The Dutch Disease or Problems of a Sectoral Boom*

By Klaus Enders

A resource boom in an industrialized country (such as Norwegian oil finds in the North Sea) is often blamed to cause de-industrialization or unempolyment (the so-called Dutch Disease). This paper explores the issue in a simple Keynesian framework on the basis of Salter's traded/non-traded goods model. It allows for domestic use of the resource as intermediate input in production. The distinction between a production boom (discovery of new deposits) and a price boom (rising world market prices) is therefore important. Some policies measures that are often advocated are studied.

I. Introduction: The "Dutch disease", or Help we have oil[1]

The term "Dutch disease" was coined in the beginning of the 70's when British economists discussed the best use of North-Sea oil, referring to the Netherlands having faced similar problems in the 60's when production of North-Sea gas had started. This resource boom was thought to have caused "... stagnation of industry, mass unemployment and what is now called 'de-industrialization'."[2]

The mechanism that is expected to produce these results is roughly as follows. Increased oil revenues improve the current account and domestic income by the same amount. As long as the marginal propensity to import is less than one, imports rise but the current account remains in surplus. Furthermore, part of the additional income is spent on non-tradeables. Both effects will lead to real appreciation of the home currency (through nominal appreciation or domestic inflation, particularly in the sheltered sector, or both), reducing the international competitiveness of the traditional export and import-competing industries.

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[1] Title of a German TV feature about Norway, ARD, August 23, 1982 („Hilfe wir haben Öl").

[2] *Kaldor* (1981), 5.

Thus the sheltered sector (typically services, construction etc.) is likely to expand while the exposed sector (including typically manufacturing) can be expected to decline. Hence the result will be some "de-industrialization".

It is as yet not clear why this should be a disease. On the contrary, since oil revenues often contain a large element of economic rent, less labour is needed to maintain any level of income. And the new structural pattern (more theatres and hospital services, less machine building) seems rather attractive.

However, three major objections have been raised. The first, and most obvious, is that the cost of adjusting to the new pattern of production might be high and unevenly spread. In particular all kinds of rigidities (labour immobility, excessive wage demands spreading from the booming sector, etc.) could hamper smooth adjustment and may split the domestic community into "losers" and "winners". Consequences of policies that the "losers" will advocate have been discussed in, e.g., *Corden* (1982), *Bjerkholt/Lorentsen/Strøm* (1981), *Enders/Herberg* (1982), *Herberg/Enders* (1983), and are one of the main topics of the present paper as well.

A second concern is about the desirability even of a successful adjustment. Here a strong manufacturing sector is seen as essential for a modern viable society, because, for example, it is exposed industries that are a main inlet for technological innovation, for learning from abroad and thus for overall economic development. This point has been made emphatically with respect to developing countries such as Mexico, facing the choice to industrialize or become an oil-rentier: "... by specializing in what the Law of Comparative Costs ordained her to do, namely as being a great Primary Product Exporter — a role for which she is destined by God und by Nature, as well as by the Americans ... [the country, K. E.] misses out on all exciting things in life. It misses out on social dynamism. It misses out on the cultural, technical and intellectual development which only a strong healthy manufacturing industry ... can provide."[3]

A third concern is that the pleasures of rentier-life may not last forever, and that allowing de-industrialization "... may also condemn that country to the typical fate of the ex-rentier — inability to earn his/her own living when the source of the unearned income ceases".[4]

To deal with the last two concerns is outside the scope of this paper since they require a long-run perspective. (A first attempt to formalize

[3] *Kaldor* (1981), 7 - 8.
[4] *Ellmann* (1981), 165.

them is *Wijnbergen* (1982 a/b).) However, the same policies sometimes advocated to prevent de-industrialization on these grounds will tend to be favoured by interest groups worrying about their own short-run problems. Thus our discussion of the appropriateness of these policies should throw some light on the other two issues as well.

The present analysis differs from models along neo-classical lines (e.g. *Long* (1982), *Corden/Neary* (1982), *Bruno/Sachs* (1982 a/b)) in e.g., that "Keynesian" unemployment prevails (households are rationed in the labour-market, firms are rationed in the goods markets). It differs from other "Keynesian" approaches (e.g. *Buiter/Purvis* (1983)) in that the rôle of the resource as an input for production of final goods is stressed. Thus it becomes important to distinguish between a *resource output boom* due to a rise in resource production and a *resource price boom* due to an increase in the resource price.

An output boom represents just an income transfer to the domestic country. It affects the domestic economy primarily from the demand side (at least under fixed exchange rates). A price boom includes a transfer component if the country is a net exporter of the resource. In addition, however, it changes the price of an input and thus affects the supply side and may alter relative prices. This will induce substitution between inputs in production as well as substitution between final goods in demand.

Most papers on resource booms and the Dutch disease disregarded domestic input use of the resource. *Bruno/Sachs* (1982 a/b) and *Herberg/Enders* (1983) took a different approach but stressed the effects of input substitution in case of a price boom. Here we concentrate our attention on demand-substitution effects assuming a "Ricardian" production technology and unemployment of labour.

The paper is organized as follows. In part II we present a simple "Keynesian" model of a small open economy producing oil and manufactures (both tradeable) as well as non-tradeable services. In parts III and IV we discuss the impact of an oil output boom and an oil price boom, respectively. In part V we look into the consequences of several policies (devaluation, export subsidy). Some concluding remarks are made in part VI.

II. The model

The home country produces three commodities, manufactures, oil and services. The output levels are Q_M, Q_R and Q_S respectively. The first two commodities are internationally tradeable, the third is a purely national good. Domestic manufactures are an imperfect substitute of

foreign manufactures while domestic and foreign oil are homogenous products.[5] We assume that the foreign currency prices P^*_F and P^*_R of foreign manufactures and oil are determined on the world market and exogenously given to the home country. Assuming the absence of any trade impediments implies

$$P_F = eP^*_F \quad , \quad P_R = eP^*_R \tag{1}$$

where P_F, P_R, e are the corresponding domestic currency prices resp. the exchange rate. The exchange rate, i.e. the home currency price of a foreign currency unit, is taken to be fixed.

Oil extraction does not require any variable factor input, and its output level Q_R is controlled by the domestic government. Manufactures and services are produced with labour and oil. The respective input-output coefficients a_{ij} are non-negative and constant (i.e. the production technology is linear limitational).

We assume average cost pricing

$$P_i = a_{iL} W + a_{iR} P_R \ , \qquad i = M, S \tag{2}$$

P_M, P_S are the home currency prices of domestic manufactures and services and W is the (fixed) nominal wage rate. The supply of labour and goods is infinitely elastic at current prices. Output and employment are thus demand determined.

Nominal income (value added) equals

$$Y = P_M Q_M + P_S Q_S + P_R R = W (a_{ML} Q_M + a_{SL} Q_S) + P_R Q_R \tag{3}$$

where

$$R = Q_R - a_{MR} Q_M - a_{SR} Q_S \tag{4}$$

are net oil exports.

Nominal domestic absorption A is a function of nominal income and nominal financial wealth V

$$A = Y + \alpha (V - kY) \ , \quad \alpha > 0, \quad k > 0, \quad 1 - \alpha k > 0 \ . \tag{5}$$

As familiar from *Dornbusch/Mussa* (1975), domestic hoarding $Y - A$ serves to close the gap between desired wealth kY and actual wealth V. Here domestic financial wealth may be regarded as the stock of domes-

[5] The commodity labels are not to be taken too literally. They are just shorthands for (and less abstract than) tradeables, non-tradeables and a tradeable intermediate good.

tic money. If bonds exist, assume that the domestic central bank keeps the domestic interest rate fixed through appropriate open market intervention.

The domestic government budget is always balanced and therefore domestic financial wealth only changes through hoarding

$$\dot{V} := dV/dt = Y - A \tag{6}$$

Domestic (quantitative) demand D_j for the j-th final good ($j = M, F, S$) is homogeneous of degree zero in all final goods prices and nominal absorption:

$$\begin{aligned} D_M &= D_M(P_M, P_F, P_S, A) \;; \qquad D_S = D_S(P_M, P_F, P_S, A) \\ &\quad - \; + \; + \; + \qquad\qquad\qquad + \; + \; - \; + \\ D_F &= D_F(P_M, P_F, P_S, A) \\ &\quad + \; - \; + \; + \end{aligned} \tag{7}$$

In (7) we assume all final goods to be gross substitutes. The possibility of complementarity between services and manufactures (where foreign and domestic manufactures remain substitutes) will be considered later. Foreign demand D_M^* for domestic manufactures depends only upon P_M/P_F since we take foreign income etc. as given:

$$D_M^* = D_M^*(P_M/P_F) \tag{8}$$

A *short-run equilibrium* is characterized by a joint equilibrium in the markets for services and domestic manufactures:

$$Q_S = D_S \tag{9a}$$

$$Q_M = D_M + D_M^* \tag{9b}$$

A *long-run equilibrium* requires, in addition, that trade is balanced and thus hoarding equals zero:

$$Y - A = 0 \tag{9c}$$

For our comparative-static analysis we need only compare long-run equilibria: If income and therefore wealth have risen in the long-run, the short-run equilibrium must have been associated with a (smaller) increase in income and a positive trade balance, and vice versa.

Let us first derive some partial derivatives. If $\hat{x} = dx/x$ denotes the relative change of x, we get from eqs. (1) and (2)

$$\hat{P}_i = \Theta_{iR}\hat{P}_R = \Theta_{iR}(\hat{e} + \hat{P}_R^*) \;, \qquad i = M, S \tag{10}$$

where $\Theta_{iR} = P_R a_{iR}/P_i$ is the unit-cost share of oil in the i-th sector.

$\Theta_{iL} = (1 - \Theta_{iR})$ is the corresponding share of labour. Eq. (10) shows that a change in domestic output prices is determined by changes in the exchange rate and the world oil price P_R. In particular, the horizontal supply curves for either domestic output shift upwards when the domestic oil price rises. This cost-push effect clearly is the stronger, the larger the unit-cost share Θ_{iR} in the respective sector.

We introduce a consumer price index P with logarithmic weights that equal initial consumption shares:

$$\log P = d_M \log P_M + d_F \log P_F + d_S \log P_S \tag{11}$$

where

$$d_i = P_i D_i / Y \tag{12}$$

From (10) and (11)

$$\hat{P} = (d_M \Theta_{MR} + d_S \Theta_{SR}) \hat{P}_R^* + (d_M \Theta_{MR} + d_S \Theta_{SR} + d_F) \hat{e} \tag{13}$$

III. Resource Output Boom

The effect of an increase in the rate of resource extraction ($\hat{Q}_R > 0$) can be analysed with the help of Fig. 1.

The output boom primarily raises domestic income through higher oil revenues, and this *transfer effect* is the only primary effect. This raises domestic demand for either final good. Prices are not affected and subsequently both outputs rise. Due to the familiar multiplier process the final income increase exceeds the initial transfer. Actual wealth V now falls short of long-run desired wealth kY. The gap is closed over time by a transitory trade balance surplus. It is transitory because with rising actual wealth imports of foreign manufactures increase while oil exports decrease as more oil is used for domestic production and, moreover, exports of manufactures stagnate. In the new long-run equilibrium output and employment have risen, and so have real and nominal income and wealth. Clearly, these expansionary effects are stronger in the long-run than in the short-run due to additional wealth effects.

The adjustment to the new long-run equilibrium is brought about by wealth accumulation only without any change in relative prices. This adjustment path differs from those given in most other models of the Dutch disease where a real revaluation is required to restore equilibrium. In fact, the present case does not show any symptoms of a disease.

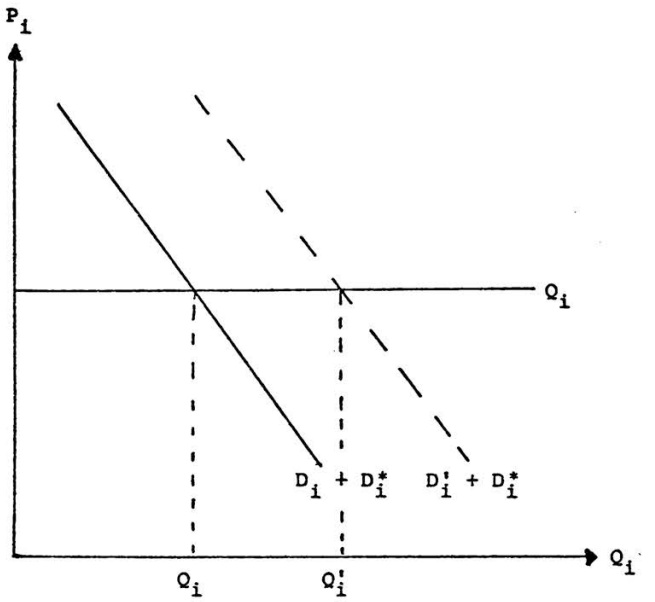

Fig. 1: Resource-Output Boom

Note, however, that our conclusion depends on the assumption that there is enough labour with the required skills so that both sectors can expand according to the increase in demand for their product. This is crucial since it allows the multiplier effect to raise income over and above the initial transfer, and, even with a propensity to import less than one, a balanced trade account can be achieved without any contraction in traditional exports.

Other crucial assumptions are

— that the supply curve is horizontal rather than upward sloping,

— that the wage level is exogeneously given,

— that the home country's manufacturing sector faces less-than-perfectly-elastic world demand.

All four assumptions are relaxed in *Enders/Herberg* (1982), and the results of an output boom are then rather less favourable. With positively sloped supply curves of both final good sectors and infinitely elastic world demand for domestic manufactures (which are perfect substitutes to foreign manufactures) additional spending goes entirely on services and foreign manufactures. Thus services prices rise, and if this carries the wage upwards, competitiveness of domestic manufactures declines and the features of de-industrialization and temporary

unemployment emerge. Different results are also obtained if the resource competes for domestic factors[6], or if some factor is internationally mobile[7].

IV. Resource Price Boom

The situation is far more complex if the boom is caused by rising oil ($P_R^* > 0$). Fig. 2 indicates the complications.

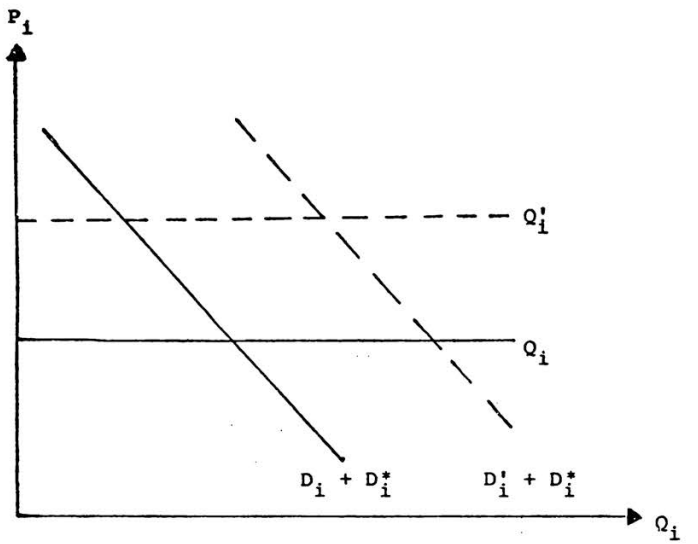

Fig. 2: Resource Price Boom

Clearly, conflicting forces are at work rendering the reaction of output and employment generally indeterminate. There is a primary *transfer* effect as before: higher oil revenues and thus, ceteris paribus, higher nominal income shift the demand curves to the right. Moreover, there are primary *cost-push effects* which shift the supply curves upwards and, due to substitution effects and purely inflationary income effects, lead to further re-location of the demand curves. The only clear-cut results that emerge immediately are (i) domestic price increases and (ii), due to the rise in P_M/P_F[8], a decline in the volume of

[6] See, for example, *Corden/Neary* (1982).

[7] Cf. *Bruno/Sachs* (1982 a).

[8] We assumed P_F^* to remain fixed. This is unrealistic since the foreign manufacturing sector should also face rising oil prices. Our results hold, however, as long as domestic manufacturing is more raw material intensive than foreign manufacturing. This seems to be the case if the oil abundance has led the home economy to specialize towards oil-intensive products.

exports of manufactures. To look into the details we have to determine the appropriate multipliers of system (9). Applying Cramèr's rule to the differential of the system (appendix A 1) we obtain:

$$
\begin{aligned}
(14a)\quad \hat{Q}_M/\hat{P}_R^* = (-1/\Delta)\,\{ & r d_M \eta_{MA} \\
& + \Theta_{MR}\,[(1 - q_S\,\Theta_{SL}\,\eta_{SA})\,(d_M\,\eta_{MM} + d_M\,\eta_{MA} + d_M^*\,\eta^*) \\
& - d_M\,\eta_{MA}\,(1 - q_M)] \\
& + \Theta_{SR}\,[(1 + \eta_{SS}\,\Theta_{SL})\,q_S\,d_M\,\eta_{MA} + (1 - q_S\,\Theta_{SL}\,\eta_{SA})\,d_M\,\eta_{MS}]\}
\end{aligned}
$$

$$
\begin{aligned}
(14b)\quad \hat{Q}_S/\hat{P}_R^* = (-q_M/\Delta)\,\{ & r\,\eta_{SA} \\
& + \Theta_{MR}\,[\eta_{SA}\,(q_M + d_M\,\Theta_{ML}\,\eta_{MM} + d_M^*\,\Theta_{ML}\,\eta^*) + \\
& + \eta_{SM}\,(1 - d_M\,\Theta_{ML}\,\eta_{MA})] \\
& + \Theta_{SR}\,[\eta_{SA}\,(q_S + d_M\,\Theta_{ML}\,\eta_{MS}) + \eta_{SS}\,(1 - d_M\,\Theta_{ML}\,\eta_{MA})]\}
\end{aligned}
$$

$$
\begin{aligned}
(14c)\quad \hat{Y}/\hat{R}_R^* = (-q_M/\Delta)\,\{ & r + \\
& + \Theta_{MR}\,[d_M\,(1 + \Theta_{ML}\,\eta_{MM}) + d_M^*\,(1 + \Theta_{ML}\,\eta^*) + q_S\,\Theta_{SL}\,\eta_{SM}] \\
& + \Theta_{SR}\,q_S\,(1 + \Theta_{SL}\,\eta_{SS}) + d_M\,\Theta_{ML}\,\eta_{MS}]\}
\end{aligned}
$$

where $q_i = P_i\,Q_i/Y$, $r = P_R\,R/Y$ are income shares, η_{ij} $(j = A, M, S, F)$ the elasticities of demand D_i with respect to absorption A and to prices P_M, P_S and P_F. The elasticity of foreign demand for domestic manufactures D_M^* with respect to P_M/P_F is η^*. Finally, Δ is the system determinant and has negative value (see eqs. (A1), (A4)).

The RHS of (14) reflect the channels through which the resource price boom operates. The *transfer effect* is given by the r-term, and is nil if the country is just self-sufficient with respect to the resource ($r = 0$). The Θ_{MR}-term describes the effects of the *cost-push* rise in P_M. It would be nil if manufactures were produced without any resource input ($\Theta_{MR} = 0$). An analogous interpretation holds for the Θ_{SR}-term.

From (14) it is clear at once that the (expansionary) transfer effect will dominate if initially net oil exports were sufficiently large (r large), whatever the cost-push effects. To study the latter more closely we assume for a while $r = 0$ and thus treat the case of a country, that is just self-sufficient with respect to oil. We start by looking at the market for manufactures. Cost-push effects primarily operate in three ways. First, the increase in P_M raises nominal income (purely inflationary), and this gives a rather weak expansionary effect if $q_M > q_S\,\Theta_{SL}\,\eta_{SA}$, i.e. if this primary effect is larger than negative feed-backs from the serv-

ices market. Two other ways are related to a negative own-price effect on domestic demand for manufactures and a negative export effect the strength of which varies with the absolute values of the corresponding elasticities η_{MM} and η^*. If they are sufficiently large, i.e. the demand curve $D_M + D_M^*$ in Fig. 2 is rather flat, there will be a fall in the quantity demanded and produced.

Similarly, two primary effects operate through the cost-push induced rise in P_S (the Θ_{SR}-term in (14a)). First, there is a cross-price effect that is positive if manufactures and services are substitutes ($\eta_{MS} > 0$). Second, there is a (purely inflationary) positive income effect which, however, may be more than offset by a negative feed-back effect if η_{SS} is sufficiently large. It is left to the reader to identify the analogous price effects in the market for services in eq. (14b).

The following table gives the overall impact for some special cases. The results require some simple though lengthy calculations, using zero-homogeneity of demands ($\eta_{iM} + \eta_{iS} + \eta_{iF} + \eta_{iA} = 0$, $i = M, S$) and adding-up constraints (A5).

Table 1

	Pure transfer effect $r > 0$	No transfer effect, $r = 0$				
		Equal cost shares	Manufactures oil intensive	Services oil intensive		
	$\Theta_{SR} = \Theta_{MR} = 0$	$\Theta_{SR} = \Theta_{MR} > 0$	$\Theta_{SR} = 0$	$\Theta_{MR} = 0$	$\Theta_{SR} = \Theta_{ML} = 0$	$\Theta_{SL} = \Theta_{MR} = 0$
$\hat{Q}_M/\hat{P}_R^*$	+	−	−	?	−	+
$\hat{Q}_S/\hat{P}_R^*$	+	?	?	−	+	−
$\hat{Y}/\hat{P}_R^*$	+	?	?	?	+	+
$\hat{y}/\hat{P}_R^*$	+	−	?	?	+	+

where $y := Y/P$ is real income.

Clearly, production of both goods is negatively affected by the cost-push effects if both domestic output prices rise by the same percentage ($\Theta_{SR} = \Theta_{MR}$). In this case their relative price P_M/P_S does not change, and the only cross-price effects are substitution of either domestic good by foreign manufactures. A sufficient condition for real income to decline is a fall in nominal revenues from traditional exports ($\Theta_{MR}(1 + \Theta_{ML}\eta^*) < 0$). This will be the case if the fall in employment

(by $d_M^* \Theta_{ML} \eta^*$ percent) due to the fall in the volume of exports (by η^* percent) more than offsets the rise in revenue from higher prices. It is the labour content that is relevant because the oil content can always be exported as crude oil.

The third resp. fifth column of table 1 represents extreme variants of what one might call the "*normal case*", namely that services are relatively less oil intensive than manufactures.[9] Then domestic production of manufactures declines since the negative effects are now strengthened by substitution towards services, the price of which rises less (in our cases: not at all). However, production of services need not necessarily rise, they only will do so if these substitution effects are strong enough to overcome the negative effects discussed in the first case, for example, if manufactures are extremely oil-intensive (column five). Only under these extreme circumstances do we get a clear (positive) sign for real (and, a forteriori, nominal) income.

In the "*perverse case*" that manufactures are less oil intensive than services, the arguments apply mutatis mutandis, yielding the reversed signs of columns four resp. six. Let us summarize:

A rise in the world market price for oil has a twofold impact upon the domestic economy. On the one hand, the rise in oil revenues has the same beneficial effects as the rise in production discussed before. On the other hand, cost-push effects make it a possibly mixed blessing: Domestic exports of manufactures decline, there is inflation, and production of the relative oil-intensive sector may decline. The negative cost-push effects clearly would be even stronger if wages were indexed and foreign export demand rather elastic.

Thus, if initially net oil exports are rather small the overall effects may be adverse resulting in a fall in nominal and real income and lower employment at least in the oil-intensive sector. A trade deficit could then develop, and the contractionary forces be strengthened over time by the decumulation of nominal financial wealth.

These findings clearly support similar conclusions reported by *Bruno/Sachs* (1982 a, b), *Bruno* (1982) and *Herberg/Enders* (1983), albeit these have been derived in a rather different context.

V. Exchange Rate Policy

We have just seen that a resource price boom will always reduce manufacturing exports and might even cause an absolute contraction of the manufacturing sector if the transfer effect is small and if manu-

[9] *Bruno* (1982) treats only this "normal" case.

factures are at least as oil intensive as services. In case such de-industrialization occurs both employers and unions in the threatened manufacturing sector are likely to complain about a loss of competitiveness and to advocate various commercial policies. We begin by investigating the consequences of a devaluation. The following multipliers are again taken from the appendix (A1), using (A2) - (A3).

$$\text{(15a)} \qquad \hat{Q}_M/\hat{e} = \hat{Q}_M/\hat{P}^*_R - (1/\Delta)\{(1 - q_S\,\Theta_{SL}\,\eta_{SA})(d_M\,\eta_{MF} - d^*_M\,\eta^*) + q_S\,\Theta_{SL}\,d_M\,\eta_{MA}\,\eta_{SF}\}$$

$$\text{(15b)} \qquad \hat{Q}_S/\hat{e} = \hat{Q}_S/\hat{P}^*_R - (q_M/\Delta)\{(1 - d_M\,\Theta_{ML}\,\eta_{MA})\,\eta_{SF} + \Theta_{ML}(d_M\,\eta_{MF} - d^*_M\,\eta^*)\,\eta_{SA}\}$$

We assume $\hat{Y}/\hat{e} > 0$ to ensure an (overall) normal trade balance reaction which is a stability requirement under a system of flexible exchange rates, given our absorption and hoarding functions. Thus we see at once that the devaluation raises (i) all domestic prices and (ii) nominal income. The latter change implies that the economy experiences a transitory trade surplus immediately after the devaluation. Therefore, sectoral production levels are rather likely to expand, and this conclusion is confirmed by eqs. (15). First of all, the devaluation works like an increase in the world oil price P^*_R in raising the domestic oil price P_R. This effect equivalent to a resource price boom is represented by the first terms in eqs. (15) and has been discussed in detail before. In addition, there are effects operating through the rise in the domestic currency price of foreign manufactures (the second terms in eqs. (15). Since we assumed all final goods to be gross substitutes these effects are unambiguously beneficial by increasing the competitiveness of the domestic manufacturing sector vis-à-vis its foreign counterpart. In particular the volume of domestic exports expands as P_M/P_F falls if $\Theta_{MR} < 1$, since then $\hat{P}_F = \hat{e} > \hat{P}_M = \Theta_{MR}\,\hat{e}$. The higher Θ_{MR}, i. e. the more oil intensive manufacturing production, and the smaller $|\eta^*|$, the elasticity of export demand (and thus the degree of "monopoly power" of the home country), the weaker the expansionary impact of the devaluation on the domestic manufacturing sector. Since a rise in oil prices is most likely to cause de-industrialization if domestic manufacturing is relatively oil intensive (see table 1), it is under these circumstances that a devaluation is least likely to be an effective cure of the Dutch disease.

To get more definite results one has to specify the relative size of the various elasticities involved. This would have to be based upon empirical estimates of the country in case. We must leave this aside being primarily interested in finding and desribing the various interacting mechanisms.

We observe, finally, that the possibility of a devaluation being a succesful cure to de-industrialization and/or rising unemployment depends heavily upon our assumption of a fixed nominal wage. If the money wage W would rise along with e, for example, if it were indexed with respect to a domestic price index, a devaluation would have no real effects at all. This can be easily inferred from (2), implying

$$\hat{P}_i = \hat{W} + \Theta_{iR}\hat{P}^*_R + \Theta_{iR}(\hat{e} - \hat{W}) \ , \qquad i = M, S \tag{16}$$

and thus *relative* prices P_i/P_F never change due to a devaluation if $\hat{e} = \hat{W}$. Due to the zero-homogeneity of the demand functions real changes require changes in *relative prices.* Thus our results remain valid only as long as the degree of wage indexation is less than 100 %, i. e. as long as real wages change. In this sense our assumption of a fixed nominal wage rate is not really restrictive. To summarize:

A devaluation could be a useful devise to dampen a decline in the manufacturing sector (i) if wages are not perfectly indexed; (ii) if manufactures are not too oil intensive such as to make inevitable cost-push effects to dominate the outcome and (iii) if export demand is sufficiently elastic.

VI. Export Subsidies

Since a devaluation may fail to bring relief to the manufacturing sector, and in any case speeds up inflation through cost-push effects, export subsidies appear to be an attractive alternative, directed more specifically at the core of the "disease".

Assume the government subsidizes exports at the rate v, financed by a lump-sum tax. Foreigners consequently have to pay only $(1 - v)\ P_M$ for domestic manufactures, and eq. (8) has to be replaced by

$$D^*_M = D^*_M\left((1 - v)\ P_M/P_F\right) \tag{17}$$

The export subsidy represents a transfer to the rest of the world and reduces disposable income by reducing revenue from a given volume of exports:

$$Y = P_M\, Q_M + P_S\, Q_S + P_R\, R - vP_M\, D^*_M \tag{18}$$

Note that again national hoarding equals $Y - A$, which in commodity market equilibrium equals the trade balance.

Assume that initially $v = 0$. The corresponding multipliers for an increase in the subsidy by $dv > 0$ are easily derived from the system (A1) as:

(19a) $$\hat{Q}_M/dv = (d_M^*/\Delta)\,\{d_M\,\eta_{MA} + (1 - q_S\,\Theta_{SL}\,\eta_{SA})\,\eta^*\}$$

(19b) $$\hat{Q}_S/dv = (d_M^*/\Delta)\,q_M\,\eta_{SA}\,(1 + \Theta_{ML}\,\eta^*)$$

(19c) $$\hat{Y}/dv = (d_M^*/\Delta)\,q_M\,(1 + \Theta_{ML}\,\eta^*)$$

First we observe that production of services expands if and only if nominal (and therefore real) income rises, which will be the case if and only if $1 + \Theta_{ML}\,\eta^* < 0$. That is, the volume of manufacturing exports must sufficiently rise ($|\,\eta^*\,|$ must be large enough) *and* require a not to small additional input of domestic labour (Θ_{ML} large enough) to overcome the negative income transfer effect. Otherwise either exports do not expand ($|\,\eta^*\,|$ small) or they are just more or less disguised oil exports — but at lower prices. Clearly, as long as $\Theta_{MR} > 0$, export subsidizing necessarily involves a loss in oil rent by selling some oil (the oil content of manufacturing exports) below the world market price. This appears only justifiable if, as a consequence, total employment increases. To find the reaction of total employment, note that $Y = WL + P_R\,Q_R - vP_M\,D_M^*$ where L is total domestic employment. Differentiation (with $\hat{P}_i = \hat{Q}_R = 0$) yields for the present case

(20) $$l\hat{L}/dv = \hat{Y}/dv + d_M^* \text{ where } l = WL/Y$$

Using (19c) and (A4) we obtain

(21) $$l\hat{L}/dv = (q_M\,d_M^*/\Delta)\,\{\Theta_{ML}\,\eta^* + d_M\,\Theta_{ML}\,\eta_{MA} + q_S\,\Theta_{SL}\,\eta_{SA}\}$$

and thus total employment increases if and only if

$$|\,\eta^*\,| > d_M\,\eta_{MA} + q_S\,\eta_{SA}\,\Theta_{SL}/\Theta_{ML} =: C_L$$

From (19a) we see that domestic production of manufactures increases if and only of if $|\,\eta^*\,| > d_M\,\eta_{MA}/(1 - q_S\,\Theta_{SL}\,\eta_{SA}) =: C_M$

It is easy to confirm by straightforward calculation that

(22) $$C_M < C_L < 1/\Theta_{ML}$$

Hence it is possible to classify the results according to the size of $|\,\eta^*\,|$, ceteris paribus. Table 2 gives details:

Table 2

Range of $\lvert\eta^*\rvert$	Result of export subsidy
$0 < \lvert\eta^*\rvert < C_M$	Production in both domestic final goods sectors, total employment and real and nominal income decline.
$C_M < \lvert\eta^*\rvert < C_L$	Manufacturing expands, but total employment, production of services and nominal and real income decline.
$C_L < \lvert\eta^*\rvert < 1/\Theta_{ML}$	Manufacturing and total employment rise. Nominal (and real) income as well as production of services decline.
$1/\Theta_{ML} < \lvert\eta^*\rvert$	Both domestic final goods sectors expand, total employment and real and nominal income rise.

Let us briefly comment on this table. First, note that $\lvert\eta^*\rvert$ may be small initially but grow over time (akin to the *j*-curve). In the first row, export demand is too inelastic and all sectors contract. Here not only the negative income transfer effect dominates but it even reduces domestic demand for domestic manufactures by more then it stimulates exports. If $\lvert\eta^*\rvert$ is somewhat larger (second row), the rise in export demand dominates the outcome in the domestic manufacturing sector. However, this reversal of deindustrialization is at the expense of the domestic service industries which contract because of a still negative income effect. If $\lvert\eta^*\rvert$ is even larger (third row) this trade-off becomes more tempting: the expansion of manufacturing is strong enough to raise total employment. However, due to the oil rent foregone income declines, i. e., the oil rentier gives away part of his rent, instead works more and sees his income on balance decline. Only if $\lvert\eta^*\rvert > 1/\Theta_{ML}$ does the export subsdiy boost production and employment in all sectors, and raises nominal and real income. Let us summarize:

As long as foreign export demand is not completely inelastic, the export subsidy stimulates traditional manufacturing exports. This involves necessarily a transfer of oil-rent to foreigners since the oil content of these exports is effectively sold below the world oil price. If the additional exports require enough labour input total employment, income, and production in both the manufacturing and the services sector rise. Otherwise, however, policy makers have to face the choice of improving the situation of the manufacturing sector at the expense of the services sector, thereby lowering income and possibly even total employment.

VII. Flexible Exchange Rates

To deal properly with the consequences of a resource output boom and a resource price boom under flexible exchange rates would require a more detailed specification of asset markets and the formation of (exchange rate) expectations. We refrain from doing so and limit ourselves to a few remarks.

Suppose we interpret our model in the sense of the "monetary approach", i. e. domestic money is the only financial asset held at home. Under flexible exchange rates the stock of domestic money is exogeneously fixed and trade is always balanced, i. e. eq. (6) has to be replaced by $Y = A$. Thus nominal financial wealth V and therefore nominal income Y never change. Whenever, under fixed exchange rates, a disturbance would lead, in the short run, to a rise in nominal income and thus a trade surplus, now a revaluation of the home currency occurs.

This clearly happens in the case of a *resource output boom*. Real income increases and in this sense the economic situation unambiguously improves. The revaluation will, however, have various *price effects* since it reduces the home currency prices P_R and P_F of oil and foreign manufactures. The fall in P_F induces substitution away from domestic products (we assumed all final goods to be gross substitutes). And the fall in P_R adversely affects the relatively labour intensive sector which benefits least from the reduction in unit cost but suffers most from substitution *between* domestic goods. In any case, the volume of manufacturing exports declines. In our "normal case" (services labour intensive), therefore, both domestic final goods sectors are subject to contractionary influences: services from losing out against manufactures in general, domestic manufactures from the decline in export business (which may or may not be offset by some expansion of domestic demand).

In the case of a *resource price boom* the same arguments apply if the transfer effect dominates the price effects, i. e., initially the country is a large net exporter of oil. Otherwise clear-cut results are difficult to obtain. A revaluation is the more likely outcome, and this will reduce, but not fully offset, the initial oil price increase. Domestic production of services and manufactures is still subject of negative cost-push effects while the price of their foreign substitute falls. At least in the "normal" case the major burden of adjustment will have to be borne by the manufacturing sector.

Finally, let us turn to an export subsidy. From table 2 we know that a revaluation and, equivalently, an increase in real income occurs if

and only if $|\eta^*| > 1/\Theta_{ML}$. Otherwise a devaluation lowers real income and will tend to stimulate manufacturing production at the expense of the service industries (as discussed before).

If we allow for interest bearing assets, we no longer can build upon the simple model of part II. An easy extension would be to assume (i) domestic and foreign bonds to be perfect substitutes and (ii) price and exchange rate expectations to be static. This means

$$i = i^* \tag{23}$$

where i resp. i^* are the domestic (foreign) nominal rates of interest. With the stock of domestic money M exogeneously fixed, and a liquidity preference demand function $L(Y, i)$, money market equilibrium requires

$$M = L(Y, i) \tag{24}$$

and thus nominal income is completely determined as a function of the foreign interest rate and the stock of domestic money. Whatever would have raised nominal income under flexible exchange rates (creating a balance of trade surplus) will now lead to a revaluation, and all the arguments above apply again.

For a more sophisticated treatment of asset markets in otherwise simpler models we refer the reader to *Buiter/Purvis* (1983) and *Eastwood/Venables* (1982). They replace, along the lines of *Dornbusch* (1976), the interest parity eq. (23) by $i = i^* + \dot{e}$ where, assuming perfect foresight, the expected and actual rate of depreciation are equal (to $\dot{e}$). Further, domestic prices change slowly (which we could not model in our present model). Temporary overshooting then becomes possible if the money market clears instantaneously. In particular, under an overshooting *revaluation* transitory output losses become possible and would, in our model, most likely hurt the domestic manufacturing sector.

VIII. Concluding Remarks

The preceding analysis has shown that a "booming" resource sector may be a mixed blessing and may, in particular, destroy jobs in other sectors without itself creating new jobs. Our simple model was designed to describe one chain of interactions that may produce these results, namely cost push effects that appear if the booming sector produces input for other domestic sectors. An important distinction then has to be drawn between possible sources of the boom. An increase in production tends to be outright beneficial (certainly under fixed exchange

rates). An increase in the world market price might have adverse side effects in other sectors by raising input costs.

Apart from the diagnosis the model explained why some of the policies that might help the sector that is hit worst amount to "wasting" part of the new riches, lower real income or even fail to achieve their purpose.

As explained, some of the simplifying assumptions (fixed money wage, fixed foreign manufacture price when oil prices rise) are not really restrictive. In addition, trade in bonds could easily be accommodated in the case of fixed exchange rates. More serious shortcomings are the neglect of (i) the rôle of the oil in the ground as part of wealth (*Buiter/Purvis* (1980) have built a model using permanent oil income, but have only one final good sector — which neglects an important part of the "Dutch disease" story), (ii) the impact upon investment flows that an oil boom might have (see *Corden* (1981)) and (iii) the fact that government spending is unlikely to replicate private spending patterns (for this point, see the apparently first paper on the "Dutch disease", *Eide* (1973)).

Appendix

Total differentiation of the system (9) and the definitional eq. (4) at an initial long-run equilibrium yields:

$$\text{(A1)}\qquad \begin{pmatrix} 0 & -1 & \eta_{SA} \\ -q_M & 0 & d_M \eta_{MA} \\ -q_M \Theta_{ML} & -q_S \Theta_{SL} & 1 \end{pmatrix} \begin{pmatrix} \hat{Q}_M \\ \hat{Q}_S \\ \hat{Y} \end{pmatrix}$$

$$= \begin{pmatrix} -E(D_S, e) & -E(D_S, P_R^*) \\ (-d_M E(D_M, e) + d_M^* \Theta_{ML} \eta^*) & (-d_M E(D_M, P_R^*) - d_M^* \Theta_{MR} \eta^*) \\ q_R & q_R \end{pmatrix}$$

$$\begin{pmatrix} 0 & 0 \\ 0 & d_M^* \eta^* \\ q_R & -d_M^* \end{pmatrix} \begin{pmatrix} \hat{e} \\ \hat{P}_R^* \\ \hat{Q}_R \\ dv \end{pmatrix}$$

where income shares q_i, d_i and cost shares Θ_{ij} as well as partial demand elasticities η_{ij} have been defined in the main text. Further, $E(D_i, x)$ is the gross elasticity of demand D_i with respect to x, for given nominal income. Thus

$$\text{(A2)}\qquad E(D_S, P_R^*) = \Theta_{MR} \eta_{SM} + \Theta_{SR} \eta_{SS}\ , \quad E(D_S, e) = E(D_S, P_R^*) + \eta_{SF}$$

$$\text{(A3)}\qquad E(D_M, P_R^*) = \Theta_{MR} \eta_{MM} + \Theta_{SR} \eta_{MS}\ , \quad E(D_M, e) = E(D_M, P_R^*) + \eta_{MF}$$

The system's determinant is

(A4) $$\Delta = - q_M (1 - q_S \Theta_{SL} \eta_{SA} - d_M \Theta_{ML} \eta_{MA})$$

Differentiation of the budget identity $A = P_M D_M + P_S D_S + P_F D_F$ with respect to A yields

(A5) $$1 = d_M \eta_{MA} + q_S \eta_{SA} + d_F \eta_{FA}$$

in an initial long-run equilibrium ($q_S = d_S, A = Y$). Thus $\Delta < 0$.

Under the adjustment mechanism we implicitly assumed throughout (production Q_i increases if there is excess demand in the i-th market), $\Delta < 0$ is necessary to assure local stability. This can be seen by drawing the loci of $Q_S = D_S$ and of $Q_M = D_M + D_M^*$ in (Q_M, Q_S)-space. Stability requires the former line to be steeper than the latter which is precisely what $\Delta < 0$ ensures.

Summary

A resource boom in a small open industrialized country is analyzed in a simple Keynesian framework, allowing for domestic use of the resource as intermediate input. It is shown that an output boom (increased resource production) is outright beneficial: demand expands through the familiar multiplier process, stimulating production and employment in all sectors. A price boom, however, has negative cost-push effects affecting relative prices. The outcome depends crucially upon sectoral resource intensities and the size of initial resource exports. Conditions are analyzed, under which exchange rate policy or subsidies to traditional exports could improve the outcome.

Zusammenfassung

Die Arbeit analysiert einen Rohstoffboom in einer kleinen offenen Volkswirtschaft mit einem Sektor handelbarer und einem Sektor nicht-handelbarer Endprodukte, welche beide den Rohstoff als Zwischenprodukt einsetzen. Außerdem besteht Keynesianische Arbeitslosigkeit. Ein Outputproblem (höhere Rohstofförderung) wirkt dann über den bekannten Multiplikatorprozeß expansiv in allen Sektoren. Ein Rohstoffpreisanstieg dagegen bringt zusätzlich kontraktive Kostendruckeffekte mit sich. Das Ergebnis hängt entscheidend von sektoralen Rohstoffintensitäten und dem Umfang der anfänglichen Rohstoffexporte ab. Anders als in den meisten Arbeiten zum Problem ist De-Industrialisierung keine notwendige Folge eines Booms. Schließlich werden Kriterien angegeben, unter denen Abwertungspolitik bzw. Exportsubventionen sinnvolle wirtschaftspolitische Maßnahmen wären.

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