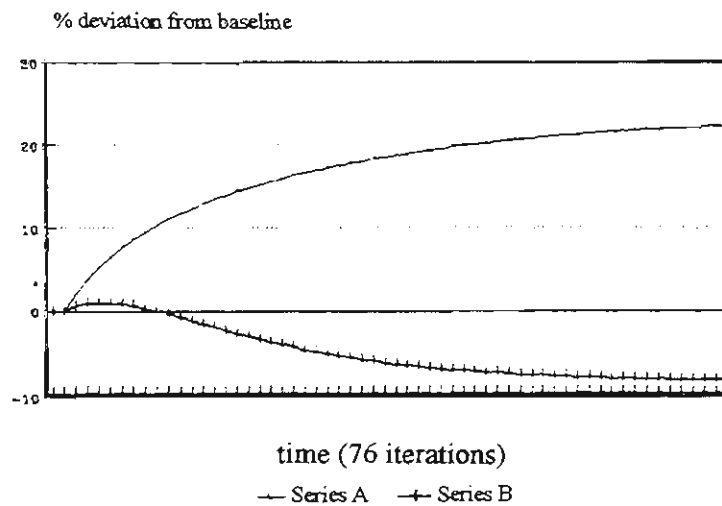
Net Foreign Assets

Developments in the stock of net foreign assets are very different for these two shocks, as shown in Figure 5.8. Initially net foreign assets accumulate in both cases, and

⁶³This is not shown here.

accumulate by more for the oil price increase case. Net foreign assets stocks accumulate continuously throughout the adjustment process in the case of an oil price shock, indicating current account surpluses, whilst for the oil production case it gradually decumulates throughout the adjustment process indicating current account deficits.

FIGURE 5.8
The Base Case*: Net Foreign Asset stock (f)



A: 10 per cent oil price increase

B: 10 per cent oil production increase

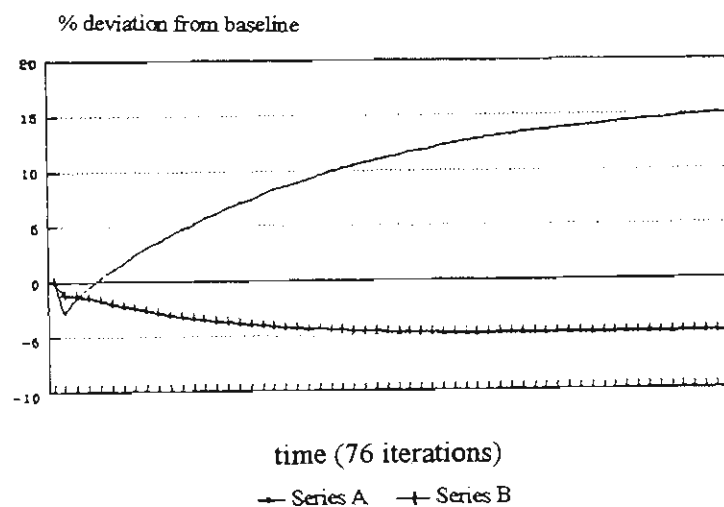
* Fixed Exchange Rate and $\tau = 0.2$

Private Sector Wealth

Private sector wealth initially declines in both cases, with the decline being larger for the oil production increase case as indicated in Figure 5.9. This is caused by a decumulation in the physical capital stock offsetting the accumulation in net foreign asset stocks, real permanent income and increase in real money balances. For the case of an oil

price increase private sector wealth recovers immediately, arising mainly from the accumulation of foreign asset stocks. On the other hand for the oil production increase case, private sector wealth continuously declines following the initial decline in net foreign asset stocks.

FIGURE 5.9
The Base Case*: Private Sector Real Wealth (w^e)



A: 10 per cent oil price increase

B: 10 per cent oil production increase

* Fixed Exchange Rate and $\tau = 0.2$

5.4 Summary, Conclusions and Policy Implications

5.4.1 Summary and Conclusions

This chapter has presented and interpreted the simulation results derived from utilising the chosen estimated parameter values of the model presented in Chapter 4, for two oil related shocks. The simulations conducted for the base case were derived from the macroeconomic model developed in Chapter 4, utilising the parameters in table 5.1. The base case assumes a fixed nominal exchange rate and highly controlled capital mobility ($\tau = .2$).

The analysis emphasised 9 key macroeconomic variables, the real exchange rate, real oil revenue (equivalent to government real income), non oil output (equivalent to private sector real income), the physical capital stock, non oil exports; non oil imports; foreign asset stocks, inflation rate, and private sector real wealth. These key variables were chosen because they are important factors in the process of economic development of the country, contributing to economic growth, income distribution and economic stability. Any changes in these variables arising from oil related shocks will influence the development of other variables and the domestic economy as a whole, as discussed in Chapter 4. The simulations conducted both assumed an instantaneous and unanticipated 10 percent increase in oil production and instantaneous and unanticipated 10 percent increase in the price of oil.

The major conclusion arising from these simulations, either for an oil price or oil production shock, is that the influence of the oil sector on such an economy is likely to be significant, both for long run steady state and for the adjustment process. For an economy such as Indonesia an oil price increase shock offers a greater benefit to the economy than an oil production increase shock.

Focussing upon the issue of the Dutch disease, we conclude that in the context of such an economy, representing Indonesia, these effects are apparent throughout the adjustment process toward long run equilibrium for both oil shocks, and are larger for the oil price than for the oil production shock.

In the long run net foreign assets and private sector wealth increased for the oil price increase shock, whilst for the oil production increase case both declined. Overall, the economy benefitted from either oil shock, regardless of the source of the shock. This is indicated by the fact that in the long run real income, which consists of government real income (equivalent to real oil revenue) and private sector real income (equivalent to non oil output), and the physical capital stock increase from their base value. Hence, the

developments in real income offset the deterioration in the non oil trade deficit. These effects were comparable for both shocks.

The adjustment process was relatively more volatile for the oil production increase case in comparison to that of the oil price increase case. Initially the effect is larger for an oil price increase than for an oil production increase, except for government and private sector real income.

The key factors influencing developments both in the long run steady state and the adjustment process, were developments in the inflation rate, real exchange rate, and the government capital transfer to the private sector, in response to the increased oil revenue.

5.4.2 Policy Implications

A major conclusion of this analysis is that overall the private sector benefits from both oil production and oil price increases, and is likely to benefit more from an oil price increase. Dutch disease consequences however exist and are most intense during the early stages of the adjustment process. This is shown by increased non oil imports and decreased non oil exports, with the developments being larger, assuming an equi-proportional change, for that of an oil price increase shock in comparison to that of the oil production increase shock. The extent of the Dutch disease consequences mainly depends upon the appreciation of the real exchange rate, the inflation rate and increases in real income.

Given that both the oil price and oil production are exogenously determined by OPEC, the government could increase the benefits from the oil boom, and hence reduce the Dutch disease consequences, by reducing the appreciation of the real exchange rate, inflation, and increasing productivity in the non oil traded sector. This would not only

help the non oil traded sector, but also improve private sector real income, private sector real wealth and the economy as a whole.

It is not advisable to help the non oil traded sector by imposing protection, such as through increased tariffs and hence a higher price for imported goods, as this policy is considerably less efficient for the development of the economy as a whole⁶⁴. An increase in the price of imported goods leads to an increase in the price of domestically produced non oil goods, resulting in a larger appreciation of the real exchange rate and at the same time inducing a higher inflation rate. This will lower the demand for non oil imports and also lower the demand for non oil exports. Hence imposing a tariff will not help the non oil sector.

For an economy such as Indonesia an increase in non oil imports, especially capital inputs, is desirable for economic development. On the other hand, the decline of non oil exports is undesirable as it is a major source of foreign exchange revenue and a source of income for most small farmers. Table 2.4 suggests that declining non oil exports largely occurred in agricultural exports, whilst manufacturing exports increased. Hence the most disadvantaged sector has been the agricultural sector. This will not only lower the foreign exchange available for economic growth (through the importation of capital goods), but most importantly, producers in the agricultural sector which are largely small businesses are unlikely to survive the initial shocks.

The government could help the non oil traded sector by increasing its competitiveness in the world market through improved productivity and capital availability for this sector, as indicated by increasing governmental capital transfers and thereby adding to the physical capital stock in this sector. It could also invest, where appropriate, in the agricultural sector, as most small farmers lack access to the capital markets⁶⁵. However the government appears to have placed most emphasis on the

⁶⁴See Corden (1978), and Ethier (1986).

⁶⁵For details see Chapter 2 of this thesis.

development of the manufacturing sector, particularly in regard to it replacing declining oil exports.

As part of the process of improving the competitiveness of the economy the government could also deregulate the financial markets, and hence allow greater capital mobility internationally, so that the financial market is largely influenced by developments in the private sector. The government has launched several deregulatory measures regarding the capital markets and has adopted a more flexible exchange rate, as discussed in Chapter 2 of this thesis. In this regard little analysis has been conducted into the appropriateness, and implications, of such measures in the context of an oil producing economy such as Indonesia. Altering the nominal exchange rate and financial market policies, could influence, more favourably, the effects of an oil related shock during the adjustment process.

In addition to the above alternative policies, the government could influence the adjustment process, and hence the effect upon key macroeconomic variables such as non oil output, the real exchange rate and inflation rate, by altering the proportion of oil production for domestic use and for exports.

These alternative policies relating to the distribution of the oil revenue to investment and consumption expenditures, the allocation of oil production between export and domestic usage, the change in the nominal exchange rate regime from fixed to flexible, and the deregulation of the financial markets, and their impact upon the adjustment process arising from oil related shocks, is conducted in the following chapter. Such an analysis is important in the identification of appropriate policy responses to oil related shocks, in order to reduce the Dutch disease effects and to maximise economic benefits.

CHAPTER 6

POLICY ANALYSIS

6.1 Introduction

This chapter focusses upon analysing alternative government policy responses towards oil shocks, and the potential effects upon the macroeconomy arising from these policy responses. These are then compared to the results from the base case outlined in Chapter 5. This analysis will provide alternative options for managing the oil related shocks in order to minimise the Dutch disease consequences, and hence enhance the benefits arising from such shocks.

The policy responses emphasised here focus upon two broad groupings. The first group consists of policy alternatives with regard to the usage of the oil production and the spending of the oil revenue generated. The second group are policy alternatives relating to the nominal exchange rate regime and the operation of capital markets⁶⁴. With regard to the use of the oil revenue, this can range from spending all of the oil revenue on consumption or investment, whilst with regard to the use of the oil production it can range from using all of the oil production either for domestic usage or for export. With regard to the nominal exchange rate, the possibilities range from fixed, managed floating to perfectly flexible systems. In the case of the capital markets, the policy could range

⁶⁶Other policy options which could be considered include imposing tariffs on non oil imported goods, or subsidising non oil exported goods, and/or controlling the price of domestically produced non oil goods. These alternative policies will alter the real exchange rate and influence the development of the rest of the key macroeconomic variables aforementioned. These policies however are not explicitly analysed in this study.

from no mobility to perfect capital mobility internationally. Indonesia has experienced various combinations of these policies. The allocation of oil production to either domestic usage or export, as well as the allocation of the oil revenue to either consumption or investment expenditure, has varied from period to period as indicated in Table 2.3. At the same time, the government has adjusted its policy with regard to the nominal exchange rate and the operation of capital markets. These two policies have ranged from a fixed nominal exchange rate combined with a very high degree of capital control, as in the base case outlined in Chapter 5, to a more flexible nominal exchange rate combined with more open capital markets. The government has pursued these adjustment policies largely in response to both the increases in oil revenue during the oil booms 1973/1983, and following the decline in the oil price thereafter, as well as the recent interaction with the global economy in order to maintain sustainable growth of the economy (see Chapter 2).

To analyse these alternative policies, the model outlined in Chapter 4, using its associated parameter values in Table 5.1, will be simulated by altering the relevant policy parameters. The analysis will again focus upon the 9 key macroeconomic variables which are: the real exchange rate; real oil revenue which is equivalent to government real income; non oil output which is equivalent to private sector real income; physical capital stock; inflation rate; and private sector real wealth, as in Chapter 5. The results will then be compared to the results derived for the base case outlined in Chapter 5. Both groups of policy alternatives will be simulated for both oil price and oil production shocks.

The discussion will be divided into alternative allocations of oil production and oil revenue relative to the base case, and alternative nominal exchange rate regimes combined with different assumptions relating to the openness of the capital markets.

Summary, conclusions, and policy implications derived from this analysis will be presented at the end of the chapter.

6.2 Alternative Use of Oil Production and Oil Revenue

The policy responses emphasised relate to the usage of oil production for either domestic purposes or for export, and the usage of the oil revenues generated either for consumption or investment expenditure. The relevant parameters for these policies are σ , the proportion of government spending directed towards development (*capital transfer*) expenditure and therefore the resulting proportion $(1-\sigma)$ going on routine (*consumption*) expenditure, and ψ the proportion of oil production going for domestic usage and the remaining $(1-\psi)$ production for export. The range of these parameters can vary from between zero to one. In this study five scenarios A, B, C, D and E will be emphasised. Scenario A is the base case outlined in Chapter 5. In Scenarios B and C the spending of the oil revenue relative to the base case "A" is changed, whilst there is unchanged usage of oil production. On the other hand, Scenarios D and E alter the usage of oil production relative to the base case "A", whilst there is unchanged allocation of the spending of the oil revenue.

Case 1 is concerned with analysing the economic effects arising from a ten per cent increase in oil production, given alternative policies regarding the spending of the oil revenues upon consumption and investment. 'A' is the base case where σ is 0.40. A more investment, or development, oriented policy towards the oil revenue is equivalent to an increase in σ , as in Scenario B or vice versa as in Scenario C. In Scenario B σ is zero, hence the government spends all of the oil revenue on consumption, whereas in Scenario C σ is 0.80. The magnitude of change between B to A, and C to A are chosen

to be identical, so as to provide comparable analyses between decreasing and increasing the oil revenue spent on investment or consumption.

Case 2 is concerned with analysing the economic effects arising from, in this case, a ten per cent increase in the price of oil. The relevant values for the parameter σ are the same as those for scenarios A, B and C in Case 1.

Case 3 is concerned with analysing the effect of alternative policies arising from a ten per cent increase in oil production, with regard to the use of such additional oil production for domestic use or for export. 'A' is the base case in which ψ is 0.5. A more export oriented policy towards oil production would be equivalent to a decrease in ψ from 0.5 to 0.2 as in Scenario D, or vice versa from 0.5 to 0.8 as in Scenario E. The value of ψ in Scenario E is to maintain the assumption of Indonesia being a net oil exporting country as discussed in Chapter 4. The values of ψ between D to A, and E to A are chosen to be identical, so as to provide comparable analyses between declining and increasing the oil production allocated for domestic purposes and export.

Case 4, as with case 3, is concerned with analysing the effect of using the alternative policies just identified, but in this case as a result of a ten per cent increase in the price of oil.

Therefore there will be 4 cases and 3 scenarios in each case to be simulated. Scenario 'A' for each case is referred to as the base case. The relevant values of the parameters σ and ψ for each case and scenario A, B, C, D and E can be summarised as follows.

Case 1: An instantaneous and Unanticipated 10 per cent increase in oil production (changes in σ^* and no change in ψ^{})**

A : $\sigma = 0.4, \psi = 0.5$

B : $\sigma = 0.8, \psi = 0.5$

C : $\sigma = 0.0, \psi = 0.5$

Case 2 : An instantaneous and unanticipated 10 percent increase in the oil price (changes in σ , no change in ψ)

A : $\sigma = 0.4, \psi = 0.5$

B : $\sigma = 0.8, \psi = 0.5$

C : $\sigma = 0.0, \psi = 0.5$

Case 3 An instantaneous and unanticipated 10 per cent increase in oil production (no change in σ , change in ψ)

A : $\sigma = 0.4, \psi = 0.5$

D : $\sigma = 0.4, \psi = 0.2$

E : $\sigma = 0.4, \psi = 0.8$

Case 4 An instantaneous and unanticipated 10 per cent increase in the oil price (no change in σ , change in ψ)

A : $\sigma = 0.4, \psi = 0.5$

D : $\sigma = 0.4, \psi = 0.2$

E : $\sigma = 0.4, \psi = 0.8$

* σ , the proportion of government spending directed towards development (*capital transfer*) expenditure.

** ψ , the proportion of oil production for domestic usage.

The analysis will focus on the nine key macroeconomic variables as in Chapter 5. The discussion is divided into two parts, the steady state properties of the models and

then the dynamic adjustment process. The steady state properties of the model will be discussed first.

6.2.1 Steady State Properties of the Model

A summary of the long run steady state properties of the model for each of the above cases, for selected macroeconomic variables, is contained in Table 6.1 below.

TABLE 6.1
Steady State Properties of the Model
(% deviation from baseline)

Variable	c	f	k	nom	nox	ysno	g	we
Case 1								
A :	-1.92	-8.46	2.16	2.86	-0.80	2.16	8.46	-4.55
B :	-0.63	-3.98	3.87	2.92	-0.27	3.97	9.62	1.43
C :	-3.02	-12.27	0.60	2.81	-1.27	0.60	8.18	-9.63
Case 2								
A :	-10.35	23.75	2.13	7.43	-5.05	2.13	2.79	16.27
B :	- 9.94	25.16	2.70	7.45	-4.8	2.70	3.03	18.15
C :	-10.70	22.45	1.64	7.42	-5.19	1.67	2.58	14.66
Case 3								
A :	-1.92	-8.46	2.16	2.86	-0.80	2.16	8.46	-4.55
D :	-6.65	9.11	2.53	5.47	-2.79	2.53	6.00	7.39
E :	2.80	-26.03	1.77	0.25	1.18	1.78	11.68	-16.48
Case 4								
A,D,E :	-10.35	23.75	2.13	7.43	-5.05	2.13	2.79	16.27

Case 1 Oil Production Increase (changes in σ , no change in ψ)

This case is concerned with analysing a positive oil production shock, and the way in which the additional revenues generated are spent. The relevant parameter here is σ . The simulation results indicate that the way in which the government spends the additional oil revenue, on consumption or investment, plays an important role in the development of all the major macroeconomic variables, as can be observed from Table 6.1.

An increase in σ from 0.4 to 0.8, as in Scenario B, leads to a smaller appreciation of the real exchange rate (c), 0.63% instead of 1.92%, whilst without government investment, as in Scenario C, the real exchange rate appreciation is larger (3.02%). Dutch disease consequences are likely to exist for all three scenarios, however the results from the simulation analysis suggest that these can be reduced through the adoption of a more development oriented stance towards the additional oil revenues. Such a strategy will improve the competitiveness and performance of non oil exports (nox) arising from a smaller appreciation of the real exchange rate, whilst not having, in relative terms, an adverse effect upon non oil imports (nom) in comparison to the other scenarios.

Real oil revenue increase with a larger σ induced by a smaller appreciation of the real exchange rate. This contributes to a larger capital transfer to the private sector which then contributes to an increase in real non oil output, and vice versa for a lower σ .

Non oil output (ysno) increases substantially the larger is σ . On the other hand without a government capital transfer to the private sector, non oil output declines below its base value. A more development oriented policy, initiated through increased government capital transfers to the private sector, contributes to a noticeable

accumulation of capital stock (k) in the private sector, thereby improving potential output on the supply side. On the demand side the smaller appreciation of the real exchange rate improves the non oil trade balance, and government income and expenditure as well as investment and private sector wealth benefit from a more development oriented strategy.

Whilst net foreign asset stocks (f) decline in all three scenarios, it is considerably less the larger is σ . This is due to a better performance in the non oil trade balance, arising from a smaller appreciation of the real exchange rate, as alluded to previously, and the improved foreign interest income balance arising from the higher net foreign asset stock itself.

Altering σ has significant effects upon private sector real wealth (w^e). A larger σ contributes to an improvement in private sector wealth, and in Scenario B actually increases this in comparison to a decline in Scenarios A and C. This can be partially explained by the previous developments, of a larger accumulation of physical capital stock and improved net foreign asset stock balance.

Overall these results suggest an important conclusion. The macroeconomic performance for an economy, such as the one under study, subject to an oil production shock, can be improved on a number of fronts by adopting a more development (investment) oriented stance towards additional oil revenue generated. This improved performance relates to trade in non oil goods and in the current account overall, real non oil output arising from a larger physical capital stock in the non oil sector, and in private sector real wealth. Emphasis upon stimulating consumption expenditure, on the other hand, will produce less favourable outcomes for each of these.

Case 2 Oil Price Shock (changes in σ , no change in ψ)

The steady state properties of the model for this case again indicate that the way in which the government spends the additional oil revenue generated from such a shock, upon consumption or investment, has an important effect upon the development of the macroeconomy. However some interesting differences from case 1 can also be observed.

A more development (investment) oriented stance towards the additional oil revenue (scenario B) leads to a smaller appreciation of the real exchange rate, from 10.35% in scenario 'A' to 9.94% in Scenario B. The opposite is true for a more consumption oriented policy stance, which leads to an appreciation of the real exchange rate by some 10.70%.

Altering σ has minor effects upon the non oil trade deficit in this case. A higher σ , whilst producing a smaller appreciation of the real exchange rate and contributing to an improvement in the trade deficit, also contributes to higher non oil output, which causes the trade balance to deteriorate. These developments are reflected in non oil imports and exports. The higher is σ the higher will be non oil imports, due to higher domestic income, whilst the decline in non oil exports will be less because the real exchange rate appreciates by less.

A larger σ leads to a larger real oil revenue, and larger, in real terms, capital transfer to the private sector, and vice versa for a lower σ . Non oil output improves noticeably the larger is σ , reflecting on the supply side a more rapid accumulation of capital stock in the private sector, induced by the more investment oriented policy stance by government. Non oil output benefits not only from an increase in the share of real oil revenue spent on investment, but also from an increase in real oil revenue itself as in

Case 1. On the demand side a better non oil trade performance, higher domestic real wealth and investment contribute to higher domestic demand.

A major difference from that of case 1 relates to developments in foreign asset stocks, which accumulate substantially in steady state for the case of an oil price increase. In fact the larger is σ the larger is the accumulation of foreign asset stocks. Another notable difference relates to developments in private sector wealth, which increases in all scenarios for the case of an oil price increase and more so the larger is σ .

These results suggest that for the case of a positive oil price shock, a more development oriented policy will have a beneficial effect upon real oil revenue, non oil output, the non oil trade balance, the real exchange rate, capital stock accumulation, private sector real wealth and most notably the foreign asset stock (current account). Overall, in percentage terms, the effect from altering the government capital transfer for the oil price increase case (Case 2) is less than for an equivalent percentage oil production increase (Case 1), as can be seen by comparing Scenario A to B and Scenario A to C in this Case to the same scenarios in Case 1 as shown in Table 6.1.

Case 3 Oil Production Shock (changes in ψ , no change in σ)

In this case a shock identical to that of case 1 occurs, and the policy response now emphasised relates to adopting a more, or less, export oriented stance towards such oil production. The relevant policy parameter in this regard is ψ . In the base scenario (Scenario A) ψ is 0.5. A more export oriented policy stance towards oil production would be equivalent to a smaller ψ (Scenario D), or vice versa for a less export (Scenario E) oriented policy stance. In this case, altering ψ has a large effect upon the real exchange rate, real oil income, the non oil trade balance, net foreign asset stocks and

private sector wealth. It has a much smaller effect upon non oil output and the capital stock.

The real exchange rate appreciates considerably more if a more export oriented policy is adopted towards oil production (scenario D). This is not surprising given the additional export revenue generated from this, and the associated additional demand for domestic currency. This contributes to a loss of competitiveness for the non oil sector, which is reflected in a deterioration in the non oil trade balance. Non oil imports rise noticeably, whilst non oil exports deteriorate. These adverse developments in non oil trade are more pronounced with a more export oriented policy towards oil production.

The government's real income is noticeably smaller with increasing oil exports (Scenario D), arising from a larger appreciation of the real exchange rate. As a result, for unchanged σ , the government capital transfer to the private sector declines. Non oil output, however, increases by more the smaller is ψ . On the supply side a major contributor to this is a larger accumulation of private capital stock, which offsets the smaller government capital transfer. On the demand side such an increase in non oil output arises from a higher level of investment and an increase in private sector real wealth. This is offset, however, by the previously mentioned deterioration in the non oil trade balance.

The net foreign asset stock benefits from a smaller ψ . In scenario D, in comparison to A and E, foreign asset stocks increase, making a significant contribution to the increase in private sector real wealth. Hence a more export oriented policy towards oil production will contribute towards current account surpluses and the accumulation of foreign asset stocks, increasing domestic private sector real wealth and

stimulating domestic demand. Private sector real wealth, as just mentioned, improves the larger is ψ , due to the larger accumulation of capital stock and foreign asset stocks.

This case suggests that a more export oriented oil policy can produce beneficial effects for an economy such as Indonesia.. Whilst the real exchange rate will appreciate by more and thereby contribute to a deterioration in the non oil trade balance and to smaller real oil revenues, these are offset by potentially higher investment and faster accumulation of productive capital stock. This latter development offers the prospect of expanding the capacity of non oil output and hence achieving faster economic growth. It also offers the prospect of current account surpluses, and the foreign exchange derived could be used to finance the import of essential capital goods to sustain economic development. This point is linked with the previous issue. Finally it has the potential to improve private sector real wealth, which has the advantage of developing this sector, in terms of stimulating consumption and creating an ability to invest over and above that of government, and enhancing its role in the developmental process.

Case 4 Oil Price Increase (changes in ψ , no change in σ)

This final case is similar to that of case 2, however the focus is still upon a policy response in terms of oil exports as in case 3. The simulation results indicate that the adjustment of the major macroeconomic variables is identical in steady state, irrespective of the value of ψ . This is not surprising, since altering oil exports has no effects on the real exchange rate. This is because total oil revenue is unchanged, and there is no distinction made on the allocation of this oil revenue between domestic non oil goods and non oil imported goods, and hence the allocation of the oil revenue on domestic non oil output and non oil imports is identical to that in Scenario A. Therefore the results are equivalent to those derivable for the case of an oil price increase alone. These simulation

results are identical to those derivable from Case 2 in Chapter 5, and are not presented here.

6.2.2 The Adjustment Process

The simulation results indicate that the way in which the government spends the oil revenue, on consumption or investment, and the way in which the government allocates oil production, for domestic usage or exports, not only influences the deviation of each macro variable from its base value, but also influences the adjustment path of each variable as shown in Figures 6.2.1 to 6.2.3. The most pronounced effects occur in the early periods of the adjustment process. A key variable in this adjustment process is the real exchange rate. The adjustment path of real oil revenue will not be discussed here, in order to focus the analyses on the effects of altering government policy on the other macroeconomic variables aforementioned.

Case 1 Oil Production Increase (changes in σ , no change in ψ)

The adjustment path of the macroeconomic variables aforementioned for this case, is presented in Figure 6.2.1. Initially the inflation rate increases in all scenarios, and the increase is greater the larger is σ (Scenario B). Thereafter it declines immediately toward its base value for Scenarios A and B, whilst it continuously increases without a government capital transfer before declining as in the other scenarios. The adjustment paths of the inflation rate contribute to developments of the real exchange rate. Initially the real exchange rate appreciates regardless of the numerical value of σ , but appreciates by more the smaller is σ . In Scenario B ($\sigma = 0.8$) the real exchange rate appreciates by less than 4% from its base value initially, overshooting its long run steady state level,

depreciating continuously thereafter. This contributes to a more competitive situation for non oil exports and an improved non oil trade balance in comparison to Scenarios A and C. Without such a governmental capital transfer (Scenario C) the real exchange rate appreciates by nearly 7% from its base value initially, overshooting its long run steady state level and then depreciating continuously thereafter as in Scenario B.

An increase in σ from 0.4 to 0.8, as in Scenario B, leads to a larger increase in non oil output on impact, 2.4% instead of 1.1% initially. The pattern of adjustment thereafter is as in the base case. However without a government capital transfer, as in Scenario C, non oil output declines to be below its base value for a period of time, although it recovers thereafter towards steady state equilibrium. This indicates that the larger is the size of government investment, or capital transfer to the private sector, the larger is the accumulation of physical capital stock, which will affect the productive capacity of this sector and make a major contribution to the development of non oil output. On the demand side a substantial improvement in private sector real wealth contributes to an increase in domestic demand.

In the early period of adjustment, however, there is a sizeable decumulation of physical capital stock in all three scenarios, although it decumulates by less the larger is government investment of the oil revenue. Without government investment, the physical capital stock remains lower than its base value for more than half the period of adjustment.

Dutch disease consequences are apparent throughout the adjustment process, regardless of the extent of the government capital transfer. However such an effect is likely to be exacerbated without a government capital transfer to the private sector. Initially non oil exports decline, overshooting their long run rate by more the smaller is σ , but thereafter improve, although remaining lower than their base value. Non oil imports

increase, overshooting their long run level the smaller is σ . These differing adjustment processes, are largely explained by the varying size of the appreciation of the real exchange rate in the three scenarios.

Foreign asset stocks initially accumulate, and this is larger with a smaller σ . They decumulate thereafter, and this is more pronounced the larger is σ . This indicates that the adjustment process is characterised by persistent current account deficits.

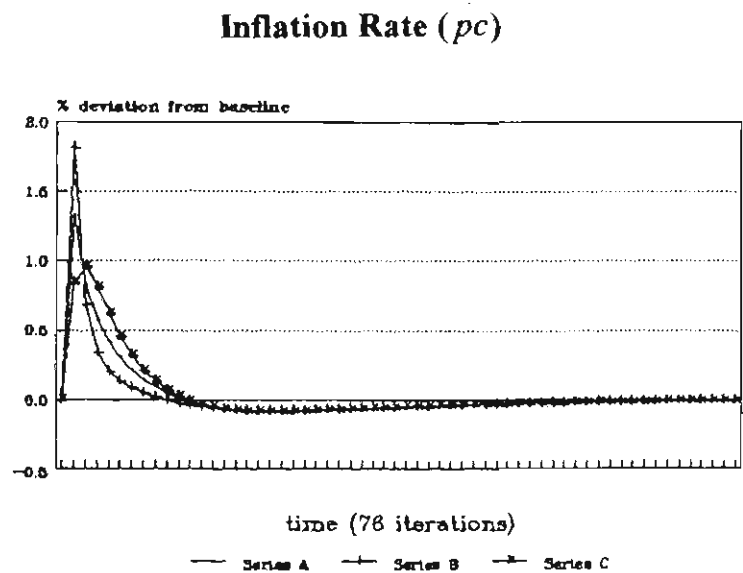
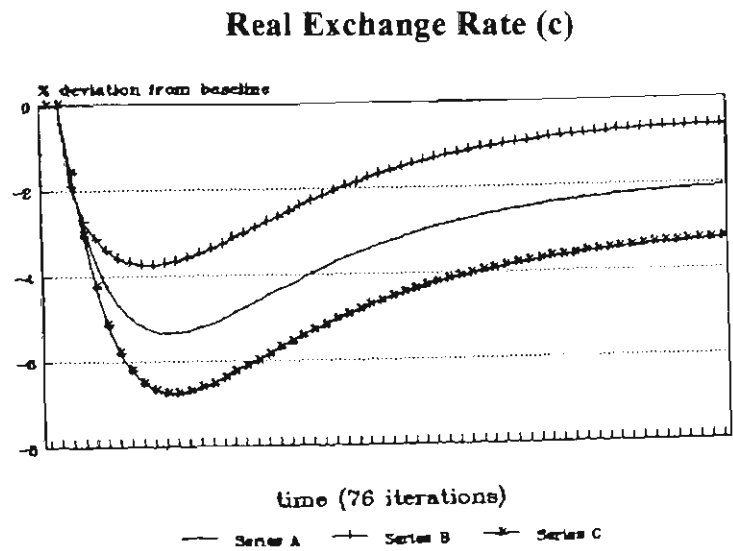
The adjustment of net foreign asset stocks, is strongly influenced by developments in the real exchange rate and in the non oil trade balance.

Private sector real wealth declines initially in all scenarios, and continuously declines for Scenarios A and C. In Scenario B, with a larger government capital transfer, private sector real wealth remains lower than its base value for more than half the period of the adjustment process, then recovering towards its long run equilibrium. The adjustment of private sector wealth is mainly influenced by developments in the net foreign asset and physical capital stocks. The slight accumulation of net foreign assets in the early period of adjustment, is not able to offset the decumulation of the physical capital stock. However, with a large government capital transfer, as in Scenario B, the large accumulation of the physical capital stock towards equilibrium is able to offset the decumulation of net foreign assets.

Overall these results suggest that an increase in the government's capital transfer relative to that of Scenario A, reduces the Dutch disease consequences throughout the adjustment process and vice versa for Scenario C. At the same time the larger is σ , the larger the benefit of the oil production increase on the rest of the aforementioned variables and the more rapid is the adjustment process. On the other hand, stimulating

FIGURE 6.2.1

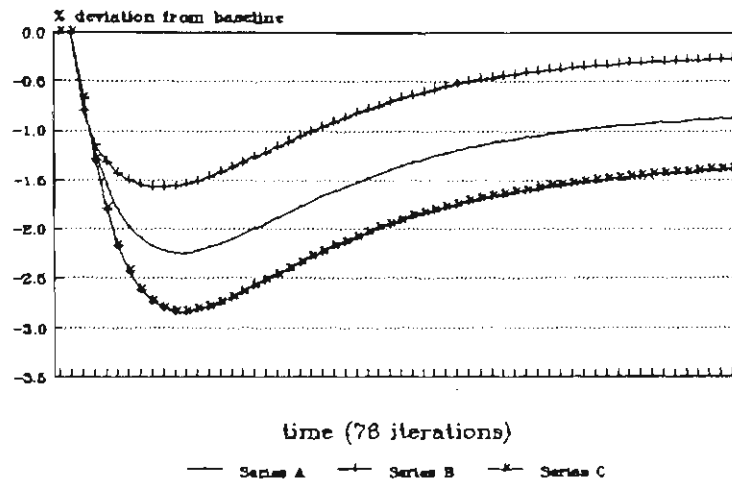
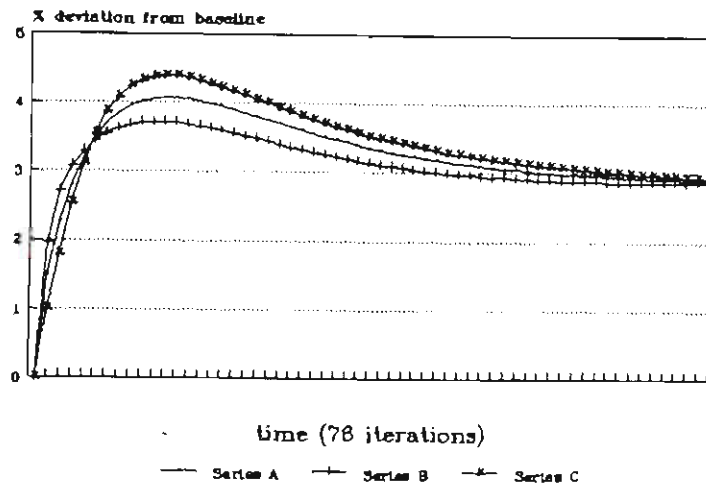
Case 1*: Oil Production Increase (changes in σ , no change in ψ)



- A: $\sigma = 0.4, \psi = 0.5$
- B: $\sigma = 0.8, \psi = 0.5$
- C: $\sigma = 0.0, \psi = 0.5$
- * Fixed Exchange Rate and $\tau = 0.2$

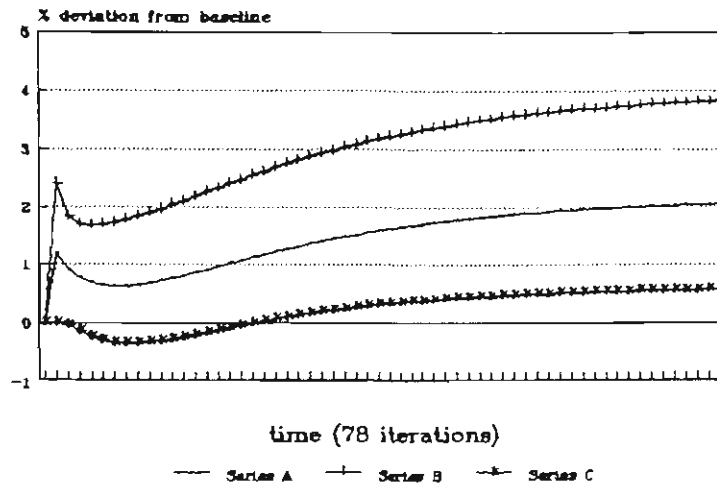
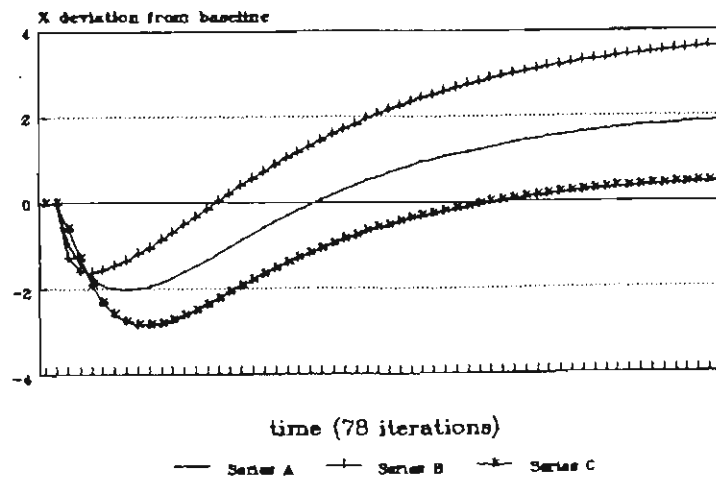
(continue over page)

(Figure 6.2.1 continued)

Non Oil Exports (nox)**Non Oil Imports (nom)**A: $\sigma = 0.4$, $\psi = 0.5$ B: $\sigma = 0.8$, $\psi = 0.5$ C: $\sigma = 0.0$, $\psi = 0.5$ * Fixed Exchange Rate and $\tau = 0.2$

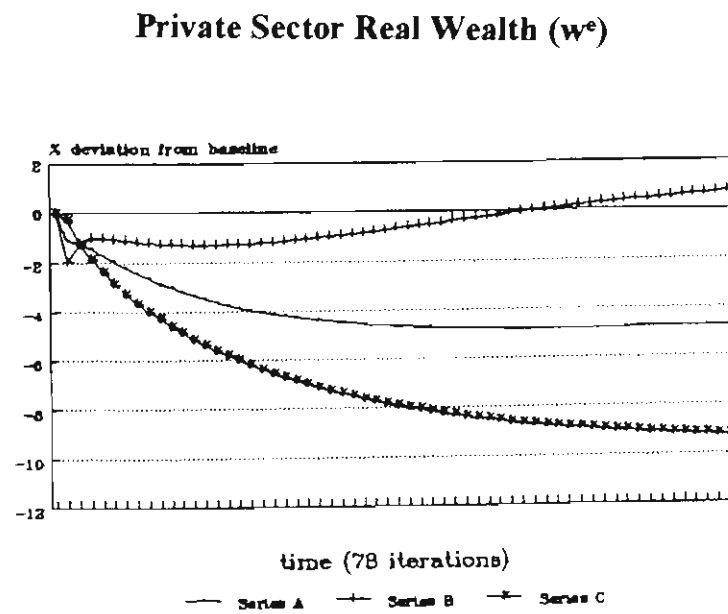
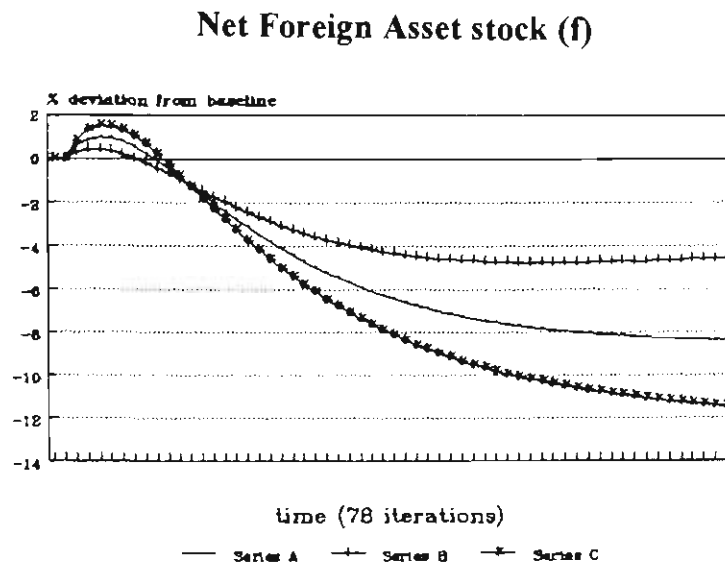
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Figure 6.2.1 (continued)

Non Oil Output (ysno)**Physical Capital Stock (k)**A: $\sigma = 0.4$, $\psi = 0.5$ B: $\sigma = 0.8$, $\psi = 0.5$ C: $\sigma = 0.0$, $\psi = 0.5$ * Fixed Exchange Rate and $\tau = 0.2$

(continue over page)

Figure 6.2.1 (continued)

A: $\sigma = 0.4$, $\psi = 0.5$ B: $\sigma = 0.8$, $\psi = 0.5$ C: $\sigma = 0.0$, $\psi = 0.5$ * Fixed Exchange Rate and $\tau = 0.2$

consumption expenditure will produce a less favourable adjustment process for each of these.

Case 2 Oil Price Shock (changes in σ , no change in ψ)

In this case altering government capital transfers to the private sector, produces important differences in the adjustment process for the three scenarios identified although this appears to be somewhat less than that for case 1. The most notable differences arise in regard to the adjustment of non oil output and the physical capital stock, both of which increase by more the larger is σ .

The real exchange rate appreciates throughout the adjustment process, and appreciates by more the smaller is σ . Without such a governmental capital transfer (Scenario C), however, the real exchange rate appreciates by more but attains equilibrium earlier than with a capital transfer, as indicated in Figure 6.2.2. Non oil output increases by more the larger is σ , throughout the adjustment process. However, without a government capital transfer, initially, non oil output declines and remains lower than its base value for a period of time. The major developments affecting the adjustment of non oil output are the size of the government capital transfer, and hence the accumulation of physical capital stock which will affect the productive capacity of such output. On the demand side the major contributor is an improvement in private sector real wealth, and this is much more significant than in Case 1.

In the early period of adjustment there is a sizeable decumulation of physical capital stock in all three scenarios, however it decumulates by less with larger government investment. Without government investment the physical capital stock

remains lower than its base value, but for a shorter period of time than that for an increase in oil production (Case 1).

Dutch disease consequences are apparent throughout the adjustment process, regardless of the extent of the government capital transfer. An increase in the government's capital transfer has a smaller effect on the adjustment of non oil imports relative to non oil exports, as it is partially offset by an increase in real income. These adjustment processes are again largely explained by the varying size of the appreciation of the real exchange rate in the three scenarios, as with Case 1.

In the early period of adjustment, varying government capital transfers have little impact upon the adjustment of foreign asset stocks. Thereafter net foreign assets accumulate by more the larger is σ , but only marginally. This indicates that the adjustment process is characterised by persistent current account surpluses.

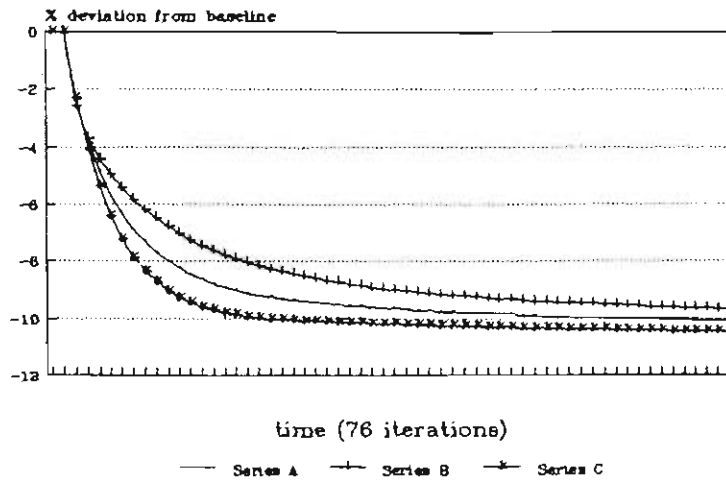
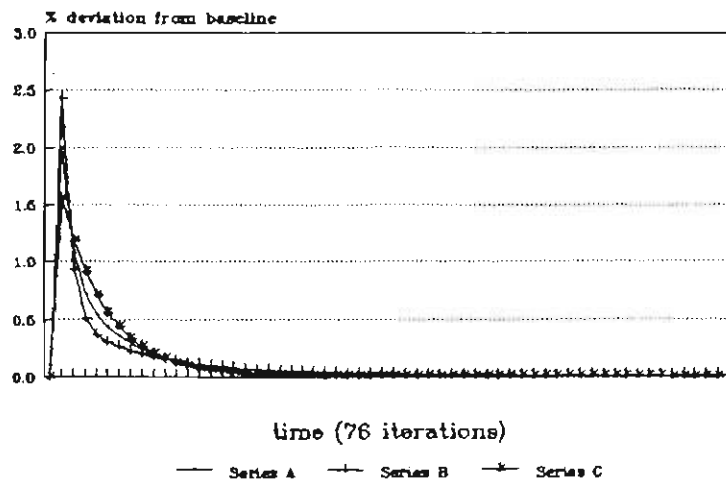
On impact private sector real wealth is lower than its base value regardless of the value of σ , but is marginally worse with a larger σ . Thereafter it increases towards the long run steady state, and benefits more the larger is σ . The decline in private sector wealth on impact arises from a higher inflation rate, which is larger for a larger σ , and the decline in the physical capital stock. Thereafter, the accumulation of net foreign assets offsets the decumulation of the physical capital stock.

Overall these results suggest that an increase in the government's capital transfer relative to Scenario A, reduces the Dutch disease consequences throughout the adjustment process. The larger is σ the greater the benefit of the oil price increase on the rest of the aforementioned variables, and the faster the adjustment process. On the other

FIGURE 6.2.2

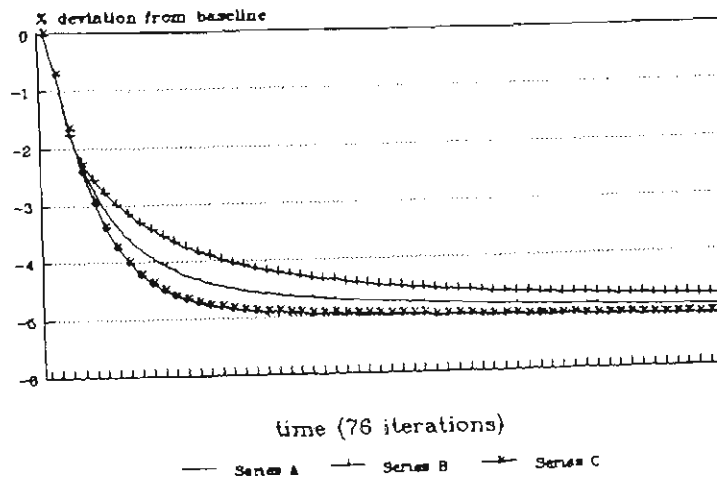
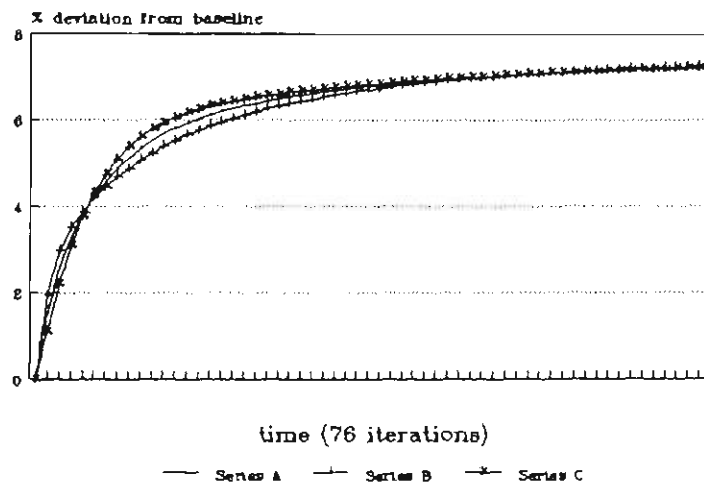
Case 2*: Oil Price Increase (changes in σ , no change in ψ)

Real Exchange Rate (c)

Inflation Rate (pc)A: $\sigma = 0.4$, $\psi = 0.5$ B: $\sigma = 0.8$, $\psi = 0.5$ C: $\sigma = 0.0$, $\psi = 0.5$ * Fixed Exchange Rate and $\tau = 0.2$

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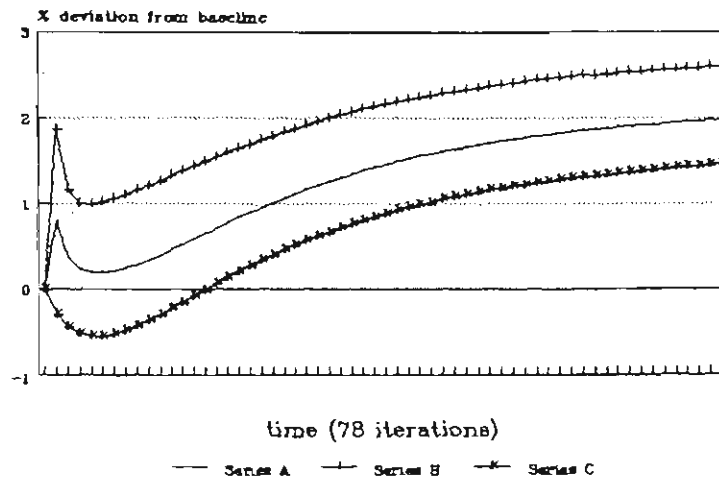
(Figure 6.2.2 continued)

Non Oil Exports (nox)**Non Oil Imports (nom)**A: $\sigma = 0.4$, $\psi = 0.5$ D: $\sigma = 0.8$, $\psi = 0.5$ E: $\sigma = 0.0$, $\psi = 0.5$ * Fixed Exchange Rate and $\tau = 0.2$

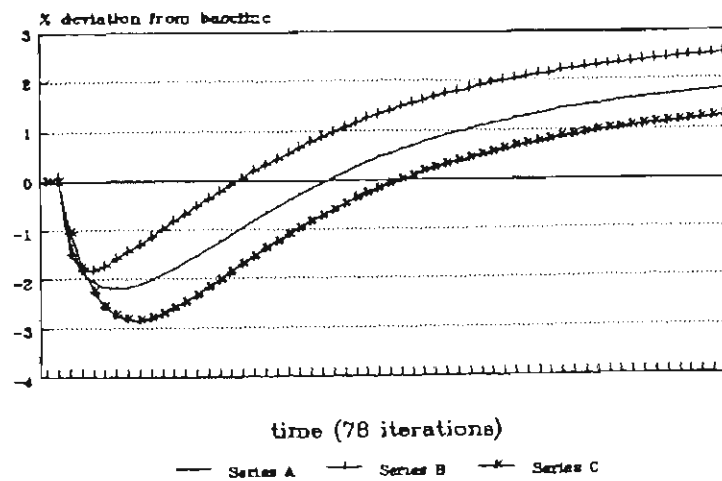
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Figure 6.2.3 (continued)

Non Oil Output (ysno)



Physical Capital Stock (k)



A: $\sigma = 0.4$, $\psi = 0.5$

B: $\sigma = 0.8$, $\psi = 0.5$

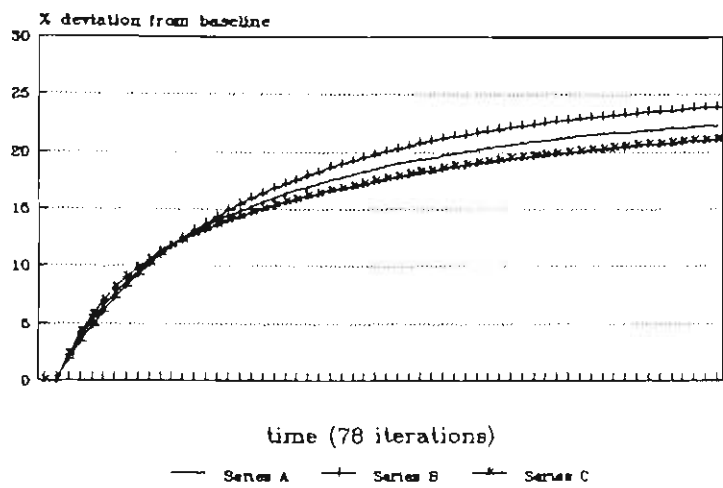
C: $\sigma = 0.0$, $\psi = 0.5$

* Fixed Exchange Rate and $\tau = 0.2$

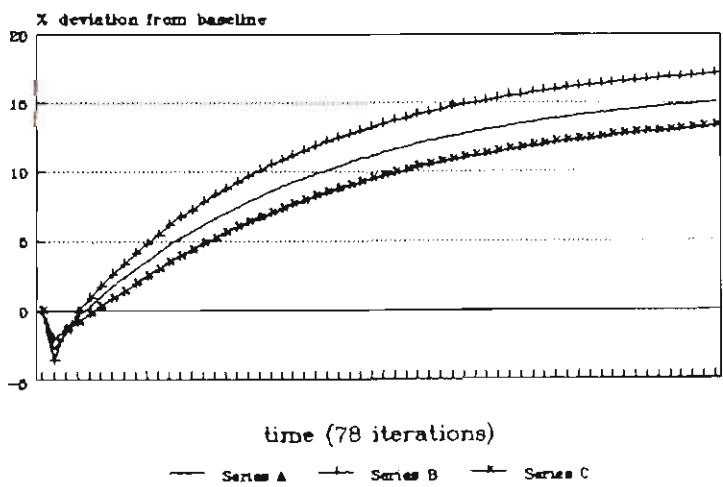
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Figure 6.2.2 (continued)

Net Foreign Asset stock (f)



Private Sector Real Wealth (w^e)



A: $\sigma = 0.4, \psi = 0.5$
B: $\sigma = 0.8, \psi = 0.5$
C: $\sigma = 0.0, \psi = 0.5$
* Fixed Exchange Rate and $\tau = 0.2$

hand, stimulating consumption expenditure will produce a less favourable adjustment process for each of these. These effects however are less than those for Case 1, except for non oil output and the physical capital stock.

Case 3 Oil Production Shock (Figure 6.2.3, changes in ψ , no change in σ)

This case is similar to Case 1 but focusses upon changing oil exports relative to its domestic usage. The results for this case produce notable differences from that of Case 1, in terms of both the adjustment path and the absolute deviation of each variable from baseline. This is mainly due to the real exchange rate response toward increased (decreased) oil exports, which is larger and in the opposite direction to that from altering government investment.

Initially the inflation rate increase is identical regardless of the value of ψ , thereafter it declines and this decline is larger with a smaller export of oil. The adjustment path of the inflation rate contributes to development of the real exchange rate as can be observed from Figure 6.2.3. Initially the real exchange rate appreciates in all scenarios, but is larger with larger oil exports (lower ψ). Over the short run the real exchange rate appreciates, overshooting its long run equilibrium value, thereafter depreciating to long run steady state. The smaller the proportion of oil exported the greater is the likelihood that the real exchange rate will depreciate over the long run, and it depreciates above its base value as indicated by Scenario E. This is influenced by a declining inflation rate below its base value.

Developments in non oil output are very similar on impact in all scenarios. Thereafter it falls for a period of time, then rises in all scenarios. Developments in non oil output are larger with a smaller export of oil. Hence a less oil export oriented policy has

potential advantages for the growth of non oil output. On the supply side this rapid growth in non oil output can be explained by a rapid accumulation of capital stock. On the demand side greater investment in the capital stock and higher private sector real wealth contribute to buoyant domestic demand, despite the deterioration of the non oil trade balance.

Dutch disease effects are more likely, the larger are oil exports. This is due to a larger appreciation of the real exchange rate, which worsens the competitiveness of non oil exports. In scenario D, with 80 per cent of oil production exported, non oil exports deteriorate almost continuously throughout the adjustment process to long run steady state. In addition non oil imports show a sharp increase. On the other hand, with scenario E, in which only 20 per cent of oil production is exported, non oil exports improve after an initial decline. Non oil imports in this case initially increase before declining towards steady state. Hence these developments suggest that a more export oriented oil policy will produce a noticeable deterioration in the non oil trade deficit.

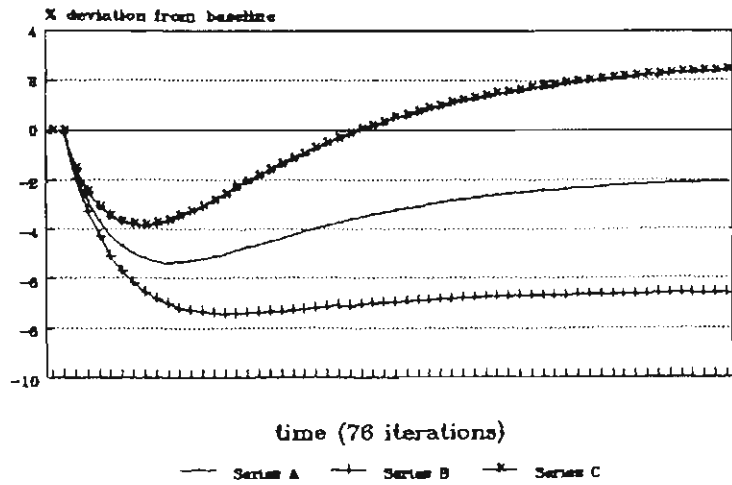
Despite the previous adverse developments in the non oil trade balance arising from larger oil exports, it is insufficient to prevent a sizeable accumulation of foreign asset stocks which is a reflection of continuous current account surpluses. Less oil exports lead to a decumulation of net foreign assets. The results presented here suggest that the adverse developments in non oil trade will be dominated by improvements in the oil trade balance.

Private sector real wealth will also be affected throughout the adjustment process. The results indicate that private sector real wealth is likely to benefit from a more export oriented oil policy, since it will lead to a more rapid accumulation of foreign

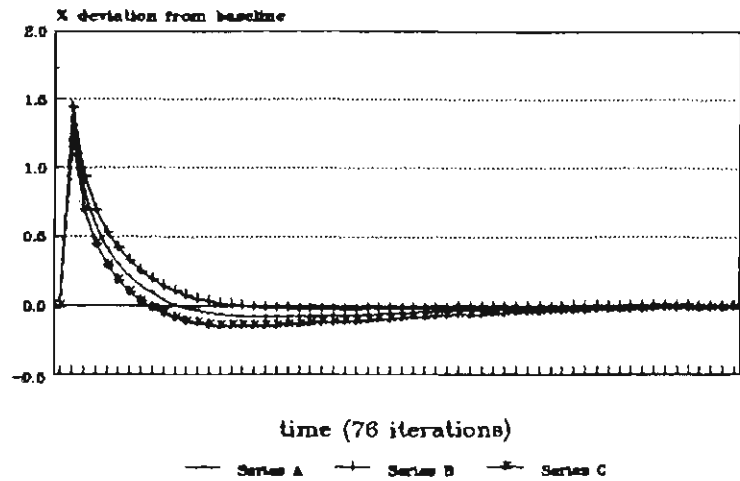
FIGURE 6.2.3

Case 3*: Oil Price Increase (changes in σ , no change in ψ)

Real Exchange Rate (c)



Inflation Rate (pc)



A: $\sigma = 0.4, \psi = 0.5$

D: $\sigma = 0.8, \psi = 0.5$

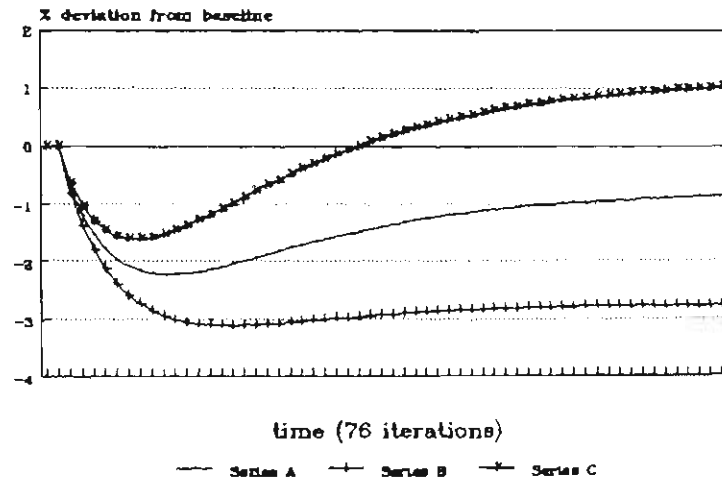
E: $\sigma = 0.0, \psi = 0.5$

* Fixed Exchange Rate and $\tau = 0.2$

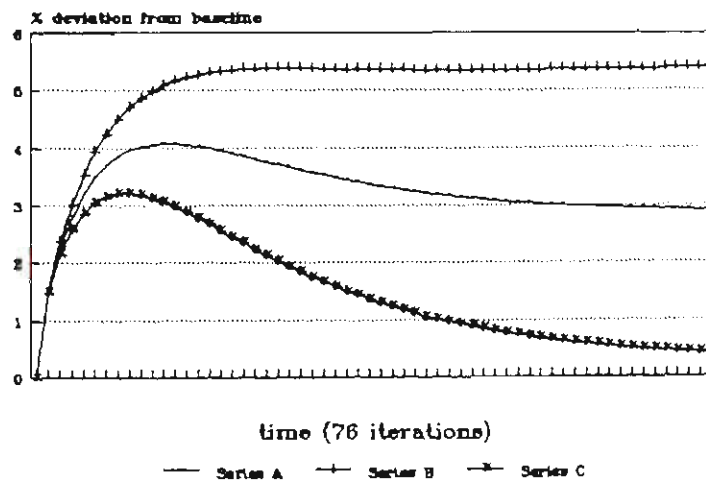
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Figure 6.2.3 (continued)

Non Oil Exports (nox)

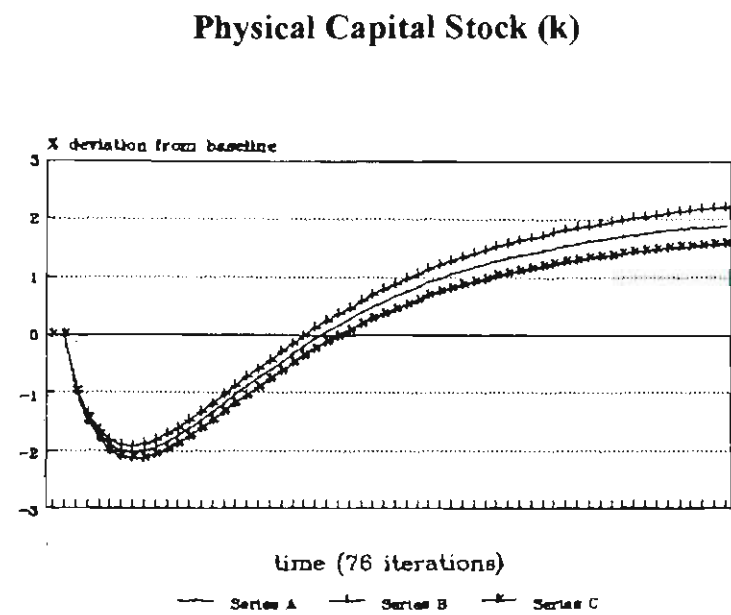
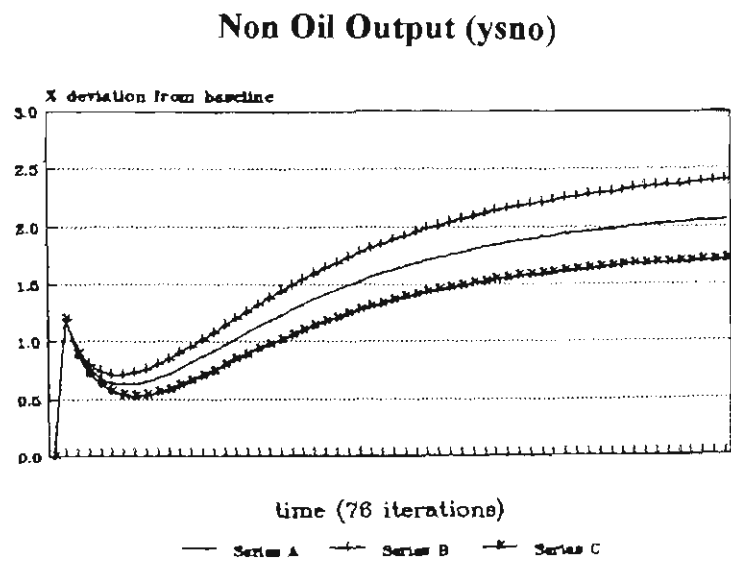


Non Oil Imports (nom)

A: $\sigma = 0.4$, $\psi = 0.5$ D: $\sigma = 0.8$, $\psi = 0.5$ E: $\sigma = 0.0$, $\psi = 0.5$ * Fixed Exchange Rate and $\tau = 0.2$

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Figure 6.2.3 (continued)

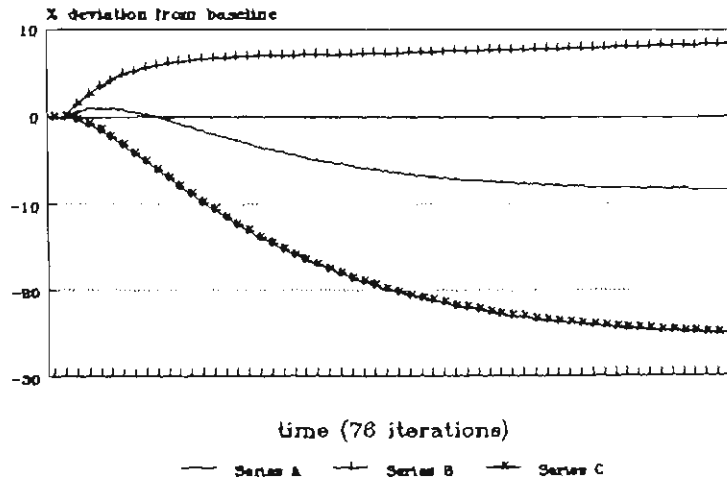


A: $\sigma = 0.4, \psi = 0.5$
D: $\sigma = 0.8, \psi = 0.5$
E: $\sigma = 0.0, \psi = 0.5$
* Fixed Exchange Rate and $\tau = 0.2$

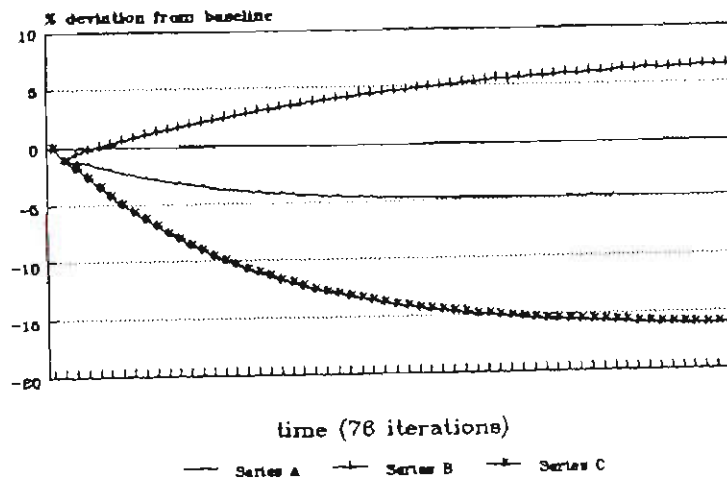
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Figure 6.2.3 (continued)

Net Foreign Asset stock (f)



Private Sector Real Wealth (w^e)



A: $\sigma = 0.4$, $\psi = 0.5$

D: $\sigma = 0.8$, $\psi = 0.5$

C: $\sigma = 0.0$, $\psi = 0.5$

* Fixed Exchange Rate and $\tau = 0.2$

asset stocks as well as capital stock. Again this may be regarded as a desirable feature in regard to the economic development of such an oil exporting economy.

Overall these results suggest that an increase in oil exports will benefit non oil output, physical capital stock, and benefit by more net foreign asset stocks and private sector real wealth. However, the Dutch disease consequences are larger with larger oil exports throughout the adjustment process. On the other hand the Dutch disease consequences are reduced by reducing oil exports, but produce a less favourable adjustment process for other variables.

Case 4 Oil Price Shock (changes in ψ , no change in σ)

The simulation results indicate that the adjustment process for each of the major macroeconomic variables is identical, irrespective of the value of ψ , as in the base case Chapter 5 (Scenario A of Case 3). This is not surprising, since for the three scenarios conducted oil production and development expenditure remain unchanged. Therefore the results are identical to those derivable for the case of an oil price increase alone, as in Case 2 of Chapter 5, and are not discussed further.

6.3 Alternative Nominal Exchange Rate and Capital Markets Policies

The policy responses emphasised here relate to the nominal exchange rate being either fixed or flexible, combined with varying degrees of control over capital markets. The relevant policy parameter for the capital market policy is τ , which represents the degree of control over capital mobility. This parameter value can range from zero to one. For τ equal to zero means that there is no capital mobility, whilst for τ equal to one there is perfect capital mobility.

In this study, 5 possible scenarios are chosen and will be conducted for both cases. Three of them, Scenario A to Scenario C, assume a fixed nominal exchange rate, and the other two, Scenario D and Scenario E, assume a flexible nominal exchange rate. Scenario "A" is the base case where τ is 0.20. Scenario B represents a liberalised policy towards the capital markets in which τ is 0.60, and Scenario C where τ is 1 representing perfect capital mobility. Scenario D is the same as for Scenario A, but assumes a flexible nominal exchange rate policy. Scenario E is as for Scenario C but for a flexible nominal exchange rate. This last case is representative of an economy with fully liberalised financial markets. Therefore there are two cases to be simulated, an oil price and oil production shock, with 5 scenarios in each case. These policy alternatives are summarised in Table 6.2 below.

Table 6.2

Alternative Nominal Exchange Rate and Capital market Policies
(for both fixed and flexible nominal exchange rate)

Nominal Exchange Rate Regime					
Fixed			Flexible		
Scenario "A" Scenario B Scenario C			Scenario D	Scenario E	
Degree of capital Mobility	$\tau = 0.2$	$\tau = 0.6$	$\tau = 1$	$\tau = 0.2$	$\tau = 1^*$
* $\tau = 1$, perfect capital mobility. $\tau = 0$, no capital mobility.					

The analysis will focus upon the same macroeconomic variables as in Section 6.2.1. The long run steady state equilibrium for each Scenario is identical to Scenario A. This is due to the fact that in all scenarios there is no monetary accommodation in the long run steady state as in equations 16 to 16c in Chapter 4. Hence these alternative policies only influence the adjustment process of the economy, which initially occurs through the adjustments in the capital market, current account balance, and the nominal exchange rate.

For a fixed exchange rate regime the adjustment of the inflation rate and real exchange rate occurs through adjustment in both the money stock and domestic non oil price, whereas for a flexible nominal exchange rate regime it occurs through adjustment in both the nominal exchange rate regime and the non oil price⁶⁷. The adjustment process will therefore be different for either case and for all scenarios. The most significant difference in the adjustment paths among these policies, arises during the adjustment process up to 20 periods. Overall, the effects involve greater fluctuations for the oil production shock than for the oil price shock. The discussion will be pursued by looking at each variable for each case. The case of a 10 per cent oil production increase shock will be discussed first.

6.3.1 Case 1 Oil Production Increase Shock

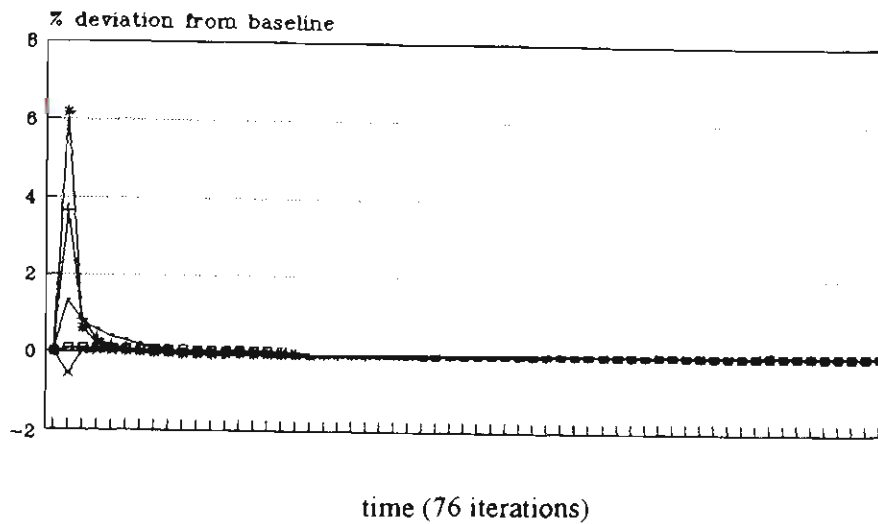
This case is concerned with analysing a positive oil production shock within the 5 scenarios aforementioned. The most pronounced effects occur on impact and in the early periods of the adjustment process, as indicated in Figure 6.3.1a to Figure 6.3.1h. The key variable in this adjustment process is the real exchange rate and the inflation rate. The latter is mainly of interest during the initial adjustment process.

⁶⁷See footnote 3 Chapter 3.

The simulation results indicate that the rate of inflation increases for the fixed nominal exchange rate scenarios (Scenario A, B and C), and is higher for Scenario C initially although in this scenario it does stabilise quickly. In Scenario A the inflation rate remains above the base line for a short period. On the other hand the inflation rate falls below its base line with a flexible exchange rate (Scenario D and E). This mainly arises from the adjustment of the nominal exchange rate.

For a fixed exchange rate the adjustment of the inflation rate is mainly influenced by the monetary growth rate, which initially increases arising from an increase in oil export revenue that leads to an accumulation of foreign exchange reserves. This adjustment however is different for different degrees of capital mobility.

Initially an increase in the monetary growth rate would induce domestic nominal interest rates to rise above the world interest rate and encourage capital inflows, which would lead to a further accumulation of foreign exchange reserves. In Scenario A ($\tau = 0.2$), however, with a low degree of capital mobility, inflation mainly arises from an increase in the monetary growth rate induced by an increase in oil export revenue, as the capital inflow is controlled by government. For Scenario B ($\tau = 0.6$) and Scenario C ($\tau = 1$), the inflation rate is induced by a combination of an increase in oil export revenue and allowing capital inflows. The lower the control on international capital mobility the larger the capital inflow, and hence the higher the initial increase in the inflation rate. However as the domestic nominal interest rate declines, such capital inflow declines as does the monetary growth rate.

FIGURE 6.3.1a (Case 1)**Inflation Rate (\dot{p})**

----- Series A ----- Series B ----- Series C ----- Series D ----- Series E

A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$

A, B and C for a nominal fixed exchange rate regime.

D and E for a nominal flexible exchange rate regime.

With a flexible nominal exchange rate regime, as we would anticipate, an increase in oil export revenue would not affect the monetary growth rate, but rather it would strengthen the nominal exchange rate. Hence developments in the inflation rate arise mainly from adjustments of the nominal exchange rate. The adjustment of the inflation rate differs, depending upon the different degrees of capital mobility in the case of a fixed nominal exchange rate regime. For Scenario D ($\tau = 0.2$) the appreciation of the nominal exchange rate would not influence capital flows, as the government controls international capital flows and hence the inflation rate. For Scenario E ($\tau = 1$) the appreciation of the nominal exchange rate induces capital outflows resulting in an initial decline of the

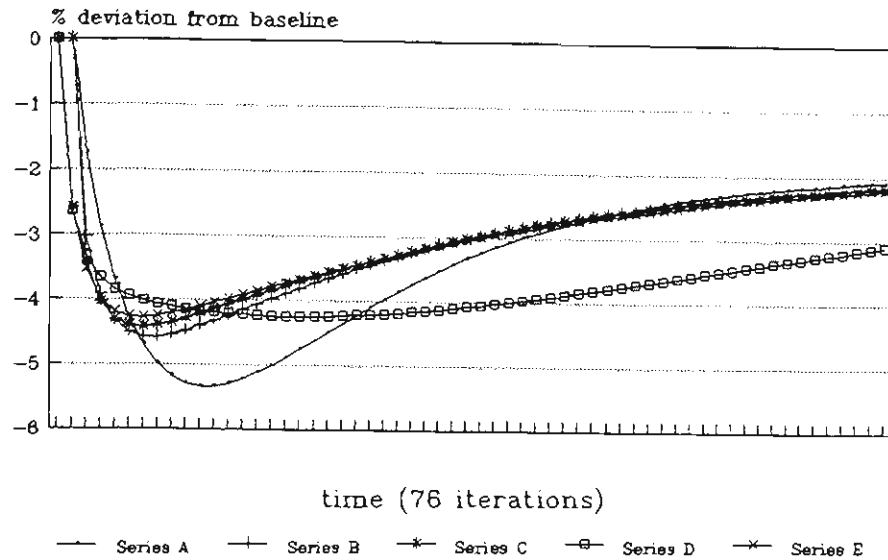
inflation rate below its base value, as indicated in Figure 6.3.1a. The adjustment path of the inflation rate will influence the initial adjustment of the real exchange rate⁶⁶.

Initially the real exchange rate appreciates regardless of the value of τ and the nominal exchange rate policy adopted, as shown in Figure 6.3.1b. The adjustment paths thereafter show interesting differences. In the early part of the adjustment process for the fixed exchange rate scenarios, the appreciation of the real exchange rate overshoots its long run steady state and is larger for a smaller τ . For Scenario A, the appreciation of the real exchange rate is not only larger but also takes longer to achieve. Hence the initial appreciation is more prolonged. This is influenced by the inflation rate which remains above its base level for a period of time. Thereafter the real exchange rate depreciates towards its long run rate in all scenarios.

For the flexible exchange rate scenarios, initially, the adjustment path of the real exchange rate is similar, but a notable divergence is then apparent. Thereafter it depreciates toward the long run steady state. The adjustment path of the real exchange rate is more volatile for a fixed than flexible nominal exchange rate for a small value of τ (Scenario A and Scenario D), but it is comparable for $\tau = 1$ (Scenario C and Scenario E). Initially this is mainly influenced by developments of the inflation rate, as can be observed from Figure 6.3.1a. The adjustment paths of the real exchange rate have a strong influence on the development of the rest of the key macroeconomic variables under study.

⁶⁶By definition the real exchange rate is the nominal exchange rate deflated by the price of the domestically produced non oil output. The inflation rate is induced by, for example, an increase in either the nominal exchange rate and/or the price of non oil output.

FIGURE 6.3.1b (Case 1)
Real Exchange Rate (c)



A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

Dutch disease consequences remain in all scenarios regardless of the nominal exchange rate regime and the value of τ , as indicated by the non oil trade deficit which is largely influenced by the adjustment paths of the real exchange rate.

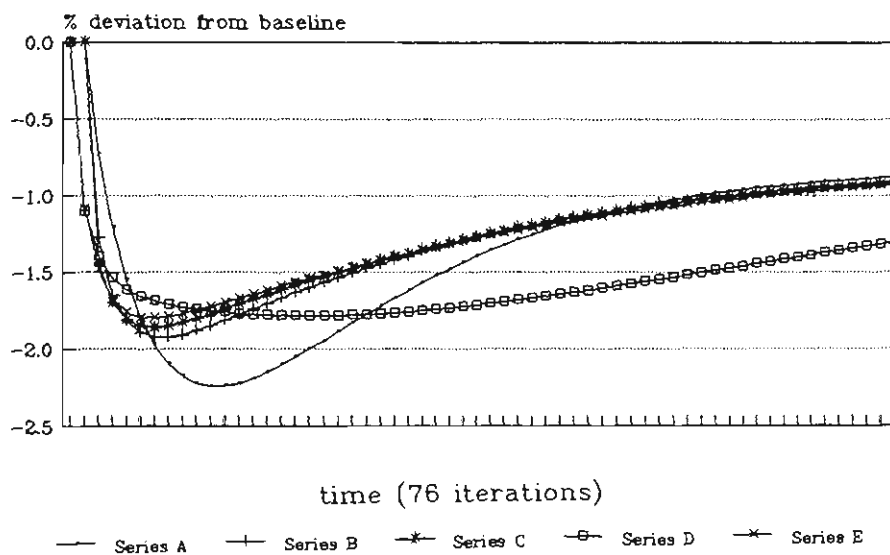
This is especially significant for non oil exports, as shown in Figure 6.3.1c, whilst developments in non oil imports, as shown in Figure 6.3.1d, are also influenced by developments in real income.

In the early period of adjustment non oil exports decline for all scenarios, and this decline is greater for a fixed than a flexible exchange rate regime for a comparable degree of international capital flow controls. Thereafter non oil exports recover but remain

below their base value. Hence adopting a flexible exchange rate combined with perfect capital mobility offers the prospect of less deterioration in non oil exports although initially, and for a very short period thereafter, it is larger than adopting a flexible exchange rate combined with a high degree of control over international capital mobility.

Developments in non oil imports are less volatile than developments in non oil exports. This is mainly due to developments in non oil imports being influenced by a combination of the real exchange rate and an increase in real income.

FIGURE 6.3.1c (Case 1)
Non Oil Exports (nox)



A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$ D: $\tau = 0.2$, E: $\tau = 1$
A, B and C for a nominal fixed exchange rate regime.
D and E for a nominal flexible exchange rate regime.

Over the short run altering the nominal exchange rate regime from fixed to flexible increases the non oil imports by less than for the high degree of control over

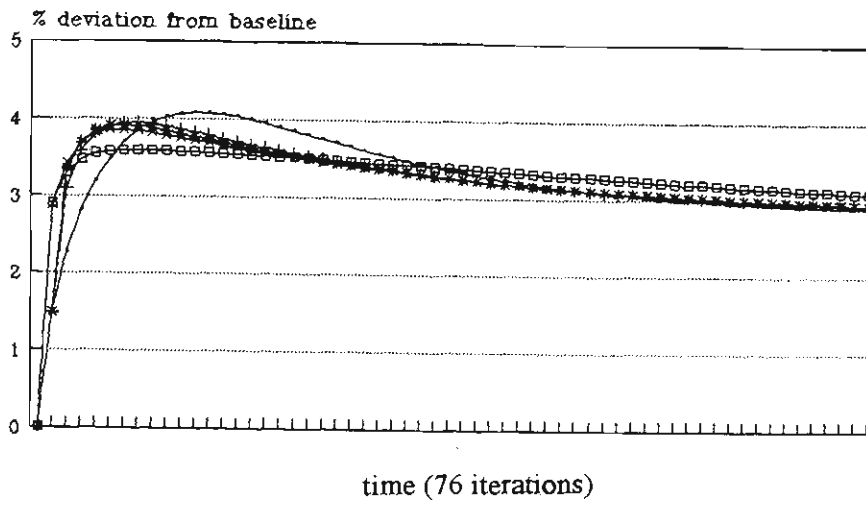
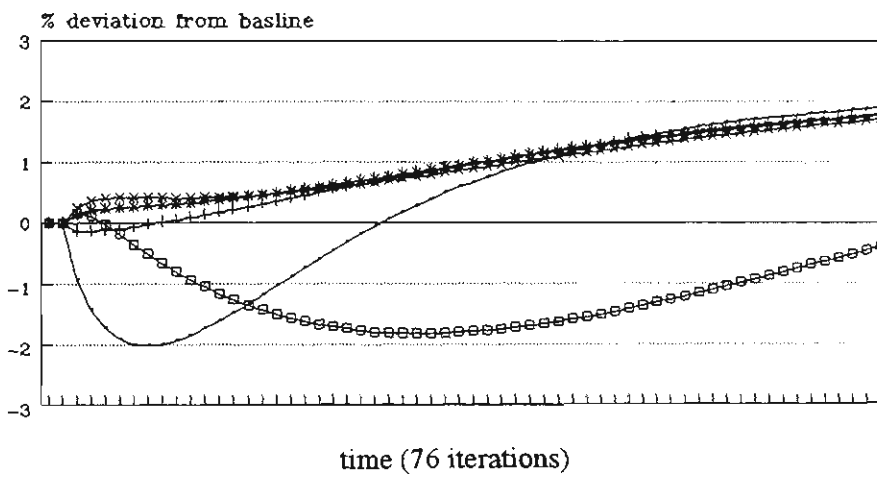
international capital mobility scenario, but it is comparable to the perfect international capital mobility scenario.

The adjustment path of non oil imports and exports suggests that a flexible nominal exchange rate combined with perfect capital mobility, offers less deterioration of the non oil trade balance hence the smaller are the Dutch disease consequences. However during the initial period of the adjustment process it is slightly larger.

The physical capital stock accumulates throughout the adjustment process for both Scenarios C and E (perfect capital mobility and a fixed and flexible exchange rate respectively). It decumulates during the early part of the adjustment process in Scenario B. In Scenario D it decumulates over the short run but then accumulates gradually, but remaining lower than its base value predominantly, as it recovers towards long run equilibrium.

The simulation results indicate that perfect capital mobility offers potential benefits to the accumulation of the physical capital stock, with this being marginally larger with a flexible exchange rate in the early period of adjustment as shown in Figure 6.3.1e. Such accumulation can play a vital role in the development process.

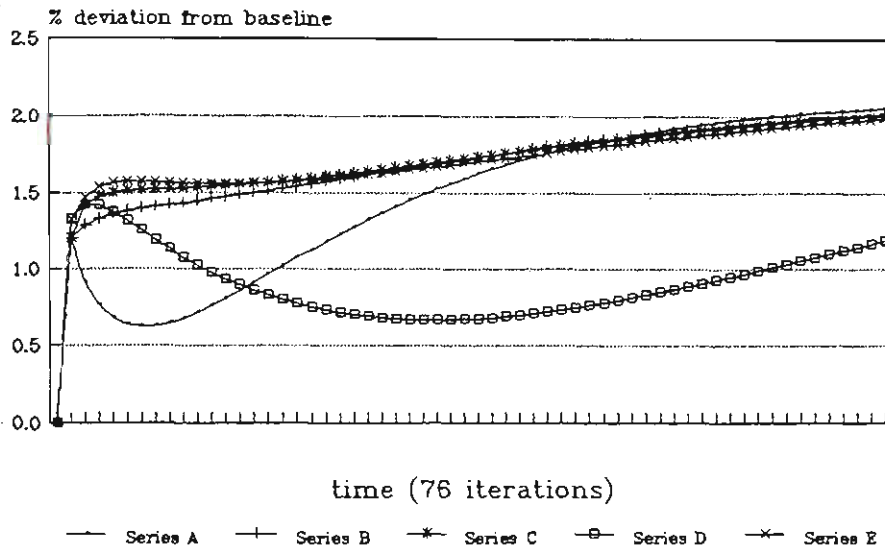
Non oil output increases initially in all scenarios, continuously increasing for Scenarios C and E, marginally increasing decreasing and then increasing again in Scenario D and immediately declining and then increasing in Scenario A. In all scenarios non oil output remains above its base value throughout the adjustment process.

FIGURE 6.3.1d (Case 1)**Non Oil Imports (nom)****FIGURE 6.3.1e (Case 1)****Physical Capital Stock (k)**

A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$ D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

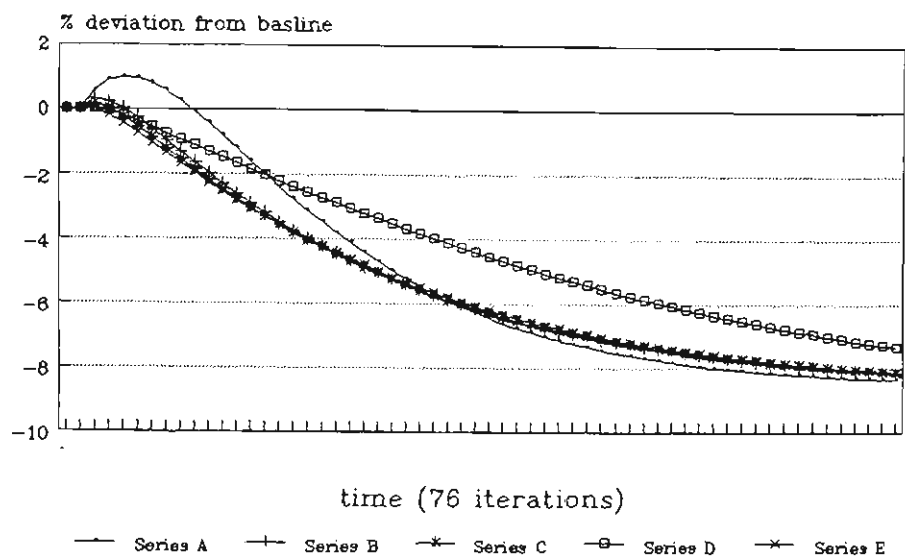
These results indicate that the largest initial benefits of an oil boom on non oil output arise from Scenario E (flexible nominal exchange rate and perfect capital mobility), and the least and most volatile adjustment of non oil output occurs for Scenario A.

FIGURE 6.3.1f(Case 1)
Non Oil Output (ysno)



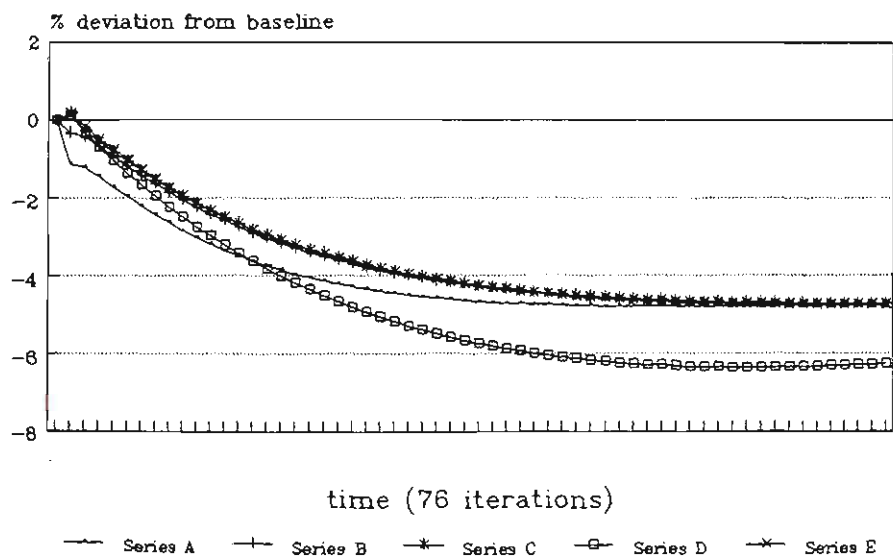
Net foreign asset stocks initially decline for all scenarios except for Scenario A, as indicated in Figure 6.3.1g. Thereafter they continuously decline in all scenarios, but they decline at a smaller rate for Scenario D. This indicates that the current account is in persistent deficit. Hence in all scenarios the deterioration of the non oil trade balance, offsets the improvement in the oil trade balance. The adjustment process of net foreign assets indicates that a flexible exchange rate, combined with a high degree of capital mobility, offers the prospect of a smaller decline of net foreign asset stocks.

FIGURE 6.3.1g (Case 1)
Net Foreign Asset Stock (f)



Private sector real wealth deteriorates in all scenarios throughout the adjustment process, except for a marginal increase in Scenario D. This indicates that the adjustment process of private sector real wealth is strongly influenced by developments in the foreign asset stock.

FIGURE 6.3.1h (Case 1)
Private Sector Real Wealth (W^e)



The above discussion indicates that Dutch diseases consequences are apparent in all scenarios. This effect is slightly less for perfect capital mobility combined with a flexible rather than fixed nominal exchange rate regime. However this process is less in the early period of the adjustment process for a flexible nominal exchange rate combined with a high degree of international capital mobility. Overall perfect capital mobility (Scenario C and E) offers potentially favourable benefits to the macro variables during the adjustment process. This is indicated by a smaller non oil trade deficit, a larger increase in non oil output, a smaller decline in private sector real wealth, and a larger accumulation of physical capital stock, although net foreign asset stocks decumulate by less. These are initially slightly more if perfect capital mobility is combined with a flexible nominal exchange rate.

6.3.2 Case 2 Oil Price Increase Shock

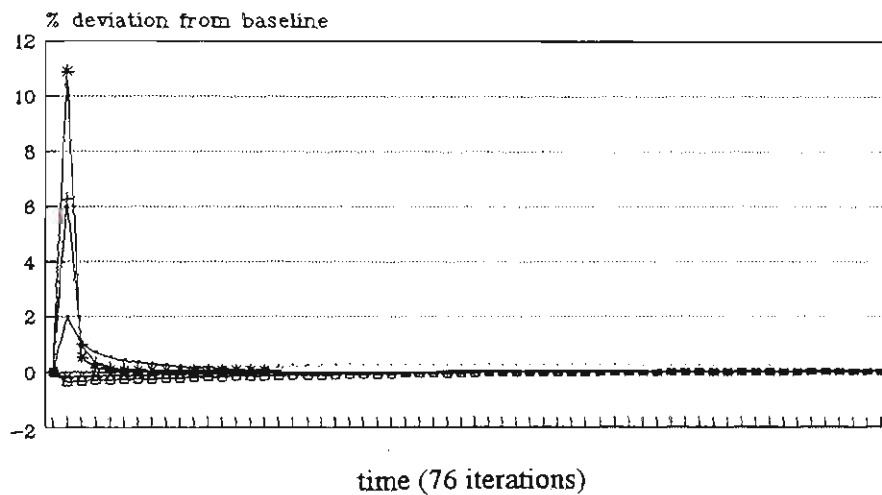
This case is concerned with analysing a positive oil price shock, associated with the 5 scenarios aforementioned. The simulation results indicate that both the nominal exchange rate regime and the degree of capital control, play an important role in the development of all the major macroeconomic variables during the adjustment process as can be observed from Figure 6.3.2a to Figure 6.3.2h. The most pronounced effects occur on impact and in the early periods of the adjustment process. The key variables in this adjustment process initially are the real exchange rate and the inflation rate. This is due to the fact that an increase in foreign currency revenue arising from an oil related shock, will initially influence the adjustment of the non oil good price for the fixed exchange rate

regime and the nominal exchange rate for the flexible exchange rate regime. These will influence the development of both the real exchange rate and the inflation rate.

The simulation results indicate that the rate of inflation increases initially with a fixed exchange rate (Scenarios A, B and C) being highest for Scenario C (perfect international capital mobility) initially, but stabilising very quickly thereafter as shown in Figure 6.3.2a.

FIGURE 6.3.2a (Case 2)

Inflation Rate (pc)



A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$

A, B and C for a nominal fixed exchange rate regime.

D and E for a nominal flexible exchange rate regime.

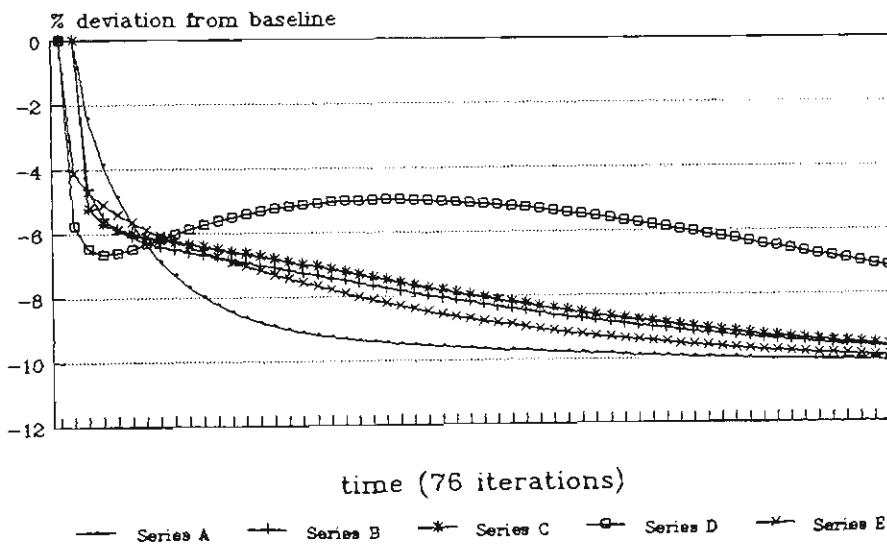
In Scenario A the inflation rate appears to remain above its base value until long run equilibrium is established. For a flexible nominal exchange rate, as we would anticipate, the inflation rate is nearly unaffected. For a fixed nominal exchange rate this adjustment process is mainly influenced by the monetary growth rate, whilst for a flexible nominal exchange rate it is influenced by developments in the nominal exchange rate.

This discussion suggests that the least effect upon inflation arising from an increase in the price of oil is for a flexible nominal exchange rate combined with perfect international capital mobility.

Initially the real exchange rate appreciates regardless of the value of τ and the nominal exchange rate policy adopted, as shown in Figure 6.3.2b. The adjustment path for each scenario indicates interesting differences. For the fixed exchange rate scenarios the real exchange rate appreciates by more initially the larger is τ , whilst for the flexible exchange rate scenarios it appreciates by less the larger is τ .

FIGURE 6.3.2b (Case 2)

Real Exchange Rate (c)



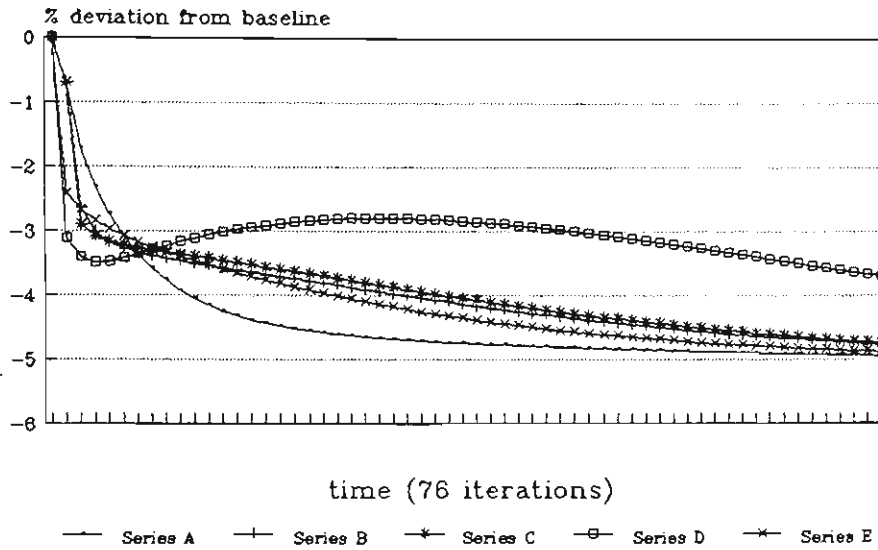
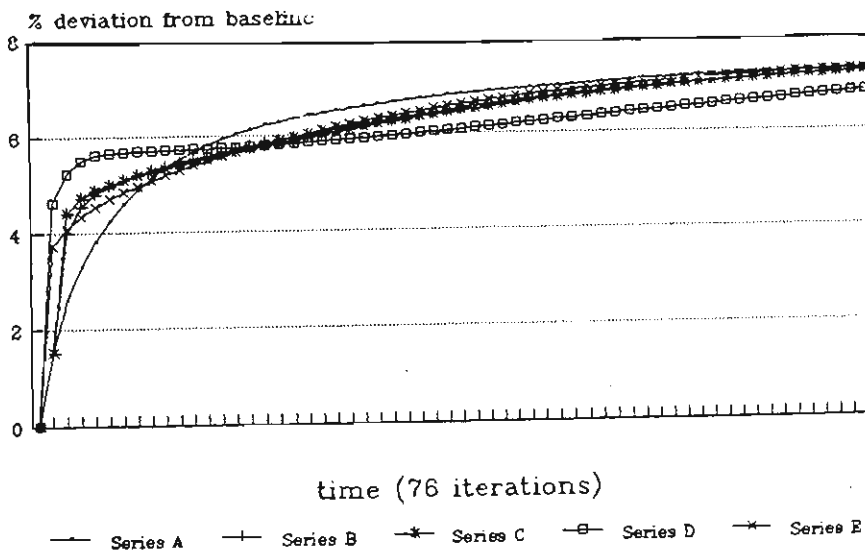
A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

It appreciates continuously thereafter except for Scenario D. In Scenario D the real exchange rate depreciates for a period of time after its initial depreciation before it appreciates towards long run steady state, with the extent of this being less than for the other scenarios.

The above discussion indicates that perfect capital mobility offers the prospect of a smoother adjustment process for the real exchange rate, and the extent of the appreciation is slightly less with a flexible exchange rate. However a flexible exchange rate combined with greater control over international capital mobility, offers a smaller appreciation of the real exchange rate throughout the adjustment process except for the initial period. The adjustment path of the real exchange rate has a strong influence on the development of the rest of the key macroeconomic variables under study.

Dutch disease consequences appear in all scenarios regardless of the nominal exchange rate regime and the value of τ . The effect is larger upon non oil exports than for non oil imports as in Case 1. Developments in non oil exports are mainly influenced by developments in the real exchange rate, whilst developments in non oil imports are influenced by a combination of developments in the real exchange rate and real income.

This discussion suggests that adopting a flexible exchange rate and perfect capital mobility offers the potential of a smoother adjustment process of the non oil trade deficit. However adopting a flexible exchange rate combined with a high degree of control over the capital market (Scenario D), leads to a more competitive situation for non oil traded goods except for the early adjustment process as shown in Figure 6.3.2d. Hence for an oil price increase the smallest Dutch disease consequence is derived under Scenario D.

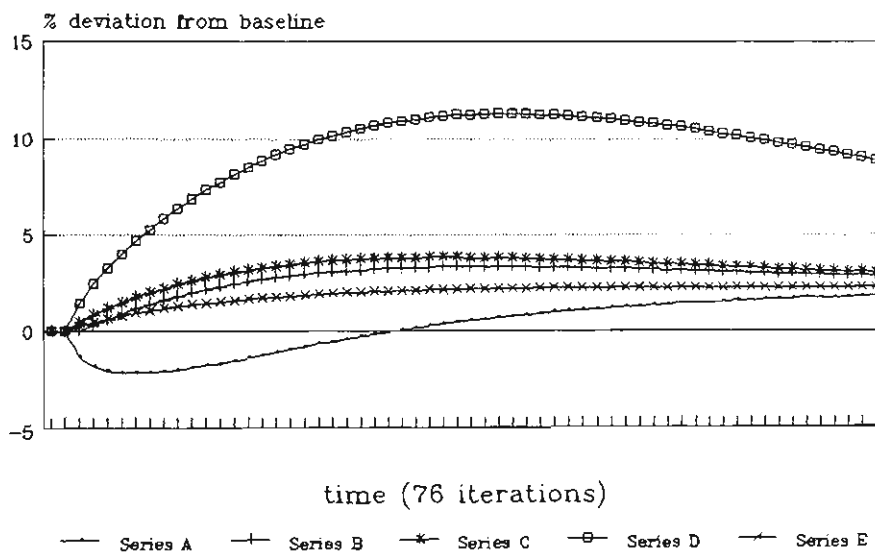
FIGURE 6.3.2c (Case 2)**Non Oil Exports (nox)****FIGURE 6.3.2d (Case 2)****Non Oil Imports (nom)**

A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$ D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

The capital stock accumulates throughout the adjustment process, except for a fixed exchange rate combined with high control over capital mobility in which it decumulates for a short period. This accumulation of physical capital stock is noticeably larger than that for the other scenarios. Hence, if the government adopts a fixed exchange rate with perfect capital mobility (Scenario D), it provides potentially the largest benefits to the accumulation of physical capital stock as in Figure 6.3.2e.

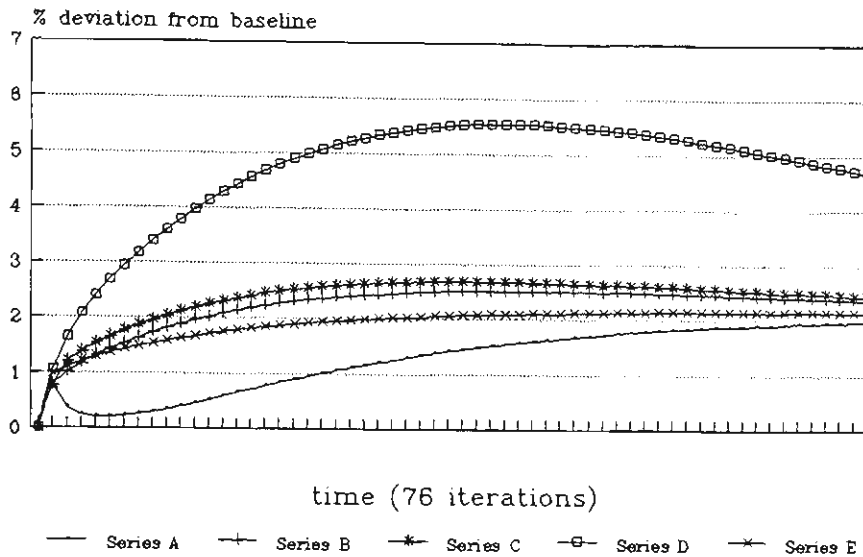
FIGURE 6.3.2e (Case 2)

Physical Capital Stock (k)



A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

Non oil output increases in all scenarios initially, and continuously increases throughout the adjustment process with the exception of Scenario A ($\tau = 0.2$). The largest increase in non oil output is under a flexible exchange rate combined with high control over capital mobility (Scenario D), with this again being much larger than the other scenarios as in Figure 6.3.2f.

FIGURE 6.3.2f (Case 2)**Non Oil Output (ysno)**

A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

Net foreign asset stocks increase throughout the adjustment process indicating current account surpluses, but are smaller with a flexible exchange rate combined with a high degree of control over international capital mobility (Scenario D) as indicated in Figure 6.3.2g. The accumulation of net foreign asset stocks is larger for more than half the period of adjustment, under a fixed exchange rate combined with high control over capital mobility. Hence in all scenarios, the oil trade balance offsets the deterioration of the non oil trade balance. The adjustment process of net foreign asset stocks, indicates that a fixed nominal exchange rate combined with a high degree of capital mobility offers potentially a larger accumulation of net foreign asset stocks.

FIGURE 6.3.2g (Case 2)
Net foreign Asset Stocks (f)

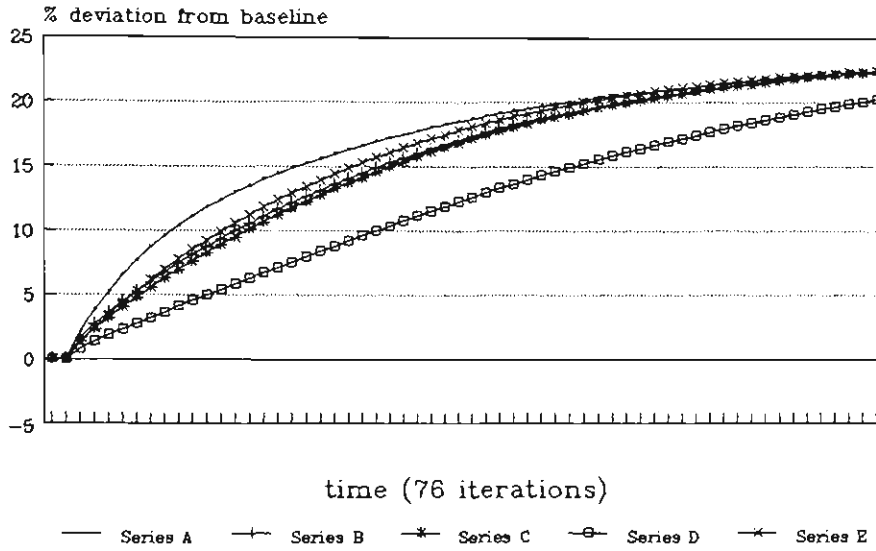
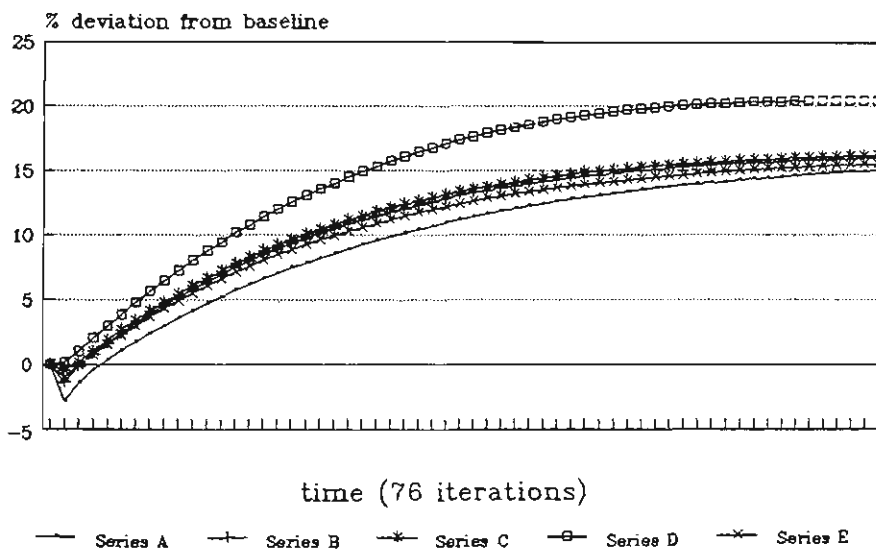


FIGURE 6.3.2h (Case 2)
Private Sector Real Wealth (w^e)



A: $\tau = 0.2$, B: $\tau = 0.6$, C: $\tau = 1$, D: $\tau = 0.2$, E: $\tau = 1$
 A, B and C for a nominal fixed exchange rate regime.
 D and E for a nominal flexible exchange rate regime.

Private sector real wealth declines initially in all scenarios, except Scenario D, as shown in Figure 6.3.2h. Thereafter it increases towards long run equilibrium, with this increase being larger for Scenario D.

The above discussion indicates that Dutch disease consequences are apparent in all scenarios. The effects however are substantially less for a flexible exchange rate combined with a high degree of international capital mobility, although in this case it is slightly larger during the early period of the adjustment process. However if the government adopted a fixed nominal exchange rate regime with perfect international capital mobility, there would be less deterioration in the non oil trade balance. The capital stock accumulates throughout the adjustment process, except for a fixed exchange rate combined with high control over capital mobility, in which there is decumulation for a short period of time. This accumulation of physical capital stock is noticeably larger than that for other scenarios. Hence if the government adopts a fixed exchange rate with perfect capital mobility (Scenario D), it provides potentially the largest benefits to the accumulation physical capital stock as in Figure 6.3.2.e.

Overall these findings suggest that a flexible exchange rate combined with a high degree of control over capital mobility (Scenario D), offers the most favourable effects upon the key major macro variables except for net foreign asset stocks. However if the government adopts a fixed nominal exchange rate policy, perfect international capital mobility (Scenario C) offers less Dutch disease consequences and at the same time the adjustments paths are smoother than with high control over international capital mobility.

6.3 Summary, Conclusions and Policy Implications

6.3.1 Summary and Conclusions

This chapter has presented the results of macroeconomic developments and Dutch disease consequences, arising from different policy scenarios towards both oil production and price shocks relative to the base case in Chapter 5. These simulations were conducted to provide alternative policy options for managing oil related shocks, in order to minimise the Dutch disease consequences and to enhance the benefits generated from such oil related shocks. In this regard two groups of policies have been analysed. In the first group of policies focus was placed upon whether government should spend more oil revenue on investment or consumption expenditure, and whether the government should export more of the oil being produced or to use it primarily domestically. In this group, 4 cases and 3 scenarios in each case, including the base case as in Chapter 5, were simulated. The second group of policies were concerned with government control over financial markets, in the determination of both the nominal exchange rate and international capital mobility. In this group there were 5 scenarios, including the base case as in Chapter 5. Different combinations of the nominal exchange rate and degree of capital control for each source of oil shock were identified.

The analysis was conducted by simulating the model outlined in Chapter 4 using the parameters estimated in Chapter 5, and incorporating different values of key policy parameters. The results were compared with those of Chapter 5, the so called base case. In steady state the analysis focussed upon 9 key macroeconomic variables as in Chapter 5 - the real exchange rate, inflation rate, government real income, non oil output (supply), the physical capital stock, non oil exports, non oil imports, net foreign asset stocks and private sector wealth.

The simulation results indicate that the government's policy response toward the usage of oil production, domestically or for export, and toward the spending of oil revenue, upon consumption or investment, has a very significant influence upon the development of key macroeconomic variables, both in long run equilibrium and during the adjustment process. In long run steady state the effect is greater for the oil production increase than for the oil price increase, regardless of the policy response adopted. The adjustment processes involved greater fluctuations for the oil price increase than oil production increase case. The most significant difference in the adjustment paths among these policies, arises during the adjustment process up to 20 periods.

The government's policy with regard to the nominal exchange rate and capital markets, also has a significant influence upon developments in those macroeconomic variables. These alternative policies however only influence the adjustment process of the economy, whilst the long run steady state equilibrium for each Scenario is identical to the base case (Scenario A). This is due to the fact that for either nominal exchange rate regime, and for a different degree of control over the capital market, in equilibrium there is no monetary accommodation and the balance of payments is zero for all scenarios. For a fixed nominal exchange rate the adjustment process initially occurs through adjustment in the price of domestic non oil goods, whilst for a flexible nominal exchange rate regime it occurs through adjustment in both the nominal exchange rate regime and the non oil price.

The government could, arising from these alternative policies, offset or worsen the Dutch disease consequences from oil related shocks, and could improve upon or deteriorate the performance of the other key macroeconomic variables. The magnitude and the adjustment path of the aforementioned macroeconomic variables, are different

for different policy options and for different shocks. The conclusion therefore will be divided into alternative outcomes derived from alternative uses of oil production and oil revenue, and from alternative combinations of the nominal exchange rate and degree of control over the capital markets.

The numerical results suggest that in steady state the macroeconomic performance of an economy, such as the one under study, subject to oil production and price shocks, can be improved by adopting a more development (investment) oriented strategy towards the additional revenue generated. The effects, in percentage terms, from altering the government capital transfer however is larger for an oil production increase than for an oil price increase, arising mainly from a greater effect on the real exchange rate. This improved performance relates to non oil output, physical capital stock, net foreign asset stocks, and has a much larger effect upon private sector real wealth. In the case of an increase in oil production, this policy improves the private sector real wealth from below to above its base value. Emphasis upon stimulating consumption expenditure, on the other hand, will produce less favourable outcomes for each of these.

The Dutch disease consequences however remain, even though the government may have spent all of the oil revenue on investment. This is mainly due to the real exchange rate appreciation arising from an increase in foreign exchange generated by additional oil export revenue, which leads initially to monetary growth, and hence inflation, which will transmit itself to an increase in the price of non oil output. In addition to that an increase in real oil revenue raises demand for non oil output which leads to an increase in the price of non oil output, resulting in a larger appreciation of the real exchange rate.

Unlike adopting a more or less development oriented policy, adopting a more or less export oriented policy has no influence upon the development of major macroeconomic variables for an oil price increase. This is not surprising since for the three scenarios conducted oil production and oil exports remain unchanged. Adopting a more export oriented policy leads to a smaller increase in non oil output and the capital stock, and is smaller than that for the more development oriented policy. However it has a large positive effect upon net foreign asset stocks and private sector wealth, and is larger than for the case of a more development oriented policy. The latter development offers the prospect of expanding the capacity of non oil output and hence achieving faster economic growth through stimulating consumption and creating an ability to invest over and above that of governments, while large increases in net foreign asset stocks offer a greater ability to import of essential capital goods to sustain economic development. Emphasis upon less oil exports, on the other hand, will produce less favourable outcomes for each of these variables.

Dutch disease consequences worsen substantially if a more oil export oriented stance is adopted, arising from a significant appreciation of the real exchange rate. However it would be partially offset by a significant increase in net foreign asset stocks and private sector real wealth, as discussed above. A less oil export oriented policy is the only one that could remove the Dutch disease consequence from the oil related shock. However, this policy would have adverse effects upon net foreign asset stocks and private sector real wealth, as discussed above.

In general, during the adjustment process, the adoption of a more development oriented policy by government towards the oil revenue, smooths out the adjustment of the major macroeconomic variables relative to the base case in Chapter 5 for both an oil production and oil price shock. However the effects are larger and more volatile for an

oil production shock in comparison to that of an oil price shock, arising from a larger and more volatile adjustment of the real exchange rate.

The most important result derived from this adjustment process is that, without a government capital transfer to the private sector, the non oil trade balance deteriorates by more than with a capital transfer, and non oil output declines below its base value for nearly 20 periods for both oil shocks. These are induced by a substantial decumulation of physical capital stock. On the other hand, for the oil production increase shock, if the government spends all of the oil revenue on investment, private sector real wealth will be higher than its base value. However during most of the adjustment process private sector real wealth remains below its base value. With regard to altering oil exports the most significant effect on the adjustment process, is that lowering oil exports leads to an increase in non oil exports above its base value. However, during nearly half of the adjustment process it remains below its base value. These findings again strongly suggest that if this study only focusses on steady state equilibrium, the conclusions would be misleading.

The Dutch disease consequences remain throughout the adjustment process regardless of allocation of oil production or spending of the revenue, except for the case of lowering oil exports. The effect is more pronounced during the first half of the adjustment process from altering government spending. On the other hand it is more pronounced during the second half of the adjustment process from altering oil exports, which lead to an increase in non oil exports higher than its base value as discussed above. These findings again strongly support the view that in analysing the macroeconomic consequences of oil related shocks for the Indonesian economy, the analysis of the dynamic adjustment process is very important.

Major conclusions with regard to alternative nominal exchange rate policies combined with varying degrees of control over capital markets can be derived from the simulation results. The most pronounced effects occur in the early periods of the adjustment, and this is larger and more volatile for oil production than for the oil price increase case. In addition to that, the adjustment process is larger and more volatile with a high degree of control on capital mobility than with perfect capital mobility for either exchange rate regime. The key variable in this adjustment process is the real exchange rate.

Dutch disease consequences exist during the adjustment process regardless of the nominal exchange rate regime and the capital market policy adopted, for either oil shock, and is larger during the short run. The effect is smaller for non oil imports as the effect of the real exchange rate appreciation is partially offset by developments in real income.

The worst effects occur for a fixed nominal exchange rate combined with a high degree of control over capital mobility (the base case). Hence changing the nominal exchange rate from a fixed to flexible regime, or reduced government control over international capital mobility, or a combination of these, would improve the performance of the non oil trade balance and hence reduce the Dutch disease consequences of the oil related shocks.

For the oil production increase shock adopting perfect capital mobility offers a smaller Dutch disease effect, and is comparable for either nominal exchange rate regime except for the initial adjustment. For the initial adjustment, however, the Dutch disease effect is less for a combination of high degree of control over international capital mobility and a flexible exchange rate regime, than perfect capital mobility.

For an oil price increase shock adopting perfect capital mobility smooths and moderates the adjustment process of non oil exports and imports for either nominal exchange rate policy, as in the case of an oil production increase shock. However controlling the capital market, combined with a flexible exchange rate, offers the prospect of a greater improvement in non oil trade, in comparison to any other policy combination although it does worsen during the initial stage of the adjustment process.

For an oil production increase shock, non oil output, physical capital stock and private sector wealth benefit more from perfect capital mobility, being nearly the same for either nominal exchange rate regime. Net foreign asset stocks benefit more from a high degree of control over international capital mobility. However this initially accumulates by more if it is combined with a fixed nominal exchange rate (base case), whilst towards the long run steady state it accumulates by more if it is combined with a flexible nominal exchange rate.

However, for the case of an oil price increase a flexible exchange rate, combined with a high degree of control over capital mobility, offers the largest benefit for the physical capital stock, non oil output and private sector real wealth from the initial adjustment process until long run steady state is achieved. Net foreign asset stocks, however, initially benefit more from the base case, whilst it is comparable with perfect capital mobility towards the long run steady state.

The above discussion suggests that, for an economy such as Indonesia, overall capital market liberalisation provides a potential benefit to key macroeconomic variables, and that this is enhanced with a flexible exchange rate.

These results strongly suggest that a dynamic analysis is important in order to identify the most appropriate policies in order to overcome the unfavourable effects of oil

related shocks and to enhance its benefits, as the effects are significantly different between the early period of the shock and in the long run. These are especially important for a developing oil exporting country such as Indonesia, as most of Indonesian business is small and finds it hard to cope with the negative effects of oil related shocks especially during the early period of adjustment.

6.3.2 Policy Implications

Within the framework of this study, to reduce the Dutch disease consequences, and to enhance the benefits generated from either oil related shock, it is concluded that the government should adopt a more development oriented policy towards the oil revenue. This will directly induce non oil output and the accumulation of capital stock that would partially offset the effects of the appreciation of the real exchange rate arising from such oil shocks, and would have further positive effects on the development of other key macroeconomic variables for either source of shock. This policy would have benefits over the long run and also during the adjustment process. The Dutch disease consequences however still remain, but their intensity could be reduced.

With regard to the allocation of the oil production, either a more or less export oriented policy would not satisfy all of the key macroeconomic variables either during the adjustment process or in the long run. For an oil production increase shock, an increase in oil exports lead to an accumulation of physical capital stock, an increase in non oil output, net foreign asset stocks, and private sector real wealth, but worsen the performance of the non oil trade balance, and vice versa for less oil exports. However it can be suggested that a more oil export oriented policy should be adopted, if the government could ensure that the larger potential benefits for the other key variables would compensate the larger deterioration in the non oil trade deficit.

Irrespective of which policy is adopted, the Dutch disease consequences however remain. The government could allocate development expenditure more to non oil exported goods, to compensate for loss of output due to the appreciation of the real exchange rate. This requires further study to analyse the most appropriate allocation of such government investment on either non traded and non oil traded goods, especially to lagging non oil traded sectors such as agriculture which would improve not only the non oil trade performance but also other key macroeconomic variables.

The above policy implications suggest that for an oil price increase the most appropriate policy is a flexible exchange rate combined with a high degree of control over the capital markets, although net foreign assets accumulate by less. On the other hand for the oil production increase case, the most appropriate policy combination is perfect capital mobility combined with a flexible exchange rate although net foreign assets decumulate by more.

Finally it is strongly suggested that when modelling, identifying and analysing the economic effects of oil related shocks, the model used should be dynamic in nature as the effects can be significantly different during the adjustment period, especially during the initial adjustment, to that in the long run.

CHAPTER 7

Summary, Conclusions, Policy Implications and Further Studies

This final chapter is devoted to bringing together the major findings and policy implications derivable from this analysis, and to suggest areas for further study which would extend the results of this study and offer further policy alternatives. This chapter will be divided into summary and conclusions, policy implications, and suggestions for further study.

7.1 Summary and Conclusions

The primary objective of this thesis has been the development of a dynamic long run macroeconomic model for Indonesia, focussing upon the contribution of oil developments on that economy's real oil revenue (equivalent to government real income), non oil output (equivalent to private sector real income), real exchange rate, physical capital stock, inflation rate, net foreign asset stock, private sector real wealth, non oil exports and non oil imports. These key variables were chosen because they are important factors in the process of economic development of the country and integral to economic growth, income distribution and economic stability. Any changes in these variables, arising from an oil related shock, will influence the development of other variables and the domestic economy as a whole. Whilst focussing upon oil developments, the model is sufficiently general, however, for analysing the economic effects arising from non oil shocks, and also offers a wide range of possible policy prescriptions that could be incorporated such as the inclusion of income tax.

The model explicitly incorporates the main characteristics of the oil sector in Indonesia, where the government has direct control over oil production and its usage, either domestically or for export, and the usage of the oil revenues either for investment,

with the objective of stimulating production, growth, and exports in certain sectors of the economy to achieve developmental objectives, or for consumption. The domestic economy is affected only by the way in which the government responds to these. These government policy responses are clearly politically determined, and have a major bearing upon the evolution of the macro economy. The impact of these policies on the domestic economy, however, would also depend on other government policies, such as those towards the exchange rate, interest rate, trade policies, capital markets, and the private sector's responses both to the oil revenue and to these other policies as well.

The model developed here took into consideration an appropriate theoretical framework related to the booming sector theory. Such a theoretical framework can be set within the context of either a static or dynamic framework, and have either a short or long run focus. The static analysis was discussed in detail by utilising the Salter model (1957), which was presented in Chapter 3 part 1. This approach however only compares equilibrium states, giving little insight into likely adjustment processes (see for example Gregory, 1976). A dynamic framework, which is central to this study, is more relevant from a policy perspective. The origin of this from the perspective of this study, was found in the contribution of Dornbusch (1976). Later analyses, which emphasised the dynamic nature of the adjustment process arising from oil related shocks, focussed upon the short to medium term (see for example Buiter and Purvis (1982), Eastwood and Venables (1982), and Bruno and Sachs (1982)), and long term (see for example Harvie (1993, 1994), Harvie and Gower (1993) and Allen, Srinivasan and Vines (1993)).

The long run nature of the adjustment process has been analysed by inclusion of capital stock accumulation in the product market. This process is particularly important in the context of a rapidly developing economy such as Indonesia, with its resulting effects upon the economy's potential supply of output, and foreign asset stock accumulation arising from developments in the current account. The long run steady

state will also have a major bearing upon the dynamic adjustment process over both the short term and medium term.

Having contrasted and compared these modelling approaches, and given the policy oriented nature of this study, the most appropriate framework in which to analyse the effects of oil related shocks for the Indonesian economy, it was concluded, was that of a long run and dynamic theoretical macroeconomic model. The Harvie and Gower (1993) and Harvie (1993) models were adopted as a foundation for the model used in this study.

A crucial assumptions underlying these studies was their emphasis on the existence of a developed economy, and this is clearly not appropriate for a developing economy such as Indonesia. In addition these studies develop cases where the oil revenues primarily accrue to, and expenditure is determined by, the private sector, which also determines the allocation of oil production for export or domestic usage or both. Hence a number of amendments were made to the basic framework, to make it relevant for the study of an economy such as Indonesia. Most importantly, this study assumes that both oil production and its revenue are in the hands of government, and both the financial and capital markets are highly controlled by government. In addition it was important to take into account that Indonesia has experienced both fixed and flexible nominal exchange rates, and finally that Indonesia has an abundance of labour, especially unskilled labour, so that labour is not a constraint to domestic production. These amendments will generate different results on the process of economic adjustment towards the long run equilibrium, and the long run equilibrium itself.

In developing the model for Indonesia some earlier studies analysing the effects of the oil boom on the Indonesian economy were also investigated, such as those by Pangestu (1986), Gelb (1985, 1986), and Warr (1986, 1990a, 1990b). These studies however have tended to focus upon the short run, and to adopt a comparative static

approach emphasising sectoral effects. In addition, and most importantly, none of these studies explicitly incorporates the fact that the government has direct control over the use of oil production and the spending of the oil revenue, which has a primary influence upon the effects of oil related shocks upon the Indonesian economy. Furthermore, all of these studies assume that the economy is operating with a fixed exchange rate with no international capital mobility. Finally, none of the existing studies consider the contribution of wealth and permanent income to the adjustment process.

The key assumptions of the model used here can be summarised as follows: it is dynamic and emphasises the long run; economic agents possess rational expectations; both oil production and oil revenue are in the hands of the government, and the government spends all the revenue. This spending will affect the domestic economy indirectly through its effects on the real exchange rate and also directly through capital transfers to the private sector, which will induce the expansion of non oil output; there is surplus labour in the economy; the domestic economy produces one composite non oil good which can be consumed domestically and is an imperfect substitute for imported goods; and finally, the economy operates under a fixed nominal exchange rate, and the government exercises control over the capital market. The last two assumptions were later relaxed to reflect the gradual movement towards a more liberalised economy. Details of the model, and its assumptions, were presented in Chapter 4.

The study also emphasised the identification of alternative, and appropriate, government policy responses to oil related shocks, in order to minimise the possible Dutch disease consequences and optimise the benefits arising from such oil related shocks. This is of particular importance to both the government and the private sector.

To compare outcomes arising from these alternative policies, the study utilised a numerical simulation procedure known as "Saddlepoint". This simulation procedure provided both the steady state properties and adjustment of key macroeconomic

variables, for the base model and variants of it. For simulation purposes only some of the structural parameters of the model were empirically estimated by using Two-Stage Least Squares (2SLS), because some of the variables, such as the real return to capital and Tobin's q ratio, are not well documented for the period of study and hence it was impossible to estimate all of the variables simultaneously. The rest of the parameters were approximated by using existing studies. The parameters were estimated for three different periods, namely during the oil boom, after the oil boom, and finally for the whole period of the study. These three different sets of parameter estimates enable an identification of the appropriate numerical value of the parameters of the model under analysis. These are essential to the generation of the simulation results presented, and the policy conclusions derivable from this. The study covered the period 1973 to 1991, capturing both the oil boom and post oil boom periods and the integration of Indonesia into the global economy as reflected in the movement toward a flexible exchange rate and integration of its financial markets, including interest rates, with global financial markets.

The analysis was conducted in two stages. The first stage involved analysing the Indonesian economy during the oil booms, from 1973 to 1983, a period characterised by a the operation of a fixed exchange rate system and substantial control over capital mobility, and is referred to as the base case. Secondly, alternative government policy responses to the oil related shocks were then incorporated, and compared to the results for the base case.

The analysis emphasised the adjustment of 9 key macroeconomic variables, as summarised previously, and two simulations were conducted,

- i) An instantaneous and unanticipated 10 percent increase in oil production; and
- ii) An instantaneous and unanticipated 10 per cent increase in the price of oil

The major conclusions arising from these simulations were that, for an economy such as Indonesia, the influence of the oil related shock has been significant on its macroeconomy both for long run steady state and for the adjustment process. The oil price increase shock has a larger potential benefit to the economy than the oil production shock, although the potential for Dutch disease effects are apparent for both cases.

In the long run, the government's real income, which is equivalent to the real oil revenue, private sector real income which is equivalent to non oil output, physical capital stock, net foreign asset stocks, and private sector wealth increased for the oil price shock. They were also relatively larger in comparison to the oil production increase case, for an equivalent percentage shock, except for non oil output and the physical capital stock. However both foreign asset stocks and private sector wealth declined for the case of an oil production shock. The adjustment process was more pronounced during its early periods for both cases, and was more volatile for the oil production than the oil price increase case.

Focussing upon the issue of the Dutch disease, it was concluded that in Indonesia the Dutch disease effects are apparent throughout the adjustment process for both oil shocks and are larger for the oil price increase case in comparison to that for the oil production increase case. Furthermore the oil related shocks have a long run effect as indicated by a prolonged adjustment of the capital stock from the short run to the long run, whilst other variables attain steady state much earlier.

The key factor influencing these developments was developments in the real exchange rate. An increase in the price or production of oil will directly influence the development of the real exchange rate, through affecting the domestic price of non oil output, given a fixed nominal exchange rate. However an increase in the price of oil will also directly influence the development of the consumer price level, which will be transmitted to the price of non oil output and hence induce a greater appreciation of the

real exchange rate (see equation 11, Chapter 4). This is not the case for an increase in the production of oil. As a result, the real exchange rate will appreciate by more in the case of an oil price increase.

The development of the real exchange rate, as well as the rest of the aforementioned variables, was also influenced by government capital transfers to the private sector, which directly induced developments in the production of non oil output which had further effects on the real exchange rate and the rest of variables. Similarly the allocation of the oil production, for either export or domestic usage, contributed to the development of these key macroeconomic variables, through its effects on the oil trade balance and thus the real exchange rate.

The assumption of a fixed nominal exchange rate and high control over capital markets also exerts a significant influence on the development of these macroeconomic variables. However the influence of these policies could not explicitly be identified from an analysis of the simulation results of the base case alone. To test for the contribution of these policies to the development of the aforementioned variables, the base case was simulated by altering these policies.

The second stage of the analysis focussed upon an analysis of alternative government policy responses towards the oil shocks, and considering the potential effects upon the macroeconomy arising from these policy responses. These were then compared with the results from the base case outlined above. This analysis provided the basis for evaluating alternative policy options arising from oil related shocks, in order to minimise the Dutch disease consequences and produce more favourable outcomes for key macroeconomic variables during the process of adjustment.

The policy responses emphasised focussed upon two broad groupings. The first group consisted of policy alternatives with regard to the spending of the oil revenue

generated, and the usage of the oil production. The second group consisted of policy alternatives regarding the nominal exchange rate regime and the operation of capital markets.

With regard to the use of the oil revenue, this can range from spending all of the oil revenue in favour of investment or consumption, whilst with regard to the use of the oil production this can range from the favouring of exports to that of domestic usage. The allocation of oil production to either domestic usage or export, as well as the allocation of the oil revenue to either consumption or investment, has varied from period to period.

With regard to the nominal exchange rate, the possibilities range from fixed to managed floating to perfectly flexible. In the case of the capital market, the policy could range from no capital to perfect capital mobility internationally. Indonesia has experienced various combinations of these policies. At the same time, the government has adjusted its policy with regard to the nominal exchange rate and the operation of capital markets. These two policies have ranged from a fixed nominal exchange rate combined with a very high degree of capital control, as in the base case outlined in Chapter 5, moving gradually towards a flexible nominal exchange rate combined with a more open capital market as outlined in the analysis of Chapter 6. The government has pursued these adjustment policies largely in response to both the increased oil revenue during the oil boom period 1973-1983 and following the decline in the oil price thereafter, as well as the recent interaction with the global economy in order to maintain sustainable growth of the economy (see Chapter 2).

The analysis was conducted by simulating the base case and incorporating different values of the key policy parameters, and focussed upon the adjustment of 9 key macroeconomic variables. Both groups of policy alternatives were analysed for the case of an oil price and oil production shock. In the first group 4 cases and 3 scenarios for

each case were simulated, whilst in the second group of policies 2 cases and 5 scenarios were simulated.

The simulation results indicated that the government's policy response towards the usage of oil production, domestically or for export, and towards the spending of oil revenue upon consumption or investment, has a very significant influence upon the development of key macroeconomic variables both in long run equilibrium and during the adjustment process. The government's policy in regard to the nominal exchange rate and capital markets, also has a significant influence upon developments in these macroeconomic variables. These latter policies, however, only influenced the adjustment process of key macroeconomic variables, because under a different nominal exchange rate regime combined with a different degree of control over the international capital market the long run monetary growth, assuming no monetary accommodation, retains its base value and the balance of payments is also in equilibrium. Hence the long run equilibrium for these alternative policies is as in the base case (Scenario A as was shown in Chapter 5).

The government could therefore, arising from these alternative policies, offset or worsen the Dutch disease consequences of oil related shocks, and could improve upon or weaken the performance of the key macroeconomic variables. The magnitude of the adjustment path of the aforementioned macroeconomic variables are different for different policy options, and for different shocks. These differences mainly arise from different initial effects of the oil related shocks on the real exchange rate.

The numerical results suggest that in the steady state, adopting a more development (investment) orientated stance towards the additional oil revenue generated improved the macroeconomic performance of the economy. This improvement in performance was more noticeable for the oil production than for the oil price shock. This improved performance related to that of non oil output, the physical capital stock, net

foreign asset stocks, with a much larger effect upon private sector real wealth. Emphasis upon stimulating consumption expenditure on the other hand, produced less favourable outcomes for each of these.

The Dutch disease consequences however remain, even though the government may have spent all of the oil revenue on investment. This is mainly due to the fact that although the government spends all of the oil revenue generated on investment, the price of domestic non oil goods stills increases relative to imported goods but is less than if the government spends some on investment and the rest on consumption. Hence the real exchange rate appreciates resulting in increased non oil imports and lower non oil exports.

Adopting a more export oriented policy stance arising from an oil production shock, suggests that in the steady state there is a large positive effect upon net foreign asset stocks and private sector wealth and that this is larger than that for an equivalent shock where a more development-oriented policy stance is adopted. The effects however are much smaller upon non oil output and the capital stock, in comparison to where a more development oriented policy is adopted. Emphasis upon less oil exports, on the other hand, will produce less favourable outcomes for each of these variables.

Adopting a more, or less, export oriented policy subject to an oil price increase, however, has no influence upon the development of major macroeconomic variables in the context of the simulation conducted. The results derived were equivalent to that of an oil price increase alone, as in the base case.

Dutch disease consequences are more likely, not surprisingly, the larger are oil exports. This is due to a greater appreciation of the real exchange rate, which deteriorates the competitiveness of non oil exports. Despite this adverse effect it is insufficient to prevent a sizeable accumulation of foreign asset stocks, which is a reflection of continuous current account surpluses. Where less oil is exported, the

analysis suggests that the adverse effects on other key macroeconomic variables dominate any improvement in non oil trade, and this may be regarded as an undesirable feature in regard to the economic development of such an oil exporting economy.

In general, during the adjustment process, adopting a more development oriented policy smooths out the adjustment of the major macroeconomic variables relative to the base case in Chapter 5, for both oil production and oil price shocks and vice versa for the opposite case. However, the effects are larger and more volatile for an oil production shock in comparison to that of an oil price shock, because of a larger and more volatile adjustment of the real exchange rate.

In this study it was shown that the Dutch disease consequences were more pronounced during the early period of the adjustment processes for both oil production and price shocks, regardless of the policy orientation adopted. The effects were larger for non oil exports, which follow closely the adjustment path of the real exchange rate.

A major conclusion with regard to alternative nominal exchange rate policies combined with varying degrees of control over the capital market derivable from the simulation results, is the most pronounced effects which occur in the early periods of the adjustment being larger and more volatile for the case of an oil production increase than for the case of an oil price increase. In addition to that, the adjustment process is larger and more volatile with a high degree of control on capital mobility than for the case of perfect capital mobility for either exchange rate regime. The key variable in this adjustment process again is the real exchange rate.

Dutch disease consequences occur during the adjustment process regardless of the nominal exchange rate regime and the capital market policy adopted, for either type of oil shock, and being larger during the short run. The effect is smaller for non oil imports, since the effect of the real exchange rate appreciation is partially offset by developments in non oil output.

For an oil price increase, adopting perfect capital mobility smooths and moderates the adjustment process on non oil exports and imports for either nominal exchange rate policy. The effect is marginally less in the early period of adjustment for the flexible exchange rate than for the fixed exchange rate, although this is reversed closer to equilibrium. However, controlling the capital market combined with a flexible exchange rate offers the prospect of a greater improvement in the non oil trade balance in comparison to any other policy combination, although it does worsen during the initial stage of the adjustment process. The worst effect of the oil price increase occurs for a fixed exchange rate combined with a high degree of control on capital mobility, as in the base case.

For the oil production increase case adopting perfect capital mobility offers smaller effects, except during the initial period. Dutch disease effects, which are smaller initially for the flexible than for the fixed exchange rate, reverse toward the final equilibrium. This contrasts with the case of an oil price increase where the high degree of control of the capital market has a smaller effect on the Dutch disease consequences for the initial period, but is then continuously larger than other policy combinations. For the fixed exchange rate policy, the Dutch disease effect worsens during the short period then improves towards the equilibrium.

With regard to other key macroeconomic variables, for the case of an oil price increase, a flexible exchange rate combined with a high degree of control of capital mobility offers the greatest benefit for the physical capital stock, non oil output and private sector real wealth. On the other hand, if the government adopted a fixed exchange rate policy, the benefit for the physical capital stock, non oil output and private sector wealth is increased by adopting perfect capital mobility. The net foreign asset stock benefits more from a flexible exchange rate, combined with a high degree of control of the capital market.

For an oil production increase non oil output, physical capital stock and private sector wealth benefit more from perfect capital mobility, and this is made larger during the early period of adjustment by adopting a flexible exchange rate rather than a fixed exchange rate. However, this is reversed later in the process towards long run equilibrium. The net foreign asset stock benefits more from a flexible exchange rate and a high degree of control on the capital markets.

Finally, the above results indicate that a dynamic analysis is important in order to identify the most appropriate policies in order to overcome the unfavourable effects of the oil related shocks, which is mostly significant during the early period of the shock. These are especially important for a developing oil exporting country such as Indonesia, as most Indonesian businesses are small in size and find it hard to cope with these shocks. Furthermore, the oil related shocks are a long run effect, indicated by the prolonged adjustment of the capital stock from the short run to the long run, whilst other variables attain steady state much earlier.

7.2 Policy Implications

The above discussion strongly suggests that to identify and to analyse economic effects of oil related shocks upon an economy such as Indonesia, the model to be developed should be dynamic and long run. Whilst the most pronounced effects on the aforementioned variables occur during the initial period of the adjustment process, the oil related shocks have a long run effect, as indicated by the prolonged adjustment of the capital stock from the short run to the long run. Some variables, such as those determined in financial markets, noticeably attain steady state much earlier.

This study has shown that the governmental policy response towards oil related shocks, either through the usage of oil production or the spending of oil revenue, will have a very significant influence upon the development of key macroeconomic variables,

both in long run equilibrium and during the adjustment process. This study has also shown, that the government's policy in regard to the nominal exchange rate and capital markets will also have a significant influence upon developments of these macroeconomic variables. Hence the government could, arising from these alternative policies, offset or weaken the Dutch disease consequences of oil related shocks, and could improve upon or deteriorate the performance of other key macroeconomic variables. These results are very significant in the context of the Indonesian economy, since the importance of oil production will remain for some time and will be increasingly taking place in the context of an economy engaging in economic liberalisation. The policy significance of the results presented in this study should therefore be apparent, not only in the context of Indonesia but for other oil exporting and developing economies.

The results presented also concluded that to reduce the Dutch disease consequences, and to improve the economic outcome arising from oil related shocks, the government should adopt a more development-oriented policy towards the oil revenue. This would directly induce a higher level of non oil output arising from a more rapid accumulation of physical capital stock, which would partially offset the effects of the appreciation of the real exchange rate arising from an oil shock, and would also have further positive effects on the development of other key macroeconomic variables for either source of oil related shock. This policy would have benefits over the long run and during the adjustment process.

With regard to the allocation of the oil production it can be suggested that a more oil export oriented policy would enhance the Dutch disease consequences, but this would be partially compensated by the larger potential benefits for other key variables especially in regard to the accumulation of foreign asset stocks and increase in private sector wealth.

Given the allocation of oil revenue to either consumption or investment expenditure or oil production to export or domestic usage as in the base case, during the adjustment process the Dutch disease consequence could be reduced, and the benefits generated from either oil shock enhanced, by altering the nominal exchange rate and capital market policies. For an oil price increase, taking such considerations into account, the most appropriate policy is a flexible exchange rate combined with a high degree of control on the capital market, although the accumulation of net foreign assets would be the least among these alternative policies. However this would be offset by an improvement in other variables. On the other, hand for the oil production increase case, the most appropriate policy combination is perfect capital mobility combined with flexible exchange rate, although towards the long run the fixed exchange rate policy offers a better outcome.

The Dutch disease consequences however remain, irrespective of which policy is adopted. To overcome this it is suggested that the government should allocate development expenditure more to the non oil traded component of the non oil goods sector, in order to compensate for the loss of output due to the appreciation of the real exchange rate. In this study, however, such a policy could not be analysed, as domestic non oil output has not be disaggregated into non traded and non oil traded goods. Therefore further study is required to analyse the most appropriate allocation of government investment on either non traded and non oil traded goods, especially in regard to lagging non oil traded sectors such as that of the agricultural sector. In addition to the disaggregation of non oil output, further research to extend upon the results of this study is summarised in the following section.

7.3 Further Studies

The simulation results could more closely represent the Indonesian case, by empirically estimating the parameters that were utilised from existing studies. These

parameters, such as the real return to capital and Tobin's q , were not available during the conduct of the study. This could be done by devoting more time and resources to the constructing of the relevant data.

Another possible area for further study would be to disaggregate non oil output into non traded and non oil traded goods, and non oil traded goods output could be disaggregated further into sectoral areas such as agriculture and manufacturing. This would enable the identification of specific policies to assist those sectors which are likely to be most adversely affected as a result of oil related shocks.

The final issue worthy of further study would be to incorporate other sources of government income, such as income tax and foreign borrowing, thereby providing a full cycle of the effects of the oil revenue.

Overall, the dynamic and long run macroeconomic model as developed and used in this study has been able to identify the long run steady state properties of key macroeconomic variables, as well as the adjustment process arising from oil related shocks. This provides a basis for comparing alternative options in regard to enhancing the benefits, and reducing the adverse effects of oil related shocks upon the economy. In addition, this model also offers a framework within which a wide range of possible policy prescriptions can be analysed and evaluated. Therefore the model developed in this thesis, and the policy prescriptions derived from it, provides an important insight for policy makers in Indonesia, as it progresses towards having an increasingly liberalised economy. This thesis has provided some indication of the likely economic consequences for Indonesia arising from the adoption of such policies, as well as providing a framework for further rigorous analysis. The policy issues identified are also of interest to other resource abundant developing economies, such as Vietnam and Papua New Guinea, which can learn from the experiences of an economy such as Indonesia.

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APPENDIX 4

METHOD OF ESTIMATION, DATA SPECIFICATION AND SIMULATION PROCEDURES

This appendix contains the specification of the data used in the estimation of the behavioural equations of the model, and the simulation procedures and properties.

A4.1 Specification of the Data

Data is not available for certain variables identified in the model. In addition to that some are only available six monthly, whilst this study requires quarterly data as discussed in Chapter 4. To overcome this problem, the data will be re-constructed with as much consistency as possible to meet the objectives of the study. Specification of the data is listed below according to the availability of the data. The source of the data is provided in the bracket beside each variable.

A4.1.1 Endogenous variables

Available as Required on a Quarterly Basis:

- y (total real income) is equal to real GDP, as measured by the total value added of output, and is equal to total real expenditure. In this study it is assumed that real GDP is only made up of ysno and g (Biro Pusat Statistik, BPS);
- ysno (real non oil output) is y minus the real value added of oil (BPS);
- g (real government revenue which is equivalent to real oil output) is the value added of oil⁶⁹ (BPS);

⁶⁹This figure also contains the value added of gas. This is used because no data is available for the oil sector alone. In addition to that the contribution of gas did not start until 1983, and from then on this contribution is still small relative to total oil and gas value added.

- pn (price of domestically produced non oil output) is the wholesale price index of exports excluding oil (BPS);
- pc (consumer price index) has been constructed by BPS;
- r (domestic nominal interest rate) is the six month interest rate on time deposits of the Central Bank of Indonesia, International Financial Statistics, IMF (Monetary Fund));
- m (nominal money supply) is the narrow money supply (M_1), that is currency plus demand deposits, (Statistik Ekonomi dan Keuangan Indonesia (Indonesian Financial Statistics, Bank Indonesia, BI);
- nom (real non oil imports) (BPS);
- nox (real non oil exports) (BPS);
- f (net foreign asset stocks in foreign currency) (IMF);
- π (inflationary expectations) is equal to the monetary growth rate (BI);
- l (real money balances) is $m - pn$;
- c (real exchange rate) is $e - pn$.

Variables to be Compiled:

- y^p (total real permanent income) is constructed by using a five year moving average of y (BPS);
- ydno (real demand for non oil output) is total real spending on non oil output, which is equal to real GDP minus real oil consumption. Data on real oil consumption is not available, therefore it is approximated by actual oil production plus imports minus exports of oil;
- gi (government real investment) is approximated by using the distribution of total government expenditure, including income tax, and other sources of income, on consumption and investment. This data is available on a six monthly basis only. To obtain quarterly data this was divided by two to get quarterly estimates. Total government expenditure is available in "Budget Statement"⁷⁰;
- gc (government real consumption) is g minus gi ;
- cp (private real consumptions) is measured by total real non oil spending minus gross investment and government consumption;

⁷⁰In the government "Budget Statement" total expenditure is disaggregated into "routine" (investment) and "consumption", but this expenditure is not itemised by sources of income such as oil revenue. Therefore to get the share of spending of oil revenue, it is approximated by using the share of government total expenditure on investment and consumption.

- ip (private investment) is measured by gross investment of the GDP component minus gi;
- w^e (private sector real wealth) is constructed by a summation of real money balances, physical capital stocks, real permanent income, and real net foreign assets in domestic currency;
- k (physical capital stock) is constructed by using data on the gross investment component of GDP expenditure⁷¹ (BPS);
- ot (oil trade) is oil exports⁷² minus oil imports⁷³ (BPS).

Not Available and Can Not Be Compiled:

- R (real profit on capital services);
- q (Tobin's q ratio).

A4.1.2 Exogenous variables

Available as Required on a Quarterly Basis;

- yso (actual oil production) is constructed from $g = yso + e + po^* - pc$ (see equation 7 of the base model in Chapter 4);
- po* (world price of oil in foreign currency) is the unit value of Indonesia's oil exports (IMF);
- pt* (world price of the non oil traded good in foreign currency) is the whole sale price index of export of USA. (IMF);
- e (nominal exchange rate) is the Jakarta market rate (IMF);
- r* (world interest rate) is the six month Eurodollar rate (IMF);
- y* (real world income (in foreign currency)) as represented by USA real income. This was chosen because the largest share of Indonesian non oil exports go to the USA (IMF).

⁷¹See Warr (1991).

⁷²This figure consists of crude oil, condensate and natural gas. This is used because there was no data available for the oil sector alone. In addition the contribution of condensate and gas to this figure is relatively small. Furthermore the contribution of gas did not start until 1983, and from then on this contribution is still relatively small to total exports of oil and gas. In addition this is used in order to be consistent with the definition of real oil output, which also contains the value added of gas.

⁷³Indonesia's imports of oil is of a lower quality of crude oil than it exports.

Those Variables Data for Which Needs to be Compiled.

- yso^p (permanen oil output) is constructed by using a five year moving averages of yso (BPS);
- ysno^p (permanen non oil output) is constructed by using a five year moving average of ysno (BPS).

A4.2 Method of Estimation

To estimate the parameters of a simultaneous-equation model it is necessary to check both the rank and order conditions of each equation, in order to check the identifiability of each equation and hence to ensure that only unique estimates of its parameters from the sample data are derived. However in practice the order condition, which is only a necessary condition, is likely to be a satisfactory rule of thumb for identification. This is due to the difficulty involved in checking the rank condition, especially in larger systems of equations. Therefore, only the order conditions were checked.

For each of the equations to be estimated, the number of excluded predetermined variables must be greater than or equal to the number of endogenous variables less one. If the number of excluded predetermined variables is equal to the number of endogenous variables less one the equation is just identified, whilst if the number of excluded predetermined variables is greater than the number of endogenous variables less one the equation is over identified. The order condition for each of the behavioural equations aforementioned is satisfied, since clearly the number of excluded exogenous variables is large compared with the number of included endogenous variables. Hence each of the behavioural equations aforementioned is over identified. It will be assumed that the rank

conditions, which are the necessary and sufficient conditions for identification, are also satisfied for each equation⁷⁴.

Only 6 equations are estimated, these being equations 4, 10, 14, 19, 20, and 21 as discussed in Chapter 4. As each equation is over identified, using ordinary least squares (OLS) would yield inconsistent estimates of the parameters⁷⁵. To give consistent estimates therefore Two-Stage Least Squares (2SLS) will be used. Another advantage of using 2SLS is that each equation in the simultaneous equation model can be estimated individually, hence it is not necessary to estimate all the equations in the model. Furthermore it is computationally less complicated. All of the exogenous variables are used as instrumental variables, in order to capture their contribution to the development of each parameter and to the whole system for simulation purposes. This estimation will utilise the Shazam package⁷⁶.

The data is not seasonally adjusted and the dummies are retained if they are significant. Finally, their serial correlation will be checked by looking at the Durbin-Watson statistic. If there is serial correlation, the regression will be repeated by correcting for first order correlation.

A4.3 The Method of Simulation and Its Properties

To analyse the macroeconomic effects arising from oil related shocks, for both exchange rate versions and different degrees of international capital mobility, the model discussed and its variants, are simulated by using a numerical algorithm known as

⁷⁴If the equation is not identified, the software used will immediately send the error messages (see Shazam, 1993, p275).

⁷⁵See, for example Fair (1971).

⁷⁶See, Shazam (1993, p.275)

"Saddlepoint" which has been devised for solving linear rational expectation models with constant coefficients. To generate simulation results this program requires certain properties of the model, as will be discussed below.

A4. 4. 3. 1 Steady State Properties of the Model

For the flexible exchange rate version, the model has the following analytically unambiguous steady state properties;

$$\dot{m} = \dot{e} = \dot{pc} = \dot{pn} = \dot{f} = \pi = 0$$

$$r = m + r^*$$

$$q = 0$$

$$R = r^* = r - \pi$$

For the fixed exchange rate version of the model, the key steady state properties of the model are ;

$$\dot{m} = \dot{pc} = \dot{pn} = \dot{f} = \pi = \dot{dce} = 0$$

$$r = m + r^*$$

$$q = 0$$

$$R = r^* = r - \pi$$

The remaining endogenous variables of the model, - k , not , $ydno$, $ysno$, y , y^p , g_i , f , l , c , w^e , and their responses to exogenous shocks, are all highly analytically ambiguous. This is not particularly surprising, given the size and generality of the model under analysis. This difficulty is overcome by solving the model using a numerical simulation procedure, and this is conducted in Chapter 5.

A4. 4. 3. 2 The Dynamic Stability of the Model

The model must exhibit dynamic properties, consistent with its underlying behavioural assumptions. It contains equations determining changes through time in real money balances (l), foreign asset stock (f), physical capital stock (k), Tobin's q (q), and the real exchange rate (c).

For the flexible exchange rate version of the model, the first three of these, l , f , and k , are predetermined, or non jump variables arising from the assumption of stickiness of price and quantity adjustment in non financial markets. The latter two variables, q and c are non pre-determined, jump variables, capable of adjusting instantaneously to an exogenous shock, because they are determined in financial markets which are presumed to be in continual equilibrium.

For the fixed exchange rate system, the real exchange rates become a predetermined, non-jumping, variable resulting in four non jumping variables l , f , k , and c , and only one, Tobin's q , is a non predetermined jump variable.

Denoting these variables by convector x , a linear approximation of the model around its equilibrium can be written as follows.

$$\dot{x} = Ax' + Bz$$

Where, z is a vector of exogenous variables, x' the deviation of x around its equilibrium value, and \dot{x} is its time derivative $(d/dt)x$. A and B are parameter matrices with dimensions of 5×5 and 5×8 , representing the 5 control variables and 8 exogenous variables. The stability of the model depends only upon the properties of the "state" matrix A . Given the

size and generality of the model presented, a complete algebraic analysis of model stability based on the characteristic equation of A is not a productive exercise. However it is possible to derive one necessary condition for stability, that is the determinant of A should be of a particular sign.

The model under discussion, a five by five dimensional system with two jump variables in the case of a flexible exchange rate, has to generate a saddlepath for these variables to jump on to. This implies that there must be just two unstable and positive roots, hence the determinant of A , which gives the product of the roots, must be negative. This is so since the other three roots, associated with the other predetermined variables, must be stable and negative. If this condition is not satisfied the model would be dynamically unstable, since the underlying dynamic adjustment is not compatible with its behavioural assumptions. Hence the stability of the model depends crucially upon the parameter values of the model.

For the fixed exchange rate system, with one jump variable, there must be just one unstable, and positive, root. Hence the determinant of A , which gives the product of the roots, must be positive. This is so since the other four roots, associated with the other predetermined variables, must be stable and negative. If this condition is not satisfied the model would be dynamically unstable, since the underlying dynamic adjustment is not compatible with its behavioural assumptions. Hence the stability of the model depends crucially upon the parameter values of the model, as in the case of the flexible exchange rate.

APPENDIX 5

THE BEHAVIOURAL EQUATIONS

A5.1 The Results

Only 3 behavioural equations have been successfully estimated. They are equations 4, 10, and 14. Several specifications of the equations, which included different exogenous variables, have been tried. The results shown in Table A5.1 below are for the 3 data periods, 1973:1 to 1983:1, 1983:1 to 1991:4 and 1973:1 to 1991:4, and are with and without the constant term. All of the results shown are statistically acceptable at 10% level of significance, except the interest rate (r) in the demand for real money balances, wealth (w^e) in demand for consumption, and relative price in supply for non oil output ($p_n - p_c$).

Equation 4, is the private sector consumption function. The income (private sector real income) elasticity ranges from 0.56 to 0.86 for the equation without a constant term. With a constant term the results are similar. In equation 10, that is the non oil output supply function, the relative price elasticity ranged from 0.10 to 0.19. They were nearly the same both during and after the booms. Equation 14 is the demand for real money balances, and the result is presented only for the periods 1973.1 to 1991.4, and 1973.1 to 1983.1 (since the results for the period 1983.1 to 1991.3 were unacceptable). The real income elasticity is greater for the period of the boom, than for the whole period, whereas there is no differences in the interest rate and wealth elasticities.

TABLE A5.1
ESTIMATION RESULTS

No ^a	Period	Equations	D-W	R ²	ρ#
4.1a	1973.1-'83.1	cp = 0.61 ysno + 0.13 we (9.15)* (3.19)*	1.91	0.94	0.44
4.1b	1973.1-'83.1	cp = 0.95 + 0.59 ysno + 0.14 we (7.25)* (8.61)* (3.39)*	1.90	0.94	0.34
4.2a	1983.1-'91.4	cp = 0.86 ysno + 0.05 we (14.03)* (2.05)*	1.93	0.98	0.25
4.2b	1983.1-'91.4	cp = 0.31 + 0.85 ysno + 0.05 we (2.08)* (13.90)* (2.16)*	1.93	0.98	0.25
4.3a	1973.1-'91.4	cp = 0.58 ysno + 0.12 we (7.02)* (1.40)*	1.89	0.89	0.40
4.3b	1973.1-'91.4	cp = 1.00 + 0.56 ysno + 0.15 we (2.91)* (6.38)* (1.56)	1.99	0.89	0.38
10.1a	1973.1-'83.1	ysno = 0.11 (pn-pc) + 0.18 gi + 0.54 k (0.90) (3.42)* (13.79)*	1.83	0.93	0.39
10.1b	1973.1-'81.3	ysno = 3.39 + 0.11 (pn-pc) + 0.19 gi + 0.54 k 10.97)* (0.72) (3.53)* (13.79)*	1.83	0.93	0.39
10.2a	1983.1-'91.4	ysno = 0.10 (pn-pc) + 0.19 gi + 0.29 k (1.38) (3.68)* (7.4)*	1.78	0.97	0.97
10.2b	1983.1-'91.4	ysno = 3.43 + 0.15 (pn-pc) + 0.13 gi + 0.23 k (14.12)* (2.09)* (2.40)* (5.7)*	1.56	0.95	0.98

(continued over page)

Table A5.1 (continued)

No ^a	Period	Equations	D-W	R ²	ρ
10.3a	1973.1-'91.3	ysno = 0.19 (pn-pc) + 0.16 gi + 0.50 k (1.49) (3.26)* (12.29)*	1.78	0.95	0.54
10.3b	1973.1-'91.3	ysno = 2.63 + 0.19 (pn-pc) + 0.16 gi + 0.49 k (11.62)* (1.49) (3.26)* (12.29)*	1.78	0.95	0.54
14.1	1973.1-'83.1	m1 - pc = 0.65 ysno - 0.05 r + 0.16 w ^e (3.43)* (-0.4) (1.4)	2.32	0.96	0.78
14.2	1973.1-'93.1	m1 - pc = 0.48 ysno - 0.05 r + 0.25 w ^e (2.32)* (-0.4) (1.80)**	2.21	0.96	0.84
* and ** indicate that the estimated coefficients are significantly different from zero at the 5 % and 10 % levels. # ρ is calculated using the Cochrane - Orcutt transformation procedure. a Equation number from the model as explained in Chapter 4.					