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RESOURCES AND NORTH - SOUTH TRADE:

A MACRO ANALYSIS IN OPEN ECONOMIES

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Abstract

The paper explores the impacts of resource export policies on major macro variables of the exporter and the importer economies. There are two regions, North and South, trading resources for industrial goods. Each region consumes two goods (basic consumption goods and industrial goods) and produces both using three inputs: capital labor and resources. The relative prices in five markets (of factors and goods) as well as the volumes of output, consumption and international trade are all determined endogenously at a general equilibrium.

The results give conditions both for positive and for negative outcomes from moves towards world equilibrium with higher volumes of resource exports. Under certain conditions, increased resource exports produce price distortions with negative consequences. When the South's technologies are dual and its traditional sector uses mostly labor, and the North has a more homogeneous economy and a high rate of profit, at the new equilibrium real wages, employment and consumption decrease in the South, and its terms of trade and real revenues worsen. This is traced to the negative impact of increased resource exports on the domestic terms of trade between the traditional and the industrial sectors. However, the profits of the south increase, thus explaining in part the existence of trade. More favourable outcomes are obtained when the exporting economy is more homogeneous, and sufficient conditions are given for an export policy to improve the welfare of the exporting country, as well as its international terms of trade and export revenues.

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I Introduction

This paper explores the impacts of resource export policies on major macro variables of the exporting and importing economies. These impacts are traced through the accompanying changes in international terms of trade and in total real revenues. The paper thus belongs to the increasing body of literature on macro analysis of open economies (e.g. (1), (2), (5)) as well as to more recent general equilibrium analysis of resource export policies (3), (6), (7).

The aim is to explore some relatively complex issues involved in North-South trade. The two trading regions have therefore macro characteristics of industrial and of developing countries. The resource exporting region has a dual structure, and its traditional sector uses mostly labor, and very few capital or oil inputs. The industrial economy is more integrated, and uses more homogeneous technologies; it does not produce resources. For completeness, however, one of the results (theorem 3) relates to the case where the resource importer is also a developing country.

The policy problems explored here are common to an extensive literature on resource trade, a literature that has gained increasing attention in recent years as the economic role of resources has become more visible, and it became apparent that the macro analysis of resource policies is less than perfectly understood by conventional one country one sector macro models where inputs are capital, labor and produced goods.

But we study here resource export policies with a particular set of problems in mind: those that are typical of a developing country that trades its resources with an industrial country in exchange for industrial goods. The problem is somewhat peculiar, its most striking characteristic being perhaps that there exists a problem at all. This is in part because the issues involved are difficult to appreciate when analysed through the prism of conventional development models, and we discuss this next.

Resource exporting is an activity that tends to bypass most of the economic engine of a developing country: the production of resources does not employ domestic factors significantly, nor do resources represent a significant input of production in the economy, especially in the traditional sector on whose output most wage income is spent.

In this sense, resources represent almost a "pure rent" good: they are almost costlessly extracted, and extracted largely for exports. The revenue obtained from this almost costless operation is then added to the country's balance of payments surplus. Thus a resource exporting developing country need not be subject to the 'worst enemy' of development according to traditional economic models: the balance of payments deficit. If resources are abundant, and they are traded for industrial goods, there are in principle no constrai for the developing country's growth perspectives. Nor should resource extraction affect negatively, in principle, the more traditional sectors of the economy, since it does not compete with them for scarce inputs.

Nevertheless the experience of the last few years indicates that oil exporting countries have not fared as well as the above reasoning would predict; this includes industrial as well as developing oil exporters. For example, the possibly harmful effect of resource exports on the domestic economy has featured on the economic agendas of the United Kingdom, Holland and Australia, being variously referred to as the industrialisation phenonem, the Dutch disease and the Gregory syndrome. Resource exports seem to have a 'knack' for affecting the domestic economy of the oil exporter in ways that can only be perceived when a general equilibrium analysis is carried out. This is not because resource exports compete for scarce resources and affect factor prices in this manner but rather, it appears, because they affect sometimes perversely the relative prices of traditional and industrial goods. Factor prices (labor and capital) are thus also affected, but from the demand rather than from the supply side.

A resource exporter may find that the expansion of its exports undermines its subsistence economy (e.g. domestic food output) and thus its domestic demand structure, through its negative impact on the domestic "terms of trade" between industry and agriculture. Thus domestic consumption and overall employment and output in the more traditional sectors may all decrease. This appears familiar in the light of the recent experience of several oil exporting countries (e.g. Venezuela, Iran, Mexico). In addition, depending on the characteristics of the importing economy, increased resource exports may also bring about worse terms of trade and even lower real export revenues as the international price of their industrial imports rises. Therefore, the volume of industrial goods traded for resources may also decrease. In order to keep the previous level of industrial consumption (or investment), the resource exporting country may therefore have to produce more industrial goods domestically, thus compounding the negative aspects of the scenario.

The aim of this paper is to explore the general macro characteristics of the trading economies that can help us understand whether a certain export policy is likely to improve welfare, international terms of trade and real revenues of the exporter, or worsen all or some of these variables. The conditions under wh one or the other outcome can be expected may yield useful information, since these may be the subject of policy within the exporting country.

The interest of the results lies in the simple as well as somewhat unexpected answers to some of these questions. Dual developing economies that use very few capital and resource inputs in their traditional sector and trade resources for industrial goods with a more homogeneous industrial economy with high rates of profit, will in general find their domestic welfare negatively affected by increased resource exports, together with their terms of trade and export revenues. Yet, even as export revenues decrease total profit income and the rate of profit may improve within the resource exporting economy, perhaps explaining why trade takes place at all in these cases. With more integrated economies and more homogeneous technologies, the domestic welfare impact of increased oil exports will in general be positive for the oil exporter, even as its terms of trade worsen with increased exports. The most positive result for the exporter is achieved when it trades with a dual economy. Here its real revenues will in general increase as it increases export volumes, but the welfare impact on the domestic economy of the oil importer may be less positive in these cases.

Clearly much work is needed to elucidate some of the most puzzling macro problems associated with resource - exporting economies. In particular, the role of exchange rates seems rather crucial, at least in short term behaviour. The usual defence for not including money will be invoked here: the sake of simplicity and the implicit belief that at least in the medium run real variables are the most important in explaining market behaviour as well as welfare. In any case, the argument goes, it may be better to understand first the 'real' aspects of the problem.

Another useful extension would be to incorporate the dynamic aspects of oil exports problems, thus taking into consideration the intertemporal decision making of an oil exporter in relation to the returns on other assets (i.e. capital) as in Hotelling type models, e.g. [6].

Finally, it could be useful to explore the possible changes of these results if one allows for a balance of payment surplus of the resource exporter, and assumes that at least part of this export surplus is reinvested in the importing economy, as in [7].

II A Macro model of Resource Trading Economies

We shall discuss here the general characteristics of the macro model, and the main results in relation to previous work.

The macro model of each region is of a general equilibrium type, consistent with that of a competitive market economy. The international resource market behaviour is as follows. A volume of resource exports is determined[1] (which may not exceed a given bound); in a world equilibrium the North's domestic (general equilibrium) reaction to this oil export volume determines the price of industrial goods which the North exports, as well as the volume of these exports. The relative international price of resources is then determined in equilibrium by the relative volumes of resources and of industrial exports. This price may therefore be positive even if resource exports from the South (plus the South's domestic consumption) do not exhaust

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[1] The determination of the volume of exports of resources is exogenous in the sense that the general equilibrium of the model is completely determined up to a level of these exports. Whether the level of resource exports is determined by policies of the South or of the North, is immaterial for the results.

the given bound on available resources.

Each region produces and consumes two commodities, basic consumption and industrial goods, with three factors of production, resources, capital and labor. Therefore there are five markets in each region, and, in equilibrium, five (endogenously determined) prices. The levels of output, consumption and employment, as well as international trade levels, are all determined endogenously at the world equilibrium.

Industrial goods are traded internationally in exchange for resources. In a world equilibrium internationally traded commodity prices are equal in both regions. However, different technologies in each region imply that other factor prices (labor and capital) may be different across regions, even though they are equal across sectors in each region.

It is of interest that a crucial condition behind the results on gains and losses from resource trade discussed above is the same that explains gains or losses from trade in basic goods in a previous paper, Chichilnisky [4], i.e. a form of technological duality represented by the sign of the inequality $\frac{c_2}{D} - \frac{2w}{p_B} < 0$, where D relates to the level of technological duality in the economy and $\frac{w}{p_B}$ is the real wage. If the importer has the opposite condition namely more homogeneous technologies $\left(\frac{c_2}{D} > \frac{2w}{p_B}\right)$ and a high rate of profit $\frac{a_1}{D} < 2r$ then the cross equilibria relation between oil exports and their (relative) price is shown here to be downward sloping, as it was the case for the exports for basic consumption goods in [4].

Thus under these conditions increases in resource exports will necessarily be accompanied by worse terms of trade for the exporter in terms of industrial goods. This may occur even if the increase in exports is determined by an increase in the (equilibrium) amount for oil demanded by the North. As will be seen in the proof of theorem 1, the sign of the expression $\frac{c_2}{D} - \frac{2w}{p_B}$ determines the slope of the relation between rates of profits and real wages across equilibrium. This can be regarded as indicating the degree of homogeneity of the economy, i.e. the extent to which the rewards to capital and labor move together, or in opposition. This relates to the finding of [4] in that the condition of duality $\frac{c_2}{D} - \frac{2w}{p_B} < 0$ was seen to bring about factor price inequalisation as exports of basic goods increased.

However, the similarity with the results in [4] does not go much further, essentially because an important factor in those results is that the export good is very labor intensive and is also the domestic 'wage 'good, which accounts for the bulk of wage income consumption. These characteristics definitely do not apply to resources. Here, instead, resources are mostly used domestically as an input to industrial goods. Wage income is spent on a basic consumption goods which is not internationally traded. The South exports an input of production rather than a consumption good , and the export activity is not labor intensive.

III Specification of the Macro Model

There are two regions called the 'North' and the 'South'. Each region produces two commodities: a basic consumption good B and a luxury/investment good denoted I (also called the 'industrial' good), and in addition the South produces a resource, which from now on we shall call oil, denoted θ. Goods B and I are consumed; oil is an input of production. The other two inputs are capital K and labour, L. The North exports industrial goods in exchange for oil from the South.

We shall first specify the model of one region, the South. The production system is formalised by the equations:

(1) $B^S = \min(L^B/a_1,\ \theta^B/b_1,\ K^B/c_1)$

(2) $I^S = \min(L^I/a_2,\ \theta^I/b_2,\ K^I/c_2)$,

where the superscripts on these indicate the sectors, and a constraint on oil supplies

$$\theta^S \leq \bar{\theta}.$$

The supply of factors K and L are price dependent, given by the following relations

(3) $L = \alpha(\frac{w}{p_B})$

(4) $K = \beta r$

where w denotes wages, r the rate of profit or quasi rent of capital and p_B the price of B.

In equilibrium we postulate the following demand behaviour

(5) $p_B B^D = wL$, where L is total labor employed,

i.e. B is a 'wage good'. Equation (5) is only valid in equilibrium; no disequilibrium demand behaviour is stipulated as we are only concerned here with behaviour across equilibria. While (5) simplifies the computations, it can be seen not to be crucial to the results of this paper: all that is required is that the proportion of wage income spent in the industrial good is significantly lower than that of profit income.

From the production relations (1) and (2) one obtains the demand for labour and capital when factors are efficiently used

(6) $$L^D = B^S a_1 + I^S a_2$$

(7) $$K^D = B^S c_1 + I^S c_2$$

These can be considered as a system of two linear equations in two unknowns, B^S and I^S, from which one obtains, in equilibrium:

(8) $$B^S = (c_2 L - a_2 K)/_D$$

and

(9) $$I^S = (a_1 K - c_1 L)/_D \quad ,$$

Where D is the determinant of the matrix of technical coefficients

$$\begin{matrix} a_1 & a_2 \\ c_1 & c_2 \end{matrix}$$

Let the super indices S and D denote supply and demand at the equilibrium of the South. Then the solutions of the model are given by the equilibrium conditions

(10) $$K^D = K^S, \text{ i.e. } c_1 B^S + c_2 I^S = \beta r,$$

(11) $$L^D = L^S. \text{ i.e. } a_1 B^S + a_2 I^S = \alpha \frac{w}{p_B}$$

(12) $$B^D = B^S, \text{ i.e. } \frac{w}{p_B} L = (c_2 L - a_2 K)/_D$$

(13) $$I^D = I^S + X_I^D \text{ , where } X_I^D \text{ denotes imports of I}$$

(14) $$\Theta^S = \Theta^D + X_\Theta^S = b_1 B^S + b_2 I^S + X_\Theta^S,$$

Where X_θ^S denotes exports of oil,

(15) balance of payments:

$$p_o \, x^S_\theta = p_I x^D_I$$

and the national income identity (Walras Law in equilibrium)

(16) $p_B B^D + p_I I^D = wL + rp_I K + p_o \Theta$, where Θ denotes total oil inputs supplied in equilibrium.

Equivalently, (16) can be written as

(16') $$p_B B^D + p_I (I^S + X^D_1) = wL + rp_L K + p_0 (\Theta^D + X^S_\Theta),$$

where Θ^D denotes the amount of oil inputs employed in the region, $\Theta^D = \Theta^S - X^S_\Theta$. Equations (16') and (16) are identical in equilibrium. Note that for given values of the international trade variables (p_o, p_I, X^S and X^D_I) the solutions to the model of the domestic economy of the South are given by 7 equations ((10) to (16)) in eight unknowns: L, K, B, I^S, Θ^S, p_B, r and w.

The model of the North is specified similarly to that of the South, but for some stylised characteristics (described by parameter values), which are discussed in the following sections, and the assumption that $\overline{\Theta} = 0$, i.e. the North produces no oil domestically.

The 2-region model is therefore specified by two sets of 14 equations plus the following four international trade equilibrium relations (the indices N and S in parenthesis are used to distinguish variables for the North and South when needed):

(17) $p_o(N) = p_o(S)$

(18) $p_I(N) = p_I(S)$

(19) $X^S_\Theta(S) = X^D_\Theta(N)$

and

(20) $X_I^S(N) = X_I^D(S)$.

Note, however, that in view of the balance of payments condition (15), only three of the four equations (17), (18), (19) and (20) are independent, for instance, (20) is always satisfied when (15), (17), (18) and (19) are. For the two-region North-South model we have therefore a system of 17 independent equations: 7 for each region and 3 for the international market. The endogenous variables of the North-South model are: 8 domestic variables of the South (K, L, B. I^S, θ^S, r, w, p_B), 7 for the North (same as for the South but with θ^S=0), and 4 international market variables: p_o, p_I, X_θ^S, X_I^S, making a total of 19. Since there are 17 equations and 19 variables, for each value of a given variable, say, the volume of resource exports X_θ^S, the solutions of the model are in principle locally unique <u>in relative prices</u>. It will be shown below that this is indeed the case, and therefore that as the oil exports vary, the equilibria of the North-South model describe a one parameter family. Along this our comparative statics exercises will be carried out in the following sections.

IV Solving the Model

This section will find explicit solutions to the model, showing in particular that the set of equilibria describe a one parameter family. The material of this section will also be useful in the study of the welfare effects of oil export policies of the following sections.

In the following, oil will be the considered numeraire, i.e. $p_O = 1$.

We shall first explore the relationships between factor markets and the domestic market for basic consumption goods in each region. These domestic markets will be linked, in turn, with the international markets for oil and industrial goods.

Consider now the equilibrium relation $B^D - B^S = 0$.

From (3) and (5) in equilibrium

(21) $$B^D = \alpha(\frac{w}{p_B})^2,$$

and from (4) (5) and (8)

(22) $$B^S = (c_2L - a_2K)/_D = (\alpha c_2 \frac{w}{p_B} - \beta a_2 r)/_D,$$

i.e.

(23) $$B^S - B^D = (\alpha c_2 \frac{w}{p_B} - \beta a_2 r)/_D - \alpha(\frac{w}{p_B})^2 = 0.$$

This is a quadratic expression in w/p_B, whose roots are

(24) $$w/p_B = {c_2}/_{2D} \pm \left(\left(\frac{c_2}{2D}\right)^2 - \frac{\beta a_2 r}{\alpha D}\right)^{\frac{1}{2}}.$$

Therefore, (24) gives two equilibrium values of real wages for each given rate of profit in equilibrium, as well as an upper bound for r, in each region:

(25) $$r < \frac{c_2^2\alpha}{4\beta a_2 D}.$$

Note that the smaller root of w/p_B in (24) is an increasing function of r, and the larger, a decreasing function of r.

We next study the relationship between domestic and international markets.

Consider the equation for imports of I, X_I^D. Across the equilibria of the South, by definition

(26) $$X_I^D = I^D - I^S.$$

By the national income identity (15) and the demand condition (5), we obtain the following equation for imports of industrial goods in equilibrium:

(27)' $$X_I^D(S) = r K + \frac{p_O}{p_I}\theta - I^S(S).$$

Now, across equilibria $p_I \; X_I^D(S) = p_O \; X_\theta^S(S)$ because of the balance of payments condition. Since $\theta = \theta^D + X_\theta^S$, we therefore obtain in an equilibrium of the South:

(28) $\quad r\,K + \frac{p_O}{p_I}\,\theta^D - I^S = 0.$ Substituting in (28) the equations for supply of labour and capital (3) and (4), and (9) for supply of I, (28) gives the following implicit relation between the international equilibrium price of industrial goods, p_I, and the domestic factor prices (rate of profit and real wages) in the South:

$$(29) \quad \beta r \left(r + \frac{a_1}{D}\left(\frac{b_2}{p_I} - 1\right) \right) + \alpha \frac{w}{p_B} \left(\frac{w}{p_B}\frac{b_1}{p_I} - \frac{c_1}{D}\left(\frac{b_2}{p_I} - 1\right) \right) = 0.$$

Since as we saw in (24), $\frac{w}{p_B}$ is a (two branched) function of r, substituting (24) into (29) one obtains an expression relating the rate of profit of the South r(s) and the international price of industrial goods, p_I, across equilibria.

For the North, consider the equation for exports of industrial goods $X_I^S(N)$. Recalling that the North does not produce oil, we obtain the equilibrium relation

$$(30) \quad X_I^S(N) = I^S - I^D = (a_1 K - c_1 L)/_D - r\,K$$
$$= \beta\left(\frac{a_1 r}{D} - r^2\right) - \alpha\frac{c_1}{D}\frac{w}{p_B},$$

where the parameters and variables refer now to the North.

We shall now show that for each given value of oil exports from the South $X_\theta^S(S)$, the North - South general equilibrium model is 'closed', and a solution can be given analytically.

Since $X_\theta^S(S) = X_\theta^D(N)$ in equilibrium, from (14), (3) and (4) one obtains an expression relating exports of oil and factor prices in the North:

$$(31) \qquad X_\theta^S(S) = \frac{\beta a_1 b_2 r}{D} + \alpha\left(b_1 \left(\frac{w}{p_B}\right)^2 - \frac{c_1 b_2}{D} \frac{w}{p_B} \right),$$

(the right hand side refers to variables and parameters of the North). Therefore for each level of oil exports, (31) gives an implicit relation between two factor prices in the North $r(N)$ and $\frac{w}{p_B}(N)$.

Together with equation (24), which gives another (independent) implicit relation between these factor prices $\frac{w}{p_B}(N)$ and $r(N)$, we can therefore obtain the equilibrium values $r(N)^*$ and $\frac{w}{p_B}(N)^*$ corresponding to each given oil export volume $X_\theta^S(S)$.

From equations (3) and (4) one then obtains total employment of labor and capital $L(N)^*$ and $K(N)^*$. Equations (8) and (9) are then used to compute the output of the consumption good B in equilibrium $B(N)^*$, and that of I, $I(N)^*$. From (31) we determine exports of industrial goods $X_I^S(N)^*$. From equation (14) we then determine the demand for oil from the North $\theta^D(N)^*$, and using the balance of payments condition, $\theta^D(N)^* = X_\theta^S(S)^* = p_I X_I^S(N)^*$, we obtain the international equilibrium price of industrial goods p_I^*.

Finally, we consider the following two price equations (for the North) which derive directly from the production relations (1) and (2) under the assumption of competitive use of factors:

$$(32) \qquad p_B = a_1 w + b_1 p_O + c_1 r p_I.$$

and

$$(33) \qquad p_I = a_2 w + b_2 p_O + c_2 r p_I.$$

Recalling that oil is assumed to be the numeraire, since both $p_I(N)^*$ and $r(N)^*$ are already known, we can obtain the nominal wage $w(N)^*$ from (33) and then from (32), the equilibrium price of B, $p_B(N)^*$, as well. This completes the computation of an equilibrium for the North, for each given volume of oil exports $X_\theta^S(S)$.

We now compute the equilibrium for the South, noting that for each given $X_\theta^S(S)$ we have already determined the level of imports of the South, since $X_I^D(S)^* = X_I^S(N)^*$ in equilibrium, and also the international equilibrium price for these imports p_I^*. Equations (24) and (29), give therefore two (independent) relations between real wages and the rate of profit of the South, whose equilibrium values we can then compute, $\frac{w}{p_B}(S)^*$ and $r(S)^*$. From equations (32) and (33) we then obtain $p_B(S)^*$ and $w(S)^*$; from (3) and (4) $K(S)^*$ and $L(S)^*$, from (8) and (9) $I^S(S)^*$ and $B^S(S)^*$, and from (14) $\theta(S)^*$. This completes the computation of a general equilibrium of the North-South model. Note that for each level of oil exports $X_\theta^S(S)$ there will exist in general more than one solution for the North-South model, depending on the initial parameter values and the characteristics of both economies, but only a finite number, i.e. the solutions are locally unique. Therefore, as the scalar $X_\theta^S(S)$ varies, we obtain (locally) a one-parameter family of equilibrium, which shall be studied in some detail in the following section. Note also that at some equilibrium a level of oil supplies below the feasible bound $\bar{\theta}$ may be obtained. This can be seen as follows. For each level of oil exports from the South $X_\theta^S(S)$, from the equilibria of the North (computed as above) we obtain the level of imports of industrial goods $X_I^D(S)^*$ and their equilibrium price p_I^*. Given these two variables, the domestic supply of basic and industrial goods in the South is then determined, B^{S*} and I^{S*}, and then, the domestic demand for oil in the South $\theta^D = b_1 B^S + b_2 B^S$. The feasibility condition requires that $X_\theta^S(S) + \theta^D(S) \leq \bar{\theta}$, but the above computation of total oil used does not imply that all the oil potentially produced is extracted, i.e. $X_\theta^S(S) + \theta^D(S) < \bar{\theta}$ is in principle possible. It is of interest, however, to remark that the fact that even though there may be "excess supply" of oil in equilibrium, the relative price of oil need not be zero because of the fact that the relative price of oil is determined by the international market equilibrium condition,

$$\frac{P_O}{P_I} = \frac{X_I^S\ (N)}{X_\theta^D\ (N)}$$

I.e. the model assumes a "passive" determination of relative oil prices by international real markets.

V. Gauging the advantages of oil export policies.

We shall now explore the welfare properties of a move towards a new world trade equilibrium with a higher level of oil exports from the South. As we shall see, certain characteristics of the economies of the North and of the South may affect rather strinkingly the outcome of such export policies, in terms of relative prices and the volume of industrial goods traded, as well as the real wages, and the overall consumption and employment of factors in both regions. We shall then be able to study the advantages and disadvantages of oil export policies, by focusing on the policy parameters that determine the welfare effects of such policies.

This section proves the main results analytically; possible policy implications are discussed later in the next section. The following stylized assumptions are now made on the technologies of both regions:

A.1 $D = a_1c_2 - a_2c_1 > 0$ in both regions, i.e. the industrial good is relatively more capital intensive and the basic consumption good more labor intensive.

A.2 The South's basic consumption uses mostly labor and very few oil and capital inputs, i.e. b_1 and c_1 are relatively small in the South.

A.3 $E = b_1a_2 - b_2a_1 \gtrsim 0$ in the North, i.e. the North's basic good is relatively more oil intensive and the industrial good more labor intensive (or they have approximately similar intensities in oil and labor both).

A.3 is a natural assumption e.g. when the "non-traded" good B in the North are services or certain manufactures, and the good I consists of consumer durables, vehicles, military equipment, etc. As it will be seen below, this assumption is not necessary to obtain the results, but it simplifies significantly the computations.

We can now prove

Theorem 1

Assume that the economies of the North and of the South are as specified in Sections II and III, and the following conditions are satisfied.

In the South

C.1 $\frac{c_2}{D} < \frac{2w}{p_B}$ and $\frac{a_1}{D} < 2\dot{r}$

e.g. the technology is 'dualistic' in its use of capital and labor, and thus D is large. In the North

C.2 $\frac{c_2}{D} > \frac{2w}{p_B}$,

e.g. there is a relatively homogeneous technology, and the rate of profit is relatively high so that $2r > \frac{a_1}{D}$.

Then a move towards a new world equilibrium with increased oil exports will necessarily worsen the terms of trade of the South and decrease its real revenues. Real wages, total employment and the domestic consumption of basic goods will all decrease in the South.

Within the North, the new equilibrium produces more employment, and increases both the real wages and the domestic consumption of basic goods. The rate of profit and total profit income increase in both regions with increases in oil exports.

Proof:

The strategy of the proof is as follows. First we show that under the conditions an increase in oil imports by the North raises the domestic rate of profit r(N) across equilibria. Next we show that as this rate of profit raises, the volume of the exports of industrial goods from the North $X_I^S(N)$ falls across equilibria, due to income effects in the North. This implies that in a world equilibrium with a higher volume of oil exports from the South, the industrial goods exports will necessarily decrease. Thus the terms of trade of the South will worsen and its real revenue (in terms of industrial goods) will fall as oil exports increase. The rest of the proof then traces the welfare impact of this international market behaviour on the domestic economies of the North and the South.

We establish in the first place that the rate of profit in the North r(N) increases with the volume of oil exports by the South, i.e.

$$\frac{\partial X_\theta^S(S)}{\partial r(N)} > 0.$$

[2] Note that the fact that $p_O \equiv 1$, and both w/r_B and r increase in the North does not imply that all factor prices move in the same direction in the North, since we are considering here real wages w/p_B deflated by the price of the good B, which is not the numeraire.

Consider the equation for oil imports by the North $X_\theta^D(N)$. Since the North produces no oil, $X_\theta^D(N) = \theta^D(N)$. In equilibrium, of course $X_\theta^D(N) = X_\theta^S(S)$, so that is sufficies to find the sign of $\frac{\partial X_\theta^D(N)}{\partial r(N)}$.

Now the total volume of oil demanded by the North is the sum of oil demanded in the industrial sector I and in the sector of basic goods B:

(34) $\theta^D(N) = X_\theta^D(N) = b_2 I^S + b_1 B^S.$

In order to find the relationship between oil imports and the rate of profit in the North we now write I^S and B^S as a function of total factors (labor and capital) employed:

$$(35) \qquad X_\theta^D(N) = \frac{b_2}{D}(a_1 K - c_1 L) + b_1 B^D,$$

$$= \frac{b_2}{D}(a_1 K - c_1 L) + b_1 \alpha\left(\frac{w}{p_B}\right)^2,$$

where we have made use of equations (5), (8) and (9). Since factors employed depend on their prices, ((3) and (4)) we obtain

$$(36) \qquad X_\theta^D(N) = \beta \frac{b_2 a_1}{D} r + \alpha\left(b_1 \left(\frac{w}{p_B}\right)^2 - \frac{w}{p_B}\frac{c_1 b_2}{D}\right),$$

so that

$$(37) \qquad \frac{\partial X_\theta^D(N)}{\partial r(N)} = \frac{\beta a_1 b_2}{D} + \alpha\left(b_1 \frac{2w}{p_B} - \frac{c_1 b_2}{D}\right) \frac{\partial w/p_B}{\partial r}.$$

In order to determine the sign of (37) we next study that of

$$\frac{\partial w/p_B(N)}{\partial r(N)}$$

Now, from equation (24) we can obtain an expression relating the changes in real wages and in the rates of profit in the North,

$$(38)\quad \frac{\partial w/p_B(N)}{\partial r(N)} = \frac{\beta a_2}{D\,\alpha\left(\frac{c_2}{D} - \frac{2w}{p_B}\right)}$$

Substituting (37) into (38) and rearranging terms one obtains:

$$(39)\quad \frac{\partial X_\theta^D(N)}{\partial r(N)} = \frac{\beta}{D\left(\frac{c_2}{D} - \frac{2w}{p_B}\right)} \left[2\,\frac{w}{p_B}\,E + b_2\right],$$

which in view of assumptions A.2 and C.2, is a positive expression. Therefore, the rate of profit in the North increases with the volume of oil exports across equilibria. Note that (39) could also be positive when $E < 0$. Since the assumption $E > 0$ is only used in this part of the proof, this shows that it is not strictly necessary for the results.

Next we consider the relation between the rate of profit in the North $r(N)$ and the volume of its exports of industrial goods, $\frac{\partial X_I^S(N)}{\partial r(N)}$. From equation (30), we have

$$(40)\quad \frac{\partial X_I^S(N)}{\partial r(N)} = \beta\left(\frac{a_1}{D} - 2r\right) - \alpha\,\frac{c_1}{D}\,\left(\frac{\partial w/p_B}{\partial r}\right)$$

and we shall now discuss the sign of both terms in the right hand side in order to determine that of (40).

From (38) and assumption C.2, the rate of profit and the real wage in the North are positively related, i.e.

$\frac{\partial w/p_B}{\partial r} \cdot > 0$. Furthermore, since by C.2 $\frac{a_1}{D} < 2r$, both terms in the right hand side of (40) are negative. It follows that as the rate of profit r(N) increases exports from the North decrease, i.e.

(41) $\frac{\partial X_I^S(N)}{\partial r(N)} < 0$, Since the supply of industrial goods I^S is an increasing function of r, and $X_I^S = I^S - I^D$, it follows that as r(N) increases, the demand for industrial goods in the North increases proportionately more than its supply, under the assumptions. Thus the negative sign of (41) is due to income effects within the North.

Together with equation (39), (41) implies

(42) $$\frac{\partial X_I^S(N)}{\partial X_\theta^D(N)} = \frac{\partial X_I^D(S)}{\partial X_\theta^S(S)} < 0, \text{ i.e.}$$

there is a negative association between the volume of oil exports and that of industrial imports across equilibria in our case.

Since $X_\theta^S(S) = p_I X_I^D(S)$, we have thus shown that

(43) $$\frac{\partial X_\theta^S(S)}{\partial p_I} > 0,$$

i.e. a move towards a world equilibrium with increased oil exports of the South increases the relative price of industrial goods, i.e. worsens the terms of trade of the South. Furthermore by (42) the volume of industrial imports of the South $X_I^D(S) = X_I^S(N)$ decreases with the volume of oil exported, so that the <u>real</u> revenues obtained by the oil exporter, in terms of industrial goods, have decreased as well. This completes the proof of the international market results of an increase of oil exports.

We now study the welfare implications of such an increase in oil exports on the domestic economies of the North and of the South. The proof will proceed by tracing the impact of the higher (relative) price of industrial goods p_I which accompany larger exports of oil on both economies. Under the assumptions, the rate of profit r(S) of the South will be seen to be positively related to

the international price of industrial goods p_I. However, because of the duality condition C.1, the rate of profit in the South r(S) is negatively correlated with real wages, employment and domestic consumption of B across equilibria of the South. This will then establish the stated effects on welfare of the South of increases in oil exports under the conditions of this theorem.

As technologies are relatively more homogeneous in the North, an increase in the rate of profit of the North r(N) is seen to be associated, instead, with higher real wages, employment and domestic consumption of B in the North. This will complete the proof of the theorem.

We study next the relation between the international price of industrial goods p_I and the rate of profit in the South r(S).

Firstly, note that as the rate of profit increases, total capital K available in the South increases, and therefore so does the supply of industrial goods, which are capital intensive. Formally, since

$$(44) \quad I^S = (a_1 K - c_1 L)/D$$

and $K = \beta r$ (from 4), we have

$$(45) \quad \frac{\partial I^S}{\partial r} = \frac{\beta a_1}{D} - \frac{c_1}{D}\left(\frac{\partial L}{\partial r}\right)$$

$$= \beta \frac{a_1}{D} - \alpha \frac{c_1}{D} \frac{\partial w/p_B}{\partial r},$$

which is positive since by the duality condition and (38), $\frac{\partial w/p_B}{\partial r} < 0$ in the South.

As the supply of industrial goods I^S increase with r, so does the demand for oil in the South, since B uses very few oil inputs (b_1 small), and oil demand is:

$$\theta^D(S) = b_2 I^S + b_1 B^S.$$ Therefore,

(46) $$\frac{\partial\theta^D(S)}{\partial r} \sim b_2\left(\frac{\partial I^S}{\partial r}\right) > 0.$$

Finally, from (28) the price of industrial goods is

(47) $$p_I = \frac{\theta^D}{I^S - rK} \quad ;$$

and we shall now check that it increases with r.

As the rate of profit in the South exceeds $\frac{a_1}{D}$ (C.1), the difference between industrial output and the return on capital decreases with r, since

(48) $$\frac{\partial}{\partial r} (I^S - rK) = \beta\left(\frac{a_1}{D} - 2r\right) - \alpha \frac{c_1}{D} \frac{\partial w/pB}{\partial r} < 0.$$

when c_1 is small.

Therefore, as r(S) increases, the denominator of (47) decreases and the numerator increases. It follows, in particular, that the international price of I industrial goods is positively associated with the rate of profit in the South i.e.

(49) $$\frac{\partial p_I}{\partial r(S)} > 0.$$

This implies that increases in oil exports are accompanied by a higher rate of profit in the South.

Now, by duality (C.1) and (38), such an increase in $r(S)$ has the opposite effect on real wages: $\frac{w}{p_B}(S)$ will decrease with oil exports.

From (3) this implies that total employment decreases in the South as well, and thus since $B^D = wL$ (by 5) it follows that the consumption of basic goods in the South decreases as well.

The welfare impact of increased oil exports on the economy of the North are the opposite. Since as exports of oil $X_\theta^S(S)$ increase the rate of profit in the North $r(N)$ increases (by (39)), and this rate of profit $r(N)$ is positively associated to real wages (by C.2 and 38), it follows that both factor prices (for labor and capital) increase in the North with oil imports. As real wages $w/p_B(N)$ increase, by (3) total employment of labor $L(N)$ increases in the North implying that total consumption of basic goods in the North, $B^D = \alpha\left(\frac{w}{pB}\right)^2$ (by (5) and (3)) also increases.

This completes the proof of the theorem.

In view of the negative welfare effects on the South of increased oil exports, it seems natural to enquire whether an economy with the characteristics of the South in theorem 1 will export oil at all. One possible answer is that such an economy may export oil because the welfare effects of increased oil exports are not the same across all income groups: as seen above both the rate of profit and the total profits income of the South increase with increases in oil exports, even as total real revenues of the region as a whole decrease. The next corollary sharpens this result to exhibit more clearly the role of the conditions of theorem 1 on the welfare of different income groups.

Corollary 2

Consider a move towards a new world equilibrium with increased oil exports from the South and lower real export revenues. Then if the economy of the South has the characteristics of theorem 1 both the rate of profit and the total profit income of the South will have increased at the new equilibrium, and this is independent of the characteristics of the economy of the North.

Proof

Consider a new equilibrium with increased oil exports, in which real revenues of the South have decreased, $\frac{\partial X_\theta^S\ (S)}{\partial X_I^D\ (S)} < 0$.

This implies that the relative price of industrial goods p_I have increased in the new equilibria, i.e. the terms of trade of the South have worsened. From (49) this implies that the rate of profit in the South r(S) has increased. Since by (4) $K = \beta r$, total capital employed also increases in the South. Therefore since r, p_I and K increased, the total profit income r p_I K will necessarily have increased as well, completing the proof of the corollary.

We now explore conditions under which more positive welfare effects on the South can be expected from increases in oil exports. The next results highlights the role of technologies of the South in the determination of welfare effects of oil export policies:

Theorem 2

Assume that the economies of the North and the South are as in theorem 1, except that the condition of dual technologies in the South $\frac{c_2}{D} < \frac{2w}{p_B}$

is replaced by $\frac{c_2}{D} > \frac{2w}{p_B}$ *, e.g. more homogenous technologies. Then an increase in oil exports will worsen the South's terms of trade and decrease its real revenues , but real wages, employment and domestic consumption of basic goods will all increase in the new equilibrium of the South, as well as its profits.*

Proof

An increase in X_θ^S will have a negative impact on the equilibrum volume of impor of industrial goods X_I^D and the South's terms of trade. This is because these effects depend only on the general equilibrium reaction of the North to increased oil exports from the South, and the Northern economy is assumed to have the same characteristics as in theorem 1.

Next, note that as in theorem 1 increases of oil exports X_θ^S increase the rate of profit in the South in this case as well, even though for different reasons.

From (47)

$$p_I = \frac{\theta^D}{I^S - rK} \cdot$$ In this case the expression

$$\frac{\partial}{\partial r(S)} \; (I^S - rK) \; = \; \beta(\frac{a_1}{D} \; - \; 2r) \; - \; \alpha\frac{c_1}{D} \; \frac{\partial w/p_3}{\partial r} \tag{50}$$

has a negative sign,

and the expression

$$\frac{\partial e^D}{\partial r(S)} = b_1 \; \frac{\partial I^S(S)}{\partial r(S)} \; = \; \beta \; (\frac{a_1}{D} \; - \alpha \; \frac{c_1}{D} \; \frac{\partial w/p_B}{\partial r} \;)$$

is positive when c_1 is small. It follows that the rate of profit $r(S)$ increases with oil exports, because as seen above $\frac{\partial x_\theta^S(S)}{\partial p_I} > 0$.

Now, consider equation (38), that determines the relation between the rate of profit $r(S)$ and the real wage in the South.

$$\frac{\partial w/p_B}{\partial r(S)} = \frac{\beta a_2}{D\alpha\left(\frac{c_2}{D} - 2\frac{w}{p_B}\right)}$$

When technologies are relatively homogeneous in the South, so that

$\frac{c_2}{D} > \frac{2w}{p_B}$, this derivative is positive, so that real wages increase with the rate of profit.

Therefore, as oil exports increase, so do real wages. From (3) employment in the South also increases, and from (5) domestic consumption of B increases as well. This completes the proof.

Finally, we explore conditions under which the real revenues of the oil exporter can be expected to improve with higher volumes of exports. Here we must of course require different characteristics of the oil importer than those of theorem 1. We have the following:

Theorem 3

Assume that the oil importer has the characteristics of theorem 1 *with two major exceptions:*

1. *its technologies are relatively dual,*
   i.e. $\frac{c_2}{D} - \frac{2w}{p_B} < 0$.

2. *its basic goods sector uses relatively few capital inputs,* $c_1 \sim 0$.

Then an increase in oil exports will increase the real revenues of the oil exporter and improve its terms of trade. Within the oil importing country, the rate of profits and the domestic use of industrial goods both decrease but real wages, employment and consumption of basic goods all increase in the new equilibrium.

Proof

Under the conditions of this theorem from equation (39)

$$\frac{\partial x^D}{\partial r} = \frac{\beta}{D\left(\frac{c_2}{D} - \frac{2w}{p_B}\right)} \left(\frac{2w}{p_B} E + b_2\right) < 0.$$

which implies that the rate of profit decreases in the oil importing country as its imports of oil increase.

From equation (40), since $c_1 \sim 0$, we obtain

$$\frac{\partial x_I^S}{\partial r} = \beta\left(\frac{a_1}{D} - 2r\right) - \alpha\frac{c_1}{D}\left(\frac{\partial \frac{w}{p_B}}{\partial r}\right) < 0,$$

which implies that the volume of industrial goods exports increase with oil imports, across equilibria. Thus, the real revenues of the oil importer improve with increased oil exports.

Since $\frac{c_2}{D} - \frac{2w}{p_B}$ is now negative within the oil importing country, from (38) and (3) and (5) lower rates of profits are associated to higher real wages, employment and domestic consumption of basic goods.

From (45) and the fact that $\frac{c_2}{D} - \frac{2w}{p_B} < 0$, it follows that the domestic supply of industrial goods, I^S, has now decreased. Since domestic use of industrial goods I^D equals $I^S - X_I^S$, exports X_I^S have increased, and output I^S decreased, the new equilibrium volume of industrial goods used domestically I^D is lower. This completes the proof.

VI Discussion and Conclusions

The results suggest that differences in certain macro characteristics of the trading economies will lead to rather different outcomes of resource export policies. This section will summarise our findings and suggest ways in which they may be useful in the analysis of policy.

In the first place we shall discuss the impact of the general equilibrium responses of the resource importing region on international markets.

A first result indicates that when our specification of the trading economies is applicable, then both the terms of trade and the export revenues of the resource exporter can be expected to worsen as the volume of its exports expands when the importing economy has the following stylized characteristics: a technologically homogeneous, integrated economy with a relatively high rate of profit, and where capital and resource intensities in the industrial and consumption goods sectors are relatively similar. This result is less than immediate, and may be worth discussing its causes.

Firstly we note that as real revenues of the resource exporter are measured in terms of industrial goods, this result establishes that at a new equilibrium a higher volume of resources will be traded for a lower volume of industrial goods. The worsening of the terms of trade follows: the relative price of industrial goods will necessarily increase at the world equilibrium. This clearly implies the existence of a negative correlation across equilibria between the price of industrial goods, and their volume of exports from the industrial economy. This negative correlation is similar to that demonstrated in [4], but in that case, it was valid only for the exports of labor intensive basic consumption goods from a developing country. Both cases, however, are due to general equilibrium income effects as shown in [4] and discussed below.

As the proof of theorem 1 demonstrates, under the appropriate conditions, the income effect of a price change of industrial goods is stronger than the price effect within the industrial economy. This is an effect that can only be observed in a general equilibrium model: As the price of industrial goods rises, their domestic supply increases, but their domestic demand increases and relatively more, thus lowering the surplus available for exports. Now, since a higher volume of oil exports is shown (in theorem 1) to be associated with higher profits in the industrial economy, and an increase in profit income increases the domestic demand for industrial goods, the final result is that higher volumes of oil exports are associated with lower volumes of industrial exports.

The welfare effects on the industrial economy of its improved international situation are positive: since the economy is rather homogeneous and integrated, the increased domestic demand and supply for industrial goods leads to higher levels of overall employment, real wages, and consumption of both goods. The impacts of increased resource imports are thus unambiguously positive for such an industrial economy.

However, these results are reversed when the resource importing economy is less homogeneous, has a "dual" technological structure, and uses few capital and resource inputs in its basic consumption good sector. These are characteristics more appropriate, perhaps, for a developing resource importing economy. In this latter case, as resources imports increase, the exporter can expect higher real revenues and better terms of trade. The impact of higher resource imports on the importing economy are however less positive. This is demonstrated in theorem 3 by tracing the general equilibrium effects symmetric to those of theorem 1. The importing country's rate of profit and the volume of industrial goods it uses at the new equilibrium , are both lower. However, real wages, employment and consumption of basic goods increase at the new equilibrium of the importing country. Increased resource imports seem to lead to 'de-industrialisation' in this case, a more basic consumption/production oriented economy.

The previous discussion dealt with impacts of increased exports of resources o the importing country and on the international economy. We shall now discuss the impact of these international markets changes on the resource exporter.

In symmetry with the above results, differences in the degree of technological dualism and of lack of integration in the exporting region also lead here to rather different results.

Theorem 1 explores the case where the resource exporting economy has a dual technology, uses few capital and resource inputs in its basic consumption sector, and has initially a relatively high rate of profit. In this case , increases in resource export volumes increase domestic profits and total profit income .This occurs even as the export revenues of the region as a whole fall.

Yet, due to the dualism and lack of integration of this economy, these increased profits lead to lower levels of employment, real wages and wage income, and a decreased output and consumption of basic goods within the resource exporting economy. As a matter of fact, in order to keep the previous level of domestic consumption of industrial goods, the region must now increase its domestic output, since its imports have decreased. The only gain of increased resource exports is in the increase of profit income. These results are traced in theorem 1, where, as in [4], the general equilibrium income effects are shown to depend significantly on the conditions of dualism of the economy. This appears more sharply in Corollary 2, which explores these results taking into consideration the characteristics of the exporting economy only.

The overall conclusion is that, under the conditions, an integrated and homogeneous importing economy may benefit unambiguously from increased exports of resources from an exporting region which has a dual economy. For the resource exporter, necessary conditions for benefitting from increased resource trade seems to be to trade with similar economies, and to keep its economy as integrated and homogeneous as possible.

Under the conditions studied here, a region that exports resources for which it has no use in the bulk of its economy (the subsistence sector) and whose exports proceeds mostly benefit its smaller internationally linked industrial sector, can only see its international position worsen in the long term if it trades with a homogeneous industrial economy. Due to a negative effect on domestic terms of trade, the welfare impacts on its subsistence sector will be negative. This occurs even when there is no competition for scarce inputs between the subsistence and the resource sectors, and even though labor is also employed in the industrial sector. The revenues from resource exports translate in this case into higher profit income that does not necessarily 'circulate' through the economy, and tend to raise the prices for the imported industrial good, without necessarily bringing about welfare improvements.

As stated in Section 1, a number of extensions and improvements on this model seem possible and desirable, in particular, some of the dynamic aspects of the problem may be usefully developed.

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