International Trade in Resource Goods and Returns to Labor in the Non-Resource Sectors

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Abstract. The World Trade Organization (WTO) is among those institutions that advocate free trade in goods, service and capital among nations. This view is not shared universally, however, especially when there are important natural resource, environmental and labor issues at stake. In fact, some countries discourage the exportation of natural resource goods, while others encourage such trade. This paper examines possible explanations for these differences, focusing on the roles of (a) the "taste" for the resource goods in the domestic economy and (b) diminishing returns to labor in the non-resource sectors.

Keywords: WTO, trade, diminishing returns, renewable resources, non-resource sector

Introduction

Why are some countries with important natural resource sectors reluctant to engage in international trade while others embrace the opportunity with enthusiasm? Does the answer lie in different attitudes toward protecting domestic industries from foreign competition? Does reluctance to trade reflect the belief that exports of resource goods will lead to degradation of the natural resource sectors, especially where such sectors are not managed? The success of the World Trade Organization (WTO) and other trade agreements may rest, in part, on finding the answers to these questions. This paper is a modest contribution to the discussion.

In fact, there is a growing literature on the consequences of trade for a country with an important renewable resource sector. McRae (1978) is among those who have explored trade issues for an economy whose resource sector is characterized by open access externalities. Segerson (1988) presents an excellent summary of the pre-1986 literature on this topic. More recently, Chichilnisky (1994) has argued that, under open access conditions a country may mistakenly behave as if it had a comparative advantage in producing resource goods, exacerbating the problem of the production externality. Important insights have been generated by Brander and Tayler (1997a, 1997b, 1998), who have considered the impacts of trade between two countries, each of which has a resource sector that is characterized by "open access" conditions. These analysts argue that the resource-exporting country experiences real income losses while the importer gains. When even one of the countries adopts a resource management strategy, it is possible that both will gain from trade. Emami and Johnston (2000), using the Brander-Taylor framework, have shown that there are circumstances where, when two countries are trading, resource management by the importing partner may lead to losses for both countries. This possibility emerges when resource management leads to higher prices of the resource good such that the (negative) terms of trade effects outweigh the gains from resource management. The importer loses and, as in the Brander-Taylor model, so does the exporter.

Recently, Hannesson (2000) has demonstrated persuasively that exporters of natural resource goods need not experience losses from higher export prices, even under open access conditions. He points out that such losses depend on "the assumption that there are constant returns in the production of other commodities (p. 123)." Through using an alternative, "specific diminishing-returns production function (ibid)," Hannesson is able to demonstrate that a country which expands exports of the resource good in response to a higher price may experience a welfare gain.

In this paper we look behind this intriguing argument. In particular, we explore possible reasons for why trade may benefit some countries but not others and we investigate the possibility that one explanation lies in the *extent* of the diminishing returns to labor in the non-resource sectors. Our analysis preserves the prevailing model in the literature, including the assumed production and consumption relationships, as well as the assumption of steady-state conditions. The paper reports on our findings to date in the form of hypotheses for further examination at both conceptual and empirical levels. Our work suggests that a country's willingness to permit exports of natural resource goods may be negatively related to (1) the wage-rate elasticity of demand for labor in its non-resource sectors and (2) the relative "taste" for the resource good in the domestic market. Additional exploration of the underlying relationships may increase understanding of why some countries are reluctant to import manufacturing and agricultural goods in exchange for natural resource goods, while other countries encourage such trade. We extend the analyses discussed above, focusing on the roles played by relative demands for the resource good and the nature of the production relationship in the rest of the economy, i.e., the non-resource good sectors.

The model

Following Hannesson, we focus on a single country, characterized by goods produced in two competitive sectors: *H*, a renewable, natural resource sector and *M*, the rest of the economy. The framework is general equilibrium, with *M* serving as the numeraire. The country is a price-taker in world markets and our interest is in the welfare effects of moving from autarky to free trade in response to higher world prices of the resource good. Will the losses that accompany a shifting of factors of production into the "inefficient," open-access, natural resource sector be offset by the real income gains from favorable terms of trade and on what factors do the net gains or losses depend? Our renewable resource is a fishery.

We retain the simple, two input, two good, steady-state production model of the current literature, as follows:

$$H^P = AKL_H\left(1 - \frac{A}{r}L_H\right) \tag{1}$$

$$M^P = L_M^{\gamma} \tag{2}$$

$$L = L_H + L_M \tag{3}$$

where A is a positive constant sometimes known as the "catchability coefficient," r is the "intrinsic growth rate" of the stock of the resource and is what makes it "renewable," K is the "carrying capacity" of the fishery, L is the total labor supply in the economy, while L_H and L_M are the amounts of labor used in the production (harvesting) of *H* and *M*, respectively. The exponent, *P*, stands for "production," while the exponent, γ , is a measure of the productivity of labor in the production of *M* (actually, it is the production elasticity of labor in *M*). In the Brander-Taylor framework, $\gamma = 1$ while, for Hannesson, $\gamma = 0.5$. Because of our interest in the role played by this coefficient we simply specify that $0 < \gamma \leq 1$, thereby ruling out increasing marginal returns to labor. Note that, while unspecified in this abbreviated version of the model, there is a second factor of production in the *H* sector: the stock of the natural resource good. Under open access conditions, it is generally assumed that economic returns to this stock - a rent - are driven to zero because of the absence of an owner to collect these returns. This results from equating the wage rate, *W*, to the value of the average product of labor in *H* and to the marginal product of labor in *M*:

$$P_H \cdot AK\left(1 - \frac{A}{r}L_H\right) = W \tag{4}$$

$$P_M \cdot \gamma\, L_M^{\gamma - 1} = W \tag{5}$$

where P_H is the price of the resource good and P_M , the price of the output of the non-resource sector, is unity.

On the demand side we retain the Brander-Taylor specification of the aggregate utility (welfare) function:

$$U = (H^C)^B (M^C)^{(1-B)} \tag{6}$$

where the "*C* " exponent donates units consumed and *B*, a "taste" indicator, is a second variable of interest in determining whether there are net gains from trade.

Clearly, any "results" that come from analysis of this model may be peculiar to the specification of the model itself. The purpose of the exercise, then, as stated earlier, is to generate possible insights into what may motivate countries' decisions on trade in natural resources and, perhaps, suggest both testable hypotheses and directions for future conceptual work.

Trade and Welfare[1]

The indirect utility function for the above model is

$$U^* = \Phi\, P_H^{-B}(P_H H^P + M^P) \tag{7}$$

where $\Phi = B^B(1 - B)^{(1-B)}$

By differentiating U^* with respect to the P_H we can investigate the determinants of whether a higher price of P_H, obtainable by shifting from autarky to trade - one that increases the incentive to expand production of (and to export) *H* - raises, reduces or has no effect on the country's economic well-being.

Thus,

$$\text{(8)} \qquad \frac{dU^*}{dP_H} = -B\Phi\, P_H^{-(B+1)}(P_H H^P + M^P) + \Phi\, P_H^{-B}\frac{d(P_H H^P + M^P)}{dP_H}$$

Equation (8) shows that the response of the optimal utility level to a change in the price of the resource good is the sum of (a) the response of optimal utility to a change in relative prices, holding income constant, resulting from an adjustment in the consumption mix and (b) the response of optimal utility to the new income level resulting from the price change (a change in relative prices affects the product mix and, thus, the income generated from production.). This new income level would, by itself - i.e., without considering the direct impact of a price change on consumption - change the consumption mix and, hence, utility.

Note that (b) is the product of (i) the rate at which U^* changes with income, holding prices constant (i.e., the marginal utility of income) and (ii) the change in income that results from the price change. This latter quantity can be further decomposed into changes in labor and non-labor income (see appendix).

So that:

(9)

$$\frac{d(P_H H^P + M^P)}{dP_H} = \frac{d(WL_H)}{dP_H} + \frac{d(WL_M)}{dP_H} + \left(\frac{1-\gamma}{\gamma}\right)\frac{d(WL_M)}{dP_H}$$

The first term is positive. With an increase in the price of the resource good, wage rates rise and more labor is drawn into the resource sector. Note that this is the case even if the production of H declines with an increase in its price. With more labor in the H sector, total payments to labor in that sector must rise. (This would be true even if there were no change in the wage rate; i.e., even if $\gamma=1$). The sign on the second term is negative because, since $0<\gamma\leq 1$ the demand for labor in the M sector is wage-rate-elastic[2]. Payments to labor in the non-resource sector will fall because the increase in the wage rate is less, on a percentage basis, than the decrease in labor employed in that sector. Finally, the last term is negative as well. With fewer units of M being produced and no change in its selling price, P_M, rental payments to the "fixed" factor in that sector must decline. As demonstrated in the appendix, however, the resource price and the total income level move together. In particular, the country's income is higher at higher prices of the resource good[3].

The situation can be depicted graphically. In Figure 1b, L represents the total labor in the economy and the VMP_{LM} curve is a graphical representation of equation (5)[4]. The horizontal difference between these two relationships is drawn as S_{LH} in Figure 1a and shows, for each wage rate, the quantity of labor available for the production of H. The VAP_{LH} curve depicts equation (4), so that equilibrium in the labor market occurs at W^*, with L^*_H used to produce H and L^*_M used in the production of M.

In equilibrium, the total payment to labor is given by the rectangle OW^*TL in Figure 1b, while rental earnings in the M sector are given by the area under VMP_{LM} and above W^*R. No rent is earned in the H sector.

An increase in P_H is reflected in an upward shift of VAP_{LH}, to VAP'_{LH}, as shown in Figure 1a. The wage rate rises to $W'$and payments to labor increase to $OW'T'L$, while rental earnings in the M sector decline by the amount $W^*W'R'R$. The net gain in total factor payments is $RR'T'T$.

This higher income, all of which we assume accrues equally to the members of the population included in L, allows consumption of both H and M to rise and, as suggested by equation (8) leads to a higher utility level. Note that this is the case even though labor shifts from the M to the H sector[5].

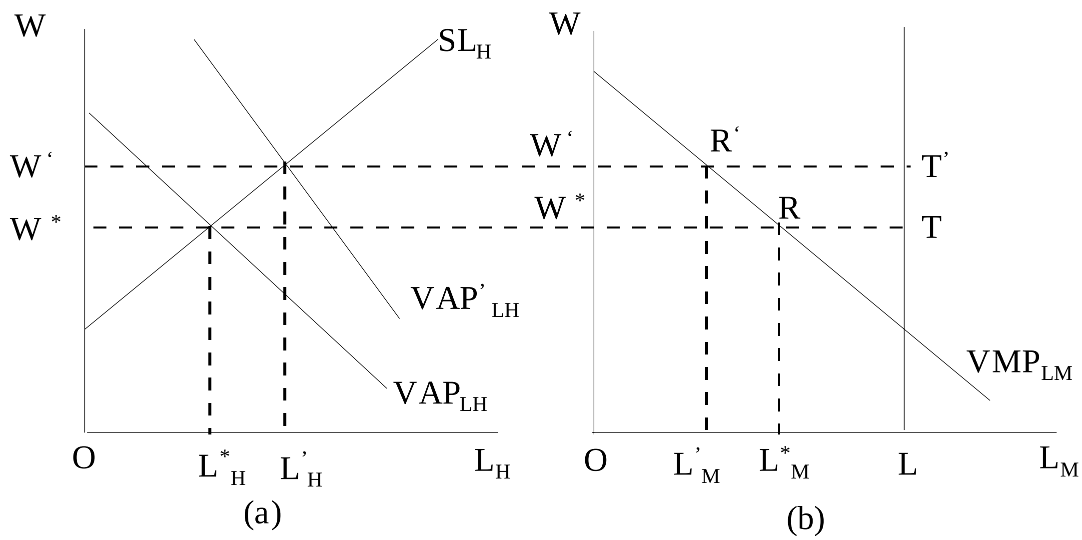

Figure 1: An Increase in P_H: Effects on Factor Payments

However, the increase in P_H has a more direct effect on U which, as indicated by equation (8) is negative[6]. At issue is whether the utility gain from higher net factor payments is high enough to offset the utility loss from higher prices of the resource good. To address this, we are attempting to determine, analytically, the relationships between parameter values and gains from trade, if any.

Meanwhile, we report simulation results (Table 1) that may suggest possible relationships. Note, however, that our chosen parameter values preclude the use of labor beyond maximum sustainable yield levels in the production of H, a condition that significantly restricts our ability to generalize our findings.

Table 1 reports, for selected γ and β combinations, both autarky prices and the lowest prices of H, $(\overline{P})$, for which the country experiences gains from exporting H without specializing in the production of H. In the table, autarky prices are higher at higher values of γ and/or β. This is also the case for the $(\overline{P})$ prices. Thus, for the selected values and ranges of the model parameters, it appears that the greater this country's "taste" for H (as reflected in higher β values) and\or the closer to "constant returns to labor" in the M sector (the higher γ), the higher must be the price of H in international markets for this country to gain from exporting H. Furthermore, export prices must be substantially above autarky prices to induce trade, at least in some cases.

Another way of saying this is that countries with relatively low γ and β values are likely to participate in international trade as exporters of the resource good over a wider range of prices than are those with higher values of those parameters. Assuming these findings hold up analytically, we offer possible explanations for the implied relationships. For given values, nominal income falls as γ decreases. Under the conditions we specify, which preclude a "positively-sloped" segment of the production possibilities frontier, lower γ values lead to a reduced set of production possibilities, lower income levels and, hence, except at extremely low γ values (not shown here), lower autarky prices. Similarly, for given γ values (i.e., given production possibility frontiers), "steeper" indifference curves (along a given ray from the origin, reflecting lower β values) intersect the frontier at lower H values in autarky, which, given the negative slope and concavity of the production possibilities frontier, means lower autarky prices of H. This, in turn, reduces the international price levels necessary to induce trade.

γ	0.7		0.3		0.05	
B	Autarky	$(\overline{P})$	Autarky	$(\overline{P})$	Autarky	$(\overline{P})$
0.9	1.94	3.63	.89	1.26	.72	.77
0.5	.96	1.65	.20	.29	.09	.10
0.1	.64	.78	.07	.09	.01	.02

(k=1000, L=50, r=.2, A=.0015 and $M^P = 4L_M^{\gamma}$)

Table 1. Autarky and Minimum Trade Prices $(\overline{P})$ for Various γ, B Combinations

Implications

If these preliminary findings hold up under more detailed analysis, they suggest that countries with relatively less elastic demands for labor in their non-resource sectors may be more inclined to participate in international trade as exporters of their resource good. In the case of the production function used in this example, this means that, all else equal, the lower the production elasticity of the non-resource sector with respect to labor usage in that sector, γ, the greater the gains (or the smaller the losses) from increased world prices of the resource good. There are many possible explanations for difference in the γ values across countries. One explanation could be that labor is simply more productive in some countries than in others, possibly due to differences in human capital (through education, for example), the quality of the "fixed" factor, such as land, or the level of technological progress. Another explanation is that even countries with identical natural resource sectors may differ in what is produced in their non-resource sectors: some may have extensive agricultural sectors while others emphasize manufacturing. In any event, it seems clear that efforts to understand the willingness of countries with important natural resource sectors to participate in international trade must examine conditions in both the resource and non-resource sectors.

Our findings also suggest that those countries for which the taste for the resource good is low, relative to that for goods from the non-resource sectors, may be trade-oriented over a broader range of world-wide prices. Here, again, the comparison is with goods produced in the non-resource sectors which may, of course, differ across countries.

Before collecting data to test these arguments empirically, we intend to develop the analytical framework more fully. Meanwhile, we hope the work to date will spark interest within the WTO and the research community in looking at the role of conditions in the non-resource sectors of various economies and in the domestic demands for resource and non-resource goods to help understand why some countries choose to participate in international trade while others do not.

In this paper we have focused on the case where the natural resource sector is characterized by open access conditions. In fact a similar story can be told for the case where that sector is managed, a topic left for a future paper.

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Appendix

From (4), $\dfrac{P_H H^P}{L_H} = W$ or, $P_H H^P = WL_H$

From (5), $\dfrac{\gamma M^P}{L_M} = W$ or, $M^P = \dfrac{WL_M}{\gamma}$

Thus,

$$P_H H^P + M^P = WL_H + \frac{WL_M}{\gamma} = W(L_H + L_M) + \left(\frac{1-\gamma}{\gamma}\right) WL_M$$

That is, total income can be broken into payments to labor, $W(L_H + L_M)$, plus payments to the

(implicit) non-labor input used to produce M, $\left(\frac{1-\gamma}{\gamma}\right) WL_M$.

From this,

$$\frac{d(P_H H^P + M^P)}{dP_H} = \frac{d(WL_H)}{dP_H} + \frac{d(WL_M)}{dP_H} + \left(\frac{1-\gamma}{\gamma}\right)\frac{d(WL_M)}{dP_H}$$

which is equation (9) in the text. Note that we also can write:

$$\frac{d(P_H H^P + M^P)}{dP_H} = \frac{d(WL_H)}{dP_H} + \frac{d(M^P)}{dP_H}$$

$$\frac{d(P_H H^P + M^P)}{dP_H} = W\frac{dL_H}{dP_H} + L_H\frac{dW}{dP_H} + \gamma L_M^{\gamma\text{-}1}\frac{dL_M}{dP_H}$$

From (5), $\gamma L_M^{\gamma-1} = W$, and we know that $\frac{dL_M}{dP_H} = -\frac{dL_H}{dP_H}$,

thus,

$$\frac{d(P_H H^P + M^P)}{dP_H} \equiv W\frac{dL_H}{dP_H} + L_H\frac{dW}{dP_H} - W\frac{dL_H}{dP_H} = L_H\frac{dW}{dP_H} > 0.$$

Endnotes

1.As used here, “welfare” refers to the well-being of this country, as measured by *U*. It is not intended to have normative implications but, rather, to aid in our understanding of what underlies trade policy differences among countries with important natural resource sectors.

2.From equation (5), note that this elasticity is [1/(γ - 1)]

3.In this analysis, “income” refers to nominal, not real, income. We use changes in the utility measure as an indicator of real income changes.

4.The relationships are depicted as straight lines for convenience, only.

5.Such a result does not occur where γ=1 (the Brander and Taylor case) because the wage rate does not respond to changes in P_H.

6.This is the only effect on utility in the case where γ=1.