Macroeconomic modelling and appraisal of alternative economic development policies for Thailand

Bhantinee Sootsukon
University of Wollongong
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MACROECONOMIC MODELLING AND APPRAISAL
OF ALTERNATIVE ECONOMIC DEVELOPMENT
POLICIES FOR THAILAND

This thesis is submitted in fulfilment of the requirements for the award of the degree of

Doctor of Philosophy

from

THE UNIVERSITY OF WOLLONGONG

by

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Department of Economics

The University of Wollongong, AUSTRALIA, 1996
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 degrees.

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

Bhantinee Sootsukon
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<thead>
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<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>AD</td>
<td>Aggregate Demand Schedule</td>
</tr>
<tr>
<td>ADB</td>
<td>Asian Development Bank</td>
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<tr>
<td>AFTA</td>
<td>ASEan Free Trade Area</td>
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<tr>
<td>AIDS</td>
<td>The Acquired Immune Deficiency Syndrome.</td>
</tr>
<tr>
<td>APEC</td>
<td>The Asian-Pacific Economic Co-operation</td>
</tr>
<tr>
<td>AS</td>
<td>Aggregate Supply Schedule</td>
</tr>
<tr>
<td>ASEAN</td>
<td>Association of South East Asian Nations</td>
</tr>
<tr>
<td>BM</td>
<td>Buiter-Miller Model</td>
</tr>
<tr>
<td>BOI</td>
<td>Board of Investment</td>
</tr>
<tr>
<td>BOT</td>
<td>Bank of Thailand</td>
</tr>
<tr>
<td>BP</td>
<td>Buiter-Purvis Model</td>
</tr>
<tr>
<td>CH</td>
<td>Charles Harvie Model</td>
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<tr>
<td>EEC</td>
<td>European Economic Community</td>
</tr>
<tr>
<td>EV</td>
<td>Eastwood-Venables Model</td>
</tr>
<tr>
<td>FDI</td>
<td>Foreign Direct Investment</td>
</tr>
<tr>
<td>FEER</td>
<td>Far Eastern Economic Review</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Products</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Products</td>
</tr>
<tr>
<td>HG</td>
<td>Harvie-Gower Model</td>
</tr>
<tr>
<td>IFS</td>
<td>International Financial Statistics</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Funds</td>
</tr>
<tr>
<td>NESDB</td>
<td>The National Economic and Social Development Board of Thailand</td>
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<tr>
<td>NICs</td>
<td>The Newly Industrialising Countries</td>
</tr>
<tr>
<td>NSOT</td>
<td>The National Statistics Office of Thailand</td>
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<tr>
<td>NW</td>
<td>Neary and Wijnbergen Model</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OPEC</td>
<td>Organization of Petroleum Exporting Countries</td>
</tr>
<tr>
<td>TDRI</td>
<td>Thailand Development Research Institute</td>
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<tr>
<td>VAT</td>
<td>The Value Added Tax</td>
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The development of a long run macroeconomic model for analysing the macroeconomic consequences of the oil related shocks for a net-oil importing economy such as Thailand is a major objective in this thesis.

The model enables the identification of the ways in which the oil related shocks have been transmitted their effects to the domestic economy, and will enable the exploration of the future shocks to the Thai economy and the policy implications which flow from them. The oil related shocks emphasised in this thesis are that an increase in the price of oil and an increase in domestic oil requirements.

The model developed contained a number of key assumptions. The domestic economy produces only a non-oil output, which can be consumed domestically and is an imperfect substitute for the imported good equivalent. The price of this good is domestically determined. 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. In addition the model developed emphasised the long run nature of adjustment process, since the oil related shocks will have a long run effect upon the Thai economy. This arises from allowing for physical capital stock accumulation and developments in the current account balance. Finally, the economy operates under a fixed nominal exchange rate, and the government exercises control over the capital market.

The model developed also provides the identification of alternative, and appropriate, governmental policy in response to the oil related shocks, in order to maintain and improve the long run economic development of the economy. Three major alternative policy options presented in this thesis are as: (1) the adoption of trade liberalisation to improve the trade performance, focusing upon a reduction in trade barriers; (2) the expansionary of public infrastructure capital stock to enhance domestic investment and to alleviate the shortage of infrastructures in Thailand, and (3) the change in nominal exchange rate from a fixed to a flexible, and the deregulation of financial markets.

The simulation results suggest that in both cases of the oil related shocks, more public capital spending can produce beneficial effects upon foreign asset stocks, private capital stock, non-oil output, real income, and domestic private sector real wealth. There is however an adverse impact upon the non-oil trade balance. This is offset by an increase in real income, causing a higher demand for imports, and consequently leading to a deterioration of the trade balance. Whilst either the adoption of a flexible nominal exchange rate and perfect capital mobility and trade liberalisation policy can produce a larger depreciation of the real exchange rate, resulting in a noticeable improvement in the trade balance, stimulating an improvement of demand for non-oil output and real income. There are however a number of losers from such policy options. These are the foreign asset stocks, private capital stock, and domestic private sector real wealth.
1.1 **Background to the Study**

The first oil price shock in 1973-74 and the second oil price shock in 1979-80 affected the Thailand economy in three major ways. Firstly, by increasing the domestic inflation rate, secondly by reducing the rate of economic growth, and finally by creating problems in financing the current account of the balance of payments.

Thailand was hit hard by the two oil price shocks, which exerted a major external impact upon macroeconomic developments in Thailand during the 1970s. The oil price increases led to a rapid expansion in payments for oil imports, subsequently increasing problems on the balance of payments, and the domestic inflation rate. Oil imports accounted for around 19% of total imports in 1974, and 30% of total imports in 1980.\(^1\) It can be clearly seen that oil imports played a significant role in the current account of the balance of payments for Thailand, which is classified as a net oil-importing economy.\(^2\)

Table 1.1 illustrates key economic indicators for periods between 1961-1971 and 1972-1981. The period 1961-1971 is chosen to represent the period prior to the oil price shocks, and the period 1972-1981 represents the period of the oil price shocks. The figures presented here are annual averages for each period.

---


\(^2\) As classified by the World Bank, IMF, and Asian Development Bank.
Table 1.1  Period-Average Key Economic Indicators For Thailand

<table>
<thead>
<tr>
<th></th>
<th>Percent</th>
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<tbody>
<tr>
<td>Real Growth Rate of GDP</td>
<td>7.2</td>
</tr>
<tr>
<td>Inflation</td>
<td>2.1</td>
</tr>
<tr>
<td>Import Prices</td>
<td>-0.2</td>
</tr>
<tr>
<td>Average Terms of Trade</td>
<td>114.0</td>
</tr>
<tr>
<td>Trade Deficits(% of GDP)</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Notes: The figures presented are the averages for the whole period for 1961-1971 and 1972-1981. The trade deficit is measured as a percentage of GDP (the difference between exports and imports, as a percentage of GDP). The terms of trade index is calculated from the ratio of export to import prices, and the base year is 1975, i.e. 1975=100. Import price is shown in terms of rate of change.

Sources: Calculated from IMF, the International Financial Statistics (IFS), various issues, 1960-1982.

As can be seen from Table 1.1, economic growth in the 1960s averaged 7.2%, while the price level rose on average only 2% a year. After the first oil price shock in 1973-74, which was combined with a world food shortage, there was a sharp rise in raw material prices and in the world interest rates. As a result of a 17% rise in import prices in the period 1972-1981, compared with a decrease of 0.2% in the period 1961-1971. In addition, Thailand's trade deficit as a percentage of GDP rose from 2.5% in the period 1961-1971 to 3.8% in the period of 1972-1981.

Table 1.2 shows the growth rate of GDP and expenditure for Thailand for the periods 1961-1971, and 1972-1981. The first two lines in Table 1.2 show the average real growth of GDP and expenditures for each period, whilst the rest are annual changes for the period 1972-1981. Thailand had high economic growth rates during 1961-1971, (7.2%), while the average annual real growth for 1972-1981 was similar at 7%. The lowest real growth rate shown in Table 1.2 is 0.8% in 1974, which is related to the first oil price shock, and again the real growth rate dropped from 7.7% in 1979 to 2.9% in 1980, arising from the second oil price shock.
Table 1.2 The Growth Rate of Real GDP (%) and Expenditures

<table>
<thead>
<tr>
<th>Year</th>
<th>Real GDP</th>
<th>Private Investment</th>
<th>Public Investment</th>
<th>Exports</th>
<th>Imports</th>
<th>Inflation Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1971</td>
<td>7.2</td>
<td>11.9</td>
<td>14.7</td>
<td>7.6</td>
<td>8.2</td>
<td>6.5</td>
</tr>
<tr>
<td>1972-1981</td>
<td>7.0</td>
<td>8.4</td>
<td>14.7</td>
<td>11.2</td>
<td>12.6</td>
<td>10.0</td>
</tr>
<tr>
<td>1972</td>
<td>8.5</td>
<td>-0.9</td>
<td>4.7</td>
<td>23.5</td>
<td>4.5</td>
<td>8.4</td>
</tr>
<tr>
<td>1973</td>
<td>14.0</td>
<td>29.0</td>
<td>-21.5</td>
<td>2.6</td>
<td>13.5</td>
<td>15.6</td>
</tr>
<tr>
<td>1974</td>
<td>0.8</td>
<td>21.6</td>
<td>-28.9</td>
<td>0.6</td>
<td>1.6</td>
<td>24.3</td>
</tr>
<tr>
<td>1975</td>
<td>4.6</td>
<td>-1.6</td>
<td>46.0</td>
<td>3.5</td>
<td>-2.8</td>
<td>5.3</td>
</tr>
<tr>
<td>1976</td>
<td>8.4</td>
<td>-1.2</td>
<td>45.7</td>
<td>41.2</td>
<td>4.7</td>
<td>4.2</td>
</tr>
<tr>
<td>1977</td>
<td>8.2</td>
<td>26.7</td>
<td>20.9</td>
<td>7.2</td>
<td>18.8</td>
<td>7.1</td>
</tr>
<tr>
<td>1978</td>
<td>10.9</td>
<td>6.2</td>
<td>15.5</td>
<td>-0.1</td>
<td>4.4</td>
<td>8.4</td>
</tr>
<tr>
<td>1979</td>
<td>7.7</td>
<td>16.8</td>
<td>7.5</td>
<td>10.9</td>
<td>11.1</td>
<td>9.9</td>
</tr>
<tr>
<td>1980</td>
<td>2.9</td>
<td>-11.4</td>
<td>36.7</td>
<td>3.5</td>
<td>7.8</td>
<td>19.7</td>
</tr>
<tr>
<td>1981</td>
<td>4.1</td>
<td>-1.5</td>
<td>20.7</td>
<td>20.8</td>
<td>5.3</td>
<td>12.7</td>
</tr>
</tbody>
</table>

Notes: Private investment and public investment are presented in terms of the percentage of GDP. Exports and Imports are presented in terms of the percent annual growth rate in real terms.

Sources: Calculated from the IMF’s IFS and the National Account of Thailand, National Economic and Social Development Board (NESDB).

As can be seen from Table 1.2, the average real growth rate declined slightly from 7.2% in the period 1961-71 to 7% in the period 1972-1981. The share of private investment also declined over the period, whilst government investment remained relatively constant. During the same period, the share of exports and imports rose by 5 and 10 percentage points respectively. Table 1.2 shows that the growth path of the Thai economy was affected after the incidents of the oil price shocks in 1974 and 1980, as can be clearly seen from a fall in the real GDP growth rate and real private investment whilst there was a rise in the trade deficit and the domestic inflation rate. The effects of both the oil price shocks in the 1970s and other related shocks in the early 1980s, such as the global economic recession, high interest rates, unstable exchange rates, and collapse of commodity prices led to balance of payments deficit for oil-importing countries such as Thailand in two ways. The first was through a
deterioration in its terms of trade, as higher oil prices increased the import bill of oil-importing countries, while secondly the price of exports, particularly primary commodities, were very vulnerable to downward movements.

There were major effects on Thailand's trade balance, as the prices of capital and manufactured goods exported by industrialised countries were not similarly flexible. As a result Thailand's growth rate of imports increased sharply from 8% during the 1960s to 12% during the period 1972-1981, subsequently Thailand experienced a heavy deterioration in its trade balance. The constraint on the volume of exports as a result of recession-induced falling incomes and the reduction in aggregate demand in industrialised countries, is reflected in the slow increase in Thailand's growth rate of exports from 7% during the 1960s to 11% during the period of 1972-1981. The recession and the protectionist pressures that were building up in developed countries checked their imports, including that of labour-intensive manufactured goods from developing Asian countries. As a net-oil importing economy Thailand was seriously affected by the oil price shocks of the 1970s and especially the second oil price shock, which, in conjunction with a poor agricultural performance, contributed to a slow down of the economy, a decline in the real growth rate of GDP, a deterioration in growth of exports and imports, and a deterioration in the domestic inflation rate as shown in Table 1.2.

Oil shocks have imposed the need for Thailand to adopt stabilization policies. Thai government intervention was focused on improving economic stability in response to the sharp oil price increases, including a controlled price increase for petroleum by approximately 50% in 1979. The increase in the domestic price of petroleum led to a rise in production costs, in particular for the manufacturing sector, and consequently affected all other economic sectors. As a result, wages and salaries increased in all economic sectors.

In recent years Thailand's economic performance has been one of the best among the ASEAN countries\(^3\). It has achieved this by adopting an outward-looking

\(^3\) Asian Development Outlook (1991), "Thailand": 115-120.
strategy and developing economic policies based on strict fiscal and financial self-discipline which have produced economic growth in the period 1982-1990 of over 7%, with the highest growth rate of 13% in 1988. This trend has continued with growth averaging 8% over 1991-1994. Real growth rates and other key economic indicators for the period 1981-1994 are presented in Table 1.3.

It can be clearly seen from Table 1.3 that Thailand was highly successful in achieving sustained economic growth during the post-oil shock period. The average real growth rate for the period 1982-1990 was over 7%, while the inflation rate dropped to 4%. During the same period the growth rate of exports and imports were sustained at the high rates of 25% and 11%, respectively. These key indicators demonstrate that the Thai government had gone in the right direction, although a number of impediments still exist after the adjustment to those shocks.

Table 1.3  Real Growth Rate and Key Economic Indicators : 1981-1994

<table>
<thead>
<tr>
<th>Year</th>
<th>Real GDP Growth Rate (%)</th>
<th>Inflation Rate (%)</th>
<th>Exports Growth Rate (%)</th>
<th>Imports Growth Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-1981</td>
<td>7.0</td>
<td>10.0</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>1982-1990</td>
<td>7.7</td>
<td>4.4</td>
<td>25</td>
<td>11.8</td>
</tr>
<tr>
<td>1991-1994</td>
<td>8.0</td>
<td>4.8</td>
<td>19.6</td>
<td>15.1</td>
</tr>
<tr>
<td>1982</td>
<td>4.0</td>
<td>18.6</td>
<td>19.4</td>
<td>-12.9</td>
</tr>
<tr>
<td>1983</td>
<td>7.2</td>
<td>19.5</td>
<td>-8.8</td>
<td>29.8</td>
</tr>
<tr>
<td>1984</td>
<td>7.2</td>
<td>23.2</td>
<td>23.1</td>
<td>4.6</td>
</tr>
<tr>
<td>1985</td>
<td>3.4</td>
<td>13.4</td>
<td>5.5</td>
<td>-10.9</td>
</tr>
<tr>
<td>1986</td>
<td>4.6</td>
<td>7.1</td>
<td>24.7</td>
<td>0.3</td>
</tr>
<tr>
<td>1987</td>
<td>8.6</td>
<td>5.4</td>
<td>31.7</td>
<td>42.8</td>
</tr>
<tr>
<td>1988</td>
<td>13.0</td>
<td>3.8</td>
<td>36.1</td>
<td>48.6</td>
</tr>
<tr>
<td>1989</td>
<td>11.5</td>
<td>5.4</td>
<td>25.7</td>
<td>27.4</td>
</tr>
<tr>
<td>1990</td>
<td>10.0</td>
<td>6.0</td>
<td>15.0</td>
<td>29.8</td>
</tr>
<tr>
<td>1991</td>
<td>8.2</td>
<td>5.7</td>
<td>23.8</td>
<td>15.8</td>
</tr>
<tr>
<td>1992</td>
<td>7.5</td>
<td>4.1</td>
<td>17.8</td>
<td>12.8</td>
</tr>
<tr>
<td>1993</td>
<td>7.8</td>
<td>4.3</td>
<td>18.4</td>
<td>15.0</td>
</tr>
<tr>
<td>1994</td>
<td>8.5</td>
<td>5.4</td>
<td>18.7</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Note: Export and import growth rates are measured in real terms

Oil costs have been a heavy drain on the economy, no oil reserves have yet been discovered in Thailand. However, natural gas has been found in the Gulf of Thailand and its use has increased in importance from 1990 through to the present day. Natural gas is one major alternative resource which can be used to replace oil. Although natural gas usage has been increasing, oil costs will continue to be a severe drain on foreign reserves both in the short term and long term. Therefore there is a need for increased natural gas production and more efficient energy use.

In addition to the need to discover and develop energy resources, government policy has been aimed at sustaining economic growth. As in other developing countries, the Thai government plays a significant role in the development of the economy. Many organizations have been established in order to improve economic growth. One is the National Economic and Social Development Board (NESDB), which is the major planning organization responsible for economic and social development.

Macroeconomic policy has been controlled by central government authorities in order to maintain economic stability. Fiscal policy operates through government expenditures and the taxation system, whereas the main instrument of monetary policy is the central bank lending rate, set by the Bank of Thailand.

Exchange rate policy was seen as the maintenance of a relatively fixed rate of the Baht to the U.S. dollar for several decades. Under this type of fixed exchange rate system, monetary policy is implemented through domestic interest rates, affecting capital flows, and consequently the trade balance. The money supply is endogenously determined in such a system.

There are a number of problems arising from the rapid growth in Thailand such as the shortage of infrastructure provision, the quality of resident's life, and environmental problems. Thailand's recent economic performance, however, is an

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4 The need for an improvement in energy use is an increasingly important objective. One is for the replacement of natural gas for oil usage. More details about current natural gas projects will be presented in the Appendix to Chapter 2.
excellent example of successful development combining adjustment with growth. The achievements since the 1980s exemplifies this, even though early in the decade Thailand, like many other developing countries, was hit hard by the global recession and the downturn in commodity prices.

A number of key factors in economic and industrial transformation led to recovery from the oil price shocks. As seen from Table 1.3, from 1987 onward Thailand entered a boom period with a higher growth path and further diversification of products and markets in all three sectors - agriculture, manufacturing, and services. The structural transformation of the Thai economy has been from an agricultural and resource-based producer and exporter to a more modern and industrial-based economy.

Although recent good economic performance has firmly ensured that Thailand could attain NIC status in the next 10 years, the expected constraints on sustaining growth in Thailand need to be considered. The rapid growth has led to increased strains on the economy, manifested in the emergence of infrastructure bottlenecks, a sharp increase in the current account deficit, and an increase in the inflation rate. In addition the issues of environmental problems, quality of life, and social problems are

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5 This statement refers to the findings of the Asian Development Bank in 1991. It states that Thailand's recent economic achievements - double digit growth in 1988 and 1989, rapid structural transformation from producer of primary commodities to a large producer of manufactures, alleviation of poverty and higher standard of living - have been remarkable. However, high rates of growth have put considerable strain on the economy. Inflation has increased as a result of both an accommodating monetary policy and supply constraints. Labour shortages have created bottlenecks and wage increases in a wide range of skilled occupations while infrastructure constraints are encouraged more frequently as the public sector attempts to keep pace with rapidly expanding demand.

6 As an agricultural-based economy, commodity prices referred to above are the prices of agricultural products. In that period, Asian neighbour countries like Vietnam, the Philippines, and Indonesia became potential competitors. Vietnam's rice, especially, has been a major import into the EU and other major markets.

7 The Newly Industrialising Countries (NICs) include four tiger countries: Hong Kong, Korea, Singapore, and Taiwan. NIC status can be categorised as: (a) a country has achieved economic growth through the successful implementation of an export-oriented development strategy; (b) a country has transformed its economic structure from agricultural based to a manufacturing based economy; and (c) international trade and investment play an important role in the industrialisation process.

8 Infrastructure bottlenecks are another major consideration in this study, hence the policy prescriptions in Chapter 6 will focus upon improvement in infrastructure development. Attention will focus upon transportation (roads, railways, harbours, airports), telecommunications networks, ports, and power systems.
also major considerations. The challenge facing policy-makers now is how best to sustain the momentum of the economy while avoiding overheating the economy and improving the domestic residents' quality of life. This in turn will require measures to remove a variety of structural impediments to growth. In particular, the need for sustainable infrastructure investment in both physical and human capital is widely recognised, and to support this a strengthening of domestic savings is required. The deregulation of domestic markets is seen as essential to improve economic efficiency and enhance the potential for growth, particularly in the area of tax reform, liberalisation of the financial system, and tariff reduction. At the same time, policy-makers have increasingly stressed the need to improve the quality of growth, which has been adversely affected by both environmental problems and a deterioration in income distribution.

As a result of the strategies pursued in response to the two oil price shocks, it has become clear that the strength of Thailand's economy has brought with it a number of major problems. Infrastructure bottlenecks have become an increasingly serious problem. Moreover, the strength of investment demand and exports have led to an increase in balance of payments surpluses, and the government has found it increasingly difficult to control monetary instruments. Arising from these inflation has increased and asset prices rapidly increased thereby causing growing concern that the economy might be overheating. Policy-makers have increasingly paid attention to these three major problem areas. They are also attempting to introduce appropriate policy settings to reduce the strength of these problems. Therefore, this study is designed to provide an analysis of alternative policy outcomes, to reduce the problems that Thailand is now facing.

A major aim of this study, is to develop a long run macroeconomic model for analysing the macroeconomic consequences of oil shocks for a net oil-importing economy such as Thailand. This is a major novelty of this study. The model enables the identification of the ways in which the oil price shocks have transmitted their effects to
the domestic economy, and will enable the exploration of future shocks\(^9\) to a Thailand like net oil-importing economy and the policy implications which flow from them. The model will incorporate the key characteristics of the non-oil sector, the role of the oil price on economic adjustment, the way in which both private and government sectors influence consumption and investment, as well as government policy towards the nominal exchange rate, financial markets, infrastructure and international trade developments, which has not been done before for Thailand in the context of the theoretical framework adopted.

The model developed has its foundations in models such as Harvie-Gower (1993) and Charles Harvie (1994) in order to capture the nature of the long run dynamic adjustment process, and it enables an analysis of the longer term impact of oil shocks upon the dynamic adjustment process of key macroeconomic variables for a Thailand like net oil-importing economy. This theoretical literature focuses upon an analysis of oil related shocks for the case of oil-exporting economies only. This is clearly not appropriate for a Thailand like net oil-importing developing economy. Therefore, the major task of this study is to develop a model changing the underlying assumptions from an oil-exporting economy to a Thailand like net oil-importing economy. This will be a major novel contribution of this study.

The theoretical analysis, however, 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 static framework, this study focuses upon Bhannupongse, N. and Warr, P.G. (1989), who conducted such an analysis of the effects of external shocks on the Thai economy. They developed an analysis of the effects of a resource boom on the adjustment of the balance of payments. Their analysis was based upon the adjustment of the balance of payments to the oil price shocks, using the experiences of Australia. A major reason for using the Australian experience is that the Australian balance of payments adjustment to the external shock employed the mechanism of exchange rate

\(^9\) Future shocks which might happen and directly affect the Thai economy, include for example: an increase/decrease in world interest rates, trade barriers shocks, and domestic investment shock.
adjustment, focusing upon the relative prices of domestic traded and non-traded goods in both resource and non-resource sectors. This implication is relevant to the development of a resource related macroeconomic model which emphasises the real exchange rate adjustment mechanism. However, such an approach only compares equilibrium states, giving little insight into likely adjustment processes.

In regard to dynamic frameworks this study starts from the seminal work of the Dornbusch (1976) model, a crucial underlying assumption of which is that financial markets continuously clear while non-financial markets are subject to sticky price and quantity adjustment resulting in non-market clearing.

In the early 1980s, Dornbusch's original model was extended to incorporate oil and included those by Buiter-Miller (1980), Buiter-Purvis (1982), Eastwood and Venables (1982), and Neary and van Wijnbergen (1984). Such analyses emphasised the dynamic nature of the adjustment process arising from oil related shocks but focused on the short to medium term. This was later extended by Harvie-Gower (1993) and Charles Harvie (1994), who emphasised the longer 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.

The macroeconomic model for Thailand developed in this study will be empirically estimated by “Two Stage Least Squares (2SLS)”, using the Shazam package. The estimation results will provide the basis for analysing the long run dynamic macroeconomic adjustment in Thailand for the period of the oil shocks and the period of the introduction of the government's policy to liberalise the economy including that in the area of international trade, public infrastructure capital spending, and the nominal exchange rate regimes combined with the operation of capital markets. The estimated, and where found necessary imposed, parameters are then used to conduct a simulation analysis by using the “Saddlepoint Program”, in order to

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10 Resource sector emphasised in Bhanumpongse and Warr (1989) is that of the mineral sector for the case of Australia.
achieve the objective of recommending what appropriate policy settings should be used to respond to oil shocks (this study pays attention to oil price and domestic oil requirements shocks)\textsuperscript{12} for economic development in Thailand.

Furthermore the model developed in this study could be used to examine the outcomes from alternative policy options. Such alternative policy options could be useful as a response to further shocks that might happen in the future. This would be useful for policy-makers concerned with economic development trends, and the adoption of appropriate policies in response to these.

The need for the adoption of alternative policy options, therefore, is required and will be addressed in this study. In particular, attention will be focused upon: (i) the issue of liberalisation of international trade; (ii) the issue of deregulation of financial markets, focusing on the nominal exchange rate and the operation of capital markets; and (iii) the issue of infrastructure development expenditure. These are three major issues which could influence Thailand's process of economic and industrial transformation into NIC status.

Firstly, trade liberalisation is one major area to be considered in this study. Basically, trade liberalisation would enhance trade performance\textsuperscript{13}, in particular, by reducing trade barriers on both the country's exports and imports. The policy-makers must very carefully consider this policy, according to the findings by Thailand's Development Research Institute.\textsuperscript{14} These state that protectionism tends to favour Thai export products at least in the short-run. This is due to the fact that the share of Thai

\textsuperscript{12} The world price of oil shock emphasised here is assumed to be exogenously determined by the world market (OPEC). Whilst the domestic oil requirements shock emphasised here refers to that exogenously determined by the energy policy adopted. An increase/decrease in oil requirements for domestic economic activities due to adoption of alternative energy usages such as natural gas. Alternative energy usage allows less oil usage in the country, arising from an improvement in advanced technology transfer and more efficient energy usage. Hence alternative energy usage policy adopted is exogenously determined by the authorities involved.

\textsuperscript{13} The organisation which is now increasingly important in the promotion of freer trade in the Asian region, and of which Thailand is a member, is "The Asia-Pacific Economic Cooperation (APEC)". The Asean Free-Trade Area (AFTA) proposal in 1994, envisaged tariff reductions on manufactured goods and processed agriculture output to 20% within 5-8 years. Some 41,000 products were identified for tariff cuts. This proposal will enhance the trade promotion of member countries, including that of Thailand.

\textsuperscript{14} F.Flatters and D.Dapice, (1990) : 2-8.
exports is still small and has not reached the limitations set by importing countries, namely textile and garments, processed foods (canned tuna and pineapple), toys, footwear, and lightly manufactured products (electronics and computer parts). However in the long-run Thai export performance can be adversely affected by excessive protectionism among its trading partners, and liberalisation in Thailand depends in part on liberalisation in other countries. This is why Thailand supports multilateral trade liberalisation.

The second proposed policy involves the role of government capital spending on infrastructure\textsuperscript{15}, which is another key policy issue considered in this study. The shortage of infrastructure has become a major impediment which needs to be remedied immediately.\textsuperscript{16} Proposed infrastructure development will be determined by government policy itself. As with other developing countries, government control over investment is still high in Thailand, although at present the Thai government has relaxed control over investment and in particular that of private investment. The demand for infrastructure is high and therefore the government should give this high priority.

A final, proposed policy relates to liberalising financial markets, by moving from a fixed nominal exchange rate to a flexible exchange rate regime and deregulating international capital flows. These will be focused upon in this thesis. A flexible nominal exchange rate would lead to automatic adjustment to an imbalance of payments, by equating supply and demand for foreign currency, whilst perfect capital mobility would automatically enable international capital flows depending upon foreign and domestic interest rate differentials.

\section*{1.2 Objectives of the Study}

\textsuperscript{15} Infrastructure spending emphasised here includes that of transportation (roads, railways, monorails, airports, and ports), telecommunications, and training or facilities education.

The study has four main objectives:

1. To investigate why the Thai economy has been growing rapidly since the mid-1980s. In order to achieve this objective, an overview of the economic situations and conditions for economic growth since 1970 will be examined, and will be presented in Chapter 2. Discussion will be focused upon Thailand's macroeconomic policy responses to external shocks, in particular the two major oil price shocks in the 1970s. In addition discussion of why the Thai economy has achieved such remarkable sustained economic growth is identified as well as the current problems it is now facing, arising from the rapid economic development. In addition this study attempts to identify further economic problems that may arise in the next 5-10 years.

2. Following an extensive review of the contribution of oil related shocks to the overall economy, the primary objective of this study is to develop a long run and dynamic theoretical macroeconomic model to analyse the effects of oil related shocks upon a Thailand like net oil-importing economy.

A theoretical macroeconomic model is developed in Chapter 4. It has as its foundation the relevant theoretical models presented in Chapter 3. The model explicitly incorporates the characteristics of the structure of the Thai economy. Estimation of the model will be conducted in Chapter 5.

3. The model developed in Chapter 4, will be further developed to identify and evaluate alternative government policy responses to oil related shocks, and this is presented and discussed in Chapter 6.

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 related to the introduction of a trade liberalisation policy to improve the trade balance. The second point of focus is in regard to government capital spending on infrastructure. A final policy alternative is the nominal exchange rate regime and the operation of capital markets, with the objectives of stimulating production, and growth in certain sectors of the economy to achieve developmental objectives.
4. To investigate appropriate policies which could be utilised to overcome economic problems, arising from oil related and domestic shocks. To achieve this objective, a comparison of the results arising from alternative theoretical models (as in objective 3) will be conducted through a numerical simulation of the theoretical macroeconomic model and these will be presented in Chapter 6. Such simulations will focus upon the adjustment of key macroeconomic variables such as real income, non-oil production, physical capital stock, foreign asset stocks, non-oil trade balance, real exchange rate, the domestic inflation rate, and domestic private sector real wealth among others.

The period of analysis will be that from 1971-1992, during which time a number of important developments occurred in Thailand. These included the two oil price shocks and post-oil shock periods and the integration of Thailand into the global economy, as reflected in the movement towards a flexible exchange rate and integration of its financial markets, including interest rate, with global financial markets. In addition the analysis will also include the period of Thailand’s support for multilateral trade liberalisation and the increasing role of the government in infrastructure spending.

1.3 Methodology

1.3.1 Data Sources

The statistical data used in this study is mainly from "The Data of National Income", estimated and collected by the National Economic and Social Development Board of Thailand (NESDB). The general literature relevant to this area was derived from previous research and other sources. Data is mostly from the Bank of Thailand, the National Statistical Office of Thailand, the Far Eastern Economic Review, Asian Development Bank, IMF, World Bank, Asian Economic Bulletin, and general literature concerning Thailand for the period 1971-1992. However, in order to examine the long term dynamic macroeconomic adjustment process in response to projected shocks in
Thailand, the parameter values utilised in the simulation analysis were derived from both the estimation of the developed model and previous macroeconomic models namely SIAM1 and SIAM2\(^{17}\).

1.3.2 Method of Study

(a) Developing a Macroeconomic Model

This study will involve both qualitative and quantitative methods. The study will primarily be a modelling exercise. A macroeconomic model of a Thailand like net oil-importing economy will be developed (presented in Chapter 4), by extending and amending existing models (discussed in Chapter 3).

In order to conduct a long run dynamic study an appropriate theoretical framework is required, the foundations of what can be found in the original contribution of Dornbusch (1976) and later extended to incorporate oil by Buitter and Miller (1981), Buitter and Purvis (1982), Eastwood and Venables (1982), Neary and van Wijnbergen (1984), and most importantly Harvie and Gower (1993), and Charles Harvie (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. A deterministic model is one in which the adjustment process is determined or known by economic agents. The deterministic model used here is analysed under the assumptions of rational expectations\(^{18}\) and this is equivalent to the case of perfect foresight. It is assumed that financial markets are 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

\(^{17}\) SIAM 1 and SIAM 2 are macroeconomic models, which have been developed by the World Bank and NESDB since 1980, for analysing the impact of shocks on the macroeconomic adjustment processes in Thailand.

\(^{18}\) The rational expectations assumption is used in the development of a macroeconomic and energy model for Thailand by the Thailand Development Research Institute, January 1989.
processes. The analysis will emphasise the long run nature of the adjustment process, since the oil related shock will have a long run effect upon the economy, by inclusion of capital stock accumulation/decumulation in the product market and foreign asset stock accumulation/decumulation arising from developments in the current account. The former process is particularly important in the context of a rapidly developing economy such as Thailand, 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 a Thailand like net oil-importing economy. These major changes rest on several factors. Firstly, the model developed is for a net-oil importing economy and it is assumed that there is no oil production at all, hence only non-oil production takes place primarily in the economy. Secondly, it is extended to distinguish between government consumption and investment spending, with the latter being equivalent to government investment in infrastructure developments. Government investment contributes to the level of aggregate demand for non-oil output, whenever the government raises (lowers) its investment there will accordingly exist a direct aggregate demand effect. Thirdly, trade restrictions on either exports and imports are incorporated in the model. Trade restrictions have a direct effect upon exports and imports, which are major contributions to the level of aggregate demand. Fourthly, less than perfect capital mobility is assumed. This is because asset markets in Thailand are not well developed as in most other developing countries, and therefore domestic and foreign financial assets are not perfect substitutes. Fifthly, the analysis will focus upon adjustment under both a fixed and flexible exchange rate system, which is relevant to Thailand which is moving to a flexible exchange rate regime in the near future. Finally the importance of income, wealth and the current account for the dynamic adjustment process is emphasised.
(b) Estimation of the Model

The model will be estimated by Two Stage Least Squares (2SLS) and will be conducted by using the Shazam package\(^{19}\). The data utilised for the estimation are quarterly data, which are collected from various sources. The quarterly data is required mainly to increase the number of observations, in order to satisfy, for estimation purposes, the required number of degrees of freedom. The data sources, for the period 1971-1992, will be divided into two sub-periods: (a) the period of 1971-1980, referred to as the "base period", which is chosen to capture the period of the oil shocks upon the long run dynamic macroeconomic adjustment of the Thai economy; and (b) the period of 1981-1992, referred to as the "adjustment period", is chosen to capture the period of the introduction of the government's liberalisation policy for the economy. The estimation of the model, using different data for the two periods identified will give two groups of the coefficient parameters. The first group of coefficient parameters from the base case will utilise data for the first sub-period (1971.1-1980.4), comprising 40 observations. Whilst the second group will be derived from the second sub-period (1981.1-1992.4), utilising data for 48 observations. The first group of coefficient parameters estimated from the base case will be utilised for the purpose of simulation analysis in Chapter 5, whilst the second group of these will be conducted for the simulation analysis in Chapter 6.

Before estimation of the model, the relevant variables will be tested for "unit roots" to determine whether the variables are stationarity or non-stationarity. Non-stationary, trended data will give incorrect statistical and therefore economic inferences, and has been mostly ignored by economists and modellers. It is simply said that regression analysis makes sense only for data which are not subject to a trend. Therefore the economic data series has to be detrended (for stationarity) before any sensible regression analysis can be performed.\(^{20}\)

\(^{19}\) Shazam, version 7, 1993

\(^{20}\) More details about unit root test for the relevant variables will be provided in Appendix 5.2 and 5.3.
The parameters, both estimated and imposed\textsuperscript{21} are then used to conduct a simulation analysis to examine what policy options should be used in response to future shocks. The program utilised to derive these results is called "\textbf{Saddlepoint}", which is designed for solving linear rational expectations models with constant coefficients. It is a continuous time analogue of the first order linear difference model with rational expectations, of the type studied in Blanchard and Kahn (1980). The simulation results for the base case will be presented in Chapter 5, whilst the results for the alternative policy options will be presented in Chapter 6. The simulation results presented in both chapters, identify the dynamic long run adjustment process and is restricted to 22 years. This is required to allow the long term trend of dynamic adjustment of some macroeconomic variables\textsuperscript{22} to reach the steady state, with 22 years being long enough to allow the variables to reach the steady state.

The theoretical models, both for the base and the alternative policy options, and the empirical estimation and simulation results suggest that the need for policy measures, such as the liberalisation of finance and trade, and government capital spending on infrastructure development, is necessary for a rapidly growing economy such as that of Thailand's. The three major policy options could be utilised in order to maintain and improve economic growth and stability in response to the external and internal shocks that may happen in the future. Details of these alternative policies will be discussed in Chapter 6.

\subsection*{1.4 Organization of the Study}

The second chapter will present an overview of Thailand's recent development performance and government policy interventions in response to the oil shocks during

\textsuperscript{21}Some parameter values were estimated by using the Two Stage Least Squares (2SLS) technique, whilst other parameter values were imposed by using equivalent coefficients identified from SIAM1 and SIAM2, which are the macroeconomic models for Thailand for the purpose of analysing the effects of external shocks on Thailand's macroeconomic adjustment.

\textsuperscript{22}These macroeconomic variables are the adjusting variables such as the general price level, the domestic price of non-oil output, and the inflation rate. These will be further discussed in more detail in Chapters 4, 5, and 6.
the period of 1971-1992. This chapter will discuss four parts: economic performance in response to the two major oil prices shocks; policy interventions related to the oil shocks, focusing upon fiscal, monetary, exchange rate, and structural policies; current problems facing the Thai economy; and key issues in response to the current problems, in particular the issues of trade and financial liberalisations and the act of government capital spending through infrastructure developments.

Chapter 3 reviews the theoretical literature which is relevant to the objectives of this study. The models identified are discussed and applied to the development of a new macroeconomic model for a Thailand like net oil-importing economy and for special purposes in this thesis, as presented in Chapter 4.

Chapter 5 presents the empirical estimation and simulation results derived from the model developed in Chapter 4. The empirical estimation and simulation results in this chapter will be referred to as the estimations and simulations for the base case. An interpretation of various cases of oil related shocks to a Thailand like net oil-importing economy is also presented.

Chapter 6 investigates the outcomes from the adoption of alternative policies to find the appropriate policies for Thailand, arising from the oil related shocks to the Thai economy. A comparative study of the results for the base case and the alternative policies is also conducted in this chapter. Furthermore, the importance of appropriate policies derived from the model and the empirical work, future prospects, and new challenges to Thai economic development are also discussed in this chapter.

A summary of the major conclusions, the policy implications, and issues for further study, and their relation to the stated objectives in the introductory chapter, are presented in Chapter 7.
2.1 Introduction

The structure of the Thai economy changed considerably during the 1970s-1980s, due to the fact that the Thai government pursued an industrialisation strategy during the 1960s and 1970s. This strategy focused upon import-substitution and export-promotion strategies, in conjunction with low wages and low priced commodities. As a result Thailand became a prime example of export-led growth, and this emerged as the central theme of the government’s development policy in the early 1980s. Table 2.1 shows that in 1970 agriculture was still the leading sector, producing 30.2% of GDP, while industrial production accounted for 25.7%. But in 1980, industrial productions replaced agriculture as the largest sector, and by the end of 1991, the share of industrial products had increased to 36.4%, while agriculture had declined to 13.8%. At the beginning of 1994, the share of agriculture accounted for only 12% of GDP, while manufacturing accounted for about 39% of GDP and services sector accounted for about 49% of GDP. During the same period, the Thai economy has become more export oriented and its exports more distinctly manufactured based. Thailand is thus undergoing a rapid transformation from a primarily agriculture-based economy to an industrial economy.

However, the Thai economy faced a period of serious imbalances and painful adjustments in the early 1980s. Because of its heavy dependence on imported oil, Thailand was seriously affected by the two oil price shocks. However, since the first oil shock coincided with a general commodity price boom, the macro balances did not immediately deteriorate and domestic energy prices were allowed to fall significantly below international prices. This, combined with a relatively expansionary fiscal policy,

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23 Commodities emphasised here refers to agricultural products.
contributed to the sharp deterioration in both fiscal and external balances when the second oil price shock hit Thailand.

Table 2.1  Sectoral Share of GDP  (per cent)

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture</th>
<th>Industry</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>30.2</td>
<td>25.7</td>
<td>44.1</td>
</tr>
<tr>
<td>1980</td>
<td>20.6</td>
<td>30.8</td>
<td>48.6</td>
</tr>
<tr>
<td>1991</td>
<td>13.8</td>
<td>36.4</td>
<td>49.8</td>
</tr>
<tr>
<td>1992</td>
<td>12.4</td>
<td>37.8</td>
<td>49.5</td>
</tr>
<tr>
<td>1993</td>
<td>12.4</td>
<td>37.9</td>
<td>49.5</td>
</tr>
<tr>
<td>1994</td>
<td>12</td>
<td>39</td>
<td>49</td>
</tr>
</tbody>
</table>

Sources:  
World Bank, "World Bank Table 1989-91 edition".  

After the second oil price shock, from 1980 onward, the Thai authorities embarked on a comprehensive adjustment program, including the depreciation of the Thai baht in 1984 to improve the competitiveness of Thai exports, the promotion of foreign direct investment in Thailand, and the elimination of most export taxes and other burdens on exporters, while domestic costs, particularly wages, remained quite low.

Resulting from the developments, Thailand has experienced an economic boom since 1986. The real GDP growth rate has risen by an average of over 10% a year, recording in 1988 its highest real GDP growth rate of 13% and this was the first year in two decades that Thailand had experienced balance of payments surpluses. Since 1986, manufacturing outputs and exports have not only increased but become more diversified: more than half of export growth over the period has been due to manufacturing exports, including garments, precious stones and jewelry, computers parts, consumer electronics, and footwear. At the same time, construction, services and the tourism sectors have grown rapidly.
2.2 Economic Performances in Response to the Two Major Oil Price Shocks: 1971-1994

An overview of Thailand's economic performance for the period 1971 - the present, in response to the two major oil price shocks during the period of the 1970s will be discussed in this section. The whole period will be broken into three main periods. The first period (1971-1980) is chosen to capture the impact of the two major oil price shocks upon Thai economic developments. The second period (1981-1985) is chosen to investigate Thailand's macroeconomic adjustment to the oil price shocks. Finally, the third period (1986-1994) is chosen to capture the boom period, arising from the Thai economic adjustment to the major oil price shocks. Each period will be discussed in details as follows.

2.2.1 The Base Period (1971-1980)

Between 1972 and 1974 the price of crude oil increased from US$1.88 to US$9.52 per barrel. This major blow came in October 1973 when OPEC unilaterally raised prices by over 260% (estimated in terms of US dollar for a barrel of oil). The rise in oil prices was the sharpest of all commodities. Other commodity prices, particularly foodstuffs, accelerated during 1972-1974.

The growth rate of Thai economy was hard hit, falling to an average of below 6% in 1974 (Table 2.2), as a result of a reduction in export growth, and the sharp deterioration in the current account balance and the deficit in the balance of payments.

In 1974 the inflation rate rose to over 15%, the highest rate on record. This was largely due to the sharp rise in oil prices, which subsequently led to a continuing rise in commodity prices, and consumer prices.

In the 1970s, Thailand was heavily dependent on imported oil, and export markets for primary commodities in the OECD countries. The oil price shock in 1973-74 hit Thai economic development hard, at a time of weak agricultural performance. Agricultural production, particularly of rice, was strong in Thailand in 1974-75, allowing Thailand's rice exports to recover and reach record levels, helping to boost export growth by over 9% from 1976 to 1978. However, due to the large current account deficit and the recession in industrialised countries, arising from the first oil price shocks during the same period, there was a decline in external demand and in manufacturing growth in Thailand, which was countered by a very large increase in government spending, especially public investment expenditure, as well as by growth in the service sector. At the same time the inflation rate declined from 15% in 1974 to 10% in 1975, and averaged around 8% until 1979.

In the period 1976-78, real growth rates accelerated to an average of 9.5% in Thailand (Table 2.2). These growth rates were moderately high for the world and particularly so for developing countries. A major season for the success in boosting

growth rates was found in the rapid expansion of international trade. Export growth strongly recovered in Thailand after the stagnant recession years of 1974-75.

Thailand's economy showed strong resilience during 1976-78, with an average real GDP growth rate of 9.5% (Table 2.2) and export growth over 9.5% per year\(^{26}\). However, the country's current account deficit rose sharply and this reflected the high growth path selected by the government, which led to increased imports of oil to meet commercial energy consumption requirements.

Thailand performed well in response to the first oil price shock. This was mainly due to the generally inflationary world environment of the post-first oil price shock period which has three beneficial aspects for the non-oil producing developing countries, which was also primarily commodity exporters like Thailand, as the country was able to increase its international competitiveness by controlling inflation relatively well. Firstly, between 1975-78 the real price of a barrel of oil declined, though it still remained well above the price prior to the first oil price shock. Secondly, the expansionary environment of the period allowed non-oil producing countries such as Thailand to borrow easily at negative real interest rates in order to finance balance of payments deficit brought about by higher oil import costs, even as it sought to build up its export industries and make energy investment. Finally, there was little resistance to increased exports from developing Asian countries, including Thailand to either OECD or oil-exporting countries as long as, generally, economic activity and trade were expanding.

These favourable conditions were unsatisfying for OECD countries, which had been losing value on existing assets due to "the inflation tax"\(^{27}\), which brought about a decline in the real value of their financial assets (negative real interest rates) on top of the declining real price of oil currently being pumped and sold.


\(^{27}\) The inflation tax referred to the situation where a government adopts a policy of promoting inflation in place of an increase in taxation to pay for its expenditures.
**Table 2.2: Thailand Economic Performance: 1971-1980**

<table>
<thead>
<tr>
<th>Year</th>
<th>1. GDP Annual Growth Rate (%)</th>
<th>2. Foreign Trade</th>
<th>3. Foreign Debt</th>
<th>4. Inflation Rate (%)</th>
<th>5. Exchange Rate (Baht/USS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>2.2</td>
<td>1.0000</td>
<td>0.9000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1972</td>
<td>2.9</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1973</td>
<td>6.3</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1974</td>
<td>9.5</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1975</td>
<td>5.4</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1976</td>
<td>6.8</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1977</td>
<td>9.0</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1978</td>
<td>10.7</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1979</td>
<td>5.0</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
<tr>
<td>1980</td>
<td>4.9</td>
<td>1.0000</td>
<td>0.8000</td>
<td>19.4</td>
<td>16.7</td>
</tr>
</tbody>
</table>

**Notes:**
- The negative sign indicates a decrease in percentage changes.
- Inflation rate is measured by percentage changes in the consumer price index.

**Sources:**
- World Bank, "World Bank Table 1989-91 edition."
Thus, between 1978 and 1979, the price per barrel\textsuperscript{28} was increased by 36% and again in 1980 by a further 63%, for a rise of over 120% in less than two years. The effects of these events were crucial for net-oil importing countries such as Thailand.

### 2.2.2 The Adjustment Period (1981-1985)

The second sharp increase in oil price occurred in 1979-80, when the price per barrel rose from US$12.70 in 1978 to US$17.27 in 1979 and to US$28.18 in 1980. The consequences of the second oil price shock for Thailand became fully apparent in the early 1980's.

**Table 2.3 Thailand's Economic Performance : 1981-1985**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GDP Annual Growth Rate (%)</td>
<td>5.9</td>
<td>6.3</td>
<td>6.5</td>
<td>6.8</td>
<td>7.5</td>
</tr>
<tr>
<td>2. Foreign Trade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Exports (US$ mil)</td>
<td>7,000</td>
<td>6,900</td>
<td>6,300</td>
<td>7,400</td>
<td>7,100</td>
</tr>
<tr>
<td>- Imports (US$ mil)</td>
<td>10,000</td>
<td>8,500</td>
<td>10,200</td>
<td>10,500</td>
<td>9,200</td>
</tr>
<tr>
<td>- Trade Balance (US$ mil)</td>
<td>-3,000</td>
<td>-1,600</td>
<td>-3,900</td>
<td>-3,100</td>
<td>-2,100</td>
</tr>
<tr>
<td>- Current Account Balance (% of GDP)</td>
<td>-3.1</td>
<td>-7.6</td>
<td>-5.4</td>
<td>-4.4</td>
<td>0.2</td>
</tr>
<tr>
<td>3. Foreign Debt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- External Debt (US$ mil)</td>
<td>10,800</td>
<td>12,100</td>
<td>13,800</td>
<td>14,900</td>
<td>17,500</td>
</tr>
<tr>
<td>- Debt-Service Ratio (% of GDP)</td>
<td>16.7</td>
<td>15.5</td>
<td>7.2</td>
<td>8.7</td>
<td>9.0</td>
</tr>
<tr>
<td>4. Inflation Rate (%)</td>
<td>12.7</td>
<td>18.6</td>
<td>19.5</td>
<td>23.2</td>
<td>13.4</td>
</tr>
<tr>
<td>5. Exchange Rate (Baht/US$)</td>
<td>21.7</td>
<td>21.5</td>
<td>23.2</td>
<td>27.6</td>
<td>25.0</td>
</tr>
</tbody>
</table>

**Notes:**
- The negative sign indicates a decrease in percentage changes.
- Inflation rate is measured by percentage changes in the Consumer Price index.

**Sources:**
- World Bank, *"World Bank Table 1989-91 edition"*.
- Asian Development Bank, *"Asian Development Outlook 1993"*.

\textsuperscript{28}These figures were estimated in terms of the US dollar.
Thailand's economic performance during the period 1980-1985 is shown in Table 2.3. Real GDP growth rates exhibited a downward adjustment following the second oil price shock, when during the period 1980-1985 its real growth rate averaged around 5.5-6%. The current account balance deficit averaged 5.5% of GDP for the period 1980-1985. Inflation rates in Thailand rose sharply from 9% in 1979 to 19% in 1980, and remained at this level through 1983, and reaching a new peak of 23% in 1984.

Table 2.3 summarises economic performance for the post-second oil price shock period (1981-1985). It is clearly seen that following the second oil price shock, Thailand experienced downward economic growth, with a decline in the real GDP growth rate, increasing current account deficit, external debt, and inflation rate.

For oil-importing country such as Thailand, the impact of the second oil price shock and the subsequent OECD recession29 was to double inflation rates to around 10% per year, while reducing real growth rates. Export growth rates declined, particularly for agricultural commodities. It major primary exports had become less competitive (e.g. rice production was being challenged by Vietnam), and its manufactured exports had not risen rapidly enough to fill the gap.

Following the second oil price shock, Thailand approached the limits of its borrowing and, at the same time, faced declining export markets. The very high cost of borrowing in real terms from private commercial sources was a further problem. As a result of the long build-up of inflationary expectations nominal interest rates climbed to record levels. This was a major difference to the period after the first oil price shock. Like many non-oil producing developing countries, Thailand was able to adjust after the first shock through borrowing as opposed to an expansion in real transfers to the oil exporters. After the second shock the monetary authorities were determined to break inflationary expectations by restricting money supply growth, leading to record

---

29 This refers to a deterioration of economic growth in OECD countries, weak economic performances, high interest rates, and high international trade protection.
high in real interest rates. The cost of private commercial borrowing increased substantially.

Therefore, the impact of the second oil price shock on Thailand, may be summarised as a sharp rise in inflationary pressure, and a fall in real GDP growth rate due to worsening export growth, as a result of increasing protectionist barriers in OECD countries. As a result current account balance for Thailand deteriorated sharply in this period.

2.2.3 The Boom Period (1986-1994)

Between 1980 and 1985, oil consumption in the world declined almost continuously. The decline resulted from the replacement of oil by other fuels\textsuperscript{30}, as a result of high energy costs, structural changes in OECD economies, and renewed and more intensive conservation and efficiency efforts by oil consumers.

In 1985 crude oil price fell from almost US$30 to US$10 per barrel and this had a major effect on the oil-importing economies, including Thailand. Economic development in Thailand led to an expansion of energy intensive industrial activity and to rapid growth in purchases of energy-consuming goods. Despite the sharp decline in oil prices in mid-1985 and 1986, Thailand demanded higher volumes of energy for industrial activities based on oil use even though current account balance improved.

In conjunction with a decline in oil price and the comprehensive development program pursued in the period 1980-1985, Thailand experienced an economic boom. Real GDP growth rates rose to 10% over a year, and the highest growth rate was recorded as 13% in 1988. Export growth rates rose over 30% a year, resulting from the diversification of export products from agriculture to manufacturing. In addition the Thai economy has changed to being more manufacturing based since the mid 1980s.

\textsuperscript{30} In Thailand, replacement of oil by natural gas is increasing significance, since the country discovered natural gas in the early 1970s, and found that it could be replaced to oil. Natural gas will continue to be the preferred fuel in the country. More details about natural gas project will be presented in Appendix 2.1.
During the 1990s, the Thai economy has been influenced by both external and internal factors. The external factors included prolonged economic recession in the US and European economies, and increased protection imposed on Thailand’s export commodities by those countries. In addition the Gulf War in 1990-1991 was another major influence, while internal factors included political turbulence in February 1992, and May 1993. These effects caused a deterioration Thailand’s economic growth, as can be seen from Table 2.4. from 1990 onward the economic growth rate averaged around 7%, in real terms, and the current account deficit stayed at a high level, averaging over 7.5% of GDP. The growth rates of exports and imports averaged around 11%-13%, and 15%-16%, respectively. The domestic inflation rates remained at a low level at around 6% through 1994.
<table>
<thead>
<tr>
<th>Year</th>
<th>GDP Annual Growth Rate (%)</th>
<th>Exchange Rate (Baht/USS)</th>
<th>Inflation Rate (%)</th>
<th>Debt Service Ratio (%)</th>
<th>External Debt (USSmil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>4.9</td>
<td>26.2</td>
<td>1.8</td>
<td>30.1</td>
<td>18505</td>
</tr>
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<td>1987</td>
<td>9.5</td>
<td>26.7</td>
<td>2.6</td>
<td>22.0</td>
<td>20305</td>
</tr>
<tr>
<td>1988</td>
<td>13.0</td>
<td>25.7</td>
<td>3.8</td>
<td>20.2</td>
<td>21664</td>
</tr>
<tr>
<td>1989</td>
<td>11.5</td>
<td>25.2</td>
<td>5.4</td>
<td>16.3</td>
<td>23451</td>
</tr>
<tr>
<td>1990</td>
<td>10.0</td>
<td>25.6</td>
<td>6.0</td>
<td>17.2</td>
<td>25868</td>
</tr>
<tr>
<td>1991</td>
<td>7.5</td>
<td>25.5</td>
<td>5.8</td>
<td>15.1</td>
<td>27420</td>
</tr>
<tr>
<td>1992</td>
<td>7.8</td>
<td>25.5</td>
<td>5.8</td>
<td>13.8</td>
<td>29066</td>
</tr>
<tr>
<td>1993</td>
<td>8.0</td>
<td>25.5</td>
<td>6.0</td>
<td>12.2</td>
<td>29600</td>
</tr>
<tr>
<td>1994</td>
<td>7.5</td>
<td>30.5</td>
<td>6.9</td>
<td>12.5</td>
<td>30598</td>
</tr>
</tbody>
</table>

Notes:
The negative sign indicates a decrease in percentage changes.
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>-0.7</td>
<td>15.5</td>
<td>18.6</td>
<td>30.9</td>
<td>3.8</td>
<td>-3.8</td>
<td>-247</td>
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<td>9.5</td>
<td>2700</td>
<td>1.05</td>
<td>110</td>
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<td>16.1</td>
<td>16.9</td>
<td>30.9</td>
<td>3.8</td>
<td>-3.8</td>
<td>-365</td>
<td>-2,700</td>
<td>28.9</td>
<td>4,190</td>
<td>25.6</td>
<td>247</td>
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<td>110</td>
<td>10.5</td>
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</table>

Table 2.5: Major Macroeconomic Indicators: 1971 - 1994

Table 2.5 summarizes the major macroeconomic indicators for the period 1971-1994. It is clearly seen that Thailand performed well in trade performance for the period 1981-1994, with a considerably improvement in growth rate of exports (25.6% for 1981-1994, and 9% for 1971-1980), while growth rate of imports was also further improved (29% for 1981-1994, and 10% for 1971-1980). Other major indicators between the two period were not much different.

2.3 Policy Intervention Related to the Oil Shocks: 1971-1994

In this section, the policy interventions in Thailand in response to the two oil price shocks in the 1970s will be discussed. Emphasis here is placed upon macroeconomic policies, related monetary, fiscal, exchange rate, and the international trade policies. In addition, structural adjustment and domestic policies are also examined.

2.3.1 Fiscal Policy

Following the two oil price shocks in the 1970s, the Thai government experienced a budget deficit of varying degrees. The fiscal deficit measured by the difference between total government revenues and expenditures, for the period 1980-1990, was highest in 1982 (Table 2.6), but then improved drastically after 1987. 1988 was the first time in 14 years that the government experienced a fiscal surplus. This was as a direct result of the economic boom of 1988 when the government collected much higher tax revenues than it had anticipated. The period 1991-1994, however, saw the Thai government again experiencing a budget deficit, due to a sharp rise in demand for capital goods for investment, whilst government revenues grew slowly and were unable to offset the rise in government expenditures.

The period between 1980-1984 was one of the most unstable in recent Thai economic history. The second oil price crisis in 1979-1980 sent negative results across all sectors of the economy. Price levels had dramatically risen, the inflation rate in 1980 was almost 20%, and the trade deficit had reached 9.7% of GDP in 1983. The
government had adopted a belt-tightening fiscal policy starting in 1981 after a free-spending year 1980. Government spending was controlled and monitored in an increasing attempt to collect more taxes. The fiscal deficit as a percentage of GDP was highest in 1982 but started to come down in 1983.

Table 2.6 Government Revenues and Expenditures: Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Revenue</th>
<th>Growth Rate (%)</th>
<th>Total Expenditures</th>
<th>Growth Rate (%)</th>
<th>Surplus (+) Deficit (-)</th>
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<td>1980</td>
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<td>120,973</td>
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<td>200,028</td>
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<td>211,988</td>
<td>3.8</td>
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<td>223,089</td>
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<td>+14,997</td>
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<tr>
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<td>265,726</td>
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<td>375,678</td>
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<td>376,798</td>
<td>5.8</td>
<td>-55,348</td>
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<td>402,100</td>
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<td>432,650</td>
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During the period 1985-1986, the significance of the foreign debt problem emerged when the debt payment constituted a major share of the annual government budget in 1985. For recovery, a new debt policy was put into place equally quickly in order to control further foreign borrowing. The tight fiscal policy continued to be observed as did monetary policy focusing on interest rates and credit.

The promotion of tourist projects began in earnest during 1987, “Visit Thailand Year”, which spearheaded tremendous growth in the number of tourists visiting Thailand from 1987 through to 1990. Exports increased even over the highest
expectations in 1988. Together with the increase in direct foreign investment, the economy surged forward to reach a growth rate of 11%.

Among macroeconomic changes since 1985, one of the most dramatic was the change in fiscal conditions of the Thai government. Several aspects are involved here: the fiscal surplus of 1988, the prospects for tax reform, foreign debt problems, public enterprise issues, and energy price management. These aspects will be discussed separately.

In the face of export earnings from tourism and direct foreign investment, what happened to the revenues of the Thai government was quite unexpected. Table 2.6 shows the size of total revenues and total expenditures of the Thai government, and the differences between the two. For the period 1980-1990, the fiscal deficit was highest in 1982, around Baht 41,000 million, dropping down to about Baht 23,000 million in 1983, but this went up again in 1984-1986 to remain in the range of Baht 33,000-39,000 million. The economic recovery of 1987 had shown signs that the fiscal picture was definitely improving as the fiscal deficit that year was less than Baht 10,000 million. In 1988 the situation changed completely. Total revenues collected for that year were 27.8% of GDP higher than the already improving level of 1987, whereas public expenditure in 1988 only grew at about 5.2% of GDP over the level in 1987. The result was a staggering surplus of over Baht 35,000 million.

Table 2.7 shows the percentage distribution and growth rates of national government revenues, classified by major sources from 1985-1993. There was a great increase in the share of three types of corporate taxes - income taxes, import duties and business taxes.

Total revenues from taxation grew rapidly from 1987 to 1990. The increase averaged 28% of GDP for 1988-90, falling back to average 6% of GDP for 1991-1993. This was due to the Thai government introducing tax reform in early 1992, namely the Value Added Tax (VAT). This tax system could improve tax collection efficiency, but initially tax revenue growth slowed as tax reform was undertaken.
Tootal Revenues

1. Taxation
2. Sales and Charges
3. Contribution from Government
4. Dividend
5. Other Revenues

Table 2.7: Case of Thailand: 1985-1993

Percentage Distribution and Growth Rates of National Government Actual Revenues Classified by Major Sources:
Obviously tax revenues increased due to activities connected with the rapid expansion of the Thai economy. As mentioned earlier, the Thai economy was quite dependent on imports. When imports increased, so did the collection of import duties. Increased manufacturing production also brought in more business tax and corporate income tax for the government. However import duties and business taxes are indirect taxes, and as such are likely to be regressive and poor stabilisers for the economy.

Table 2.8  Government External Debt : Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Government Debt</th>
<th>Government Guarantee Obligation</th>
<th>Grand Total</th>
<th>Growth Rate (%)</th>
<th>% of GDP</th>
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<tr>
<td>1980</td>
<td>30,245.5</td>
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<td>138,735.5</td>
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<td>101,430.1</td>
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<td>17.1</td>
</tr>
<tr>
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<td>128,059.1</td>
<td>201,838.4</td>
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<td>168,201.9</td>
<td>280,562.7</td>
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<td>187,374.2</td>
<td>316,480.9</td>
<td>12.8</td>
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<td>21.2</td>
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<td>15.4</td>
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</table>


Increased tax collection means that less foreign savings would be required. As mentioned, Thailand detected its debt problems before they become critical for the economic solvency of the country. Several adjustments were carried out such as a moratorium on new debts, a careful scrutiny of new investment projects, a scaling down of existing projects, and a refinancing of old debts with new debts which are less costly. As shown in Table 2.8, the total external debt of the Thai government was reduced by 4% in 1988 compared to 1987. The debt at the end of 1988 stood at Baht
300,000 million or about 20.7% of GDP, a decline from the peak of 25.6% of GDP in 1986 and 1987 - back to the level in 1984. In spite of the fact that the government in 1989 raised the ceiling of public external borrowing from US$1,000 million to US$1,200 million, even this was not going to pose many external debt problems for Thailand if economic prosperity continued.

2.3.2 Monetary Policy

Of all macroeconomic policies in Thailand, the monetary policy as conceived and implemented by the Bank of Thailand (BOT) has been the most consistent and relatively effective. This reflected the traditional professionalism of the BOT as the monetary authority of the country. The major instrument of monetary policy is the central bank lending rate, and it is used as an intermediate target. In the period 1970-1986, the type of monetary policy being applied included movements in the bank rate as well as changes in the monetary growth rate. The results are shown in Table 2.9 which is divided into two periods, expansionary and contractionary, which are identified by changes in the BOT lending rate.

From 1970-1986, monetary policy changed direction five times. The longest expansions lasted about three years (1970-72 and 1975-77), whilst the longest contraction lasted four years (1978-1981). Monetary policy since 1970 had been counter-cyclical, except during 1975-1977, when policy was expansionary despite economic growth being as high as 7.6%. Otherwise expansionary measures were associated with a slow-down in economic growth, and contractionary measures with strong growth. According to the analysis of Bhannupongse and Warr (1989), there was a deviation in real income growth from its trend path between 1971 and 1985 as shown in Figure 2.1. They discerned that a deviation in real growth rate mainly depended upon the major shocks in the period 1971-1985, which were the commodity boom and the oil price shocks. The figure shows that the first oil price shock caused

32 Commodity means that agricultural commodity.
a sharp drop in the real growth rate, and again the oil price shock in 1979-80 affected the real growth rate decline in 1981, whilst the commodity boom in 1983 brought the real growth rate down in 1985. It seems clear that these shocks were not caused by the effects of monetary policy of the monetary authorities.

Table 2.9  Thailand: Monetary and Fiscal Discretionary Policies

<table>
<thead>
<tr>
<th>Note</th>
<th>Direction of monetary policy are identified from the changes of The Bank of Thailand, basic lending rate.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>N. Bhannupongse and P.G. Warr, &quot;Macroeconomic Adjustment to External Shocks: Thailand&quot;, Australian National University, November 1989, p.28</td>
</tr>
</tbody>
</table>

Figure 2.1 also indicates that fluctuations in the income growth rate in the period 1971-1979, were higher than the fluctuations between 1980-1985. The existence of external shocks in the first period induced these greater fluctuations,
whilst subsequent oil shocks brought about a sharp decline in the growth rate in 1974 and 1979.

In the post-1980 period, it was the tight monetary policy of the BOT from 1980-1985 that helped stabilise the Thai economy. After 1985, however, as the stability of the economy improved, monetary policy had become more relaxed in order to accommodate economic recovery.

Figure 2.1 Thailand: Trend Real GDP Growth Rate: 1971-1985

2.3.3 Exchange Rate Policy

The value of the Baht has been maintained by policy at a fixed exchange rate for several decades. For a long time, the exchange rate between the Thai Baht and the US dollar was relatively fixed, varying around 25 bahts for a dollar. Under such as fixed exchange rate policy any monetary contraction, arising from a balance of payments deficit, will raise the domestic interest rate and induce capital inflows, thereby forcing the interest rate downwards again. Monetary expansion will do the reverse.

While the Thai monetary authorities have not been fully able to control capital movements in the long-run, in the short-run Thailand’s capital account is sufficiently
closed to enable monetary authorities to pursue short-run discretionary monetary policies in combination with a fixed exchange rate.

While Thailand's exchange rate has been fixed, devaluations have been used as a policy response to external shocks. A summary of these devaluations in Thailand is shown in Table 2.10.

Table 2.10 Thailand: Dates and Magnitudes of Devaluation

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>1981</td>
<td>1.1%</td>
</tr>
<tr>
<td>July</td>
<td>1981</td>
<td>8.7%</td>
</tr>
<tr>
<td>November</td>
<td>1984</td>
<td>14.9%</td>
</tr>
<tr>
<td>December</td>
<td>1985</td>
<td>1.9%</td>
</tr>
</tbody>
</table>


As can be seen from this, the largest devaluation of 14.9% was undertaken in November 1984, when the exchange rate rose from 23 to 27 Baht per a dollar. The objective of the devaluations in 1981 and 1984 was to reduce the existing current account deficit.

2.4 Current Problems Facing the Thai Economy

2.4.1 Industry Transition

Since the Thai government launched its industrialising strategy, including import-substitution and export promotion, the structure of the Thai economy has been changing. The manufacturing sector surpassed agriculture in 1985, which indicates that one condition for becoming a NIC\textsuperscript{33} has been fulfilled, as shown in Table 2.11.

\textsuperscript{33}The conditions for joining the ranks of the Newly Industrialising Countries (NICs) can be categorised as: a country has achieved remarkable economic growth through the successful
Table 2.11 shows that the share of agriculture in real GDP has declined continuously from 1985. In fact, the decline had started from the level of about 40% as soon as the Thai government launched its first economic development plan in 1961. In 1990 the share of agriculture in total GDP was 16.9%, which is much smaller than the share of manufacturing at 23%. It also shows that the rising share of manufacturing and the falling share of agriculture crossed at the share value of about 20% in 1984. So 1985 was the first year that the significance of the manufacturing sector (measured in value-added) had exceeded that of agriculture.

Later on it will be shown that exports of manufactures also exceeded those of agriculture as early as 1985, thus fulfilling another condition of becoming a NIC. However, the GNP per capita income of Thailand was still too small even in 1990 to be qualified a NIC (US$1250).

However, Table 2.11 also shows the growth rates of manufacturing as well as other service-related sectors such as construction, electricity and water supply, wholesale and retail trade, and especially banking, insurance and real estate have been increasing rapidly in the last few years. If these trends continue, the NIC status will become more obvious for the Thai economy.

It can be seen from Table 2.11 that the rate of growth of the agricultural sector in 1988 was 8.6% which was quite high, when compared to 1986 and 1987 where the corresponding rates of growth were 0.2 and -2.0%, respectively. Whilst the manufacturing sector has been the larger sector since 1985, the growth rate of this sector dramatically increased from 9% in 1988 to 13% in 1989 and to 12% in 1990.
### Table 2.11: Share of Gross Domestic Product by Industrial Output and Growth at 1980 prices: Case of Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture</th>
<th>Mining and Quarrying</th>
<th>Construction</th>
<th>Manufacturing</th>
<th>Electricity and Water Supply</th>
<th>Communication</th>
<th>Transportation and Wholesale and Retail Trade</th>
<th>Banking, Insurance, and Real Estates</th>
<th>Privatization of Dwellings</th>
<th>Ownership of Dwellings</th>
<th>Public Administration and Defence</th>
<th>GDP constant price</th>
<th>GDP current price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>7.3</td>
<td>3.9</td>
<td>-4.6</td>
<td>3.4</td>
<td>4.5</td>
<td>2.0</td>
<td>3.9</td>
<td>2.1</td>
<td>1.0</td>
<td>-2.2</td>
<td>-2.0</td>
<td>1.234</td>
<td>1.234</td>
</tr>
<tr>
<td>1991</td>
<td>6.9</td>
<td>3.4</td>
<td>4.4</td>
<td>3.6</td>
<td>4.3</td>
<td>2.2</td>
<td>3.6</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.5</td>
<td>-1.7</td>
<td>1.227</td>
<td>1.227</td>
</tr>
<tr>
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<td>6.5</td>
<td>3.2</td>
<td>5.1</td>
<td>3.9</td>
<td>4.5</td>
<td>2.0</td>
<td>3.9</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.7</td>
<td>-2.1</td>
<td>1.244</td>
<td>1.244</td>
</tr>
<tr>
<td>1993</td>
<td>6.7</td>
<td>3.0</td>
<td>5.2</td>
<td>3.6</td>
<td>4.3</td>
<td>2.0</td>
<td>3.8</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.9</td>
<td>-2.4</td>
<td>1.244</td>
<td>1.244</td>
</tr>
<tr>
<td>1994</td>
<td>6.5</td>
<td>3.3</td>
<td>4.9</td>
<td>3.7</td>
<td>4.4</td>
<td>2.1</td>
<td>3.7</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.6</td>
<td>-2.1</td>
<td>1.244</td>
<td>1.244</td>
</tr>
<tr>
<td>1995</td>
<td>6.5</td>
<td>3.3</td>
<td>4.9</td>
<td>3.7</td>
<td>4.4</td>
<td>2.1</td>
<td>3.7</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.6</td>
<td>-2.1</td>
<td>1.244</td>
<td>1.244</td>
</tr>
<tr>
<td>1996</td>
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<td>3.4</td>
<td>4.8</td>
<td>3.7</td>
<td>4.4</td>
<td>2.1</td>
<td>3.7</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.6</td>
<td>-2.1</td>
<td>1.244</td>
<td>1.244</td>
</tr>
<tr>
<td>1997</td>
<td>6.7</td>
<td>3.4</td>
<td>4.8</td>
<td>3.7</td>
<td>4.4</td>
<td>2.1</td>
<td>3.7</td>
<td>2.1</td>
<td>0.9</td>
<td>-2.6</td>
<td>-2.1</td>
<td>1.244</td>
<td>1.244</td>
</tr>
</tbody>
</table>


In 1991-1992 the percentage share of the agricultural and mining sectors to GDP fell to 14% in 1991 and 13% in 1992, the manufacturing sector increased to 26% in 1991 and remained at this level until the end of 1992. The construction sector expanded greatly to 7% for both years, due to huge direct foreign investment from, in particular, Japan and USA.

As mentioned earlier, Thailand adopted an import substitution policy in its early stage of industrialisation. In the early 1960s, the authorities adopted an industrial strategy based on the private sector. The Board of Investment (BOI) was created to administer a package of investment incentives designed initially to promote import substituting industries. Private investment both from within and outside the country was actively promoted through investment promotion packages (import-substitution strategy) which included guarantees against nationalisation and competition from state enterprises; tariff and business tax exemptions on imports of capital goods and raw materials; a two-year corporate tax holiday; and the possibility of import surcharges on competing imports. However, the growth in the industrial sector was limited by the domestic market and the role of the public sector was limited to provide basic infrastructure. In addition, there was the need for intermediate and capital goods to be domestically produced to reduce demand for imported finished consumer goods.

Thailand did not pursue a second-stage import substitution strategy but followed an export oriented industrialisation strategy from the early 1970s. In 1972 the government improved its incentives for exports of manufactures such as drawbacks or rebates of taxes on raw material used for export products, rediscount facilities for exporters and special investment promotions for manufacturing exports. Through skills adoption and low domestic costs, exports enjoyed a comparative advantage over many competitors, resulting in sharp growth of exportables. Many manufactured products

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Second-stage import substitution involves the replacement of the imports of intermediate goods and producer and consumer durable by domestic production. These commodities have rather different characteristics from those replaced at the first-stage. Intermediate goods, such as petrochemicals and steel, tend to be highly capital-intensive. They are also subject to important economics of scale, with efficient plant size being large compared to the domestic needs of most developing countries and costs rising rapidly at lower output level.
such as garments, footwear, jewelry and processed food products were new items for export from the late 1970s.

In the late 1970s, the government attempted to adjust the structure of the industry sector with the assistance of the World Bank, which offered a structural adjustment loan to tackle the efficiency problems in the public finance systems as well as the other areas where structural adjustment were needed. The outcomes of the attempt at industrial, however, were not good enough in terms of the government’s policy changes.

In the mid-1980s, the industrial development strategy was in turn supported by changes in financial policies. The par value of the exchange rate was fixed to the US dollar in 1963. In addition the economy was very open with current account transactions generally free, and capital controls limited to outflows. As a result of these policies, investment soared during the 1980s. Industrial output grew rapidly, initially in agroindustries (such as food processing) and in textiles, and then in heavy industries such as petroleum refining, chemical, and transport equipment. Although agriculture remained the main sector of the economy, its share in GDP fell sharply, and the dominance of rice and other traditional crops began to be challenged by new export crops (such as sugarcane, maize, and cassava). This development was greatly facilitated by substantial improvements in infrastructure, especially in irrigation, electricity supply, and transportation, and be expansion in the commercial banking system.

However, the development of the industrial sector has been limited due to major obstacles not only in terms of infrastructure, but also shortages of skilled and educated labour in the areas of high technology and science required for advanced manufacturing processes. Infrastructure bottleneck is an increasingly serious problem, arising from the rapid growth of the industry sector. At the same time, shortages of skilled and educated labour, in particular skilled engineers and technicians, have emerged. Subsequently, environmental problems, quality of resident’s life, and a deterioration of income distribution are also becoming major issues.
2.4.2 Foreign Trade and Investment

The expansion of the Thai economy in the late 1980s depended on rapid growth in exports, tourism, and foreign direct investment, especially in 1988. There were, however, a number of obstacles for continuous growth, relating to both trade and investment. As mentioned previously, political turbulence was a major subject. In addition, the prolonged economic recession in both the US and European economies, as well as the deterioration of the Japanese economy, influenced the growth of Thailand's economy.

(a) Export-Import Pattern

The substantial increase in Thai total exports in 1988 was seen as an important factor contributing to the size of economic growth in the economy. As shown in Table 2.12, the 1988 exports of Thailand brought in Baht 403,570 million (US$16,142 million), representing an increase of 34.6% over the export values of 1987, while world trade only grew at about 7% in 1988. The growth rates of total exports in 1989 and 1990 were about 22.6% and 12.9%, respectively. Recently, the export growth rate has declined due to external and internal developments. The growth rate of total exports in 1993 (15%) was less than 1992 (15.9%) and 1991 (21%). The growth rate continuously declined from 1991 until the end of 1993. However, a better performance in 1994 led to a slight improvement by the end of the year. The growth rate of total exports is expected to slowly push up throughout 1995 and 1996. Table 2.12 also shows that manufactured exports constituted the highest share of Thailand's total exports in 1988 (about 65.4% of total exports).

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35 Figures in Table 2.12 are measured in real terms.
Table 2.12 Major Export Sectors of Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture</th>
<th>Manufacturing</th>
<th>Services and Others</th>
<th>Re-Exports</th>
<th>Total Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>101,422</td>
<td>193,882</td>
<td>3,786</td>
<td>763</td>
<td>301,453</td>
</tr>
<tr>
<td>1988</td>
<td>127,558</td>
<td>271,368</td>
<td>3,694</td>
<td>1,250</td>
<td>403,570</td>
</tr>
<tr>
<td>1989</td>
<td>132,515</td>
<td>282,430</td>
<td>3,680</td>
<td>1,342</td>
<td>516,315</td>
</tr>
<tr>
<td>1990</td>
<td>143,549</td>
<td>282,873</td>
<td>3,782</td>
<td>1,285</td>
<td>589,813</td>
</tr>
<tr>
<td>1991</td>
<td>149,620</td>
<td>293,570</td>
<td>3,879</td>
<td>1,320</td>
<td>725,630</td>
</tr>
<tr>
<td>1992</td>
<td>157,652</td>
<td>301,576</td>
<td>4,023</td>
<td>1,376</td>
<td>824,644</td>
</tr>
<tr>
<td>1993</td>
<td>163,790</td>
<td>452,364</td>
<td>4,122</td>
<td>1,393</td>
<td>940,862</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Agriculture</th>
<th>Manufacturing</th>
<th>Services and Others</th>
<th>Re-Exports</th>
<th>Total Exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>4.9</td>
<td>45.6</td>
<td>58.3</td>
<td>-40.8</td>
<td>31.7</td>
</tr>
<tr>
<td>1988</td>
<td>20.4</td>
<td>28.5</td>
<td>5.9</td>
<td>2.6</td>
<td>36.1</td>
</tr>
<tr>
<td>1989</td>
<td>3.7</td>
<td>3.9</td>
<td>0.3</td>
<td>2.6</td>
<td>25.7</td>
</tr>
<tr>
<td>1990</td>
<td>7.6</td>
<td>1.1</td>
<td>2.6</td>
<td>2.6</td>
<td>15.0</td>
</tr>
<tr>
<td>1991</td>
<td>4.0</td>
<td>3.6</td>
<td>2.5</td>
<td>4.0</td>
<td>21.0</td>
</tr>
<tr>
<td>1992</td>
<td>5.0</td>
<td>2.6</td>
<td>3.5</td>
<td>12.0</td>
<td>15.9</td>
</tr>
<tr>
<td>1993</td>
<td>3.7</td>
<td>33.3</td>
<td>2.4</td>
<td>3.5</td>
<td>15.0</td>
</tr>
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</table>


Table 2.13 Major Import Products of Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumer Goods</th>
<th>Intermediated Products and Raw Material</th>
<th>Capital Goods</th>
<th>Fuel and Lube</th>
<th>Other Imports</th>
<th>Total Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>33,844</td>
<td>119,792</td>
<td>105,916</td>
<td>44,177</td>
<td>30,480</td>
<td>334,209</td>
</tr>
<tr>
<td>1988</td>
<td>38,874</td>
<td>179,847</td>
<td>203,874</td>
<td>38,828</td>
<td>51,691</td>
<td>513,114</td>
</tr>
<tr>
<td>1989</td>
<td>39,587</td>
<td>212,525</td>
<td>285,563</td>
<td>38,765</td>
<td>203,490</td>
<td>384,448</td>
</tr>
<tr>
<td>1990</td>
<td>41,205</td>
<td>232,578</td>
<td>295,654</td>
<td>40,521</td>
<td>232,170</td>
<td>378,832</td>
</tr>
<tr>
<td>1991</td>
<td>48,567</td>
<td>289,450</td>
<td>321,856</td>
<td>46,789</td>
<td>252,170</td>
<td>378,832</td>
</tr>
<tr>
<td>1992</td>
<td>53,893</td>
<td>308,670</td>
<td>321,856</td>
<td>50,634</td>
<td>241,258</td>
<td>356,980</td>
</tr>
<tr>
<td>1993</td>
<td>62,890</td>
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<td>435,890</td>
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<td>257,480</td>
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<table>
<thead>
<tr>
<th>Year</th>
<th>Consumer Goods</th>
<th>Intermediate Products and Raw Material</th>
<th>Capital Goods</th>
<th>Fuel and Lube</th>
<th>Other Imports</th>
<th>Total Imports</th>
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<tr>
<td>1987</td>
<td>38.3</td>
<td>42.0</td>
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<td>36.5</td>
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<td>42.8</td>
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<td>1988</td>
<td>14.9</td>
<td>50.1</td>
<td>92.5</td>
<td>-12.1</td>
<td>21.2</td>
<td>48.6</td>
</tr>
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<td>1989</td>
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<td>18.1</td>
<td>40.0</td>
<td>3.6</td>
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<tr>
<td>1990</td>
<td>3.6</td>
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<td>2.5</td>
<td>9.2</td>
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<tr>
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<td>2.5</td>
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<td>0.2</td>
<td>0.9</td>
<td>1.5</td>
<td>13.8</td>
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<td>1992</td>
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<td>11.0</td>
<td>3.7</td>
<td>1.7</td>
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<td>14.3</td>
</tr>
<tr>
<td>1993</td>
<td>3.0</td>
<td>15.7</td>
<td>4.9</td>
<td>3.8</td>
<td>3.8</td>
<td>10.9</td>
</tr>
</tbody>
</table>

The major manufactured exports that enjoyed high growth rates included plastic products, computer components, electronic circuits, and canned foods. The US was still the major trade partner, followed by Japan, Singapore, Netherlands, and Germany.

In addition to exports, imports are a major factor which need to be considered. Table 2.13 shows that the rapidly expanding economy of 1988 gave a rise to a greater demand for imports of capital goods, intermediate products and raw materials. Total imports in 1988 amounted to Baht 513,114 million (US$20,525 million), an increase of 53.3% over the value of imports of 1987. As a result the trade deficit in 1988 reached Baht 109,544 million (US$4,382 million), which was the highest ever experienced in Thai history.

Table 2.13 shows that the recent growth rates of total imports were similar to exports. That is, the growth rate of total imports in 1991, 1992, and 1993 were about 13%, 14%, and 10%, respectively. These growth rates were less than those of 1988, 1989, and 1990. These outcomes were affected by decreased demand for imported goods, in particular intermediate and capital goods, arising from decreased investment and production of manufactured goods.

(b) Foreign Direct Investment

Foreign direct investment (FDI) in Thailand has been growing steadily since industrialisation began in the early 1960s. During the 1970s, the amount of FDI averaged about Baht 1,800-1,900 million (US$72-76 million) annually. But in the early 1980s, the amount of FDI increased sharply. As shown in Table 2.14, the total amount of FDI increased from Baht 6,431 million (US$258 million) in 1985 to Baht 27,609 million (US$1,105 million) by 1990.

According to Table 2.14 over half of the additional investment in 1990 came from Japan, followed by the US. with a share of 11.3%. Taiwan and Hong Kong came very close at 11.2% and 10.8% of total FDI, respectively.
Table 2.14   Net Inflows of Direct Foreign Investment: Thailand

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount (millions of baht)</th>
<th>% Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>3,049</td>
<td>3,268</td>
</tr>
<tr>
<td>USA</td>
<td>1293</td>
<td>1815</td>
</tr>
<tr>
<td>Australia</td>
<td>46</td>
<td>25</td>
</tr>
<tr>
<td>South Korea</td>
<td>4.6</td>
<td>22</td>
</tr>
<tr>
<td>Taiwan</td>
<td>132.6</td>
<td>687.3</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>955.7</td>
<td>796.9</td>
</tr>
<tr>
<td>Singapore</td>
<td>403.1</td>
<td>535.5</td>
</tr>
<tr>
<td>Malaysia</td>
<td>7.9</td>
<td>9.2</td>
</tr>
<tr>
<td>China</td>
<td>28.3</td>
<td>63.1</td>
</tr>
<tr>
<td>UK</td>
<td>251.7</td>
<td>328.9</td>
</tr>
<tr>
<td>Others</td>
<td>88.1</td>
<td>73.5</td>
</tr>
<tr>
<td>Total</td>
<td>6360.0</td>
<td>7624.1</td>
</tr>
</tbody>
</table>


Meanwhile, the rapid appreciation of the Japanese yen since 1985-86, affected the increased in FDI in Thailand, due to the appreciation of the currency leading to a rapid increase in the costs of production. Hence the Japanese needed to look outside Japan for investment to avoid increased costs. Similar problems occurred in Taiwan as Taiwanese investors started to look more outside their country for investment to avoid the rapid increase in production costs from the appreciation of the Taiwanese dollar.

Differences in the investment strategies between Japanese and American investors are examined by Somsak (1989), who shows that Japanese investment in industries were largely concentrated within the Board of Investment (BOI) promotion program, and commonly took the form of joint ventures with local equity participation. American investment was found more outside the scope of the BOI program, and a significant portion of this investment was found in the energy sector. Taiwan still maintained its interest in investing in Thailand, but most Taiwanese investments are in the BOI promotion program, with the joint ownership with Thai businessman. Hong

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Kong and Singapore are also now among the major sources of FDI inflows into Thailand.

The current problems relating to foreign trade and investment that Thailand is now facing result from the increased competitiveness from China and other Asian countries, such as Vietnam, Malaysia, and Laos. Although the Thai government has attempted to reduce trade barriers, in particular export taxes, Thailand is now facing problems of high costs of production, arising from higher wages and a shortage of skilled labour. In addition, an unstable political situation is also a major impediment for foreign direct investment. At the same time, the worldwide economic recession in the early 1990s, in particular in Japan and the US, - Thailand's major trade partners and foreign investors, have not yet ended.

2.5 Key Issues in Response to the Current Problems

2.5.1 Financial Reform

Financial reforms have been a major impetus for structural adjustment in Thailand's response to the oil price shocks over the past decades and to the current problems facing the Thai economy. By the end of the 1980s, as Thailand's growth and industrialisation accelerated, it appeared that the initial efforts at interest rate liberalisation had encouraged long term deposit-taking and enabled commercial banks to adjust themselves to a more flexible interest rate system.

Foreign exchange transactions were also liberalisation. In May 1990, the authorities accepted the obligations of “Article VIII of the Articles of Agreement”38.

38 The IMF's Article of Agreement were adopted by the Board of Government on June 28, 1990. One of the main purposes of the IMF is to facilitate the expansion and balanced growth of international trade and, thereby, to contribute to high levels of employment and real income and to assist in establishing a multilateral system of payments with respect to current transactions between IMF members. One way that the IMF seeks to achieve these objectives is by helping to eliminate restrictive practices in the exchange and payments areas, which is an objective of Article VIII of the IMF's Articles of Agreement. Members accepting the obligations of Article VIII undertake to refrain from imposing restrictions on the making of payments and transfers for current international transactions and from engaging in discriminatory currency arrangements or multiple currency practices without the approval of the IMF. Since December 1989, three members have notified the IMF that they have
Meanwhile commercial banks could approve foreign exchange transaction without an approval from the Bank of Thailand (BOT). A further package of financial liberalisation included changes to capital account transactions introduced in April 1991, and permitting free repatriation of investment funds, including dividends and loan repayments, without the prior approval of the BOT.

The authorities are now, 1995, preparing a three-year plan that encompasses a broad range of liberalisation measures. The new reforms will focus on the efficiency of the financial system to cope with further challenges and international competition. At the same time, the authorities consider that the ability of financial intermediaries to absorb the reforms has greatly increased in recent years. The old managerial style of family control has been replaced by professional management teams. Most banks and a number of financial and securities companies have increased their capital adequacy, their portfolio quality has improved, and the profitability of financial institutions has risen sharply.

In particular, this study will focus upon two measures of financial liberalisation: alteration of a fixed nominal exchange rate to a flexible nominal exchange rate system, and liberalising the capital market from imperfect to perfect capital mobilisation internationally.

2.5.2 Trade Liberalisation

Since the early 1970s, the industrial strategy has been focused upon export promotion, although import substitution has also played a major role in the strategy. However, the government has attempted to pursue export promotion as the major trade policy, and many institutional changes have been made to accommodate this, for example, increased incentives geared towards exports, simplified export producers, quicker tax refunds, and rebates to exporters, the setting up of the Export Development Committee chaired by the Ministry of Commerce, and active marketing

accepted the obligations of Article VIII of the Articles of Agreement - Swaziland, Turkey, and Thailand. Thailand is the sixty-eighth member to accept these obligations.
assistance by the Export Service Center and the Department of Commercial Relations, which arranged frequent trade fairs and trade exhibitions. Although many problems remain in the implementation of export promotion policy, the progress made in the 1980s was impressive, with growth rates for exports reaching 34.6% in 1988³⁹.

In the area of trade liberalisation, this discussion would not be complete without considering the subject of the exchange rate system. It was mentioned earlier that due to a high degree of pegging of the Thai baht to the US dollar prior to 1984, the Thai baht had become overvalued when the US dollar was kept artificially high. The pressure on the dollar reserves of Thailand, and the urgent need to re-adjust the exchange rate between the Thai baht and other major currencies to make it more realistic and to help stimulate exports and slow down imports, forced the Thai government to devalue the baht by about 14% against the US dollar in November 1984. This devaluation was a major re-adjustment measure which seemed to work by itself in generating greater export demand for Thai commodities and services.

In the 1990s, as Thailand prepares for accelerated industrial development, the tariff structure is one major area to be concentrated upon. Therefore, tariff reform has become more important in the authorities' program of market liberalisation. As a first step, in October 1990, tariffs on capital goods used in manufacturing were reduced from 20% to 5%, and the tariff exemptions or reductions on these goods granted by the BOI were eliminated. The authorities followed with a second package of tariff reforms during 1991, including a reduction in tariffs on raw materials, intermediate products and certain capital goods, and some finalised products, aimed at benefiting exporters and export suppliers who have not been granted reduction by the BOI.

In this study, trade liberalisation will be focused upon eliminating trade barrier on international trade. When the Thai government launched its export-promotion policy, it tried to eliminate export taxes which created a burden on exporters. However, import tariffs are still a major issue despite agreements within AFTA to phase out tariff barriers in the coming years. This study will examine the impact of the

removal of trade barrier as well as the effects of trade liberalisation in the rest of the world on Thailand.

2.5.3 Investment Reform

There have been several changes in the investment promotion policies under the authority of the BOI since 1985. One major change was the announcement by the BOI on September 1, 1987 giving further incentives to investors who decided to invest in the area outside Greater Bangkok, and at the same time reduced benefits normally received by investors in the Greater Bangkok area.

As a result of the increasingly serious problem of infrastructure bottlenecks, the government introduced new reforms to encourage investment in infrastructure, in particular roads, railways, monorails, airports, and telecommunications. For investment in infrastructure area, tax exemptions on capital equipment and imported raw material were very useful instrument in order to enhance investment. This issue is also a major concern of this study.

2.5.4 Public Enterprise Issues

A major change in the area of public finance since 1985 has been the privatisation of public enterprises, influencing the privatisation policy. The government announced the strategy for two reasons. First was to minimise or reduce the external debt of public enterprises, and to achieve this demanded changes in the pricing practices of public enterprises to reflect full cost plus profit margin. Secondly, a few public enterprises have been privatised by leasing them to private companies or selling them on the Securities Exchange of Thailand. Large public enterprises which have attempted such privatisation including Thai Airways International, the Electricity Generating Authority of Thailand, and the Port Authority of Thailand. However, there

40 This issue will be considered in terms of proposing an alternative policy in order to improve the country’s economic growth. It represents an area for future research, which could be extended from this study for Thailand’s policy-makers.
is still a problem with the direction and speed of privatising public enterprises in Thailand.

2.6 Summary and Conclusions

Following the oil crises in the 1970s, Thailand has improved its economic stability in several ways. Major policy changes were imposed in macroeconomic policy such as monetary, fiscal, exchange rate and international trade policies, in order to maintain economic development. However slower growth in the world economy, and domestic constraints, have checked expansion of the Thai economy over the past few years. The Thai government attempted to adopt economic stabilisation policy for adjustment to the external shocks as well as attempting to liberalise its economy (for international trade and finance), and re-structuring the economy. Optimism over economic performance in 1993-1994 is likely to encourage the continuation of these policies over the next few years.

The February 1991 political crisis affected the economic environment, especially foreign investors' perceptions. Foreign investors found that investments in Thailand have had a high level of risk due to instability in the political and domestic policy environment. However, Thailand has performed well in comparison with other countries despite this. With the development of a wide range of export products, Thailand's economic performance has remained strong. Infrastructure constraints, however, have presented a major obstacle. Thailand has been successful in pursuing an export strategy based upon the lower end of the technological ladder, with an emphasis on agro-industries, light manufactures and consumer goods. Thailand must now begin to place greater emphasis on higher technology industries. This can be achieved through the encouragement of foreign investment in the country. Recent foreign investment by Japan, in particular, has targeted this objective. Additional resource must be devoted to education, particularly at the secondary school and technical college levels. Further infrastructure expenditure on items such as roads, and public services
will also be a major requirement. This will help close the gap in regional income levels, which has widened in recent years.

There have been some suggestions from Medhi (1989) in the area of structural adjustments for further growth and stability which might be included in the government's future strategy. Firstly, the government needs to be concerned about the continuing problems of the saving-investment gap, as this can be a major cause of long-term economic difficulties. In its own role, the government must be able to mobilise domestic resources more efficiently, and to a certain extent, become more equitable through its tax and public enterprise system. Secondly, the government must provide adequate infrastructure and the utilities needed for increased development. Thirdly, the government needs to develop science and technology in a suitable way for the country's future. This may include ways of improving the education and skills of the labour force, the clever application of research findings, and newly-acquired technology transfers. Finally, the government must protect the environment, both physical and human, so that the success of development can be enjoyed by all in the long run.

The Thai economy showed considerable resilience in 1992, and this continued through the first half of 1994, as evidenced by its rapid recovery from the setbacks endangered by political crisis in May 1993. Tourism and related services were the hardest hit, followed by exports. However, various problems of a more long-standing nature continue to beset the economy. The increasing inadequacy of infrastructure, especially transportation and telecommunications, needs to be overcome quickly. Serious environmental and quality of life issues need to be addressed, such as the competing uses of natural water resources for personal, agricultural and industrial consumption; and large discrepancies exist among group of people and regions in terms of income and access to jobs and services. The acquired immune deficiency syndrome (AIDS) problem has received a lot of attention, publicity and funds, mitigation efforts need to be maintained. Despite some changes in the composition of

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the industrial sector in favour of higher technology and the production of heavy and intermediate goods, more efforts are needed to ensure the continued depending of Thailand's industrial structure. There is the need to upgrade educational levels and secure a rapid expansion in the supply of skilled and professional labour, shortages of which are inhibiting the transition to higher technology-intensive production.

To complete the discussion, the policy responses to the external shocks through fiscal policy, monetary policy, exchange rate policy, and structural adjustment policies in agriculture, industry policy, foreign trade policy, and the role of government in the economic development in Thailand will be investigated.

However the policy prescriptions which will be focused upon include that of financial and trade policies, as well as government capital spending. With regard to financial policy, the possible foreseeable policy is further moves towards liberalising this sector. This can range from liberalising the exchange rate regime from a fixed to a flexible exchange rate, as well as the operation of capital markets, which range from highly controlled capital mobility, imperfectly controlled capital mobility, to perfect capital mobility (no controls at all by the authorities) internationally. With regards to trade policy, the possible alternative policy addressed to that of liberalise international trade. This can be regarded as the elimination of barrier on international trade. Government expenditures should be more focused upon spending on infrastructure development, in view of the major bottlenecks for sustained economic growth through the shortage of infrastructure (transportation and telecommunications).

This thesis, therefore, pays attentions to the three main issues outlined in section 2.5, which must be tackled to maintain a sustained economic growth, and prepare for further external shocks that could happen in the future. More details will be available in Chapter 6, in which the economic effects of these policies will be examined in the context of Thailand.
CHAPTER 3
RESOURCE RELATED THEORETICAL MACROECONOMIC MODELS: AN OVERVIEW

3.1 Introduction

This chapter provides an overview of existing theoretical models concerned with identifying macroeconomic adjustments arising from resource shocks. The theoretical basis and assumptions of these will be investigated with the objective of developing a long run macroeconomic model for a Thailand like net oil-importing economy, which can be used to analyse the impact of oil related shocks and in particular that of an oil price and domestic oil requirements shock.

As mentioned in the previous chapters the major external factor affecting the Thai macroeconomy in the 1970s was the two oil price shocks. Three main effects arising from the two oil price increases can be identified, these being "a deterioration of the balance of payments", "an inflationary effect", and "a deterioration of real economic growth effect". A deterioration of the balance of payments arises from an increase in oil-import payments, due to Thailand being a net-oil importing economy. Oil price increases also affect domestic commodity prices and domestic consumer prices, generating an increase in the domestic inflation rate. Such effects also directly affect the country's economic growth rate.

There exists a sizable literature devoted to analysing the impact of resource shocks upon the Thai macroeconomy, for example Amrannand, G., and Grais, W., (1982 and 1983), Nunmenkamo, P., (1986), and Bhannupongse, N., and Warr, P.G., (1989). These studies conduct a comparative static analysis and direct their attention to the ways in which the oil price shocks affect the domestic economy and in particular its structure. In this chapter, the study of Bhannupongse, N., and Warr, P.G., (1989) will be emphasised.

These three effects are identified and presented in Bhannupongse and Warr (1989).
However, the main objective of this study is to develop a dynamic long run macroeconomic model for a Thailand like net oil-importing economy, and in doing so relevant literature relating to the macroeconomic consequences of resource shocks is reviewed. The research relates to both short run and long run models, and provides a useful basis for development of a macroeconomic model for a net oil-importing economy like Thailand. However, in the context of Thailand, existing models need to be amended in numerous ways. Models emphasising the income and/or wealth-generating consequences arising from oil-shocks, and primarily taking a short-run perspective include those of Buiter, W.H., and Miller, M., (1981), Buiter, W.H., and Purvis, D.D., (1983), Eastwood, R.K., and Venables, A.J., (1982), and Neary, J.P., and Wijenbergen, S., (1984), whilst long-run models including those of Harvie, C., and Gower, L., (1983), and Harvie, C., (1994) are also reviewed.

The models emphasised here were developed for resource-exporting developed economies such as Australia and the UK, therefore such models are not appropriate for a net oil-importing developing economy such as Thailand. A number of amendments are required to make them more applicable to Thailand and this will be discussed in section 3.5 of this chapter. The model presented in Chapter 4 has its theoretical foundations based upon the models which are reviewed in this chapter. The economic effects arising from the oil shocks depend upon a number of factors: the size of the shock; the source of the shock, whether from price or domestic requirements shocks or both; 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.

The focus of this chapter is upon contrasting the economic effects arising from oil related shocks, 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 shocks is of primary concern.
3.2 Comparative Static Analysis Arising from Oil shocks

The discussion of this will draw upon the work of Bhannupongse and Warr (1989), which was developed for conducting a comparative static analysis of the effects of external shocks on the Thai economy using an aggregate demand and supply framework. In this it is assumed that the country produces two composite goods in which the price is free to move to equilibrate domestic demand and supply. By definition traded goods are those goods that can be traded internationally whilst non-traded goods are those goods that are costly to export, as well as those tradable goods that are subject to binding quotas and price controls. Traded and non-traded goods are produced only in the non-oil sectors, given the assumption of a Thailand like net oil-importing economy. The real exchange rate is the price of traded goods relative to the price of non-traded goods. 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.

The effects of the oil price increases in the 1970s upon adjustment, using an aggregate demand and supply analysis, is as follows. Aggregate supply and demand curves may easily be derived from a standard short-run macroeconomic model. In the static model, aggregate demand (AD) and aggregate supply (AS) curves are drawn with respect to the domestic general price level (p) and GNP (y) level on the vertical and horizontal axes respectively, as shown by Figure 3.1.
The aggregate demand curve is negatively sloped with respect to the price and real GNP levels. It is negatively sloped because at higher price levels, the real money supply (M/P) is reduced, requiring a higher interest rate and a lower output level for simultaneous equilibrium in the money and goods markets, whilst the aggregate supply curve is upward sloping in the short run model. The equilibrium of aggregate demand and supply is presented as point E, which gives the price level at \( p_0 \), and the real GNP level at \( y_0 \).

The effects of an increase in the price of oil upon economic adjustments of a net oil-importing economy such as Thailand are shown in Figure 3.2, with an initial equilibrium in the economy at point \( E_0 \), corresponding to the rate of GNP \( y_0 \), and the price level at \( p_0 \).

An increase in the real price of oil shifts the aggregate supply curve upward to the left because the cost of production is now higher at each level of output. Because wages do not adjust enough in the short run, given the assumption of the stickiness of adjustment of wages and prices, the economy moves into an unemployment equilibrium at \( E_1 \). Prices are higher and output is lower because of the reduction in
real money balances. Therefore the new equilibrium is at $E_1$, incorporating the higher price level at $p_1$ and the lower real output at $y_1$.

**Figure 3.2 Oil Price Shock in the AD-AS Model**

In the case of Thailand, the 1974 oil shock resulted in a leftward shift in the aggregate supply curve from $AS_0$ to $AS_1$ (Figure 3.3). This supply curve shift was also compounded by the world inflationary experience of 1973 in addition to the recession in OECD countries, which caused a collapse in export demand in 1974 and 1975 resulting in the inward shift of the aggregate demand curve ($AD_0$ to $AD_1$). The new equilibrium after the first oil shock is at point $E_2$, with the price level at $p_2$ and level of real GNP at $y_2$.

The second oil price shock in 1979 and the prolonged worldwide recession can be represented in a similar fashion, as in Figure 3.3. For simplicity, the two-stage oil price increase is represented by a one-time leftward shift of the aggregate supply curve from its original position ($AS_0$ to $AS_1$).
The second oil price shock resulted in very steep increases in the rates of inflation and moderate declines in real GNP growth rates. The monetarists, however, argued that the oil price shock alone could not achieve a sustained rise in inflation. They argued that the expansion in the money supply, which is an accommodatory policy, is the key to explaining the sustained rise in the price level. Economic growth became sluggish in the OECD countries beginning in 1980, and the recession continued in 1981 and deepened in 1982. This recession is reflected in the shift of the aggregate demand curve (AD₀ to AD₁). This brought generally slower export growth and rather sharp declines in economic growth rates from those before the second oil price shock. Unlike the effects induced by the first oil price shock, the recession was deeper and more prolonged with the second oil price shock because of no monetary accommodation which is an important factor contributing to a severe economic downtown. This reflects the priority given to inflation over output at this time.
The aggregate demand and supply short-run model can also explain the impact of a sharp decline in the oil price on the adjustment process for an oil-importing economy. This would tend to shift AS down and to the right, allowing a higher level of non-oil output and lower the price level (Figure 3.4). If the gain in income via reduced import bills from lower oil prices was greater than losses due to reduced contracts and exports to oil-exporters, non-oil countries could also experience some increase in the AD function causing a shift from $AD_0$ to $AD_1$. Hence, the effects of a sharp decline in the oil price on the economy has a symmetrically opposite effect from that of an oil price increase. A sharp decline in oil prices leads to a virtual non-inflationary boom and replaces the stagflation brought on by the earlier oil shocks.

A number of studies suggest that structural adjustment policies such as trade liberalisation, financial reform, and transformation of production processes may be significant factors in dealing with future oil price fluctuations and other exogenous factors impacting on Thai macroeconomic developments. These key issues will be emphasised in this study, and will be incorporated in a model developed in the next

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43 For example, Kajonwan, P., (1980), Bhannupongse, N. and Warr, P.G.,(1989), and Somsak, T., (1989).
chapter. In addition this study will analyse the effects upon the adjustment process arising from trade and financial liberalisation and infrastructure developments, and their effects upon the process adjustment arising from the oil price shocks.

3.3 A Dynamic Analysis Arising from Oil Related Shocks

This section will discuss the dynamic adjustment process arising from oil shocks in a small-open oil producing and exporting economy. In doing so existing models will be examined in order to develop a model for a net oil-importing economy such as Thailand.

The important contributions to the study of the impact of oil shocks on macroeconomic adjustment in a resource dependent economy are those of Charles Harvie (1994), and Harvie-Gower (1993), denoted from now on as CH and HG, respectively.

Although the two models developed for examining the impact of resource shocks on macroeconomic adjustments are for a resource-exporting economy, they can be appropriately amended to apply to a net oil-importing economy such as Thailand. The previously mentioned models provide a starting point for developing a long run macroeconomic model for a Thailand like net oil-importing economy which can then be used to assess the economic effects arising from future oil shocks and how this can be affected by different policy responses.

The major novelty of this thesis is the development of a long run macroeconomic model for analysing the macroeconomic consequences of oil related shock for a Thailand like net oil-importing economy through amending and extending existing theoretical models. The model developed enables identification of the ways in which oil price shocks have affected domestic economic developments, and enables exploration of the impact of future shocks upon the Thai economy. Further issues to be incorporated are those relating to financial liberalisation, trade liberalisation, and government infrastructure expenditure, as emphasised in Chapters 1 and 2. This has not been done before in the context of the theoretical framework adopted for Thailand.
The model to be developed can be applied to analyse not only oil shocks, but also other shocks that may be pertinent in the future. In addition, the issues emphasised here relate to current problems of economic development that Thailand is now facing. Regarding financial liberalisation, the exchange rate system and the operation of the capital market will be focused upon. Elimination of trade barriers will be focused upon in regard to the issue of trade liberalisation. Infrastructure expenditure developments is also a crucial issue for economic development in Thailand, especially in the areas of transportation (roads, railways and airports), telecommunications, and educational or training labour.

The HG (1993) and CH (1994) models represent extensions to those models emphasising the income and/or wealth-generating consequences arising from oil output and which primarily take a short-run perspective and include those of Buiter, W.H., and Miller, M., (1981), Buiter, W.H., and Purvis, D.D., (1983), Eastwood, R.K., and Venables, A.J., (1982), and Neary, J.P., and Wijnbergen, S. (1984). They represent an extension of the Dornbusch (1976) framework incorporating oil production. In these a deterministic framework is adopted in which economic agents are assumed to process rational expectations. This is equivalent to the case of perfect foresight. Non-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 literature 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 onto the stable saddlepath instantaneously, which will then ultimately take the economy to its new steady state equilibrium.

As mentioned, Buiter-Miller(BM) (1981), Buiter-Purvis(BP) (1983), Eastwood Venables(EV) (1982), and Neary-Wijnbergen(NW) (1984) provide the basic framework for the HG and CH models. While the first group of models focus upon

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44 See Buiter and Purvis (1982) for example.
the short-run, the CH and HG models focus upon the long-run. The long run models, unlike the short run models, emphasise wealth effects and foreign asset stock accumulation arising from developments in the current account, which can only be captured by taking a long run perspective. Secondly, the short run models assume that oil production will have no sustainable impact upon non-oil output, hence they do not consider that oil production contributes to the accumulation of capital stock in the non-oil sector. The long run models also argue that higher capital stock not only contributes to further domestic wealth effects, with consequential effects upon domestic demand for output and financial assets, but also expands potential domestic production permanently in the non-oil sector.

The inclusion of medium and long run developments arising from foreign asset stocks and capital stock accumulation is particularly important within the context of models which assume that economic agents possess rational expectations. If the steady state properties of the short and long run models diverge, then the corresponding adjustment process can be very different. Models that emphasise the short run may not give an accurate picture of developments in comparison to models containing long run properties. It is the contention of this thesis that to accurately identify the short run adjustment process arising in the related model, it should contain long run properties.46

The main objective in the following section is to compare and contrast the adjustment processes between models emphasising the short run and the long run.

The models identified in this section can be usefully classified as being either short or long run. The BM, 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 emphasise 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.

3.3.1 Short-Run Models

The key assumptions underlying the short run models are as follows. Firstly the economy is assumed to be a net oil exporter. Secondly the economy produces a non-oil good which can be consumed domestically or exported, and is an imperfect substitute for the overseas equivalent. Finally, the economy is operating with a perfectly flexible exchange rate, and finally there is assumed to be perfect capital mobility.

The BM, 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 price, 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 income, and oil price. The approach adopted here is to focus upon the BP model, but also contrasting it with the other three models. The equations of the BP model are presented in log-linear form as follows:

**BP Model**

\[
\begin{align*}
y^{d}_{\text{non}} &= \beta_{1} y + \beta_{2} y^{t} - \beta_{3} (e-pn) - \beta_{4} (r- pn) \quad (1) \\
y &= \sigma_{1} y^{d}_{\text{non}} + (1- \sigma_{1}) y_{0} + (1- \sigma_{2}) Po + (\alpha_{1} - \sigma_{2})(e-pn) \quad (2) \\
y^{t} &= \sigma_{2} y^{d}_{\text{non}} + (1- \sigma_{2}) y_{0}^{t} + (1- \sigma_{2}) Po + (\alpha_{1} - \sigma_{2})(e-pn) \quad (3) \\
m-pc &= \sigma_{1} y - \sigma_{2} r + \sigma_{3} y^{t} \quad (4) \\
pc &= \alpha_{1} pn + \alpha_{2} (Po+e) + (1- \alpha_{1} - \alpha_{2}) e \quad (5) \\
e &= r - r^{*} \quad (6) \\
pn &= \phi_{1} + \phi_{2} (y^{d}_{\text{non}} - y^{t}_{\text{non}}) + \phi_{3} m \quad (7) \\
c &= e - pn \quad (8)
\end{align*}
\]
A dot (.) above a variable signifies its rate of change.

All variables are in natural logarithmic form except for the domestic and foreign interest rates. The model consists of 9 equations with 9 endogenous variables and 8 exogenous variables. The endogenous variables are the demand for non-oil output \( y'_{\text{non}} \), real income \( y \), permanent income \( y' \), nominal exchange rate \( e \), consumer price level \( p_c \), domestic interest rate \( r \), real exchange rate \( c \), real money balances \( l \), and the domestic price of non-oil output \( p_n \). The exogenous variables are the natural level of non-oil output \( y_{\text{non}} \), permanent non-oil output \( y'_{\text{non}} \), actual oil production \( y_o \), permanent oil production \( y'_o \), world interest rate \( r^* \), money stock \( m \), and the world price of oil in foreign currency \( P_o \).

Equation (1) identifies aggregate demand for non-oil output \( y_{\text{non}} \). This is demand-determined and depends upon the real exchange rate \( e - p_n \), which is defined here as the nominal exchange rate deflated by the price of non-oil output, the real interest rate \( r - p_n \), real income \( y \) and permanent income \( y' \).

Real and permanent income definitions, as utilised by the BP model, are shown by equations (2) and (3). Equation (2) shows that real income depends upon non-oil output, the world price of oil, the real exchange rate as emphasised here, and exogenous oil production. Equation (3) identifies permanent income, which depends upon exogenous permanent non-oil output \( y'_{\text{non}} \), exogenous permanent oil output \( y'_o \), the world price of oil, and the real exchange rate.

Equations (2) and (3) are log-linear approximations to the definitions of real and permanent income given by \( (2') \) and \( (3') \), where uppercase symbols are the antilogarithms of the corresponding lower ones.

\[
Y = \frac{(P_n Y_{\text{non}} + E P_o Y_o)}{p_c} \quad (2')
\]

\[
Y' = \frac{(P_n Y'_{\text{non}} + E P_o Y'_o)}{p_c} \quad (3')
\]
It is assumed that \( d = \frac{PnY_{\text{non}}}{PcY} \), is the share of non-oil production in total value added. It is further assumed that \( d \) does not change as a result of oil production, is treated as being the same in real and permanent income, and is constant through time. For simplicity, BP defined permanent income in terms of real rather than permanent prices.

If the share of oil output in domestic real income \( (1 - d) \) is smaller than its share in domestic consumption \( (\alpha_2) \), then this economy will be an oil importer during its period of production. In the case of Thailand, for simplicity, it is assumed that there is absolutely no oil production in the economy. This implies that the share of oil output in domestic real income must be zero \( (1 - d = 0) \), thus \( d = 1 \).

Hence equations for real and permanent income can be obtained by substituting \( d = 1 \) in the model, as follows:

\[
\begin{align*}
    y &= y_{\text{non}}^d - Po - (1 - \alpha_1)(e-pn) \quad (2a) \\
    y^l &= y_{\text{non}}^l - Po - (1 - \alpha_1)(e-pn) \quad (3a)
\end{align*}
\]

Equation (4) represents equilibrium in the money market, in which demand for real money balances [nominal money stock \( (m) \) deflated by the consumer price level \( (pc) \)] is a function of real income, representing a transactions demand, permanent income or wealth \( (y^l) \), representing an asset demand for money, and the domestic nominal interest rate \( (r) \).

The consumer price level is given by equation (5). It is a weighted average of the domestic non-oil goods price \( (pn) \), the domestic currency cost of oil \( (Po + e) \), and the nominal exchange rate \( (e) \).

Equation (6) represents the condition of uncovered interest rate parity. Deviations of the domestic nominal interest rate \( (r) \) from the world interest rate \( (r^*) \), in a world in which there is assumed to be perfect capital mobility, results in instantaneous adjustment of the exchange rate, leading to offsetting expectations regarding the adjustment of the nominal exchange rate.
The adjustment of domestic prices is generated by an expectations augmented Phillips curve, as given by equation (7). Domestic price adjustment arises from demand pressure for non-oil relative to its available supply, as given by its natural level of output ($y_{\text{non}}$) and inflationary expectations which are assumed to be based upon the monetary growth rate ($m$).

Finally, equations (8) and (9) define two variables used throughout the model. Equation (8) identifies the real exchange rate, whilst equation (9) is real money balances. Such definitions were first used by Buiter and Miller (1980, 1981).

From the above model equations the main differences and similarities between the BP, BM, EV, and NW models can be identified. These are as follows.

(1) The first distinction can be identified in Equation (1). The BP model assumes that permanent income, arising from wealth, has a direct role to play in the determination of the demand for real money balances, and this is also maintained in the NW model. Whilst in the BM and EV models wealth has no direct role to play in the determination of the demand for money, i.e. the coefficient $\beta_4 = 0$ in the BM and EV models.

(2) The second difference is that the BP model distinguishes between non-oil output and real income. No such distinction is found in the BM, EV, and NW models, hence these models do not incorporate an equation for real income (Equation 2).

(3) The equation of permanent income (Equation 3) in the BP model is replaced by a simpler relationship in the BM, EV, and NW models and is expressed as:

$$y^t = y_{\text{non}}^t + e + Po - pc$$

(4) The BM model replaces the importance of permanent income in the demand for money with the real value of resource production, i.e. $yo + e + Po - pc$. In addition, the BM model does not distinguish between consumer prices and domestic prices. External effects upon prices are ignored, equivalent to setting $\alpha_1 = 1$, and $\alpha_2 = 0$ in the BP model.
In conclusion it can be seen that the short run BP and NW models are very similar with the exception that no distinction is made between non-oil output and real income, and that a much simpler definition of permanent income (wealth) is adopted. The EV model further diverges from the BP model by excluding a direct role for wealth in the demand for money equation. Moreover, the BM model differs further by eliminating the distinction between consumer and domestic prices, whilst actual oil production replaces oil wealth in influencing the demand for money. A more detailed summary of the similarities and differences between the short and long run models is presented in Table 3.1, which follows the 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 (1993) and CH (1994), are now emphasised. 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 in non-financial (asset) markets.

The short run models discussed above only consider price/wage stickiness in the adjustment process with no quantity stickiness. In addition, wealth is likely to be endogenously determined, influenced by foreign asset stocks accumulation / decumulation, developments in the current account, and physical capital stock accumulation/decumulation in the non-oil sector. The latter development suggests that the supply of non-oil output available in the long run is not restricted to be at some fixed natural level. It is primarily the latter two influences, i.e., developments in the current account and capital stock accumulation/decumulation in the non-oil sector, that distinguish the short-run models from the long run models.

Both the HG and CH models argue that in analysing the dynamic adjustment arising from the resource shocks, in particular oil shocks, emphasis should be placed upon the long run nature of adjustment. Such shocks will have an impact upon capital
stock accumulation/decumulation, and hence investment and the longer term development of the economy, which can only be captured taking a long run 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 equations of the model are categorized under the following broad headings - goods markets, asset markets, foreign sector, price/wage nexus, and definitions. All equations in the model, except the domestic nominal interest rate and the world interest rate, are presented in log-linear form.
**HG Model**

### Goods Market

\[ y^d_{\text{non}} = \beta_1 y + \beta_2 w^p + \beta_3 (k + \beta_4 k) + \beta_5 G^* + \beta_6 y^s_{\text{non}} \quad (1) \]
\[ y = \partial y^d_{\text{non}} + (1 - \partial) y_o + (1 - \partial - \alpha_2) P_0 + (\alpha_1 - \partial) (e - w) \quad (2) \]
\[ y^s = \partial y^d_{\text{non}} + (1 - \partial) y_o + (1 - \partial - \alpha_2) P_0 + (\alpha_1 - \partial) (e - w) \quad (3) \]
\[ k = \eta q \quad (4) \]
\[ y^s_{\text{non}} = \lambda_1 + \lambda_2 k - \lambda_3 (w - pc) \quad (5) \]

### Asset Market

\[ m - pc = \sigma_1 y - \sigma_2 r + \sigma_3 w^p \quad (6) \]
\[ w^p = \gamma_1 (f + e - pc) + \gamma_2 (m - pc) + \gamma_3 (k + q) + \gamma_4 y^s \quad (7) \]
\[ e = r - r^* \quad (8) \]
\[ R = \epsilon_1 + \epsilon_2 y - \epsilon_3 k \quad (9) \]
\[ q = \delta_3 \{ q - \delta_1 R + \delta_2 (r - \pi) \} \quad (10) \]

### Foreign Sector

\[ t_{\text{non}} = \mu_1 (p^* + e - pc) - \mu_2 y + \mu_3 y^* \quad (11) \]
\[ f = Y_1 t_{\text{non}} + Y_2 r^* f + Y_3 (Oe + P_0) - (1 - Y_2 + Y_3) (e - pc) \quad (12) \]
\[ Oe = - \tau_1 Or + \tau_2 (y_o - y) \quad (13) \]

### Price/wage Nexus

\[ pc = \alpha_1 w + \alpha_2 (P_0 + e) + (1 - \alpha_1 - \alpha_2) (p^* + e) \quad (14) \]
\[ w = \phi_1 + \phi_2 (y^d_{\text{non}} - y^s_{\text{non}}) + \phi_3 \pi \quad (15) \]

### Definitions

\[ \pi = m \quad (16) \]
\[ c = e - w \quad (17) \]
\[ l = m - w \quad (18) \]
All variables are in natural logarithmic form except for the domestic and foreign interest rates, 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: real income (y), permanent income (y'), aggregate demand for non-oil output (yd_{non}), the nominal exchange rate (e), the general price level (pc), nominal domestic interest rate (r), real exchange rate (c), real money balances (l), as in the short run models, and the rest are: the nominal wage rate (w), which is equivalent to that of (pn) used in the short run models, non-oil output supply (y^*_non), domestic private sector real wealth (w^p), physical capital stock (k), foreign asset stocks (f), Tobin's q (q), real profit (R), non-oil trade balance (t_{non}), and net oil exports (Oe). The exogenous variables are: actual oil production (y_o), permanent oil production (y^*_o), permanent income value of non-oil output (y_{non}^b), the world price of oil (P_o), the world interest rate (r^*), and the money stock (m), as in the short run model, and the rest of the world real income (y^*). The parameters in front of each variable indicates its partial elasticity.

Equilibrium in the model depends upon equilibrium in the goods market, asset market, and foreign sector.

Goods market equilibrium consists of five equations. Equation (1) describes the demand for non-oil output as comprising real income, domestic private sector real wealth, domestic gross investment (k + \beta_k), exogenous government capital spending, and the non-oil trade balance. Equations (2) and (3) describe real income and permanent income, arising from both the oil and non-oil sectors, and are derived in a similar fashion as explained earlier in the BP model, therefore these can be ignored. Equation (4), the investment equation, equal to the change in the stock of capital (\dot{k}), depends on Tobin's q ratio (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.
The asset market equilibrium conditions are described by Equations (6)-(10). Equation (6) describes the money market equilibrium condition which equates the supply of real money balances, the nominal money supply \( m \) deflated by the domestic price level \( p_c \), to its demand, which depends positively on the aggregate demand for non-oil output and domestic private sector real wealth, and negatively on the domestic interest rate \( r \). Domestic private sector real wealth is given by Equation (7), as depending positively on the real domestic currency value of domestically held foreign assets \( f \), on the value of the physical capital stock held by the private sector, on real money balances, and permanent income. Equation (8) 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 (6). Equation (9) describes the return on capital services as depending positively on real income, and negatively on the physical capital stock, due to diminishing marginal productivity. Equation (10) describes the change in Tobin's q ratio and comes from the arbitrage condition equating the return on non money financial assets and equities.

The foreign sector is comprised of 3 equations, which are the non-oil trade balance, the current account, and net oil exports. The non-oil trade balance is given by Equation (11), as depending positively on the real exchange rate and world real income \( y^* \), and negatively on domestic real income. Equation (12) defines the current account of the balance of payments, and is equivalent to the change in domestic holdings of foreign assets, as the sum of the non-oil trade balance, net interest income, net oil exports, and the real exchange rate. In long run steady state the current account balance must be zero, otherwise further wealth effects will arise requiring further macroeconomic adjustment.

Equations (14) and (15) define the wage/price nexus. Emphasis is placed upon the sticky or slow adjustment of nominal wages. Equation (14) defines 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 price of oil. The adjustment of domestic wages is generated by an expectations augmented Phillips
curve, as given by Equation (15). Such adjustment arises from three possible sources: developments in productivity, wage fixing or bargaining \( (\phi_1) \), excess demand for labour as measured by current production of non-oil output relative to its potential supply production; and inflationary expectations.

Finally, Equations (16)-(18) define the following. Equation (16) shows that inflationary expectations depend upon the monetary growth rate. Equation (17) and (18) define the real exchange rate \( (c) \) and real money balances \( (l) \), respectively.

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 flexible nominal exchange rate. With a fixed nominal exchange rate, the nominal money stock now becomes an endogenous variable. Hence Equation (8) in the HG model is replaced by Equation (8a) in the CH model.

\[
e = r - r^* \quad (8) \\
m = dsc + res \quad (8a)
\]

where the money supply depends upon increases in the domestic component of the money supply, described here as the exogenous domestic credit expansion \( (dsc) \), and changes in foreign exchange reserves \( (res) \).

\[
res = r - r^* + f \quad (8b)
\]

Capital inflows/outflows depend upon the interest rate 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. With a fixed nominal exchange rate, there will be balance of payments surplus or deficit arising, with a resultant accumulation/decumulation of foreign exchange reserves. These will impact on the domestic money supply.
The amendment of Equations (8) to (8a) and the addition of Equation (8b) to the model, represents the major departures from the flexible exchange rate version of the model.

3.4 The Major Similarities and Differences of the Basic Models

A brief review will be conducted of the short- and long-run models discussed previously, emphasising their fundamental similarities and differences, as shown in Table 3.1.

3.4.1 Steady State Equilibrium of the Model

To contrast and compare the adjustment processes arising between the models, emphasising the short and long run, Harvie (1994) conducted a comparative simulation analysis of the models discussed and outlined previously, by imposing numerical values upon the parameters of the models. To generate such a numerical simulation a program known as "Saddlepoint" was utilised. This is a program, designed for solving linear rational expectations models with constant coefficients. It is the continuous time analogue of the solution to linear difference equation models with rational expectations studied in Blanchard and Khan (1980). 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 are consistent with the underlying behavioural assumptions of the model.
### Table 3.1

**A Summary of the Alternative Dynamic Models Assumptions**

<table>
<thead>
<tr>
<th></th>
<th>Short Run Models</th>
<th>Long run Models</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BM</td>
<td>EV</td>
</tr>
<tr>
<td>The Nominal Exchange Rate</td>
<td>$\beta_4$</td>
<td>$\alpha_1$</td>
</tr>
<tr>
<td>Equation of the demand for real money balances (m-pc), $y$ is replaced by actual oil production : $y = y_0 + e - Po - pc$</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>The equation for real income is redundant</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>The equation for permanent income is replaced by $y = y_0 + e + Po - pc$</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Real income is included in the model</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Permanent income is included in the model</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Domestic private-sector real wealth is included in the model</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>The physical capital stock is included in the model</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Foreign asset stocks are included in the model</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Non-oil trade balance is included in the model</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>The consumer price level is included in the model</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Notes:**

One oil shock simulation case is emphasised here, that of a 10% increase in the world price of oil (Po). The analysis emphasises the adjustment of a number of key macroeconomic variables including that of non-oil output, real income, inflation, foreign asset stocks, physical capital stock, 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 the stability of the model, in that the control variables adjust in such a manner which is consistent with the model's underlying assumptions. The steady state results\textsuperscript{47} derived for a 10 per cent increase in the world price of oil are presented in Table 3.2.

\textsuperscript{47} See Harvie (1994)
Table 3.2
A Summary of the Steady States Properties of the Models
The Case of a 10% Unanticipated and Permanent Increase in the World Price of Oil

<table>
<thead>
<tr>
<th></th>
<th>c</th>
<th>y#</th>
<th>y^d_{non}</th>
<th>k</th>
<th>f</th>
<th>t_{non}</th>
<th>w^p</th>
<th>w</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short-run Models</strong></td>
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<tr>
<td>BM</td>
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<td>?</td>
<td>0</td>
<td>?</td>
<td>?</td>
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<td>EV</td>
<td>-</td>
<td>?</td>
<td>0</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
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<tr>
<td>NW</td>
<td>-</td>
<td>?</td>
<td>0</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
</tr>
<tr>
<td>BP</td>
<td>-</td>
<td>+</td>
<td>0</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
</tr>
<tr>
<td><strong>Long-run Models</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HG</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>CH</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>

**Notes**
- Increase (depreciation) of the variables
- Decrease (appreciation) of the variables
? Change in the variable not known, since not explicitly included in the model
# A distinction between y and No is not made in the BM, EV, and NW models, emphasis being placed upon demand for non-oil output (y^d_{non}) only.
* In steady state, the result is identical for both the fixed and flexible exchange rate regimes

Table 3.2 shows the directional change from an initial equilibrium to the new steady state, arising from a 10% increase in the world price of oil. The results suggest that all the dynamic short- and long-run models indicate an appreciation of the real exchange rate in steady state. The short run models suggest either no change or an increase in real income, whilst the long run models suggest a rise. The BP model suggests no change in non-oil output as with the other three short run models, due to no capital stock accumulation, however the long run models indicate a higher level of non-oil output in steady state.
The BM, EV, and NW models do not distinguish between non-oil output and real income, whilst the BP model indicates an increase in real income as is also indicated by the long run models.

The short run models do not include the physical capital stock, foreign asset stocks, non-oil trade balance, and domestic private-sector real wealth. Hence they have little to say in regard to them. The long run models also anticipate that an increase in the world price of oil will lead to an accumulation of physical capital stock and foreign asset stocks, which contribute to an accumulation of domestic private-sector real wealth. Due to an appreciation of the real exchange rate, the long run models suggest that there is a deterioration in the non-oil trade balance.

Both the short- and long-run models indicate that an increase in the world price of oil contributes to no sustained impact upon the domestic inflation rate.

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 the capital stock and foreign asset stocks 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 rate.

### 3.4.2 Dynamic Stability of the Models

There is only one unique dynamic adjustment saddlepath consistent with the underlying behavioural assumptions of the model. Each requires the derivation of a stable saddlepath, which ultimately takes the system to a new equilibrium steady state. The dynamic equations of the model cover a set of endogenous control variables. For the short run models these consist of real money balances (l), and the real exchange rate (c); for the long run models these same two variables are joined by the foreign asset stocks (f), physical capital stock (k), and Tobin's q (q). In the short run models, the real exchange rate is the non-predetermined or jump variable, capable of adjusting
instantaneously to an exogenous shock, whilst real money balances is the predetermined or non-jump variable which exhibits sluggishness of adjustment. In the long run models, the real exchange rate is a non-predetermined variable for the flexible nominal exchange rate version, with \( q \) being the same in both versions, and the foreign asset stocks, physical capital stock, and real money balances are predetermined in both long run models.

The stability of the model depends upon the properties of the "state" matrix \( A \). Stability of each model depends upon the determinant of matrix \( A \) being a particular sign. The determinant of \( A \) gives the product of the roots of the system. The short run models with two endogenous control variables (\( c \) and \( l \)) will produce two roots, one of which must be positive (non-predetermined or jump variable, \( c \)), and the other must be negative (predetermined or non-jump variable, \( l \)) imparting stability to the system. Hence the determinant of matrix \( A \) should be negative. A stable saddlepath will arise onto which the jump variable will instantaneously jump, taking the economy to its long run steady state equilibrium. In the long run flexible exchange rate model, the system contains five roots, two of which are positive (\( c \) and \( q \)), and three of which are negative (\( l \), \( f \), and \( k \)). Whilst in the long run fixed exchange rate model, there is only one positive root (\( q \)), and four stable and negative roots (\( c \), \( l \), \( f \), and \( k \)). The determinant of matrix \( A \) for the flexible exchange rate version should be negative, and positive for the fixed exchange rate model version. These conditions are satisfied for the simulation analysis.

Analysis of the solutions of the rational expectation model are provided in Appendix 3.1, as is a technical discussion of steady state equilibrium and the dynamic stability of the model.

3.5 Amendments for a Thailand like Net Oil-Importing Economy

The basic models discussed above, especially the two long run models of HG and CH, are able to identify the effects of oil price shocks upon actual oil output, permanent oil output, the price of domestic non-oil output, real income, wealth, and
trade in both the oil and non-oil sectors. During the adjustment process, some economic variables may be better or worse off than in the steady state equilibrium. A knowledge of possible outcomes during the adjustment process is equally important for government, producers, and consumers in optimising the benefits from the oil shocks and offsetting its adverse effects as well. These implications are important for a Thailand like net oil-importing developing economy, as most producers and consumers are small in size.

The long run assumption of the HG and CH studies are of particular relevance to a net oil-importing economy like Thailand, as domestic wealth effects arise from developments in foreign asset stocks (through the current account), changes in real money balances, and changes in the valuation of the physical capital stock. The importance of developments in the current account and capital stocks, focusing upon the longer term development of the economy, is highly relevant in the context of a rapidly growing developing economy such as Thailand.

However all of the models discussed above have been based upon the existence of an already developed economy which is a resource (oil) producer and exporter, so that a number of their underlying assumptions are not appropriate for a likely developing net resource (oil) importing economy. Hence a number of amendments are required in order to make it a more applicable framework to a study of a likely net resource(oil) importing economy such as Thailand's. There are four major amendments required for the case of Thailand.

(1) The major amendment for the development of a Thai macroeconomic model is that it be developed for a net oil-importing economy. The HG and CH models emphasise a developed oil-exporting economy. Their assumptions are clearly not appropriate for Thailand. Therefore, the model developed does not incorporate actual oil production, permanent oil production, and net oil exports as presented in the HG and CH models. These will reflect real and permanent income, generated from the
production of the non-oil sector only. In addition the economy will be a net oil importer.

(2) As with most developing countries, Thailand's asset market is not yet well developed, and capital is not characterised as being perfectly mobile internationally. It is highly controlled by the monetary authorities, especially capital outflows from the country. At the same time the government exercises control over the domestic interest rate. Therefore, the assumption of perfect capital mobility is not fully appropriate for Thailand.

To overcome this problem, less than perfect capital mobility is assumed. Thus, domestic and foreign financial assets are not perfect substitutes. In the present context, returns on domestic financial assets are equalised continuously, but this can diverge temporarily from those on foreign financial assets.

To capture the characteristics of Thailand's exchange rate system, the model developed will emphasise the existence of a fixed nominal exchange rate system similar to that of the CH model.

Therefore, the second amendment is that the model developed will be based upon the characteristics of imperfect international capital mobility and a fixed nominal exchange rate system. This issue will be developed further through the introduction of financial liberalisation, regarding the movement from a fixed exchange rate system to a flexible nominal exchange rate system with perfect international capital mobility.

(3) In the HG and CH models the non-oil trade balance depends upon real income, the real exchange rate, and foreign income. It can be argued that in worldwide international trade, a major factor such as trade barriers will directly affect domestic and international trade, hence the model to be developed will emphasise the trade effects upon exports and imports from reducing trade barriers to achieve the objective of trade liberalisation.

The model to be developed will incorporate equations for non-oil exports and imports. Non-oil exports are assumed to depend upon foreign income, the real exchange rate, and the existence of world trade barriers. While non-oil imports are
assumed to depend upon the real exchange rate, domestic real income, and domestic trade barriers. These amendments will be developed further to identify the implications for the Thai economy arising from trade liberalisation, which is one major issue emphasised in this study.

(4) In contrast to the HG and CH models which assume that government policy is exogenously determined, the contribution of government support is very significant to all economic activities. This study emphasises that government capital spending impacts upon the macroeconomic adjustment process. The model is developed to incorporate government investment spending, in particular infrastructure spending, and its impact upon the supply of output. Aggregate demand for non-oil output is assumed to depend upon private consumption and investment, non-oil exports and imports, and for simplicity on exogenous government consumption and investment. This is a major policy issue due to the serious problem of infrastructure bottlenecks which Thailand is now facing.

3.6 Summary and Conclusions

Overall the focus of this chapter has been placed upon analysing the macroeconomic adjustment process of key macroeconomic variables, arising from resource related shocks, emphasising in particular an increase in the world price of oil.

This chapter has presented basic models which can be used to develop a macroeconomic model for a net resource (oil) importing economy such as Thailand. Emphasis was placed upon a comparative static and dynamic analysis. Regarding the static analysis, an aggregate demand and aggregate supply model, developed by Bhannupongse and Warr (1989) was taken into a consideration in this context. It was utilised to analyse the impact of the resource boom upon economic adjustment, in particular for the case of Thailand. It suggested that an oil price increase would lead to a rise in inflation and a fall in real income, and such problems could be offset by policy responses such as monetary accommodation and structural adjustment policy.
The dynamic models considered have characteristics similar to those of Dombusch (1976). Some of these have a short-run orientation, while two models were based upon the long run and assumed either a fixed or flexible nominal exchange rate.

The short run model emphasised was that of the BP model, whilst the other three short run models - BM, EV, and NW - were taken into account for contrasting and comparing with the BP model. The two long run models - HG and CH - were presented and discussed, the major difference between these being that the HG model assumes a flexible nominal exchange rate, whilst the CH model assumes a fixed exchange rate.

Harvie (1994) conducted a simulation analysis for three cases to examine the adjustment process for each model. In particular this study focused upon the case of a 10% increase in the world price of oil. The results suggest that the effects of the resource (oil) related shock upon the macroeconomy are greater and more volatile than for the short run models with the inclusion of physical capital stock, foreign asset stocks, and domestic private sector real wealth in the long run models. Such variables make a major distinction between the short run and the long run.

The short and long run dynamic models show the adjustment of the economy towards steady state equilibrium in response to the oil related shocks, whilst this is clearly not possible with the static model. Hence a dynamic framework is more useful for a policy analysis. 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 the 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 the guideline for developing a macroeconomic model for a Thailand like net resource (oil) importing economy. Such basic models could be amended appropriately for the case of Thailand, in particular a long run
Dynamic model. Developing a dynamic long run macroeconomic model for Thailand will be presented and discussed in Chapter 4, by using as a basis the long run dynamic models discussed in this chapter, with appropriate amendments.
CHAPTER 4
A RESOURCE RELATED MACROECONOMIC MODEL FOR A
THAILAND LIKE NET OIL-IMPORTING ECONOMY

4.1 Introduction

This chapter is concerned with modelling a resource-related macroeconomic model for a Thailand like net oil-importing economy. The model will explicitly identify the ways in which external shocks affect the domestic economy, as well as the structure of the Thai economy. The external shock emphasised here are the two major oil price increases, occurring in 1973-74 and 1979-80. The model emphasises the long term nature of the dynamic adjustment process, recognising the effects which such oil shocks have had upon the development of the Thai economy (see Chapters 2 and 3). The economic developments emphasised are those of real income, non-oil output production, physical capital stock, foreign asset stocks, non-oil exports and imports, the real exchange rate, private sector real wealth, and the domestic inflation rate. The resource related macroeconomic model adopted for Thailand has its foundation in the CH model, which was developed for the case of a fixed exchange rate, as outlined in the previous chapter.

The model developed is based upon the characteristics of the Thai economy. These are as follows: a net-oil importing economy; the existence of a fixed exchange rate regime, a high degree of government control over international capital mobility; the importance of government capital spending in infrastructure development; and the existence of both domestic and international trade barriers. This represents the Thai economy during the period of the oil shocks (1973-1980), and is considered as being the "base model". Whilst the second period is chosen to represent the Thai economy

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48 The resource emphasised here is oil.
49 The base model is chosen to capture the period of the two oil price shocks (1973-1980) on the economy, which was at that time heavily regulated.
during the period of the post-oil price shocks (1981-1992)\textsuperscript{50}, and is referred to as the "adjustment case".\textsuperscript{51}

The model developed is capable of explicitly incorporating government spending on consumption and investment, especially investment in infrastructure development. The re-structuring of the Thai economy in the context of infrastructure development is a key policy issue, which has important implications for the development of the Thai economy as mentioned earlier. This issue will be discussed further in 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 Thailand 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 discussed in Chapter 6.

4.2 The Major Assumptions of the Model

This section will discuss the key assumptions underlying the theoretical model, which are summarised as follows: the model is dynamic and focuses upon long run adjustment; economic agents possess rational expectations; the oil shocks\textsuperscript{52} will affect the domestic economy indirectly through their effect on the real exchange rate and also directly through capital stock accumulation and the non-oil trade balance, which will induce a change of non-oil output, and foreign assets (foreign bonds) generated from the oil shocks; there is a labour surplus 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 government control over the capital

\textsuperscript{50} The general review of the Thai economy conducted in Chapter 2 was until 1994. For the purposes of modelling and estimation data are available only until 1992, hence the “adjustment case” will focus upon the period 1981-1992.

\textsuperscript{51} The “adjustment case” is conducted in order to show the effects of eliminating trade barriers for the Thai economy, this will be representative of the Thai economy during the post-oil shocks period.

\textsuperscript{52} The oil shocks emphasised here are: (a) oil price shocks, and (b) domestic oil requirements shock.
market. The last two assumptions are ultimately abandoned to reflect a gradual movement towards a liberalised economy.

However, developing the resource related macroeconomic model for a Thailand like net oil-importing economy needs further extensive refinement, representing major extensions to the CH model. These are as follows.

(1) The model developed is for a Thailand like net-oil importing economy, where for simplicity it is assumed that there is no oil production at all in the economy. Hence only non-oil production takes place in the economy, producing what is equivalent to real national 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 shock for a Thailand like net oil-importing economy.

(2) It is assumed that government spending consists of both consumption and investment spending, with the latter being equivalent to government investment in infrastructure development. Government investment contributes to the level of aggregate demand for non-oil output. Whenever the government raises (lower) its investment, there will accordingly exist a direct rise (fall) in aggregate demand, as well as indirect increase in the aggregate supply of non-oil output. The distribution of government consumption and investment spending is primarily politically determined, and in the context of the model is assumed to be exogenous. Alternative spending options allows the identification of an appropriate policy that would enhance the level of aggregate demand for non-oil output, and aggregate supply of non-oil output.

These assumptions would lead to different adjustment paths, as well as steady states for the economy, in comparison to those for the models identified in Chapter 3. These changes are made in order to make the model more prevalent to an analysis of a Thailand like net oil-importing economy.

(3) The model assumes that the nominal exchange rate is fixed, and there is significant government control over international capital mobility. Thailand'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\textsuperscript{53}. This is the third main amendment of the CH model. Imperfect capital mobility implies that the return on domestic financial assets is not equated continuously with that on foreign assets.\textsuperscript{54} This best represents Thailand during the period under analysis for this study.

These assumptions are gradually relaxed to indicate reduced government controls over the capital market, and the case of full liberalisation in these markets is also considered. At the same time a change in the nominal exchange rate regime from fixed to flexible is also considered.\textsuperscript{55} It is relevant to adopt these assumptions for Thailand, since its integration with the global market economy means that the government cannot isolate the domestic capital market from world capital market developments. These assumptions allow the identification of appropriate policies in regard to varying the nominal exchange rate regime and capital market controls, and their implications for the adjustment process arising from oil shocks for Thailand. In the context of the model, these represent key policy issues which are simulated and the results compared to the "base case".

(4) 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 CH model, such sticky adjustment can arise from both sticky prices, such as nominal wages, and quantity adjustment. In the case of Thailand there is a 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 for the case of Thailand. Of greater significance is the lack

\textsuperscript{53} For example, the NICs have adopted a liberalisation strategy for their economies, in particular Taiwan.

\textsuperscript{54} The CH model considers four financial assets, these are: domestic money, domestic bonds, foreign bonds, and equity claims on the domestic physical capital stock. Hence the foreign assets emphasised here are foreign bonds.

\textsuperscript{55} Although the government proposes a flexible nominal exchange rate as a future policy option, it is currently primarily a managed float. To reduce the complication arising from a managed float, emphasis in this study is placed upon the extremes of a fixed or perfectly flexible exchange rate regime.
of capital and technology, and the stickiness of adjusting these to increased production in the domestic market. The assumption of a 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 modeled, 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 develop proportionally to the accumulation/decumulation of the physical capital stock.

(5) The model will explicitly distinguish between non-oil export and import equations. This is conducted in order to examine the major factors influencing non-oil exports and imports, rather than only the non-oil trade balance. Non-oil exports and imports also depend upon domestic and international trade policies. These represent key policy issues, and the outcomes from varying policy stances regarding both domestic and international trade policies can be compared through a simulation analysis. This assumption represents another major departure from the CH model, and is representative of Thailand during the period 1981-1992 which is considered to be the “adjustment case”. During this period a freer trade policy was adopted to enhance the trade performance.

A key objective of this study is to identify the implications of alternative policies, such as trade liberalisation, financial liberalisation and an expansion of public infrastructure spending, upon overall macroeconomic performance. These policy implications from the basis of the adjustment cases, discussed further in Chapter 6.

This amendment of assumptions leads to an extensive modification of the modelling of the macroeconomic consequences of oil related shocks for a Thailand like net oil-importing economy, in comparison to that of the CH model. The model is now explicitly developed in the following section.
4.3 A Macroeconomic Model for a Thailand like Net Oil-Importing Economy

The model presented in this section is considered to be the "base case", which is chosen to capture structural developments in the Thai economy arising from oil shocks during the period 1973-1980.

The model is divided into five subheadings; goods market, assets market, foreign sector, price/wage nexus, and definitions. All equations in the model, except the domestic nominal interest rate and the world interest rate, are presented in log-linear form. The symbols are defined in the box following the equations.

The Base Model

Goods Market

\[ y^d_{\text{non}} = \beta_1 p + \beta_2 p^d + \beta_3 \delta^g + \beta_4 \delta^g + \beta_5 t + (1 + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5)tm \]  

\[ y = y^d_{\text{non}} - \alpha_2 p_0 + (1 - \alpha_1) (e - pn) - (1 - \alpha_1 - \alpha_2) p^* \]  

\[ y^f = y^d_{\text{non}} - \alpha_2 p_0 + (1 - \alpha_1) (e - pn) - (1 - \alpha_1 - \alpha_2) p^* \]  

\[ y^g_{\text{non}} = \lambda_1 + \lambda_2 kP + \lambda_3 k^g + \lambda_4 (pn - pc) \]  

\[ cP = \kappa_1 y + \kappa_2 wP \]  

\[ iP = kP = \eta q \]  

\[ \delta^g = \frac{\delta k}{\delta^g} \]  

\[ i^g = k^g = \psi (k^g - k^g) \]

Assets Market

\[ m - pc = \sigma_1 y - \sigma_2 r + \sigma_3 wP \]  

\[ wP = \gamma_1 (f + e - pc) + \gamma_2 (m - pc) + \gamma_3 (kP + q) + \gamma_4 y^f \]  

\[ \dot{m} = \dot{A} + \dot{f} s = \Omega (r - r^* + f) \]  

\[ \dot{q} = \delta_3^{-1} \{ q - \delta_1 R + \delta_2 (r - \pi) \} \]  

\[ R = \varepsilon_1 + \varepsilon_2 y - \varepsilon_3 kP + \varepsilon_4 k^g \]
Foreign Sector

\[ tx = \Sigma_1 y^* + \Sigma_2 (p^* + e - pn) - \Sigma_3 Pw^* \]  
(14)

\[ tm = m_1 y - m_2 (p^* + e - pn) - m_3 Pd^* \]  
(15)

\[ f = \tau_1 tx - \tau_2 tm + \tau_3 r^* f - \tau_4 (Oni + Po) - (1-\tau_3+\tau_4)(e-pc) \]  
(16)

\[ Oni = \theta_1 Or^* + \theta_2 y \]  
(17)

\[ fs = \Omega(r - r^* + \dot{f}) \]  
(18)

Price/wage Nexus

\[ pc = \alpha_1 pn + \alpha_2 (Po + e) + (1 - \alpha_1 - \alpha_2)(p^* + e) \]  
(19)

\[ pn = \phi_1 + \phi_2 (y^d_{non} - y^s_{non}) + \phi_3 \pi \]  
(20)

Definitions

\[ \pi = m \]  
(21)

\[ c = e - pn \]  
(22)

\[ l = m - pn \]  
(23)

A dot (.) above a variable signifies its rate of change.
Table 4.1

List of Symbols

Endogenous Variables

\[ y \quad \text{Real income} \]
\[ y^d \quad \text{Permanent income} \]
\[ y_{\text{non}} \quad \text{Aggregate demand for non-oil output} \]
\[ y_{\text{non}}^d \quad \text{Aggregate supply of non-oil output} \]
\[ w^P \quad \text{Domestic private sector real wealth} \]
\[ Oni \quad \text{Net oil imports} \]
\[ r \quad \text{Domestic nominal interest rate} \]
\[ pc \quad \text{Consumer price level, (CPI)} \]
\[ pn \quad \text{Price of domestically produced non-oil output} \]
\[ tx \quad \text{Non-oil exports} \]
\[ tm \quad \text{Non-oil imports} \]
\[ fs \quad \text{Foreign exchange reserves held by the central bank} \]
\[ cP \quad \text{Private consumption spending} \]
\[ iP \quad \text{Private investment spending} \]
\[ c \quad \text{Real exchange rate} \]
\[ l \quad \text{Real money balances} \]
\[ f \quad \text{Foreign asset stocks} \]
\[ kP \quad \text{Private capital stock} \]
\[ k^G \quad \text{Public capital stock} \]
\[ q \quad \text{Tobin's q ratio} \]
\[ m \quad \text{Nominal money stock} \]
\[ \pi \quad \text{Inflationary expectations} \]

Exogenous variables

\[ e \quad \text{Nominal exchange rate} \]
\[ Or^* \quad \text{Domestic oil requirements} \]
\[ r^* \quad \text{World nominal interest rate} \]
\[ Po^* \quad \text{World price of oil} \]
\[ p^* \quad \text{World price of non-oil goods} \]
\[ y^* \quad \text{World real income} \]
\[ y_{\text{non}}^t \quad \text{Permanent non-oil output} \]
\[ A \quad \text{Domestic credit expansion} \]
\[ PW^* \quad \text{World Trade Protection (A rise represents more protection)} \]
\[ PD^* \quad \text{Domestic Trade Protection (A rise represents more protection)} \]
\[ eG \quad \text{Government consumption spending} \]
\[ kG \quad \text{Government policy determined level of public capital stock} \]
\[ iG \quad \text{Government investment spending} \]
The equilibrium of the model depends upon equilibrium in the goods market, assets market, and foreign sector. Equilibrium in the goods market will be firstly discussed.

The goods market equilibrium consists of eight equations, which are represented by Equations (1)-(8). Aggregate demand for non-oil output \( (y_{\text{non}}^d) \) is given by Equation (1). In this study, aggregate non-oil output comprises private consumption, private investment, government consumption, government investment, and the non-oil trade balance consisting of exports less imports. The parameters \( (\beta_i) \) represent the weights of spending in each category. The composition of government spending upon consumption and investment is assumed to be exogenous and policy determined. This can be analysed by varying the degree of politically determined spending on infrastructure on the Thai macroeconomic development process, which will be discussed in Chapter 6. This is a major departure from the existing basic CH model.

Equations (2) and (3) describe real income and permanent income. Real income is given by Equation (2), depending upon non-oil output, the world price of oil, the real exchange rate, emphasised here as being \( (e-pn) \), that is the nominal exchange rate \( (e) \) deflated by the domestic non-oil price, and the exogenously determined world price of the non-oil imported product \( (p^*) \). Equation (3) identifies the economy's permanent income, derived in a similar fashion to that of real income, consisting of that from permanent non-oil output, the world price of oil, the real exchange rate, and the world price of the non-oil imported product.

Equations (2) and (3) indicate that real and permanent income are affected negatively by the world price of oil, the extent of this is influenced by the share of oil in domestic consumption \( (\alpha_2) \).

In this study, Equations (2) and (3) are similar to those derived in the HG and CH models. However, to capture the nature of a net oil-importing economy and the assumption of no oil production, real income and permanent income are different in
that they depend only upon real and permanent non-oil output production, the world price of oil, the world price of non-oil imported goods, and the real exchange rate.

The price of non-oil output used here is \( (pn) \), this is equivalent to \( w \) (nominal wage) used in the HG and CH models. This difference arises from the assumption of a labour surplus in Thailand, 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 HG and CH models.

Equation (4) represents the aggregate supply of non-oil output \( (y^*_{non}) \), which is endogenously determined within the model. Fluctuations in non-oil output supply in the short and long run depend upon the economy's aggregate production function. Output supply depends upon the private physical capital stock \( (kP) \) and government capital stock \( (kg) \), and the real price of domestically produced non-oil output, treated here as the real wage rate in the non-oil sector as described in the HG and CH models. Such differences from that of the HG and CH models are made in order to focus upon the role of government control over investment for a developing country like Thailand, where the government plays a significant role upon economic activity. The key policy implications arising from the role of government investment in infrastructure will be discussed in Chapter 6.

Unlike the HG and CH models, private sector consumption is explicitly modelled as indicated by Equation (5). It is assumed to depend positively upon the level of real income, and private sector real wealth. Private sector gross investment is also explicitly modelled as in Equation (6), this captures the partial adjustment hypothesis, as in the CH model, and will not be discussed further here.

Equations (7) and (8) explicitly model government consumption and investment expenditure. Government consumption spending is an exogenous policy determined variable, whilst government capital spending arises from a gradual adjustment of the actual government capital stock to its policy determined level as in Equation (8). It is further assumed that government capital spending is policy determined. Hence the change in the optimum public capital stock, achieved through
government investment in infrastructure, is policy determined. These major differences from the CH model emphasise the important contribution of government in regard to investment spending on infrastructure. Identifying the contribution of this to the Thai economy is one major objective of this study.

Assets market equilibrium is given by Equations (9)-(13). There are four financial assets here, these being, domestic money, domestic bonds, foreign bonds, and equities. The latter represents claims to the ownership of the capital stock in the private sector. 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 international 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 significant amendment to that of the CH model.

Equation (9) represents the demand for real money balances, which depends upon real income (transactions demand), the nominal domestic 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 (10) as in the CH model.

Equation (11) identifies the characteristic of a fixed exchange rate and imperfect capital mobility. With the nominal exchange rate fixed the money stock becomes an endogenously determined variable in the model. 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 exchange rate expected returns on domestic and foreign financial assets are not equalised, and divergences in the returns on these will lead to changes in capital inflows or outflows. Such flows will affect domestic reserves and have an impact upon the domestic money supply, resulting in changes, for example, in the consumer price level.
In the case of a fixed nominal exchange rate, the money supply is endogenously determined. It depends upon increases in the domestic component of the money supply, described here as the exogenous domestic credit expansion (A), and changes in foreign exchange reserves by the central bank (fs), as shown in Equation (11).

\[ m = A + fs \quad (11) \]

"A" is exogenously determined by government and for simplicity it is assumed here to be zero. Changes in foreign reserves (fs) are endogenously determined by balance of payments surpluses or deficits, which arise from a fixed nominal exchange rate and developments in the current account and capital flows as shown in Equation (18).

\[ fs = \Omega(r - r^* + \dot{f}) \quad (18) \]

where \( \Omega \) represents the degree of capital mobility. Capital flows depend upon the difference between the domestic nominal interest rate and the world interest rate, whilst the current account position is indicated by the accumulation/decumulation of foreign exchange reserves. Substituting (18) into (11), then Equation (11\*) becomes as follows.

\[ m = \Omega(r - r^* + \dot{f}) \quad (11\*) \]

With a fixed nominal exchange rate there will be balance of payments surpluses or deficits resulting in an accumulation/decumulation of foreign exchange reserves (fs), and a consequential increase/decrease in the domestic money supply.

Equation (12) represents equilibrium in domestic non money asset markets. Domestic equities are assumed to be only held by domestic residents, with the expected real return on domestic equities being equalised with returns on alternative financial assets through arbitrage. This is as in the CH model, and will not be further
discussed here. Equation (13) defines real profit, the real return on private capital services, as depending positively on the level of real income, and negatively on the stock of private capital \((k_P)\) due to diminishing returns, and positively on public capital. The latter holds because it is assumed that public capital and private capital are complementary in nature, the productivity of private capital rises as the government provides more public capital stock. This is an extension to the CH model.

Foreign sector equilibrium consists of five equations, as presented in Equations (14)- (18). Non-oil exports are given by Equation (14). It positively depends upon world real income, the real exchange rate, and negatively to exogenous world trade protection. Whilst Equation (15) represents non-oil imports, which are derived in a similar fashion, they, however, are negatively related to domestic real income, the real exchange rate, and exogenous domestic trade protection.

Meantime, the non-oil trade balance, \((tx-tm)\), is a significant component of the current account as shown in Equation (16), which is derived from Equation (16a).

\[
\dot{f} + e - pc = \tau_1 tx - \tau_2 tm - \tau_3(r^f + e - pc) - \tau_4(Oni + Po + e - pc)
\] (16a)

Re-arranging (16a) and expressing this in terms of changes in foreign bond holdings, then Equation (16) is obtained. It indicates that the accumulation/decumulation of foreign assets, as reflected in the current account balance \((\dot{f})\), depends upon the non-oil trade balance (non-oil exports less non-oil imports), real foreign interest earnings \((r^f)\), and net oil imports \((Oni+Po)\). In the long run steady state the current account balance must be zero, otherwise further wealth effects will arise requiring further macroeconomic adjustment.

Equation (17) identifies net oil imports \((Oni)\), which positively depend upon real income and the exogenously determined domestic oil requirements. This is another major difference to the CH model.

The development in foreign exchange reserves \((f_s)\) is given by Equation (18). It is endogenously determined by balance of payments surpluses or deficits which arise
varying the parameter values in respect to the world trade barrier and the domestic trade barrier as described in Equations (14) and (15), which are treated as exogenously determined variables. The parameter values, (Σ₃) and (m₃) can range from zero to one. A rise in each parameter value means an increase in trade barriers or protection (both domestic and international).

If Σ₃ = 0, this implies that there is no world trade barrier. As a result this should lead to an improvement in Thailand's exports to the rest of the world, whilst if Σ₃ = 1 this means that the world trade barrier is fully imposed and presents a complete obstacle to Thailand's exports. Whilst if m₃ = 0 this implies that there is no domestic trade barrier resulting in an increase in Thai imports from the rest of the world, but if m₃ = 1, this means that the domestic trade barrier is fully imposed on Thai imports. These alternative possibilities will be discussed further in Chapter 6.

4.4.2 Alternative Public Infrastructure Spending Policies

Another alternative policy deals with an analysis of the effects of government capital spending on infrastructure developments. No amendments to the base model, except for varying the policy determined variable (k[^]) , resulting to the adjustment in the government capital stock, as described in Equation (8) of the base model, is required in this case. The policy determined parameter (k[^]) can range from less to more. If (k[^]) is more than zero, this implies that an expansionary public capital spending on infrastructure development adopted, whilst if (k[^]) is less than zero this implies that a contractionary public capital spending on infrastructure development adopted.

4.4.3 Alternative Financial Liberalisation Policies

This category of alternative versions of the base model allows the oil related shocks to occur in a Thailand like net oil-importing economy operating with either a fixed or flexible exchange rate system, combined with different degrees of international capital mobility. Three different versions of the base model are considered in this
category, as follows: (1a) a fixed nominal exchange rate combined with perfect international capital mobility; (1b) a flexible exchange rate combined with highly controlled capital market; and (1c) a flexible exchange rate combined with perfect international capital mobility. Modifications to Equation (11) in the base model, are shown in the following equations.

\[
\begin{align*}
\dot{m} &= \Omega (r - r^* + \dot{f}) \\
\dot{m} &= (r - r^* + \dot{f}) \\
\dot{f} &= -\Omega (r - r^* - e) \\
e &= r - r^*
\end{align*}
\]

Equation (11) is used in the base model where the nominal exchange rate is fixed, and \( \Omega \) represents the degree of capital mobility as previously discussed. This parameter value can range from zero to one. For \( \Omega = 0 \), means that there is no international capital mobility, whilst for \( \Omega = 1 \) there is perfect international capital mobility. Equation (11a) 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 \( \dot{m} \) is 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 (11b) is therefore the relevant equation where the nominal exchange rate is flexible, combined with highly controlled international capital mobility.
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 require agents to be 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 presented by Equation (11c), this is as in the HG model.

Before conducting a simulation analysis, the model will be estimated by the econometric technique of Two Stage Least Squares (2SLS), using the Shazam package. The coefficient parameters will then be used in the simulation analysis to examine the impact of the oil related shocks upon the macroeconomic adjustment process. The model is simulated by using a numerical algorithm known as "Saddlepoint". The details of the properties of this estimation and simulation procedure are discussed in Chapter 5. Estimation and simulation of the model for the "base case" are presented in Chapter 5. The simulation will be conducted for both oil price and domestic oil requirement shocks. The simulation results for all of the alternative policy implications will be presented in Chapter 6, by using the estimated parameter values derived from the "adjustment case" presented in Chapter 5.

To generate results which are representative for a Thailand like net oil-importing economy, the parameters of the model will be empirically estimated by using appropriate data wherever possible. To focus the analysis upon the effects of alternative policies, the parameters values used in the simulations are the same for both the "base case" and "adjustment case" with the exception of those parameters which are policy determined, and changed for different simulations. The source of the data and method of estimation will be discussed in the next chapter.
4.5 Limitations of The Theoretical Model

In this section the limitations of the theoretical model presented previously will be examined. These relate to the underlying theoretical basis of the model as well as its representation of the Thai economy and key sectors of it. Limitations of the theoretical basis of the model will be firstly discussed.

The assumption of a deterministic framework in which economic agents possess rational expectations, equivalent to the case of perfect foresight, is a very strong assumption which is unlikely to be satisfied in the real world situation. A deterministic framework is one in which the outcome from a shock is known with certainty by economic agents. Random or stochastic disturbances are therefore ruled out, and the temporary or permanent nature of a shock not considered. The assumption of the rational expectations hypothesis implies that economic agents have information on the model, use all available information, and do not make systematic or persistent errors in their forecasts. A unique stable saddlepath to achieve the long run equilibrium exists. The ability of economic agents to derive this stable saddlepath, particularly in the context of the complex model presented previously, can be questioned.

The appropriateness of such a theoretical framework for a developing economy such as that of Thailand's should also be borne in mind. Limitations of the framework as a representation of the Thai economy are as follows. Firstly, the adjustment of financial markets play a crucial role in the model. However Thai financial markets are not yet that well developed. Like other developing countries Thailand's financial markets are heavily regulated by the authorities, even though the government has tried to relax the degree of control over them. In addition the returns on domestic financial and real assets are unlikely to be equated continuously as assumed in the model.

Secondly, the model developed has not been disaggregated into key sectors. It analyses only the adjustment of non-oil output, and does not clearly distinguish between developments in major sectors in the economy such as agriculture,
manufacturing, or service production sectors. Hence structural adjustments cannot be clearly identified.

Thirdly, the importance of wealth, incorporated in the model, may not be appropriate for the case of Thailand. The model developed assumes that in the long run domestic real wealth effects arise from developments in foreign asset stocks (through the current account), changes in real money balances, and changes in the valuation of the physical capital stock. Developments in foreign asset stocks through the current account is highly regulated by the government authorities.

Fourthly, the theoretical model developed emphasises only the operation of a fixed and a perfectly flexible exchange rate regime. Whilst Thailand actually operates under a system of a managed floating exchange rate.

Fifthly, the model emphasises the existence of a flexible interest rate (both domestic and international), however the Thai government exercises substantial control over the domestic interest rate. Therefore, the assumption of a market driven interest rate is not fully appropriate for Thailand.

Sixthly, the issue of a government budget constraint, and the key issue of its funding, has not been explicitly incorporated in the model. Seventhly, the model is based upon a linear relationship between the economic variables. This may not be appropriate in all circumstances.

Finally, the model, and the simulation results derived from it, are based upon constant parameter values. In a rapidly developing economy such as Thailand's where major structural and dynamic changes are occurring, the constant parameters assumption may not be appropriate particularly in attempting to derive future developments of the economy.

These are just some of the limitations of the model which should be borne in mind as results from it are derived.
4.6 Summary and Conclusions

The focus of this chapter has been upon the development of a model to analyse the macroeconomic effects of an oil shock on a Thailand like net-oil importing economy.

In this study it is assumed that the domestic economy produces only non-oil output, which can be consumed domestically and is an imperfect substitute for the imported good equivalent. The price of this good is domestically determined. 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. In addition the model developed emphasises the long run nature of the dynamic adjustment process, since the oil shocks will have a long run effect upon the Thai economy. This arises from allowing for physical capital stock accumulation and developments in the current account balance. The inclusion of developments in the current account balance captures developments in oil imports and the non-oil trade balance, which has 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 model explicitly incorporates the fact that only non-oil output production is considered in the model, and is therefore equivalent to the economy's real income. Aggregate demand for non-oil output is dependent upon private sector consumption and investment, government sector consumption and investment, and the non-oil trade balance (non-oil exports less imports). Government consumption and investment spending are assumed to be politically determined variables. The economic developments emphasised related to that of real income, non-oil output production, physical capital stock, which is broken down into private and public capital stock, foreign asset stocks, non-oil trade balance, consisting of non-oil exports and imports, the real exchange rate, inflation rate and private sector real wealth.
The model developed is representative of the oil shock period when the nominal exchange rate was fixed, combined with imperfect international capital mobility, and the existence of trade barriers on both domestic and international trade upon a Thailand like net oil-importing economy. This is referred to as the base model.

Private and government capital spending contributes to an expansion of the physical capital stock in the non-oil sector, enhancing the productive capacity of non-oil output. Most importantly aggregate demand and supply of non-oil output grows proportionally with the development of the physical capital stock. This arises from the labour surplus in the economy, and hence the labour supply is a non constraint upon economic growth. This represents another major amendment of the existing basic models.

Therefore the base model developed in the early part of this chapter is representative of the Thai economy during the period of the oil shocks (1973-1980), whilst the adjustment case represents the Thai economy during the post-oil shock period (1981-1992). Since this period the Thai government has implemented an adjustment policy to re-structure to the economy in response to the oil shocks. The policy issues emphasised in particular relate to that of trade liberalisation, financial liberalisation, and public infrastructure capital spending. These three policy issues will be further developed from the base model, and will be discussed and presented in Chapter 6.
CHAPTER 5
EMPIRICAL ESTIMATION AND BASE CASE SIMULATION OF THE MODEL

5.1 Introduction

The objective of this chapter is to estimate the base model developed in Chapter 4 using econometric techniques, and to use these estimated coefficients for simulation analysis of the impact of oil related shocks upon the Thai macroeconomy. This will be done by firstly discussing the data sources and methods of analysis of the model, secondly by empirically estimating the model and finally by analysing the model using a simulation approach for two oil related shocks.

5.1.1 Data Sources

This study covers the period 1971 to 1992, which includes the period of the two oil price shocks in 1973-74 and 1979-80, which had major adjustment implications for the Thai economy. The period following saw the introduction of significant adjustment policies in response to the two oil price shocks, and contributed to the economic boom from 1988 onwards. The data sources are therefore divided into two sub-periods, (a) the period 1971-1980, and (b) 1981-1992. The first period is chosen to capture the period of the two oil price shocks on the economy, which was at that time heavily regulated. This period will be referred to as the "base case". The second period was chosen to capture the post-oil price shock effects which coincided with trade liberalisation, in the form of reducing trade barriers to both domestic and international trade; financial liberalisation, focusing upon the nominal exchange rate and the degree of control over capital markets; and public capital spending particularly in the form of infrastructure investment. This period will be referred to as the "adjustment case".

Attempts were made to estimate as many of the parameters of the model as possible from the data and, where appropriate, three groups of data samples were used
to calculate the preferred parameter values. The first is for the period 1971.1 to 1980.4, referred to here as the "base case". The second period is 1981.1 to 1992.4 referred to here as the "adjustment case". Finally, the parameters were estimated for the whole period of study from 1971.1 to 1992.4. 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 statistical data used in this study are from previous research studies and other sources. Data is mostly from the Bank of Thailand (BOT), the National Economic and Social Development Board (NESDB), the National Statistics Office of Thailand, Far Eastern Economic Review (FEER), Asian Development Bank (ADB), International Monetary Fund (IMF), World Bank, Asian Economic Bulletin, World Tables from 1970 to 1993, and general sources concerning Thailand for the period 1971-1992. Each variable is defined and its sources noted in Appendix 5.1. Like other developing countries, some data is not available. In other cases some data may be available, but not appropriate to the definitions of the relevant simulation variables. In addition to that some material is available only on an annual 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 freedom. To overcome this problem the data has been compiled with the objective of achieving as much consistency as possible.

5.1.2 Methodology

The base model derived in Chapter 4 consists of 20 equations and 3 definitions, which include 45 parameters. A summary of these parameters is presented in Table 5.1.

---

56 Variable definitions and data sources for all parameters used in the estimation process are presented in Appendix 5.1.
57 The latest statistical data we have available is for 1992, which dictated the end of our sample.
58 Quarterly data used in this study is obtained by using the DX data base program. The program transforms yearly data to quarterly observations. See Note 2 of Appendix 5.1 for a brief description of this method.
Table 5.1
Parameters Used in the "Base Case" Model

<table>
<thead>
<tr>
<th>Equation</th>
<th>Parameters</th>
<th>Equation</th>
<th>Parameters</th>
<th>Equation</th>
<th>Parameters</th>
</tr>
</thead>
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<tr>
<td>(1)</td>
<td>$\beta_1$</td>
<td>(6)</td>
<td>$\eta$**</td>
<td>(14)</td>
<td>$\Sigma_1$*</td>
</tr>
<tr>
<td></td>
<td>$\beta_2$</td>
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<td></td>
<td>$\Sigma_2$*</td>
</tr>
<tr>
<td></td>
<td>$\beta_3$</td>
<td></td>
<td></td>
<td></td>
<td>$\Sigma_3$**</td>
</tr>
<tr>
<td></td>
<td>$\beta_4$</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>$\beta_5$</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(2), (3), and (19)</td>
<td>$\alpha_1$</td>
<td>(7)</td>
<td>$\gamma_1$*</td>
<td>(15)</td>
<td>$m_1$*</td>
</tr>
<tr>
<td></td>
<td>$\alpha_2$</td>
<td></td>
<td></td>
<td></td>
<td>$m_2$*</td>
</tr>
<tr>
<td>(4)</td>
<td>$\lambda_1$*</td>
<td>(8)</td>
<td>$\gamma_2$*</td>
<td>(16)</td>
<td>$\tau_1$*</td>
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<td>$\lambda_2$*</td>
<td></td>
<td></td>
<td></td>
<td>$\tau_2$*</td>
</tr>
<tr>
<td></td>
<td>$\lambda_3$*</td>
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<td></td>
<td></td>
<td>$\tau_3$*</td>
</tr>
<tr>
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<td>$\lambda_4$*</td>
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<td></td>
<td></td>
<td>$\tau_4$*</td>
</tr>
<tr>
<td>(5)</td>
<td>$\kappa_1$*</td>
<td>(9)</td>
<td>$\delta_1$</td>
<td>(17)</td>
<td>$\theta_1$*</td>
</tr>
<tr>
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<td>$\kappa_2$*</td>
<td></td>
<td></td>
<td></td>
<td>$\theta_2$*</td>
</tr>
<tr>
<td>(6)</td>
<td>$\varepsilon_1$</td>
<td>(10)</td>
<td>$\delta_2$</td>
<td>(20)</td>
<td>$\phi_1$</td>
</tr>
<tr>
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<td>$\varepsilon_2$</td>
<td></td>
<td></td>
<td></td>
<td>$\phi_2$</td>
</tr>
<tr>
<td></td>
<td>$\varepsilon_3$</td>
<td></td>
<td></td>
<td></td>
<td>$\phi_3$</td>
</tr>
<tr>
<td></td>
<td>$\varepsilon_4$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- Parameters with a * will be estimated by the method of "Two Stage Least Squares (2SLS)".
- $\Omega$, $\varepsilon$, $\Sigma$, $\delta$, $\phi$, $\theta$, $\gamma$, $\eta$, $\lambda$, $\kappa$, $\mu$ are policy parameters.
- $\psi$ is determined parameter, responsive to the government capital stock variable.
- Equation (7) is not included in the table because there is no corresponding parameter to the variable, since government consumption is assumed to be exogenously determined.
- Equations (21), (22), and (23) are not included in the table because they are definitions.

The equations in the model are grouped into three general categories - "identity", "adjustment", and "behavioral" equations, which in turn determine how the simulation parameter values were obtained.

The identity equations will be discussed first. Log-linear equations (1), (2), (3), (19), and (21) are classified as "identity " or "proportional" equations, consisting of 9...
parameters, which use values from existing studies\textsuperscript{59}. Equation (7) identifies government consumption as an exogenously determined variable. Equations (22) and (23) are as defined in the Harvie-Gower (1993) model.

The adjustment equations are (6), (8), (11), (12), (13), (18), and (20). Equation (6) identifies the adjustment of the private capital stock, and the adjustment coefficient is also derived from previous studies\textsuperscript{60}. Equation (8) represents adjustment of the public capital stock, which captures the partial adjustment process. This partial adjustment arises from the political process of adjusting the actual public capital stock \( k^g \) to its policy determined level \( \bar{k}^g \). Equation (11) identifies money stock adjustment, with the adjustment coefficient \( \Omega \) the same as in equation (18). All parameters in equation (13) were derived using results from existing studies\textsuperscript{61} whilst equation (20) shows the adjustment of the price of domestically produced non-oil goods.

The remaining eight equations (4), (5), (9), (10), (14), (15), (16), and (17), are behavioural equations\textsuperscript{62}, which all together comprise 25 parameters, in which 23 parameter values will be estimated and 2 parameter values are policy determined \( \Sigma_3 \) and \( m_t \). Empirical estimation of these equations for the "base case" period 1971.1-1980.4 (40 observations) using the Shazam package will give the required estimated coefficients, which will be used in the simulation analysis using the "Saddlepoint" program. The simulation results are presented in Section 5.3 which identify the dynamic long-run adjustment process.

Before estimating the model, unit root tests will be used to determine whether the regression variables are stationary or non-stationary. Whilst details of these tests

\textsuperscript{59} The existing studies emphasised here refer to (a) Harvie-Gower (1993), (b) Harvie C. (1993), (c) Harvie C. (1994), (d) The coefficient parameters estimated from SIAM1 (1982), and the coefficient parameters estimated from the Macroeconomic and Energy Model Training Program, by the Thailand Development Research Institute (1989). The actual values used (and their explicit sources) are detailed in Table 5.3 of Section 5.3.

\textsuperscript{60} As for footnote 59.

\textsuperscript{61} This is mainly due to the unavailability of a real profit series for Thailand, hence it is necessary to use the parameter utilised in existing studies, as for footnote 59.

\textsuperscript{62} The behavioural equations will be estimated because they portray the structure of an economy, including the aggregate behaviour of economic agents.
are available in Appendix 5.2, we note here that non-stationary data may give contemporaneous and spurious results which may cause misleading statistical and therefore economic inferences (which has tended to be ignored by some developing country economists and modellers). Consequently, any non-stationary economic data series have to be detrended (to achieve stationarity) before any sensible regression analysis can be performed.

Therefore the first task of this chapter is to test whether the relevant variables are stationary or non-stationary. As shown in Appendix 5.2 and summarised in Table 5.2 all 23 variables are found to be non-stationary of different orders, according to the augmented Dickey-Fuller tests. Perron (1989)\(^6\) shows that these tests can be biased towards finding non-stationarity when structural change is present. Accordingly the variables are transformed using one of four methods, all of which regress the variable in question against time using either the dummy variable method (which explicitly incorporates the effects of structural change), the time square method, the natural log method, or a combination of these (which all include differing specifications of non-linear growth). As explained in Appendix 5.3, comparing these results and choosing the best specification according to \(R^2_{\text{adjusted}}\) and F statistic criteria, increases the chance of correctly modelling the trend, which is preferable to the alternative mechanistic successive differencing method that takes no explicit account of these phenomena. The preferred detrending model for each of the 23 variables is shown in Table 5.3A of Appendix 5.3. The variables are then transformed accordingly to each preferred model and Table 5.3B of Appendix 5.3 shows that each detrended variable is I(0) stationary according to the augmented Dickey-Fuller tests. These results are summarised in Table 5.2. The detrended variables are then used in the following econometric estimations.

---

### Table 5.2
Summary of Unit Roots Test for the Relevant Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Difference Order of Raw Data (^{(1)})</th>
<th>Detrending Specification (^{(2)})</th>
<th>Difference Order After Detrending (^{(3)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer price level (pc)</td>
<td>I(2)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Current account balance ( (f ))</td>
<td>I(1)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Demand for non-oil output ((y'_{non} ))</td>
<td>I(3)(3)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Domestic nominal interest rate ((r ))</td>
<td>I(1)(1)</td>
<td>(3)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Domestic oil requirements ((Or^* ))</td>
<td>I(3)(3)</td>
<td>(4)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Domestic price of non-oil output ((pn ))</td>
<td>I(1)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Domestic private sector real wealth ((w^))</td>
<td>I(2)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Foreign asset stocks ((f ))</td>
<td>I(2)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Net oil import ((Oni ))</td>
<td>I(2)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Nominal exchange rate ((e ))</td>
<td>I(1)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Nominal money stock ((m ))</td>
<td>I(1)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Non-oil exports ((tx ))</td>
<td>I(2)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Non-oil imports ((tm ))</td>
<td>I(3)(3)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Permanent income ((y^))</td>
<td>I(3)(3)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Physical private capital stock ((k^p ))</td>
<td>I(1)(1)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Private consumption ((c^p ))</td>
<td>I(3)(3)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Public capital stock ((k^p ))</td>
<td>I(1)(1)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Real income ((y ))</td>
<td>I(2)(1)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>Supply of non-oil output ((y'_{non} ))</td>
<td>I(2)(3)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
<tr>
<td>World nominal interest rate ((r^* ))</td>
<td>I(2)(3)</td>
<td>(3)</td>
<td>I(0)</td>
</tr>
<tr>
<td>World price of non-oil output ((p^* ))</td>
<td>I(2)(3)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>World price of oil ((Po^* ))</td>
<td>I(2)(3)</td>
<td>(2)</td>
<td>I(0)</td>
</tr>
<tr>
<td>World real income ((y^* ))</td>
<td>I(1)(1)</td>
<td>(1)</td>
<td>I(0)</td>
</tr>
</tbody>
</table>

**Notes:**

1. Conclusion of Augmented Dickey-Fuller tests:
   - I(0) means stationary in levels.
   - I(1) means stationary in first differences.
   - I(2) means stationary in second differences.
   - I(3) means stationary in third differences.

2. Preferred detrending specifications:
   - (1) Dummy variable growth: \(X(t) = \alpha + \beta t + \gamma (D) t \)
   - (2) Quadratic growth: \(X(t) = \alpha + \beta t^2 \)
   - (3) Composite non-linear growth: \(X(t) = \exp(X(t)) + \beta t^2 \)
   - (4) Logarithmic growth: \(X(t) = \log(\beta t) \)

3. According to Perron (1989), it shows that these tests can be biased towards finding non-stationarity when structural change is present.
5.2 Empirical Estimation

Seven of the eight behavioural equations are overidentified according to the Order Condition\(^{64}\), and given the presence of endogenous explanatory variables the equations will therefore be estimated by using the Two Stage Least Squares (2SLS) method\(^{65}\) in order to obtain consistent parameter estimates. The full results are shown in Appendix 5.5.

All eight behavioral equations fit the data well in terms of very high \(R^2\) between observed and predicted variables. In addition the Durbin Watson statistics are mostly close to 2.0 and the rho (\(\rho\)) values are close to zero, which implies reasonable model specification. It is clear from the results in Appendix 5.5 that there is a multicollinearity problem for most regressions. This is due to the very high \(R^2\) between observed and predicted variables coupled with high pairwise correlation coefficients between variables and large confidence intervals, some of which include zero (which implies that these estimated coefficients are not significantly different from zero). For example, all of the estimated parameters in Equation (10) are not significantly different from zero, whilst the \(R^2\) between the observed and 2SLS predicted values of the detrended variable (domestic private sector real wealth) is 0.996.

\(^{64}\)The identification conditions enable us to determine whether each equation of a simultaneous system is exactly identified, underidentified, or overidentified. Identification of each equation determines the appropriate (if any) regression estimation procedure. More details about the rules of identification are contained in Appendix 5.4.

\(^{65}\)Two Stage Least Squares (2SLS) analysis can be conducted by using the Shazam package (Shazam, version 7, 1993). Each regression has the same eight instrumental variables which are world real income (\(y^*\)), the world price of non-oil output (\(p^*\)), international trade barriers (\(P_w^*\)), domestic trade barriers (\(P_d^*\)), the world interest rate (\(r^*\)), the world price of oil (\(P_o^*\)), domestic oil requirements (\(O_r^*\)), and the controlled nominal exchange rate (\(e\)).
<table>
<thead>
<tr>
<th>Upper</th>
<th>Lower</th>
<th>Upper</th>
<th>Lower</th>
<th>Upper</th>
<th>Lower</th>
<th>Upper</th>
<th>Lower</th>
<th>Upper</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.060</td>
<td>0.038</td>
<td>0.055</td>
<td>0.015</td>
<td>0.013</td>
<td>0.002</td>
<td>0.002</td>
<td>0.028</td>
<td>0.020</td>
<td>0.004</td>
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<td>1.025</td>
<td>1.079</td>
<td>0.030</td>
<td>0.010</td>
<td>0.004</td>
<td>0.002</td>
<td>0.002</td>
<td>0.022</td>
<td>0.014</td>
<td>0.007</td>
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<td>0.011</td>
<td>0.008</td>
<td>0.008</td>
<td>0.005</td>
<td>0.003</td>
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<td>0.910</td>
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<td>0.001</td>
<td>0.000</td>
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<td>0.096</td>
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<td>0.141</td>
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<td>0.151</td>
<td>0.155</td>
<td>0.159</td>
<td>0.163</td>
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<td>1.340</td>
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<td>0.38</td>
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<td>0.424</td>
<td>0.446</td>
<td>0.468</td>
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<td>0.056</td>
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</table>

**Equation (a)**: Parameters

<table>
<thead>
<tr>
<th>Equation (a)</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Case</strong></td>
<td><strong>Base Case</strong></td>
</tr>
</tbody>
</table>

**Note**: This table is a statistical analysis of certain parameters and their relationships. The values represent coefficients and intervals used in calculating these parameters. The table is divided into upper and lower limits for each parameter, indicating the range of validity for the calculated values.
The coefficients estimated from this period will be used as a base for the simulation analyses in Chapter 6.

The coefficients estimated from this period will be used as a base for the simulation analyses in Section 5.3.

### Notes

**Confidence Intervals (95%) based on a t-distribution (t-value=1.960) for the two sub-periods.**

For the whole period they will also be stationary for the two sub-periods and for the two sub-periods assume that since the transformed variables are stationary.

**Notes**

- **Equation (a):** Parameters
- **Equation (b):** Parameters
- **Equation (c):** Parameters
- **Equation (d):** Parameters
- **Equation (e):** Parameters
- **Equation (f):** Parameters
- **Equation (g):** Parameters
- **Equation (h):** Parameters
- **Equation (i):** Parameters
- **Equation (j):** Parameters
- **Equation (k):** Parameters
- **Equation (l):** Parameters
- **Equation (m):** Parameters
- **Equation (n):** Parameters
- **Equation (o):** Parameters
Multicollinearity makes the estimated parameters sensitive to the equation specification and widens the confidence intervals for the coefficients of these possibly significant variables. For the purpose of simulation most of the calculated 95% confidence intervals (which exclude zero) give a wide range of values for each parameter, from which a value can be chosen which will ensure the simulated model will be stable. These intervals are summarised in Table 5.3. All estimated parameters (with a couple of exceptions) have the expected signs, which will now be considered in turn.

Equation (4) is the supply of non-oil output. The real private capital stock ($\lambda_2$) elasticity is 0.819 for the whole period, 0.988 for the first sub-period, and insignificant for the second sub-period\textsuperscript{66}. The real government capital stock ($\lambda_3$) elasticities, whilst not significantly different from zero, are 0.258, 0.110, and 1.650 respectively.

Equation (5) is the private consumption function. The income elasticity ($\kappa_1$) whilst insignificant, is 0.257 for the whole period which is a little larger than for the first sub-period (0.234), but smaller than the second sub-period (0.428). The income elasticity in the second sub-period is larger than the others, due to no oil related shocks occurring in this period and the government imposing adjustment policies in response to the earlier oil related shocks. On the other hand, the wealth elasticity with respect to consumption ($\kappa_2$) is bigger in the first sub-period (0.770) than the second sub-period (0.574). This indicates that individuals whose wealth decreased in the “adjustment period” did not decrease their consumption by as much.

Equation (9) represents the demand for real money balances, defined as the nominal money stock deflated by the consumer price index (m-pc). The real income elasticity ($\sigma_1$) is 0.374 for the whole period, 0.278 for the first sub-period which includes the shocks and 0.512 for the second sub-period of adjustment\textsuperscript{67}. The real wealth elasticity ($\sigma_3$) for the whole period is 0.626, and 0.716 for the first sub-period, and not significantly different from zero for the second sub-period, arising from the

\textsuperscript{66} These estimated coefficients are elasticities because the equations are in log-linear form. The estimates for the two sub-periods assume that since the transformed variables are stationary for the whole period they will also be stationary for the two sub-periods.

\textsuperscript{67} These estimated coefficients are not significantly different from zero since their respective confidence intervals include zero.
economy rapidly growing in the second period of the study. An improvement in the trade balance in 1988 moved Thailand into a current account surplus, leading to an improvement in domestic real wealth. There are no differences for the insignificant interest rate elasticity ($\sigma_2$).

Equation (10) represents domestic private sector real wealth. The elasticity of the real domestic currency value of domestically held foreign assets ($\gamma_1$) is insignificant. The real money balance elasticities ($\gamma_2$) are also not significantly different from zero for all periods. The elasticities for the private capital stock ($\gamma_3$) are again not significantly different from zero for all periods, whilst the permanent income elasticity ($\gamma_4$) is only significantly different from zero for the first sub-period.

Equation (14) identifies non-oil exports. The elasticity of the world real income ($\Sigma_1$) are 1.010 for the whole period, 1.000 for the first period, and 0.950 for the second period. This implies that higher world real income will induce a more non-oil export from the country. The elasticities of the world price of non-oil output ($\Sigma_2$) are not significantly different from zero.

Equation (15) is the non-oil imports function. The real income elasticity ($m_1$) is 1.000 for the whole period, 1.010 for the first period, and 1.000 for the second period. This implies that higher domestic real income will induce more non-oil imports from the overseas countries. But the estimated parameters of the world price of non-oil output ($m_2$) is not significantly different from zero.

Equation (16) represents the current account balance. The first three estimated parameters for this equation were unsatisfactory because they have wrong signs or they are not significantly different from zero. However the real net oil imports elasticity ($\tau_4$) is significantly different from zero, that is 0.720 for the whole period, which is larger than the first sub-period (0.550) but smaller than the second sub-period (0.760).

Equation (17) is the net oil imports function. The elasticity of domestic demand for oil ($\theta_1$) is significantly different from zero for only the second sub-period. This

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68 These estimated elasticities are significantly different from zero due to the confidence intervals not including zero.
69 These estimated coefficients are all significantly different from zero.
indicates that for the second sub-period if the price of oil increases, net imports of oil will increase. The income elasticities with respect to net oil imports ($\theta_2$) are different, that is $0.775$ for the whole period, which is bigger than the first period ($0.560$) and the second period ($0.600$).\(^7\)

In summary most of the parameters have the expected signs and reasonable magnitudes, although many of the associated confidence intervals are disappointingly large. Whilst it was argued earlier that severe multicollinearity would widen these confidence intervals, this required increasing the frequency of annual data to quarterly data. The necessary detrending of the data and the need to use instruments in the regression estimation process, would all have contributed to a loss in statistical efficiency and widening of the confidence intervals.

5.3 Simulation Analysis

In this section the “base case” macroeconomic model developed in Chapter 4 will be simulated. The relevant parameter values used will be based on the econometrically estimated coefficients derived from the first sub-period of study (1971.1-1980.4) and values which had to be imposed due to unsuccessful attempts to estimate them or, in order to maintain the stability of the model. (The estimated coefficients derived from the second sub-period of 1981.1-1992.4, will be used as a basis for the simulation analysis of the “adjustment case” in Chapter 6).

Table 5.4 shows that the 23 estimated parameters in Equations (4), (5), (9), (10), (14), (15), (16) and (17), which are significantly different from zero, have been chosen either in terms of the actual expected parameter values or a value within the respective 95% confidence intervals. All 23 estimated parameters are used in simulation analysis, in which 14 estimated parameters are chosen within the respective

\(^7\)All of these estimated coefficients are significantly different from zero.
95% confidence intervals, and 9 estimated parameters are insignificance and they are also out of boundaries of 95% confidence intervals. Hence the 9 parameters\textsuperscript{71} are imposed from the relevant existing studies in Thailand instead, as identified in Table 5.4. Values have been imposed for the remaining estimated parameters which are not significantly different from zero. The justification for using non-zero values here is because of the reasons mentioned in the previous section including the extreme multicollinearity that was present in the econometric estimation, all of which increase the width of the estimated confidence intervals to frequently, and possibly incorrectly, include zero. These parameter values and those in the remaining equations, (1), (2), (12), (13), and (19) are consequently taken from similar studies, which are noted in Table 5.4.

In the “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 economy. In addition the economy is dependent upon both world and domestic trade protection and government capital spending on infrastructure. Therefore, the coefficients \( \Omega \), \( \Sigma_3 \), and \( m_3 \) are identified as policy parameters. The parameter for the degree of capital mobility \( \Omega \), as shown in equations (11) and (18), can range from 0 to 1. If \( \Omega = 0 \), it represents the case of no international capital mobility, whilst if \( \Omega = 1 \) there is perfect capital mobility.

\textsuperscript{71}The 9 parameter values were chosen which differed from their estimated values. The following explanations are as: (1) Of the 9 parameters, 3 were exogenous \( (\Sigma_2, m_2, \text{ and } \tau_3) \) and 1 was a constant term \( (\lambda_1) \), which are less important in the simulation analysis, (2) all of the 8 non-constant parameters \( (\Sigma_2, m_2, \tau_3, \lambda_4, \sigma_2, \gamma_1, \tau_1, \text{ and } \tau_2) \), 95% confidence intervals estimates were found to include zero, indicating that each of these parameter estimates were insignificantly different from zero at the 5% level of significance, (3) these are suspected that the poor quality data and preference of structural changes have caused these results, rather than these variables not being significant themselves, and (4) accordingly, in order to include these relevant variables, non-zero parameter values were obtained from the SIAM 1 Model and the TDRI model.
### Table 5.4

Parameters Chosen for the “Base Case” Simulation (1971.1-1980.4)

<table>
<thead>
<tr>
<th>Equation</th>
<th>Parameters</th>
<th>Estimated Coefficients</th>
<th>Confidence Intervals(a)</th>
<th>Chosen Parameter for Simulation</th>
<th>Sources for Imposed Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>$\beta_1$</td>
<td></td>
<td></td>
<td>0.1*</td>
<td>(C), (D)</td>
</tr>
<tr>
<td>(1)</td>
<td>$\beta_2$</td>
<td></td>
<td></td>
<td>0.1*</td>
<td>(C), (D)</td>
</tr>
<tr>
<td>(1)</td>
<td>$\beta_3$</td>
<td></td>
<td></td>
<td>0.1*</td>
<td>(C), (D)</td>
</tr>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(1)</td>
<td>$\beta_5$</td>
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<td></td>
<td>0.1*</td>
<td>(C), (D)</td>
</tr>
<tr>
<td>(2), (3)</td>
<td>$\alpha_1$</td>
<td></td>
<td></td>
<td>0.6*</td>
<td>(A), (B)</td>
</tr>
<tr>
<td>(2), (3)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>(4)</td>
<td>$\lambda_1$</td>
<td>-1.271(b)</td>
<td></td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(4)</td>
<td>$\lambda_2$</td>
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<td>0.080 - 1.875</td>
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<td>(C), (D)</td>
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<tr>
<td>(4)</td>
<td>$\lambda_3$</td>
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<td>-0.803 - 1.025</td>
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<td>-0.220 - 0.015</td>
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</tr>
<tr>
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<td>(A), (B)</td>
</tr>
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<td>(5)</td>
<td>$\kappa_2$</td>
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<td>0.039 - 1.505</td>
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<tr>
<td>(6)</td>
<td>$\eta$</td>
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<td>(A), (B)</td>
</tr>
<tr>
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<td>(C), (D)</td>
</tr>
<tr>
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</tr>
<tr>
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<td>-0.006 - 0.006</td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(9)</td>
<td>$\sigma_3$</td>
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<td>0.141 - 1.290</td>
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<td>(C), (D)</td>
</tr>
<tr>
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<td>-0.100 - 0.130</td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(10)</td>
<td>$\gamma_2$</td>
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<td>-0.340 - 0.908</td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(10)</td>
<td>$\gamma_3$</td>
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<td>-0.435 - 0.815</td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(10)</td>
<td>$\gamma_4$</td>
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<td>0.002 - 0.950</td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(11)</td>
<td>$\Omega$</td>
<td></td>
<td></td>
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<td>(C), (D)</td>
</tr>
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<td>(C), (D)</td>
</tr>
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<td>(A), (B)</td>
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<td>(A), (B)</td>
</tr>
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<td>(A), (B)</td>
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<td>(13)</td>
<td>$\varepsilon_2$</td>
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<td>0.5*</td>
<td>(C), (D)</td>
</tr>
<tr>
<td>(13)</td>
<td>$\varepsilon_3$</td>
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<td>(C), (D)</td>
</tr>
<tr>
<td>(13)</td>
<td>$\varepsilon_4$</td>
<td></td>
<td></td>
<td>0.5*</td>
<td>(C), (D)</td>
</tr>
<tr>
<td>Equation</td>
<td>Parameters</td>
<td>Estimated Coefficients</td>
<td>Confidence Intervals(a)</td>
<td>Chosen Parameter for Simulation</td>
<td>Sources for Imposed Parameters</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>------------------------</td>
<td>-------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>(14)</td>
<td>Σ1</td>
<td>1.000</td>
<td>0.960 - 1.045</td>
<td>1.0***</td>
<td>(C),(D)</td>
</tr>
<tr>
<td></td>
<td>Σ2</td>
<td>0.002(b)</td>
<td>-0.013 - 0.051</td>
<td>0.5*</td>
<td>(C),(D)</td>
</tr>
<tr>
<td></td>
<td>Σ3</td>
<td>0.987(b)</td>
<td>-0.202 - 2.158</td>
<td>0.5**</td>
<td>(C),(D)</td>
</tr>
<tr>
<td>(15)</td>
<td>m1</td>
<td>1.010</td>
<td>0.980 - 1.040</td>
<td>1.0***</td>
<td>(C),(D)</td>
</tr>
<tr>
<td></td>
<td>m2</td>
<td>0.001(b)</td>
<td>-0.010 - 0.029</td>
<td>0.5*</td>
<td>(C),(D)</td>
</tr>
<tr>
<td></td>
<td>m3</td>
<td>-0.764(b)</td>
<td>-0.276 - 1.804</td>
<td>0.5**</td>
<td>(C),(D)</td>
</tr>
<tr>
<td>(16)</td>
<td>τ1</td>
<td>-0.053(b)</td>
<td>-0.330 - 0.235</td>
<td>1.0*</td>
<td>(C),(D)</td>
</tr>
<tr>
<td></td>
<td>τ2</td>
<td>0.340(b)</td>
<td>0.005 - 0.690</td>
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</tr>
<tr>
<td></td>
<td>τ3</td>
<td>0.74x10^{-6}(b)</td>
<td>-0.3 x 10^{-5} - 0.4 x 10^{-5}</td>
<td>1.0*</td>
<td>(C),(D)</td>
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<tr>
<td></td>
<td>τ4</td>
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<td>0.210 - 0.880</td>
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<td>(C),(D)</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>θ2</td>
<td>0.560</td>
<td>0.060 - 1.050</td>
<td>1.0***</td>
<td></td>
</tr>
<tr>
<td>(20)</td>
<td>φ1</td>
<td></td>
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<td></td>
<td>φ2</td>
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</tr>
<tr>
<td></td>
<td>φ3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:

* Stated parameter values, derived from existing studies (refer to (A),(B),(C), and (D) below)
** Policy parameters
*** Whilst these parameters were estimated from 2SLS regressions the chosen parameters for simulation are different due to the objective of maintaining the stability of the model. Therefore the chosen parameters are taken from: (i) the boundaries of their respective 95% confidence intervals, or (ii) the middle region of the 95% confidence intervals.

(a) Confidence Intervals (95%) based on t-distribution (t-value=1.980)
(b) Parameter is not significantly different from zero.

In the “base case”, the parameter value (Ω) is chosen as 0.2 and the optimum government capital stock (\( \overline{k^g} \)) is a policy determined variable is also set to zero for the base case, having a responsive parameter value of speed of adjustment of government capital spending (\( \psi \)) is also set to 0.2. Whilst attempts were made to estimate the policy parameters for the trade barriers (\( \Sigma_3 \)) and (m_3) the estimated coefficients were not significantly different from zero, hence they are set to 0.5, as per relevant existing studies. These values represent the Thai economy during the period of 1971-1980.

The following analysis will focus upon the adjustment of eight key variables: the real exchange rate; foreign asset stocks; private capital stock; non-oil output; non-oil trade balance (non-oil exports less non-oil imports); private sector real wealth; real income (national income); and domestic inflation rate; arising from shocks to the price of oil and domestic oil requirements. These key variables are chosen because they are important factors in the process of economic development of Thailand, affecting economic growth, income distribution and economic stability. Any changes in these variables arising from oil related shocks such as the price of oil and domestic oil requirements, will influence the development of other variables and the domestic economy as a whole, as discussed in Chapter 4.

The parameters used in the simulation for the “base case” are summarised in Table 5.5.

5.3.1 Steady State Properties

The simulation period of the “base case” model presented in Chapter 4 is set to 22 years (equivalent to 88 observations) in order to identify the dynamic long-run adjustment process. This is sufficient time to allow the long term dynamic adjustment of some macroeconomic variables\(^{72}\) to attain their steady state.

\(^{72}\) As for footnote (21) in Chapter 1.
Table 5.5
Parameter Values Used in the Simulation Analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$</td>
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<td>$\gamma_1$</td>
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<td>$m_1$</td>
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</tr>
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<td>$\gamma_2$</td>
<td>0.5</td>
<td>$m_2$</td>
<td>0.5</td>
</tr>
<tr>
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<td>$\gamma_3$</td>
<td>0.5</td>
<td>$m_3$</td>
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</tr>
<tr>
<td>$\beta_4$</td>
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<td>$\gamma_4$</td>
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<td>$\tau_1$</td>
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</tr>
<tr>
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<td>$\delta_1$</td>
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<td>$\delta_2$</td>
<td>0.5</td>
<td>$\tau_3$</td>
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<td>$\delta_3$</td>
<td>0.5</td>
<td>$\tau_4$</td>
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<td>$\xi_1$</td>
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<td>$\theta_1$</td>
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<tr>
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<td>$\xi_2$</td>
<td>0.5</td>
<td>$\theta_2$</td>
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</tr>
<tr>
<td>$\lambda_4$</td>
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<td>$\xi_3$</td>
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<td>$\phi_1$</td>
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</tr>
<tr>
<td>$\kappa_1$</td>
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<td>$\xi_4$</td>
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<tr>
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<td>$\Sigma_1$</td>
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<td>$\phi_3$</td>
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<td>$\Sigma_2$</td>
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<td>$\eta$</td>
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<td>$\Sigma_3$</td>
<td>0.5</td>
<td>$\psi$</td>
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<td>$\Omega$</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$r^*$</td>
<td>0.05</td>
</tr>
</tbody>
</table>
The two cases simulated are:

Case 1  An unanticipated increase in the world price of oil (Po) by 1%.
Case 2 An unanticipated increase in domestic oil requirements (Or*) by 1%.

A summary of the long run steady state properties of the macroeconomic model for both an oil price and domestic oil requirements shock, is contained in Table 5.6. 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, r, R, \( p_n, p_c \) and e do not change as there is no monetary accommodation 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.

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73 Domestic oil requirements as emphasised here refer to that exogenously determined by both government and the private sector, for usage in consumption and investment. In particular this thesis emphasises a domestic oil requirements shock, arising from an increase/decrease in oil requirements for domestic economic activities due to a changed usage of an alternative energy source such as natural gas. Alternative energy sources allows less oil usage in the country, as well as that arising from an improvement in technology and more efficient energy usage. However such an energy policy is assumed to be exogeneous.

74 Monetary policy is accommodating when the money supply is increased in order to prevent interest rates from increasing. Monetary accommodation is also referred to as monetizing budget deficits, meaning that the government borrows from the central bank to pay for its deficits. The term "accommodation" is also used more generally. When the oil price increased in the 1970s, the government accommodated the higher prices by raising the money stock.

"Monetary accommodation" emphasised in this study is mainly due to the assumption of the balance of payments equaling zero in long run equilibrium, hence the growth rate of the money stock will be zero. However with a fixed nominal exchange rate the money stock will be endogenously determined in the model, and will change due to balance of payments surpluses and deficits during the adjustment process. Therefore in this study the presumption of no monetary accommodation will be emphasised in order to maintain the long run equilibrium adjustment of the current account balance to be equal to zero, otherwise the wealth effect will persist in the long run.
Table 5.6

Simulation Results from the “Base Case” Model

(% deviation from the baseline)

<table>
<thead>
<tr>
<th>Variables</th>
<th>c</th>
<th>f</th>
<th>kP</th>
<th>y</th>
<th>y_dnon</th>
<th>t_non</th>
<th>wP</th>
<th>pc</th>
</tr>
</thead>
</table>

**Shocks**

**Case 1 Po*(+)**

- Instantaneous impact:<sup>(a)</sup>
  - Short run impact:<sup>(b)</sup>
  - Medium run impact:<sup>(c)</sup>
  - Long run impact:<sup>(d)</sup>

<table>
<thead>
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<th>0.05</th>
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<th>-0.07</th>
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<td>0.15</td>
<td>0.30</td>
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<td></td>
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<td>-0.08</td>
<td>0.62</td>
<td>-5.28</td>
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</tr>
</tbody>
</table>

**Case 2 Or* (+)**

- Instantaneous impact:<sup>(e)</sup>
  - Short run impact:<sup>(b)</sup>
  - Medium run impact:<sup>(c)</sup>
  - Long run impact:<sup>(d)</sup>

<table>
<thead>
<tr>
<th>Variables</th>
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<th>0.05</th>
<th>-0.0001</th>
<th>0.05</th>
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<td>0.09</td>
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<td>-0.23</td>
<td>-0.16</td>
<td>0.97</td>
<td>-6.26</td>
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</tr>
</tbody>
</table>

**Notes:**

- + increase (depreciation of that variable)
- - decrease (appreciation of that variable)

- **c**: The real exchange rate
- **f**: Foreign asset stocks
- **kP**: Physical private capital stock
- **y**: Real income
- **y_dnon**: Demand for non-oil output
- **t_non**: Non-oil trade balance
- **wP**: Domestic private sector real wealth
- **pc**: Domestic inflation rate

**Case 1** A rise of 1% in the world price of oil.
**Case 2** A rise of 1% in domestic oil requirements.

- (a) The instantaneous impact is represented for the base period (0).
- (b) The short run impact is represented from years 0-2 (time period 0-8).
- (c) The medium run impact is represented from years 2-5 (time period 8-20).
- (d) The long run impact is represented from year 5 onwards (time periods 20 onwards).
5.3.2 Adjustment Process

The adjustment process emphasises the eight key macroeconomic variables discussed previously, namely the real exchange rate, foreign asset stocks, physical private capital stock, non-oil output, real income, non-oil trade balance (non-oil exports less non-oil imports), domestic private-sector real wealth, and domestic inflation rate. The adjustment process involved in these cases is presented in Figures 5.1 to 5.8. The vertical axis for each diagram measures the percentage deviation of that variable from its base value, indicated here from zero, while the horizontal axis measures the time period. These diagrams show an adjustment period arising from a shock lasting 22 years, since by this time most of the variables have achieved long run steady state equilibrium. This indicates that the effects of the oil shocks have long run effects. Each diagram contains the two simulated cases, as discussed above. The adjustment process will be divided into the instantaneous impact, short run, medium run, and long run periods, to simplify the discussion of the adjustment process for the major macroeconomic variables arising from the oil related shocks.

(a) Instantaneous Impact

Once the oil related shocks occur, the simulation results suggest that for both cases the effects on the key macroeconomic variables are very similar in both direction and magnitude except for the rate of inflation. Initially the inflation rate falls from its base value in Case 1, but it increases instantaneously by 0.05% above its base value in Case 2. The non-oil trade balance instantaneously improves by 0.05% from its base value in both cases. This is because of a rise in non-oil exports rather than a fall in non-oil imports. An improvement in the non-oil trade balance leads to a rise in real income and consequently leads to a rise in demand for non-oil output. However private sector real wealth instantaneously deteriorates in both cases, due to the nature of an oil-importing economy like Thailand\textsuperscript{23}. The real exchange rate, private physical capital

\textsuperscript{23} As mentioned earlier, an unanticipated oil price increase would deteriorate the country’s current account, due to higher oil import bill payments. These would also deteriorate the private sector real wealth.
stock and foreign asset stocks do not change instantaneously, since they are control variables in the model. However they will be affected by the oil related shocks in the short, medium and long run.

(b) Short Run Adjustment

During the short run period the inflation rate increases in Case 1 whilst it decreases in Case 2 as shown in Figure 5.1. By the end of the short run, however, it remains below its base value in Case 1, but above its base value in Case 2. An increase in the oil price will lead to an increase in the consumer price level and the price of non-oil goods in the short run period, because the price of oil directly contributes to the consumer price level and the price of non-oil output as indicated in Equation (19) of Chapter 4. As shown in Figure 5.1, the short run impact of an increase in the oil price induces a noticeable increase in the domestic inflation rate, (after an initial sharp decrease on impact), arising from an increase in the price of non-oil goods.\textsuperscript{76} For the case of an increase in domestic oil requirements, the domestic inflation rate increases for most of the short run. Inflation is higher with Case 2, due to an increase in money wage growth and the weakness of the nominal exchange rate. Money wage growth is due to the initial increase in non-oil output demand relative to its supply. This puts upward pressure on nominal money wage growth. The weakness of the real exchange rate is a reflection of higher domestic oil requirements. Furthermore both cases contribute to a higher non-oil output supply arising from an accumulation of physical capital stock.

The depreciation in the real exchange rate arises from developments in the price of non-oil goods, as indicated by Equation (21) of Chapter 4. Hence an unanticipated increase in the oil price leads to a depreciation of the real exchange rate by some 0.31%, given a fixed nominal exchange rate, as shown by Figure 5.2. The real exchange rate depreciation will be larger for Case 2, with the results indicating that in the short run the real exchange rate depreciates by 0.44%.

\textsuperscript{76}This development in the price of non-oil output is not shown in the diagram.
Figure 5.1  Inflation Rate

Figure 5.2  Real Exchange Rate
Figure 5.3  Non-oil Trade Balance

Figure 5.4  Demand for Non-oil Output
Figure 5.5  Real Income

Figure 5.6  Private Physical Capital Stock
Figure 5.7  Foreign Asset Stocks

Figure 5.8  Domestic Private Sector Real Wealth
The non-oil trade balance improves, arising from a depreciation of the real exchange rate, by some 0.30% by the end of short run period for the case of an oil price increase and by some 0.42% for the case of an oil requirements increase, as shown in Figure 5.3.

The development of non-oil output is significantly influenced by adjustments in the real exchange rate and the trade balance. As shown in Figure 5.4, non-oil output significantly improves in the short run period by some 0.15% for the case of an oil price increase and by some 0.09% for the case of a domestic oil requirements increase, arising from a depreciation of the real exchange rate and an improvement in the non-oil trade balance.

The development of demand for non-oil output largely reflects developments in real income (equivalent to national income) as indicated by Equation (2) of Chapter 4. In addition the real exchange rate and the world price of oil also contribute to the developments in real income. The short run impact upon non-oil output demand is favourable for both cases due to a depreciation of the real exchange rate and an improvement in the non-oil trade balance. The increase in non-oil output in the short run period contributes to a favourable effect upon real income. However, by the end of the short run real income increases by only 0.02% for the case of an oil price increase and by only 0.04% for the case of an oil requirements increase. The size of adjustment is very small, as shown in Figure 5.5.

The short run impact upon the supply of non-oil output is also favourable, arising from an accumulation of the private physical capital stock. Figure 5.6 indicates that the private physical capital stock accumulates by some 0.10% in the short run period for Case 1 and 0.09% for Case 2. This is largely influenced by an increase in the real return on private capital services (real profit, R), due to increased profitability.

An unanticipated increase in the world price of oil produces a sharp increase in the consumer price level, contributing to lower real money balances. In addition an increase in the price of oil also leads to a decrease in foreign asset stocks. An increase in oil payments, which are denominated in foreign currency, will decrease foreign
exchange reserves. The short run effect upon foreign asset stocks is a decumulation by 2.5% from its base value for the case of an oil price increase, and by some 4% from its base value for the case of an oil requirements increase. A prolonged deficit on current account is indicated by Figure 5.7.

With a depreciation of the real exchange rate there is an improvement in the non-oil trade balance. A deterioration in foreign asset stocks and real money balances, will lead to a deterioration in domestic real wealth for the short run period. Hence the short run impact upon domestic real wealth is very similar to that for foreign asset stocks and real money balances, as shown in Figure 5.8.

(c) Medium Run Adjustment

The effects of either an increase in the oil price or an increase in oil requirements differs from the short run for some variables. The domestic inflation rate declines over the period for Case 2 but increases for Case 1, as shown in Figure 5.1. The inflation rate increases by 0.01% and back to its base value by the end of the medium run period for the case of an oil price increase. For the case of an oil requirements increase, the inflation rate decreases gradually but it remains above its base value by the end of the medium run period.

The price of non-oil output continues to rise over this period contributing to a further depreciation of the real exchange rate by 0.40% from its base value in Case 1 by the end of the medium run, 0.70% from its base value in Case 2. This development also produces a continual improvement in the non-oil trade balance which improves to 0.42% above its base value in Case 1 and 0.69% in Case 2.

The development of non-oil output over the medium run is different from that of the short run period. Figure 5.4 clearly indicates that for Case 1, in the medium run non-oil output declines from 0.14% above its base value by the end of the short run to 0.12% above its base value by the end of the medium run period. This is primarily due to a prolonged deterioration of foreign asset stocks and domestic real wealth. A decline in domestic real wealth leads to a decline in private consumption, contributing
to the decline of non-oil output. Whilst for Case 2, non-oil output continually increases through to the end of the medium run arising from an accumulation of private capital stock on the supply side and an improvement of the non-oil trade balance on the demand side. However by the end of the medium run, non-oil output has increased over its base level by some 0.15%.

Real income is directly affected by developments in non-oil output. Non-oil output declines in the medium run period resulting in a decline in real income, as shown by Figure 5.5 for either Case 1 or 2. For Case 1 real income declines by 0.04% below its base level by the end of the medium run whilst for Case 2 real income declines by only 0.001% below its base value. The extent of adjustment is therefore very small.

The development in the private physical capital stock is mainly affected by the changes in the real return on private capital services (R). As shown in Figure 5.6, Case 1 will lead to a decline in the private capital stock consistent with a decline in non-oil output in the medium run. Non-oil output declines arising from a prolonged decline in foreign asset stocks and domestic real wealth, resulting in a decline in private consumption. Whilst in Case 2 the private physical capital stock continually increases and is consistent with an increase in non-oil output and real income through to the end of the medium run.

Foreign asset stocks and domestic private sector real wealth decline in this period of adjustment for both cases, as shown in Figures 5.7 and 5.8. This is mainly from the oil related shocks producing a persistent current account deficit. Foreign asset stocks primarily decline because of persistent current account deficits, given the nature of an oil-importing economy. The developments in foreign asset stocks affect domestic private sector real wealth. Domestic private wealth will decline consistently with a decline in foreign asset stocks, and real money balances.
(d) **Long Run Adjustment**

There is no effect upon domestic inflation in the long run steady state equilibrium, since in long run equilibrium there is no monetary accommodation.

However there are a number of interesting adjustments for the other macroeconomic variables. The real exchange rate continuously depreciates towards its long run equilibrium by just over 0.48% from its base value for Case 1 and by 0.85% for Case 2, as shown by Figure 5.2. As mentioned an oil price increase will increase oil payments, consequently leading to an increase in the balance of payments deficit. To maintain balance of payments equilibrium the demand for domestic goods (emphasised here as non-oil output) and the imported good must be decreased. A decrease in demand for domestic output decreases its price via the Phillips curve relationship (Equation (20) of Chapter 4). Developments in the real exchange rate have a significant influence upon developments in the remaining macroeconomic variables, as can be observed in the model for the "base case" in Chapter 4.

The long run adjustment also indicates that the non-oil trade balance improves throughout the adjustment process for both cases. This is indicated by a combination of an improvement in non-oil exports and a decline in non-oil imports throughout the adjustment process, as shown in Figure 5.3. 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. The non-oil trade balance continually improves towards long run equilibrium. This is due to an increase in non-oil exports and a continuous decline in non-oil imports throughout the adjustment process to long run steady state. This pattern of adjustment is significantly influenced by developments in the real exchange rate. In addition, an improved non-oil trade balance is required in steady state to ensure current account equilibrium.

Non-oil output is directly encouraged by private consumption and investment and developments in the trade balance. Non-oil output continually decreases from the medium run through to the long run steady state for Case 1, whilst it starts to decline
by the end of the medium run through to the long run steady state for Case 2. This is due to a decline in domestic private consumption and investment. Private consumption declines because of a prolonged current account deficit producing a continual decline in domestic real wealth. Investment declines because of a decumulation in private capital stock, arising from a lower real return on private capital services (a lower R). However with a fixed nominal exchange rate, the real exchange rate will depreciate implying a lower price of domestic goods relative to the price of imported goods. A lower price of domestic goods increases international competitiveness and hence the trade balance is improved.

Real income experiences an initial increase in the short run, but from the medium run it gradually declines until reaching the long run steady state for both cases as in Figure 5.5. The oil related shocks have an adverse impact upon national income for an oil-importing economy like Thailand because of its heavy dependence on imported oil. This is mainly affected through a prolonged negative impact upon the current account deficit consequently leading to an increase in long-term external debt. The persistent external-debt will further induce a higher tax income, consequently a lower real income. Real income declines and is consistent with a decline in non-oil output, as indicated by Equation (2) of Chapter 4.

The simulation results indicate that the private capital stock declines below its base level by only 0.32% for the case of an oil price increase and by only 0.16% for the case of an oil requirements increase, in the long run steady state equilibrium.

The development of the private sector capital stock is largely influenced by developments in the real return to private capital services (R), defined as real profit. The real return on private capital services largely arise from developments in the real income, private capital stock, and government capital stock. The development of the real return on domestic equities (Tobin’s q) is largely influenced by the development in the real return to private capital services. A deterioration in the real return to private capital services will induce a deterioration in the real return on domestic equities, which will further induce a deterioration in the private capital stock. The real return on
private capital services is largely influenced by real income, which would deteriorate due to the effect of the oil price increase. The lower level of real income has decreased the quantity of money demanded, the interest rate falls. A lower nominal domestic interest rate further reduces the rate of return to domestic equities, which are equalised with a lower returns on alternative financial assets through arbitrage.

The simulation results for both cases suggest that foreign asset stocks gradually decline throughout the adjustment process to long run steady state by over 8.08% and 10.68% from their base values, for Cases 1 and 2 respectively. This is due to the decumulation of foreign asset stocks arising from increased oil payments and decreased foreign reserves via the current account equation, as indicated by Equation (16) of Chapter 4. The decumulation of foreign asset stocks throughout the adjustment process indicates persistent current account deficits. The oil shocks cause current account deficits for an oil-importing economy like Thailand. With a fixed exchange rate, the central bank has to sell foreign exchange to those who demand it and when the foreign asset is sold it reduces domestic high-powered money and therefore the money stock. Hence with a fixed exchange rate system, selling foreign exchange to keep the exchange rate from depreciating reduces the domestic money stock implying endogeneity of the money supply.

A depreciation of the real exchange rate improves the non-oil trade balance but overall the current account deteriorates, leading to a deterioration in foreign asset stocks, which leads to a deterioration in domestic private sector real wealth.

Domestic real wealth continually declines to long run steady state by over 5.28% from its base value for Case 1 and by 6.26% from its base value for Case 2, as shown by Figure 5.8. This is primarily caused by a decline in the physical capital stock and foreign asset stocks.

The development of domestic real wealth affects equilibrium output. The oil shocks have a negative impact upon the level of domestic wealth. This is mainly due to a rise in the consumer price level causing lower real money balances and a continual decline in foreign asset stocks (as indicated by Equation (10) of Chapter 4). The
decline in foreign asset stocks leads to a lower domestic capital stock and so investment declines. Hence non-oil output supply will be lower reflecting lower investment, and consequently a lower level of national income will result.

The simulation results, therefore confirm that the oil related shocks lead to a decline in domestic private sector real wealth from its base value and this is most relevant for the case of an oil-importing economy like Thailand.

5.3.3 A Comparison Between Actual Developments and the Simulation Results

In this section a comparison between actual developments arising from the oil shocks of the 1970s and that derived from a simulation of the theoretical model, for an unanticipated oil price shock, will be conducted. The case of an unanticipated oil price increase during the period of the 1970s is focused upon. Thailand was hit hard by the two oil price shocks, which exerted a major external impact upon macroeconomic developments in Thailand during this period. In addition this shock also clearly enables an identification of the actual developments of the key macroeconomic variables during the economic adjustment in Thailand to such shocks, which can then be explicitly compared with the simulation results derived for the unanticipated oil price shock case.

Emphasis is placed upon the adjustment process of four key macroeconomic variables, namely the real exchange rate, the domestic inflation rate, real income, and the current account deficit. A summary of the adjustment process for the actual and simulated cases are presented in Figures 5.9(a) to 5.12(b). The vertical axis for each diagram measures the percentage deviation of that variable from its base value, set equal to zero here. While the horizontal axis measures the relevant time period. Each diagram contains what actually happened to that variable and the simulation results derived for that variable for an unanticipated oil price increase of 1%.

77 The actual developments emphasised are those which occurred in Thailand during the period of the 1970s, arising from the two unanticipated oil price increases in 1973-1974 and 1979-1980.
78 The simulation results presented refer to those obtained for the impact and short run periods, which represent the time period from 0-2 years.
Firstly, the actual adjustment process and the simulation results from the oil price shocks in 1973-1974 and 1979-1980 on the real exchange rate, will be presented in Figures 5.9(a) and 5.9(b) respectively. From Figure 5.9(a) the simulation results indicate that an oil price shock will depreciate the real exchange rate during the short run period (1973-1975), and this is similar to what actually happened in the Thai economy over the equivalent period. The first oil price shock from the simulation leads to a depreciation of the real exchange rate by some 0.31%, given a fixed nominal exchange rate. The actual real exchange rate depreciation was much smaller however, by only 0.02%, and then returned to its base value by the end of the short run period.

Figure 5.9 (b) indicates that for the second oil price shock in 1979-1980, there would again be a continual depreciation of the real exchange rate from its base year (1979) towards the year 1981 by some 0.31%, from the simulation results. Actual developments saw the real exchange rate depreciate in the year 1981 by some 0.01%.

The second macroeconomic variable emphasised is the domestic inflation rate. The adjustment process for the simulation and what actually happened for the domestic inflation rate, will be presented in Figures 5.10 (a) and 5.10 (b).

Figure 5.10 (a) presents the adjustment process of the domestic inflation rate during the period of the first oil price increase (1973-1975). The simulation suggests that the oil price increase will lead to an initial sharp increase in the domestic inflation rate in the early part of 1973 by some 0.07%, then it gradually declines to be above its base value over the short run period by some 0.01%. Actual developments suggests a more gradual but continual increase by some 0.06% in the early part of 1974, then a gradual decline to 0.01% above its base value by 1975.
Figure 5.9 (a)

Real Exchange Rate: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1973-1975

Figure 5.9 (b)

Real Exchange Rate: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1979-1983
Figure 5.10 (a)

Domestic Inflation Rate: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1973-1975

![Figure 5.10 (a) Diagram](image)

Figure 5.10 (b)

Domestic Inflation Rate: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1979-1983

![Figure 5.10 (b) Diagram](image)
Figure 5.10 (b) indicates that the second oil price shock lead to a gradual increase in the inflation rate throughout 1979 but then a sharp increase in the domestic inflation rate in the second quarter of 1980 by some 0.05%, based upon actual developments in the Thai economy. These results are similar to the simulation results.

The third macroeconomic variable emphasised is real income. The adjustment process of real income for both actual developments and the simulation are presented in Figure 5.11 (a) for the period of the first oil price shock, and Figure 5.11 (b) for the period of the second oil price shock.

Figure 5.11 (a) indicates that the first oil price increase will lead to an improvement in real income over the short run period, suggested by the simulation results. Actual developments indicate that real income sharply declined by mid-year 1973, then quickly improved by some 0.15% from its base value in the last quarter of 1973. It again sharply deteriorated by some 0.09% in the early part of 1974, then gradually improved over the short run period.

Figure 5.11 (b) indicates that the second oil price shock will lead to an improvement in real income over the period of 1979-1981, as indicated by the simulation results. Actual developments suggest that real income sharply declined in the second quarter of 1979, due to a sharp increase in the oil price shock leading to a larger deterioration in the current account deficit. It then quickly increased by some 0.10% in the last quarter of 1979. However there was a persistent current account deficit, which contributed to a gradual decline in real income in the early part of 1980. There were stabilising macroeconomic policies adopted in the early part of 1980, contributing a gradual improvement in real income from 1981 onwards.
Figure 5.11 (a)

Real Income: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1973 - 1975

Figure 5.11 (b)

Real Income: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1979 - 1983
Figure 5.12 (a)

Current Account Deficit: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1973 - 1975

Figure 5.12 (b)

Current Account Deficit: Comparison between the actual developments and the simulation result from the unanticipated oil price increases by 1%: 1979 - 1983
A final key macroeconomic variable emphasised is that of the current account deficit. The adjustment process for both actual developments and the simulation results arising from the two oil price shocks, are presented in Figures 5.12 (a) and 5.12 (b).

Figure 5.12 (a) represents the adjustment process for both during the period of the first oil price increase (1973-1975). The simulation result suggests that the current account deficit continually deteriorates throughout the short run, and a similar adjustment is apparent for actual developments in the Thai economy. Figure 5.12 (b) again indicates that the current account deficit continually deteriorates over the period of the second oil price shock, as suggested by the simulation result. Actual developments show that the adjustment process of the current account deficit was much more variable than that for the simulation results.

The actual development of the key macroeconomic variables emphasised are mainly influenced by the oil price increase during the period of the 1970s. The development of the real exchange rate during the period 1970s was unchanged, due mainly to a fixed nominal exchange rate system. The two oil price increases largely affected the current account deficit, the trade performance, investment, and the domestic inflation rate. As a net oil-importing economy, Thailand's trade deficit was adversely affected mainly due to a higher oil import payment during the period of the oil price shocks, contributing to a persistent deterioration in the current account deficits and consequently a fall in real income. A fall in real income induces a decumulation in physical private capital, contributing to a further deterioration in domestic investment. The world oil price increase induced an increase in the domestic price of petroleum, which would lead to a rise in production costs, in particular for the manufacturing sector, and consequently affected all other economic sectors. As a result, wages and salaries increased in all economic sectors. These would contribute to a rise in the domestic inflation rate.
5.4 Summary and Conclusions

This chapter has had two primary objectives. Firstly to empirically estimate a significant part of the base model as outlined in Chapter 4, and secondly to present and interpret the simulation results based on these estimated parameter values for two oil related shocks.

First, before doing any regression estimation all relevant data needs to be tested for stationarity or non-stationarity, according to the augmented Dickey-Fuller unit root tests. The results indicated that all of the economic time series were non-stationary, and appropriate detrending procedures, which corrected for structural change and non-linear growth, were applied to obtain stationary data. Given the presence of endogenous explanatory variables the Order Condition was then used to check for equation identification, and all eight behavioural equations were accordingly estimated by the Two Stage Least Squares (2SLS) technique in order to obtain consistent parameter estimates. Using the detrended data, the 2SLS regression results fit the data very well but indicate that severe multicollinearity is present, which widens the 95% confidence intervals of the estimated coefficients. Accordingly a number of estimated parameters which were not significantly different from zero were replaced, by imposing the parameters derived from relevant existing studies.

The simulations conducted for the “base case” were derived from the macroeconomic model developed in Chapter 4, utilising the parameters in Table 5.4 for the first sub-period (1971.1-1980.4). The “base case” assumes a fixed nominal exchange rate and highly controlled capital mobility, combined with high trade barriers on both domestic and international trade as well as a poor provision of public infrastructure spending.

The analysis emphasised eight key macroeconomic variables, the real exchange rate, foreign asset stocks, private capital stock, non-oil output, real income (national income), non-oil trade balance (non-oil exports less non-oil imports), domestic private real wealth, and the domestic inflation rate. 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 unanticipated 1 percent increase in the oil price and an unanticipated 1 percent increase in domestic oil requirements.

The major conclusion arising from these simulations, either for an oil price or oil requirements shock, is that the effects of the oil related shocks on an oil-importing economy like Thailand is likely to be significant, both for long run steady state and for the adjustment process. An oil-importing economy such as Thailand is likely to face major negative impacts from an increase in domestic oil requirements and an oil price increase shock.

In the long run equilibrium, foreign asset stocks, private capital stock, non-oil output, real income, and domestic real wealth declined for either an oil price increase or domestic oil requirements increase. Overall the two oil related shocks have an adverse impact upon the economy. This is indicated by the fact that in the long run real income and the physical private capital stock decline from their base value. This decline in real income will adversely affect consumption and imports on the demand side. The reduction in private physical capital stock will reduce investment which will have an important adverse effect upon the supply of output.

A major conclusion of this analysis is that overall the two oil related shocks have an adverse impact upon the economy, and it is likely to be more so from an equivalent shock to domestic oil requirements. The oil shock consequences exist and are more intense during the early stages of the adjustment process. This is shown by an increase in non-oil exports and a decrease in non-oil imports, arising from a larger depreciation of the real exchange rate.

In conclusion, an oil-importing economy like Thailand could alleviate the impact of the two oil related shocks upon its economy by focusing upon three major alternative policy options. These alternative policies relate to; the contribution of the
public capital stock to enhance domestic investment; the contribution of a trade liberalisation policy, focusing upon a reduction in trade barriers to improve the performance of the trade sector; a change in the nominal exchange rate regime from fixed to flexible; and deregulation of financial markets, to better cope with the adjustment process arising from oil related shocks. An analysis of these alternative policies will be conducted in the following chapter.
CHAPTER 6
ALTERNATIVE POLICY ANALYSIS

6.1 Introduction

This chapter focuses upon analysing alternative government policy responses towards oil related shocks, and the potential effects upon the macroeconomy arising from these policy responses. These are then compared to the results derived for the base case outlined in Chapter 5. This analysis will provide alternative policy options for managing the oil related shocks in order to minimise their macroeconomic consequences, and hence enhance the improvement of macroeconomic management.

The policy responses emphasised focus upon three broad categories. The first category consists of alternative policies with regard to trade liberalisation, whilst the second category deals with the act of public infrastructure capital spending. Finally, the third category deals with financial liberalisation, emphasising the nominal exchange rate regime and the operation of capital markets. Trade liberalisation\(^7^9\), as emphasised here, focuses upon the reduction of trade barriers to enhance trade performance, with this ranging from less to more trade protection. With regards to the role of government capital spending, this can range from less to more spending on infrastructure development\(^8^0\). Such infrastructure spending being assumed complementary to that of private investment. Whilst with the final category, the nominal exchange rate can range from being fixed to perfectly flexible. In the case of capital markets, the policy could range from no mobility to perfect capital mobility internationally.

Thailand performed its macroeconomic adjustment to the oil related shocks, with a fixed exchange rate regime combined with a very high degree of capital control,

\(^7^9\)Trade liberalisation emphasised in this study relates to the reduction in trade barriers in order to enhance trade performance, and in particular non-oil trade. The trade barriers emphasised are imposed on both non-oil exports and non-oil imports. In order to analyse the effect of a reduction in trade barriers, the degree of trade barriers imposed on non-oil exports and non-oil imports will be varied from less to more.

\(^8^0\)Throughout this thesis, infrastructure as emphasised here relates to transportation (roads, railways, airports) and telecommunications networks.
a poor provision of infrastructure, and the country's trade was highly subjected to trade regulations. To achieve economic growth and stability for the country, the government is attempting to liberalise the economy through trade liberalisation, increased public infrastructure capital spending, and by adopting a more flexible nominal exchange rate combined with a more open capital market. These alternative policy options could be utilised to overcome economic problems as well as the recent interaction with the global economy in order to maintain sustainable growth of the economy, arising from oil and domestic shocks.

To analyse these alternative policy options the model outlined in Chapter 4, using its associated parameter values estimated in Chapter 5, will be simulated and the results compared from altering the relevant policy parameters. As mentioned in

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81 Thailand is a small-open economy, whose trade will be affected by developments in the rest of the world. International trade is a significant issue for domestic economic development. Hence the imposition of trade regulations by both the domestic authority and the rest of the world will affect domestic international trade performance. Hence trade liberalisation policy is one major area of policy which government is attempting to liberalise in order to achieve economic growth and stability for the country. In doing so, both domestic and international trade barriers will be taken to be a major focus of a movement toward a trade liberalisation policy.

82 The World Bank Report (1990) suggested that an outward-oriented growth strategy will serve Thailand's aspiration to become a NIC. More specifically, export promotion (mainly of the less interventionist, market-led kind) will remain a promising principal strategy for the Thai economy in the medium term. At the same time, however, it would be risky to rest the whole cause of growth on this one strategy.

83 This issue has been stated in the findings of Tambunlertchai, S. (1989). This research asserted that the growth of the Thai economy had strained the capacity of the country's infrastructure, in particular transportation, telecommunications networks, and skilled labour. The research suggested that for further growth and development, public sector investment in infrastructure projects should continue for a number of years. In addition, the government is expected to invest more in transportation, telecommunications networks, and education facilities to upgrade labour force skills and particularly in scientific research.

84 This issue is confirmed by a study conducted by Tambunlertchai, S. (1989) that a stable macroeconomic environment and rational economic policies on trade and investment are important internal factors that would influence Thailand’s future development. Thailand has been relatively successful in maintaining economic stability. The prudent approach toward macroeconomic management should be continued in the future. A flexible management of the exchange rate to avoid overvaluation of the baht is important. The incentive structure on trade and investment, which still renders high protection to some-import-competing industries, should be further rationalised.

85 According to the findings from Tambunlertchai S. (1989), despite the impressive economic achievements and favourable predictions for the economy of Thailand, a number of major issues need to be addressed. First, the very bullish growth of the Thai economy has now strained the capacity of the country's infrastructure, in particular transportation, telecommunications networks, and the educated labour force. Second, the country is facing increasing trade pressure, especially under conditions of sluggish the OECD growth and increased trade protectionism. Third, there will be increasing environmental problems arising from the speed of industrialisation. Fourth, past economic growth has not resulted in a more equitable income distribution. Hence the income distribution has worsened and the majority of the population is still poor.
Chapter 5, the analysis will focus again on eight key macroeconomic variables which are: the real exchange rate, foreign asset stocks, private physical capital stock, non-oil output, real income, non-oil trade balance (non-oil exports less non-oil imports), domestic private real wealth, and the domestic inflation rate. The simulation results for these alternative policy options are then compared to the results derived for the base case outlined in Chapter 5.

The discussion will be divided into three sections; the adoption of a trade liberalisation policy and how this compares relative to the base case, the use of public infrastructure spending policy options relative to the base case, and alternative nominal exchange rate regimes combined with different assumptions relating to the openness of capital markets.

A summary, conclusion and policy implications derived from this analysis will be presented at the end of the chapter.

6.2 Trade Liberalisation Policy

In this policy analysis, three Scenarios A, B, and C will be emphasised. Scenario A is the base case outlined in Chapter 5. Whilst Scenarios B and C represent different degrees of trade liberalisation relative to the base case. For Scenario B the trade barriers\(^{86}\) imposed on both exports and imports are reduced relative to the base case, representing the adoption\(^{87}\) of a trade liberalisation policy. In Scenario C, trade barriers imposed on both exports and imports are increased relative to the base case, representing a movement by the country and world towards greater trade protection.

\(^{86}\) The trade barriers emphasised here are imposed on both Thailand’s exports and imports. Trade barriers on exports are considered to be increased trade protectionism by the OECD, whilst trade barriers on imports are considered as import tariffs and import quotas imposed by the domestic authorities.

\(^{87}\) The term "adoption" needs to be clarified in the present context. The Thai government can only directly control barriers to imports, however in a broader context, such as participation in APEC, it can also contribute to a reduction in trade barriers imposed by other countries on Thai exports.
The relevant policy parameters in this regard are $\Sigma_3$ and $m_3$. In the base case $\Sigma_3$ and $m_3$ are 0.5. A trade liberalisation policy stance would be equivalent to a smaller $\Sigma_3$ and $m_3$ so that $\Sigma_3$ and $m_3$ are 0, as in Scenario B, or vice versa for the increased trade barrier stance, $\Sigma_3$ and $m_3$ are 1, as in Scenario C. These three scenarios will be simulated for the two oil shock cases, previously presented in Chapter 5. Each oil related shock case will be discussed separately. The long run steady state equilibrium will be summarised in tables, whilst the discussion of the adjustment process will be divided into instantaneous impact, short run, medium run, and long run periods as previously discussed in Chapter 5.

6.2.1 Case 1: A Positive Shock to the Oil Price

This case is concerned with an analysis of an unanticipated positive oil price shock, under alternative trade orientated policies. A summary of the long run steady state properties of the model for the oil price shock arising from alternative trade oriented policies is contained in Table 6.1 below.

In this case, altering $\Sigma_3$ and $m_3$ will have an effect upon the real exchange rate, the non-oil trade balance, non-oil output, foreign asset stocks, and domestic private sector real wealth. It has a much smaller effect upon the physical capital stock and real income.
Table 6.1
Steady State Properties of the Model for a 1% Increase in the Price of Oil in
Conjunction with Trade Policies
(% deviation from the base level)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Instantaneous impact</th>
<th>Short-run (a)</th>
<th>Medium-run (c)</th>
<th>Long-run (d)</th>
<th>Instantaneous impact</th>
<th>Short-run (b)</th>
<th>Medium-run (c)</th>
<th>Long-run (d)</th>
<th>Instantaneous impact</th>
<th>Short-run (b)</th>
<th>Medium-run (c)</th>
<th>Long-run (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td></td>
<td>0.31</td>
<td>0.40</td>
<td>0.48</td>
<td></td>
<td>0.83</td>
<td>1.29</td>
<td>1.89</td>
<td></td>
<td>0.38</td>
<td>0.42</td>
<td>0.56</td>
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<tr>
<td></td>
<td>c</td>
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<td>0</td>
<td>0.09</td>
<td>f</td>
<td>-1.82</td>
<td>-3.49</td>
<td>-8.08</td>
<td>kP</td>
<td>0.10</td>
<td>0.04</td>
<td>-0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.05</td>
<td>y</td>
<td>0.02</td>
<td>0.04</td>
<td>-0.27</td>
<td>y^non</td>
<td>0.05</td>
<td>0.12</td>
<td>-0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.05</td>
<td>t_non</td>
<td>0.15</td>
<td>0.12</td>
<td>-0.08</td>
<td>w^P</td>
<td>-0.005</td>
<td>0.42</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.005</td>
<td></td>
<td>-0.89</td>
<td>1.98</td>
<td>5.28</td>
<td></td>
<td>-0.01</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Notes: + Increase (depreciation) of that variable
- Decrease (appreciation) of that variable

Scenario A1 The "base case" (outlined in Chapter 5), where \( \Sigma_3 = 0.5, \) and \( m_3 = 0.5, \) in conjunction with an increase in the oil price by 1%.

Scenario B1 The case of trade liberalisation relative to the "base case", where \( \Sigma_3 = 0, \) and \( m_3 = 0, \) in conjunction with an increase in the oil price by 1%.

Scenario C1 The case of increased trade protectionism relative to the "base case", where \( \Sigma_3 = 1, \) and \( m_3 = 1, \) in conjunction with an increase in the oil price by 1%.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>The real exchange rate</td>
</tr>
<tr>
<td>f</td>
<td>Foreign asset stocks</td>
</tr>
<tr>
<td>kP</td>
<td>Physical private capital stock</td>
</tr>
<tr>
<td>y^non</td>
<td>Demand for non-oil output</td>
</tr>
<tr>
<td>y</td>
<td>Real income</td>
</tr>
<tr>
<td>t_non</td>
<td>Non-oil trade balance (non-oil exports less non-oil imports)</td>
</tr>
<tr>
<td>w^P</td>
<td>Domestic private sector real wealth</td>
</tr>
</tbody>
</table>
Domestic inflation rate

(a) Instantaneous impact is represented by the base period (0)
(b) The short run is represented from years 0-2
(c) The medium run is represented from years 2-5
(d) The long run is represented from year 5 onwards.

(a) **Instantaneous Impact**

The instantaneous impact of a positive shock to the oil price is an immediate decrease in the domestic inflation rate in all scenarios. This is mainly due to an immediate fall in the price of non-oil output (Equation 20 of Chapter 4). Increased trade protectionism produces a very much larger fall in the inflation rate as in Scenario C1. In the base case the inflation rate decreases slightly, in comparison to Scenarios B1 and C1. The non-oil trade balance improves slightly in all scenarios. Scenario A1 produces a larger improvement in the non-oil trade balance. This is because of a rise in non-oil exports rather than non-oil imports. An improvement in the non-oil trade balance contributes to a slight increase in real income, consequently leading to a rise in domestic demand for non-oil output. However private sector real wealth instantaneously deteriorates in all scenarios. Table 6.1 clearly shows that the results of a deterioration in private sector real wealth are identical in all scenarios, due to the nature of an oil-importing economy like Thailand.

The real exchange rate, foreign asset stocks and private physical capital stock do not change instantaneously, since they are control variables in the model. However they will be affected by an increase in the price of oil in the short, medium, and long run.

(b) **Short Run Adjustment**

The inflation rate increases in all scenarios during the short run period, as shown in Figure 6.2.1 (a). By the end of the short run however it remains below its base value in Scenarios A1 and B1, but reaching its base value in Scenario C1. By the
end of the short run period, a larger decline occurs in Scenario B1 where a trade liberalisation policy is adopted.

The real exchange rate adjustment is explained by the adjustment of the price of non-oil output. Over the short run period, the price of non-oil output gradually declines. This decline will lead to a depreciation of the real exchange rate, given the definition of the real exchange rate (Equation 22 of Chapter 4). The real exchange rate depreciates regardless of the numerical values of $\Sigma_3$ and $m_3$, as shown in Figure 6.2.1(b). A trade liberalisation policy produces a larger depreciation of the real exchange by over 0.8% from its base value as in Scenario B1, whilst it depreciates by some 0.4% from its base value in Scenario C1 and in Scenario A1 it depreciates by only 0.3% from its base value.

The adjustment paths of the non-oil trade balance in the short run period in Scenario C1 is similar to that of Scenario A1, whilst with Scenario B1 there is a noticeable difference. Figure 6.2.1 (c) clearly shows these developments. That is the non-oil trade balance improves by the end of the short run by some 0.3% from its base value in Scenario A1, by 0.85% in Scenario B1, and by 0.35% from its base value in Scenario C1. The non-oil trade balance noticeably improves in the scenario where a trade liberalisation policy is adopted, arising from a larger depreciation of the real exchange rate.

As can be seen from Figure 6.2.1(d), a trade liberalisation policy leads to an improvement in non-oil output demand in the short run. The pattern of adjustment thereafter is as in Scenario A1. Whilst the increased trade protectionism leads to a decline in demand for non-oil output over the short run. On the demand side, demand for non-oil output increases due to an improvement in the non-oil trade balance, resulting in a rise in real income and domestic demand. On the supply side, non-oil output increases due to an accumulation of physical capital stock, reflecting a rise in investment. The development paths of real income and physical capital stock are shown in Figures 6.2.1 (e) and 6.2.1(f).
Foreign asset stocks gradually decline over the short run, as can be clearly seen from Figure 6.2.1 (g). A larger decline in foreign asset stocks arises from a trade liberalisation policy (Scenario B1). The development of foreign asset stocks contributes to the development of domestic private sector real wealth. Private sector real wealth decumulates in all scenarios over the short run, and is consistent with a decline in foreign asset stocks, as can be seen in Figure 6.2.1(h).

(c) Medium Run Adjustment

Over the medium run, there is a negligible effect upon the inflation rate in Scenarios A1 and C1, but this is not so for Scenario B1, as shown in Figure 6.2.1(a). Over the medium run the inflation rate noticeably increases, but it remains below its base value by 0.02% by the end of the medium run. The real exchange rate depreciates with a fixed nominal exchange rate, arising from a decline in the price of non-oil output. A trade liberalisation policy also leads to a larger depreciation of the real exchange rate, as can be seen from Figure 6.2.1(b). The non-oil trade balance improves over the medium run, with a larger improvement where a trade liberalisation policy is adopted.

Non-oil output demand gradually declines over the medium run in Scenario A1. It continually improves over the same period in Scenario B1. Where there is increased trade protectionism non-oil output continually declines, as shown in Figure 6.2.1(d). However Table 6.1 clearly indicates that by the end of the medium run, the demand for non-oil output improves by 0.12% from its base value in Scenario A1, 0.4% from its base value in Scenario B1 whilst it deteriorates by 0.04% from its base value in Scenario C1. The non-oil trade balance improvement leads to a rise in demand for non-oil output, consequently a rise in real income under a trade liberalisation policy.

Over the medium run the physical capital stock starts to decline in Scenario A1, whilst in Scenario B1 it continually increases from the end of the short run. By the end of the medium run, the physical capital stock however still accumulates by some 0.1%
Figure 6.2.1
Trade Policy Response to a Positive Shock to the Oil Price

(a) Inflation Rate

![Graph showing domestic inflation rate over years for different scenarios (Scenario A1, Scenario B1, Scenario C1).](image)

(b) Real Exchange Rate

![Graph showing real exchange rate over years for different scenarios (Scenario A1, Scenario B1, Scenario C1).](image)
(c) Non-Oil Trade Balance

![Non-oil trade balance graph](image)

(d) Demand for Non-Oil Output

![Non-oil output graph](image)
(e)  Real Income

![Real Income Graph]

(f)  Private Physical Capital Stock

![Physical Private Capital Stock Graph]
(g) Foreign Asset Stocks

![Graph showing Foreign asset stocks with percentage deviation from the base level over years for different scenarios.]

- Scenario A1
- Scenario B1
- Scenario C1

(h) Domestic Private Sector Real Wealth

![Graph showing Domestic private sector real wealth with percentage deviation from the base level over years for different scenarios.]

- Scenario A1
- Scenario B1
- Scenario C1
from its base value in Scenario A1 and by 0.27% in Scenario B1. It continually
decumulates by some 0.04% in Scenario C1, from its base value.

The adjustment paths of foreign asset stocks and domestic private sector real
wealth are very similar. They continually decline through to the end of the medium run,
which is indicative of persistent current account deficits.

(d) Long Run Adjustment

The simulation results suggest that there is no long run effect upon the inflation
rate in all scenarios, this is due to the fact that there is no monetary accommodation in
the long run equilibrium\(^ {88}\). The real exchange rate depreciates through to the long run
in all scenarios, with a larger depreciation in Scenario B1. This contributes to a larger
improvement in the non-oil trade balance. Increased trade protectionism in conjunction
with an increase in the price of oil, results in a smaller improvement in the non-oil trade
balance mainly due to a smaller depreciation of the real exchange rate.

A trade liberalisation policy has a more favourable effect upon non-oil output
demand in comparison to the other scenarios. Non-oil output demand slightly
decreases by only 0.0002% from its base value. This can be explained on the supply
side by a smaller decline in the capital stock. On the demand side, a larger
improvement in the non-oil trade balance contributes to an increase in non-oil demand,
consequently a smaller decline in overall domestic demand.

Over the long run the private capital stock continually declines through to the
long run steady state, with a trade liberalisation policy producing a smaller decline in
this.

Foreign asset stocks decline below their base value in long run equilibrium in all
scenarios. The adoption of a trade liberalisation policy produces a larger decumulation
in foreign asset stocks. This indicates that the adjustment process is characterised by
persistent current account deficits.

\(^{88}\) In the long run the current account balance must be zero, otherwise wealth effects will persist.

There will be no monetary accommodation in the long run equilibrium hence \(<m, pc\) and \(<pn\) will be equal to zero.
Private sector real wealth declines initially in all scenarios, and continuously thereafter until reaching long run steady state equilibrium. The adjustment of private sector real wealth is mainly influenced by developments in the foreign asset stock. A larger decumulation of private sector real wealth arises from trade liberalisation as in Scenario B1.

Overall these results suggest that the adoption of a trade liberalisation policy relative to that of Scenario A1, has favourable effects upon the non-oil trade balance, physical capital stock, non-oil output, and real income. Whilst such a strategy has potentially unfavourable effects upon foreign asset stocks and private sector real wealth.

6.2.2 Case 2: A Positive Shock to Domestic Oil Requirements

The steady state properties of the model for this case again indicate that a trade liberalisation policy in conjunction with a domestic oil requirements increase, has an important effect upon the development of the macroeconomy. A summary of the steady state properties of the key macroeconomic variables and the adjustment to a positive shock to domestic oil requirements is summarised in Table 6.2. These results are similar to those of case 1, but the size of adjustment is different.

(a) Instantaneous Impact

The results for some variables for this case are similar to those of case 1, but the size of adjustment of each key variable is noticeably different. The interesting difference occurs for the rate of inflation. Table 6.2 suggests that the domestic inflation rate immediately increases on impact in Scenarios A2 and B2, with a larger increase in Scenario B2. Whilst it instantaneously declines by some 0.03% below its base value in Scenario C2. A positive domestic oil requirements shock produces a rise in the rate of inflation on impact, in conjunction with a trade liberalisation policy. Whilst an increase in trade protection will cause a decline in the rate of inflation on impact. The rate of inflation declines, arising from an instantaneous decline in the price of non-oil output.
The adjustment path of the price of non-oil output contributes to developments of the real exchange rate for the short, medium, and long run.

The non-oil trade balance slightly improves in all scenarios, with a larger improvement in Scenario A2. This contributes to an increase in demand for non-oil output, consequently leading to a rise in real income.

Private sector real wealth instantaneously decumulates in all scenarios, arising from an increase in domestic oil requirements. A larger decumulation in private sector real wealth arises from an increase in trade protection as in Scenario C2.

The real exchange rate, foreign asset stocks, and private capital stock do not change on impact, since they are control variables in the model.

(b) Short Run Adjustment

Over the short run, the inflation rate increases from its base value in Scenario A2, but decreases below its base value in Scenario B2 whilst it reaches its base value in Scenario C2. A larger decrease occurring where a trade liberalisation policy is adopted, as indicated in Figure 6.2.2 (a). Whilst Figure 6.2.2 (b) indicates that the real exchange rate depreciates in all scenarios over the short run, with a larger depreciation in Scenario B2 where a trade liberalisation policy is adopted. The development of the real exchange rate arises from developments in the price of non-oil output, given the definition of the real exchange rate in Chapter 4.
Table 6.2
Steady State Properties of the Model for a 1% Increase in Domestic Oil Requirements in Conjunction with Various Trade Policies

(% deviation from the base level)

<table>
<thead>
<tr>
<th></th>
<th>c</th>
<th>f</th>
<th>k^P</th>
<th>y</th>
<th>y^d non</th>
<th>t^non</th>
<th>w^P</th>
<th>*</th>
<th>pc</th>
</tr>
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<tr>
<td><strong>Scenario A2</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact^a</td>
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<td>0.05</td>
<td>-0.0001</td>
<td>0.05</td>
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<td>0.04</td>
<td>0.09</td>
<td>0.42</td>
<td>-1.32</td>
<td>0.02</td>
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<tr>
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<td>-0.16</td>
<td>0.97</td>
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<tr>
<td><strong>Scenario B2</strong></td>
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<td>0.00001</td>
<td>0.00001</td>
<td>0.00001</td>
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<tr>
<td>Short-run (b)</td>
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<td>0.19</td>
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<tr>
<td>Medium-run (c)</td>
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<tr>
<td>Long-run (d)</td>
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<td>0.05</td>
<td>-0.57</td>
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<td>2.06</td>
<td>-25.38</td>
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<tr>
<td><strong>Scenario C2</strong></td>
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<td></td>
</tr>
<tr>
<td>Instantaneous impact^a</td>
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<td>0</td>
<td>0</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.004</td>
<td>-0.0003</td>
<td>-0.03</td>
<td></td>
</tr>
<tr>
<td>Short-run (b)</td>
<td>0.10</td>
<td>-0.48</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.02</td>
<td>0.09</td>
<td>0.23</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Medium-run (c)</td>
<td>0.14</td>
<td>-0.88</td>
<td>0</td>
<td>0.01</td>
<td>0.0002</td>
<td>0.13</td>
<td>-0.55</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Long-run (d)</td>
<td>0.17</td>
<td>-2.04</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.20</td>
<td>-1.70</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

+     Increase (depreciation of that variable)
-     Decrease (appreciation of the variable)

Scenario A2  The base case (outlined in Chapter 5), where \( \Sigma_3 = 0.5 \), and \( m_3 = 0.5 \), in conjunction with an increase in domestic oil requirements by 1%

Scenario B2  The case of trade liberalisation relative to the “base case”, where \( \Sigma_3 = 0 \), and \( m_3 = 0 \), in conjunction with an increase in domestic oil requirements by 1%

Scenario C2  The case of increased trade protectionism relative to the “base case”, where \( \Sigma_3 = 1 \), and \( m_3 = 1 \), in conjunction with an increase in domestic oil requirements by 1%

(a) Instantaneous impact is represented for the base period (0)
(b) The short run is represented from years 0-2
(c) The medium run is represented from years 2-5
(d) The long run is represented from year 5 onwards.

c  The real exchange rate
It can be seen in Figure 6.2.2 (c) that the non-oil trade balance improves in all scenarios. A larger improvement in the non-oil trade balance arises from a larger depreciation of the real exchange rate as in Scenario B2. The short run adjustment paths of non-oil output demand in the base case and Scenario B2 are very similar but the magnitudes are quite different. It rises over the short run, increasing by more where a trade liberalisation policy is adopted, as shown in Figure 6.2.2 (d). There is also an increase in non-oil output supply arising from an accumulation of physical capital stock, as shown in Figure 6.2.2 (e). Increased trade protectionism will lead to a slight decumulation in the physical capital stock by only 0.02% from its base value.

Foreign asset stocks decline in all scenarios over the short run, with a larger decline in Scenario B2 where trade liberalisation is adopted, as shown in Figure 6.2.2 (f). This is reflected in a decline in private sector real wealth over the short run.

(c) **Medium Run Adjustment**

The adjustment path of each macroeconomic variable in conjunction with a positive shock to domestic oil requirements in the medium run is very similar to those of case 1. By the end of the medium run, the inflation rate increases above its base value by only 0.01% in Scenario A2. Whilst it declines below its base value by 0.01% in Scenario B2, but it declines to its base value in Scenario C2. The real exchange rate continually depreciates from the short run to the end of the medium run, with a larger depreciation apparent where a trade liberalisation policy is adopted.

The non-oil trade balance continually improves over the medium run in all scenarios. A larger depreciation of the real exchange rate contributes to a larger
improvement in the non-oil trade balance as in the scenario where a trade liberalisation policy is adopted.

The medium run adjustment path of non-oil output is similar to that of case 1. It continually increases over this period in all scenarios. In Scenario B2 non-oil output demand largely increases by just under 0.3% from its base value, whilst in Scenario C2 non-oil output demand slightly increases by 0.0002% from its base value over the period. This can be explained by an accumulation in the physical capital stock which contributes to a rise in non-oil output on the supply side. On the demand side an improvement in non-oil output will stimulate domestic demand, which leads to an increase in non-oil output demand consequently resulting in an increase in real income.

Foreign asset stocks deteriorate in all scenarios over the medium run. This deterioration is larger where a trade liberalisation policy is adopted, where it is below its base value by some 12%. In Scenario A2 foreign asset stocks decline by some 6% below its base value, and in Scenario C2 it declines below its base value by only 0.8%. Domestic private sector real wealth decumulates in all scenarios over the medium run, and is consistent with the decline in foreign asset stocks.

(d) Long Run Adjustment

The simulation results suggest that there is no effect upon the domestic inflation rate in all scenarios in the long run equilibrium, this is due to there being no monetary accommodation. A trade liberalisation policy produces a larger depreciation of the real exchange rate, contributing to a larger improvement in the non-oil trade balance.

A trade liberalisation policy has a favourable effect on non-oil output as in Scenario B2. On the supply side, this growth in non-oil output can be explained by growth of the capital stock. On the demand side greater investment in the capital stock and higher private sector real wealth contribute to buoyant domestic demand, combined with a larger improvement of the non-oil trade balance.
However, foreign asset stocks decline by more with a trade liberalisation policy. Private sector real wealth will also be affected throughout the adjustment process. The results from Table 6.2 clearly indicate that a trade liberalisation policy produces an unfavourable effect upon foreign asset stocks and private sector real wealth, arising from an oil requirements increase.

Overall these results suggest that a trade liberalisation policy, in conjunction with an increase in domestic oil requirements, will benefit the non-oil trade balance, non-oil output, real income, and physical capital stock. Whilst such a strategy produces an unfavourable effect upon foreign asset stocks and private sector real wealth, in the long run steady state.89

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89 These results are consistent with the World Bank Report (1990). This study indicated that a trade development strategy will benefit the whole economy in the medium term.
Figure 6.2.2
Trade Policy Responses to a Positive Shock to Domestic Oil Requirements

(a) Inflation Rate

![Inflation Rate Graph]

(b) Real Exchange Rate

![Real Exchange Rate Graph]
(c) Non-Oil Trade Balance

![Non-oil trade balance graph]

(d) Demand for Non-Oil Output

![Non-oil output graph]
(e) **Real Income**

![Real Income Graph](image)

(Scenario A2 — Scenario B2 — X — Scenario C2)

(f) **Private Physical Capital Stock**

![Private Physical Capital Stock Graph](image)

(Scenario A2 — Scenario B2 — X — Scenario C2)
(g) Foreign Asset Stocks

Foreign asset stocks

% deviation from the base level

years

Scenario A2  —  Scenario B2  — Scenario C2

(b) Domestic Private Sector Real Wealth

Domestic private sector real wealth

% deviation from the base level

years

Scenario A2  —  Scenario B2  — Scenario C2
6.3 Public Infrastructure Capital Spending Policy

The policy response emphasised here relates to that of public infrastructure capital spending. The policy determined variable is the optimum public capital stock ($k^g$). The model can be shocked by raising or lowering the optimum public capital stock level. Three policy Scenarios A, D, and E will now be emphasised. Scenario A is the base case outlined in Chapter 5. In Scenarios D and E the optimum government capital stock level relative to the base case is changed. Scenario D represents the case where the optimum public capital stock is increased by 1% ($k^g$ is set equal to 0.01). Whilst Scenario E represents the case where the optimum public capital stock is decreased by 1%, setting $k^g$ equal to (-0.01). A summary of the consequences from altering the optimum public capital stock, $k^g$ is shown in Table 6.3 below.

Table 6.3
A Summary of Altering the Public Infrastructure Capital Spending Policy

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>$k^g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>The “base case”</td>
<td>0</td>
</tr>
<tr>
<td>Scenario D</td>
<td>Increased by 1% (0.01)</td>
</tr>
<tr>
<td>Scenario E</td>
<td>Decreased by 1% (-0.01)</td>
</tr>
</tbody>
</table>

Each oil related shock case will be discussed separately as in the previous section. The long run steady state equilibrium will be summarised in tables. Whilst the discussion of the adjustment process will be divided into the instantaneous impact, short run, medium run, and long run. Case 1 will be discussed firstly.

6.3.1 Case 1: A Positive Shock to the Oil Price

This case is concerned with analysing a positive oil price shock, occurring in conjunction with the adoption of a public infrastructure capital spending policy. The
Simulation results indicate that additional infrastructure investment plays an important role in the development of all major macroeconomic variables, as can be observed from Table 6.4. The adjustment path for each macroeconomic variable aforementioned is presented in Figures 6.3.1 (a) to 6.3.1 (h).

(a) **Instantaneous Impact**

An unanticipated increase in the oil price leads to an instantaneous decline in the domestic inflation rate in Scenarios A1 and D1, whilst the case where the optimum public capital stock is decreased results in the domestic inflation rate instantaneously increasing by some 0.03% as shown in Scenario E1 and clearly shown in Table 6.4.

A public capital spending policy produces an instantaneous decline in private sector real wealth, although this is almost negligible. A larger decline is apparent in Scenario A1, although again this is very small.

The non-oil trade balance instantaneously improves in all scenarios. This improvement stimulates the demand for non-oil output, and consequently contributes to a rise in real income. It can be clearly seen from Table 6.4, however, that these improvements are very slight.

The real exchange rate, foreign asset stocks, and private capital stock do not change instantaneously, since they are control variables in the model.
Table 6.4
Steady State Properties of the Model for A 1% increase in the Price of Oil in
Conjunction with Various Public Infrastructure Spending Policies
(% deviation from the base level)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Instantaneous impact&lt;sup&gt;(a)&lt;/sup&gt;</th>
<th>Short-run&lt;sup&gt;(b)&lt;/sup&gt;</th>
<th>Medium-run&lt;sup&gt;(c)&lt;/sup&gt;</th>
<th>Long-run&lt;sup&gt;(d)&lt;/sup&gt;</th>
<th>Instantaneous impact&lt;sup&gt;(a)&lt;/sup&gt;</th>
<th>Short-run&lt;sup&gt;(b)&lt;/sup&gt;</th>
<th>Medium-run&lt;sup&gt;(c)&lt;/sup&gt;</th>
<th>Long-run&lt;sup&gt;(d)&lt;/sup&gt;</th>
<th>Instantaneous impact&lt;sup&gt;(a)&lt;/sup&gt;</th>
<th>Short-run&lt;sup&gt;(b)&lt;/sup&gt;</th>
<th>Medium-run&lt;sup&gt;(c)&lt;/sup&gt;</th>
<th>Long-run&lt;sup&gt;(d)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario A1</td>
<td>0.44</td>
<td>-3.02</td>
<td>0.09</td>
<td>0.04</td>
<td>0.09</td>
<td>0.42</td>
<td>-1.32</td>
<td>-0.01</td>
<td>0.85</td>
<td>-10.68</td>
<td>-0.16</td>
<td>-0.23</td>
</tr>
<tr>
<td>Scenario D1</td>
<td>-0.12</td>
<td>0.42</td>
<td>0.78</td>
<td>0.27</td>
<td>0.58</td>
<td>0.65</td>
<td>0.04</td>
<td>-0.04</td>
<td>0.93</td>
<td>1.89</td>
<td>1.16</td>
<td>1.06</td>
</tr>
<tr>
<td>Scenario E1</td>
<td>-0.16</td>
<td>-0.22</td>
<td>-0.25</td>
<td>-0.22</td>
<td>-0.29</td>
<td>-0.05</td>
<td>-0.22</td>
<td>0.02</td>
<td>-0.20</td>
<td>-2.40</td>
<td>-2.50</td>
<td>-1.59</td>
</tr>
</tbody>
</table>

Notes:
+ Increase (depreciation of that variable)
- Decrease (appreciation of the variable)

Scenario A1 The base case (outlined in Chapter 5), in which $k^e$ is set to 0, and $\psi$ is set to 0.2, in conjunction with an increase in the oil price by 1%.

Scenario D1 The case of an increase in $k^e$ by 1% (0.01), whilst $\psi = 0.2$, in conjunction with an increase in the oil price by 1%.

Scenario E1 The case of a decrease in $k^e$ by 1% (-0.01), whilst $\psi = 0.2$, in conjunction with an increase in the oil price by 1%.

(a) Instantaneous impact is represented for the base period (0)
(b) The short run is represented from years 0-2
(c) The medium run is represented from years 2-5
(d) The long run is represented from year 5 onwards.

c The real exchange rate
f Foreign asset stocks
$k^p$ Physical private capital stock
$y^d_{non}$ Demand for non-oil output
y Real income
Short Run Adjustment

Initially the inflation rate increases in Scenarios A1 and D1, whilst the case where the optimum public capital stock is decreased the domestic inflation rate decreases to its base value, as clearly shown in Figure 6.3.1(a). Over the short run, a larger depreciation of the real exchange rate occurs in the case where the optimum public capital stock is increased by 1%, as shown in Figure 6.3.1(b) and this contributes to an improvement in the non-oil trade balance. Figure 6.3.1 (c) indicates a larger improvement in the non-oil trade balance arising from the larger depreciation of the real exchange rate in Scenario D1, over the short run adjustment period. Whilst an appreciation of the real exchange rate occurs in the case where the optimum public capital stock is decreased by 1%, as shown in Scenario E1, contributing to a deterioration in the non-oil trade balance by some 0.05%, as indicated in Figure 6.3.1 (c).

Scenario D1 shows that non-oil output benefits from an increase in both public and private investment as indicated by an accumulation of physical capital stock, and an improvement in the non-oil trade balance. A depreciation of the real exchange rate contributes to an improvement in non-oil exports, consequently an improvement in the non-oil trade balance. On the demand side, an improvement in the non-oil trade balance stimulates real income and domestic demand for non-oil output. On the supply side, the accumulation of physical capital stock, arising from greater investment, increases the supply of non-oil output. Over the short run non-oil output gradually increases for the case where the optimum public capital stock is increased by 1% (as in Sceneario D1) and it gradually decreases for the case where the optimum public capital stock is decreased by 1% (as in Scenario E1), as indicated by Figure 6.3.1(d). The accumulation of both private physical capital stock, as shown in Figure 6.3.1(f), and an
increase in the optimum public capital stock \( \left( \bar{k}^g \right) \) consequently result in a larger non-oil output supply. Whilst a decrease in the optimum public capital stock, as in Scenario E1, produces a larger decumulation of private physical capital stock, resulting in a larger decline in non-oil output.

Figure 6.3.1 (g) clearly shows that over the short run foreign asset stocks decline from the base value in all scenarios, with a larger decline occurring in Scenario A1. Whilst the development of foreign asset stocks contributes to developments in domestic private sector real wealth (Figure 6.3.1(h)). More public infrastructure capital produces a larger accumulation of private sector real wealth, with the former being complementary to private investment. Hence over the short run period, foreign asset stocks increase by some 0.04% in Scenario D1 where an expansionary public capital spending policy is adopted.

(c) Medium Run Adjustment

The adjustment path for each macroeconomic variable in the medium run is very similar to that in the short run. Inflation continually increases over the medium run to its base value in Scenarios A1 and D1, except in Scenario E1 where it remains its base value. The real exchange rate continually depreciates in Scenarios A1 and D1. A larger depreciation of the real exchange rate is apparent the greater is the optimum public capital stock \( \left( \bar{k}^g \right) \). As clearly shown in Figure 6.3.1 (b) an appreciation of the real exchange rate occurs in the case where the optimum public capital stock is decreased, as in Scenario E1.

A larger accumulation in private physical capital stock arises from more public capital spending. This is indicative of "a crowding in effect". This is a current issue emphasised by economists and economic modellers. Over the medium run foreign asset stocks increase by some 0.04% in Scenario D1 where an expansionary public capital spending policy is adopted.

90 The "crowding in effect" is a very up to date issue of concern to economists and economic modellers. It is opposite to the "crowding out effect". Crowding out occurs when expansionary fiscal policy causes interest rates to rise, thereby reducing private spending, particularly investment. In this study, an expansionary fiscal policy causes a rise in private investment, since public capital is assumed to be complementary to that of private capital. The so-called "crowding in effect" occurs.
stocks start to rise in Scenario D1 indicative of current account surpluses, whilst they continually decline in Scenarios A1 and E1 indicative of current account deficits.

An improvement in the non-oil trade balance arises from developments in the real exchange rate. It continually improves over the medium run in Scenarios A1 and D1, except for Scenario E1. A greater improvement in the non-oil trade balance arises from more public capital spending. Whilst a deterioration in the non-oil trade balance, as shown in Scenario E1, arises from a larger appreciation of the real exchange rate over the medium run period.

Domestic private sector real wealth gradually increases in Scenario D1, whilst they continually decline in Scenarios A1 and E1. More public capital spending produces a larger accumulation in private sector real wealth, arising from a larger accumulation of foreign asset stocks and private physical capital stock. Whilst less public capital spending produces a larger decumulation in private sector real wealth, arising from a larger decumulation in foreign asset stocks and private capital stock, as shown in Scenario E1.

(d) Long Run Adjustment

The simulation results suggest that there is no effect upon inflation in the long run equilibrium. The real exchange rate continually depreciates by some 0.93% throughout the long run equilibrium by an expansion in public capital spending policy, as in Scenario D1. Whilst a contraction in public capital spending policy would produces an appreciation of the real exchange rate in long run equilibrium by some 0.20%.
Figure 6.3.1
Public Infrastructure Capital Spending Policy Responses to a Positive Oil Price Shock

(a) Inflation Rate

Domestic inflation rate

- Scenario A1 -+ Scenario D1 -x- Scenario E1

(b) Real Exchange Rate

Real exchange rate

- Scenario A1 -+ Scenario D1 -x- Scenario E1
(c) Non-Oil Trade Balance

![Non-oil trade balance graph](image)

(d) Demand for Non-Oil Output

![Non-oil output graph](image)
(e) Real Income

![Real income graph]

(f) Private Physical Capital Stock

![Physical private capital stock graph]
(b) Domestic Private Real Wealth

![Graph of Domestic Private Real Wealth](image)

The graph shows the % deviation from the base level of domestic private real wealth over years for different scenarios (A1, D1, E1). The data indicates a downward trend, with scenarios A1 and D1 starting at a slightly higher level compared to scenario E1.
However an expansion in public capital spending on infrastructure, despite the larger depreciation of the real exchange rate, does not much improve the non-oil trade balance. This is offset by the improvement in real income which increases demand for imports and deteriorates the trade balance. There is clearly seen an adoption of the public capital spending policy on infrastructure contributes a slight improvement in the non-oil trade balance, which is offset by an improvement in real exchange rate over the long run equilibrium, as shown in Table 6.4.

An increase in \((k^g)\) as in Scenario D1, leads to an improvement in foreign asset stocks as well as private capital stock. Without such an expansionary capital spending policy, as in Scenario A1, foreign asset stocks continually decline below the base value throughout the long run period. The private capital stock also declines eventually to be below its base value. A contractionary public capital spending policy, as in Scenario E1, results in foreign asset stocks and private capital stock continually declining below their base values over the long run to equilibrium. This indicates that the larger is the size of government investment, or infrastructure expenditure, the larger is the improvement of foreign asset stocks and private capital stock, which will affect the productive capacity of this sector and make a major contribution to the development of the supply of output. On the demand side, a substantial improvement in private sector real wealth contributes to an increase in domestic demand. This result is relevant in the context of evidence from cross-country studies, which conclude that the role of public investment should be complementary to that of domestic private investment. This is especially important in areas where there are large externalities arising from

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91 Note that, in principle, an expansionary fiscal policy causes interest rates to rise, consumption spending could be reduced by increases in the interest rate, and then both investment and consumption would be crowded out. Further, an expansionary fiscal policy creates a tendency for interest rate to rise leading to an appreciation and therefore to a fall in exports and increased imports. The crowding out takes place not only because higher interest rates reduce investment, but also because the exchange rate will appreciate reducing net exports in the long run equilibrium.

92 See footnote 89 for the “crowding in effect”.

such investment. The key areas are: (a) physical infrastructure involving public or quasi-public goods, natural monopolies or very large capital investments such as in road and telecommunications networks; (b) human resource development; and (c) protection of the environment.

Foreign asset stocks continually decumulate in Scenario A1 and the case where the optimum public capital stock is decreased, whilst foreign asset stocks continually accumulate throughout the long run period the larger is the public infrastructure capital stock as in Scenario D1.

The private capital stock initially accumulates, but thereafter gradually decumulates through to the long run equilibrium in Scenario A1. With a public capital spending response, as in Scenario D1, private capital increases above its base level in the long run equilibrium. With this increase being larger the greater is the public infrastructure spending response. With a contractionary public capital spending, as in Scenario E1, private capital stock continually declines below its base value in the long run equilibrium.

Real income declines below its base value in Scenarios A1 and E1, whilst a higher optimum public capital spending level leads to higher real income as in Scenario D1. The development of real income is mainly affected by developments in non-oil output.

Non-oil output is larger for a larger \( (\bar{k}^8) \), arising from a larger accumulation of private capital stock, foreign asset stocks, and domestic private sector real wealth.

Overall these results suggest that for the case of a positive oil price shock, a more development oriented policy through public infrastructure spending will have a beneficial effect upon the real exchange rate, foreign asset stocks, private physical capital stock, real income, non-oil output, and domestic private real wealth. However such a strategy could have a slightly beneficial effect upon the non-oil trade balance. Notice that there appears to be a strong “crowding in” effect from the results generated\(^{94}\).

\(^{94}\) See footnote 89 for the “crowding in effect”.
6.3.2 Case 2: A Positive Shock to Domestic Oil Requirements

The steady state properties of the model for this case again indicate that public infrastructure capital spending has an important effect upon the development of key macroeconomic variables, in conjunction with an increase in domestic oil requirements. There are a number of interesting differences in this case from those of case 1. The steady state properties of the model is presented in Table 6.5, whilst the adjustment path for each variable is presented in Figures 6.3.2(a) to 6.3.2(h).

(a) Instantaneous Impact

Table 6.5 clearly shows that an instantaneous impact upon each variable is very similar to that of case 1. There is an instantaneous decrease in the inflation rate in Scenario D2, whilst it instantaneously increases in Scenarios A2 and E2 by 0.06% and 0.01% respectively, from its base value. The non-oil trade balance improves in all scenarios. An improvement in the non-oil trade balance contributes to an immediate increase in real income, and consequently leading to a rise in non-oil output demand. Domestic private sector real wealth experiences an instantaneous negative impact from an unanticipated shock to domestic oil requirements due to the nature of an oil-importing economy such as Thailand. Whilst the real exchange rate, foreign asset stocks, and physical capital stock do not change on impact, since they are control variables in the model.
Table 6.5

Steady State Properties of the Model for a 1% Increase in Domestic Oil Requirements in Conjunction with Various Public Infrastructure Spending Policies

(% deviation from the base level)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Instantaneous impact&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Short-run&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Medium-run&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Long-run&lt;sup&gt;d&lt;/sup&gt;</th>
<th>c</th>
<th>f</th>
<th>k&lt;sub&gt;p&lt;/sub&gt;</th>
<th>y</th>
<th>y&lt;sub&gt;non&lt;/sub&gt;</th>
<th>t&lt;sub&gt;non&lt;/sub&gt;</th>
<th>w&lt;sub&gt;p&lt;/sub&gt;</th>
<th>pc</th>
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</thead>
<tbody>
<tr>
<td>Scenario A2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.10</td>
<td>0.05</td>
<td>0.05</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>-0.08</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-run&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.44</td>
<td>-3.02</td>
<td>0.09</td>
<td>0.04</td>
<td>0.09</td>
<td>0.42</td>
<td>-1.32</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium-run&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.70</td>
<td>-5.56</td>
<td>0.16</td>
<td>0.01</td>
<td>0.16</td>
<td>0.69</td>
<td>-2.70</td>
<td>0.01</td>
<td></td>
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<tr>
<td>Long-run&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.85</td>
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<td>-0.16</td>
<td>0.97</td>
<td>-6.26</td>
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<td></td>
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<tr>
<td>Scenario D2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>0.01</td>
<td></td>
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</tr>
<tr>
<td>Instantaneous impact&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-run&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.92</td>
<td>0.40</td>
<td>-0.24</td>
<td>0.29</td>
<td>0.65</td>
<td>0.77</td>
<td>-0.05</td>
<td>-0.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium-run&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.45</td>
<td>1.01</td>
<td>-0.18</td>
<td>0.57</td>
<td>1.15</td>
<td>1.17</td>
<td>1.42</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-run&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.53</td>
<td>1.96</td>
<td>0.67</td>
<td>1.11</td>
<td>1.73</td>
<td>0.97</td>
<td>7.97</td>
<td>0</td>
<td></td>
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</tr>
<tr>
<td>Scenario E2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-run&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-0.03</td>
<td>-0.23</td>
<td>-0.37</td>
<td>-0.21</td>
<td>-0.22</td>
<td>0.08</td>
<td>-0.26</td>
<td>0.01</td>
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<td></td>
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</tr>
<tr>
<td>Medium-run&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>-0.69</td>
<td>-0.93</td>
<td>-0.55</td>
<td>-0.57</td>
<td>0.22</td>
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</tr>
<tr>
<td>Long-run&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>-2.76</td>
<td>-1.54</td>
<td>-1.47</td>
<td>0.94</td>
<td>-2.01</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: + Increase (depreciation of that variable)  
- Decrease (appreciation of the variable)

Scenario A2: The base case (outlined in Chapter 5), in which $k^s$ is set to 0, and $\psi$ is set to 0.2, in conjunction with an increase in domestic oil requirements by 1%.

Scenario D2: The case of an increase in $k^s$ 1% (0.01), whilst $\psi = 0.2$, in conjunction with an increase in domestic oil requirements by 1%.

Scenario E2: The case of a decrease in $k^s$ 1% (-0.01), whilst $\psi = 0.2$, in conjunction with an increase in domestic oil requirements by 1%.

(a) The instantaneous impact is represented for the base period (0)  
(b) The short run is represented from years 0-2  
(c) The medium run is represented from years 2-5  
(d) The long run is represented from year 5 onwards.

The real exchange rate
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f$</td>
<td>Foreign asset stocks</td>
</tr>
<tr>
<td>$k_P$</td>
<td>Physical private capital stock</td>
</tr>
<tr>
<td>$y_{\text{non}}$</td>
<td>Demand for non-oil output</td>
</tr>
<tr>
<td>$y$</td>
<td>Real income</td>
</tr>
<tr>
<td>$t_{\text{non}}$</td>
<td>Non-oil trade balance (non-oil exports less non-oil imports)</td>
</tr>
<tr>
<td>$w_P$</td>
<td>Domestic private sector real wealth</td>
</tr>
<tr>
<td>$p_c$</td>
<td>Domestic inflation rate</td>
</tr>
</tbody>
</table>

(b) **Short Run Adjustment**

As shown in Figure 6.3.2 (a) the inflation rate decreases instantaneously in Scenario D2, thereafter it gradually increases over the short run period. However it remains below its base value by the end of the period. Whilst it is clearly seen that the inflation rate increases instantaneously in Scenarios A2 and E2, thereafter it gradually declines to its base value. It however is still above its base value in Scenarios A2 and E2 by the end of the short run period.

Over the short run the real exchange rate depreciates by more in Scenario D2 for an increase in public infrastructure capital spending in conjunction with a domestic oil requirements shock, as shown in Figure 6.3.2(b). A larger depreciation of the real exchange rate occurs the greater is $(k^*)$, arising from a larger decline in the price of non-oil output. A smaller depreciation of the real exchange rate is achieved the smaller is $(\bar{k}^*)$, as in Scenario A2. Whilst the simulation results suggest that there would be an appreciation of the real exchange rate by only 0.03% as in Scenario E2, for the case where there is a contraction in public capital spending.

The development of the non-oil trade balance arises from developments in the real exchange rate. Figure 6.3.2 (c) clearly shows that a larger improvement in the non-oil trade balance occurs the greater is the public capital stock as in Scenario D2. Whilst a contractionary public capital spending policy produces a slight improvement in the non-oil trade balance, offsetting a slight appreciation of the real exchange rate over the short run period. Non-oil output demand gradually increases in Scenarios A2 and D2, but decreases in Scenario E2.
Figure 6.3.2
Public Infrastructure Capital Spending Policy Responses to Domestic Oil Requirements Shock

(a) **Inflation Rate**

![Inflation Rate Graph]

(b) **Real Exchange Rate**

![Real Exchange Rate Graph]
(c) Non-Oil Trade Balance

![Non-oil trade balance graph]

(d) Demand for Non-Oil Output

![Non-oil output graph]
(e) **Real Income**

![Graph of Real Income](image)

(years) 
- Scenario A2 — Scenario D2 — Scenario E2

(f) **Private Physical Capital Stock**

![Graph of Private Physical Capital Stock](image)

(years) 
- Scenario A2 — Scenario D2 — Scenario E2
(g) **Foreign Asset Stocks**

![Graph showing foreign asset stocks with different scenarios.](image)

- Scenario A2
- Scenario D2
- Scenario E2

(h) **Domestic Private Sector Real Wealth**

![Graph showing domestic private sector real wealth with different scenarios.](image)

- Scenario A2
- Scenario D2
- Scenario E2
An expansion in public capital spending produces a larger increase in non-oil output demand, arising from the larger public investment. Whilst a contractionary public capital spending policy would produce a deterioration in demand for non-oil output, arising from the decumulation in public investment. The adjustment paths of demand for non-oil output and real income are shown in Figures 6.3.2 (d) and 6.3.2(e).

Foreign asset stocks continually deteriorate in all scenarios over the short run, as shown in Figure 6.3.2 (g). Without a public capital spending policy a larger deterioration in foreign asset stocks is derived, as shown in Scenario A2. Figure 6.3.2 (f) represents the adjustment path of the private capital stock which accumulates over the short run, and is larger the greater is $(k^s)$\textsuperscript{95}.

Domestic private sector real wealth decumulates in all scenarios, as shown in Figure 6.3.2 (h). A larger decumulation in private sector real wealth is shown in Scenario A2, and this is mainly due to a larger decumulation in foreign asset stocks and private capital stock.

**Medium Run Adjustment**

Over the medium run period the inflation rate continually declines in Scenarios A2 and E2, whilst it continually increases in Scenario D2 from the end of the short run period. The real exchange rate continually depreciates over the medium run in Scenarios A2 and D2, with a larger depreciation of the real exchange rate occurring where an expansionary public capital spending policy is adopted. A contractionary public capital spending policy would produce a slight depreciation of the real exchange rate, by only 0.01%, throughout the medium run period. The development of the real exchange rate arises from the development of the price of non-oil output, as given by the definition of the real exchange rate (Equation (22) of Chapter 4). Over the medium run the price of non-oil output declines slightly in Scenarios A2 and D2, causing the real exchange rate to depreciate in Scenarios A2 and D2.

\textsuperscript{95} See footnote 89 for the “crowding in effect”.
Foreign asset stocks continually fall throughout this period in all scenarios. As in case 1, over the medium run, private capital stock continually accumulates in Scenarios A2 and D2, and this accumulation is larger with a greater \( k^b \), as in Scenario D2. The development of public infrastructure capital spending contributes to an improvement in domestic investment, consequently leading to an increase in the supply of non-oil output. Whilst an improvement in the non-oil trade balance contributes to an increase in real income, consequently contributing to an increase in demand for non-oil output. Non-oil output continually rises over the medium run period in Scenarios A2 and D2, whilst a contractionary public capital spending policy contributes to a decumulation in private capital stocks, and consequently a deterioration in domestic investment, leading to a decrease in the supply of non-oil output. Demand for non-oil output continually declines, arising from a decline in real income over the period of adjustment.

The non-oil trade balance continually improves over the medium run in all scenarios, although it does not improve by much over the medium run in Scenario E2. This is mainly due to only a slight appreciation of the real exchange rate over the period of adjustment. Whilst an expansionary public capital spending policy contributes to a larger improvement in the non-oil trade balance, arising from a large depreciation of the real exchange rate, as shown in Scenario D2.

Private sector real wealth continually decumulates in Scenarios A2 and E2, whilst it continually accumulates in Scenario D2. This development arises from developments of foreign asset stocks and the private capital stock.

(d) Long Run Adjustment

In the long run steady state equilibrium there is no effect upon the inflation rate, since there is no monetary accommodation in the long run equilibrium.

The real exchange rate continually depreciates in Scenario A2, and the case where an expansionary public capital spending policy is adopted as in Scenario D2. An expansion in the public capital spending policy contributes to a larger depreciation of
the real exchange rate as in Scenario D2. Whilst a contraction in the public capital stock would produce a slight depreciation of the real exchange rate throughout long run equilibrium by only 0.17%. The development of the real exchange rate is mainly affected by developments in the price of the domestically produced non-oil output.

The non-oil trade balance performance will be affected where there is a public capital spending policy is adopted, in which an expansion in the public capital spending policy contributes a slightly larger improvement than a contraction in public capital spending policy is adopted. Foreign asset stocks and private capital stock benefit from an increase in public infrastructure investment. A more development oriented policy initiated through increased public infrastructure spending, contributes to a noticeable accumulation of capital stock in the private sector thereby improving potential output on the supply side. On the demand side the public investment expenditure improves investment and income as well as private sector real wealth.

Overall the results suggest that an expansionary public infrastructure expenditure policy will have a beneficial effect upon the physical capital stock, foreign asset stocks, real income, non-oil output, the non-oil trade balance, and domestic real wealth. However an adoption of the public capital spending policy would produce a slight improvement in the non-oil trade sector.

6.4 Alternative Nominal Exchange Rate and Capital Market Policies

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

In this policy analysis, five possible scenarios are chosen and will be conducted for both simulation cases. Three of them, Scenarios A, F, and G, assume a fixed

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*See footnote 89 for the “crowding in effect”.*
nominal exchange rate, and the other two, Scenarios H and I, assume a flexible nominal exchange rate. Scenario A is the base case where $\Omega$ is 0.20, as outlined in Chapter 5. Scenario F represents a liberalised policy towards the capital market in which $\Omega$ is 0.50, and Scenario G, where $\Omega$ is 1, represents perfect capital mobility. Scenario H is the same as for Scenario A, but assumes a flexible nominal exchange rate policy. Scenario I is as for Scenario G, but for a flexible nominal exchange rate. This last case is representative of an economy with fully liberalised financial markets. Again two cases will be simulated, an oil price and oil requirements shock, with five scenarios in each case. These policy alternatives are summarised in Table 6.6 below.

### Table 6.6

**Alternative Nominal Exchange Rate and Capital Market Policies**

<table>
<thead>
<tr>
<th>Degree of capital mobility</th>
<th>Fixed nominal exchange rate</th>
<th>Flexible nominal exchange rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>F</td>
</tr>
<tr>
<td>$\Omega$</td>
<td>0.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The analysis will focus upon the same eight macroeconomic variables as in previous sections. These alternative policies influence both the long run steady state equilibrium and the adjustment process of the economy.

With a fixed nominal 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 output price, whereas for a flexible nominal exchange rate it occurs through adjustment in both the nominal exchange rate and the non-oil output price.  

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97 The adjustment of the inflation rate and the real exchange rate, in particular in this study, depends on the definition of the real exchange rate as emphasised in Chapter 4. By definition the real exchange rate is the nominal exchange rate deflated by the price of the domestically produced non-oil output. The consumer price is induced by, for example, an increase in either the nominal exchange rate and/or the price of domestically produced non-oil output.
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 from the early period of adjustment through to the long run steady state. Overall, the effects involve greater fluctuations for the oil price than for the domestic oil requirements shock. The discussion will be pursued by looking at each variable for each case.

6.4.1 Case 1: A Positive Shock to the Oil Price

This case is concerned with analysing an unanticipated increase in the oil price, associated with the five scenarios aforementioned. The long run steady state equilibrium is summarised in Table 6.7. The discussion of the adjustment path for each variable will be divided into instantaneous impact, short run, medium run, and long run periods, as presented in Figures 6.4.1(a) to 6.4.1(h).
Table 6.7
Steady State Properties for Alternative Nominal Exchange Rate Regimes and Capital Market Policies in Conjunction With a 1% Increase in the Price of Oil

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Instantaneous impact(a)</th>
<th>Short run(b)</th>
<th>Medium run(c)</th>
<th>Long run(d)</th>
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<td>A1</td>
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<td>0.40</td>
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<td>0.10</td>
<td>0.04</td>
<td>-0.32</td>
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<td>-0.89</td>
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<td>-0.004</td>
<td>0.03</td>
<td>0.15</td>
<td>-0.93</td>
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<td>-2.53</td>
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<td>-9.46</td>
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<td>-0.02</td>
<td>-0.22</td>
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<td>0.18</td>
<td>0.15</td>
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<td>-9.46</td>
</tr>
<tr>
<td>G1</td>
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<td>0.53</td>
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<td>-14.23</td>
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<td>1.26</td>
<td>0</td>
<td>-7.36</td>
</tr>
</tbody>
</table>

Notes: + Increase (depreciation) of that variable
- Decrease (appreciation) of that variable

Scenario A1 The base case (outlined in Chapter 5), in conjunction with an increase in the price of oil by 1%.
Scenario F1 The case of a fixed exchange rate combined with reduced control over international capital markets, where \( \Omega = 0.5 \), in conjunction with an increase in the price of oil by 1%.
Scenario G1 The case of a fixed exchange rate combined with perfect international capital mobility, where \( \Omega = 1 \), in conjunction with an increase in the price of oil by 1%.
Scenario H1  The case of a flexible exchange rate combined with a highly controlled capital market, where $\Omega = 0.2$, in conjunction with an increase in the price of oil by 1%.

Scenario II The case of a flexible exchange rate combined with perfect international capital mobility, where $\Omega = 1$, in conjunction with an increase in the price of oil by 1%.

c The real exchange rate
f Foreign asset stocks
$k_P$ Physical private capital stock
$y_{non}$ Demand for non-oil output
y Real income
$t_{non}$ Non-oil trade balance (non-oil exports less non-oil imports)
wP Domestic private sector real wealth
\( pc \) Domestic inflation rate

(a) Instantaneous impact is represented for the base period (0)
(b) The short run is represented from years 0-2 (time period 0-8)
(c) The medium run is represented from years 2-5 (time period 8-20)
(d) The long run is represented from year 5 onwards (time periods 20 onwards)

The most pronounced effect occurs on impact and in the early period of the adjustment process. The key variables in this adjustment process are initially the real exchange rate and the inflation rate. This is due to the fact that a decrease in foreign currency arising from an oil price shock, will initially influence the adjustment of the non-oil goods price for a fixed nominal exchange rate regime and the nominal exchange rate for a flexible exchange rate regime. These will influence the development of both the real exchange rate and the inflation rate.

(a) **Instantaneous Impact**

An unanticipated increase in the oil price produces an instantaneous decrease in the domestic inflation rate in all scenarios as can be observed in Table 6.7. A larger decrease is in Scenario GI where a fixed nominal exchange rate is combined with perfect international capital mobility. The real exchange rate depreciates
instantaneously in Scenarios H1 and H1 where a flexible nominal exchange rate regime is adopted. Both scenarios produce an identical result in terms of the depreciation of the real exchange rate. Where a fixed exchange rate is adopted the real exchange rate does not change on impact, since it is a control variable in the model. Foreign asset stocks and physical capital stock also do not change in all scenarios, since they too are control variables in the model as previously discussed.

The non-oil trade balance instantaneously improves in all scenarios, with a larger improvement in the base case where the real exchange rate does not immediately change. An improvement in the non-oil trade balance leads to a rise in real income, consequently to an increase in domestic demand. This will increase non-oil output demand. Domestic private sector real wealth decumulates instantaneously, arising from the instantaneous increase in the oil price.

(b) Short Run Adjustment

The simulation results suggest that the rate of inflation increases initially in all scenarios, a larger increase with a fixed nominal exchange rate is combined with perfect international capital mobility, but it declines to its base value by the end of the short run period as shown in Figure 6.4.1(a).

For a fixed exchange rate the adjustment of the inflation rate is mainly due to monetary implications and the price of non-oil output, which initially increases arising from an increase in the oil price. This adjustment however is different for different degrees of capital mobility. Initially a decrease in the degree of capital control would induce the domestic nominal interest rate to rise above the world interest rate and encourage capital inflows, which would lead to an accumulation of foreign exchange
reserves. In the base case ($\Omega = 0.2$), however, with a low degree of capital mobility the inflation rate mainly arises from an increase in the non-oil output price, as the capital inflows are substantially controlled by government and hence its monetary implications are reduced. In Scenario F1 ($\Omega = 0.5$) and Scenario G1 ($\Omega = 1$), the inflation rate is induced by a combination of an increase in the price of non-oil output and larger capital inflows. A larger capital inflow arises with a lower degree of capital control, arising from a rise in the domestic nominal interest rate above the world rate and contributing to larger capital inflows as previously discussed. The lower the control over international capital mobility the larger the capital inflows, and hence the higher the initial increase in the inflation rate due to the larger monetary implications. However as the domestic nominal interest rate declines, such capital inflows decline as does the monetary growth rate.

With a flexible nominal exchange rate regime, an increase in the oil price would not have much of an effect upon the inflation rate. The developments in the inflation rate arise mainly from adjustments of the nominal exchange rate, since the monetary implications arising through the balance of payments do not occur. Hence a flexible exchange rate provides insulation for the domestic economy. The adjustment of the inflation rate differs depending upon the degree of capital mobility, as in the case of a fixed nominal exchange rate regime. In Scenario H1 ($\Omega=0.2$) the depreciation of the real exchange rate would not influence capital inflows, as the government substantially controls international capital mobility. In Scenario I1 ($\Omega=1$) perfect capital mobility and a flexible nominal exchange rate regime is adopted. In practice, capital flows depend upon exchange rate expectations. It is this which produces a difference between the domestic and the world nominal interest rate, as indicated in Equation (11
c) of Chapter 4. Under a flexible exchange rate regime, a depreciation of the real exchange rate will induce a decline in capital outflows, arising from a decline in the domestic nominal interest rate below the world interest rate.

The discussion so far suggests that over the short run the smallest effect upon inflation arising from an increase in the price of oil, occurs with a fixed nominal exchange rate combined with high control over international capital mobility as in the base case.

Figure 6.4.1(b) clearly shows that the real exchange rate depreciates initially regardless of the value of $\Omega$ and the nominal exchange rate policy adopted. The adjustment path for each scenario indicates interesting differences. With a fixed nominal exchange rate, the real exchange rate depreciates by more initially the larger is $\Omega$, whilst with a flexible nominal exchange rate it also depreciates by more the larger is $\Omega$.

The short run adjustment path of the non-oil trade balance, arising from the real exchange rate adjustment, is shown in Figure 6.4.1(c). The non-oil trade balance initially improves in all scenarios. A larger improvement in the non-oil trade balance can be observed as in Scenario II, where a flexible nominal exchange rate combined with perfect international capital mobility is adopted.

The demand for non-oil output increases initially in all scenarios, as shown in Figure 6.4.1(d). A flexible nominal exchange rate regime produces a smoother adjustment path for non-oil output demand. The domestic nominal interest rate falls below the world rate, inducing capital outflows. These capital outflows will lead to a depreciation of the real exchange rate and a gain in competitiveness, and hence a rise in demand for domestic output.
Private capital stock accumulates in all scenarios except where a fixed nominal exchange rate is combined with perfect international capital mobility, as in Scenario G1. Whilst foreign asset stocks accumulate where a flexible nominal exchange rate is adopted, it gradually decumulates where a fixed nominal exchange rate is adopted. These adjustment paths are shown in Figure 6.4.1(f) and 6.4.1(g).

Figure 6.4.1 (h) clearly shows that domestic private sector real wealth accumulates over the short run in all scenarios where a flexible exchange rate is adopted, and this is consistent with the development of foreign asset stocks and private capital stock. The adjustment paths of the physical private capital stock is shown in Figure 6.4.1(g).

(c) Medium Run Adjustment

The medium run adjustment path for each variable is very similar to that of the short run. The inflation rate declines to its base value in all scenarios, and there is no effect upon the inflation rate by the end of the medium run. The real exchange rate continually depreciates in all scenarios, a larger depreciation of the real exchange rate occurs where a flexible nominal exchange rate is adopted.

Foreign asset stocks decline eventually throughout the medium run. A larger decline occurring where a fixed nominal exchange rate is adopted. Private capital stock starts to decline in the base case, whilst a larger decline occurs in Scenario G1 where a fixed nominal exchange rate is combined with perfect international capital mobility. The developments of foreign asset stocks and private capital stock contribute to the development of private sector real wealth. Over the medium run private sector real
wealth continually decumulates, a larger decumulation arises where a fixed nominal exchange rate and perfect international capital mobility is adopted.

The non-oil trade balance improves eventually in all scenarios. A larger improvement occurs in Scenario II where a flexible nominal exchange rate is combined with perfect international capital mobility. Non-oil output continually accumulates in all scenarios, with a larger accumulation in Scenario II.

(d) Long Run Adjustment

The simulation results suggest that there is no effect upon the inflation rate in the long run equilibrium. The real exchange rate depreciates continuously until reaching the long run steady state. The flexible exchange rate scenarios produce a larger real exchange rate depreciation than the fixed exchange rate scenarios, as can be observed in scenarios H1 and II. The results also suggest that a flexible exchange rate combined with perfect international capital mobility, offers a larger and a smoother depreciation of the real exchange rate throughout the adjustment process. 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.

The discussion suggests that adopting a flexible exchange rate and perfect capital mobility, offers the potential of an improved adjustment process of the non-oil trade balance. The adoption of a flexible exchange rate combined with perfect international capital mobility produces a larger improvement in the non-oil trade balance in the long run equilibrium, arising from a larger depreciation of the real exchange rate. Non-oil output demand improves initially in scenarios where a fixed nominal exchange rate is adopted, but thereafter gradually decreases through to the
long run equilibrium. Whilst scenarios adopting a flexible exchange rate will lead to an initial increase, and further continuous increase throughout the adjustment process except for Scenario H1. The largest increase in non-oil output is under a flexible exchange rate regardless of the degree of control over capital mobility as in Scenarios H1 and I1.

The physical capital stock accumulates for a short period in all scenarios except for a fixed nominal exchange rate combined with perfect international capital mobility, as in Scenario G1. However all scenarios gradually produce a decumulation through to the long run equilibrium. Adopting a fixed exchange rate combined with perfect capital mobility will lead to a larger decline, throughout the adjustment process. This decumulation of capital stock is noticeably larger than that for the other scenarios. Hence if the government adopts a fixed exchange rate with perfect capital mobility, it provides a potentially less favourable development of the physical capital stock.

Foreign asset stocks decrease throughout the adjustment process indicating current account deficits except for the adoption of a flexible exchange rate as in Scenarios H1 and I1, in which it accumulates for a very short period. The decumulation of foreign asset stocks is larger under a fixed exchange rate combined with perfect capital mobility.

Private sector real wealth declines initially in all scenarios, except with the adoption of a flexible exchange rate. Thereafter it continuously decreases towards long run equilibrium, with this decrease being larger with the adoption of a fixed exchange rate and perfect international capital mobility.
Figure 6.4.1

Alternative Nominal Exchange Rate and Capital Market Policies

(a) Inflation Rate

(b) Real Exchange Rate
(c) Non-Oil Trade Balance

![Non-oil trade balance graph](image)

(d) Demand for Non-Oil Output

![Non-oil output graph](image)
(e) **Real Income**

- Scenario A1
- Scenario F1
- Scenario G1
- Scenario H1
- Scenario I

(f) **Private Physical Capital Stock**

- Scenario A1
- Scenario F1
- Scenario G1
- Scenario H1
- Scenario I
(g) Foreign Asset Stocks

![Graph of Foreign Asset Stocks](image)

(b) Domestic Private Sector Real Wealth

![Graph of Domestic Private Sector Real Wealth](image)
The above discussion indicates that the effects of an increase in the oil price on the key macroeconomic variables are substantially more with a flexible exchange rate combined with a high degree of international capital mobility. Although in this case it tends to be larger during the early period of the adjustment process. However if the government adopted a flexible nominal exchange rate regime with perfect international capital mobility, there would be a larger improvement in the non-oil trade balance.

The capital stock decumulates throughout the adjustment process except for a fixed nominal exchange rate combined with high control over capital mobility, in which case there is an accumulation for a short period of time. However, if the government adopts a flexible exchange rate combined with perfect capital mobility, it provides potentially the largest benefits to the improvement of the non-oil trade balance.

Overall, these findings suggest that a flexible exchange rate combined with perfect capital mobility offers the most favourable effects upon the key major macroeconomic variables in conjunction with an increase in the oil price.

6.4.2 Case 2: A Positive Shock to Domestic Oil Requirements

This case is concerned with analysing a positive domestic oil requirements shock within the five scenarios aforementioned. The long run steady state of each variable is summarised in Table 6.8. The most pronounced effects occur on impact and in the early periods of the adjustment process, as indicated in Figures 6.4.2(a) to 6.4.2(h). The adjustment process will be divided into the instantaneous impact, short run, medium run, and long run, as discussed in previous sections. The key variable in this adjustment process again is the real exchange rate and the inflation rate.
(a) Instantaneous Impact

An unanticipated increase in domestic oil requirements, leads to an instantaneous decrease in the inflation rate in all scenarios except in the base case and Scenario H2. The inflation rate increases instantaneously in the scenarios where high control over capital mobility is adopted regardless of the nominal exchange rate regime. The real exchange rate immediately depreciates in scenarios where a flexible nominal exchange rate is adopted, regardless of the degree of control over capital mobility. Whilst the real exchange rate does not change on impact in scenarios where a fixed exchange rate is adopted, since it is a control variable in the model.

Foreign asset stocks and physical capital stock do not change on impact in all scenarios, given that they too are control variables in the model.

The non-oil trade balance instantaneously improves in all scenarios, although this is relatively small, contributing to a rise in real income and demand for domestic output. Whilst private sector real wealth experiences an instantaneous negative effect, arising from a 1% increase in domestic oil requirements.

(b) Short Run Adjustment

The simulation results indicate that the rate of inflation decreases in the scenarios where high control over capital markets is adopted in the short run, as shown in Figure 6.4.2(a). Whilst it increases to its base value in the scenarios where the degree of capital mobility is relaxed. This is mainly due to the adjustment of the inflation rate arising from the monetary implications of balance of payments adjustment and the price of domestically produced non-oil output. A higher domestic demand for oil results in higher net oil imports. This will initially influence the adjustment of the
non-oil goods price, and will influence the development of both the inflation rate and the real exchange rate. The adjustment of the inflation rate however is different for different degrees of capital mobility. With a flexible nominal exchange rate, the inflation rate development is affected by the nominal exchange rate and the price of domestically produced non-oil output. Figure 6.4.2(b) shows that the real exchange rate depreciates in all scenarios over the short run period, with a larger depreciation occurring in the base case. For the flexible exchange rate scenarios, initially, the adjustment path of the real exchange rate is somewhat similar to that for the fixed exchange rate adjustment. It depreciates initially, with a larger depreciation of the real exchange rate occurring the higher is the value of $Q$. The development of the real exchange rate is mainly influenced by developments of the inflation rate. The adjustment paths of the real exchange rate have a strong influence over the rest of the key macroeconomic variables.

The non-oil trade balance initially improves in all scenarios, as shown in Figure 6.4.2(c). A larger improvement is apparent in the base case. On the supply side private capital stock sharply increases in the base case, contributing to a substantial increase in non-oil output supply. Whilst on the demand side, a larger improvement in the non-oil trade balance leads to a higher real income and a higher domestic demand for non-oil output. The adjustment path of demand for non-oil output is shown in Figure 6.4.2(d). Non-oil output demand initially increases in the base case and Scenario 12, whilst it decreases initially in the other scenarios. A larger decline occurs in Scenario H2 where a flexible nominal exchange rate is combined with high control over capital markets.
Table 6.8  
Steady State Properties for Alternative Nominal Exchange Rate Regimes and Capital Market Policies in Conjunction With a 1\% Increase in Domestic Oil Requirements

<table>
<thead>
<tr>
<th>Scenario</th>
<th>c</th>
<th>f</th>
<th>k^p</th>
<th>y</th>
<th>y^d^non</th>
<th>t^non</th>
<th>w^p</th>
<th>pc</th>
</tr>
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<tr>
<td>Scenario A2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact(^a)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.10</td>
<td>0.05</td>
<td>0.05</td>
<td>-0.0001</td>
<td>0.12</td>
</tr>
<tr>
<td>Short run(^b)</td>
<td>0.31</td>
<td>-1.82</td>
<td>0.10</td>
<td>0.02</td>
<td>0.15</td>
<td>0.30</td>
<td>-0.89</td>
<td>0.02</td>
</tr>
<tr>
<td>Medium run(^c)</td>
<td>0.40</td>
<td>-3.49</td>
<td>0.04</td>
<td>-0.04</td>
<td>0.12</td>
<td>0.42</td>
<td>-1.98</td>
<td>0.01</td>
</tr>
<tr>
<td>Long run(^d)</td>
<td>0.48</td>
<td>-8.08</td>
<td>-0.32</td>
<td>-0.27</td>
<td>-0.08</td>
<td>0.62</td>
<td>-5.28</td>
<td>0</td>
</tr>
<tr>
<td>Scenario F2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact(^a)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.10</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>-0.03</td>
</tr>
<tr>
<td>Short run(^b)</td>
<td>0.10</td>
<td>-0.48</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.02</td>
<td>0.09</td>
<td>-0.23</td>
<td>0</td>
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<tr>
<td>Medium run(^c)</td>
<td>0.14</td>
<td>-0.08</td>
<td>0</td>
<td>0.01</td>
<td>0</td>
<td>0.13</td>
<td>-0.55</td>
<td>0</td>
</tr>
<tr>
<td>Long run(^d)</td>
<td>0.17</td>
<td>-2.04</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.20</td>
<td>-1.70</td>
<td>0</td>
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<td>Scenario G2</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact(^a)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.11</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.0002</td>
<td>-0.03</td>
</tr>
<tr>
<td>Short run(^b)</td>
<td>0.10</td>
<td>-0.46</td>
<td>-0.06</td>
<td>0.01</td>
<td>-0.06</td>
<td>0.09</td>
<td>-0.26</td>
<td>0</td>
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<tr>
<td>Medium run(^c)</td>
<td>0.11</td>
<td>-0.95</td>
<td>-0.08</td>
<td>0</td>
<td>-0.08</td>
<td>0.12</td>
<td>-0.74</td>
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<td>Long run(^d)</td>
<td>0.17</td>
<td>-2.81</td>
<td>-0.09</td>
<td>-0.05</td>
<td>-0.09</td>
<td>0.22</td>
<td>-2.53</td>
<td>0</td>
</tr>
<tr>
<td>Scenario H2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact(^a)</td>
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<td>0</td>
<td>0.003</td>
<td>0.01</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.003</td>
<td>0.01</td>
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<tr>
<td>Short run(^b)</td>
<td>0.22</td>
<td>-0.09</td>
<td>-0.01</td>
<td>-0.05</td>
<td>-0.14</td>
<td>0.10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Medium run(^c)</td>
<td>0.22</td>
<td>-0.42</td>
<td>-0.04</td>
<td>-0.06</td>
<td>-0.15</td>
<td>0.14</td>
<td>-0.35</td>
<td>0</td>
</tr>
<tr>
<td>Long run(^d)</td>
<td>0.18</td>
<td>-2.08</td>
<td>-0.08</td>
<td>-0.11</td>
<td>-0.18</td>
<td>0.17</td>
<td>-2.12</td>
<td>0</td>
</tr>
<tr>
<td>Scenario I2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instantaneous impact(^a)</td>
<td>0</td>
<td>0</td>
<td>0.003</td>
<td>0.01</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.003</td>
<td>-0.03</td>
</tr>
<tr>
<td>Short run(^b)</td>
<td>0.22</td>
<td>-0.12</td>
<td>0.01</td>
<td>-0.04</td>
<td>0.01</td>
<td>0.18</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Medium run(^c)</td>
<td>0.21</td>
<td>-0.38</td>
<td>0.01</td>
<td>-0.05</td>
<td>0.01</td>
<td>0.16</td>
<td>-0.27</td>
<td>0</td>
</tr>
<tr>
<td>Long run(^d)</td>
<td>0.19</td>
<td>-1.47</td>
<td>-0.03</td>
<td>-0.08</td>
<td>-0.03</td>
<td>0.11</td>
<td>-1.44</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:

+ \quad \text{Increase (depreciation) of that variable} \\
- \quad \text{Decrease (appreciation) of that variable} \\

Scenario A2: The base case (outlined in Chapter 5), in conjunction with an increase in domestic oil requirements by 1\%.

Scenario F2: The case of a fixed exchange rate combined with reduced control over international capital markets, where \(\Omega = 0.5\), in conjunction with an increase in domestic oil requirements by 1\%. 

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Scenario G2 The case of a fixed exchange rate combined with perfect international capital mobility, where $\Omega = 1$, in conjunction with an increase in domestic oil requirements by 1%.

Scenario H2 The case of a flexible exchange rate combined with high control over capital markets, where $\Omega = 0.2$, in conjunction with an increase in domestic oil requirements by 1%.

Scenario I2 The case of a flexible exchange rate combined with perfect international capital mobility, where $\Omega = 1$, in conjunction with an increase in domestic oil requirements by 1%.

c The real exchange rate
f Foreign asset stocks
kp Physical private capital stock
y\text{\_non} Demand for non-oil output
y Real income
t\text{\_non} Non-oil trade balance (non-oil exports less non-oil imports)
wP Domestic private sector real wealth
pc Domestic inflation rate

(a) Instantaneous impact is represented for the base period (0)
(b) The short run is represented from years 0-2 (time period 0-8).
(c) The medium run is represented from years 2-5 (time period 8-20).
(d) The long run is represented from year 5 onwards (time periods 20 onwards)

Over the short run period the private capital stock increases in the base case and Scenario I2, contributing to an increase in non-oil output on the supply side as shown in Figure 6.4.2(f). Whilst in the other scenarios the physical capital stock slightly declines below its base value, resulting in a decline in non-oil output on the supply side.

Foreign asset stocks decline initially in all scenarios, with a larger decline occurring in the base case where a fixed nominal exchange rate is combined with high control over capital mobility as shown in Figure 6.4.2(g). However private capital stock accumulates initially in the base case and Scenario I2, whilst it decumulates in the other scenarios. Whilst Figure 6.4.2(h) clearly shows that domestic private sector real wealth gradually declines over the short run, arising from a decline in foreign asset stocks. The latter is indicative of persistent current account deficits over this adjustment period.
(b) **Medium Run Adjustment**

Over the medium run the inflation rate continually declines to its base value. However it remains above its base value in the base case, indicating that the adjustment process of the rate of inflation takes a longer time to achieve its equilibrium.

The real exchange rate depreciates eventually over the medium run, and is larger in the base case. A larger depreciation of the real exchange rate benefits the non-oil trade balance. Over the medium run the non-oil trade balance continually improves in all scenarios.

Non-oil output starts to decline over the medium run in the base case, and continually declines in other scenarios. A larger decline occurs in Scenario H2 where a flexible nominal exchange rate is combined with high control over capital mobility, arising primarily from the development of the non-oil trade balance.

The private capital stock experiences a gradual decline in the base case, whilst it continually declines in the other scenarios. Foreign asset stocks decumulate throughout the medium run. This contributes to a continual decumulation in private sector real wealth as well.

(d) **Long Run Adjustment**

The simulation results indicate that the rate of inflation increases initially for all scenarios, and is higher for Scenario G2 although in this scenario it does stabilise quickly. In the base case the inflation rate remains above the base line for a short period. However the inflation rate decreases quickly to the base line in the long run steady state equilibrium for all scenarios.
Initially the real exchange rate depreciates regardless of the value of $\Omega$ and the nominal exchange rate policy adopted. In the early part of the long run adjustment process for the fixed exchange rate scenarios, the depreciation of the real exchange rate towards its long run steady state is larger for a smaller $\Omega$ as in the base case. The depreciation of the real exchange rate in the base case is not only larger but also takes longer to achieve.

During the period of adjustment the non-oil trade balance improves for all scenarios. A larger improvement in the non-oil trade balance over a longer period is apparent for a fixed than for a flexible exchange rate regime, for comparable degrees of international capital mobility. Hence adopting a fixed exchange rate combined with high control over capital markets offers the prospect of larger improvements in the non-oil trade balance. Whilst 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. The adjustment path of the non-oil trade balance suggests that a fixed exchange rate combined with high control over capital markets, offers the largest improvement of the non-oil trade balance.

In the long run non-oil output declines in all scenarios, with a smaller decline occurring with a flexible exchange rate combined with perfect international capital mobility as in Scenario 12. Under fully perfect international capital mobility and a flexible nominal exchange rate policy, any current account deficit must be financed by private capital inflows. Capital inflows induced by a depreciation of the real exchange rate, contribute to greater competitiveness and improved non-oil exports. The non-oil trade balance benefits and demand for non-oil output increases. Hence in the long run equilibrium, non-oil output and private capital stock benefit from the adoption of a flexible exchange rate combined with perfect international capital mobility.

The private capital stock benefits from the adoption of a flexible exchange rate, regardless of the degree of control over the capital market. With a fixed nominal
Figure 6.4.2
Altering Nominal Exchange Rate and Capital Market Policies

(a) Inflation Rate

(b) Real Exchange Rate
(c) Non-Oil Trade Balance

![Non-oil trade balance graph]

(d) Demand for Non-Oil Output

![Non-oil output graph]
(e) **Real Income**

Real income

% deviation from the base level

years

--- Scenario A2 - Scenario F2 - Scenario G2 - Scenario H2 - Scenario I2

(f) **Physical Private Capital Stock**

Physical private capital stock

% deviation from the base level

years

--- Scenario A2 - Scenario F2 - Scenario G2 - Scenario H2 - Scenario I2
(g) Foreign Asset Stocks

```
Foreign asset stocks

% deviation from the base level

Scenario A2 — Scenario F2 — Scenario G2 — Scenario H2 — Scenario I2
```

(h) Domestic Private Sector Real Wealth

```
Domestic private sector real wealth

% deviation from the base level

Scenario A2 — Scenario F2 — Scenario G2 — Scenario H2 — Scenario I2
```
exchange rate combined with high control over capital markets, the private capital stock develops unfavourably in the long run equilibrium.

Foreign asset stocks initially increase for a flexible exchange rate regardless of the value for $\Omega$, but then gradually declines through to the long run steady state equilibrium. Foreign asset stocks decline initially with a fixed exchange rate. The long run steady state indicates that foreign asset stocks decline below base level, with this decline being largest for a fixed exchange rate combined with high control over the capital market as in the base case. This indicates that the current account is in persistent deficit. The adjustment process of foreign asset stocks also indicates that a flexible exchange rate, combined with perfect international capital mobility, offers the prospect of a smaller decline of foreign asset stocks.

Private sector real wealth deteriorates in all scenarios throughout the adjustment process until the long run equilibrium, indicating that the adjustment process of private sector real wealth is strongly influenced by developments in foreign asset stocks.

The above discussion indicates that altering the nominal exchange rate and the degree of control over the capital market affects the development of the key macroeconomic variables. The adoption of a flexible nominal exchange rate combined with perfect international capital mobility, offers a more favourable effect upon foreign asset stocks, physical capital stock, non-oil output, and domestic real wealth. Whilst the adoption of a flexible exchange rate combined with high control over the capital market offers an unfavourable effect upon the non-oil trade balance, and the largest decline in non-oil output.

Overall perfect capital mobility offers potentially favourable benefits to the macroeconomic variables during the adjustment process. This is indicated by a smaller decumulation of foreign asset stocks, physical capital stock, private sector real wealth, and non-oil output. These are initially more, if perfect capital mobility is combined with a flexible nominal exchange rate policy.
6.5 Summary, Conclusions and Policy Implications

Throughout this chapter the results of macroeconomic developments from the oil related shocks, arising from different policy scenarios towards both an oil price and domestic oil requirements shock relative to the base case in Chapter 5, have been discussed. These simulation results were conducted to provide alternative policy options for managing oil related shocks, in order to minimise the oil shock consequences and to enhance the benefits generated from such alternative policy options.

Three groups of policies have been emphasised. The first group placed focus upon a trade liberalisation policy, emphasising a reduction in trade barriers to enhance trade performance. The second group identified the benefits of expansionary public capital spending on infrastructure developments, the latter being a major problem in Thailand. The final group of policies were concerned with government control over financial markets, in the determination of both the nominal exchange rate and international capital mobility.

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 focused upon eight key macroeconomic variables as in Chapter 5 - the real exchange rate, foreign asset stocks, private capital stock, real income, non-oil output, non-oil trade balance (non-oil exports less non-oil imports), private sector real wealth, and the domestic inflation rate.

The simulation results indicate that the governmental policy responses toward trade liberalisation, public infrastructure spending expansion, and financial liberalisation, have 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 an unanticipated increase in domestic oil requirements has a greater influence upon the key macroeconomic variables than those of an equivalent increase in the oil price, regardless of the policy response adopted. The
adjustment process involved greater fluctuations for the oil price increase than for the oil requirements increase case. The most significant difference in the adjustment paths among these policies, arises during the adjustment process up to 10 years.

The three groups of governmental policies also have a significant influence upon developments in those macroeconomic variables in different ways. For a fixed nominal exchange rate the adjustment process initially occurs through adjustment in the price of domestic goods (non-oil output prices), whilst for a flexible nominal exchange rate regime it occurs through adjustment in the nominal exchange rate regime and the price of domestically produced non-oil goods.

The government could, arising from these alternative policies, offset or worsen the oil shock consequences, and could improve upon or deteriorate the performance of the key macroeconomic variables. The magnitude and the adjustment path of the key macroeconomic variables, are different for different policy options and for different shocks. The major conclusions therefore will be divided into alternative outcomes derived from the alternative policy options provided.

The numerical results suggest that in steady state the macroeconomic performance of an economy, such as Thailand, subject to oil price and domestic oil requirement shocks, can be improved by adopting a trade liberalisation policy, an expansion of public infrastructure capital spending, and financial liberalisation. The effects, in percentage terms, from altering the government’s policies however are larger for an oil requirement increase than for an oil price increase case, arising from different policy options.

In the case of an oil price increase, an expansion in public capital spending policy can produce beneficial effects upon foreign asset stocks, private capital stock, non-oil output, real income and domestic private real wealth. There is however a slight improvement in the non-oil trade balance. Whilst either the adoption of a flexible nominal exchange rate and perfect capital mobility and trade liberalisation policy can produce a larger depreciation of the real exchange rate, resulting in a noticeable
improvement in the trade balance, stimulating an improvement of non-oil output and real income. There are however a number of losers from such policy options. These are the foreign asset stock, private capital stock, and private real wealth. For the case of an oil requirements shock, the results are very similar to those of case 1, but the size of adjustment is different. There is a larger effect upon the key macroeconomic variables for case 2 than that for case 1.

Even though the government could adopt these alternative policy options, however, oil shock consequences still remain. This is mainly due to the nature of an oil-importing economy. The real exchange rate depreciation arising from a decline in foreign exchange generated by oil payments, leads initially to inflation which transmits itself to an increase in domestic output. In addition to that an increase in oil requirements raises demand for net oil imports which leads to an increase in the current account deficit, resulting in a larger depreciation of the real exchange rate.

Unlike adopting a trade liberalisation policy, the results for the three scenarios are different for both simulation cases. However it has a large positive effect upon the trade sector, where the non-oil trade balance significantly improved. This policy option offers the prospect of a trade liberalisation policy to enhance the non-oil trade performance and consequently leading to an improvement in the non-oil trade balance.

Overall, the effect of oil related shocks would be worse without the government’s policy responses. The adoption of one policy option could not improve all economic outcomes. This is mainly due to one policy option having a worse effect upon some variables, whilst other policy options may make such variables perform better. Hence Thailand needs to adopt a combination of policies to improve its economic performance arising from shocks, with specific emphasis here having been given to an oil price and oil requirement shocks.

\[98\] Hence Thailand’s membership of APEC (with the objective of reducing trade barriers) must be seen as important for the future development of the economy.
CHAPTER 7
SUMMARY, CONCLUSIONS, POLICY IMPLICATIONS,
AND FURTHER STUDIES

This final chapter attempts to summarise the major findings and policy implications derivable from this thesis, and analysing alternative policies for a Thailand like net oil-importing economy in order to maintain sustained economic growth. I finally suggest some areas for further study which could be done using the methodology of this thesis.

7.1 Summary and Conclusions

7.1.1 General Review of the Study

The oil related shocks in the 1970s had an adverse impact upon the macroeconomic adjustment of the Thai economy. Such shocks have imposed the need to adopt stabilisation policies for a Thailand like net oil-importing economy, and such policy interventions have been implemented. Many of these, such as fiscal, monetary, and exchange rate policies, have been implemented by the central government authorities, in order to maintain economic stability. In addition, structural adjustment policies, such as agricultural transition policy, industrial policy, and international trade policy, were also imposed to maintain and enhance economic stability. The Thai government attempted to adopt economic stabilisation policy for adjustment to the external shocks, as well as to liberalise and re-structure the economy. There are, however, a number of obstacles for internal adjustment, arising from the external effects. Firstly, the shortage of infrastructure is a crucial problem that Thailand is now facing and requires immediate attention, otherwise it will bring further problems which will reduce the long run economic potential of the Thai economy. Secondly international trade, since Thailand is a small-open economy whose trade will be
affected by developments in the rest of the world. International trade is a significant issue for domestic economic development. Hence it must be seen as important for the future development of the economy. Finally, financial policy is another important issue for Thai macroeconomic policy, since this sector is heavily regulated by the authorities. According to the major obstacles, key issues in response to these will be considered. Firstly, the issue of financial reform involves the introduction of financial liberalisation, focusing upon the appropriate nominal exchange rate regime and degree of control over financial and capital markets. Secondly, the movement towards trade liberalisation is also emphasised, relating to the reduction in trade barriers in order to enhance trade performance. The trade barriers emphasised here are imposed on both Thailand’s exports and imports. The Thai government can only directly control barriers to imports, however, in a broader context, such as participation in APEC, it can also contribute to a reduction in trade barriers imposed by other countries on Thai exports. Finally, the adoption of public infrastructure spending to encourage infrastructure developments particularly in transportation and telecommunications networks.

7.1.2 Developing A Macroeconomic Model

The major objective of this study has been the introduction and development of a dynamic long run macroeconomic model for a Thailand like net oil-importing economy, focusing upon the impact of oil related shocks on the economy's real income, non-oil output, real exchange rate, private physical capital stock, foreign asset stocks, private sector real wealth, non-oil trade balance (non-oil exports less non-oil imports), and the domestic inflation rate. These 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 the oil related shocks, will influence the development of other variables and the domestic economy as a whole.

The theoretical framework presented in Chapter 4 is a major extension to that first presented by Harvie and Gower (1993) and Charles Harvie (1994), focusing upon
the development of a dynamic model for a net-oil importing economy like Thailand. This enabled the identification of the various ways in which oil related shocks have transmitted their effects to the domestic economy, as well as exploring policy implications for Thailand arising from them. The model incorporated the key characteristics of the non-oil sector, the role of the oil price on economic adjustment, the way in which both private and government sectors influence consumption and investment, as well as government policy towards the nominal exchange rate, financial markets, infrastructure and international trade developments, which has not been done before in the context of this type of theoretical framework nor for an economy such as Thailand. Whilst focusing upon the oil related shocks, the model is sufficiently general, however, for analysing economic effects arising from non-oil shocks, and so offers a wide range of possible policy prescriptions that could be incorporated such as the inclusion of public infrastructure capital spending policy, altering the nominal exchange rate and degree of control over the capital markets, and reducing trade barriers. The latter development should be emphasised, particularly in the context of Thailand's membership of APEC, with the objective of reducing trade barriers.

The analysis of oil shocks for the Thai economy was developed step by step from a comparative static to a dynamic framework. Regarding the comparative static analysis, an aggregate demand and aggregate supply model, developed by Bhannupongse and Warr (1988), was taken into consideration in this context. It was utilised to analyse the impact of the resource boom upon economic adjustment, in particular for the case of Thailand. It suggested that an oil price increase would lead to a rise in the inflation rate and a fall in real income, and such problems could be offset by policy measures such as that of monetary accommodation and structural adjustment policy.

The dynamic models identified assumed either a fixed or flexible nominal exchange rate. The original theoretical contribution from the perspective of this study, was found in the work of Dornbusch (1976). Later analyses, which emphasised the dynamic nature of the adjustment process arising from oil related shocks, focused upon
the short to medium run. The short run models examined included Buiter and Purvis (BP)(1983), Buiter and Miller (BM)(1981), Eastwood and Venables (EV)(1982), and Neary and Wijnbergen (NW)(1984). Two long run models, Charles Harvie (CH) (1994), and Harvie and Gower (HG)(1993), were presented and discussed. The major difference between these models is that the HG (1993) model assumes a flexible nominal exchange rate, whilst the CH model (1994) assumes a fixed nominal exchange rate.

Having contrasted and compared those modelling approaches, presented in Chapter 3, it was concluded that the most appropriate framework in which to analyse the impact of oil related shocks for a Thailand like net oil-importing economy was a long run dynamic theoretical macroeconomic model. The HG (1993) and CH (1994) models were adopted as a foundation for the model used in this study.

The model developed contained a number of key assumptions. The domestic economy produces only non-oil output, which can be consumed domestically and is an imperfect substitute for the equivalent imported good. The price of this domestic good is domestically determined whilst that of the imported is simply given (exogenous). 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. In addition the model developed emphasises the long run nature of the adjustment process, since the oil shocks will have a long run effect upon the Thai economy. This arises from allowing for physical capital stock accumulation and developments in the current account balance. The inclusion of developments in the current account balance captures developments in oil imports and the non-oil trade balance, which has a further impact upon developments in private sector real wealth. This is important since developments in the private sector play a crucial role in the process of developing the economy. This process is particularly important in the context of a rapidly developing economy such as Thailand, with its resulting effects upon the long run adjustment of the economy's potential
developments. The long run steady state will also have a major bearing upon the dynamic adjustment process over both the short term and medium term. Finally, the economy operates under a fixed nominal exchange rate, and the government exercises control over capital markets. This assumption was 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 model developed explicitly incorporated the fact that only non-oil production is considered in the model, which is treated here as aggregate demand for non-oil output and has a major influence on the economy's real income. Aggregate demand for non-oil output is dependent upon private sector consumption and investment, government sector consumption and investment, and the non-oil trade balance (non-oil exports less non-oil imports). Government consumption spending is assumed to be exogenously determined, whilst government investment spending is assumed to be endogenously determined, adjusting so as to achieve the optimal public capital stock determined by the government. The model developed is representative of the oil shock period when the nominal exchange rate was fixed, combined with a very high degree of capital control, and the existence of trade barriers, as well as the effects of a poor provision of infrastructure development upon the Thai economy. This was referred to as the "base case". Whilst the further developed models which allow for the introduction of the government's liberalisation policy as well as an expansion in public infrastructure spending, is referred to as the "adjustment case".

7.1.3 Estimation of the Model

The model was estimated by Two Stage Least Squares (2SLS), and was conducted by using the Shazam package. This is because a simultaneous equation system is defined as being overidentified. In addition some of the variables, such as the real return to capital and Tobin's q ratio and permanent non-oil output, are not well documented for the period of study and hence it was impossible to estimate simultaneously. Such variables are not available for the period of study, instead
parameter values used in alternative studies were adopted. The estimation of the model, using different data for the two periods identified, gave two groups of coefficient parameters. The first group of coefficient parameters for the base case utilised data from the first sub-period (1971.1-1980.4), comprising 40 observations. Whilst the second group were derived from the second sub-period (1981.1-1992.4), utilising data for 48 observations. The first group of coefficient parameters estimated from the base case were utilised for the purpose of simulation analysis in Chapter 5, whilst the second group were utilised to conduct the simulation analysis in Chapter 6.

7.1.4 Simulation Analysis

The estimated parameters were then used to conduct a simulation analysis, in conjunction with imposed parameter values derived from existing studies where appropriate. These were essential to the generation of the simulation results presented, and the policy conclusions derived. The simulation analysis conducted was used to examine what policy options should be used in response to future shocks. The simulation program utilised to derive these results is called “Saddlepoint”, which is designed to solve linear rational expectations models with constant coefficients.

The analysis was conducted in two stages. The first stage involved analysing the Thai economy during the oil related shocks, from 1971-1980, a period characterised by the operation of a fixed nominal exchange rate system with a very high degree of capital control, a poor provision of infrastructure, and the country’s trade was highly subjected to trade regulations. This 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. Alternative government policy responses emphasised related to the reduction in trade barriers, public infrastructure spending expansion, and changing from a fixed to a flexible nominal exchange rate regime combined with different degrees of control over capital markets. These are referred to as the “adjustment cases”.

The analysis emphasised the adjustment of eight key macroeconomic variables for the base case and the adjustment cases - the real exchange rate, foreign asset stocks, physical capital stock, non-oil output, real income, which is equivalent to national income, non-oil trade balance (non-oil exports less non-oil imports), domestic private sector real wealth, and the domestic inflation rate, as outlined in Chapters 5 and 6. The analysis emphasised two simulation cases.

(1) An unanticipated increased in the world price of oil by 1%; and

(2) An unanticipated increased in domestic oil requirements by 1%.

The major conclusion arising from these simulations, either for an oil price or oil requirements shock, is that the influence of the oil related shocks on a Thailand like net oil-importing economy as likely to be significant, both for long run steady state and for the adjustment process.

A major conclusion from these simulations is that overall the two oil related shocks have had an adverse impact upon the economy, and this is likely to be greater for an equivalent shock to domestic oil requirements. The oil shock consequences exist and are most intense during the early stages of the adjustment process. This is shown by an increase in non-oil exports and decrease in non-oil imports, with the developments being larger from a larger depreciation of the real exchange rate.

Therefore, the second stage of the analysis focused upon an analysis of alternative government policy responses towards the oil shocks, and then considering the potential effects upon the macroeconomy arising from these alternative policy responses. The contributions of these policies to the development of the aforementioned variables were obtained by conducting simulations based upon the adoption of these alternative policies. These were then compared with the results from the base case outlined above. This analysis provided the basis for policy evaluation arising from the oil shocks, in order to produce more favorable outcomes for key macroeconomic variables during the process of adjustment.
With regard to a trade liberalisation policy, this focused upon a reduction in trade barriers. With regard to a more development oriented policy through public infrastructure spending, this can range from less to more public infrastructure capital stock. The contribution of public capital stock to the economy has a major influence on both the long run steady state and the adjustment process. With regard to the nominal exchange rate regime, the possibilities range from a fixed to a flexible regime. In the case of the capital market, the policy could range from no capital to perfect capital mobility internationally.

7.1.5 Major Conclusions From The Adoption of Alternative Policies

The simulation results indicated that the alternative policy responses toward trade liberalisation, public infrastructure spending, and financial liberalisation, had a very significant influence upon the development of key macroeconomic variables, both in the long run equilibrium and during the adjustment process. In the long run steady state the effect is greater for the oil requirements increase than for the oil price increase, regardless of the policy response adopted. The adjustment process involved greater fluctuations for the oil price increase than for the oil requirements increase case. The most significant difference in the adjustment paths among these policies, arises during the adjustment process up to 10 years. The government could, arising from these alternative policies, offset or worsen the oil shock consequences, and could improve upon or deteriorate the performance of the key macroeconomic variables. The magnitudes and the adjustment path of the key macroeconomic variables, are different for different policy options and for different shocks.

The analysis of three groups of alternative policy responses towards the two oil related shocks, can be summarised as follows.

(i) A major conclusion in regard to a trade liberalisation policy, is that there is a larger effects upon the key macroeconomic variables for an increase in the price of oil case than for an increase in domestic oil requirements case. A trade liberalisation policy will initially produce a larger favourably effect upon the trade
sector. The non-oil trade balance noticeably improves, arising from a larger depreciation of the real exchange rate. There is a greater favourable effect upon real income, demand for non-oil output and physical private capital stock, arising from a larger improvement in the non-oil trade balance. However, foreign asset stocks and domestic private sector real wealth experience a larger decumulation in the long run equilibrium under a trade liberalisation policy. This is mainly due to a persistent current account deficit arising from the oil related shocks, given the characteristics of this oil-importing economy. There is no effect upon the inflation rate in the long run, arising from the adoption of such a policy.

(ii) An expansion of public infrastructure capital spending will improve the macroeconomic performance of the economy. This improved performance was a little different between the oil price and domestic oil requirements shock. A larger favourable effect occurs in the case of a domestic oil requirements shock. The improved performance related to foreign asset stocks, physical capital stock, non-oil output, real income, private sector real wealth, and the non-oil trade balance. Foreign asset stocks and domestic private sector real wealth experience a larger accumulation in a case of a domestic oil requirements shock. However in the long run steady state, the results suggest that an expansion of public infrastructure spending will improve the macroeconomic performance of the economy as a whole.

(iii) This study also shows that adopting a more liberal policy towards the nominal exchange rate and the degree of control over capital markets, would influence the major macroeconomic variables in both the long run equilibrium and the adjustment process for both the oil price and the oil requirements shock. 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 that the most pronounced effects occur in the early periods of the adjustment. These are larger and more volatile for the case of the oil price increase than for the case of the domestic oil requirements increase. In addition to that, the adjustment process is larger and more volatile with a high degree of control over 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. In addition the results also suggest that full financial liberalisation (a flexible nominal exchange rate combined with perfect capital mobility) will improve the non-oil trade balance and demand for non-oil output for the case of the oil price shock, whilst the other key macroeconomic variables such as foreign asset stocks, physical capital stock, real income, and domestic private sector real wealth are very similar to the base case. For the case of a domestic oil requirements shock, the results generated indicate that full financial liberalisation will improve the macroeconomic performance as a whole despite there being an unfavourable effect upon the non-oil trade balance.

(iv) Overall, the effects of oil related shocks would be worse without the government’s policy responses. The adoption of one policy option could not improve all economic outcomes. This is mainly due to one policy option having a worse effect upon some variables, whilst other policy options may make such variables perform better. Hence Thailand needs to adopt a combination of policies to improve its economic performance arising from shocks, with specific emphasis here having been given to oil price and domestic oil requirements shocks.

7.2 Policy Implications

The study has shown that the model to be developed should be dynamic and emphasise the long run, in order to identify and to analyse the economic effects arising from oil shocks upon a developing net oil-importing economy such as Thailand. The results strongly suggest that the most pronounced effects on macroeconomic variables occur during the initial period of the adjustment processes, with the oil shocks having a long run effect as indicated by the prolonged adjustment of the capital stock from the short run to the long run.

The study also shows that the government’s policies towards either financial or trade liberalisation or public spending on infrastructure developments, have a significant influence upon these key macroeconomic variables both in long run
equilibrium and during the adjustment process. The study, in particular, showed that the government's policies in regard to an expansionary public infrastructure capital spending has a positive impact upon the key macroeconomic variables. Whilst a trade liberalisation policy has a strong effect upon the trade sector by improving the non-oil trade balance. Alternative nominal exchange rate and capital market policies have a larger and more volatile effect upon the development of the key macroeconomic variables. Hence the government could, arising from these alternative policies, offset or worsen the effects of the oil shocks, and could improve upon or deteriorate the performance of the key macroeconomic variables. These results are very significant in the context of the Thai economy, because of the continuing importance of imported oil to the economy. These are also significant policy options, not only in the context of Thailand, but for other developing resource-importing countries who are seeking appropriate policies to overcome the external shocks that may occur for them in the future.

7.3 Further Studies

The purpose of this study has been to develop a dynamic long run macroeconomic model for a Thailand like net oil-importing developing economy. The model developed was utilised to analyse and investigate the effects of oil shocks upon key macroeconomic variables. This was conducted by means of a simulation analysis, conducted by empirically estimating the parameters derived from the 2SLS regression estimations and from existing studies.

The results suggest that the Thai government could gain from economic liberalisation policies (both trade and financial), and an expansion of infrastructure spending. However, there are further possible policy adoptions available for the Thai authorities to consider to improve the future economic performance of the economy. These can also be incorporated within the context of the theoretical framework presented, and represent further extensions to it.
A further study would be to incorporate the issue of privatization. This is one way to improve the economic efficiency and competitiveness of the whole economy. Because the public sector does not have the managerial capacity to administer all economic sectors, and it also does not have enough investment resources. Hence privatization not only helps to reduce the budget deficit but also is essential to finance investment and increase productivity.

This thesis has placed emphasis upon non-oil goods and barriers on exported and imported goods. A further study could pay attention to service trade liberalisation. This issue could be considered in a further study by incorporating the services sector explicitly into the model. The introduction of service trade liberalisation, focusing upon financial services (banking and insurance), could be adopted to examine the effects of such a strategy on the development of Thailand as a worldwide financial center.

The final issue for further study would be to incorporate government revenues such as income tax and foreign borrowing. Such government revenues would contribute to government consumption. Hence in a further study, government consumption would depend upon government revenues arising from income tax and foreign borrowing, instead of it being assumed to be an exogenous variable as in the base model outlined in Chapter 4. This would provide the basis for an investigation of the effectiveness of a tax reform policy and foreign borrowing patterns.

Overall, the development of a dynamic long run macroeconomic model for a Thailand like net oil-importing economy has been the major purpose of this study. It has been possible to identify the long run steady state properties of the chosen key macroeconomic variables, as well as the adjustment process arising from the oil related shocks. This study also provides alternative policy options in regard to maintaining and enhancing long run economic developments for the Thai economy. In addition, this model also offers a framework within which a wide range of possible policy

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prescriptions can be analysed and evaluated. The model developed, and the policy prescriptions derived from it, is able to provide a guideline for Thai policy makers, as the results suggest that the Thai economy would benefit from the effects of economic liberalisation.

In addition, this study has provided a framework which will be useful for other researchers who wish to examine key issues confronting the Thai economy. The policy issues identified are also of interest to other developing resource-importing economies such as the Philippines and Laos, which can learn from the experiences of an economy such as Thailand.
Appendix 2.1

Natural Gas In Thailand

Natural gas was firstly discovered in Thailand in the early part of the 1970s, nearly ten years would pass before a 34-inch diameter, 425km pipeline brought gas from the Gulf of Thailand to the southeastern coastal city of Rayong. At the time of construction, this was the longest offshore pipeline in the world and credit must go to the infant domestic enterprise, the Petroleum Authority of Thailand (PTT), for its foresight and vision. It invested in the pipeline after the private sector failed to take up the opportunity.

Each day this pipeline now carries more than 900 million cubic feet of natural gas, and is the nation's energy life line. More than 50% of all electricity generated in Thailand is produced from natural gas.

In the future, natural gas will continue to be the preferred fuel for power generation because of economic and environmental factors. The demand for gas is expected to more than double in the next decade to over 2,000 million cubic feet per day. To cater for this growing demand, there are plans to duplicate the existing single pipeline, expand the onshore lines to Bangkok power plants, construct the main pipeline around Bangkok and take off feeder spurs to nearby industrial and commercial areas. Agreements with neighbouring countries for additional supplies via pipeline are also likely to be concluded. Countries with whom discussions have already been held regarding gas imports include Myanmar, Vietnam, Malaysia, and Indonesia, with first imports expected during 1996. In fact, Thailand has good reserves of gas, currently rated at 8.5 trillion cubic feet recoverable and good prospects for more discoveries. At present fifty concession blocks have been explored but only 29 are in production. The success ratio for both onshore and offshore exploration is 1 : 1.25.

However, Thailand has been facing a problem that its growth rate has been so great, that meeting infrastructure needs is a planner's nightmare. Between 1988 and 1991 GDP growth rate was greater than 10% a year (and subsequent years not much less) and in 1990 energy consumption grew nearly 20%. Forecast natural gas demand now outstrips prevent reserves, and Thailand's planners therefore encounter with the question of economics of supply options spanning possible additional indigenous supplies, imports by pipeline, or imports by the Liquidity Natural Gas Project (LNG).

Like the other developing countries, Thailand has learned from developed countries to adjust the economy in response to the external and internal shocks. One major supervisor is the Australian expertise in the area of resource development. Australians have faced these issues in the past and sure to be involved in these future gas developments. One of the pioneers of Australian involvement here has been the Gas and Fuel Corporation of Victoria (GASCOR) through its Consulting Division, GASCOR Consulting International.

In 1982, while Thailand was hit by the second oil price shock, GASCOR established in conjunction with the Royal Thai Government Thailand's first energy saving scheme. GASCOR played a significant role in establishing the Energy Conservation Centre of Thailand with which it has maintained a continuous and close relationship.

GASCOR is Australia's largest gas utility and the largest of its type in the southern hemisphere, and has its greatest strength in gas distribution and utilisation expertise. Both of these capabilities have been extensively used throughout Asia over many past years. In 1988 GASCOR Consulting International reviewed prospects, carried out designs and recommended actions for distribution of gas to industrial for the whole of the eastern seaboard and Bangkok regions. It designed and supervised construction of the first gas pipeline to the now very important Laem Chabang Industrial Estate.
Reflecting Australia’s and GASCOR’s leading position in the world in using natural gas in the transport sector, Thailand has just completed the designed project management supervised by GASCOR. The designed project is the first major compressed natural gas refuelling station for city buses. This station, reportedly the best in the world, is now helping to reduce Bangkok’s pollution by refuelling 82 city buses which ply the city centre running on environmentally and friendly natural gas. Current government plans will greatly extend the size of the natural gas fuelled bus fleet and hopefully see an end to the black-smoke belching Bangkok diesel bus.

In recent years many more Australian consultants and contractors have brought their expertise to Thailand. Australian expertise in natural gas is equal to, if not better than, any in the world. This offers the great prospect and vision for Thailand to improve its resource developmental ability and energy consumption.
Appendix 3.1

Steady State Properties of the Model

More details of the steady state equilibrium and dynamic adjustment stability of the model will be discussed. However, before we consider the complex macroeconomic model, it is useful to consider a simple two dynamic variable model in order to derive the analytical expression for the convergent path when the saddlepoint conditions are obtained.

A simple model

(a) \[ \dot{x} = ax + by + h \]
(b) \[ \dot{y} = cx + dy + k \]

In order to derive a saddlepoint solution which is characteristic of rational expectations models. This needs to be mentioned.

\[ a > 0, \ b > 0, \ c < 0, \text{ and } d < 0 \]

Writing the system in matrix form as:

\[
\begin{bmatrix}
\dot{x} \\
\dot{y}
\end{bmatrix} = \begin{bmatrix}
a & b \\
c & d
\end{bmatrix} \begin{bmatrix}
x \\
y
\end{bmatrix} + \begin{bmatrix}
h \\
k
\end{bmatrix}
\]

The characteristic equation for the coefficient matrix is given by:

\[ 0 = \begin{vmatrix}
a - \lambda & b \\
c & d - \lambda
\end{vmatrix} = \lambda^2 - (a + d) \lambda + (ad - cd) \]

Which has two solutions:

\[ \lambda = \frac{1}{2} \left[ (a+d) \pm \sqrt{(a+d)^2 - 4(ad-cd)} \right] \]
Given the above sign restriction on the coefficient, \((ad-bc)\) is negative, and \(\{(a+d)^2-4(ad-bc)\}^{1/2}\) is larger in absolute value than \((a+d)\), confirming that one eigenvalue is positive and one is negative. Choosing the negative solution,

\[
\lambda = \frac{1}{2} \left[ (a+d) - \{(a+d)^2 - 4(ad-bc)\}^{1/2} \right]
\]

The solution to the system is:

\[
\begin{align*}
x &= \lambda (x - x^*) \\
y &= \lambda (y - y^*)
\end{align*}
\]

where \(x^*\) and \(y^*\) denote the steady state value of \(x\) and \(y\) obtained when \(\dot{x} = \dot{y} = 0\) in the system.

The above sample discusses a simple macroeconomic model with only two equations. The following is a discussion of a general model with the linear system of \((n)\) first order differential equations in \((n)\) variables \(x_{it}\) at time \(t\):

\[
\begin{align*}
\dot{x}_{1t} &= a_{11}x_{1t} + a_{12}x_{2t} + \ldots + a_{1n}x_{nt} + h_1 \\
\cdots \\
\cdots \\
\dot{x}_{nt} &= a_{n1}x_{1t} + a_{n2}x_{2t} + \ldots + a_{nn}x_{nt} + h_n
\end{align*}
\]

which, in matrix notation, may be written as:

\[
\dot{x}_t = Ax_t + h
\]
where

\[ x_{\text{it}} = \begin{bmatrix} x_{1t} \\ x_{2t} \\ \vdots \\ x_{\text{n}t} \end{bmatrix}, \quad A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ a_{21} & \cdots & a_{2n} \\ \vdots & & \ddots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix}, \quad h = \begin{bmatrix} h_1 \\ h_2 \\ \vdots \\ h_n \end{bmatrix} \]

Consider the eigenvalue (\(\lambda\)) of the coefficient matrix \(A\), obtained by solving the matrix \(|A - \lambda I| = 0\), in which \(I\) is an identity matrix which \((n \times n)\) dimensions. These eigenvalues may be real or complex. If the real parts of all \((n)\) eigenvalues are negative, the system is Globally Stable, convergent to the steady state from any initial position. If the real parts of \((n)\) eigenvalues are positive, the system is Globally Unstable, diverging from all initial positions except the steady state itself.

To analyse the dynamic macroeconomic processes that follow a resource shock, it is useful to understand the derivation of solutions for rational expectations model. In particular, this study will concentrate on the contributions of the short run models, Eastwood and Venables (EV), and Neary and Wijnbergen (NW)\(^{101}\). These models tend to be very simple, and capable of giving clear results for the dynamic adjustment process of the domestic real exchange rate and prices for the oil exporting economy.

**Model**

\[
\begin{align*}
   m &= pc + \kappa y - \lambda r \\
   y &= \delta(e+p^*-p) + \gamma y - \sigma(r - p) + \eta(O+e-p) \\
   pc &= \alpha p + (1-\alpha)(e+p^*) \\
   e &= r - r^* \\
   p &= \pi(y - \bar{y})
\end{align*}
\]

Mathematically and diagramatically derivation are applied to solve the dynamics of the model. Setting $e$ and $p$ to zero, then the dynamics of the model can be obtained from the following matrix equations\(^{102}\),

**Short-run dynamic adjustment**

$$
\begin{align*}
&M = \begin{bmatrix}
-\lambda(\sigma(\alpha - \beta) + \lambda(\delta + \eta) & \pi(\lambda(\delta + \eta) - \sigma(1 - \alpha + \beta) \\
(1 - \gamma - \sigma\beta)(\alpha - \beta) - \kappa(\delta - \eta) & (1 - \alpha + \beta)(1 - \gamma - \sigma\pi) + (\kappa(\delta + \eta))
\end{bmatrix}
\end{align*}
$$

$$
\begin{align*}
&\begin{bmatrix}
\frac{1}{\Delta} \left[ \begin{array}{ccc}
-\lambda(\sigma(\alpha - \beta) + \lambda(\delta + \eta) & \pi(\lambda(\delta + \eta) - \sigma(1 - \alpha + \beta) \\
(1 - \gamma - \sigma\beta)(\alpha - \beta) - \kappa(\delta - \eta) & (1 - \alpha + \beta)(1 - \gamma - \sigma\pi) + (\kappa(\delta + \eta))
\end{array} \right]
\begin{bmatrix}
p \\
e
\end{bmatrix}
\right]

+ \frac{1}{\Delta} \begin{bmatrix}
0 & \pi\sigma & \pi(\lambda \eta - \sigma\beta) \\
-(\pi\kappa + \lambda(1 - \gamma - \sigma\pi)) - \kappa\sigma\pi & -(1 - \gamma - \sigma\pi) & -(1 - \gamma - \sigma\pi) - \beta(1 - \gamma - \sigma\pi + \eta\kappa)
\end{bmatrix}
\begin{bmatrix}
r^* \\
p^* \\
y
\end{bmatrix}
\end{align*}
$$

where $\Delta = \sigma\kappa + \lambda(1 - \gamma - \sigma\pi) > 0$,

So that a stable adjustment path of short-run dynamic adjustment of $e$ and $p$ from one long run steady-state equilibrium to another equilibrium points that are consistent with long run stability. Figure 1 demonstrated this situation.

---

A necessary and sufficient condition for the system to exhibit saddlepoint behaviour is that the determination of $M < 0$. In the EV and NW models, they also conduct two conditions in order to achieve of $M < 0$.

\[(1-\gamma-\sigma\beta)(\alpha-\beta) > \kappa(\delta+\eta) \quad (a)\]
\[\lambda(\delta+\eta) > \sigma(1-\alpha+\beta) \quad (b)\]

Condition (a) implies that an increase in the domestic price level would increase the demand for money, and subsequently decrease real output. To offset this situation, an increase in the nominal interest rate would be required, and bringing about expectations of a depreciation of nominal exchange rate. While condition (b) suggests that a depreciation of the exchange rate would lead to an increase in non-oil output and the domestic price level. Conditions (a) and (b) underly the work of Dornbusch, EV, and NW, and ensure that the manifold is negatively sloping.
<table>
<thead>
<tr>
<th>Notes</th>
<th>Data Sources</th>
<th>Exogenous Variables</th>
<th>Endogenous Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public capital stock (this is a politically determined variable) and data is available in annual basis.</td>
<td>Derived from Cross Domestic Capital Formation for public sector.</td>
<td>(y)</td>
<td>(x)</td>
</tr>
<tr>
<td>and data is available on an annual basis. and will be used in this report.</td>
<td>Derived from Cross Domestic Capital Formation for private sector.</td>
<td>(y)</td>
<td>(x)</td>
</tr>
<tr>
<td>and data is available on an annual basis.</td>
<td>Derived from Domestic Government Consumption Expenditure, and</td>
<td>(y)</td>
<td>(x)</td>
</tr>
<tr>
<td>Derived from Private Government Consumption Expenditure, and available on an annual basis.</td>
<td>Calculated from Total GDP at market price. The data is available on</td>
<td>(y)</td>
<td>(x)</td>
</tr>
<tr>
<td>Derived from Total GDP at market price. The data is available on an annual basis.</td>
<td>Derived from National Income. The data is available on an annual basis.</td>
<td>(y)</td>
<td>(x)</td>
</tr>
</tbody>
</table>

Variable Definitions and Data Sources in the Base Model

Appendix 5.1
<table>
<thead>
<tr>
<th>Notes</th>
<th>Data Sources</th>
<th>Endogenous Variables</th>
<th>Exogenous Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Derived from ( Y = \frac{1}{n} \text{ Var}(y) ), as the definition used in simulation.</td>
<td>NESEDB</td>
<td>Permanent income (P)</td>
<td>Domestics private real wealth</td>
</tr>
<tr>
<td>Derived on an annual basis, plus Public Consumption Expenditure on Fuel and Light, the data is available.</td>
<td>NESEDB</td>
<td>(O*)</td>
<td>Domestic oil requirements</td>
</tr>
<tr>
<td>Derived from Private Sector Real Wealth and be consistent with the data is available. To obtain Domestic real wealth and be consistent with the data is available, the model is derived from existing studies (as H model (1993) and CH model (1994)).</td>
<td>NESEDB, NOSL</td>
<td>Real Profits (P)</td>
<td>Net of Imports (Comp)</td>
</tr>
<tr>
<td>The data is not available, as not appropriate to the definition of the table is available on a quarterly basis.</td>
<td>World Bank IMF</td>
<td>Government Investment (G)</td>
<td>Private Investment (I)</td>
</tr>
</tbody>
</table>

The data is not available, as not appropriate to the definition of the table is available on an annual basis. | NESEDB, NOSL |
<table>
<thead>
<tr>
<th>Notes</th>
<th>Data Sources</th>
<th>Endogenous Variables</th>
<th>Exogenous Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>The data is available on a quarterly basis. The parameter is estimated from existing studies.</td>
<td>World Table</td>
<td>World price of oil (Po)</td>
<td>Inflationary expectation (τ)</td>
</tr>
<tr>
<td>The data is available on an annual basis.</td>
<td>PEER</td>
<td>IMF</td>
<td>Output (Yn)</td>
</tr>
<tr>
<td>The data is available on an annual basis.</td>
<td>IMF, BOT</td>
<td>IMF</td>
<td>Domestically produced price of General price level (Pp)</td>
</tr>
<tr>
<td>The data is available on a quarterly basis.</td>
<td>IMF, BOT</td>
<td>IMF</td>
<td>Bank of Thailand (P)</td>
</tr>
<tr>
<td>The data is available on an annual basis.</td>
<td>IMF, BOT</td>
<td>IMF</td>
<td>Foreign Exchange Reserves in Current account balance (C)</td>
</tr>
<tr>
<td>The data is available on a quarterly basis.</td>
<td>IMF, BOT</td>
<td>IMF</td>
<td>Foreign asset stocks (I)</td>
</tr>
<tr>
<td>The data is available on an annual basis.</td>
<td>IMF, BOT</td>
<td>IMF</td>
<td>Money supply (M)</td>
</tr>
<tr>
<td>The data is available on a quarterly basis.</td>
<td>IMF, BOT, World Table</td>
<td>IMF, BOT</td>
<td>Non- oil imports (In)</td>
</tr>
<tr>
<td>The data is available on a quarterly basis.</td>
<td>IMF, BOT, World Table</td>
<td>IMF, BOT</td>
<td>Non- oil exports (Ex)</td>
</tr>
<tr>
<td>The data is available in Thailand for the purpose of simulation.</td>
<td>NESDB</td>
<td>IMF, BOT</td>
<td>Permanent non- oil imports (Yn) (a)</td>
</tr>
<tr>
<td>Data Type</td>
<td>Notes</td>
<td>Exogenous Variables</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td>World Table</td>
<td>IMF, World Table</td>
<td>World Real Income (Y*)</td>
<td></td>
</tr>
<tr>
<td>IMF, BOT, Peer</td>
<td></td>
<td>World Real Income (Y*)</td>
<td></td>
</tr>
<tr>
<td>Nominal Interest Rate (r)</td>
<td></td>
<td>Domestic trade barriers (p_d)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(p_w)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>World Table</td>
<td></td>
</tr>
</tbody>
</table>

The data is available on a quarterly basis.

*Derived from US’s CPI, The data is available on a quarterly basis.

*Derived from US’s National Income. The data is available on a quarterly basis.

**Data Sources:**
It is known that the current series would appear as 25 for each of the corresponding quarters of the new series when the disturbe command is chosen. To illustrate, if the current series has an annual frequency and the transformed series is to have a quarterly frequency, an observation value of 100 in

According to "DX Econ Data : The Time Series Data Express" (1994), the program offers an operation to transform data frequencies.

Data transformed to quarterly observations using the DX data base program

| The National Economic Office of Thailand | NEOST |
| Far Eastern Economic Review | FEER |
| Bank of Thailand | BOT |
| International Monetary Fund | IMF |
| The National Economic and Social Development Board | NESDB |

Notes (1)
Appendix 5.2

Unit Root Tests

A test for unit roots can be conducted by using the Shazam Package\textsuperscript{103}. The finding of a unit root in a time series indicates non-stationarity which has implications for economic theory and modelling and is important in econometric work which involves time series analysis of trended data. With non-stationary data standard econometric estimation may give misleading statistical and therefore economic inferences. It is therefore necessary to ensure that the data is stationary.

In order to test for a unit root in the 23 variables of interest the Dickey-Fuller test is used. For a time series $Y_t$, two forms of the "augmented Dickey-Fuller" regression equations are:

\begin{align*}
(1) \quad \Delta Y_t &= \alpha_0 + \alpha_1 Y_{t-1} + \Sigma \gamma_j \Delta Y_{t-j} + \epsilon_t \\
(2) \quad \Delta Y_t &= \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 t + \Sigma \gamma_j \Delta Y_{t-j} + \epsilon_t
\end{align*}

Equation (2) is used here because it includes a time trend, which is a characteristic of the relevant time series. So the following tests are used:

(a) $\alpha(1) = 0$, t-test
(b) $\alpha(0) = \alpha(1) = \alpha(2) = 0$, F-test for unit root test (zero drift)
(c) $\alpha(1) = \alpha(2) = 0$, F-test for unit root test (non-zero drift)

and the results are shown and explained in Table 5.2A:

\footnotesize{\textsuperscript{103} Shazam, version 7, 1993, pp.157-168.}
Table 5.2A

Results of the Augmented Dickey-Fuller Tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>Null hypothesis</th>
<th>Asy. Critical value 10%</th>
<th>Test Statistics for I(0)</th>
<th>Test Statistics for I(1)</th>
<th>Test Statistics for I(2)</th>
<th>Test Statistics for I(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real income (y)</td>
<td>(a)</td>
<td>-3.13</td>
<td>0.298</td>
<td>-1.87</td>
<td>-4.29</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>1.65</td>
<td>1.60</td>
<td>6.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>1.58</td>
<td>1.94</td>
<td>9.21</td>
<td></td>
</tr>
<tr>
<td>This implies that real income is stationary in the second difference. This is because for (a) $\alpha = 0$, t-estimated is insignificant for I(0), and I(1), whilst it is significant for I(2). For hypotheses (b) and (c), F-statistics are insignificant for I(0), and I(1), but they are significant for I(2). This procedure is also applied to all the variables below.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Consumption (cP)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-0.044</td>
<td>-1.73</td>
<td>-2.89</td>
<td>-5.23</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>1.46</td>
<td>1.60</td>
<td>2.86</td>
<td>9.14</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>1.47</td>
<td>1.76</td>
<td>4.27</td>
<td>13.69</td>
</tr>
<tr>
<td>This implies that private consumption is stationary in the third difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic private sector real wealth (wP)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-1.49</td>
<td>-1.91</td>
<td>-3.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>1.97</td>
<td>1.37</td>
<td>4.76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>2.27</td>
<td>1.88</td>
<td>7.12</td>
<td></td>
</tr>
<tr>
<td>This implies that domestic private sector real wealth is stationary in the second difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent income (y*)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-2.57</td>
<td>-3.07</td>
<td>-3.18</td>
<td>-5.44</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>2.90</td>
<td>3.23</td>
<td>3.40</td>
<td>9.94</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>3.66</td>
<td>4.84</td>
<td>5.09</td>
<td>14.91</td>
</tr>
<tr>
<td>This implies that permanent income is stationary in the third difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net oil import (Oni)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-1.96</td>
<td>-2.38</td>
<td>-4.54</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>1.64</td>
<td>1.93</td>
<td>6.89</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>1.98</td>
<td>2.88</td>
<td>10.334</td>
<td></td>
</tr>
<tr>
<td>This implies that net oil imports is stationary in the second difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-oil exports (tx)</td>
<td>(a)</td>
<td>-3.13</td>
<td>1.23</td>
<td>-1.35</td>
<td>-9.76</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>1.95</td>
<td>1.71</td>
<td>31.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>2.46</td>
<td>1.69</td>
<td>47.67</td>
<td></td>
</tr>
<tr>
<td>This implies that non-oil exports is stationary in the second difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-oil Imports (tm)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-2.81</td>
<td>-2.12</td>
<td>-2.80</td>
<td>-11.72</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>3.12</td>
<td>1.57</td>
<td>3.32</td>
<td>46.07</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>4.16</td>
<td>2.34</td>
<td>4.71</td>
<td>69.02</td>
</tr>
</tbody>
</table>
| This implies that non-oil imports is stationary in the third difference.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Null hypothesis</th>
<th>Asy. Critical value 10%</th>
<th>Test Statistics for I(0)</th>
<th>Test Statistics for I(1)</th>
<th>Test Statistics for I(2)</th>
<th>Test Statistics for I(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical private capital stock (kP)</td>
<td>(a) -3.13</td>
<td>-1.04</td>
<td>-3.88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>1.70</td>
<td>5.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>1.90</td>
<td>7.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that private physical capital stock is stationary in the first difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government capital stock (kG)</td>
<td>(a) -3.13</td>
<td>-2.12</td>
<td>-5.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>1.64</td>
<td>11.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>2.32</td>
<td>16.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that government capital stock is stationary in the first difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply of non-oil output (y_nonl)</td>
<td>(a) -3.13</td>
<td>2.36</td>
<td>-0.60</td>
<td>-4.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>2.55</td>
<td>1.72</td>
<td>6.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>3.78</td>
<td>1.49</td>
<td>8.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that non-oil output supply is stationary in the second difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Asset Stocks (f)</td>
<td>(a) -3.13</td>
<td>-1.65</td>
<td>-1.50</td>
<td>-5.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>2.44</td>
<td>1.56</td>
<td>11.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>3.06</td>
<td>1.68</td>
<td>17.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that foreign asset stocks is stationary in the second difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign exchange reserves (fs)</td>
<td>(a) -3.13</td>
<td>-0.17</td>
<td>-0.56</td>
<td>-7.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>1.34</td>
<td>2.23</td>
<td>17.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>1.44</td>
<td>1.86</td>
<td>26.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that foreign exchange reserves is stationary in the second difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current account balance (f)</td>
<td>(a) -3.13</td>
<td>-2.38</td>
<td>-3.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>1.92</td>
<td>4.08</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>2.86</td>
<td>5.96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that current account balance is stationary in the first difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal money stock (m)</td>
<td>(a) -3.13</td>
<td>0.58</td>
<td>-3.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b) 4.03</td>
<td>3.20</td>
<td>4.41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) 5.34</td>
<td>2.63</td>
<td>6.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This implies that nominal money stock is stationary in the first difference.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic price of non-oil output (pn)</td>
<td>(a) -3.13</td>
<td>-2.82</td>
<td>-3.69</td>
<td></td>
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<td>This implies that domestic price of non-oil goods is stationary in the first difference.</td>
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<td>Consumer price level (pc)</td>
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<td>-2.31</td>
<td>-4.03</td>
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<td>3.05</td>
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<td>This implies that consumer price level is stationary in the second difference.</td>
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<td>(a) -3.13</td>
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<td>10.30</td>
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<td>World nominal interest rate (r*)</td>
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<td>World price of oil (Po*)</td>
<td>(a) -3.13</td>
<td>-1.58</td>
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<td>-4.47</td>
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<td>Nominal exchange rate (e*)</td>
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<td>6.52</td>
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<td>Domestic oil requirements (Or*)</td>
<td>(a) -3.13</td>
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<td>3.46</td>
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<td>World real income (y*)</td>
<td>(a) -3.13</td>
<td>-2.67</td>
<td>-3.75</td>
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<td></td>
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</tr>
<tr>
<td>World price of non-oil output (p*)</td>
<td>(a) -3.13</td>
<td>-1.60</td>
<td>-3.42</td>
<td>-4.32</td>
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<tr>
<td></td>
<td>(b) 4.03</td>
<td>3.56</td>
<td>3.93</td>
<td>6.27</td>
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<td></td>
<td>(c) 5.34</td>
<td>4.79</td>
<td>5.87</td>
<td>9.39</td>
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<tr>
<td>This implies that world price of non-oil output is stationary in the second difference.</td>
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</tbody>
</table>
Notes * Exogenous variables

(1) I(0) unit root test on zero differences for stationarity
(2) I(1) unit root test on the first difference for stationarity at the first difference
(3) I(2) unit root test on the second difference for stationarity at the second difference.
(4) I(3) unit root test on the third difference for stationarity at the third difference.

(a) $a(1) = 0$, t-test
(b) $a(0) = a(1) = a(2) = 0$, F-test for unit root test (zero drift)
(c) $a(1) = a(2) = 0$, F-test for unit root test (non-zero drift)

For all the variables included in the above Table, the test statistics (t and F tests) indicate that all the coefficients are not significantly different from zero at the 10% level. Therefore we conclude that the null hypothesis of a unit root (or higher) cannot be rejected for all variables.
Appendix 5.3
Transformation of Data and Re-Testing for Unit Roots

All variables tested in Appendix 5.2 were found to be non-stationary. This appendix considers the methods of transforming these variables into stationary series. The methods all rely on data detrending, after which, each detrended variable will be re-tested to ensure that it is stationary, before using it to estimate the parameters of interest.

Step 1

The observed non-stationarity results from structural changes in the economy and time trending of the data. There are two general procedures used for detrending data\textsuperscript{104}.

1. Estimating regressions on time.
2. Successive differencing.

In this study the first procedure, namely regression estimation, is used because testing different specifications in time gives a greater scope for correctly modelling the trend. In addition to this, Perron (1989)\textsuperscript{105} shows that structural change biases the Dickey-Fuller test away from finding I(0) and successive differencing is mechanical which takes no account of these structural phenomena.

The 23 detrended variables can be found by solving:

\[ X_t = X_t(t) + X_t(dt) \]  

where \( X_t \) is the variable at time \( t \)
\( X_t(t) \) is the trended variable at time \( t \)
\( X_t(dt) \) is the detrended variable at time \( t \)

\textsuperscript{104} See Maddala (1992): 258-259.
To give:

\[ \text{X}_t (dt) = \text{X}_t - \text{X}_t (t) \]  

(b)

To obtain \( \text{X}_t (t) \), regressions will be run on the following four specifications:

\[
\begin{align*}
\text{X}_t (t) &= \alpha + \beta \text{time} + \gamma (\text{Dt}) \cdot \text{time} \\
\text{X}_t (t) &= \alpha + \beta \text{time}^2 \\
\text{X}_t (t) &= \exp (X_t) + \beta \text{time}^2 \\
\text{X}_t (t) &= \log (\beta \text{time})
\end{align*}
\]

(1) (2) (3) (4)

where \( \text{Dt} \) is the dummy variable (\( \text{Dt} = 1 \) for the second period of observations 41 - 88).

\( \alpha \) is the constant term

\( \exp \) is the exponential operator

\( \log \) is the natural logarithm operator

Equation (1) above involves a regression with dummy variables which is one method of “quantifying” structural change. This is relevant to Thai economic development, which has been significantly affected by structural changes during the period 1970-1990.

Equation (2) indicates regressions on time squared (quadratic) trends. Equation (3) identifies mixed non-linear time trends, and Equation (4) defines natural logarithmic time trends.

Each variable is subsequently detrended by using the predicted value of \( \text{X}_t (t) \) from each of the preferred regressions based on the maximum \( R^2_{\text{adjusted}} \), and F test statistic. These selected regressions are summarised in Table 5.3 A.
| (q), (a) | 94378 0.0024 | 1.00 | -1.33 + 0.67 time - 0.28 (Di) time |
| (q), (a) | 4216.28 5.55 | 0.00 | 0.30 + 0.15 time |
| (q), (a) | 95848 0.0028 | 0.00 | 1.00 + 0.67 time - 0.27 (Di) time |
| (q), (a) | 1236.89 0.045 | 86.0 | -1.09 + 0.33 time - 0.07 (Di) time |
| (q), (a) | 114.16 0.0026 | 99.0 | 1.08 + 0.12 time - 0.18 (Di) time |
| (q), (a) | 100.05 0.0135 | 0.00 | 1.36 + 0.64 time - 0.09 (Di) time |
| (q), (a) | 751.12 0.0003 | 1.00 | 0.113 + 0.57 time - 0.113 (Di) time |

**Notes:**
- Adjusted R-squared
- Real GDP
- Private consumption
- Real income (y)
- Explanatory variables

Preferrred Determining Model for Each Variable

**Table 5.3A**
<table>
<thead>
<tr>
<th>(q)</th>
<th>(r)</th>
<th>(s)</th>
<th>(t)</th>
<th>(u)</th>
<th>(v)</th>
<th>(w)</th>
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<tbody>
<tr>
<td>07 2</td>
<td>17185.3</td>
<td>690</td>
<td>(1.3 + 0.5) (\text{D})\text{time})</td>
<td>Permanent income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(q)</td>
<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>00000</td>
<td>16365</td>
<td>00</td>
<td>(0.68 + 0.34) (\text{D})\text{time})</td>
<td>World real income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(q)</td>
<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>422.03</td>
<td>11.57</td>
<td>00</td>
<td>(0.62 + 0.31) (\text{D})\text{time})</td>
<td>Foreign exchange reserves on the Bank of Thailand (S)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(q)</td>
<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>421.82</td>
<td>17.03</td>
<td>00</td>
<td>(0.92 + 0.46) (\text{D})\text{time})</td>
<td>Foreign asset stocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(q)</td>
<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>69849</td>
<td>00</td>
<td>00</td>
<td>(0.12 - 0.64) (\text{D})\text{time})</td>
<td>Current account balance (f)</td>
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<td></td>
</tr>
<tr>
<td>(q)</td>
<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>173.8</td>
<td>00</td>
<td>00</td>
<td>(0.19) (\text{D})\text{time})</td>
<td>Domestic oil requirements (O)</td>
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<td></td>
</tr>
<tr>
<td>(q)</td>
<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>18239.4</td>
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<td>00</td>
<td>(0.34 + 0.49) (\text{D})\text{time})</td>
<td>Net oil imports (Q)</td>
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<td>(r)</td>
<td>(s)</td>
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<td>(w)</td>
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<tr>
<td>17108</td>
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<td>00</td>
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<td>(v)</td>
<td>(w)</td>
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<tr>
<td>17435</td>
<td>00</td>
<td>00</td>
<td>(0.28 + 0.14) (\text{D})\text{time})</td>
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<td>(r)</td>
<td>(s)</td>
<td>(t)</td>
<td>(u)</td>
<td>(v)</td>
<td>(w)</td>
</tr>
<tr>
<td>68131</td>
<td>00</td>
<td>00</td>
<td>(0.70 + 0.29) (\text{D})\text{time})</td>
<td>Government capital stock (K)</td>
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Notes:
- Estimated
- Projected
- Final
- Sales

Method Used:
- Variance
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<th>Notes</th>
<th>Preferred Detrending Model for Each Variable</th>
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<th>0.0024</th>
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<td>1.2386</td>
<td>0.0023</td>
<td>1.33 + 0.15 (De) time</td>
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<td>(q)</td>
<td>(a)</td>
<td>1.9</td>
<td>5.688</td>
<td>0.0046</td>
<td>-0.07 (De) time</td>
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<tr>
<td>(q)</td>
<td>(a)</td>
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<td>1.1469</td>
<td>6.6</td>
<td>-0.13 (De) time</td>
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<tr>
<td>(q)</td>
<td>(a)</td>
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<td>0.0005</td>
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<td>Private Consumption</td>
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Notes:
- R²: R-squared
- F-statistic
- Method Used:
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<td>49365 0.00 1</td>
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<td>(a)</td>
<td>11.2 22 0.00</td>
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<td>(q)</td>
<td>(a)</td>
<td>11.7 3 0.00</td>
<td>Foreign asset stocks</td>
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<td>(q)</td>
<td>(a)</td>
<td>100 698.49 0.00</td>
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<td>(a)</td>
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<td>(a)</td>
<td>18239 4 0.00</td>
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<td>(a)</td>
<td>1710 5 0.00</td>
<td>Non-resident imports (m)</td>
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<th>Notes</th>
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<p>| Error | Post-est. Sig. | K** |</p>
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<td>q, q'</td>
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<td>0.01</td>
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<tr>
<td>q, q'</td>
<td>343.93</td>
<td>1.33</td>
<td>0.01</td>
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<tr>
<td>q, q'</td>
<td>418.407</td>
<td>1.61</td>
<td>0.01</td>
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</table>

- **World nominal interest rate:** \( r_t \) = 0.01
- **Domestic nominal interest rate:** \( r_t \) = 0.01
- **Nominal exchange rate:** \( r_t \) = 0.01
- **World price of oil:** \( r_t \) = 0.01
- **Domestic price of non-oil commodities:** \( r_t \) = 0.01

**General price level:**

<table>
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<th>( t )</th>
<th>( r_t )</th>
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<tbody>
<tr>
<td>( t )</td>
<td>( 15517 )</td>
<td>7.96</td>
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</tbody>
</table>

**Estimated Real GDP:**

- **Estimated:**
- **Real GDP:**

**Notes:**

- **Method Used:**
- **Stochastic Trends:**

**Variables:**
\[
\begin{align*}
X(1) &= 0.0^2 \\
X(1) &= \exp(X(1)) \\
X(1) &= 0.0^2 \\
X(1) &= 0.0^2 \\
\end{align*}
\]
Step 2

After detrending all variables, it is necessary to re-test each variable to ensure that they are non-stationary. The results for the 23 detrended data for all variables are shown in Table 5.3B.

### Table 5.3B

#### Results of Unit Root Tests on Detrended Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Null hypothesis</th>
<th>Asy. Critical value 10%</th>
<th>Test Statistics for I(0)(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real income (y)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-3.98</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>5.58</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>8.08</td>
</tr>
<tr>
<td>Private Consumption (cP)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.02</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>5.87</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>8.45</td>
</tr>
<tr>
<td>Domestic private's real wealth (wP)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-3.50</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>4.32</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>6.49</td>
</tr>
<tr>
<td>Permanent income (yt)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.98</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>6.43</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>7.89</td>
</tr>
<tr>
<td>Net oil imports (Oni)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.50</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>7.02</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>10.43</td>
</tr>
<tr>
<td>Non-oil exports (tx)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-3.6</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>6.75</td>
</tr>
<tr>
<td>Non-oil Imports (tm)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.16</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>5.81</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>8.72</td>
</tr>
<tr>
<td>Physical private capital stock (kP)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.96</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>8.23</td>
</tr>
<tr>
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<td>(c)</td>
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<td>12.34</td>
</tr>
<tr>
<td>Government capital stock (kG)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-3.56</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>4.27</td>
</tr>
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<td></td>
<td>(c)</td>
<td>5.34</td>
<td>6.39</td>
</tr>
<tr>
<td>Variable</td>
<td>Null hypothesis</td>
<td>Asy. Critical value 10%</td>
<td>Test Statistics for I (0)³</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------</td>
<td>-------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Supply of non-oil output ( y^\text{non}_t )</td>
<td>(a)  -3.13 5.34</td>
<td>-5.36 14.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>9.60 14.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>14.40 14.40</td>
<td></td>
</tr>
<tr>
<td>Demand for non-oil output ( y^d_{\text{non}} )</td>
<td>(a) -3.13 5.34</td>
<td>-5.47 14.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>7.98 14.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>9.09 14.40</td>
<td></td>
</tr>
<tr>
<td>Foreign Asset Stocks ( f )</td>
<td>(a) -3.13 5.34</td>
<td>-3.50 6.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>4.10 6.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>6.16 6.16</td>
<td></td>
</tr>
<tr>
<td>Foreign exchange reserves ( f_s )</td>
<td>(a) -3.13 5.34</td>
<td>-3.96 6.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>5.40 6.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>8.04 6.16</td>
<td></td>
</tr>
<tr>
<td>Current account balance ( f )</td>
<td>(a) -3.13 5.34</td>
<td>-3.86 7.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>5.17 7.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>7.73 7.73</td>
<td></td>
</tr>
<tr>
<td>Nominal money stock ( m )</td>
<td>(a) -3.13 5.34</td>
<td>-4.24 9.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>6.02 9.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>9.03 9.03</td>
<td></td>
</tr>
<tr>
<td>Domestic price of non-oil output ( p_n )</td>
<td>(a) -3.13 5.34</td>
<td>-3.43 5.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>4.04 5.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>5.91 5.91</td>
<td></td>
</tr>
<tr>
<td>Consumer price level ( p_c )</td>
<td>(a) -3.13 5.34</td>
<td>-5.19 14.21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>9.48 14.21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>14.21 14.21</td>
<td></td>
</tr>
<tr>
<td>Domestic nominal interest rate ( r )</td>
<td>(a) -3.13 5.34</td>
<td>-3.63 6.77</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>4.51 6.77</td>
<td></td>
</tr>
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<td></td>
<td>(c)  5.34 5.34</td>
<td>6.77 6.77</td>
<td></td>
</tr>
<tr>
<td>World nominal interest rate ( r^* )</td>
<td>(a) -3.13 5.34</td>
<td>-3.75 7.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>4.70 7.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>7.04 7.04</td>
<td></td>
</tr>
<tr>
<td>World price of oil ( p_{o^*} )</td>
<td>(a) -3.13 5.34</td>
<td>-4.29 9.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>6.15 9.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>9.23 9.23</td>
<td></td>
</tr>
<tr>
<td>Nominal exchange rate ( e^* )</td>
<td>(a) -3.13 5.34</td>
<td>-3.79 7.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(b)  4.03 5.34</td>
<td>4.80 7.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c)  5.34 5.34</td>
<td>7.20 7.20</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Null hypothesis</td>
<td>Asy. Critical value 10%</td>
<td>Test Statistics for I (0)(a)</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------</td>
<td>-------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>World real income (y*)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.63</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>7.23</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>10.79</td>
</tr>
<tr>
<td>World price of non-oil output (p*)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-3.65</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>4.51</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>6.69</td>
</tr>
<tr>
<td>Domestic oil requirements (Or*)</td>
<td>(a)</td>
<td>-3.13</td>
<td>-4.72</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>4.03</td>
<td>7.43</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>5.34</td>
<td>11.12</td>
</tr>
</tbody>
</table>

Notes

* Exogenous variables

(1) I(0) unit root test on zero differences, defined as stationary

(a) \( \alpha(1) = 0 \), t-test

(b) \( \alpha(0) = \alpha(1) = \alpha(2) = 0 \), F-test for unit root test (zero drift)

(c) \( \alpha(1) = \alpha(2) = 0 \), F-test for unit root test (non-zero drift)

The t-ratios and F-statistics show that the tests statistics for each detrended variable are outside the critical boundaries. It can be concluded that the null hypothesis of a unit root can be rejected at the 10% level of significance for each of the detrended variables. That is, all of the 23 detrended variables are I(0) stationary.
Appendix 5.4

Rules for Identification

In principle, it is important to determine the identification of an equation in a system of simultaneous equations. If an equation in a system is over-identified, Two Stage Least Squares (2SLS) estimation should be used. Therefore the Order Condition identification rule is considered in this appendix.

The Order Condition for Identifiability

If

\[
\begin{align*}
M &= \text{number of endogenous variables in the model} \\
m &= \text{number of endogenous variables in a given equation} \\
K &= \text{number of predetermined variables in the model} \\
k &= \text{number of predetermined variables in a given equation.}
\end{align*}
\]

then in a model of \( M \) simultaneous equations, with \( K \) predetermined variables, a necessary (but not sufficient) condition for identification, known as the Order Condition is:

for \( K - k = m - 1 \), the equation is exactly identified.
for \( K - k > m - 1 \), the equation is overidentified.
for \( K - k < m - 1 \), the equation is underidentified.

All eight behavioural equations are checked as follows.
Equation (4) \( y_{non} = \lambda_1 + \lambda_2 k^p + \lambda_3 k^q + \lambda_4 (pn-pc) \)

\( M = 17, m = 5 \quad K = 8, k = 0 \)

As \( K-k > m-1 \), so that \( 8-0 > 5-1 \),

then Equation (4) is overidentified.

Equation (5) \( c^p = \kappa_1 y + \kappa_2 w^p \)

\( M=17, m=3 \quad K=8, k =0 \)

As \( 8-0 > 3-1 \)

then Equation (5) is overidentified.

Equation (9) \( m-pc = \sigma_1 y - \sigma_2 r + \sigma_3 w^p \)

\( M=17, m=5 \quad K=8, k =0 \)

As \( 8-0 > 5-1 \)

then Equation (9) is overidentified.

Equation (10) \( w^p = \gamma_1(f+e-pc) + \gamma_2(m-pc) + \gamma_3(k^p+q) + \gamma_4 y^f \)

\( M=17, m=7 \quad K=8, k =1 \)

As \( 8-1 > 7-1 \)

then Equation (10) is overidentified.
Equation (14) \( tx = \Sigma_1 y^* + \Sigma_2 (p^*+e-pn) - \Sigma_3 Pw^* \)
\[ M=17, \ m=2 \quad K=8, \ k=4 \]
As \( 8-4 > 2-1 \)
then Equation (14) is overidentified.

Equation (15) \( tm = m_1 y - m_2(p^*+e-pn) - m_3 Pd^* \)
\[ M=17, \ m=3 \quad K=8, \ k=3 \]
As \( 8-3 > 3-1 \)
then Equation (15) is overidentified.

Equation (16) \( \dot{f} = \tau_1 tx + \tau_2 tm + \tau_3 f^* - \tau_4 (Oni + Po^*) - (1-\tau_3 - \tau_4)(e-pc) \)
\[ M=17, \ m=6 \quad K=8, \ k=3 \]
As \( 8-3 = 6-1 \)
then Equation (16) is exactly identified\(^{106}\).

Equation (17) \( Oni = \theta_1 Or^* + \theta_2 y \)
\[ M=17, \ m=2 \quad K=8, \ k=1 \]
As \( 8-1 > 2-1 \)
then Equation (17) is overidentified.

\(^{106}\)OLS estimation is also appropriate for exactly identified equations see Maddala (1992).
<table>
<thead>
<tr>
<th>Variables</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rho 0.081</td>
<td>D.W. 1.811</td>
</tr>
<tr>
<td>-0.053</td>
<td>2.073</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimated coefficients (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td></td>
<td>0.123</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimated coefficients (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td></td>
<td>0.095</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimated coefficients (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td></td>
<td>0.141</td>
</tr>
</tbody>
</table>

### Notes

- Estimation by OLS
- Estimated coefficients based on distribution (t-value=1.96)
(c) Estimation of 2SLS: Each equation has the same right-hand-side variables which are the world price of oil, the world real income, and the domestic trade barriers on imports (p_d) and the international trade barriers on exports (p_w). The estimated coefficients, Rho, D.W., F-statistics, R^2, and Std. Error are reported for each equation. The confidence intervals of the estimated coefficients are also provided. The estimated coefficients and their confidence intervals are based on the distribution (1 - value = 0.980).

### Table: Estimated Coefficients and Confidence Intervals

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
<th>Lower Bound (95%)</th>
<th>Upper Bound (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>w</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
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</tr>
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<td>c</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes

- R^2 = 1.000
- Std. Error: 0.042
- D.W.: 2.173
- F-statistics: 73.96
- Confidence Intervals (95%)

### Equation (5)

\[ c = \alpha + \beta w \]
Estimation by 2SLS. Each equation has the same sixth instrumental variables which are the world real income

<table>
<thead>
<tr>
<th>Variables</th>
<th>Correlations</th>
<th>( \hat{R}^2 )</th>
<th>DW</th>
<th>F-Statistics</th>
<th>Sl. Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.067</td>
<td>2.08</td>
<td>7.300</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.067</td>
<td>2.08</td>
<td>7.300</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.067</td>
<td>2.08</td>
<td>7.300</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.067</td>
<td>2.08</td>
<td>7.300</td>
<td>0.035</td>
</tr>
</tbody>
</table>

Notes

Equation (9) \( \hat{m} - \hat{p}c + \omega \hat{w} = 0 \)
<table>
<thead>
<tr>
<th>Variables</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y \rightarrow x )</td>
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<td>0.000</td>
</tr>
<tr>
<td>( y \rightarrow w )</td>
<td>0.995</td>
<td>0.996</td>
</tr>
<tr>
<td>( y \rightarrow B )</td>
<td>0.996</td>
<td>0.997</td>
</tr>
</tbody>
</table>

Notes:
- Estimation by 2SLS.
- Each equation has the same set of instrumental variables, which are the world real income and the world nominal interest rate.
- The world price of non-oil exports, the world price of oil, and the domestic trade balance on imports.
- The equation is estimated using 2SLS.

### Correlations
- **Rho:**
  - \( \rho_{x,y} = -0.118 \)
- **D.W.:**
  - \( D.W. = 2.200 \)
- **F-statistic:**
  - \( F = 412.47 \)

### R-squared
- **R-squared:**
  - \( R^2 = 0.995 \)
- **R-squared adj.:**
  - \( R^2_{adj} = 0.990 \)

### Estimated Coefficients
- **OLS:**
  - \( \beta_{OLS} \)
  - \( \gamma_{OLS} \)
  - \( \delta_{OLS} \)
- **2SLS:**
  - \( \beta_{2SLS} \)
  - \( \gamma_{2SLS} \)
  - \( \delta_{2SLS} \)

### Confidence Intervals (95%)
- **Lower:**
  - \( \beta_{lower} \)
  - \( \gamma_{lower} \)
  - \( \delta_{lower} \)
- **Upper:**
  - \( \beta_{upper} \)
  - \( \gamma_{upper} \)
  - \( \delta_{upper} \)
The table presents the estimated coefficients and their 95% confidence intervals for the equation:

\[ \hat{\gamma} + (\hat{\varepsilon} - \hat{\beta})a + d = 0 \]

<table>
<thead>
<tr>
<th>Estimated coefficients</th>
<th>95% Confidence Intervals (Lower)</th>
<th>95% Confidence Intervals (Upper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( x )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(e) Estimation by 2SLS. Each equation has the same endogenous variables which are the world price of oil (**o**), the world real income (**y**), the nominal interest rate (**p**), and the domestic trade barriers on imports (**p_d**).

<table>
<thead>
<tr>
<th>Variable</th>
<th>0.000</th>
<th>1.000</th>
<th>( p_d ) + e - p_n</th>
<th>1.000</th>
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</thead>
<tbody>
<tr>
<td>( 1/p_o )</td>
<td>0.675</td>
<td>0.000</td>
<td>-0.675</td>
<td>0.675</td>
</tr>
<tr>
<td>( 1/p_n )</td>
<td>1.014</td>
<td>1.000</td>
<td>1.014</td>
<td>1.000</td>
</tr>
<tr>
<td>( 0.086 )</td>
<td>0.096</td>
<td>0.086</td>
<td>0.096</td>
<td>0.086</td>
</tr>
<tr>
<td>Variables</td>
<td>( p_d ) + e - p_n</td>
<td>1.000</td>
<td>( p_d ) + e - p_n</td>
<td>1.000</td>
</tr>
</tbody>
</table>

**OLS Regression Results:**

- **R-squared:** 0.993
- **Adjusted R-squared:** 0.992
- **F-statistic:** 129.98
- **D.W.:** 1.840
- **S.E.R.:** 0.053
- **R2 b/w observed and predicted variables:** 0.992

**Variables:**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p_o )</td>
<td>-0.168</td>
<td>-0.030</td>
</tr>
<tr>
<td>( 1/p_o )</td>
<td>1.090</td>
<td>1.030</td>
</tr>
<tr>
<td>( 0.006 )</td>
<td>-0.007</td>
<td>0.019</td>
</tr>
<tr>
<td>( 0.006 )</td>
<td>-0.007</td>
<td>-0.017</td>
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<tr>
<td>( 0.006 )</td>
<td>0.020</td>
<td>0.019</td>
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</tbody>
</table>

**Confidence Intervals (95%)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p_d ) + e - p_n</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

**Notes:**

- (f) Estimation by 2SLS. Each equation has the same endogenous variables which are the world price of oil (**o**), the world real income (**y**), the nominal interest rate (**p**), and the domestic trade barriers on imports (**p_d**).

---

Equation (15):

\[
\text{OLS} \quad m_1 \cdot \hat{y} + m_2 \cdot p_d + e - p_n = m_3 \cdot p_d
\]

---

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(c) Since the equation is exactly identified according to the Center Combination to appear in Appendix 4, OLS estimation is also applicable.

and.reg. (c)+(e) f e error (c) f. the exogenous variables on errors (c) + (e), the expected reduction in volatility and the domestic trade patterns on imports (c) + (e). the world nominal interest rate (c), the nominal exchange rate (c) or the world price of oil (c), the world real income (c). The world real income (c).

Variable(s)  | Estimated Coefficients (c)  | Estimated Coefficients (e)  | Estimated Coefficients (f)  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>1.000</td>
<td>0.775</td>
<td>0.847</td>
</tr>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>1.000</td>
<td>0.847</td>
<td>0.969</td>
</tr>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>1.000</td>
<td>0.987</td>
<td>0.848</td>
</tr>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>1.000</td>
<td>0.978</td>
<td>0.995</td>
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</table>

Correlations

<table>
<thead>
<tr>
<th>Variables</th>
<th>Rho</th>
<th>D.W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>0.329</td>
<td>1.320</td>
</tr>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>-0.232</td>
<td>2.460</td>
</tr>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>(Om + P0 + e - pc)</td>
<td>0.987</td>
<td>0.987</td>
</tr>
</tbody>
</table>

Notes

(a) Estimation by 2SLS: Each equation is the same as the instrumental variables which are the world price of oil (c), the world real income (c).

(b) Confidence intervals based on t-distribution (t-value = 1.645)

(c) Estimated by OLS

(d) Estimated by 2SLS

Estimated coefficients (a)

OLS

Estimated coefficients (b)

Estimated coefficients (c)

OLS

Estimated coefficients (d)

Estimated coefficients (e)

Estimated coefficients (f)

Estimated coefficients (g)

Estimated coefficients (h)

Estimated coefficients (i)

Estimated coefficients (j)

Estimated coefficients (k)

Estimated coefficients (l)

Estimated coefficients (m)

Estimated coefficients (n)

Estimated coefficients (o)

Estimated coefficients (p)

Estimated coefficients (q)

Estimated coefficients (r)

Estimated coefficients (s)

Estimated coefficients (t)

Estimated coefficients (u)

Estimated coefficients (v)

Estimated coefficients (w)

Estimated coefficients (x)

Estimated coefficients (y)

Estimated coefficients (z)
(a) Estimation by ZLS. Each equation has the same right-hand-side variables which are the world real income.

Notes:

Estimated coefficients (b) of OLS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Estimated coefficients (c) of 2SLS

<table>
<thead>
<tr>
<th>Variable</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation (17)  

\[ y = \theta_1 \theta_2 + \theta_3 x + \theta_4 \]


Amsden, A.H., (1989), "Asia's Next Giant: South Korea and Late Industrialization", Oxford University Press, USA.


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Warr, P.G., and Bhannupongse N., (1989), "Macroeconomic Adjustment to External Shocks: Thailand", Department of Economic Research School of Pacific Studies, Australian National University, No.89/12, November.
