9

North Sea oil

9.1 THE UK AS AN OIL PRODUCER

Oil production

Oil has played a major role in the UK economy during the 1970s and 1980s for two reasons: the price of oil has fluctuated dramatically and, partly in response to higher oil prices, there has been large-scale investment in North Sea oil production, resulting in the UK becoming a major oil-exporting country. The price of oil is shown in figures 9.1 and 9.2. It had been constant throughout the 1960s with, for example, Libyan oil, the price of which is shown in figures 9.1 and 9.2, selling for $2.58 per barrel. Because prices of other goods were rising, however, the real price of oil was falling steadily during the 1960s. By 1972 the price had 'crept' up to $3.37. Then, in 1973, the price rose by over 40 per cent to $4.80 and in 1974 a further rise of 190 per cent brought the price to $13.84 per barrel. The price remained at about this level till 1979, though the real price fell by 29.3 per cent because of the high rates of inflation that industrial countries were experiencing during this period. In 1979 the price rose sharply to over $35 per barrel. During the 1980s the oil price fell sharply, in both real and nominal terms, until the crisis over Kuwait caused the price to rise sharply to around $40 per barrel during 1990.

So far we have considered the world price of oil, both in US dollars and in relation to the price level prevailing in industrial countries as a whole. To obtain the price of oil to the UK we have to convert the price into sterling. This is done in figure 9.1. During this period the value of

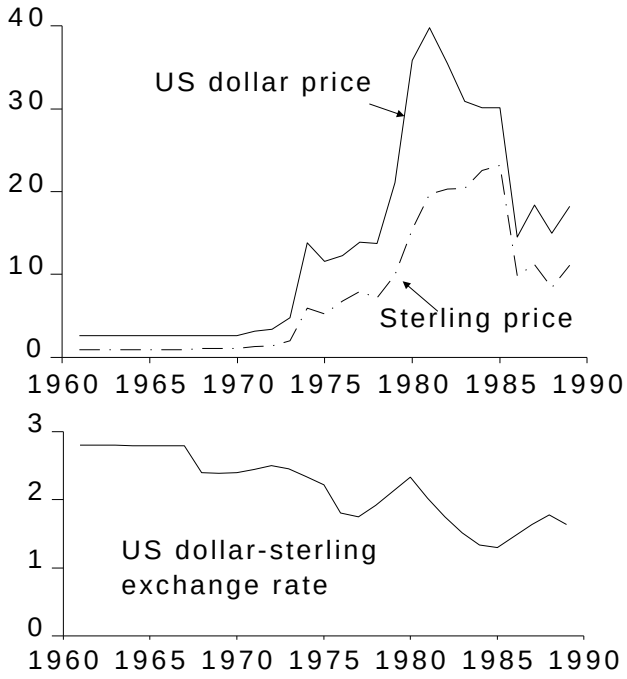

Figure 9.1 The nominal price of oil, 1961-89
Source: International Financial Statistics. Oil price is Libyan oil to 1985 and UK (Brent) thereafter.

sterling has declined, which has meant that the sterling price of oil has risen faster than its dollar price. Furthermore, the rise in the value of sterling during the 1979-80 oil price rise meant that the sterling price of oil did not reach its peak until 1983: the appreciation of sterling insulated the UK from the full extent of the oil price rise.

North Sea oil is very expensive, with high development and production costs, but the price rises of the 1970s made it profitable to exploit it on a large scale, and a high level of investment took place. Investment in oil and gas extraction accounted for 6-8 per cent of all UK fixed investment from 1975 to 1983 (as shown in figure 9.3). During the 1980s the share of investment being allocated to the oil and gas extraction has fallen, for two reasons. The first is that, partly because of the fall in the price of oil, real investment in oil and gas, measured in 1985 prices, fell from over £3 billion per annum up to 1984 to below £2 billion in 1987. The second is that, with the expansion of the economy

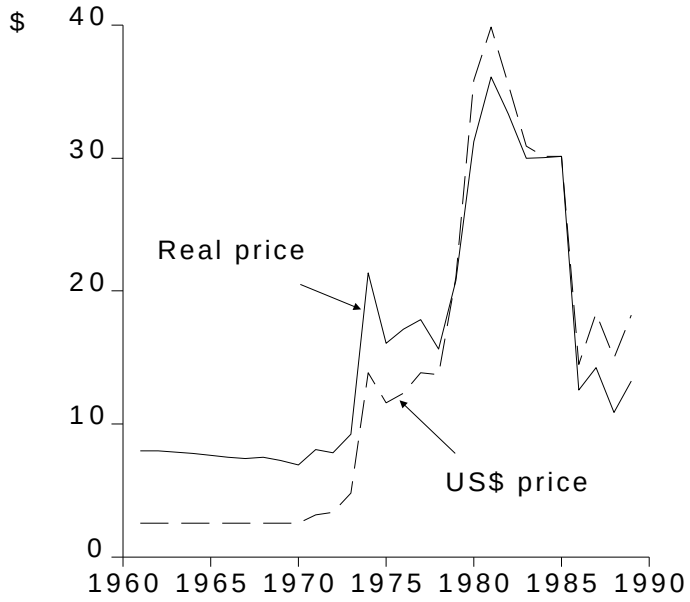

Figure 9.2 The real price of oil, 1961-89
Source: US dollar price from fig 9.1, deflated with industrial countries export price index from *International Financial Statistics*.

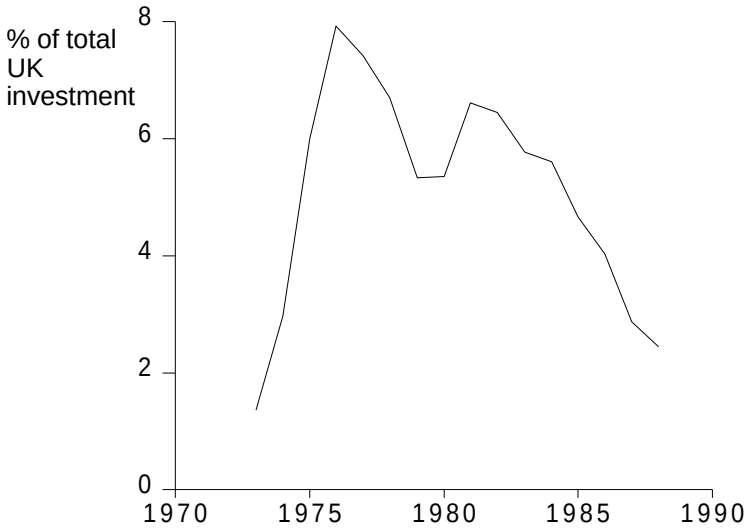

Figure 9.3 Investment in oil and gas extraction, 1973-88
Source: United Kingdom National Accounts.

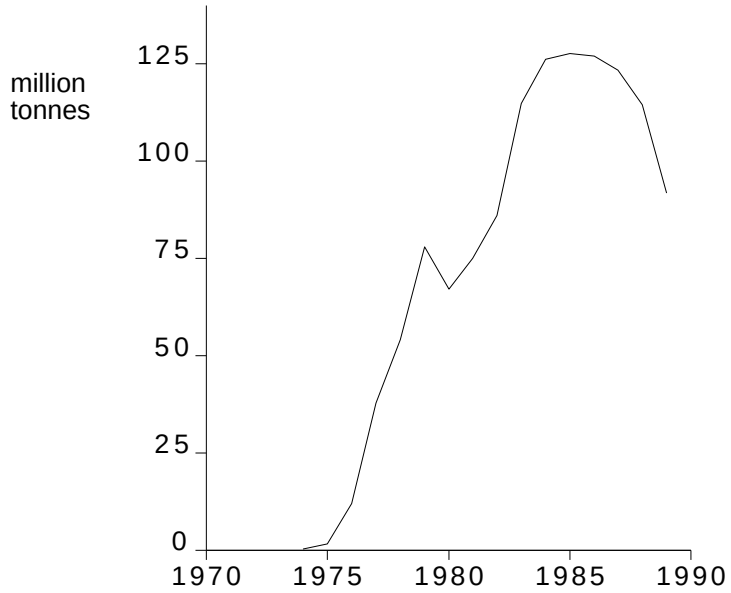

Figure 9.4 UK oil production, 1970-89
Source: Monthly Digest of Statistics.

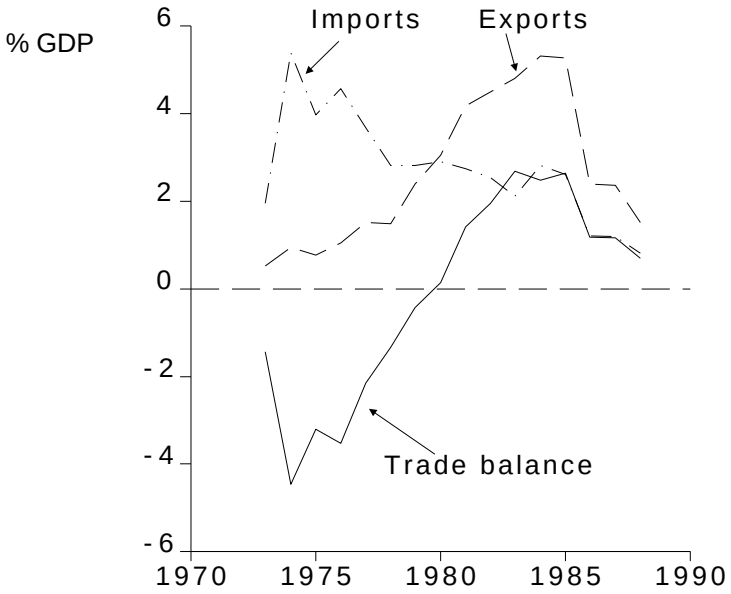

Figure 9.5 The trade deficit in oil, 1973-88
Source: United Kingdom Balance of Payments.

after 1981, real investment in the UK as a whole has risen: this rise in investment has reduced the share taken by oil and gas extraction to under 3 per cent.

The result of this high level of investment was a sharp rise in UK oil production. Oil production was negligible before 1975 but by 1980 it had risen to 603 million barrels per annum, 2.6 per cent of world production. By 1985, partly because of a continued rise in UK production to 953 million barrels a year, and partly because OPEC virtually halved its production in an attempt to keep the price of oil high, UK production accounted for 4.6 per cent of world production. Since 1985 production has fallen slightly. Without investment in discovering and developing new fields current levels of production cannot be sustained and falling oil prices significantly reduced the incentive for the oil companies to undertake such investment in the North Sea.

Oil and the balance of payments

The oil price rise of 1973-4 left the UK, in common with most other industrial countries, with a large balance of payments deficit, because of the sharply increased cost of importing oil. In 1974 the cost of oil imports rose to £4.1 billion, the result being an oil deficit (i.e. imports minus exports of oil) of £3.4 billion, or 4.5 per cent of GDP. The growth of North Sea oil production, together with the effects of high oil prices and measures to economize on oil consumption (it was at this time, for example, that speed limits were introduced for all roads), resulted in this oil deficit being eliminated by 1980: exports rose and imports were reduced, as shown in figure 9.5. As North Sea production rose still further, the UK became a net exporter of oil, the surplus reaching £8.1 billion, or 2.7 per cent or GDP by 1985.

The trade deficit in oil, however, is not the only way in which North Sea oil affects the balance of payments. Three other things have to be taken into account: profits and dividends due abroad; overseas investment in the North Sea; and expectations about the future.

- A substantial part of the investment undertaken in the North Sea has been financed from abroad, both through foreign investment in UK oil companies and through direct investment by foreign-owned oil companies. This means that part of the profits earned on oil production accrues to foreigners. These profits, which may be paid as interest, dividends or transfers of profits, are shown in figure 9.6.

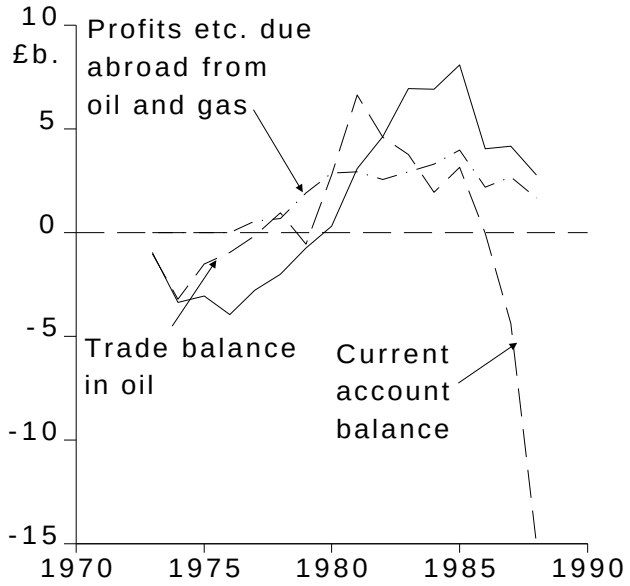

Figure 9.6 Oil and the balance of payments, 1973-88
Source: United Kingdom Balance of Payments.

These profits due abroad and the trade deficit in oil are the two main links between the North Sea and the current account balance of payments. These are shown in figure 9.6, which suggests a close link between developments in the North Sea and the current account.

- Overseas investment in the North Sea enters the capital account. This is something on which data are not available, for it is frequently impossible for the CSO to tell whether overseas investments are in the North Sea or elsewhere in the UK (exceptions are, of course, large identifiable items of capital equipment such as oil rigs). This overseas investment will have been large during the mid-1970s when the North Sea oilfields were being developed.

- The fact that North Sea oil production improves the current account may affect investors' views about what will happen to the balance of payments and hence their views on the likely value of sterling. If this occurs it will affect the capital account: confidence

in sterling will lead to capital inflows simply to benefit from sterling's strength, not for investment in oil. In other words, the North Sea programme may, through altering investors' expectations about the future, affect the capital account of the balance of payments and the exchange rate. Though this effect is clearly something on which reliable quantitative data do not exist, the day-to-day responsiveness of sterling to news about oil production suggests that it is important.

9.2 OIL AND THE STRUCTURE OF THE UK ECONOMY

Structural change in the UK

The main feature of the oil extraction industry is that it is extremely capital-intensive, as is shown in table 9.1. From the point of view of the economy as a whole employment in oil extraction is negligible (26,000 out of a workforce of about 28 million). On the other hand, the capital stock employed is enormous, this being reflected in a capital-labour ratio of £1,370,000 per employee, compared with a national average of only £43,000 (if we exclude housing). Much of this capital has been supplied from overseas and in any case capital is very mobile between countries, which means that the development of North Sea oil is unlikely to have had a significant resource-movement effect (see box

Table 9.1 Capital, labour and output by sector, 1988

Sector	Capital-output ratio	Output per employee	Capital per employee
Oil and gas extraction	3.53	£388,000	£1.37m.
Agriculture, forestry and fisheries	4.78	£18,326	£87,577
Manufacturing	3.04	£16,628	£50,534
Construction	0.72	£21,332	£15,262
Whole economy	4.49	£14,257	£63,997
Whole economy (excluding housing)	3.01	£14,257	£42,895

Source: United Kingdom National Accounts.

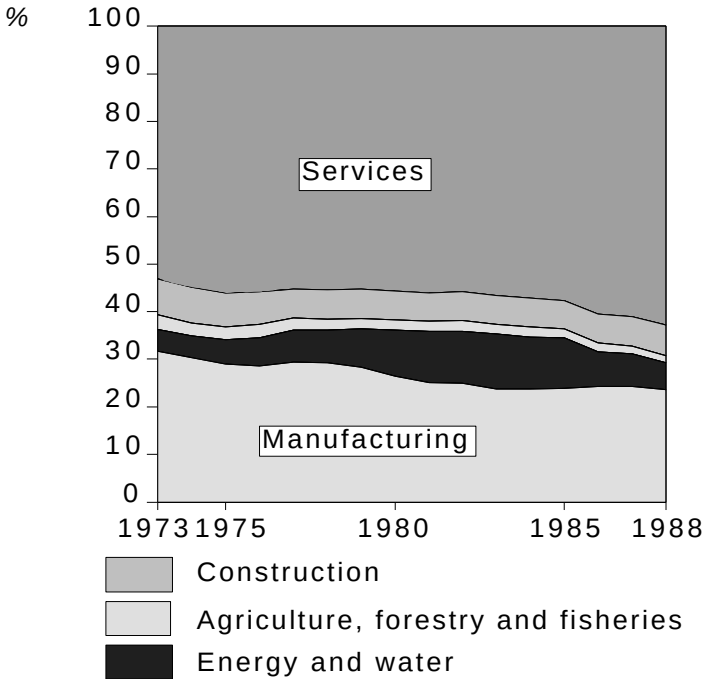

Figure 9.7 The sectoral composition of output, 1973-87
Source: United Kingdom National Accounts.

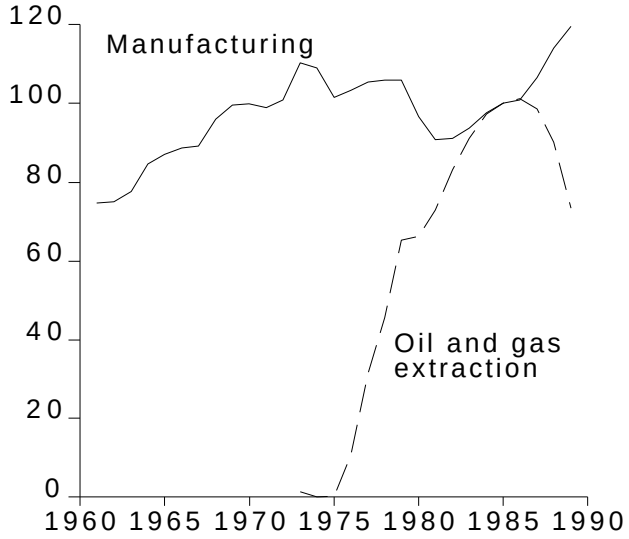

Figure 9.8 Output in manufacturing and oil extraction, 1960-89
Source: United Kingdom National Accounts.

9.1). The main effect of North Sea oil must, in the long run, be the spending effect.

If the theory outlined in box 9.1 is applicable, we would expect the spending effect to cause a shift away from manufacturing towards services. Figure 9.7 shows the behaviour of sectoral shares since 1973, whilst figure 9.8 shows what has happened to real output (GDP) in oil extraction and manufacturing. The main features of this are a rise in the share of output in energy and water supply, and a decline in the share of manufacturing. Over the period covered by figure 9.7 manufacturing fell from 31.7 per cent to 24.2 per cent of GDP. It is tempting to see this as a symptom of the Dutch disease. The problem is, however, more complicated, for there are other factors to take into account.

The decline in UK manufacturing is a long-term phenomenon but, in the period we are considering, the major decline took place between 1978 and 1981 when manufacturing's share of GDP fell from 29.3 per cent to 25.0 per cent — a 4 percentage point drop in three years. There are at least three possible explanations for this: permanent effects of North Sea oil; short-run, temporary effects of oil production; and causes not connected with oil.

- There has been a sudden, long-term shift out of manufacturing caused by North Sea oil coming on stream during the late 1970s. It could be argued that the oil price rise of 1979 significantly raised the value of North Sea oil revenues, increasing substantially the wealth effect on spending.

- The decline in manufacturing around 1980 was the result of short-run dynamic effects of oil production. It could, for example, be argued that with the introduction of the Medium Term Financial Strategy (see chapter 13) monetary policy ceased to be accommodating: the supply of money failed to keep pace with demand and the result was high interest rates and recession. Alternatively, and this is generally thought a more likely explanation, it could be that the rise in the real exchange rate in 1978-80 (see chapter 11), the timing of which fits very closely with the decline of manufacturing, was caused, at least in part, by the advent of North Sea oil revenues.

- Manufacturing might have declined for reasons unconnected with the North Sea. In particular, the decline may have been due simply to restrictive monetary policy. If, as seems highly likely,

monetary policy operated primarily via the exchange rate, a restrictive monetary policy would have affected manufacturing worse than sectors less exposed to international competition.

Since around 1985, however, the situation has changed in that manufacturing has recovered, with the share of oil declining. This decline in the share of oil extraction was almost entirely the result of the fall in the price of oil after 1985. This change, however, does not help us tell which of above explanations is the right one: the revival of manufacturing could be caused by the falling share of oil and a reversal of the Dutch disease phenomena, or it could be because of other factors. It is thus necessary to find some way to disentangle these various effects.

Table 9.2 The UK economy in 1976

	Production	Exports	Imports	Consumption
Primary	9	-1.2	8.0	15.8
Manufacturing	48.9	-24.9	22	46
Construction	22.5	-0.2	0.3	22.6
Distribution and services	88.1	-18.8	16.9	86.2
Public administration	13.5	-	-	13.5
	181.9	-45.1	47.3	184.1

Values are £billion.
Source: Forsyth and Kay, *Fiscal Studies*, 1980. Exports are measured, unconventionally, as value added by each sector.

Measuring the effects of North Sea oil

The original analysis of the effects of North Sea Oil production on the structure of the UK economy was undertaken by Forsyth and Kay in 1980. Their methods and assumptions have been heavily criticized, but their work nonetheless provides a useful starting point that is fairly easy to understand. After examining their work we will turn to some of the criticisms.

Forsyth and Kay started with the UK economy as it existed in 1976, the last year before North Sea oil production became significant. The structure of the UK economy is summed up in table 9.2. Column 1

gives production (value added) for each of the major sectors of the economy, total production being £181.9 billion (the whole analysis is at 1980 prices). Columns 2 and 3 give the exports and imports associated with each sector. If we subtract output that is exported and add imports we get the level of domestic consumption corresponding to each of these sectors, as shown in column 4. Note that in 1976 there was a deficit on the balance of trade, amounting to £2.2 billion, and that consumption equals production plus the trade deficit.

Starting from this position Forsyth and Kay worked out the effects of a rise in oil production to £10 billion. This has the following effects.

(1) Primary production rises by £10 billion to £19 billion.
(2) Total production rises to £191.9 billion. Note that this is a rise of 5.5 per cent. If the trade deficit remains unchanged, consumption must rise to £194.1 billion.
(3) Assume that when domestic consumption rises, consumption of all goods rises in the same proportion (this is similar to the movement from A to C in figure 9.B1.2). If we assume that consumption of each sector's output rises by 5.5 per cent we get the results shown in column 4 of table 9.3.
(4) If primary output rises to £19 billion but consumption rises to only £16.7 billion the result is that the primary balance of trade moves from a deficit of £6.8 billion to a surplus of £2.3 billion. This gives us the entry in table 9.3.
(5) At this stage we assume that the overall balance of trade is to remain unchanged at £2.2 billion. If the primary balance improves

Table 9.3 The effects of North Sea oil: stage I

	Production	Exports	Imports	Consumption
Primary	19	-2.3		16.7
Manufacturing				48.5
Construction				23.8
Distribution and services				90.9
Public administration				14.2
	191.9	2.2		194.1

Source: as table 9.2.

Table 9.4 The effects of North Sea oil: stage II

	Production	Exports	Imports	Consumption
Primary	19		-2.3	16.7
Manufacturing	46.3	-22.2	24.4	48.5
Construction	23.8	-0.2	0.3	23.8
Distribution and services	88.8	-16.7	18.8	90.9
Public administration	14.2	—	—	14.2
	191.9		2.2	194.1

Source: as table 9.2.

by £9.1 billion this means that the non-primary balance must deteriorate by the same amount. The simplest assumption is that exports fall and imports rise by the same percentage, which turns out to be about 11 per cent. This gives the figures for exports and imports shown in table 9.4.

(6) The final stage is to add exports to consumption and to subtract imports to obtain levels of production for each sector. These are shown in column 1 of table 9.4.

If we compare column 1 of table 9.4 with column 1 of table 9.2 we obtain the effects of North Sea oil on the structure of production. Primary production rises by 111 per cent, simply because we took a rise from £9 billion to £19 billion as our initial assumption. Because they are barely involved in trade, construction and public administration rise by the same as national income: by 5.5 per cent. The interesting changes are in services (which rise by only 0.9 per cent) and manufacturing (which *falls* by 5.7 per cent). These are the main non-primary sectors producing tradeable goods (notice that, in contrast with the theoretical models discussed in box 9.1, the distinction between manufacturing and services is not the same as between tradeable and non-tradeable goods).

The mechanism which produces the required changes is, of course, the exchange rate. The rise in oil revenues leads to an appreciation of the exchange rate which causes a rise in imports and a fall in exports. Though they admit that there is a large amount of guesswork involved, Forsyth and Kay suggested that, given conventional estimates of demand elasticities, a rise in the value of sterling of about 20-25 per cent would be required to produce these changes.

BOX 9.1 'DUTCH DISEASE' MODELS

There are two related problems commonly associated with a natural resource discovery: De-industrialization — a decline in the manufacturing sector of the economy and a shift towards services; and a rise in the real exchange rate, causing a loss of international competitiveness and a rise in the price of services relative to manufactured goods. These two problems were thought to have arisen in Holland in the 1960s as a result of the discovery and exploitation of natural gas reserves, hence the term 'Dutch disease'. Notice that although we use the term 'disease', and although we are concerned with some of the problems associated with natural resource discoveries, there is no suggestion that such discoveries make an economy worse off. Some sectors may suffer, but overall the economy gains.

Long run 'static' effects

The effects of an oil discovery (we use the term 'oil discovery' as a convenient shorthand, though the arguments refer to any natural resource and though it is the exploitation of the resource rather than just its discovery that matters) are usually analysed in terms of two effects: the spending effect and the resource-movement effect.

- ❑ *The resource-movement effect*: oil production may take resources away from other sectors of the economy, forcing up factor prices. This effect will be larger for resources which are scarce and cannot be traded internationally.

- ❑ *The spending effect*: the revenues from oil production will raise incomes and hence spending.

To see how these effects work we divide the economy into two sectors: one producing tradeable goods, the other non-tradeables. Tradeables can be thought of as including manufactures plus oil and non-tradeables as services. Consider first the resource-movement effect. Assume that capital is internationally mobile and that the supply of capital is completely elastic: its price is fixed in world markets. The only scarce resource is labour, the

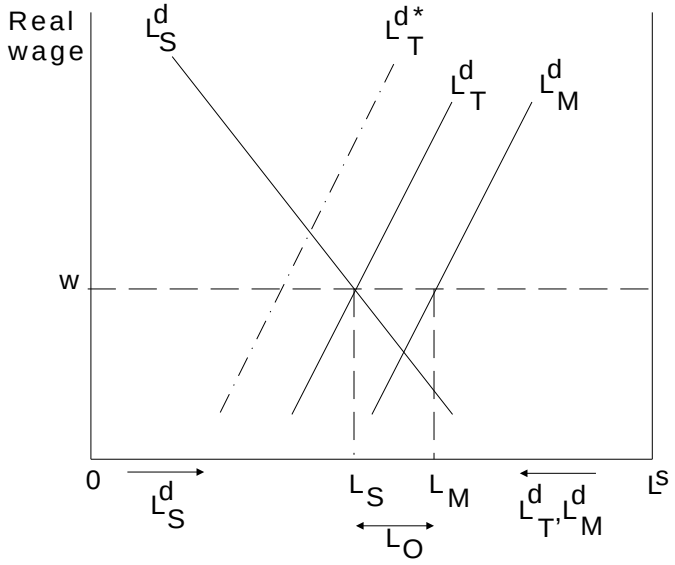

Figure 9.B1.1 The labour market

market for which is depicted in figure 9.B1.1. Demand for labour by the services sector, L_S^d, is measured from left to right, and demand for labour by manufacturing, L_M^d, from right to left. Both sectors have conventional, downward-sloping demand curves for labour. If we add the oil-producing sector's demand for labour to that of the manufacturing sector we have total demand for labour for tradeables, L_T^d. Supply and demand for labour are equal where L_S^d and L_T^d intersect. We can read off employment in each of the three sectors.

Now suppose there is an increase in demand for labour by the oil sector. This will shift L_T^d to the left, leaving the other demand curves unchanged. The result will be a rise in the real wage rate and a fall in employment in both services and manufacturing. Similarly, if there were no oil sector, L_T^d would be identical to L_M^d, and the real wage would be where L_S^d intersects with L_M^d. The oil sector's demand for labour raises the real wage rate, reducing employment in the other two sectors.

To illustrate the spending effect we will eliminate the resource-movement effect by assuming that oil-extraction uses a negligible amount of labour and that any capital can be purchased on

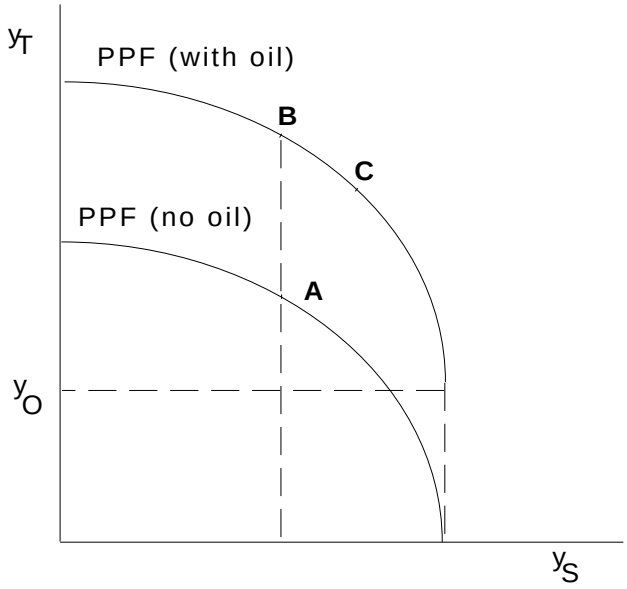

Figure 9.B1.2 The goods markets

international markets without affecting the domestic cost of capital. In figure 9.B1.2 we have drawn a production possibility frontier for tradeables and non-tradeables, both in the absence of oil production and with a given level of oil production. Note that because oil makes no demands on domestic resources, an oil discovery shifts the production possibility frontier vertically upwards. It affects potential output of neither manufactures nor services. Potential output of tradeables rises because it includes manufactures plus oil.

Assume that the socially optimal level of output is at A (though it is not drawn, we could imagine a social indifference curve tangential to the production possibility frontier at A). The oil discovery shifts the production possibility frontier upwards, permitting higher consumption of both tradeables and non-tradeables. For the balance between manufacturing and services to remain unchanged, the economy would have to move to B: in other words, people would have to spend *all* their increased income on tradeable goods (remember that we need not distinguish between oil and manufactures because they can exchanged for each other on the world market). In general people will use higher incomes to increase spending on both tradeables and non-tradeables,

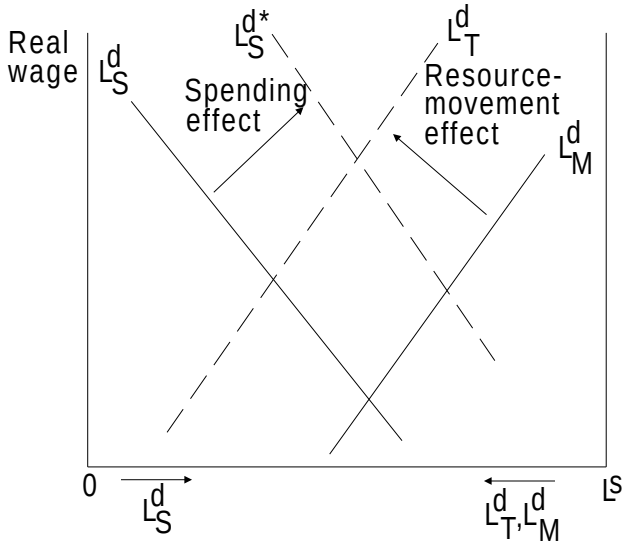

Figure 9.B1.3 The overall effect of an oil discovery

which means that the economy will move to a point such as C. Three things happen in the movement from A to C: (1) output of services rises; (2) output of manufactured goods falls; (3) the price of services rises relative to manufactures (i.e. the production possibility frontier is steeper at C than at A).

The spending effect, therefore, can produce both de-industrialization and a rise in the real exchange rate (a rise in the price of services relative to manufactures).

When the the resource-movement and spending effects on manufacturing are combined the result is that manufacturing will decline, but production of services may rise or fall, depending on whether the resource-movement or the spending effect is stronger. This is illustrated in figure 9.B1.3. The real wage on the vertical axis is now measured in terms of tradeable goods (before, because relative prices were not changing we did not have to specify what the real wage was measured in) and in addition to the leftward shift in $L_T{}^d$ there is a rise in $L_S{}^d$, caused by the rise in the price of services. The real wage in terms of tradeables rises, causing manufacturing to decline, whilst whether services increase or decline depends on whether it is $L_S{}^d$ or $L_T{}^d$ that shifts the most.

Short-run dynamic effects

In the static models considered so far there is full employment: oil discoveries affect the way in which resources are allocated between sectors, but they do not cause resources to be under-utilized. However, in addition to these long run effects there are short run effects which may cause unemployment. These include the effects of an expenditure lag; the effects of oil revenues on the demand for money; and real wage inertia.

An expenditure lag: an oil discovery increases expected future real incomes and hence the level of consumption. This rise in consumption raises the level of aggregate demand, thus offsetting the effects of a rising real exchange rate (which lowers demand). Suppose, however, that foreign-exchange markets are forward-looking and take account of oil revenues very quickly, but that consumers respond more slowly. The result would be a rise in the real exchange rate, reducing aggregate demand, without any compensating rise in consumption. This could produce a recession.

Effects on the demand for money: the rise in wealth caused by an oil discovery should raise the demand for money. If there is no rise in the money supply the result will be a rise in interest rates and possibly a recession.

Real wage inertia: there is considerable evidence to suggest that, in the medium term (say 2 to 5 years) nominal wages are flexible, but that real wages are fairly sticky (see chapter 6). Wage-earners consume both manufactured goods and services, so the real consumption wage (W/P_C) is a weighted average of the real product wage rates in manufacturing (W/P_M) and services (W/P_S). Assume that W/P_C is constant (extreme real wage stickiness). An oil discovery will, through the spending effect, produce a rise in the real exchange rate. Because manufacturers face international competition they will have to accept lower (sterling) prices, which causes a rise in W/P_M, reducing employment in manufacturing. At the same time there will be a fall in W/P_S. Because the consumption wage is fixed, the overall wage rate cannot adjust to maintain full employment, and so the overall effect on employment will depend on the relative strength of these two effects. If demand for labour in services is relatively inelastic compared with manufacturing, employment may fall.

FURTHER READING

A good survey of the major issues is C. Bean 'The impact of North Sea oil,' in R. Dornbusch and R. Layard (eds) *The Performance of the British Economy*. Oxford: Oxford University Press, 1987. The classic article on the problem of North Sea oil is P. J. Forsyth and J. A. Kay 'The economic implications of North Sea oil revenues,' *Fiscal Studies* 1, 1980, pp. 1- 28.

Since 1973 oil prices have fluctuated enormously, so prediction is hazardous. Some articles which analyse the effects of oil price changes are: Powell and Horton 'The economic effects of lower oil prices, Government Economic Service Paper, No. 76 (1985); P. Odell 'Back to cheap oil?' *Lloyds Bank Review* April 1985, pp. 1-15; P. Odell 'The prospect for oil prices and the energy market,' *Lloyds Bank Review*, July 1987; S. Hall, S. G. B. Henry and Herbert 'Oil prices and the economy,' *National Institute Economic Review*, May 1986. The treatment of North Sea oil in the main macroeconomic forecasting models is discussed in K. F. Wallis *et al.* 'Modelling North Sea oil', in *Models of the UK Economy: Second Review by the ESRC Macroeconomic Modelling Bureau* (Oxford: Oxford University Press, 1985).