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A COMPARATIVE STUDY OF FIVE DUTCH DISEASE MODELS

A Thesis Presented in Partial Fulfilment of the Requirements
for the Degree of
Master of Philosophy in Social Sciences
at Massey University

by

LEE TIN TAN

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ABSTRACT

During the past decade, the sudden and sharp increases in oil prices, coupled with the discovery and extraction of oil in the North Sea, have contributed considerable interest in the macroeconomic problems of oil-exporting countries. It is well known that a domestic oil discovery can give rise to wealth effects that cause a squeeze in the traded goods sector of an open economy. The decline of the manufacturing sector following an oil discovery is termed the 'Dutch disease', and has been investigated in many recent studies which embody a general equilibrium model. This is detailed in Chapter One where the development of Dutch disease literature is discussed.

Despite the development of a wide range of the Dutch disease models, There is still a lack of consensus regarding the analysis on the issue of Dutch disease. This thesis aims to study a number of different models of the Dutch disease by focussing on the following considerations:

i) the underlying theoretical framework with reference to some main-stream economic theories, such as those based on Trade theory, Neoclassical and Keynesian traditions;
ii) the assumptions made within each framework regarding monetary and supply-side conditions;
iii) analysis of the various effects of exogenous disturbances on the economy; and

iv) evaluation of the relationship between the underlying assumptions and the conclusions drawn from the model analysis.

Chapter Two outlines the classification of the Dutch disease model into three broad categories. These categories distinguish between the types of macroeconomic effects which give rise to the Dutch disease phenomenon. Detailed algebraic specification of each model, using standard notations developed for this thesis, along with the assumptions made are described in Chapter Three. Chapter Four is devoted to a comparative study of the models. In each section, two models are compared to draw out the differences in their assumptions and approach, and to show how these differences can affect their final conclusions about the effect of various exogenous disturbances. A summary of the main results of the comparative study is given in Chapter Five. Some points for further research are also briefly discussed.

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CHAPTER 1 INTRODUCTION

Major energy price increases during the periods 1973/4 and 1979/80 caused significant increases in national wealth in oil-exporting economies. Similar windfalls occurred in economies that enjoy major resource discoveries. In both cases, the wealth increases have a systematic impact on the domestic economy,leading to some adjustment problems. These adjustment problems often take the form of a decline in the level of activity in both the export oriented and import-competing manufacturing sector. This experience is now commonly referred to as the "Dutch disease". The term "Dutch disease" was coined when the problems that North Sea oil might create for Britain were widely discussed[1]. It relates to the Dutch experience where the 1960's discoveries of the Schlochteren natural gas allowed the Netherlands to have a higher exchange rate than otherwise, with the net result that her export industries were squeezed, and a decline in Dutch manufacture set in. The Dutch experience is discussed in Ellman (1977), and in Barker & Brailovsky (1981).

The analysis of the Dutch disease has been the subject of many recent studies, and also a topic for lively debates in the United Kingdom in the early 1980's. Earlier studies on what later came to be known as the Dutch disease problem consisted of some empirical articles using partial-equilibrium analysis. Gregory (1976) made the earliest suggestion that the development of a natural resource implies a necessary relative decline in manufacturing industry. Gregory 's paper outlined the structural shifts likely to occur in the Australian economy as a result of the development of a large-scale mining sector. This analysis was applied to the United Kingdom and North Sea oil by Forsyth & Kay (1980). The theoretical stance taken by Forsyth & Kay was almost identical to that of Gregory, although their presentation differed considerably. Instead of adopting a formal model, Forsyth & Kay compared the structure of the U.K. economy in 1976 (which they asssumed to be a non-oil economy) with an economy which had undergone the structural adjustment to the introduction of North Sea oil. Forsyth & Kay analysis was strongly criticized in the Astridge lecture by the Governor of the Bank of England (1980). This view maintains that the large increase in the exchange rate and the fall in manufacturing production levels in the late 1970's and early 1980's is a pure coincidence and that the effects of North Sea oil production have largely been to protect the United Kingdom economy from having to make large structural adjustments to the 1973/4 and 1979/80 oil price rises.

The three articles cited above are well discussed in Hall & Atkinson (1983). They concluded that the exploitation of a natural resource will cause an absolute decline in the domestic production of tradables, provided that the economy starts from a position of balance of payment equilibrium and if nothing else changes. They pointed out that the Forsyth & Kay analysis was far too simple, and that in the 1970's, oil production in U.K. was superimposed on a substantial balance of payment deficit, while between 1979 and 1981, the decline in manufacturing production was mainly the result of restrictive economic policies and the consequent high exchange rate. They also pointed out that the recession was against a background of a long-term trend of decline in the share of manufacturing in total output - a process called de-industrialisation, which was apparent well before the arrival of North Sea oil.

Other discussions on the issues of energy, industrialisation, and economic policy relating to the experience of Canada, Mexico, Norway and the United Kingdom can be found in Barker & Brailovsky (1981).

Despite their important contribution, especially on the empirical issues involved, these studies fall short of formulating a comprehensive theoretical framework for a general equilibrium analysis. However, in the Australian case, Snape (1977) extended Gregory's framework by allowing for general equilibrium repercussions, but retaining his main assumptions. Snape obtained results which are modification or extension of those of Gregory. Following this, Corden & Neary (1982) drew on and extended the Australian analyses by Gregory and Snape in a general equilibrium framework in the study of a booming resource sector and de-industrialisation in a small open economy. During this period, other studies of the problem of Dutch disease were also published. These include those of Buiter & Purvis (1982); Eastwood & Venables (1982); Bruno & Sachs (1982b); and Neary & Purvis (1982). Some later studies were carried out by Pesaran (1984); and Fender (1985). These studies have all included a general equilibrium model with an explicit treatment of an energy/oil sector in open economy for the analysis of various energy shocks.

While these analyses of the Dutch disease were developed to a sophisticated level, they still failed to produce a general model on the subject. They display the folowing five different approaches to model building:

i. a focus on macroeconomic effects of a resource boom with short-run dynamics arising from sluggish adjustment of domestic prices adopted from Dornbusch (1976) specification. This approach is in Buiter & Purvis ;and Eastwood & Venables.

ii. a focus on macroeconomic effects but followed a Keynesian macroeconomic framework with foreign exchange controls and government budget constraints; and with a dynamic structure arising through private sector asset position. This is in the study carried out by Pesaran.

iii. a focus on the sectoral resource allocation and income distribution of an economy with a booming resource sector. Corden & Neary draw on the standard tools of international trade theory in this approach.

iv. an analysis on the sectoral effects of a resource boom with dynamics arising from short- and long-run adjustment of consumption and investment demand. This is carried out in the study by Bruno & Sachs (1982b). Their model incorporates far-sighted behaviour by firms and household (in their investment, consumption and savings decisions); as well as capital accumulation in the aggregate.

v. a study on the nominal and real adjustment of energy shocks. This is in Fender, and Neary & Purvis. However, the Fender's model is an extension of the Buiter & Purvis model with the inclusion of a nontradable services sector and treats oil as an intermediate input. Neary & Purvis adopted the basic framework of Corden & Neary, but with an extension to include study on dynamics arising from the short-run capital adjustment process as well as monetary adjustment.

This thesis attempts to explore the manner in which each model address the macroeconomic impact and sectoral effects of an economy experiencing a resource boom. That is, it will examine the different arguments put forward in each model regarding the Dutch disease phenomenon. Despite the different approaches used in the seven articles cited previously, they all shared the aim of analysing the effects of energy shocks on the rest of the economy, especially on the implications on tradable manufacturing sector.

This research will begin with a detailed study on the structure of each model, drawing out the inherent assumptions governing the theoretical framework and analysis of each model. Whenever possible, comparison between models will be carried out to highlight the influence of a particular model characteristic to the subsequent analysis and results.

note:

1) See Corden, W.M. (1982).

CHAPTER 2 MODELS OF THE "DUTCH DISEASE"

As one of the main aims of this research is to look at different modelling approaches for the analysis of Dutch disease type problems, the review will focus on the more recent studies. These consist of the works of Buiter & Purvis; Eastwood & Venables; Corden & Neary; Bruno & Sachs (1982b); Neary & Purvis; Pesaran; and Fender. Hereafter, they will be refered to, respectively, as BP, EV, CN, BS, NP, Pesaran, and Fender. Each of these studies (except CN) embodies an explicit algebraic model that enables comparisons to be carried out.

The models involved can be broadly divided into three categories as follows:

1) Models on macroeconomic effects;

2) Models on sectoral effects;

3) Models including both sectoral and macroeconomic effects.

2.1 Models on Macroeconomic Effects

Models in this category explicitly include a resource (usually oil) sector in the macroeconomic model of the open economy. This type of model focuses on the macroeconomic effects of a resource boom. They attempt to address the question of whether an increase in oil revenue will have a contractionary or expansionary effect on the economy. This type of model tends to assume just one domestically produced nonoil good. The economy modelled this way has two sectors :

1) resource sector;

2) non-resource sector.

and a commodity structure with the following three goods :

1) resource goods[1];

2) domestic nonoil goods (consisting of traded and non-traded goods[2] or more specifically, manufactures and services); and

3) imported nonoil goods.

Such a framework is the basis of the models of BP; EV; and Pesaran.

The work of BP is most frequently cited in the literature on energy shocks for its contribution on the monetary effects of oil shocks. BP provide a framework for a critical examination of the Dutch disease diagnosis. Their framework separate the effects on the real exchange rate of increases in the world price of oil, discoveries of domestic oil reserves, and monetary disinflation in an open economy.

In response to oil shocks (new discovery and price changes), the BP model shows that the economy will experience transitional de-industrialisation. The mechanism involved is the real appreciation[3] arising from the resource boom in conjunction with sticky domestic prices [adopted from the Dornbusch(1976) specification]. In addition, their model shows that under a flexible exchange rate and with international capital mobility, monetary disinflation will cause a large and rapid fall in the nominal exchange rate[4], thus causing a loss of competitiveness of the domestic nonoil sector. This leads BP to argue that the role of domestic stabilisation policies, especially tight monetary policies, in response to inflationary pressure due to oil price increases should be given due consideration in explaining de-industrialisation.

These results contrast sharply with those of EV, whose model assumptions are very similar to those of BP. EV show that anticipated future oil revenues will be expansionary in the absence of a demand lag[5]. According to their model, when there is a time lag between wealth and spending, there will be a current recession. However, this will be followed by a boom period, after spending has adjusted.

Given such differences exist for models which are essentially similar, it is necessary to undertake a closer comparative study to resolve this issue.

The Pesaran model is quite different from those described above. Pesaran's model is built in the context of a Keynesian underemployment model[6] with domestic prices set according to a mark-up rule. There is an explicit inclusion of the government budget constraint and strict foreign exchange rate controls on private capital flows. According to Pesaran, these characteristics are more appropriate for most oil-exporting countries in the Middle East, Africa, and Latin America[7]. Pesaran's aim is to examine the short- and long-run macroeconomic consequences of an increase in oil revenues in an oil-exporting country.

Pesaran's general conclusion is that with the appropriate policy responses, oil income need not bring in de-industrialisation for the nonoil sector.

Pesaran's analysis emphasises the role of government policy through the government budget constraint in explaining the macroeconomic responses of oil revenue increases. The optimistic outcome certainly makes it worthwhile to study the model in greater detail and compare the mechanism involved with those of BP; and Eastwood & Venables.

2.2 Model on Sectoral Effects

Models of sectoral effects such as the model used in CN are concerned with the medium-run effects of asymmetric growth on resource allocation and income distribution. The modelling framework employed is a general equilibrium model with particular emphasis on the factor and income adjustment between the following three sectors :

1) a booming, traded resource sector;
2) a traded goods sector;and
3) a nontraded goods sector,

and a commodity structure with the following four goods:

1) resource goods(which is traded);

2) domestic nonoil traded goods (manufactures which are exportable and import-competing);

3) imported nonoil traded goods

4) domestic nonoil, nontraded goods;

As the model aims to highlight the structural aspects of a boom, monetary considerations are ignored and the focus is on the implications of the resource boom for real rather than nominal variables.

Using this three-sector framework which draws on the standard tools of international trade theory, CN investigate the channels whereby a resource boom can lead to the Dutch disease. Two main channels are identified :

1) a **resource movement** effect, whereby the booming sector directly or indirectly shifts transferable resources (such as mobile labour and/or capital in the longer-run) away from the manufacturing sector; and

2) a **spending effect** which raises the demand for services and so lowering the real exchange rate (the relative price of traded to nontraded goods), leading to real appreciation. It will draw resources out of the manufacturing sector into the services sector, as well as shifting demand away from the manufacturing sector towards the services sector. This effect thus squeezes profitability in the manufacturing sector.

These results suggest that sectoral effects are important elements in understanding the Dutch disease effect. However, the CN analysis involves extensive use of geometric tools which would complicate the presentation and diffuse the focus of this thesis. Thus, this thesis will not proceed to a detailed study of the CN model. This omission does not bias the outcome of the research because, as will be apparent in the next section, NP have included the CN main results in their study of the Dutch disease effect.

One other model that analyses the sectoral effects of resource boom is the BS model. BS adopt a slightly different approach in their dynamic model of the Dutch disease. They present a three-sector (traded, nontraded and resource goods) model which is further divided into different funtional blocks such as : Production Technology, Household Sector, Market Equilibrium Conditions, Balance of Payments Identities, and Fiscal policy. The underlying framework is the extension of their earlier research[8] on supply-side shocks, incorporating the effects of short-run capital specificity and long-run capital mobility as well as far-sighted intertemporal optimizing behaviour by households and firms. The model allows for a quantitative assessment of the adjustment path of the economy. However, the resulting complexity makes it no longer analytically tractable and hence have to be solved by computer simulation.

The results from the BS model simulation show that the net effect of a boom in the resource sector is to reduce long-run production of other traded goods, and to improve the economy's terms of trade on final goods. In addition, the size of this effect depends on government budget policies concerning the redistribution of oil revenue to the private sector.

Although BS provide an interesting attempt in the integration of short-run adjustment due to oil shocks (especially changes in oil prices) and long-run growth model through the effects on capital accumulation and savings, it will not be included in this research. The use of computer simulation in the BS analysis makes it impossible to keep track of the analysis using algebraic equations alone.

2.3 Models on Both Sectoral and Macroeconomic Effects

Models in this category have a basic commodity structure similar to those on sectoral effects. The main difference is that the models described here also focus on the short-run macroeconomic adjustment problem usually arising from sluggish adjustment of domestic prices such as those adopted by BP; and EV.

Papers which deal with both macroeconomic and sectoral effects include the works by NP(1982); and Fender(1985). Turning first to the model adopted by NP, this model attempts to cover the deficiencies of those models that deal with either macroeconomic effects or sectoral effects alone, by including the important features from both types of models.

The NP model retains the three-sector framework of CN but modifies the underlying structure to reflect the BP view that, direct labour market effects arising from expansion of the resource sector are minimal. To this end, NP constructed two models: the real model with basic production and consumption relationships and an augmented monetary model which combines the production structure with an explicit treatment of money-market equilibrium and rational exchange rate expectations.

The result of the NP Model is a more elaborate analysis of the Dutch disease problem. They have included in the analysis , the real effects of a resource boom through the spending effect and resource movement effect working on the real exchange rate; as well as the monetary effect which they called **liquidity effect**, working from the money market equilibrium condition. The NP model has provided the most complete analysis of the Dutch disease problem. Therefore it will be a useful framework for further study. However, it does not relate well to the developing country oil exports problem studied by Pesaran and hence, we do not yet have a truly general model.

The Fender model differs from NP in that it retains most of the features underlying the BP model, but relaxes their assumption of a single nonoil domestically produced good and instead asssumes two such goods: a traded good and a nontraded good. With this framework, Fender carry out analyses on both short- and long-run effects of oil shocks as well as on the effects of monetary disinflation as in the BP analysis. The analysis elaborates on the sectoral effects of oil discovery and the results differ slightly from those of BP. A comparative study of the BP model and the Fender model will reveal the reasons that give rise to these differences. Fender also looked at the conditions under which an oil discovery is likely to be expansionary or contractionary and shows that the expansionary result obtained by EV is a special case when changes in oil revenue have no direct effect on the demand for money.

2.4 Overview of Models

Table 2.4.1 below shows the classification of each model in relation to the economics of oil shocks.

TABLE 2.4.1 Classification of Model

Model	General Focus	Specific Effects	Market Structure
BP	macroeconomic responses only 2 sectors: oil & nonoil	demand-side spending[9] effect and liquidity effect	commodity market; money market; & foreign exchange market
EV	macroeconomic responses only 2 sectors: oil & nonoil	demand-side spending effect only	commodity market; money market; & foreign exchange market
Pesaran	macroeconomic responses only 2 sectors: oil & nonoil	demand-side private-sector absorption effect only	commodity market; & financial market

TABLE 2.4.1 Classification of Model-continued

Model	General Focus	Specific Effects	Market Structure
C & N	sectoral adjustment only 3 sectors: resource, traded & nontraded goods	both demand-side spending effect and supply-side resource movement effect	commodity market; labour market; & capital market
Fender	macroeconomic and sectoral adjustment 3 sectors: resource, traded & nontraded goods	demand-side spending effect and liquidity effect	commodity market; money market; labour market; & foreign exchange market
N & P	macroeconomic and sectoral adjustment 3 sectors: resource, traded & nontraded goods	demand-side spending effect and liquidity effect ; supply-side resource movement effect	commodity market; labour market; capital market; money market; & foreign exchange market

The table also introduces the contributions of each model to the analysis of the Dutch disease.

The BP; EV; and Pesaran models will shed light on the macroeconomic responses of oil shocks through the different mechanisms specific to each model. Fender presents a less complex framework among the two models with interactions between macroeconomic and sectoral adjustment in the general framework. The model which is a direct extension of that of BP , reveals the issues involved in sectoral adjustment within a macroeconomic framework. NP presents a more complex approach which combines the analyses of BP and CN, and hence provides an important link between macroeconomic responses and sectoral adjustments.

This section summarises both the basic approaches in models of the Dutch disease and the relationships between the different models. A more detailed description of the model structure and comparative study of these models will be undertaken in Chapters 3 and 4.

Notes:

1. The resource goods in the models covered by this thesis refer to oil. While in CN, resource goods are refered to as 'energy', they are more specifically refered to as 'benzine' in NP. In more general usage, the resource sector is of an extractive kind: such as minerals in Australia, natural gas in the Netherlands, oil in the United Kingdom, Norway and some members of OPEC.
2. To maintain consistency with terminology, the terms 'traded goods' and 'nontraded goods' are used hereafter, in place of 'tradeables' and 'nontradeables' as in the Fender model. In addition, both CN and NP specifically refers to the traded and nontraded good sectors as 'manufactures' and 'services' respectively. However, they also pointed out that many alternative interpretations of the two terms are possible. For example, in Australia and Nigeria, one of the sectors which has been most squeezed as a result of the resource (mineral and oil, respectively) boom is her export-oriented agricultural sector.
3. The real appreciation in the BP model refers to a fall of the relative prices of nonoil imports to domestic nonoil goods (manufactures and services), which is also equivalent to a decline in the competitiveness of the home goods.
4. The nominal exchange rate in all the models considered is expressed as the domestic price of foreign currency.
5. Refers to the case in which, while savings rationality holds (ie. where agents do not anticipate an unbounded accumulation of domestic or foreign assets), spending reaches its final level significantly later than the date of discovery of oil reserves.

6. This refers to the extension of standard open Keynesian macroeconomic models where short-run unemployment is assumed. See Turnovsky & Kaspura (1974).
7. These economies are unlike the U.K. economy, where highly developed financial markets already exist.
8. The model structure is very similar to the model in Sachs (1982); the analysis is an extension of Bruno (1982) from a two-period model to the infinite horizon case; and the model is a direct extension of the framework described in Bruno & Sachs (1982 a). In the analysis, BS use the standard tools of international trade theory such as the Heckscher-Ohlin-Samuelson model, and the Rybczynski line.
9. Spending effect in the BP and EV models refer to a transitory loss of manufacturing output as a result of loss in competitiveness due to real appreciation. The real appreciation is a result of increased demand for the home good due to increased oil income. The effect here defers from CN or NP in that it is not due to the shifts in the composition of domestic nonoil production such as the shifts out of manufacturing into nontraded services.

CHAPTER 3 STRUCTURE OF MODELS

Sections 3.1, 3.2, and 3.3 describe the structures and assumptions of the models by Buiter & Purvis; Eastwood & Venables; (hereafter refer to as BP and EV respectively) and Pesaran. Sections 3.4 and 3.5 consist of the models with a three sector framework; that is, those of Fender and Neary & Purvis (henceforth NP) respectively.

3.1 The Buiter & Purvis Model

The model contains two productive sectors:

1. Oil producing sector; and
2. Domestic nonoil goods sector.

The following assumptions are made:

a. Oil is treated as a final goods rather than as intermediate input;

b. Oil is produced and consumed domestically and can be imported or exported at an exogenous world price in terms of the foreign currency;

c. The flow of domestic oil production is treated as exogenous and oil production does not compete for resources with nonoil production;

d. The nonoil domestic goods is produced at home but consumed at home and abroad and its foreign demand is less than perfectly elastic;

e. The nonoil domestic goods is an imperfect substitute for the imported manufactured goods and the home country is large in the world market for domestically produced goods and hence prices of nonoil export are equal to domestic prices of nonoil goods;

f. The model abstracts from the role of nontraded goods. As such it cannot handle the shifts in the composition of domestic nonoil production.

There are three markets:

1. Goods Market
2. Money Market
3. Foreign Exchange Market.

These markets operate under the following further assumptions:

g. There is a slow adjustment of the goods market relative to money and foreign exchange markets. The dynamics arise as a result of sluggish adjustment in the domestic prices relative to the interest rate and the exchange rate;

h. There is international capital mobility and a perfect foresight path is assumed throughout;

i. The exchange rate is flexible and it adjusts to maintain equilibrium in the assets markets instantaneously.

The BP model is presented below:

Unless otherwise stated, all variables are expressed in logarithmic form and are in lowercase characters. Uppercase characters are the antilogs of the corresponding log variables.

1. Commodity Market

Actual Income:

(1.1) $y = vy_{ne} + (1 - v)y_e + (1 - v - \beta_2)p_e^w + (\beta_1 - v)(e - p_{ne})$

Permanent Income:

(1.2) $y^p = vy_{ne} + (\beta_1 - v)(e - p_{ne}) + (1 - v)y_e^p + (1-v-\beta_2)p_e^w$

where $v = (P_{ne}Y_{ne})/PY$ is the share of nonoil production in total value added.

Equations (1.1) And (1.2) are log-linear[1] approximations to real income, where the levels of current and permanent real income are defined, respectively, by:

(1.1′) $Y = (P_{ne}Y_{ne} + EP_e^wY_e)/P$

(1.2′) $Y^p = (P_{ne}Y_{ne}^p + EP_e^wY_e^p)/P$

Domestic Cost of Living:

(1.3) $p = \beta_1 p_{ne} + \beta_2(e + p_e^w) + (1 - \beta_1 - \beta_2)e$

Output of Nonoil Goods(demand determined):

(1.4) $y_{ne} = -\gamma_1(r - \dot{p}) + \gamma_2(e - p_{ne}) + \gamma_3 y^p + \gamma_4(e + p_e^w - p_{ne})$

This is also a short-run domestic goods market equilibrium condition.

Rate of Change of Price of Domestic Nonoil goods:

(1.5) $\dot{p}_{ne} = \phi y_{ne} + \mu$

where $\mu = \dot{M}$, rate of growth of the nominal money stock.

That is, the rate of change of the price in excess of the underlying trend rate of inflation depends on the excess demand for these goods.

2. Money Market

Demand for Real Money Balances:

(1.6) $m - p = ky^{p} + (1 - k)y - \lambda^{-1}r$

Real Balances in terms of the home goods:

(1.7) $l = m - p_{ne}$

3. Foreign Exchange Market

Domestic Rate of Interest:

-not in logarithmic form

(1.8) $r = r^{w} + \dot{e}$

where $\dot{e}$ = expected rate of exchange rate depreciation.

This interest rate formulation is also known as the uncovered interest parity condition. This condition has the implication that one can no longer predict the direction of capital flows from the interest-rate differentials alone. If the domestic rate of interest is lower than the foreign rate of interest plus the expected depreciation in the exchange rate (that is, $r < r^{w} + \dot{e}$), then there will be a capital outflow from the domestic economy. However, r could be greater than r^{w} but still less than $r^{w} + \dot{e}$ if $\dot{e}$ is positive, because a depreciation of the domestic currency is expected in the near future. Thus, capital flows are affected by expectations of exchange rate changes as well as by the interest-rate differentials.

The adjustment of the nominal exchange rate under rational expectations and perfect capital mobility is discussed in Appendix B2.

Real Exchange Rate (Competitiveness):

(1.9) $\rho = e - p_{ne}$

4. Key Parameters

β_1 = share of the home goods in domestic consumption

β_2 = share of oil in domestic consumption

γ_1 = real interest rate elasticity on domestic demand/output for nonoil goods

γ_2 = price elasticity of foreign manufactured goods on domestic demand/output for nonoil goods

γ_3 = Income elasticity on domestic demand for nonoil goods

γ_4 = oil price elasticity on domestic demand for nonoil goods.

5 Status of Variables

Endogenous Variables: e, m, p, p_{ne}, r, y, y^p, y_{ne}.

Exogenous Variables : p_e^w, r^w, μ, y_e^p, y_e.

State Variables : l, ρ.

6 Signs of Coefficients

$0 \leq \beta_1, \beta_2, (1 - \beta_1 - \beta_2) \leq 1$

$\gamma_1, \gamma_2, \gamma_3 > 0$

$\gamma_4 \lesseqgtr 0$

$\phi \geq 0$

$k, \lambda > 0$

$0 \leq v \leq 1$

3.2 The Eastwood & Venables Model

This model has the same sectoral, as well as market and commodity structure as the model of BP described in section 3.1. The assumptions employed by EV on these features are also similar to those of BP except that in EV, oil discovery is considered as a foreign exchange increment to national wealth. Thus, oil revenue is independent of depletion policy and is not dependent on whether the oil is exported or used domestically .

The EV model is presented as follows:

All equations and variables, except equation (2.4), are expressed in logarithmic form. The log variables are expressed in lowercase characters, while the antilogs are in uppercase characters.

1. Commodity Market

Output/Demand for domestic nonoil goods:

(2.1) $y_{ne} = -\gamma_1(r - \dot{p}_{ne}) + \gamma_2(e - p_{ne}) + \gamma_3 y_{ne}$

This equation also gives the short-run domestic goods market equilibrium condition.

With oil discovery,

(2.1′) $y_{ne} = -\gamma_1(r - \dot{p}_{ne}) + \gamma_2(e - p_{ne}) + \gamma_3 y_{ne} + \eta(f + e - p_{ne})$

where f = infinite term annuity value of the oil wealth in foreign currency. Therefore, oil revenue is measured by the real present value of oil wealth in home currency.

Rate of Change of Prices of Domestic Nonoil Output:

(2.2) $\dot{p}_{ne} = \beta(y_{ne} - \bar{y}_{ne})$

This equation describes the short-run dynamics for domestic price adjustment.

2. Money Market

Demand for real money balances:

(2.3) $m = \phi y_{ne} - \lambda r + \beta_1 p_{ne} + (1 - \beta_1)e$

The components $\beta_1 p_{ne} + (1 - \beta_1)e$ describe the contributions of the domestic nonoil output price and the import price respectively to the price index appropriate to the demand for domestic money. Note that the price of oil does not enter the price index due to the way oil revenue is defined in this model.

3. Foreign Exchange Market

Domestic Rate of Interest:

(2.4) $r = r^{w} + \dot{e}$

This is identical to the interest-parity condition described previously in equation (1.8), Section 3.1.

The adjustment of the nominal exchange rate under rational expectation and perfect capital mobility is discussed in Appendix B2.

Post-oil Steady State Values:

The steady state values for e and p after oil discovery are obtained from (2.1′), (2.2), (2.3) and (2.4) by setting $\dot{e} = \dot{p}_{ne} = 0$ and solving for $\bar{e}$ and $\bar{p}$:

(2.5) $\bar{e} = m - [\beta_1 \eta/(\gamma_2 + \eta)]f$

(2.6) $\bar{p} = m + [(1 - \beta_1)\eta/(\gamma_2 + \eta)]f$

4. Key Parameters

β_1 = expenditure share of domestic nonoil goods

$(1 - \beta_1)$ = expenditure share of foreign manufactured goods

γ_1 = real (in terms of domestic nonoil price)interest rate elasticity on domestic demand/output for nonoil goods

γ_2 = price elasticity of foreign manufactured goods on domestic demand/output for nonoil goods

γ_3 = income elasticity of demand for domestic nonoil goods

η = elasticity of aggregate demand with respect to oil revenue

ϕ = income elasticity of demand for real balances

λ = interest rate elasticity of demand for real balances.

5. Status of Variables

Endogenous Variables: e, m, p_{ne}, r, y_{ne}

Exogenous Variables: f, r^w, $\bar{y}_{ne}$

6. Signs of Coefficients

γ_1, γ_2, γ_3, ϕ, λ, $\eta > 0$

$0 \leq \beta_1 \leq 1$

3.3 The Pesaran Model

The model consists of 4 sectors:

1. Oil producing sector
2. Nonoil sector (manufacturing and services)
3. Government sector
4. Private sector;

The following assumptions are made;

a. The model abstracts from oil role as an intermediate goods;

b. All foreign exchange earnings from the (net) export of oil are treated as the 'external rent' and costs of oil production are ignored;

c. Oil is produced by the private sector and the net revenue from its sale is taxed at a higher rate as compared with the taxation of nonoil income;

d. The rate of extraction of oil and its export price are set exogenously by political and long term considerations regarding the absorptive capacities of the oil-exporting countries and the expected future availability of the alternative sources of energy;

e. The nonoil home-produced goods is consumed at home and part of which will be sold abroad at prices the same as the domestic prices; This

implicitly assumed a multi-country situation where each country tends to import a large number of commodities, while being rather specialised in its exports.

f. The prices on domestically produced nonoil goods are determined by a fixed mark-up on labour costs and the costs of the required imported inputs;

g. Goods produced domestically are not perfect substitutes for goods produced abroad;

h. The central bank and government are integrated into a public sector and refered to as 'the government', and the commercial banks are incorporated within the private sector;

i. The model abstracts from the role of non-traded goods.

There are 3 markets:

1. Commodity market
2. Financial market
3. Foreign exchange market;

These markets operate under the following further assumptions:

j. There is strict foreign exchange control on private capital flows, and foreign exchange rate is fixed;

k. In the financial sector; private sector financial assets are assume to be composed of 'high powered money' and government bonds. Private citizens do not hold foreign currencies or foreign bonds as assets.

The Pesaran model is described below:

1. Commodity Market

Goods market equilibrium condition:

(3.1) $y = a(y_d, L_{-1}/P, r) + g + b$

where a = real private sector absorption;

g = real government expenditure;

b = real surplus (deficit) of the current account of the balance of payment; and

$0 < a_1 \leq 1;\ 0 \leq a_2 < 1;\ a_3 \leq 0$

Government's total tax receipts:

(assuming a linear tax structure)

(3.2) $T = t_{ne}Y_{ne} + t_eY_e$

$= t_{ne}(Y - Y_e) + t_eY_e$

where $Y_{ne} = P_{ne}y_{ne}$; $Y_e = ep^w_ey_e$; $Y = Y_{ne} + Y_e = Py$

and assumed that : $0 < t_{ne} < t_e \leq 1$;

that is, tax rate for oil revenue is higher than that of nonoil income.

Real private sector disposable income:

(3.3) $y_d = (Y - T)/P$

$= (1 - t_{ne})y - (t_e - t_{ne})(eP^w_ey_e)/P$

With $\rho = eP^w/P$ = competitiveness index

and $y^w_e = P^w_ey_e/P^w$ = real value of oil revenue income in terms of forei gn

prices;

(3.3a) $y_d = (1 - t_{ne})y - (t_e - T_{ne})\rho Y_e$

Output of the Nonoil sector:

(3.4)[2] $y_{ne} = (1 - \xi)\ (y - \rho Y_e)/(1 - \xi\rho)$

Prices definition:

Imported prices in domestic currency:

(assumed import prices to vary proportionately with the nominal exchange rate)

(3.5) $P_z = eP^w$

Prices of nonoil, domestically produced goods:

(3.6) $P_{ne} = (1 + \theta)(\lambda_0 W + \lambda_1 P_z)$

(that is, determined by a fixed mark-up on labour costs and the costs of the required imported inputs)

where θ = fixed mark-up factor of domestic nonoil prices on production cost

λ_0 = labour cost input coefficient

λ_1 = imported inputs costs coefficient

W = pre-tax money wage rate

Consumer price index:

(3.7) $P = (1 - \xi)P_{ne} + \xi P_z$

(3.7a)[3] $P = \{\xi + \lambda(1 - \xi)(1 + \theta)\}eP^w + \lambda_0(1 - \xi)(1 + \theta)W$

where ξ = share of imports in total aggregate supply for domestic use

Prices of nonoil exports in domestic currency:

(3.8) $P_x = P_{ne}$

that is, the prices of nonoil exports are the same as the prices of home-produced nonoil output

Competitiveness index expressed in terms of post-tax real wage rate[4]:

(3.9) $\rho = \pi_0 - \pi_1 \bar{w}$

where $\pi_0 = 1/\{\xi + \lambda_1(1 - \xi)(1 + \theta)\}$

$\pi_1 = \pi_0 \lambda_0 (1 - \xi)(1 + \theta)/(1 - t_n)$

$\bar{w} = (1 - t_n)W/P$

= post-tax real wage rate

i.e. under fixed post-tax real wage rate, ρ (and hence P) will also be fixed. It follows that with a fixed exchange rate and constant foreign prices, both the domestic prices and the competitiveness index will be fixed irrespective of whether money-wage or real-wage rigidity is assumed.

2. Financial Market

Net acquisition of financial assets by the private sector:

(3.10) $\Delta L = \Delta H + \Delta D$

$= Y - T - A$;(that is, the excess of the private sector's disposable income over its absorption, $A = Pa$)

Government budget constraint (using national income identities) :

(3.11) $\Delta H + \Delta D = G - T + X + Y_e - Z$

where X = nonoil exports at current domestic prices;

Z = total imports at current domestic prices.

It is further assumed that there are 2 separate decision processes in the determination of the split of ΔL between ΔH and ΔD:

i) Net foreign lending (or borrowing):

(3.12) $\Delta F = (1 - \sigma)(X + Y_e - Z)$; $0 < \sigma \leq 1$

where σ measures the extent to which official capital flows are used to sterilize the effect of current account surpluses (or deficits)

ii) assumed that official net lending is financed out of current government revenue; have

government's domestic budget deficits/surpluses financing rule:

(3.13) $\Delta D = (1 - \delta)(G - T + \Delta F)$; $0 < \delta \leq 1$

where δ = proportion of government's domestic financial needs financed by printing high powered money

Changes in the supply of high powered money (domestic component of the money supply):

(derived from equations (3.11), (3.12) and (3.13))

(3.14) $\Delta H = \delta(G - T) + \underline{\sigma}(X + Y_e - Z)$

where $\underline{\sigma} = \delta + \sigma(1 - \delta)$, $0 < \underline{\sigma} \leq 1$; and

$\underline{\sigma} \geq \delta$; due to strict foreign exchange controls on private capital flows

Demand for real balances:

(3.15) $H/P = h(a + g, r)$ and $h_1 > 0$; $h_2 < 0$

such specification ensures that increases in oil revenues that are completely sterilized by means of official capital outflows will have no effect upon domestic demand for real balances.

Money market equilibrium conditions:

(for a given initial supply of high powered money)

(3.16) $h(a + g, r) = H_{-1}/P + \delta(g - t_{ne}y - (t_e - t_{ne})\rho Y_e) + \underline{\sigma}b$

3. Foreign Exchange Market

Balance of Payment on current account:

(assumed changes in oil income result in immediate simultaneous shifts in the balance of payment)

(3.17) $B = Y_e + X - Z$

$= eP_e y_e + P_{ne}x(P_{ne}/eP^w) - eP^w z(a + g, eP^w/P_{ne})$

and $x_1 < 0$; $z_1 > 0$; $z_2 < 0$.

-assuming the world's income is fixed, real non-oil exports depend only on the ratio of domestic to foreign prices.

-real demand for imports (z) is taken to be a function of total real absorption (a + g) and the relative price of foreign goods in terms of domestic goods.

-assumed that all of the oil output is exported.

deflating equation (3.17) by the CPI. ,

(3.18) $b = \rho y_e^w + [(1 - \xi\rho)/(1 - \xi)]x[(1 - \xi\rho)/(\rho - \xi\rho)] -$

$\rho z[a + g, (\rho - \xi\rho)/(1 - \xi\rho)]$

By definition, $1 - \xi\rho > 0$

This model is highly nonlinear

4. Key Parameters

θ = fixed mark-up factor of domestic nonoil prices on production cost

λ_0 = labour cost input coefficient

λ_1 = imported inputs costs coefficient

ξ = share of imports in total aggregate supply for domestic use

5. Status of Variables

Endogenous variables: A, a, B, b, D, F, H, h, K, P, P_{ne}, ρ, r, T, X, x, Y, y, Y_d, y_d, Y_{ne}, y_{ne}, Z, z.

Exogenous variable : e, G, g, H_{-1}, L_{-1}, P^w, P_e^w, P_z, t_e, t_{ne}, W, Y_e, y_e, y_e^w, σ, δ

3.4 The Fender Model

The model contains three productive sectors:

1. Oil producing sector;
2. Manufacturing (traded) sector; and
3. Services (nontraded) sector.

The two traded goods are oil and manufactured goods.

The following assumptions are made:

a. Oil is treated as an intermediate input in the production of the traded goods, rather than as a final consumption good;

b. Oil is produced and can be used as an intermediate input in domestic traded goods production or can be exported at an exogenous world price;

c. The production of oil is treated as exogenous and is assumed to require no resource inputs;

d. The traded goods can be bought or sold on world markets at a given world price. That is, the country is a price taker in manufactured goods;

e. The world price of traded goods is normalised to unity. Thus, the nominal exchange rate is the domestic currency price of the traded goods;

f. Domestic producers of traded goods, supply output taking the various prices they face as given;

g. The price of the nontraded goods is determined by a mark-up on the money wage.

There are four markets:

1. Commodity Market;
2. Money Market;
3. Foreign Exchange Market; and
4. Labour Market.

These markets operate under the following further assumptions:

h. In the short-run, more labour is always forthcoming if demanded, as there is a 'natural rate of unemployment'[5]. However, in the long-run a constant level of employment must be obtained and hence an increase in the nontraded output can only come about at the expense of traded output. This is because the steady state is characterised by full employment at its natural level.

i. There is perfect capital mobility and rational expectations in the foreign exchange market. That is, the exchange rate is assumed to be always perfectly foreseen and efficiently responding to maintain equilibrium in the assets market.

j. The money wage is assumed to be a predetermined variable that cannot 'jump' instantaneously but must adjust to disturbances over time.

The Fender model is presented below:

1. <u>Commodity Market</u>

Nominal National Income:

(4.1) $Y = ey_t(e/W,P^w_e) + \alpha Wy_n + eP^w_e[h - q(e/W,P^w_e)]$

where $\alpha W = P_n$ = price of nontraded goods which is a mark-up on wages. Thus, the change in P_n is directly dependent on the changes in the level of money wages and hence on the wage-setting process;

h = contribution of oil to permanent income; and

q = domestic use of oil.

With e measuring the domestic currency price of the foreign exchange and of the traded goods. The latter definition of e is due to the (exogenous) world price of the traded goods being normalised to unity. So national income is equal to the value of the traded and nontraded outputs plus net exports of oil.

Relationship of nominal income to real income:

(4.2) $Y = P(e, \alpha W)y$

where the price index used is homogeneous of degree one in the prices of the traded goods and nontraded goods.

Demand for, and output of the nontraded goods:

(4.3) $y_n = y_n[y, i, e/(\alpha W), M/P]$

That is, the nontraded output is demand determined at the mark-up price, and the real balance effect is present.

2. Money Market

Money market equilibrium condition:

(4.4) $M/P = m(y, r)$

That is, domestic residents divide their wealth among domestic money, domestic yield-bearing assets (bonds and capital), and foreign currency bonds. All non-money assets are viewed by wealth-owners as perfect substitutes; their common nominal rate of return in terms of domestic currency is denoted by r.

Real Money Supply:

(4.5) $l = M/W$

The real money supply function is expressed in wage units due to the assumption that the price of nontraded goods is a mark-up on money wage.

3. Foreign Exchange Market

Domestic rate of interest:

(4.6) $r = r^w + \dot{e}/e$

where $\dot{e}/e$ = expected percentage depreciation of the exchange rate[6].

This formulation has similar intepretation as the interest-parity condition described previously in equation (1.8), Section 3.1.

Real interest rate:

(4.7) $i = r - \mu$

where $\mu = \dot{M}/M$, that is, the rate of growth of the nominal money stock.

In addition, Fender follows BP in assuming that the inflationary expectations depend on the rate of growth of the money stock.

Real Exchange Rate (also measuring competitiveness):

(4.8) $\rho = e/W$

4. Labour Market

Expectations Augmented Phillips Curve:

(4.9) $W/W = g[n_t(e/W,\ P^w_e),\ n_n(y_n)] + \mu$

the g[....] term depends positively on the difference between the total demand for labour and the exogenously given 'natural' level (near full employment) of employment. The institutional assumption made here is that an economy-wide nominal wage is determined in advance of the period in which it is to prevail, with workers agreeing to supply all the labour required by employers during that period. Expected real wages rise gradually over time whenever the demand for labour by firms persistently exceeds a fixed natural level of labour supply, and decline over time in the opposite situation. The model may thus be interpreted as one in which workers and firms respond with a lag to move the real wage towards its long-run target level, thus allowing temporary fluctuations in employment and output. The unitary coefficient of μ suggests that given the rate of unemployment, workers are rational and can completely adjust their money wage to compensate for expected inflation. That is, they do not suffer from money illusion[7].

5. Status of Variables

Endogenous Variables: Y, y, e, r, i, n, $\dot{e}/e$ and W/W

Exogenous Variables: P_e^w, h, μ, α, r^w

Predetermined (by the past history of the economy) Variables: W, M.

6. Signs of Coefficients

$y_{n1} > 0$, $y_{n2} < 0$, $y_{n3} > 0$, $y_{n4} > 0$

$y_{t1} > 0$, $y_{t2} < 0$, $q_1 > 0$, $q_2 < 0$

$P_1 > 0$, $P_2 > 0$

$m_1 > 0$, $m_2 < 0$

$g_1 > 0$, $g_2 > 0$, $n_{t1} > 0$, $n_{t2} < 0$, $n_{n1} > 0$

3.5 Neary and Purvis Model

There are two models in the NP framework:

I. A 'basic' model in which 'real' effects only are considered;

II. An 'augmented' model with real and nominal effects.

The models contain three production sectors:

1. Manufactures (traded) sector;
2. Services (nontraded) sector; and
3. Oil producing sector.

The following assumptions are made:

a. The resource good, benzine, is treated as a final consumption good.

b. Production of benzine is assumed to require a specific factor in addition to capital, but not labour.

c. Manufactured goods are produced using capital and labour while services are produced using only labour.

d. The economy is small in terms of world markets so that it takes the foreign currency prices of the two traded good (benzine and manufactures), and hence their relative price (terms of trade) as given. That is, it is a dependent economy model in which domestic demand for these goods plays no role in determining their prices or output level.

e. The domestic price of services is identified throughout with the wage rate as the output of services is presumed to require only labour.

There are five markets:

1. Commodity market
2. Labour market
3. Capital market
4. Foreign exchange market; and in the augmented model,
5. Money market.

These markets operate under the following further assumptions:

f. Due to the economy being a price taker in the market for both benzine and manufactured goods, the domestic demand repercussions of the exogenous shocks have direct influence only in the service sector.

g. While the services and manufactures sectors compete directly for labour, there is no direct link between the service and resource sectors since the latter does not use labour.

h. There are indirect links between services and energy sectors through the capital market, since capital is used in the production of both benzine and manufactures.

i. The allocation of capital between the sectors in which it is used, the resource and manufacturing sectors, is fixed in the short-run and variable only in the long-run.

j. In long-run equilibrium, the capital stocks in the benzine sector and manufacturing sector adjust so as to equalize their rates of return.

k. Private capital is internationally mobile.

l. In the basic model, national income and expenditure are always equal, implying a zero trade balance at all times.

m. Unlike the basic model, the current account in the augmented model need not be in balance, except in long-run equilibrium. Hence the level of domestically held wealth changes throughout the adjustment period and national expenditure and national income are not equal.

n. The price of services in the basic model moves flexibly to equalize domestic supply and demand, but sluggish adjustment of this price is assumed in the augmented model.

o. In the augmented model, exchange rate expectations are formed rationally, domestic and foreign interest-bearing assets are perfect substitutes and a flexible exchange rate regime is assumed. Thus, with assumption 14, we have the Dornbusch (1976) case of instantaneous assets market adjustment contrasting with sluggish goods market adjustment.

The NP model is presented below: Unless otherwise stated, all variables are measured as natural logarithms, and expressed in terms of deviations from their values in the initial equilibrium. This is equivalent to choosing units of measurement so that their initial equilibrium levels of all variables are equal to unity. All uppercase characters are the antilogs of the corresponding log variables.

I. The Basic Model

1. Commodity Market

Production of traded (manufactured) goods[8]:

(5.1) $Y_t = Y_t(K_t, N_t)$

Production of resource (benzine):

(5.2) $Y_e = Y_e(K_e, V)$

where V = the endowment of the specific factor used in the resource sector

Domestic price of traded goods:

(5.3) $P_i = P_i^w + e; \quad i = e, t.$

where the subscripts e = energy sector;

t = traded (manufacturing) sector.

Consumer price index:

(5.4) $p = \beta_e p_e + \beta_t p_t + \beta_n p_n$

where the β's are expenditure shares.

Real income:

(5.5) $y = \theta_v V + (\theta_e - \beta_e)\rho_e$

where θ_v = share of the specific factor, V, in national income;

θ_e = share of resource output in national product;

β_e = share of resource output in national expenditure.

That is, there are only two sources of change in real income:

i) an increase in V, whose impact depends on the share of the specific factor in national income;

ii) an increase in the world relative price of the resource output which raises real income on the assumption that the resource output is a net export that is, $(\theta_e - \beta_e) > 0$.

2. Labour Market

Labour supply:

(5.6) $N = N_t + N_n$

It is assumed that labour is fully employed (at the 'natural' level about which actual employment can fluctuate) at all times, with the stock of labour allocated between the manufacturing and services sectors.

Output of services:

(5.7) $Y_n = N_n$

That is, nontraded services are highly labour-intensive and by appropriate choice of units, the input/output coefficient is set equal to unity.

Domestic price of services:

(from the relation in equation (5.7))

(5.8) $p_n = w$

Demand for services[9], also demand for labour in service sector:

(5.9) $c_n = n_n = -\varepsilon_n p_n + \varepsilon_e p_e + \varepsilon_t p_t + \eta y$

where ε_i = compensated elasticities of demand. ε_e and ε_t are positive by the assumption that all commodities are net substitutes.

η = income elasticity of demand.

Demand for labour in manufactures[10]:

(5.10) $n_t = k_t - \gamma_t(w - p_t)$

where γ_t = wage elasticity of the demand for labour in manufactures.

That is, the demand for labour in manufacturing sector depends on the capital stock (predetermined in the short-run) in that sector and on the manufacturing real wage rate $(w - p_t)$.

Full-employment constraint[11] for labour:

(based on assumption that the resource extractive sector does not use labour)

(5.11) $\lambda_{lt}n_t + \lambda_{ln}n_n = 0$

where λ_{ij} = proportion of labour used in sector j, and

the subscript j = t, n; with t = traded (manufacturing) sector,

n = nontraded (services) sector.

Labour-market equilibrium locus[12]:

(5.12) $\lambda_l k_t + \varepsilon\rho + \alpha_l = 0$

where $\varepsilon = \lambda_t \gamma_t + \varepsilon_n > 0$

$\lambda_l = \lambda_{lt}/\lambda_{ln}$

and $\alpha_l = \eta\theta_v V + [\varepsilon_e + \eta(\theta_e - \beta_e)]\rho_e$

= exogenous disturbance which corresponds to the spending effect discussed in Chapter 2, section 2.2, whereby a resource boom results in an increased expenditure on services and hence creates an excess demand for labour.

Labour-market /services-market adjustment mechanism:

(note that an increase in the real exchange rate ρ, is equivalent to a fall in the relative price of services.)

(5.13) $\dot{\rho} = \psi(y_n - c_n) \qquad \psi(0) = 0 , \quad \psi' > 0$

This equation allowed for the possibility that the relative price of services adjusts sluggishly in response to imbalances between supply and demand. While this sluggish relative price adjustment is allowed in this section, the model is still a real one in which nominal magnitudes are not determined.

3. Capital Market

Demand for capital in the resource sector[13]:

(5.14) $k_e = V - \gamma_e(r_e - p_e)$

where γ_e = rental elasticity of capital demand

In long-run equilibrium, $r_e = r_t$; and r_t is related to the wage rate by the requirement that the price of manufactures must just cover unit costs:

Price of manufactures (covered unit costs)

(5.15) $p_t = \theta_{lt}W + \theta_{kt}r_t$

where θ_{ij} is the share of factor i in the value of output in the manufacturing sector, and the subscript i = l, k; with l = labour, and k = capital.

Full-employment constraint for capital:

(5.16) $\lambda_{ke}k_e + \lambda_{kt}k_t = 0$

That is, in the short-run, total stock of capital in the economy is fixed so that the capital stock adjustment process involves reallocation capital from one sector to the other through $k_t + k_e = k$ and this follows the tradition of the Heckscher-Ohlin model of international trade.

Capital-market equilibrium locus[14]:

(5.17) $\gamma_e^{-1}\lambda_k k_t - \theta_l \rho + \alpha_2 = 0$

where $\lambda_k = \lambda_{kt}/\lambda_{ke}$

$\theta_l = \theta_{lt}/\theta_{kt}$

$\alpha_2 = \gamma_e^{-1}V + \rho_e$

= exogenous shock which corresponds to the resource movement effect of the resource boom discussed in Chapter 2, section 2.2. In this case, an increase in V or ρ_e reduces the demand for k_t, and either k_t must fall or ρ must rise to restore equilibrium.

The long-run equilibrium values of k_t and ρ may be found by solving equations (5.12) and (5.17) simultaneously. This yields:

(5.18) $\Delta\bar{k}_t = -(\theta_l\alpha_1 + \varepsilon\alpha_2)$

(5.19) $\Delta\bar{\rho} = -\gamma_e^{-1\lambda}k\alpha_1 + \lambda_1\alpha_2$

where $\Delta = \lambda_1\theta_1 + \gamma_e^{-1}\lambda k\varepsilon > 0$

Long-run capital adjustment process:

(5.20) $k_t = \phi(r_t - r_e) \qquad \phi(0) = 0 \, , \; \phi' > 0$

That is, the capital stock in manufactures adjusts through time in response to differences in the rentals earned by capital in the two sectors. This sluggish allocation of capital which NP refered to as the 'Marshallian dynamics'[15], gives rise to a framework in which resource allocation and exchange rate movement are interrelated.

4. Foreign Exchange Market

Terms of trade:

(5.21) $\rho_e = p_e^w - p_t^w$

$= p_e - p_t$ [from equation (5.3)]

With the assumptions that the resource goods is an exportable and the country is a net exporter of benzine, the price rise represents a terms of trade improvement, yielding the normal spending effect through α_1 in equation (5.12).

Real exchange rate:

(defined as the relative price of manufactures in terms of services with manufactured goods as numeraire)

(5.22) $\rho = p_t - p_n$

$= e + p_t^w - w$ [from equations (5.3) and (5.8)]

II. Augmented Model

This macroeconomic framework has the same underlying structure as the basic model, except for the introduction of the money market and modifications to some equations.

5. Money Market

Rate of change of price of services:

(with assumption that the nominal price of domestic nontraded goods moves slowly to eliminate imbalances between supply and demand)

(5.23) $\dot{p}_n = \psi(c_n - y_n) \qquad \psi(0) = 0 , \psi' > 0$

Real exchange rate:

(5.24) $\rho = e + p_t^w - p_n$

where p_t^w = price of manufactures in foreign currency, assumed to be exogenously determined.

Domestic nominal interest rate:

(note that r denotes the level, not the logarithm of the interest rate)

(5.25) $r = r^w + \dot{e}$

This is identical to the interest-parity condition described previously in equation (1.8), Section 3.1.

Demand for real balances:

(5.26) $M/P = m(y, r) \qquad m_1 > 0 , m_2 < 0$

Price index[16]:

(5.27) $p = (e + p_t^w) + \beta_e \rho_e - \beta_n \rho$

Money-market equilibrium condition:

(5.28) $m - p = \xi y - \delta^{-1} r$

Money-market equilibrium locus:

(5.29) $\bar{e} - \beta_n \pi + \alpha_3 = 0$

where $\alpha_3 = \xi\theta_v V + [\xi\theta_e + (1 - \xi\beta_e)]\rho_e - m - \delta^{-1} r^w + p_t^w$

= exogenous shock which corresponds to the liquidity effect refered to by NP, whereby the resource boom on real income increases the demand for money and hence tends to cause the nominal exchange rate to fall. Thus, it works toward nominal appreciation in response to a resource boom.

This expression is derived by substituting equations (5.5) and (5.27) into the money market equilibrium condition in equation (5.28).

Long-run value of the nominal exchange rate:

(5.30) $\bar{e} = \beta_n \Delta^{-1}(-\gamma_e^{-1}\lambda_k \alpha_1 + \lambda_1 \alpha_2) - \alpha_3$

This expression is obtained from combining equation (5.29) with equation (5.19). The three channels by which the nominal exchange rate is affected by exogenous shocks; α_1, α_2, & α_3, correspond respectively to the spending, resource-movement and liquidity effects[17].

5. Status of Variables

Endogenous Variables : y_t, k_t, n_t, y_e, k_e, e, P, p_n, y, n_t, n_n, y_n, W, C_n, ρ, r_t, r, e, m.

Exogenous Variables : K, L, V, p_e^w, p_t^w, n, r^w, α_1, α_2, α_3, ρ_e

Predetermined Variables : k_t, k_e (only in the short-run)

6. Signs of Coefficients

Except where previously noted, all coefficients are defined to be positive.

Notes:

1. See Appendix B1 for derivation.
2. Equation (3.4) is derived from the Pesaran definition of the output of the nonoil sector, which is written as:

$$y_{ne} = (Y - Y_e)/P_{ne}$$
$$= (P/P_{ne})(y - \rho Y_e)$$

Upon using the definition of price index in equation (3.6) and noting that $P_z = eP^w$ in equation (3.5), the expression in equation (3.4) can be obtained by some algebraic manipulation.
3. Equation (3.7a) is derived by substituting equations (3.5) and (3.6) into (3.7) to express the price index in terms of foreign prices and money-wages.
4. This expression is derived from dividing both sides of equation (3.7a) by P and noting that $\rho = eP^w/P$.
5. The natural rate of unemployment is defined as that rate of unemployment which is consistent with labour-market equilibrium, and at which the price level could be stable. The natural rate of unemployment is determined by the real factors which affect the amount of frictional and structural unemployment in the economy. See Levacic & Rebmann, Chapter 18, p. 344.
6. The term $\dot{e}/e$ is equivalent to $\dot{e}$ in BP, EV, and NP; bacause the nominal exchange rate, e, in the latter three models is expressed in logarithmic form. Hence $d\ln e = de/e$.
7. If workers do not fully take into account the inflation that they expect to occur when estimating their real income from their money income, they are said to have 'money illusion'. Refer to Levacic & Rebmann, pp. 343 -345.

8. To maintain notational consistency with all other models, the subsript 't' is used to denote domestically produced nonoil traded goods (that is, manufactured). The original notation in NP is denoted by 'M'.

9. This equation is expressed in compensated form, see Appendix B3 for detailed explanation.

10. This equation is the log-linear function of the form:

$$N_t = K_t(P_t/P_n)^{\gamma t}$$

where $P_n = W$ from equation (5.8).

This manufacturing demand for labour function can be derived from the first-order conditions of profit maximisation if the explicit form of the production function in equation (5.1) is given.

11. This constraint is derived from total differentiation of the labour supply function in equation (5.6) and dividing by N.

That is: $dN = dN_t + dN_n = 0$, noting that $dN_j = N_j n_j$ and $\lambda_{1j} = N_j/N$

where $j = t, n$: t = traded, n = nontraded; and

where n_j = natural log of N_j expressed in terms of deviation from its initial equilibrium value.

12. This labour-market equilibrium relationship is derived from substituting the two labour demand equations (5.9) and (5.10) into the full-employment condition in equation (5,11); and noting that:

$w = p_n$; $\rho = p_t - p_n$; $\varepsilon_n = \varepsilon_e + \varepsilon_t$; and $\rho_e = p_e - p_t$

from equations (5.8), (5.20), (5.9) and (5.19) respectively.

13. This equation is the log-linear function of the form:

$$K_e = V(r_e/P_e)^{-\gamma e}$$

This resource sector demand for capital function can be derived from the first-order conditions of profit maximisation if the exact form of the production function in equation (5.2) is given.

14. The capital-market equilibrium locus is derived from substituting equation (5.14) into the full-employment constraint for capital in equation (5.16) and noting that in the long-run equilibrium; $r_e = r_t$ and r_t is related to p_t through equation (5.15). In addition, it is necessary to know that $\rho = p_t - p_n$; $\rho_e = p_e - p_t$; and to note that $\theta_{lt} + \theta_{kt} = 1$ by the zero-profit maximisation conditions.
15. NP point out that Marshall's partial-equilibrium analysis stressed the overshooting of a relative price because of short-run factor fixity, while the NP analysis derives this result in a general equilibrium context.
16. The price index as expressed in equation (5.25) is derived from using equations (5.10), (5.22) and the relation (5.3). Note that with ρ_e constant, a change in p_t^w implies a uniform change in the foreign prices of oil and nonoil goods.
17. These three concepts are first introduced in Chapter 2. These effects will be discussed in greater details in Chapter 4: the spending & resource-movement effects will be described on pp. 89-90, while the liquidity effects will be described on p. 97.

CHAPTER 4 COMPARISON OF MODEL STRUCTURE, ANALYSIS AND RESULTS

In this chapter, the structure and analysis of each model are compared and contrasted with those of the BP model. The BP model is used as a basis of comparison because among all the models described in chapter three, it can be considered as a fore-runner in providing a monetary framework for the analysis of the Dutch disease. The main aims of this comparative study are to draw out the assumptions and conclusions of each model, and to find out how do those conclusions depend on the assumption made. In each section, the assumptions described in chapter three, and the modelling approach will be compared and contrasted with those of the BP model. The theory that underlies some of the main assumptions will also be discussed. These will be discussed in the first part of each section. The second part will consist of discussion on the analysis and conclusions of each model.

4.1 Eastwood & Venables Compared With Buiter & Purvis

4.1.1 Assumptions and Structure

The models of BP and EV share many common features that are adopted from the macroeconomic framework of Dornbusch(1976).

These features are:

1. The price adjustment mechanism expressed in equations (1.5) and (2.2) is based on the Dornbusch short-run price adjustment dynamics. That is, the rate of change of the price of domestic nonoil goods depends on the excess demand for them. Furthermore,

the speed of adjustment of the price of domestic output is assumed to move slowly relative to the interest rate and the exchange rate.

2. The interest rate and nominal exchange rate, as expressed in equations (1.8) and (2.4), are determined in the asset market. Flexible exchange rate, perfect capital mobility and rational expectations in the foreign exchange market are assumed. Thus, the exchange rate dynamics under rational expectations as discussed in Appendix B2 are also applicable in this case. In particular, there is a possibility of the exchange rate overshooting in the short-run, caused by the instantaneous jump in the nominal exchange rate alongside sluggish adjustment in the price of domestic nonoil goods.
3. Output of domestic nonoil goods expressed in equations (1.4) and (2.1) are in the same form as Dornbusch. That is, the output is demand determined and depends on the real interest rate, the relative prices of foreign and domestic goods, and real and permanent income. However, EV differ from BP in the specification of demand for domestic goods after the discovery of oil. This will be discussed later in this section.
4. Equations (1.6) and (2.3) specify the demand functions for real money balances. They follow the Dornbusch assumption of a conventional demand for money which has real income and interest rates as the key variables and will, in equilibrium, equal the real money supply. It is also assumed that the money market always clears due to instantaneous adjustment in the foreign exchange rate. However, as will be discussed in more detail later, EV have not included the wealth effect of the oil discovery in the money demand function; and

5. Nominal money supply is assumed fixed.

Despite these similarities, the EV model includes some functional differences that ultimately lead to different conclusions about the macroeconomic impact of oil discovery.

In comparison with BP, the EV study has a narrower focus. EV look only at the maroeconomic impact of the oil discovery, while BP have a broader aim to include also a study on the effects on real exchange rate of tight monetary policies implemented in response to inflation set off by increases in oil prices. Thus an exogenous policy variable (denoted by μ) is included in equation (1.5) of BP model to model the influence of the rate of growth of nominal money stock on the rate of change of prices of domestic nonoil goods. This is absent in EV.

Another significant difference rests in the way each model handles the impact of oil in relation to the rest of the economy. Oil prices and output enter BP model directly through their influence on income and wealth as in equations (1.1) and (1.2). Changes in either influence both the demand for domestic nonoil output and demand for real money balances in equations (1.4) and (1.6) via their implications for actual income and permanent income. In addition, world prices of oil enter the model through a substitution effect on the demand for domestic nonoil goods.

As the main purpose of EV's paper is to analyse the macroeconomic impact of oil discovery, the effect of oil prices is completely ignored and hence there is no substitution effect of oil on domestic demand in equation (2.1′). In this aspect, the EV model contains less detail as compared with the BP model. Oil revenues enter the EV model only as income effect influencing the demand for domestic nonoil goods as described in equation (2.1′). In EV, domestic oil discovery[1] is considered as an increment to national income by an amount f + e − p. Closer examination of equations (2.1) and (2.3) brings to the surface that the national income influences these two equations via the domestic nonoil output, y_{ne} (which in the absence of oil, is equal to national income[2]). So, an increase in domestic oil revenue would, at unchanged nonoil output, have no effect on the demand for money in the EV model.

On technical ground alone, the oil discovery which increases the national income from y_{ne} to y_{ne} plus f + e − p, should replace equations (2.1) and (2.3) respectively by:

$(2.1')^3 \quad y_{ne} = -\gamma_1(r - \dot{p}_{ne}) + \gamma_2(e - p_{ne}) + \gamma_3 y_{ne} + \eta(f + e - p_{ne})$

$(2.3') \quad m = -\lambda r + \beta_1 p_{ne} + (1 - \beta_1)e + \phi y_{ne} + \varepsilon(f + e - p_{ne})$

Hence, by considering equation (2.1′) as the only change to the economy following the discovery of oil, EV have introduce a serious inconsistency to their equation system.

This inconsistency can be avoided if EV have specify national income y (which will include both oil and nonoil income contributions) instead of y_{ne} in their demand equations. As y_{ne} is not an appropriate measure of national wealth in an oil economy, specification along the lines of BP will solve this problem, and still be consistent with the assumptions made.

The absence of an oil wealth effect on the EV specification of demand for money is also pointed out in Fender(1985); and Neary & Wijnbergen (1984) (hereafter referred to as NW). Fender, using a three sector model (to be described in greater detail in section 3.3), has included in his analysis the conditions under which an oil discovery is likely to be either expansionary or contractionary. He finds that the condition for oil discovery to be expansionary depends on the magnitude of several parameters measuring the impact of oil output. In particular, if changes in oil output/income have no direct effect on the demand for money, an increase in oil revenue must be expansionary. Thus, in resolving the contrasting conclusions between BP and EV, Fender has exposed the deficiency in the EV specification of the money demand function.

With a similar aim to Fender, NW set out to reconcile the contradiction in the results of BP and EV. However, they approach the problem directly, amending the EV analysis by incorporating a direct wealth effect on asset markets to an equation identical to equation (2.3′). Their conclusion is similar to Fender. In addition, they pointed out that the omission in EV is difficult to justify on economic considerations. This is well summed up in the following statement[4]:

> On liquidity grounds alone, to the extent that the oil revenue accrues as a transfer to the private sector it should raise transactions demand for money directly. Probably more important is its assets effect as a result of the oil-induced increase in wealth. Even when all the oil revenue accrues to the government, this should raise private sector wealth through the anticipated reduction in future tax liabilities. In any case, we find it difficult to conceive a situation in which an oil discovery would raise spending but leave money demand permanently unaffected.

4.1.2 Analysis and Conclusions

The EV omission of the wealth effect in real money demand has the effect of moderating the extend of long-run exchange rate appreciation and exaggerating the increase in the domestic price. As NW have shown, the post-oil steady state values for e and p, derived in the same way as those for equations (2.5) and (2.6) but using equation (2.3′) instead of equation (2.3), are given as:

(2.5′) $\bar{e}_1 = m - [(\beta_1 \eta + \varepsilon\gamma_2)/(\gamma_2 + \eta)]f$

(2.6′) $\bar{p}_1 = m + [\{(1 - \beta_1)\eta - \varepsilon\gamma_2\}/(\gamma_2 + \eta)]f$

Equation (2.5′) shows that the wealth effect ($\varepsilon > 0$) under the oil discovery (a rise in f) leads to a long-run nominal appreciation (a fall in e) that is larger than that in EV′s equation(2.5). In addition, the stronger the wealth effect, the larger will be the exchange rate appreciation. The higher real money demand after an increase in f must also be accommodated (given the nominal money supply) by a change in the price of domestic nonoil. In this case, there will be a smaller increase in the price of domestic nonoil than in the EV case (where $\varepsilon = 0$) or even a decline. The latter is possible when $\varepsilon\gamma_2 > (1 - \beta_1)\eta$ in equation (2.6′). These long-run results suggest that the wealth effect of the oil discovery causes a large appreciation, so that the increase in aggregate demand which it also triggers, is insufficient to offset the deflationary impact on the goods market. This result, which also holds in BP, is purely due to the wealth effect of the resource discovery on money demand and is impossible in the EV specification (that is, when $\varepsilon = 0$).

In addition, the short-run overshooting of exchange rate is ruled out in the EV model because of the large increase in the price of domestic output in the long-run. In this case, the short-run adjustment path does not necessitate an exchange rate overshooting. Thus, the net result in EV shows an expansionary effect generated by oil revenue. This is in contrast with the results in both BP and NW analyses. In these two models, the direct wealth effect of higher oil wealth increases the demand for money which, given the nominal money supply, subjects the economy to a contractionary shock which may be sufficiently great to offset the direct expansionary effects of the oil discovery on domestic spending.

Further to the analysis on the macroeconomic effects of an oil discovery, EV incorporate a demand lag into the model. This demand lag corresponds to the situation where there is a time lag between the resource discovery and the spending of the resource revenue. Under such circumstance, the EV analysis shows that the economy necessarily experiences a period of unemployment associated with price deflation. The exchange rate appreciates sharply at the date of discovery under the influence of expectations, and the deflationary impact of this appreciation is not offset by oil generated demand during the interval before spending reaches its final level. Thus, the domestic nonoil output falls sharply at the date of discovery, and the recession ends at the end of the demand lag interval. In fact, a boom period will follow. Taking into consideration the wealth effect in the asset market, NW show that this recession will continue past that time. This result is again due to the greater appreciation of the exchange rate and the lower post-shock equilibrium price level induced by the wealth effect which EV have omitted.

Although EV's analysis points to potential problems of timing in adjusting to an oil discovery, its implications are relatively optimistic due to the absence of the wealth effect in the asset market. This omission therefore makes the EV model inadequate for the study of the Dutch disease.

4.2 Pesaran Compared With Buiter & Purvis

The macroeconomic framework of Pesaran is very different from that of BP. In this section, the main features of Pesaran will be contrasted with those of BP.

4.2.1 Assumptions and Structure

Both the BP and Pesaran models set out to study the macroeconomic effects of oil shocks. Hence, the two models shared the following assumptions:

1. Oil is treated as a final goods rather than as intermediate input. Thus, there is no distinction between the influence of oil on domestic costs and prices. Consequently, changes in the prices of oil will not entail a supply shock and the negative real income effect of an oil price increase is not likely.
2. The production of oil is treated as exogenous and does not compete for resources with nonoil production. There will not be direct "de-industrialisation" with factors of production such as labour and capital shifted out of the nonoil sector (eg. Manufacturing industry). This assumption makes the subsequent analysis focus entirely on the "spending effect"[5].
3. Both models described a small open economy with some market power in the world market for their nonoil goods. Thus, prices of nonoil exports are the same as the prices of domestic nonoil output. In Pesaran, this assumption is made to simplify the analysis to focus

on a single price level of all domestically produced goods. It implicitly assumes a multi-country situation where each country tends to import a large number of commodities while being rather specialised in its exports[6].

4. Both models abstract from the role of nontraded goods. This rules out analysis on the likely shifts in the composition of domestic nonoil production. Such shifts may be out of manufacturing into nontraded services because the income elasticity of demand for services may be higher.

Despite these similarities, BP and P have specific aims which are different from one another. BP basically set out to substantiate the view that "de-industrialisation" experienced by many industrial countries in the late 1970's is not necessary wholly a result of oil shocks. They pointed out that monetary contractions, which are essentially neutral in the long-run, can generate real appreciation in the short-run with a sharp fall in manufacturing activity.

In order to carry conviction with those advocating monetarist policy, BP follow a basically Neoclassical framework[7] with the following characteristics:

1. The economy is capable of self-adjusting, the role of government is almost non-existent. Government's influence only comes in through its monetary policy to speed up and/or smooth out the process of adjustment.
2. The rate of increase in the price of domestic nonoil goods is

proportional to an excess demand of these goods. That is, price adjustment is consistent with the market demand and supply conditions. However, price adjustment is sluggish relative to nominal exchange rate movement.

3. Exchange rate is formulated in an assets market model[8] where international capital mobility is an important aspect of exchange rate formation, this formulation introduces the exchange rate dynamics and of overshooting arising from differential adjustment speeds in goods and assets markets.

In contrast, Pesaran aimed toward a study of developing oil-exporting countries where highly developed financial markets do not exist. The framework in which Pesaran attempted to study is also characterised by strict foreign exchange controls on private capital flows and a fixed exchange rate regime. Thus, Pesaran adopted a Keynesian framework which differs in many fundamental ways from BP.

For example in Pesaran model, the equilibrium level of output can be below the full-employment level[9] where government intervention is required to restore full employment by raising the level of aggregate demand. Pesaran achieved this by introducing an explicit government sector through the government budget constraint. In BP, government played only a very limited role through implementing monetary policy.

Prices of domestic nonoil goods in Pesaran are set by producers as some mark-up on average costs. This approach virtually makes the price level an exogenous variable as its institutional determinants (W and P_z)[10] are not made endogenous in this type of maroeconomic model. Whereas, the price of domestic nonoil goods in BP adjusts according to the demand condition and as such is an endogenous variable which adjusts to any exogenous shocks experienced by the system. In fact, the sluggish adjustment of prices of domestic nonoil goods relative to nominal exchange rate adjustment in BP constitute a main source of dynamics in the analysis.

In the financial market, using the national income identities, Pesaran described the influences of balance of payment on current account and of government budget constraint on private sector assets position and on the supply of high powered money in some detail. These influences, as described in equations (3.10) to (3.16), provide the links between the government and the external sector to the monetary sector. These relations mean that, under fixed exchange rate and in the absence of complete sterilisation, domestic money stock is endogenous since the monetary base (H) as described in equation (3.13), is dependent on both the government budget constraint and balance of payment position. In contrast, these relations do not exist in BP model. This is due to the treatment of money supply function in equation (1.7) as exogenous[11] (that is, predetermined by monetary authority). Furthermore, BP formulate the exchange rate in terms of an assets market and do not include the relation between the current account and the exchange rate which arises, for instance in the Dornbusch and Fischer (1980) model.

Along with fixed exchange rate, Pesaran also imposed strict control on private sector capital flow in the foreign exchange market. This reflects Pesaran's aim of modelling an economy where the financial market is not highly developed and the authorities still exert controls in the markets. This again differed from BP where there is no government control in foreign exchange market and where the rational expectation approach to domestic interest-rate formation takes into account the influence of perfect capital mobility. In BP, capital mobility will ensure the equalisation of expected net yield so that the domestic interest rate, less the expected rate of depreciation will equal the world rate [refer to equation (1.8)]. From an analytical point of view, introduction of capital movements in Pesaran would combine flow and stock adjustment in the balance of payment equation, eliminating the clean separation of short-run equilibrium and stock adjustment in the model. This could further complicate the analysis while not adding any substantial result[12].

In the commodity market, the real private sector absorption in equation (3.1) of Pesaran included the real balance effect[13] arising from the changes in the assets position of the private sector. This specification ensures that persistent stock disequilibrium in the face of an exogenous change in oil revenues will have repercussion on the equilibrium level of the real income and the balance of payment. Thus, the inclusion of real assets in the domestic absorption function adds a channel of dynamic adjustment to the model. In fact, it adds to the dynamic stability of adjustment for the economy by enabling it to move back to a full-stock equilibrium position. This effect is absent in BP specification of the expenditure function. Hence the long-run goods market equilibrium locus is independent of real balances.

In BP, the only source of dynamic adjustment was through the combination of sticky domestic prices, mobile capital and rational expectations in the foreign exchange market. These effects coupled with the exogenous changes under consideration can have transitional effects on the level of international competitiveness, and hence on the level of activity of the manufacturing sector. Thus, the monetary sector in BP exerts an indirect influence on the commodity market via the dynamic of the foreign exchange market.

Oil income enters the Pesaran model through its influence as external rent on the balance of payment on current account [see equation (3.16)]. Changes of oil income will influent both the goods market equilibrium and money market equilibrium conditions via its implications for national income (through private sector absorption) and government budget constraint (through taxation).

Equation (3.2) reflects the assumption that oil and nonoil incomes are taxed at different rates. In particular, net revenue from oil sale is taxed at a higher rate compared with the taxation of nonoil income. Thus, the role of oil revenue is emphasized in the government's taxation income and in part reflects Pesaran's intention of modelling the oil industry as in most oil-exporting countries. This has the effect of making a large part of oil revenues accrue to the state in the form of taxes and therefore the outcome of the increase in oil income will depend on the fiscal policy stance adopted by the government.

This way of modelling certainly makes Pesaran's analysis differ greatly to the line of analysis used by BP. As will be apparent in the following discussion, Pesaran's analysis focuses on the role of fiscal policy in influencing the final outcome of oil shock while BP analysed the problems of adjustment arising from energy shocks in comparison with the implementation of contractionary monetary policy in the context of sluggish domestic price adjustment.

4.2.2 Analysis and Conclusions

The analysis in Pesaran involved comparative static analysis on the effects of changes in oil revenues. The results are as follows:

1. Short-Run Analysis

Pesaran's short-run analysis consists of comparative static results of the goods market and money market equilibrium conditions where the initial stocks of the private sector financial assets are given and the economy is operating under fixed exchange rate, constant foreign prices and rigid post-tax real wages. In this analysis, Pesaran focuses on the case where the rise in oil revenue is not accompanied by any change in government policy. The result is that a rise in oil revenue will increase national income. This increase is partly due to the inclusion of oil income in the measurement of national income as shown in equation (3.1).

The nonoil sector also benefits from an increased in oil revenue. However, this expansionary effect is only partly due to the increase in private sector disposable income. The main influence comes from an increase in the private sector absorption due to a reduction in the interest rate. The fall in the interest rate is a result of government ability to reduce national debt. This result holds as long as the conditions:$a_3 \neq 0$, $\sigma \neq 0$ and $\delta \neq 1$ are all satisfied. They correspond respectively to the conditions where the private sector absorption is interest sensitive, where not all oil revenues accrue to the government are invested abroad, and where not all government's domestic financial needs are met by printing high-powered money.

This result is the opposite of BP's short-run analysis in which there is real exchange rate overshooting in relation to its long-run value which results in a drop in domestic nonoil (manufacturing) output. This overshooting is a combination of sluggishness in adjustments of both money supply ($l = m - p_{ne}$) and price of nonoil goods (p_{ne}) as well as instantaneous responsiveness of nominal exchange rate. The increase in real income brought about by unanticipated increase in oil production results in the increase in demand for money. To restore monetary equilibrium, the real exchange rate must jump downward (an instantaneous fall in e while P_{ne} remains sticky) to bring about a fall in y_{ne} and a rise in r. Hence, overshooting occurs. This result showed that unlike Pesaran, the increase in real income did not benefit the nonoil sector; instead it affects the demand for money and (in the context of rational expectations, high capital mobility and a flexible exchange rate in the foreign exchange market, but a sticky domestic price level) this leads to an offsetting loss of competitiveness which will reduce the demand for nonoil output. Due to fixed exchange rate and constant foreign prices assumption, the competitiveness index in Pesaran is fixed and hence this effect is absent in his model.

Pesaran added that the above analysis depends also on the assumption that there are no repercussions on foreign prices. This assumption is unrealistic if the rise in oil income is due wholly to oil price increases. This led Pesaran to discuss briefly the macroeconomic implication of increased oil prices in his model. The result suggested that the effect on national income depends on the relative magnitudes of the wealth effect, private sector interest sensitivity, and elasticity of foreign prices to the increase in oil prices. Hence, the net effect is indeterminate.

In BP, for a net oil exporting country, the impact effect is again a case of real exchange rate overshooting its long-run value. Even in the case where an increase in oil prices has a positive direct effect on the demand for the home goods, this effect is offset by the indirect reduction in demand due to the real appreciation, and the economy suffers a condition in which "Dutch disease" style de-industrialisation could be likely in the context of a sectoral model. In Pesaran, this mechanism is again absent due to the reasons discussed in previous section.

2. Long-Run Analysis

In the long-run analysis, the assets stocks are changing at each point in time responding to budget imbalance and international payments imbalance due to changes in oil income. Movement of these stock through time moves the short-run equilibrium over time until the full stock equilibrium is reached. In the Pesaran model, there are two dynamic adjustment mechanisms moving the money stock: the government budget deficit and the balance of payments imbalances. Thus, the dynamic evolution of the system is derived from equations (3.11) and (3.14) in which the govenment budget position (G -T) and the balance of payment position $(X + Y_e - Z)$ are the major components in influencing the rate of change of money stock (ΔH). A budget deficit, $(G - T) > 0$, or a balance of payment surplus, $(X + Y_e - Z) > 0$ contributes to $\Delta H > 0$, so the money stock increases and adjustment to full stock equilibrium takes place.

The long-run analysis in Pesaran consists of a comparative static analysis of the goods and money markets when full stock equilibrium is achieved. In this analysis, Pesaran considered the case when there are rigid post-tax real wages and the case of flexible post-tax real wages.

(a) Rigid post-tax real wages

With this constraint, adjustment of competitiveness is not possible and there is no mechanism to drive the current account to zero. This is because according to equation (3.9), rigid post-tax real wages fixes the competitiveness index. The stock equilibrium condition[14] for this case is given by $\Delta L = 0$, which can be written as $(g - t) + b = 0$. That is, under rigid post-tax real wages, in the absence of government intervention, a stock equilibrium solution is one in which $g - t = -b$, so that any payments imbalance is just offset by a government imbalance, and the money stock is no longer changing (that is, $\Delta H = 0$).

Under these conditions, the long-run response of higher oil income is an increase in national income. This effect is due to stock adjustment in response to a balance of payment imbalance and a government budget deficit. In this case, an oil income increase brings about a balance of payment surplus and an increase in government taxation from oil income. These increases, under full stock equilibrium conditions, result in an expansionary effect on real income due to the adjustment of money stock. The nonoil sector also benefits from this expansionary effect as, by equation (3.4), the positive effect on real income are transfered to the nonoil sector as well. Any expansionary government fiscal stance (such as higher g) will further stimulate the economy and results in a more expansionary effect.

Unlike Pesaran, BP's long-run analysis is carried out in the context of flexible exchange rate adjustment and hence the adjustment of competitiveness index is possible. In BP, the competitiveness index is expressed as $\rho = e - P_{ne}$ and both e and P_{ne} are endogenous variables, though with differential speed of adjustment. Moreover, BP do not take into consideration the long-run dynamics implicit in a budget imbalance, or an international payments imbalance, for the movement of an initial short-run equilibrium to a full stock equilibrium. Thus, the long-run expansionary result of Pesaran analysis is not directly comparable to that of BP in this section.

(b) Flexible post-tax real wages

In this case,Pesaran allows for the possibility of adjustments in the competitiveness index to maintain full external and internal balance, that is, G - T = 0 and B = 0. The adjustment can be bought about through changes in the exchange rate and/or changes in money wages as $\rho = eP^{w}/P$ and equation (3.7a) shows that the price index depends on nominal exchange rate and money wages.

In response to higher oil revenue, the balance of payment and budget deficit positions both influence the rate of change in the money stock. This in turn enables the commodity and money market equilibrium position to adjust, reducing the budget deficit/surplus. The payment imbalance is also adjusting as, with flexible post-tax real wages, the competitiveness index is free to adjust to reduce this imbalance to zero. Through this mechanism, full stock equilibrium is achieved when the budget deficit and the payments balance are both zero, and the money stock is at rest. This condition determines stock equilibrium real income and foreign price competitiveness and is dependent crucially on the government's fiscal policy response.

With unchanged govenment fiscal policy, the long-run effect of higher oil income will require a permanent reduction in the country's foreign competitiveness to restore full-stock equilibrium. This is achieved by the authority appreciating the nominal exchange rate or raising money wages to its long-run stock equilibrium level. The effect on the real income and on nonoil sector is generally uncertain. However, if oil exports as a proportion of total exports are relatively small, higher oil revenue will cause a contraction of the nonoil sector. This result, due to the Marshall-Lerner condition[15], means that an appreciation of the exchange rate will lead to a net decrease in exports minus imports $(X + Y_e - Z)$. When the oil exports as a proportion of total exports are insignificant, this results in a fall in the aggregate demand for domestic nonoil output.

This result is similar to that of BP where the typical long-run response to an oil discovery is a worsening of the competitiveness position of the nonoil goods. However in BP, the mechanism involved is different from Pesaran's financial stock adjustment to long-run stock equilibrium. The long-run appreciation in BP is a result of an increase in the relative price of home goods to counter the larger demand arising from the increase in permanent income due to a rise in oil income.

In the case of oil income increase accompanied by a change in fiscal policy, Pesaran considered the situation of a simultaneous increase in real government expenditure. In this case, the long-run effect on foreign competitiveness will depend on the actual size of the increase in real government expenditure in relation to the magnitude of the rise in oil income. Since it is the fall in the foreign price competitiveness index in respond to oil income increase that brings about a contraction of the nonoil sector, it is desirable for the increase in real government expenditure to maintain the level of competitiveness. Thus, Pesaran considers the situation when the real government expenditure[16] is increased to just prevent a fall in the country's foreign competitiveness index. Under such an expenditure policy, the long-run effect on the real income and nonoil sector will always be expansionary.

Thus, Pesaran's analysis on the effect of higher oil income emphasizes the role of government fiscal response to the level of foreign competitiveness. This leads Pesaran to conclude that a rise in oil income need not be followed by industrial decline, if the authorities in oil-exporting countries can respond by an appropriate fiscal policy. In comparison, BP did not explicitly study policy responses of exogenous oil shocks. However, in their conclusion, BP pointed out that by permitting finite responses in the level of nominal money stock (rather than a tight monetary policy), thus making the real money supply flexible, the new long-run equilibrium in response to oil shock can be achieved without any need for short-run overshooting of the real exchange rate.

Finally, it should be noted that Pesaran analysis is very much along the line of Keynesian views that fiscal policy is a more effective policy tool because of the fundamental Keynesian concern with the problem of an under-full-employment equilibrium. In the context of a developing economy, where the capacity to absorb oil revenues is relatively high, due to an under utilisation of productive factors and the lack of capital stock, government's ability to achieve fuller employment by raising the level of aggregate demand is emphasized. The effectiveness of such policy will largely depend on the private-sector's absorptive capacity. In contrast, BP's assumption of a full-employment equilibrium makes fiscal policy less effective on the equilibrium level of real output due to "crowding out" effect on the private-sector.

4.3 Fender Compared With Buiter & Purvis

4.3.1 Assumptions and Structure

Apart from some major differences to be discussed later, Fender shares a few similar assumptions with BP. These are discussed as follows:

1. They both assume perfect capital mobility and rational expectations in the foreign exchange market. Thus, the type of exchange rate dynamics described in Appendix B2 are also applicable to the nominal exchange rate movements in the Fender analysis.
2. Both Fender and BP assume that oil production does not compete for resources with nonoil production. These two models do not allow any participation by the oil sector in the domestic factor markets and

hence there is no overall constraint in the oil producing sector. This assumption of exogenous oil production also means that in both models, there will not be any resource movement effect and no direct de-industrialisation. There is then only a spending effect and the key mechanism of resource reallocation is the real appreciation caused by a fall in the nominal exchange rate.

3. Both models abstract from the role of assets stock effect due to current account imbalances such as those discussed in the Pesaran model. So the current account plays no role in either model.

The Fender model differs from that of BP mainly in its extension from a single nonoil domestically produced goods to two such goods: a traded and a nontraded good. This is in line with the concluding remarks made by BP about the effects of an oil discovery on domestic production of nonoil goods. BP recognise that their model do not provide for the possible shifts in the composition of domestic nonoil production. They point out that such shifts are likely to be out of manufacturing into nontraded services. That is, there is the possibility of de-industrialisation. BP then suggest an alternative model with a framework that will provide for the analysis of the de-industrialisation process. This extended framework is modified and adopted by Fender. Thus, in the model described in algebraic form from equations (4.1) to (4.9), the role of nontraded goods is disaggregated from the domestic nonoil output to exert its own influence on the rest of the economy.

The three-sector framework of Fender also means that his price determination mechanism is different from the BP price structure where a large country assumption unlocks the price of domestic production from the world price. In the Fender model, the oil producing sector and manufacturing sector are completely exposed to foreign competitiveness. Hence, they both face fixed world prices for their outputs and there is no need to introduce a separate equilibrium condition for the traded sector. This is because the small country assumption ensures that the quantity of traded goods which producers wish to produce at any given domestic price can always be sold on the world market at the world price.

However, a key issue in the small open economies is the effect of the oil boom on the real exchange rate, that is, the relative price of traded to nontraded goods. This issue is examined in Fender by the presence of the nontraded goods sector whose price is determined endogenously. Hence, the real exchange rate in Fender is expressed as $\rho = e/W$ in equation(4.8). In comparison, the price determination process in BP is different fom the Fender model due to the following two reasons. Firstly, the BP model has a two-sector framework, producing two traded goods; namely, the oil and the nonoil goods. The nonoil goods consist of an aggregate of traded and nontraded goods. Secondly, BP assume that the home economy has some monopoly in its export market. Hence, unlike Fender, the price of nonoil export is determined by domestic goods market condition.

Thus, the price determination mechanism for the domestic nonoil goods in BP has much similarity to that of Fender's nontraded goods. This makes the domestic nonoil sector in BP more akin to the Fender's nontraded goods sector. It follows that the real exchange rate in the BP model is expressed as $\rho = e - p_{ne}$ in equation (1.9). For the same reasons, the other key state variable, the real money supply in terms of the home goods is expressed as $l = e/W$ in Fender; and $l = e - p_{ne}$ in BP.

The three-sector framework of the Fender model also enables it to explicitly include the labour market. This is expressed as the expectations augmented Phillips curve in equation (4.9). Employment in the traded goods sector depends on the relative price of traded to nontraded goods (e/W) and world currency price of oil; while employment in the nontraded goods sector is related to nontraded output. The wage adjustment process described by the expectations augmented Phillips curve also imposes a dynamic structure which is slightly different from that of BP. In the Fender analysis, the temporary real effects of money and the dynamics of adjustment are consequences of the wage-setting process, which responds only over time to labour-market pressures and inflationary expectations. In contrast, the BP analysis has short-run movements in the real variables induced by the speed-of-adjustment differentials between assets and goods markets. Thus, the type of exchange rate dynamic discussed in both the Fender and the BP analyses, are basically similar. The only different is through the explicit introduction of nontraded goods in the Fender model, so that the dynamic adjustment is the result of the differential speeds of adjustment between the money and labour markets.

The introduction of an explicit labour market and the assumption of long-run full employment at its natural level enables the Fender model to consider an overall factor (labour) constraint in the traded goods and nontraded goods sectors. The utilisation of labour in both the nonoil sectors allows the spending effect of an oil boom to draw labour resource out of the traded sector into the nontraded sector. Thus, the Fender framework fulfills the suggested extension by BP as discussed at the beginning of this section.

Fender also elaborates on the production side to incorporate the role of oil as an intermediate input in the production of traded goods. This is shown in equations (4.1) and (4.9), in which oil enters the model as a cost component[17] in the domestic production of traded goods. This influence also filters through to the labour demand function for the traded goods sector[18]. In addition, the role of oil also includes that of net oil export earnings. As oil is an intermediate input, its price does not enter into the price deflator in equation (4.2). Hence, in this case, any changes in oil prices will not directly affect the consumers, even though they are indirectly affected through changes in the production of traded goods and movements in the exchange rate. In BP, oil is modelled only as a final consumption goods. Thus, oil prices enter the BP model through their influence on the price index, as substitution effect in the demand for domestic nonoil goods and their implications for the actual and permanent incomes. These are shown in equations (1.3), (1.1) and (1.2) respectively. Thus, in contrast to the Fender model, oil price changes will affect the consumers directly through its impact on the price index and the latter will affect the domestic real income level.

Fender's demand for nontraded goods in equation (4.3) includes the real balance effect. The real balance effect provides a crucial link between the money market equilibrium condition and the demand for nontraded goods. The presence of real balance effect means that monetary shocks are no longer 'neutral', even in the long-run. This is another feature that is absent in BP.

4.3.2 Analysis and Conclusions

To highlight the importance of these differences, the analysis on the effects of various exogenous changes are compared between the two models. Fender studied the same types of exogenous shocks as those in the BP analysis. These are: the steady state and impact effects of changes such as monetary disinflation, discovery of a domestic oil reserve and increase in the world price of oil. However, Fender only briefly discuss the effects of changes in oil prices.

(A) Monetary Disinflation

In response to a reduction in the rate of monetary growth, μ, both models generate an increased demand for real money balances at the steady state. However, only the Fender model shows a long run appreciation of real exchange rate. The real balance effect presence in Fender is crucial for this result; the higher real balances held in the steady state with a lower rate of monetary expansion generates extra demand for the nontraded goods, and hence the real exchange rate must appreciate to restore the equilibrium. The increase in demand for the nontraded goods means that employment must also rise. In order to maintain steady state employment, the money wage must rise and hence the real exchange rate must appreciate[19]. In BP, μ exerts no long-run effect on the real exchange rate due to the assumption of long-run neutrality of money.

In the short-run, due to the sluggish adjustment of the money wage rate, the real exchange rate appreciates instantaneously, overshooting its new long-run equilibrium value. Corresponding to this exchange rate adjustment, production of both traded and nontraded goods falls initially (as $y_1 > 0$; $n_3 > 0$: that is, these outputs adjust in the same direction as the real exchange rate). During this time, there is nothing to increase their output as real money balances are initially unchanged. However, in the medium-run, the recession created by the decline in the output of both goods ensures that the money wage increases by less than the money stock and hence the level of real money balances rise. At this short-run equilibrium, the real interest rate and the relative price of the notraded goods also decline. These effects tend to increase the demand for nontraded goods. Hence, at the new steady state, the effect is expansionary for the nontraded sector, but deflationary for the traded sector[20]. Thus, the short-run dynamic of a monetary disinflation in the Fender analysis also involves the differential speed of adjustment between the money wage and the rate of change in monetary expansion.

In comparison, the BP analysis also involves short-run appreciation of real exchange rate and the overshooting phenomenon. The initial fall in real exchange rate is due to the instantaneous response of the nominal exchange rate to monetary disinflation[21]. In contrast, the real liquidity (that is, $l = m - p_{ne}$, expressed in terms of the price of domestic nonoil) adjusts sluggishly. The dynamics then involve improving competitiveness and increasing real liquidity until the steady state is reached. This initial appreciation results in a sharp fall in activity in the domestic nonoil sector. However, unlike Fender, the long-run sectoral effect is absent because of aggregation of nontraded goods within the domestic nonoil output.

(B) Discovery of Oil

The discovery of domestic oil reserves causes a long-run decline in competitiveness of the nonoil manufacturing sector in both the BP and Fender analyses. This is mainly due to the spending and liquidity effects induced by the increased income. In the Fender analysis, spending on nontraded goods increases and hence, either a fall in the real exchange rate (that is, real appreciation) or a decrease in real money balances (or both) is required to restore equilibrium in the money market. The increase in oil revenue also increases the demand for money and hence, real exchange rate appreciation is also required through the money market. While the typical long-run response to an oil discovery is a worsening of the competitiveness position of the nonoil goods, the effect on long-run real money balances is ambiguous. Fender studies this issue in some details, while BP discuss only the case when there are long-run increases in the real money balances.

However, BP also notes that it is possible to have a decline in the long-run real money balances with no short-run overshooting.

The Fender analysis produces some very interesting results. In the Fender model, whether the real balances increase or decrease in the steady state depends crucially on the rise in money wage rate relative to the rate of monetary expansion[22]. If the second effect predominates, then the real balances increase in the steady state. The dynamic adjustments are fairly similar to those of monetary disinflation. There is an initial sharp fall in, and overshooting of real exchange rate, which then gradually rises to its new steady state level. Traded goods output falls initially, and then rises to its new steady state level which is still below its 'pre-shock' level. However, although nontraded output steadily rises in the adjustment path from the short-run to long-run euilibrium, the net effect is unclear. This ambiguity is due to the positive income effect of oil revenue increase offsetting the opposite effect of the increase in the relative price of the nontraded goods and the increase in the real interest rate

Thus, the initial effect of the oil discovery is deflationary; unemployment rises above its natural level for a time so that the increased real money balances to be held in the steady state can be generated by a money wage rising less rapidly than the money supply.

The case where there is a steady state decline in real balances is a result of the money wage rising faster than the rate of monetary expansion. In this case, there is no overshooting of real exchange rate. The oil discovery is hence expansionary; even if tradable output falls because of an exchange rate appreciation. This is outweighed by the initial increase in tradable output. It is this latter analysis that agrees with the conclusion of EV discussed in section 4.1.

Fender proceeds to explore the conditions under which the oil discovery is more likely to be expansionary, and finds that the expansionary result occurs when:

i) the greater the oil discovery effects on the demand for labour, and the less its effect on the demand for money; and

ii) the lower the effect of changes in competitiveness on the demand for labour and the greater the effect of changes in competitiveness on the demand for money; and

iii) the oil discovery must be expansionary if changes in oil revenue have no direct effect on the demand for money.

Thus, the Fender analysis not only provides a detailed explanation on the likely effects of oil discovery, it also resolves the conflicting conclusions between EV and BP on the effects of oil discovery.

(C) <u>Changes in the World Price of Oil</u>

Differences due to the role of oil as a final consumption good in BP and as an intermediate input in Fender are reflected in the analysis on the effects of a change in the world price of oil (P_e^w). However, in his paper, Fender only briefly discuss the effects of oil price changes on real income and employment.

In Fender, the effects on income of an increase in the world price of oil depend on whether the country is a net importer or a net exporter of oil. The effect would be negative in the net importer case. If the country is a net oil exporter, then the value of net oil exports increase, but traded output falls. Thus, the effect on income depends on which effect predominates. These complications are caused by the role of oil as an intermediate input. There are two offsetting effects here. In as much as it reduces the domestic demand for oil, it tends to increase income, but in as much as it reduces traded output, it tends to reduce it. However, the net effect on income is more likely to be negative, the more substitutable oil and labour are in the production of traded goods.

In the case when the effect on income is negative, a depreciation of the exchange rate is likely to result. However, it is not clear whether output and employment increase in the traded goods sector, since the expansionary effect of the depreciation will be offset by the contractionary effect of the increase in P_e^w. If the latter effect predominates, then there is a situation where the rise in P_e^w is both inflationary and deflationary. It is inflationary in that prices tend to rise whereas deflationary in its effect on output and employment.

When an increase in the world price of oil results in a rise in real income, there is an exchange rate appreciation due to the spending effect. The rise in the world price of oil reinforces the effect of the exchange rate on output and employment. Thus, although real income rises, producers of the traded goods suffer both because of the fall in the price of their output and the increase in the cost of one of their inputs.

However, in the BP case, where oil is a final consumption good, the income effect for a net oil importing country could be positive. It will be a negative effect if the country is a sufficiently large net user of oil so that the nagative income effect dominates the substitution effect. For a 'small ' net user, the effect would be positive, as substitution between oil and domestically produced output takes place.

Furthermore, the results in BP largely depend on the relative magnitude of the income and substitution effects of oil as a final consumption good. The general conclusion of BP on the increase in world price of oil is that it can have a transitional negative effect on manufactured output, even for a net oil exporter. This negative output response is linked to the case that the real exchange rate overshoots its long-run value. This overshooting is brought about by the nominal exchange rate versus domestic nonoil price adjustment mechanism.

4.4 Neary & Purvis Compared with Buiter & Purvis

4.4.1 Assumptions and Structure

In terms of the structural similarities, these two models have the following common features:

a) Both models treated oil/benzine as a final consumption good. Thus, there is no distinction between the influence of oil on domestic costs and prices. This issue is important only when considering the effects of oil price increases. As NP do not explicitly discuss the effects of oil price shocks, we will not pursue with this point.

b) Oil/benzine is produced domestically and traded on world market at a given world price;

c) NP recognise the BP argument that de-industrialisation is not necessarily associated with a significant movement of labour into the booming sector, but instead emphasizes the real appreciation arising from the resource boom in conjunction with sticky dometic prices. To this end, NP have modified their underlying structure to include a framework for monetary adjustment as described in the augmented model. Thus, the following assumptions are common to both models:

   i) There is international capital mobility;

   ii) Domestic and foreign interest-bearing assets are perfect substitutes;

   iii) Exchange rate expectations are formed rationally, and the exchange rate operates under a flexible regime.

   Hence, the Dornbusch analysis (as described in Appendix B2), which highlights the role of domestic disturbances in generating exchange rate variability such as the 'overshooting' phenomenon is also applicable in the NP augmented model;

d) In the NP augmented model, the current account need not be in balance except in the long-run equilibrium. This assumption is also shared by BP. However, both BP and NP did not proceed to include the dynamic links between the exchange rate movements and the current account. Instead, they follow the Dornbusch (1976)-type of exchange rate dynamic arising from nominal stickiness in prices of domestic nonoil goods combined with a freely floating exchange rate.

The differences between the NP and BP models mainly arise from their underlying macroeconomic framework to analyse the consequences of energy shocks. The NP model aims to examine the resource allocation and stabilisation consequences of a resource boom in a small open economy. For this purpose, NP have retain the CN framework in their basic model structure. Consequently, the NP model consists of a three-sector framework in which the distinction between traded goods, nontraded goods and resource goods is explicitly illustrated. This is a distinct characteristic of the 'dependent economy model'[23] which underlies the CN model.

In addition, BP make the assumption that the home economy has some monopoly power in its export market, and the price of nonoil exports is influenced by domestic conditions. Thus, the terms of trade is endogenous, and so the nonoil sector in BP is more akin to NP's nontraded services sector. This is because in a trade-dependent economy, the small open economy assumption makes the terms of trade exogenous. That is, the output of the tradable sector (namely, resource goods and manufacturing goods) faced a given world price, and is independent of the domestic repercussions of exogenous shocks. The effect of the resource boom on the real exchange rate (that is, the relative price of traded to nontraded goods) comes, instead, through the nontraded services sector. As the nontraded sector is sheltered from foreign competition, the prices and output level of services are directly influenced by domestic demand conditions.

In contrast, the BP framework consists of only two sectors: oil and nonoil. The nonoil sector includes both the domestically produced traded goods and the nontraded services. Thus, the BP model could not handle the problems related to the reallocation of resources such as the shifts out of manufacturing into nontraded services.

The NP model also differs from BP in that the former has an elaborate production structure which highlights the supply-side effect of resource boom and monetary shock. The production structure in NP is characterised by different degrees of intersectoral factors mobility. Factors of production differ not only with respect to where they are used, but also with respect to how quickly they can move between uses. Labour is freely mobile between the two sectors in which it is used: manufacturing and services. In contrast, the allocation of capital between the sectors in which it is used, resource and manufacturing, is fixed in the short-run and variable only in the long-run. These production relationships, which form the real part of the NP model are described in the labour and capital markets representated by equation (5.6) through to equation (5.20). With this model, the effects of exogenous shocks on factor (capital and labour) allocation between the three sectors are studied.

Furthermore, production of the resource in NP is not exogenous as it competes for capital with nonoil manufacturing. This inclusion of capital in resource production partly gives rise to de-industrialisation through a direct resource movement effect under a resource boom. In contrast, the model in BP has no explicit production structure. Instead, it focuses on the income- or wealth-motivated demand effects. This is reflected in equation (1.4) where the output of nonoil goods is demand-determined and the factor markets in capital and labour have no explicit role in the model. The BP model also differs from NP in the treatment of resource production. Oil production in BP is treated as exogenous and it does not compete for resources with nonoil production. Thus, the energy shocks have no resource movement effect whatsoever, only the spending effect and liquidity effect. Hence, the factor market pressure that is present in the NP model does not exist, and "de-industrialisation" occurs instead through the foreign exchange market due to real exchange rate appreciation.

Nevertheless, it should be noted that BP are primarily concerned with the issues involving oil shocks and real exchange rate overshooting. Thus, from an analytical point of view, the simplications they make with respect to the structure of factor markets is a virtue rather than a vice. They are concerned to show that the adjustment problems due to the spending effect of an oil boom can be corrected by appropriate monetary policy. However, as far as understanding real phenomena is concerned, most energy sectors must make use of some factors (at least in the short-run) which are available only in the home country and are in limited supply, so that their diversion towards the energy sector imposes additional costs on manufacturing. For a complete understanding of the Dutch disease, therefore, the resource movement effect discussed in NP is important.

4.4.2 Analysis and Conclusions

The following analyses of NP illustrate the way in which the NP model differed from the BP model:

Resource Boom

Resource boom in NP referred to either a 'discovery' of new resources (that is increase in supply of the specific factor V) or an increased in the price of resource[24], p_e. The rise in real income leads to extra spending on services which amounts to an increased demand for labour in the services sector. To maintain equilibrium at the labour market, the demand for labour in manufacturing must fall. At a given real exchange rate and hence at given factor proportions, this is accomplished through a reduction in capital in the manufacturing sector. This describes the **spending effect** of the boom. The **resource movement effect** of the boom comes about when the boom raises the rate of return to capital in the resource sector and results in a long-run reallocation of capital away from manufacturing towards resource sector. The net long-run result of these two effects is a fall in stock of capital in manufacturing sector and a fall in real exchange rate (real appreciation), when the spending effect dominates.

NP further elaborate their analysis by incorporating two types of short-run dynamics; capital adjustment process and labour-market/ services-market adjustment mechanism.

(a) Capital Adjustment Process (Marshallian Dynamics)

In the short-run, the capital stock is fixed and hence on impact, there is no resource-movement effect. The economy experiences only a spending effect which works on relative prices and results in unambiguous real appreciation. In summary , the impact effects of the resource boom are as follows: the increase in national income raises the demand for services, causing a shift of labour out of the manufacturing sector into services and a rise in the real wage (that is, a rise in p_n which is equivalent to a real appreciation). There is in fact an overshooting of the real exchange rate from its new equilibrium value. This overshooting is the result of Marshallian distinction between short- and long-run supply responses to an endogenous disturbance. In the longer-run, the discrepancy in the return to capital between the booming resource sector and the manufacturing sector that occurs in response to the short-run effects in the labour market gives rise to dynamic adjustment in the capital market. This long-run capital stock adjustment mechanism is given in equation (5.20). The reduction in the manufacturing labour force causes a fall in the returns earned by capital in that sector. This is opposite of the change in the return to capital in the resource sector since the initial disturbance being considered is an increase in the factor used in conjuction with capital in producing the resource goods.

Thus, the short-run disturbances lead to an incentive to run down the stock of capital in manufacturing, either by reallocating existing capital goods or by allowing them to depreciate without replacement. This results in the real exchange rate and the demand for services gradually rising. The latter is due to the fall in their relative price and to capital being allocated more efficiently between sectors, which raises real income. Hence, the equilibrium output of services must rise, which squeezes labour out of the manufacturing sector. Since manufacturing is simultaneously losing capital, the sector's output must fall steadily as the economy moves away from its short-run equilibrium until the long-run equilibrium is reached.

Hence, with the labour-market clearing continually (that is, under the assumption that domestic prices are instantaneously flexible), the economy follows a monotonic path in which capital stock in manufacturing steadily declines accompanied by constant real appreciation until the new long-run equilibrium described previously is reached. This adjustment in capital stock moderates the required adjustment in relative prices and therefore of real exchange rates so that the initial movement of exchange rates is an overshoot.

(b) Labour-Market/Services Market Adjustment

Here, NP extended their analysis to the case where the **relative** price of services adjusts sluggishly in response to imbalances between supply and demand according to the mechanism described in equation (5.13). In contrast to previous section, the economy is no longer constrained to lie on the labour-market equilibrium locus due to the presence of non-market clearing in the services market. Under the influence of short-run fixity of capital stock with relative price rigidities in the services market, the real exchange rate may, or may not overshoot its long-run value. The extent of overshooting now depends on the speed of price adjustment relative to the speed of capital reallocation. If the speed of the relative price adjustment is slower (that is $\psi' < \Phi'$),the less likely is the real exchange rate overshooting. The slow relative price adjustment will result in the economy following a direct path of real depreciation accompanied by declining capital stock in manufacturing towards its new long-run equilibrium.

In comparison to BP, NP provided a different perspective on the economy's responses to a resource boom. With a framework covering both the demand- and supply-side of the economy, NP are able to analyse the effects of the boom on domestic service-market demand and the consequent changes in the real exchange rate and factor market reallocation via the two main effects; namely, the spending effect and resource movement effect. The links between demand repercussions due to exogenous disturbance, and factor reallocation is not discussed in the BP analysis because the BP model did not include a production structure. Hence, the study of capital and labour reallocation through direct resource movement effect is not possible with the BP framework.

When comparing exchange rate dynamics, it is important to note that the overshooting in NP is that of **real** exchange rate in response to a **real** disturbance. It is a result of a **real** rigidity which arises from the short-run fixity of the capital stock. Furthermore, NP's inclusion of short-run relative price rigidities provides a different kind of influence on the dynamic adjustment path, in comparison with the Dornbusch (1976) -type of dynamics. Consequently, its response to short-run rigidity of relative prices differs greatly to the Dornbusch (1976) analysis of nominal overshooting. Here, instead of overshooting of exchange rate resulting from sluggish adjustment of nominal prices; sticky relative prices in fact provide a "stabilizing" influence on the real exchange rate. In the context of Marshallian adjustment, sluggish relative price adjustment actually mitigates the extent to which the real exchange rate overshoots its long-run value. Thus, the relative price rigidities in NP in fact provides a "stabilizing" influence on the real exchange rate. This result contrasts sharply with the BP case where the sluggish adjustment of nominal prices is the main cause of exchange rate overshooting. This again constitutea an interesting exposition of real analysis which BP do not dealt with.

(c) Monetary Adjustment

In recognition of the fact that exogenous shocks in influencing the real variables, also has its effect on the nominal variables, NP introduced a monetary framework to examine the dynamics that arise when both the price of services (p_n) and allocation of capital are slow to adjust, while the nominal exchange rate is allowed to float. This is described by the nominal price (domestic price of services) adjustment in equation (5.23) and the condition for domestic nominal interest rates formation in equation (5.25). Thus, the analysis based on the augmented framework largely involves the adjustment of r and e (for given values of m, p_n and y) to maintain equilibrium in the money market. In the long-run, however, the ratio of e to p_n is determined by the conditions for real equilibrium outlined in the previous analysis. So, for a given M and with real income at its full-employment level (contingent on given values of the exogenous valuables), the value of p_n adjusts to ensure that equilibrium of the real and nominal sectors is simultaneously attained.

With this framework, NP extend their analysis to consider the dynamic responses of the full model to the following exogenous shocks:

(i) Monetary Deflation

In NP, monetary shocks are modelled as changes in the level of foreign prices or the domestic money supply. NP consider the dynamic adjustment to an unanticipated once-and-for-all reduction in the domestic money supply.

In the long-run, the nominal exchange rate and the domestic price of services fall in proportion to the reduction in the money supply and so monetary disinflation is neutral. This is because the NP model assumes that money is neutral in the long-run and affects nothing real, as can be seen by the unitary coefficient of m in equation (5.28). However, on impact, monetary deflation means there is excess demand for money. With a sticky nominal price of services, the short-run price of services cannot fall below its initial value. Hence, the exchange rate must bear all the brunt of ensuring that the money market clears[25] for given values of y and r. In the short-run, the equilibrium therefore requires the nominal exchange rate to fall by more than the proportionate reduction in money supply. This is consistent with rational expectations since the fall in real money (due to $l = m - p_n$; a fall in nominal money with a sticky price means l must fall) causes the equilibrium interest rate to rise. From the condition for uncovered interest parity in equation (5.25), a higher interest rate is possible only if there is expected depreciation. Speculators therefore set the current spot exchange rate below its long-run value so that the actual adjustment of the exchange rate is consistent with these expectations. The exchange rate then rises monotonically during the adjustment period until it reaches its new long-run value.

NP also discussed briefly the dynamics when **both** the price of services and the allocation of capital adjust slowly. In this case, there is still short-run overshooting of the exchange rate, but the adjustment path will likely be cyclical rather than monotonic as in the previous situation.

Corresponding to the adjustment of nominal variables, real variables are also adjusting, since with a sticky domestic price of services, the initial monetary deflation has real effects. In the new short-run equilibrium, the relative price of services has risen, giving rise to excess supply in that sector. According to equation (5.23), the price of services starts to fall; this in turn tends to raise real balances and to reduce the domestic interest rate. Corresponding to the initial higher relative price of services is a rise in the real wages (as the manufacturing real wage rate is $w - p_t$ which is equal to $p_n - p_t$). Hence, there is an incentive to reallocate capital from the labour-using manufacturing sector to the resource sector.

The consequence for the real economy of such adjustment is that with the exchange rate overshooting its final equilibrium value, manufacturing profitability falls even more in the short-run than in the long-run.

The above analysis is carried out without consideration of the influence of Marshallian dynamic in the capital market. When both the price of services and the allocation of capital adjust slowly, the analysis of the model is considerably more complicated. In this case, the results of the previous analysis still hold, that is, there is still short-run overshooting of the exchange rate. However, the adjustment path is likely to be different because the interaction between prices and capital adjustments could give rise to a cyclical path. The interest parity condition also required such adjustment path to converge to the new long-run equilibrium, since phases of depreciation must be associated with values of the domestic interest rates which are above the return available on the foreign securities.

(ii) A Resource Boom

In response to a resource boom, as far as the labour/services market equilibrium is concerned, we know already that both the spending and the resource movement effects lead to excess demand for services at initial prices. The rise in real income also raises money demand and, if the domestic money supply is not changed, the domestic services price level must fall to restore money-market equilibrium. This third effect of the boom, which operates through the money market is the liquidity effect. When the price of services adjusts instantaneously, the nominal exchange rate may overshoot its long-run value followed by a steady depreciation as capital is reallocated out of the manufacturing sector. This possibility is due to the impact effect where the domestic interest rate has risen. From the interest parity condition in equation[26] (5.25), this can occur only if there is a simultaneous expectation of depreciation of the domestic currency (that is, a rise in e). Rational speculators will therefore set the current exchange rate below its long-run value; if the long-run exchange rate itself falls, then there must be short-run overshooting.

In the case where the price of services is sluggish to adjust, the long-run result does not alter. However, the short-run adjustment mechanism is exactly the same as the short-run effect of monetary deflation discussed previously. That is, there will be overshooting of the exchange rate due to the differences in the speed of adjustment between the domestic price of services and the nominal exchange rate. Hence, sticky domestic price in the presence of floating exchange rates exacerbates the Dutch disease.

NP also consider the effects of the boom when the sectoral allocation of capital and the nominal price of services are fixed in the short-run. Under these influences, there will be a more severe real overshooting. This is because the nominal price stickiness causes the nominal exchange rate to overshoot, while the real rigidity in the capital stock adjustment causes the real exchange rate to overshoot in the manner described previously. Furthermore, we know from equation (5.24) that real appreciation will result from nominal appreciation if the price of services is fixed. Hence the short-run real appreciation due to real rigidity is further aggravated by the nominal appreciation due to sluggish price adjustment. The resource boom thus gives rise to a sharp decline in competitiveness of the manufacturing sector accompanied by a rise in unemployment.

In the previous section on the NP analysis, the net result in response to monetary shocks and resource boom is similar to that of BP. This is demonstrated by the fact that both BP and the NP analysis show long-run neutrality of monetary changes but experience short-run repercussion of exchange rate overshooting. In addition, their analysis of a resource boom indicated long-run exchange rate appreciation and short-run overshooting. These have the same qualitative effect of long-run deterioration of the manufacturing sector and short-run transitional de-industralisation. The similarity of NP and BP analysis along the line of nominal adjustment are expected as they both follow the Dornbusch(1976) framework in their respective model.

In the analyses on exchange rate dynamics, NP differ slightly from BP in their emphasis. BP focus on the adjustment of real exchange rate (that is, $\rho = e - p_{ne}$ which also measures competitiveness of domestic nonoil goods) in response to monetary as well as real disturbances. This reflects the BP aim to demonstrate that monetary shocks under sluggish domestic price adjustment will have real effect in the short-run with adverse consequences for the competitiveness of the domestic manufacturing sector. In the BP model, both monetary shocks and resource boom can have a short-run negative effect on the country's competitiveness through a fall in nominal exchange rate which leads to real exchnage rate overshooting.

However, NP pursue this subject in greater detail by introducing a framework with a clear distinction between real and monetary influences. With the basic model, NP emphasize the real effects of real disturbances where the dynamics of the system stem from real criteria consisting of: short-run fixity of capital and short-run stickiness on relative price of domestic services. The main adjustment variable in this model is the real exchange rate ($\rho = p_t - p_n$)[27]. With this framework, NP demonstrate the possibility of short-run real exchange rate overshooting due to real rigidity in the capital market.

In recognition of the fact that changes in the real exchange rate reflect changes in both the nominal price of services, p_n and the nominal exchange rate[28], NP develop an augmented model which focuses on monetary considerations. This framework enables NP to study monetary shocks and resource boom in the context of real and monetary adjustments. These two frameworks provide interesting results regarding the structure of the model itself. That is, the real equilibrium can be solved for independently of the monetary equilibrium. The solutions for the real variables can then be used to solve for the equilibrium values of the nominal variables, including the exchange rate.

This result is particularly significant with regard to the discussion on the exchange rate overshooting result derived by NP. That is, from the NP model, one can deduce that when real variables are slow to adjust, real shocks will be accompanied by **real** exchange rate overshooting, while when nominal variables are slow to adjust, monetary shocks will be accompanied by **nominal** exchange rate overshooting. Their model illustrates a more severe short-run overshooting when both short-run capital fixity and short-run commodity price stickiness are present because the nominal appreciation exacerbates the real appreciation. Moreover, in both cases, the overshooting of both real exchange rate and nominal exchange rate lead to inappropriate domestic allocation by temporarily altering relative prices.

In terms of policy implications, NP examine the ability of monetary policy to stabilize the economy. NP point out that there is justification for government intervention due to the resource allocation problems arising from domestic price-stickiness. However, they caution that policy errors which arise from confusing real and monetary shocks may worsen macroeconomic performance. For instance, the authorities could intervene by reducing the money supply in the mistaken belief that the economy should be shielded from the exchange rate depreciation. This situation could arise when the economy is experiencing the medium-run effects of nominal and real depreciation in response to a resource boom as discussed in earlier sections. In this case, the economy will suffer from the adverse consequences of delays[29] in the attainment of the long-run equilibrium. This will lead to more transitional unemployment and loss of output than if no intervention is involved.

Nevertheless, NP suggest that the authorities can and should take action to offset the effects of significant and clearly identifiable shocks; such as the nominal and real overshooting arising from the short-run fixity of sectoral allocation of capital and of the nominal price of services. They advocate the option of expanding the domestic money supply so as to partly offset the initial appreciation and point out that the restoration of full-employment in the short-run could be a possible strategy. This policy option is also advocated by BP. In the context of the BP model, the increase in the nominal money supply will permit the immediate achievement of the new long-run equilibrium, without any need for overshooting.

Notes:

1. See Eastwood and Venables (1982), pp. 289-290 for the details.
2. See Eastwood and Venables, p. 287. EV denote domestic (nonoil) output as 'y' and use it interchangeably with national income.
3. EV treat oil and nonoil incomes separately as they believe that oil revenue and nonoil current income might have different impacts on domestic demand. See Eastwood and Venables, footnote 2, p.290.
4. Quote from Neary and Wijnbergen (1984), pp. 390-391.
5. The spending, resource-movement and liquidity effects are first introduced in Chapter 2, sections 2.2 and 2.3. These effects will be discussed in greater details in section 4.4: the spending & resource-movement effects will be described on pp. 89-90, while the liquidity effects will be described on p. 97.
6. Refers to Turnovsky and Kaspura (1974), pp. 356 - 357.
7. This is consistent with the United Kingdom experience in the late 1970's when the Conservative government under Mrs. Thatcher adopted as the chief plank of its economic policy a steady reduction in the rate of monetary growth. It reflects the Neoclassical view which emphasizes the importance of monetary policy while downgrades that of fiscal policy.
8. See Dornbusch (1980), Chapter 11, pp. 202 - 213 and Dornbusch (1976).
9. Pesaran's framework is to some extent similar to the Turnovsky and Kaspura (1979) model which consists of a short-run unemployment model. This is in line with the standard Keynesian analysis where the role of government action to stablilise economic activity by 'fine-tuning' is emphasized.

10. Treating the money wage rate as an exogenous variable has been a characteristic of Post-Keynesian economics.
11. This is consistent with the monetarist position that money supply in an open economy with flexible exchange rates has a large element of exogeneity. See Levacic and Rebmann (1980), Chapter 9. pp. 162 - 163. The monetary base is ultimately under the government's control and this gives it control over the money supply.
12. See W. H. Branson (1976), p. 350.
13. This specification is more in line with the monetarist transmission mechanism which provides a direct link between changes in the money supply and changes in consumption and investment. In traditional Keynesian analysis, this link is indirect, people adjust to any excess demand or supply of money by respectively moving out of or into bonds. This affects the interest rate, which in turn influences investment and possibly the demand for consumer durables. The introduction of a wealth effect into the consumption function means that changes in the money supply have a more direct and diffused impact on aggregate demand than that allowed for in the traditional Keynesian transmission mechanism.
14. Upon using equations (3.2) and (3.17) in (3.11), this condition can be written as $g - t_n y - (t_e - t_n e)\rho Y_e + b = 0$.
15. The Marshall-Lerner condition requires that the sum of the price elasticity of the demand for exports plus the price elasticity of demand for imports must exceed 1.0 for a devaluation/revaluation to have a favourable/negative impact on the current account. In Pesaran's analysis, this condition is required for stability of the system.
16. This level of real government expenditure is also compatible with

the condition where no cut in real wages is possible (or desirable, that is, dw = 0 as $\rho = \theta_0 - \theta_1\bar{w}$).

17. This can be deduced from the expression for output of traded goods in equation (4.1) where:

$$y_t = y_t(e/W, P^w_e),$$

and from the sign of coefficient; $y_{t2} < 0$. It is clear that as world price of oil increases, the production for traded goods will decline. This condition holds because of the treatment of oil as an intermediate input and hence the oil price constitutes a cost component to the domestic production of traded goods.

18. From equation (4.9), the expression for the labour demand function in the traded goods sector is given by:

$$n_t = n_t(e/W, P^w_e), \text{ and}$$

from the sign of coefficient; $n_{t2} < 0$.

Thus, with similar reasons to those discussed in note 16, the role of oil price is a cost component in the domestic production of traded goods.

19. With the real exchange rate expressed as $\rho = e/W$; an excess demand for labour results in a rise in W which means that ρ must fall, indicating an appreciation of the exchange rate.

20. The steady state traded output is still less than the level before the monetary shock, as the new equilibrium real exchange rate is at a level below the initial steady state value. The medium-run depreciation is insufficient to recover the real exchange rate from the sharp initial appreciation. As the real exchange rate (or the relative price of traded goods) is a crucial determinant of the production of traded goods, real appreciation in the long-run necessarily means a deflationary effect on this good.

21. See Appendix B2.

22. On impact, the increase in oil revenue tends to increase the demand for money (because of its effects on income which operates through the liquidity effect) and hence the rate of monetary expansion. It also tends to increase the demand for labour by raising the demand for nontraded goods through the spending effect.

23. The dependent economy model has its origin in the writings of Wilson, Swan, and Salter in the Australian trade literature. The CN model is a variant of the dependent economy model of Salter (1959), which produces two traded goods and one nontraded good. In the dependent economy model, the country is assumed to be a price taker in the world market for importables and exportables alike. The terms of trade are thus exogenously given, and a distinction between importables and exportables becomes immaterial. With no need to distinguish between exportables and importables, they can be aggregated into a composite commodity (that is, a group of goods whose relative prices are given) called traded goods. Traded goods as a group are then distinguished from nontraded goods or home goods. See Dornbusch (1980), Chapter 6 and Corden & Neary (1982).

24. Refer to notes following equation (5.5).

25. Refer to Appendix B2 on the section on monetary disturbances and overshooting.

26. See Appendix B2.

27. This expression for real exchange rate, although different from BP's specification, has the same qualitative meaning of describing competitiveness of domestic manufacturing sector.

28. This is because $\rho = p_t - p_n$ can be rewritten as $\rho = EP_t^w/P_n$. Therefore, with P_t^w exogenous, changes in exchange rate is

dependent on changes in nominal exchange rate, e, and price of services, P_n.

29. This is in line with earlier discussion on the NP model responses to an unanticipated once-and-for-all reduction in the domestic money supply. There will be overshooting of exchange rate and a cyclical path to the long-run equilibrium if both the price of services and the allocation of capital adjust slowly.

CHAPTER 5 SUMMARY

5.1 Model Characteristics and Responses

Table 5.1.1 below summarises the main characteristics of each model.

TABLE 5.1.1 Summary of Model Characteristics

Characteristics	Model				
	BP	EV	Pesaran	Fender	NP
Oil Sector					
1. Exogenous Oil Production	+	+	+	+	-
2. Oil as a Final Consumption Good	+	+	+	-	+
Nonoil Sector					
1. Small Country Assumption	-	-	-	+	+
2. Full employment (near to full employment) framework	+	+	-	+	+
3. Stickiness in Prices of Domestic nonoil goods	+	+	-	+	+
4. Flexible Exchange Rate & Rational Expectations	+	+	-	+	+
5. Perfect International Capital Mobility	+	+	-	+	+
6. Explicit Current Account & Government Budget Constraint	-	-	+	-	-
7. Supply-side Consideration	-	-	-	+	+
8. Sluggish Adjustment in Capital Stock	-	-	-	-	+

where the '+' sign indicates the presence of the specified characteristic in the corresponding model, while the '-' sign indicates the absence of such characteristic.

The BP model treats oil as a final consumption good and emphasizes the monetary effect of oil boom. The study on the monetary effect is based on differential adjustment speeds between the prices of domestic nonoil goods and the nominal exchange rate. These effects are analysed in the context of perfect capital mobility, flexible exchange rates and rational expectations in the foreign exchange market. However, the supply-side effects are not considered in the BP model as their main focus is on the short-run monetary adjustment problems.

The EV model shares many similar characteristics with the BP model. A crucial difference in the EV approach is their (implicit) assumption that increased oil revenue has no direct effect on the demand for money. In the BP model, oil revenue is a component of the income term which is an argument of the demand for money function.

Among the five models, the Pesaran model is unique in that it takes a very different approach in modelling the nonoil sector. It arises from its approach in analysing oil shocks in the context of a Keynesian underemployment model. In his model, the financial repercussions of the government budget and current account imbalances are emphasized. Nevertheless, alongside BP and EV, Pesaran does not consider the supply-side effects of an oil boom, nor the role of oil as an intermediate input.

The Fender model have similar monetary framework as the BP model, but it includes the supply-side effects. This is possible in the Fender model due to its extension to a three-sector framework, with the addition of a nontraded goods sector. The nontraded goods sector is assumed to be labour intensive and hence the labour market is explicitly introduced. The domestic nonoil traded goods sector is now operating under a small country assumption, with the price of traded goods exogenously given. Fender also depart from the other models in his treatment of oil as an intermediate input. However the supply-side of the Fender model is still not complete as it treats oil production as exogenous and does not include capital stock in the production of nonoil traded goods.

In comparison, the NP framework is more complete than the Fender framework. NP elaborate on the supply-side effects of oil shock by explicitly introducing the labour and capital markets in a three-sector framework, and have included oil production in the domestic factor markets in that the oil sector is competing for capital with the nonoil traded goods sector. Moreover, there is assumption of short-run sluggish adjustment in the stock of capital, which enables NP to study the dynamics arising from real adjustments. Apart from having an elaborate production structure, the NP model also contain augmenting money and foreign exchange markets, which allow for monetary consideration of an oil boom. The augmented monetary model in NP hold many similar assumptions with the BP, EV and the Fender models. In particular, NP also emphasize on the problems associated with nominal stickiness in the context of a flexible asset price (namely, the nominal exchange rate) under rational expectations and perfect capital mobility.

The way in which each of these five models responds to various exogenous shocks are summarised in Table 5.1.2.

TABLE 5.1.2 Basic Responses of Model

(A) The Discovery of Oil:

Model	Long-run Effects	Short-run Effects	Net Result
BP	A fall in the real exchange rate	Real exchange rate appreciation and overshooting	Transitional negative effect on manufacturing output & long-run worsening of the competitiveness position of the nonoil good
EV	The domestic nonoil sector experiences an expansionary effect of the oil generated spending	Exchange rate appreciates sharply at the date of discovery under the influnce of expectations	Domestic nonoil output falls sharply at the date of discovery. The recession ends abruptly after spending adjusts & a boom period will follow

TABLE 5.1.2 Basic Responses of Model-continued

	(A) The Discovery of Oil:-continued		
Model	Long-run Effects	Short-run Effects	Net Result
Pesaran	In the absence of government intervention, with a flexible post tax real wages, a contraction of the domestic nonoil sector is most likely. When post tax real wages are fixed, the effect will be expansionary	Expansion of the nonoil sector even if the boom is not supplemented by an increase in government expenditure	In an underemployed economy, an oil boom is more likely to be expansionary for the domestic nonoil sector
Fender	Appreciation of the real exchange rate	Sharp fall in competitiveness due to exchange rate overshooting	Deflationary with unemployment rising above its natural level There is a decline in both the absolute and relative size of the traded goods sector

TABLE 5.1.2 Basic Responses of Model-continued

Model	Long-run Effects	Short-run Effects	Net Result
	(A) The Discovery of Oil:-coninued		
NP	Real Adjustment There is a shift in labour & capital from the manufacturing sector to the services sector due to real appreciation. Real & Monetary Adjustments There is real and nominal appreciations	When capital stock is sluggish to adjust, there is overshooting of the real exchange rate. When both real & nominal stickiness are present, there is a more severe appreciation of exchange rates	Generally, a deflationary effect on the manufacturing sector When there are short-run real & nominal rigidities, the boom gives rise to a sharp decline in competitiveness of the manufacturing sector accompanied by a rise in unemployment
	(B) Increase in World Prices of Oil:		
BP	In a net oil importer case, the demand for home goods will be reduced. In the net exporter case, there is real appreciation and the incresed demand for home goods is offset by the real appreciation	In both cases, the real exchange rate appreciates & overshoots its new long-run value.	In both cases, the economy experiences a transitional loss in manufacturing output.

TABLE 5.1.2 Basic Responses of Model-continued

Model	Long-run Effects	Short-run Effects	Net Result
	(B) Increase in World Prices of Oil:-continued		
Fender	Fender did not explicitly discuss the effects of a change in the world price of oil. However, he pointed out the complexities associated with the oil role as an intermediate input. In the net oil importer case, an oil price increase has negative impact on income. However, in a net oil exporter case, the value of net oil exports increases, but traded output falls. The net effect depends on which effect predominates. Similar complications arise with the effects on the demand for labour. If income rises, then the demand for nontraded goods and hence labour increases; however, there is an offsetting effect on the demand for labour from the traded sector.		
	(c) Monetary Disinflation:		
BP	Competitiveness is not altered, but the steady state level of real money balances is increased.	There is real appreciation with real exchange rate overshooting its new long-run value.	The initial appreciation results in a sharp fall in activity in the manufacturing sector. However, there is no long-run effect due to the neutrality of monetary changes.

TABLE 5.1.2 Basic Responses of Model-continued

	(c) Monetary Disinflation:-continued		
Model	Long-run Effects	Short-run Effects	Net Result
Fender	Appreciation of real exchange rate and a rise in real money balances	The exchange rate appreciates instantaneously and overshoots its new long-run value	Output of both domestic nonoil goods falls initially. Then traded output falls because of decline in competitiveness, while nontraded output rises due to extra demand generated by higher real balances
NP	**Augmented Model**		
	The nominal exchange rate and the domestic price of services fall in proportion to the reduction in the money supply.	The nominal exhange rate falls and overshoots its new long-run value	During the initial stage of the adjustment process, the manufacturing output falls below its steady state level. In the long-run, monetary shock is neutral

In response to an oil discovery, all the four models with a full (or near to full) employment framework show a decline in the competitiveness position of the domestic manufacturing output. Their short-run response to an oil boom shows a more severe fall in competitiveness due to the overshooting of the real exchange rate. These results thus confirmed the Dutch disease phenomenon. The EV model, because of their exclusion of a direct impact of higher oil wealth on money demand, shows that an oil discovery can lead to an expansionary effect on the domestic nonoil sector.

The Pesaran analysis differs greatly from the other four models in that its underemployed economic framework requires the extra oil wealth generated income to stimulate its domestic nonoil sector. Furthermore, in the context of a fixed exchange rate regime, appreciation of exchange rate is not possible and hence the competitiveness index is not allowed to change except in the case when there is flexible post tax real wages. In addition, Pesaran emphasizes the importance of expansionary government policy in supplementing the effects of an oil boom.

In contrast, the analyses in the BP, and NP models point to the use of appropriate monetary policy to overcome the problems of short-run exchange rate overshooting. In both cases, monetary expansion is advocated to mitigate the initial sharp falls in the real and nominal exchange rates. If successfully implemented, the increase in the nominal money stock will permit the immediate attainment of the new steady state and hence some of the transitional loss of output and employment could be avoided.

5.2 Special Features

The model characteristics and responses to various exogenous disturbances discussed in section 5.1 point to certain unique features in each model. These features contribute to the understanding of the Dutch disease phenomenon, and are summarised in Table 5.2.1.

TABLE 5.2.1 Special Features and Contribution of the Model

Model	Special Features	Contribution
BP	An analysis of oil shocks in the context of short-run sluggish price adjustment, rational expectations in the money & foreign exchange markets, flexible exchange rates & perfect international capital mobility	Provides a framework where the real appreciation which causes the Dutch disease phenomenon can be traced to adjustment problems in the nominal variables such as the prices of domestic output or domestic wages
Pesaran	A Keynesian underemployment framework where imbalances in the government budget position and the current account have financial repercussions through their effects on the domestic money supply.	Provides a framework in which the short-run & long-run monetary repercussions of changes in oil income that operate through the government budget constraint and the current account played an important role

TABLE 5.2.1 Special Features and Contribution of the Model-continued

Model	Special Features	Contribution
Fender	A three-sector framework with oil as an intermediate input in the production of traded ouput	Ponts to the sectoral implication of exchange rate appreciation in response to oil shocks in the context of differential adjustment speeds in goods & money markets. Also points out the complexities of the problem when oil is treated as an intermediate input
NP	A basic real adjustment-oriented model with overshooting arising as a result of the slow adjustment of a real variable rather than a nominal variable. Also allow for monetary consideration arising from nominal stickiness in domestic prices of nontraded goods	It highlights the many channels through which real disturbances influence the equilibrium real exchange rate. Also shows the interaction of real and nominal disturbances in influencing the exchange rate behaviour. Hence, provides a more thorough analysis of the Dutch disease.

The EV model is not included in Table 5.2.1 because their approach has ommited an important channel where higher oil revenues could adversely affect the domestic nonoil output. As table 5.2.1 is self-explanatory, we will move on to the final section of this thesis.

5.3 Suggestions For Further Research

It is inevitable that in building a sufficiently complex model to describe the dynamic behaviour of an economy with an oil sub-sector, the authors of the five Dutch disease models described previously have made a number of simplifying assumptions. These assumptions are justified in the context of a model built for the purpose of focusing on a few specific problems relating to the Dutch disease. In general, there are still some important issues that need to be addressed. For the purpose of further research, the following considerations could be useful for future extension or modification of the existing models.

1. Model Dynamics

Although all the five models contain a dynamic structure which arises from stickiness in real and/or nominal variables, they still inadvertently miss out a number of important considerations. They are:

a) households simply consume current income rather than optimizing their investment, consumption and savings decisions over time;

b) while there is an international capital market, there is no focus on national borrowing or lending in the light of an oil boom (the current account is either balanced or ignored);

c) induced changes in national income along the adjustmnet path are ignored. For example, the discovery of a natural resource base generates important incentives for current account imbalances. National income will have to be adjusted to take into account the economy's net foereign investment position;

d) no allowance is made for depletion of the resource base. If agents in the economy recognize that the oil is a depleting resource, so that current national income exceeds expected future level, they will not (having in mind far-sighted, optimizing agents) consume all current oil revenues, but will rather save in anticipation of the future decline in energy production. Thus, much of the current energy revenues should show up in current account surpluses. To the extent that the revenues are saved in the short-run, the sectoral reallocation of production is postponed for the future. A focus on current production levels, without considering the longer-term resource depletion problems, therefore overstates the resource allocational consequences of the oil sector.

e) firms investment decisions are based on static expectations of profitability.

It is noted that BP have included permanent income as well as current income, while Pesaran has taken into consideration point (b). However, both models have not dealt with the period-by-period dynamics that the above points implied. Under the circumstances described in points (a) to (e), the issue of foreign borrowing, as suggested in BS■, plays an important role in the adjustment problems.

2. Wage Resistance

All the four models, apart from the Pesaran model, have examined the implications of price stickiness. However, wage stickiness could have very similar effects. This issue is important as the oil boom is more likely to require a fall in wages, whether real or nominal, than a fall in the nominal price of services. Moreover, the result could be very different between the cases of real as opposed to nominal wage resistance. These issues are discussed briefly in Neary (1984) and Fender (1984).

3. Capital in Nontraded Goods Sector

All the five models have a restrictive assumption that the nontraded goods sector does not utilize capital. It might be argued that most nontraded goods, mainly services, are typically labour intensive and do not use capital intensively. This issue is taken up by Sachs in his comment on NP (1983). Indeed, in the BS model, capital moves over time between the manufacturing and services sectors rather than between the manufacturing and oil sectors. Their approach is based on the argument that the physical capital use in the oil sector is a traded good itself, so that capital expenditure in natural resources can rise without depriving traded outputs of capital inputs. Sachs points out that there is not likely to be much direct competition for savings for new investment in the two sectors, since such investment can be financed from abroad in the context of perfect international capital mobility.

4. Decomposition of the Manufacturing Sector

There are suggestions in the literature [for example, Neary(1984) and Corden (1984)] that the Dutch disease model should have four, not two or three, sectors. This is to account for the possibility that some of the nonoil traded goods industries actually expand even though the sector as a whole contracts. Thus, the manufacturing sector should be divided into import-competing and export-oriented industries. Under such circumstance, the real adjustment problems are likely to fall upon the traditional exporters. The import-competing industries lose market shares because of the appreciation of the currency, but the spending effects are considerable and will offset this negative effect.

Although the four main points introduced might not have been exhaustive enough to deal with the different issues that the Dutch disease model could have covered, practical considerations made it necessary to have a realistic focus. One could possibly find a wide variety of models of the Dutch disease in the literature, but the next step should be to attempt to see which model applied to a specific problem. In particular, there is a need to develop a model which analyses specific cases based on empirical observations.

Notes:

1. BS is briefly introduced in Chapters One and Two, particularly in section 2.2, pp. 12-13. Most of points (a) to (e) are in fact explicitly modelled in the BS period-by-period dynamics model of the Dutch disease. However, the BS model does not include a monetary sector. Therefore, the issues of nominal price stickiness and overshooting of the nominal exchange rate are not considered.

APPENDIX A NOTATIONS GUIDE

A1 Functional Notations & Subscripts

Dot '.' over variable denotes time derivative of that variable
Δ denotes first differencing operator;

eg. $\Delta H = H - H_{-1}$

Subscripts attached to variables

ne denotes non-energy or non-oil
e denotes energy
t denotes traded goods
nt denotes non-traded goods

Subscript attached to functions

Numeric or alpha-numeric subscript attached to a function indicate the partial derivative of the function with respect to the relevant argument:

ie. $f_i = \partial f(x_1, x_2, x_3, \ldots, x_n)/\partial x_i$

eg. $y_n = y_n(y, r, \ldots\ldots)$

therefore $y_{n1} = \partial y_n/\partial y$; $y_{n2} = \partial y_n/\partial r$; etc.

A2 Variable Notations & Definition[1]

In equations where variables are expressed in logarithmic form, the definition of variables is slightly different from those defined below. For instance, uppercase symbols are the antilogs. of the corresponding lowercase variables expressed in logarithmic form.

In alphabetical order:

Upper case	Lower case
A = Private sector absorption	a = real[2] private sector absorption
B = Balance of Payment on current account	b = real surplus (deficit) of the current account of the balance of payments.
D = Stock of government bonds	e = nominal exchange rate[3], (domestic currency price of foreign exchange)
F = Government's net holding of foreign assets	

Variable Notations & Definition-continued

Upper case

G = Nominal government expenditure

H = High powered money

H_{-1} = Initial supply of high-powered money

K = Stock of capital

L = Stock of private sector's assets

L_{-1} = Initial stock of private sector assets

M = Nominal money balances

N = Labour

P = General price level(domestic)

P_n = Domestic price of non-traded goods

P_t = Domestic price of traded goods

P_e = Domestic price of energy/oil

P_{ne} = Domestic price of non-energy (traded & non-traded)goods

P_e^w = World price of energy/oil (in foreign currency)

P^w = Foreign prices

P_z = Import prices measured in domestic currency

Lower case

g = real government expenditure

i = real interest rate

k_e = stock of capital used in the resource sector

k_t = stock of capital used in the traded goods sector

m = real money balances

n_t = labour demand/supply for producing the traded goods

n_n = labour demand/supply for producing the non-traded goods

r = nominal interest rate

r^w = world nominal interest rate

r_e = rental on capital in energy sector

Variable Notations & Definition-continued

Upper case	Lower case
T = Government total tax receipts	t = marginal tax rate
	t_e = constant marginal tax rate of energy/oil incomes
	t_{ne} = constant marginal tax rate of non-energy/non-oil incomes
W = Money wage rate	w = real wage rate
X = Non-oil export at current domestic price	x = real non-oil exports ($x = X/P_{ne}$ in Pesaran)
Y = Nominal national income	y = real income/domestic output
Y_d = Nominal private sector disposable incomes	y_d = real private sector disposable income
	y^P = real permanent income
Y_e = energy/oil income at current domestic price ($Y_e = eP^w_e y_e$)	y_e = domestic energy/oil output
	y_{ne} = non-energy/oil (traded & non-traded) output
	y_t = traded output
	y_n = non-traded output
	$\bar{y}$ = full employment level of output
Z = total imports at current domestic prices	z = real imports
ρ = real exchange rate,also measure foreign price competitiveness	
μ = Rate of growth of the nominal money stock	

NOTES

1. The standardised notations are not quite 'standardised' in that in the actual models they may be expressed in logarithmic forms or have very slightly different definitions. For example, certain variables which are unique to a particular model are not described here. Their precise definition can be found in the relevant section in Chapter 3.

2. Note that a real measure of a variable defined in nominal units is obtained by dividing the nominal by P (the general price level). Similarly the nominal measures of a variable defined in real units is obtained by multiplying the real measure by P.

3. 'e' in BP; EV also indicates the domestic price of the imported manufactured goods because the foreign currency price of import is normalized to unity.

A 3 Standardised as Compared With Actual Model's Notations[a]

S	BP	EV	F	NP	P
e	e	e	e	e	E
i			ρ		
k_e				k_B	
k_t				k_m	
l	l		M/W		L/P
m	m	m	M/P		h = H/P
n_t			l^t	l_M	
n_n			l^n	c_s	
p_t			e	p_M	
p_n			αw	p_s	
P_{ne}	p_H	p			P_n
p^w_e	P^f_b		q	P^f_B	P_o
r	r	r	r	i	r
r^w	r^f	r^*	r^*	i^f	
W				w	W
y_e	q_b	f	h	x_B	q_o
y_{ne}	q_H	y			q_n
y_t			t^s	x_M	
y_n			n	x_s	
Z					M
ρ	c		c	π	e

Key

S = Standardised

BP = Buiter & Purvis

EV = Eastwood & Venables

F = Fender

NP = Neary & Purvis

P = Pesaran

Note a:
This list is not exhaustive; a few symbols used only briefly within a single model are not listed here. Definition for the symbols not found in this list is described within the relevant model in Chapter 3.

APPENDIX B TECHNICAL DEFINITION & DERIVATION

B1 Derivation of Log-linear Approximation

From section 3.1, the levels of current and permanent **real** income are defined respectively by:

(1.1′) $Y = (P_{ne}Y_{ne} + EP^{w}_{e}Y_{e})/P$

(1.2′) $Y^{p} = (P_{ne}Y^{p}_{ne} + EP^{w}_{e}Y^{p}_{ne})/P$

Firstly, taking differentials of equation (1.1′), we have:

(B1.1) $PdY + YdP = Y_{ne}dP_{ne} + P_{ne}dY_{ne} + EY_{e}dP^{w}_{e} + EP^{w}_{e}dY_{e} + P^{w}_{e}Y_{e}dE$

Dividing both sides of equation (B1.1) by PY, we get:

(B1.2) $dY/Y + dP/P = P_{ne}Y_{ne}/(PY).dY_{ne}/Y_{ne} + P_{ne}Y_{ne}/(PY).dP_{ne}/P_{ne}$
$+ EP^{w}_{e}Y_{e}/(PY)[dP^{w}_{e}/P^{w}_{e} + dY_{e}/Y_{e} + dE/E]$

when $y = \ln Y$, $dy = dY/Y$, therefore equation (B1.2) can be written as:

(B1.3) $dy + dp = vdy_{ne} + vdp_{ne} + (1 - v)[dp^{w}_{e} + dy_{e} + de]$

where $v = P_{ne}Y_{ne}/(PY)$

Now, by integrating equation (B1.3), we obtain:

(B1.4) $y + p = vy_{ne} + vp_{ne} + (1 - v)(p^{w}_{e} + y_{e} + e) + K$

where K = constant.

Equation (B1.4) can be approximated by

(B1.5) $y \simeq vy_{ne} + vp_{ne} + (1 - v)(p^{w}_{e} + y_{e} + e) - p$

By substituting equation (1.3) of section 3.1 and with some algebraic manipulation, equation (B1.5) can be expressed as:

(B1.6) $y = vy_{ne} + (1 - v)y_{e} + (1 - v + \beta_{2})p^{w}_{e} + (\beta_{1} - v)(e - p_{ne})$

which is identical to equation (1.1) in BP. Thus, equation (1.2) can be obtained from equation (1.2′) in exactly the same way as that just described.

B2 Expectations and Exchange Rate Dynamics

For illustrative purpose, this section follows the model developed in Dornbusch (1976). This is to highlight the mechanism that brings about the short-run exchange rate overshooting resulting from the combination of sticky prices, mobile capital and rational expectations in the foreign exchange market. Although the BP, EV, Fender and NP models have included the impact of oil, the underlying mechanism of short-run exchange rate overshooting is the same as in Dornbusch.

The Model

Unless otherwise stated, all equations are expressed in logarithmic form.

Foreign Exchange Market

Domestic interest rate(not in logarithmic form):

(B2.1) $r = r^{w} + \dot{e}$

This equation represents perfect capital mobility, and it is assumed that incipient capital flows will ensure that this condition holds at all times. It also represents the uncovered interest parity condition.

Expected rate of depreciation of the domestic currency:

(B2.2) $\dot{e} = \theta(\bar{e} - e)$

where θ is the adjustment coefficient. That is, the exchange rate is expected to depreciate in proportion to the discrepancy between the long-run equilibrium exchange rate $\bar{e}$ and the current actual rate e.

Money Market

Money demand function:

(B2.3) $m - p = -\lambda r + \phi y$

Thus, combining (B2.1), (B2.2) and (B2.3) yields:

Asset market equilibrium condition:

(B2.4) $m - p = -\lambda r^{w} - \lambda\theta(\bar{e} - e) + \phi y$

Note that, with a stationary money supply, the long-run equilibrium will imply equality between interest rates, because current and expected exchange rates are equal. This implies that the long-run equilibrium price level is:

(B2.5) $\bar{p} = m + (\lambda r^{w} - \phi y)$

By substituting (B2.5) into (B2.4), we obtain a relationship between the exchange rate and the price level:

(B2.6) $e = \bar{e} - [1/(\lambda\theta)](p - \bar{p})$

Therefore, given long-run values of exchange rates and prices, this equation serves to determine the current spot price of foreign exchange as a function of the current level of prices. An increase in the price level, because it raises interest rates, gives rise to an incipient capital inflow that will appreciate the spot rate to the point where the anticipated depreciation exactly offsets the increase in domestic interest rates.

Goods Market

Rate of increase in the price of domestic goods:

(B2.7) $\dot{p} = \pi[\mu + \delta(e - p) + (\gamma - 1)y - \sigma r]$

where μ = constant;

$e - p$ = relative price of domestic goods, so that $\delta(e - p)$ reflects the substitution between domestic and foreign goods.

By setting $\dot{p} = 0$ and $r = r^w$ for the long-run, where markets clear and exchange rates are constant, $\dot{p}$ can be expressed in terms of deviations from the non-inflationary long-run equilibrium as:

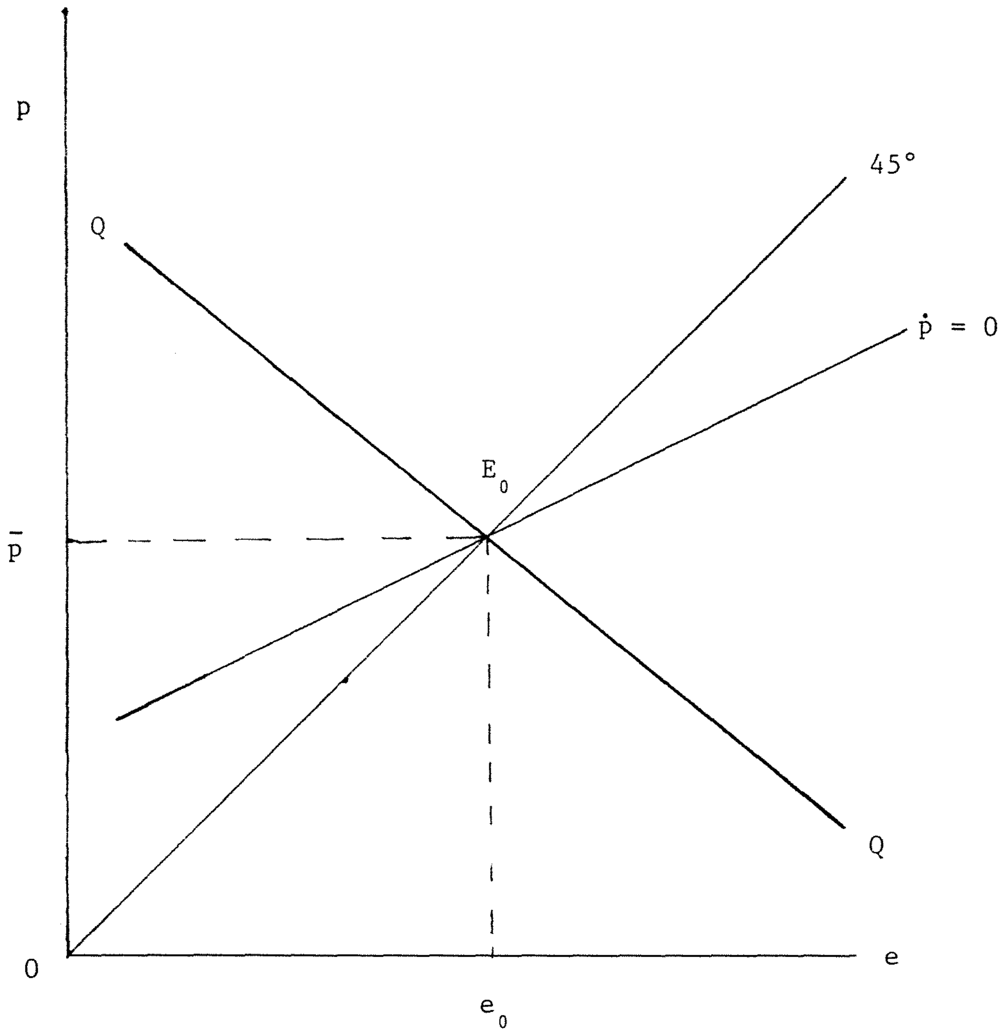
(B2.8) $\dot{p} = \pi[\delta(e - \bar{e}) + (\delta + \sigma/\lambda)(\bar{p} - p)]$

$= -\pi[(\delta + \sigma\theta)/(\lambda\theta) + \delta](p - \bar{p})$, upon substituting equation (B2.6).

The Adjustment Process

The strategic assumption is that assets market clears continuously and that prices adjust slowly over time. The exchange rate adjustment path and the domestic prices adjustment path are shown in Figure (B2.1):

FIGURE (B2.1)



Source: Dornbusch (1980)

The downward sloping QQ schedule reflects the simultaneous conditions of money market equilibrium and yields equalisation, given the expectations formation process. A higher price level implies a lower level of real balances, a higher interest rate and, with equalised yields, the expectations of depreciation. An expectation of depreciation, however, must imply that the spot rate falls short of the long-run equilibrium rate. The $\dot{p} = 0$ schedule shows combinations of price levels and exchange rates for which the goods market and money market are in equilibrium. An increase in the price level creates an excess supply because it raises the relative price of domestic goods and raises interest rates through reduced real balances. To restore equilibrium, the exchange rate must depreciate proportionately more, so as to offset the deflationary impact of higher interest rates.

From (B2.8), the rate of adjustment of prices can be written as:

(B2.9) $\dot{p} = -v(p - \bar{p})$

where $v = \pi[(\delta + \sigma\theta)/(\lambda\theta) + \delta]$

The **perfect foresight** path is one in which the expectations formation process in (B2.2) correctly predicts the actual path of the exchange rate. That is, where $\theta \equiv v$. Hence, if this condition is satisfied, The actual and anticipated exchange rate depreciation coincides and we have:

(B2.10) $\theta \equiv v = \pi[(\delta + \sigma\theta)/(\lambda\theta) + \delta]$

It follows that the consistent expectations coefficient, $\bar{\theta}$, obtained by the positive root of the quadratic equation in (B2.9) is given by:

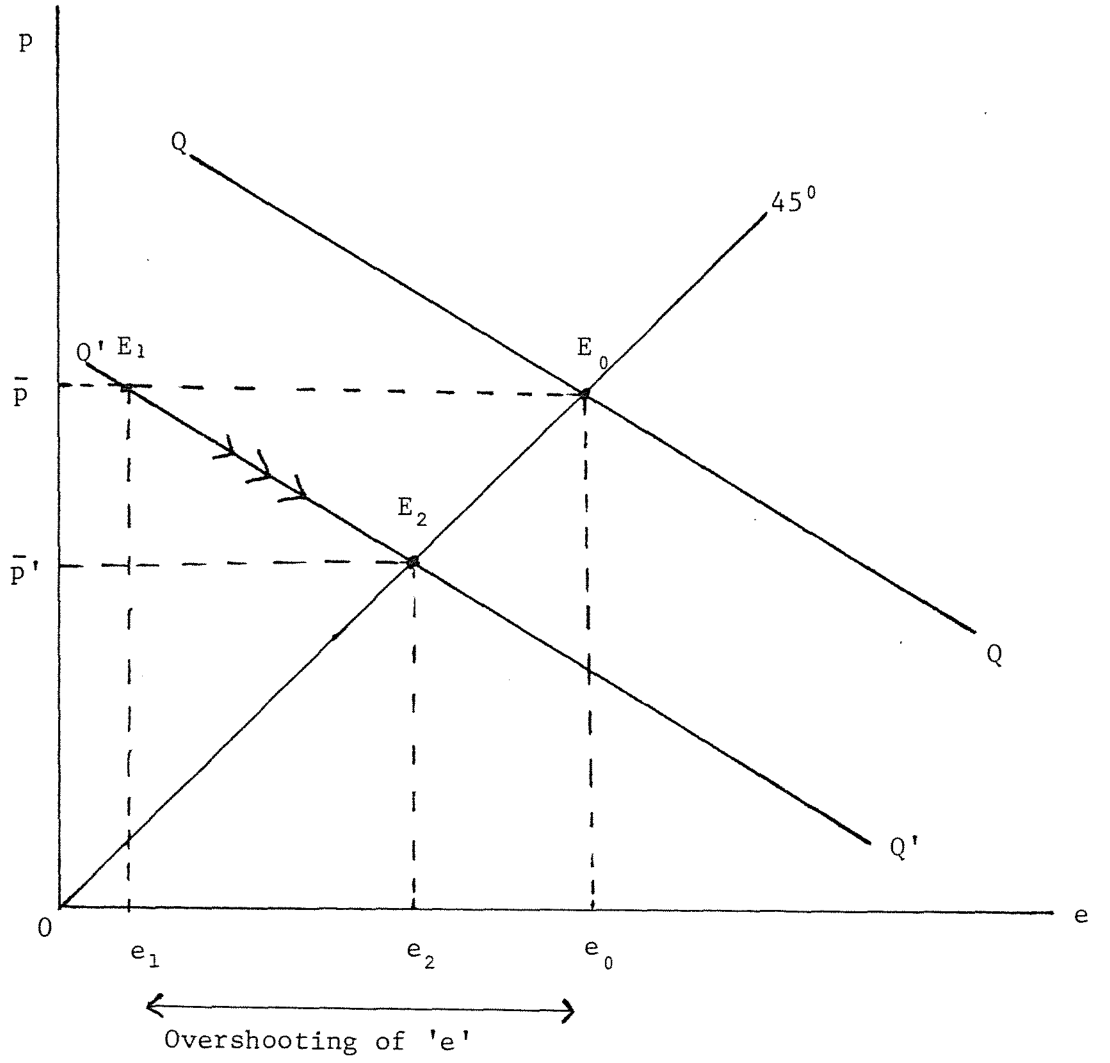
(B2.11) $\bar{\theta} = 1/2\ \pi(\sigma/\lambda + \delta) + 1/2[\pi^2(\sigma/\lambda + \delta)^2 - 4\pi\delta/\lambda]^{1/2}$

Equation (B2.11) gives the rate at which the economy will converge to the long-run equilibrium along the perfect foresight path.

<u>Monetary Disturbances and Overshooting</u>

A monetary contraction will cause a goods and asset market disequilibrium at the initial exchange rate and price. To maintain asset market equilibrium, the decreased quantity of money would have to be matched by lower prices and/or an appreciation in the exchange rate. The asset market equilibrium schedule will shift down to Q′Q′ as shown in Figure (B2.2); a shift that is proportionately equal to the decrease in the nominal quantity of money.

FIGURE (B2.2)



Source: Dornbusch (1980)

The new long-run equilibrium is therefore at point E_2, where both goods and asset markets clear and, the exchange rate and price changes exactly reflect the fall in money. This result is consistent with long-run neutrality of money.

However, the economy cannot instantaneously jump to the new long-run equilibrium because prices can only adjust gradually. In the short-run, the level of prices is given and a fall in nominal money therefore is a fall in real money. The equilibrium interest rate will rise and leads to the anticipation of an appreciation in the long-run and, therefore, at the current exchange rate to the expectation of an appreciating exchange rate. Both factors serve to increase the attractiveness of domestic assets, lead to an incipient capital inflow, and thus cause the spot rate to appreciate. The impact effect of a monetary contraction is therefore to induce an immediate long-run appreciation, since only under these circumstances will the public anticipate a depreciating exchange rate and thus be compensated for the higher interest on domestic assets. Thus, there is overshooting of exchange rate in the short-run. This is shown by the sharp fall in e from the initial equilibrium point E to the short-run equilibrium point E_1 in figure (B2.2).

From equation (B2.4), noting that $de = dm = d\bar{p}$ (because of the long-run neutrality of money and with rational expectations), the exchange rate appreciation is given by:

(B2.12) $de/dm = 1 + 1/(\lambda\bar{\theta})$

Thus, the extent of the overshooting will depend on the interest response of money demand and the expectations coefficient. More generally, those factors that serve to slow down the adjustment process, in particular low price elasticities, will therefore serve to aggravate the impact effect of a monetary contraction on the exchange rate. This effect relies entirely on the expectations about the subsequent path of the economy rather than on current interaction between goods and assets markets.

At point E_1, there is an excess supply for domestic output, both of higher r and a higher relative price of domestic goods. The excess supply leads to price deflation and the economy adjusts along Q'Q' until the new long-run equilibium at E_2 is reached. Thus, both the interest rate and the price of domestic goods constitute independent channels through which monetary changes affect the demand for domestic output.

In relation to the analysis in BP, the short-run overshooting of nominal exchange rate(appreciation) means a sharp fall in the competitiveness index. This is because the competitiveness index is expressed as $\rho = e - p_{ne}$ and with p_{ne} predetermined in the short-run, a sharp fall in e will bring about a sharp decline in the level of competitiveness. This will inevitably result in a transitory loss of competitiveness in manufacturing output and hence adversely affects the demand for domestic manufacturing goods.

B3 Log-linear Demand Function with Compensated Elasticities

This section is written with reference to Intriligator(1978), Chapter 7 and Baumol (1977), Chapter 14.

Equation (5.9) is derived from the log-linear or constant elasticity form. It specifies the demand function as:

(B3.1) $C_n = P_n^{-\varepsilon_n} . P_e^{\varepsilon_t} . P_t^{\varepsilon_t} . Y^{\eta}$

Taking logarithms leads to the log-linear representation:

(B3.2) $\ln C_n = -\varepsilon_n \ln P_n + \varepsilon_e \ln P_e + \varepsilon_t \ln P_t + \eta \ln Y$

When expressed in the notations consistent to the main text (ie. all log variables in lower case letters), equation (B3.2) can be expressed as:

(B3.3) $c_n = -\varepsilon_n + \varepsilon_e p_e + \varepsilon_t p_t + \eta y$

and this equation is identical to equation (5.9).

In this functional form, all of the coefficients are in fact the elasticities where,

$\varepsilon_n = \partial \ln C_n/(\partial \ln P_n) = \partial C_n/(\partial P_n). P_n/C_n$ = own price elasticity of demand for services

$\varepsilon_i = \partial \ln C_n/(\partial \ln P_i) = \partial C_n/(\partial P_i). P_i/C_n$ = cross price elasticities of demand for services

where the subscript i = e, t with e = energy (resource) sector;
t = traded (manufacturing) sector.

and $\eta = \partial \ln C_n/(\partial \ln Y) = \partial C_n/\partial Y. Y/C_n$ = income elasticity

In fact, equation (B3.3) is also in the form of the compensated demand function. The compensated demand function is a demand function from which the income effect has been removed so that it describes only the substitution effect. It does this by taking the consumer to have been compensated for the loss in purchasing power that would otherwise occur when there is a price rise (or a rise in purchasing power resulting from a price fall). In other words, it tells us how a consumer's purchases will change when some price, p_i, is replaced by $p_i + \Delta p_i$ and the consumer is simultaneously provided enough additional income to keep the utility level (real income) unchanged. Thus, the derivation of the compensated demand curve, $\partial C_n / \partial P_i$, is precisely the substitution effect of a change in the price of good i upon the quantity of that good purchased. Hence, the compensated elasticities ε_i's give a better measure of substitutes and complements as they are compensated for changes in real income.

In addition, equation (B3.3) is homogeneous of degree zero in prices. That is, the compensated price elasticities of demand obey the homogeneity restriction ($-\varepsilon_n + \varepsilon_e + \varepsilon_t = 0$). This means that a proportionate change in all prices will leave quantities demanded entirely unaffected.

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