Trade, Resources and Subsistence

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ABSTRACT

Using a general equilibrium model that has a resource (fisheries) sector and that incorporates subsistence consumption into consumer preferences, we examine the costs and benefits of participating in international trade. In some cases income transfers may permit potential, but otherwise unachievable, gains from trade to occur.

Keywords: Trade, Resources, Subsistence, Poverty, Fisheries, WTO

I. INTRODUCTION

There exists a rich literature that addresses, from a conceptual perspective, the correction of natural resource and environmental externalities in the context of international trade (see, for example Sutton, 1988; Batabyal and Beladi, 2001). Much of this literature draws upon the Ageneral theory of distortions@ associated with Haberler (1950); Bhagwati and Ramaswami (1963); Bhagwati, Ramaswami and Srinivasan (1969) and focuses on the design of environmental and trade policies that improve the welfare of an open economy. Contributions have been made on how the "optimal tariff" framework can be utilized in the course of addressing environmental externalities (Krutilla, 1991). The associated welfare changes are not "gains from trade" but are, rather, gains from the reduction of externalities for a country that is already trading. That is, this literature compares the economic well-being of trading countries before and after the implementation of environmental or resource management policies. Recent extensions include consideration of cross-boundary externalities, imperfectly competitive markets and strategic behavior among trading partners (Kennedy, 1993; Copeland and Taylor, 1995; Ruseski, 1998).

There exists a parallel literature whose focus is on whether countries with internal environmental - natural resource externalities experience gains from trade similar to those experienced by countries without such externalities (Segerson, 1988). In contrast to the work cited above, the comparison in this literature is between trade and autarky situations. Chichilnisky (1994), Brander and Taylor (1997a, 1997b, 1998) are among those who have explored, from a conceptual perspective, the consequences of trade in a natural resource good within a two-good, two-factor, two-country general equilibrium framework. The primary lesson from this work is that trade may exacerbate the problem of excessive use of productive factors in the natural resource sector (for example, the "open access" problem of an unmanaged fishery[1]) by expanding the demand for goods produced by that sector. Trade, then, may reduce real incomes for the country that appears to have a comparative advantage in the production of the natural resource good to below its autarky level. In the case where one of the trading partners manages its natural resource sector (viewed as a substitute for strengthened property rights) while the other does not, a similar result may emerge unless, with trade, the latter country is so severely exploiting its resource sector in autarky that trade leads it to import the resource good. 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, the exporter loses as well. It may be possible, however, to mitigate the damage through the use of more trade-sensitive approaches to resource management.

Recently, Hannesson (2000) has demonstrated 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. Our IIFET 2000 paper explores this issue in some depth and illustrates the sensitivity of the gains from trade to the degree to which there are diminishing returns to labor in the non-resource sector. Our objective was to 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.

2. WHAT ABOUT POVERTY?

Meanwhile, events "on the ground" have been capturing the attention of policy-makers and analysts. Actual and proposed trade agreements, including those under the World Trade Organization (WTO), have raised questions (and generated large-scale protests) about the impacts of such agreements on labor and the environment.(see for example, Anon.). Among the concerns is that those in subsistence sectors of less-developed countries will suffer economic harm from trade that further degrades the environment within which they exist or that replaces their labor and small-scale production techniques with more modern and technically-efficient process, either at home or in competing countries abroad.

This aspect of "trade and the environment" is an interesting and often-overlooked feature of the Chichilnisky model. Workers in the subsistence sector use their labor to extract resources from a natural resource pool which, in turn, is used to produce a resource-intensive final good for export and a capital-intensive good that is both produced domestically and imported. The subsistence harvester exchanges the resource good for the capital-intensive good at competitive market prices. Chichilnisky demonstrates that, under the assumption of a low elasticity of commodity substitution between the capital-intensive good and leisure (in utility for the subsistence worker), a tax imposed on the resource good will not only fail to reduce the harvesting activity but will expand it. This follows because, within the general equilibrium context, the assumptions lead to a backward-bending supply of labor and, thus, of the resource good. The tax, intended to correct the "open access" problem, in fact "can increase poverty and lead to more (resource) extraction." (Chichilnisky, p. 864). The tax leads to a lower price that workers receive for their product and "can force (them) to work harder and lead them to extract more rather than less of the resources."(*ibid*., p. 855).

3. MODELING TRADE, RESOURCES AND SUBSISTENCE

The present paper builds on the growing literature on trade and the environment, including our own work, with particular attention to the consequences of trade for a small country in which the exportable resource good is produced in a subsistence sector**.** Our approach differs from Chichilnisky's in several respects. First, the resource good in our model is not an input but, rather is one of two goods produced in the economy. Second, we by-pass the leisure-goods issue and treat the subsistence question directly through the individual's utility function. Third, while Chichilnisky assumes those in the subsistence sector and those in the non-subsistence sector have different utility functions, preferences are assumed to be the same for all members of the society in our model. We do preserve the assumption that labor within the subsistence sector cannot move in and out of that sector in response to (implicit) wage-rate differences.

It has been demonstrated that the nature of the links between trade and the environment is importantly determined by assumptions about demand for the traded goods (e.g., Rauscher, 1994). One potentially important consideration is the role of subsistence consumption. A demand system that considers subsistence consumption explicitly is the linear expenditure system, based on the Stone-Geary utility function (Phlips, 1983). While this system has seldom been considered in analytical work on the relationship between trade and natural resources, it does play a major role in computable general equilibrium (CGE) models. (see Shoven and Whalley, 1984; Francois and Shiells, 1994; and Hewings and Madden, 1995, for examples.)

The linear expenditure system is not without its drawbacks, however. Because of some of its less-desirable properties (expenditure and price elasticities are approximately proportional; inferior goods are ruled out, as are (net) substitutes) empirical estimates of demand relationships based on the model must be interpreted with great care (Deaton and Muellbauer, 1980, esp. pp. 137-142).

For our purpose, which does not include demand estimation, these limitations are outweighed by the benefits of the system. Vargas, et al, point out that "the linear expenditure system is the most commonly used (demand system) used in CGE analysis due, in part, to convention and because it allows representation of subsistence consumption…."(Vargas, *et al*, p. 18). This argument is particularly appealing when dealing with less developed countries, especially those with limited possibilities for increased production of a major food item. As Ruckes pointed out during the 1994 IIFET conference, "(t)he constraints limiting increases in production of fish will put severe strains on the nutritional situation of the countries and population groups with high dependence on fish for their protein supplies and on small-scale fisheries for employment and income." (Ruckes, 1995, p. 15). He identifies countries in East and South Asia as being particularly vulnerable.

McCulloch *et al*. (2001) and Bannister and Thugge (2001) provide valuable discussions and helpful reviews of much of the literature on linkages between trade policy and poverty.

Our model also preserves the Hannesson assumption of diminishing returns to labor in the non-resource good sector and employs the basic framework introduced by Brander and Taylor, with the notable exception of labor mobility between sectors.

4. THE MODEL

Our economy consists of two sectors, a natural resource sector producing good (fish) and an "all other goods" sector . Each sector has its own labor supply, and and labor is immobile between sectors and across countries. We initially assume that all labor in each sector is employed. Our country is a price-taker in international markets

Production in each sector is given by

(1) ,

(2) , and .

Where, are parameters associated with the Schaefer model of "steady state" fish production. The superscript denotes "production" and represents labor units.

The utility function for the representative consumer (worker) is

, , and

Where, superscript represents consumption", and are subsistence levels of and respectively.[2] We assume all consumers have identical preferences and, thus, the utility function for sector can be represented by given in (3).

(3)

Where, denote the sector's total consumption of and respectively. The sector's total subsistence level of consumption of and are denoted by and . Let and denote income for and sectors respectively. Set the price of , the nume3raire good, at unity. For equal numbers of workers in each sector we can derive demand functions for the sector as follows:

(4)

Assuming, , the first order condition yields:

(5)

(6)

Solving simultaneously for and and noting that for the sector, while for the *H* sector yields each sector's demands for and given in equations (7) through (10) as follows:

(7)

(8)

(9)

(10)

The autarky price can be derived to be:

(11)

For requires that , and . That is, production of each good must be higher than the sum of the subsistence levels of that good across the two sectors. Note that, for the resource good, the smaller the gap between domestic production and subsistence, the higher the autarky price. While not reflected in (11) it must also be the case that, in equilibrium, , , and . In autarky, satisfying these four inequalities is a sufficient condition for to have a positive value.

5. FISHERY MANAGEMENT

Suppose that the *H* sector were to manage its fishery. Under the assumptions of this model it would appear that the opportunity cost of labor in that sector is zero. After all, there are no alternative employment possibilities in that sector and labor cannot travel across sectors. Thus, it would further appear that, on a sustainable basis, the maximum economic yield is the maximum sustainable yield (MSY).

Under fishery management then, if happens to be larger than the level associated with MSY the argument implies that labor should be restricted to its MSY level (through restricted entry, total allowable catch\individual quota arrangements, or other management strategy). As a consequence, sustainable production would rise, as would the sector's income level.

The foregoing assumes no change in the price of *H* or a demand for *H* that is price-elastic. Within a general equilibrium framework, the issue is more complex. In addition to being producers of the resource good, the residents of the *H* are also consumers of *H*. Thus, an increase in the production of *H* will, in general, lead to a lower autarky price, as shown in equation (11), thus, (a) reducing real incomes in the *H* sector, while (b) simultaneously lowering the price of a consumption good. The net impact on the economic well-being of individuals in that sector will depend on the relative sizes of the effects of (a) and (b). In general, however, gains will accrue to members of the *M* sector because they experience no change in the price of *M* (the numeraire good) and benefit from a lower price of *H*. This is an issue we are exploring in some depth but the relationship clearly depends on the assumed values of parameters of the model, especially .[3]

6. INTERNATIONAL TRADE

What are the consequences of international trade? For the remainder of paper we consider the case of a higher (relative) world price of than exist in autarky, suggesting that this country will export and import . What happens to and at the higher level?

The indirect utility function for the two sectors, and , are:

(12)

(13)

Then, changes in each sector's utility as a result of change in the price of resource good are

(14) as ,

(15) as

subject to the limitations discussed below.

From (11), in autarky , which implies that , so that, for , would have to lie below the autarky price. For , and. thus, the sector will lose from trade.

The sector will, in general, gain. Note that in autarky, so that simply requires that the world price exceed the autarky price. An exception to this is the case of a world price that is so high that the sector's production is not sufficient to allow its members to purchase the subsistence level of . In this case the sector must "opt out" of the international markets and it is likely that either the country will maintain its autarky position or that the sector will trade on the international market, bypassing the sector entirely.

Can trade "pull a country out of poverty"? Suppose that either or , so that one of the goods is not produced in sufficient quantity to meet the subsistence requirements of all workers/consumers in the economy. In this case, autarky cannot be viable because some members of the country will not survive.

Should the country open itself to free trade, however, it may be able to address the problem successfully. It turns out that such success is possible over only a range of free trade prices. For all members of the economy to reach subsistence consumption levels requires that .
Consider the sector,

(16)

(17)

For the *H* sector,

(18)

(19)

Thus, to permit subsistence levels to be reached in both sectors and for both goods requires

(20)

Suppose we let . Then,

(21)

What are the conditions on and that permit this inequality to be satisfied? Start by finding from (21) when

.

(22)

Suppose , so that is the good whose consumption cannot reach subsistence levels for all consumers in autarky. This condition indicates that, the larger , the smaller can be for there to be a set of free trade prices that permit subsistence levels to be met by all consumers.[4]

Note that, from (21), free trade prices cannot be "too high" or "too low". If

(23) ,

income levels in the sector are not high enough relative to the price of , to permit consumers in that sector to achieve subsistence. If

(24)

income in the sector are relatively low because of the low prices of the good it produces and, in fact, are so low that consumers in that sector cannot consume at or above subsistence levels.

Even in this case, however, trade may be able to pull the country out of poverty. One way for this to occur is for the sector that produces enough to cover subsistence consumption levels of its product for all consumers to transfer some of its output to the other sector. This is illustrated in Figure 1, where, at the world price , no trade that involves all members of the economy is possible (although as before the sector could abandon the *M* sector and trade only in international markets). However, with the transfer depicted, the sector's "endowment" is large enough for "gains from trade" to accrue to both sectors.

Table 1 shows simulation results that illustrate the situation for particular parameter values. For and, at , no trade involving both sectors is possible. However, with a transfer of from *H* to *M*, both sectors gain from international trade.

There is something unappealing about transferring units of an unmanaged resource to another sector. For the assumed parameter values, however, even if fishery management led to increase production of H, without transfer to the non-resource sector, gains from trade would probably not be realized unless the non-resource sector were ignored.

7. CONCLUSIONS AND FUTURE RESEARCH

Our analysis treats the general equilibrium case of a country consisting of two sectors, each producing one of two products, a resource good and an "all other goods" composite, using a single input, labor. Preferences are represented by a Stone-Geary utility function and are the same for all members of the population, who are both workers and consumers. Labor is immobile across sectors. This assumption may appear to be restrictive although, for the subsistence sectors of low-income countries, it is probably reasonably accurate. Our "findings," which we express in the form of testable hypotheses, include the following:

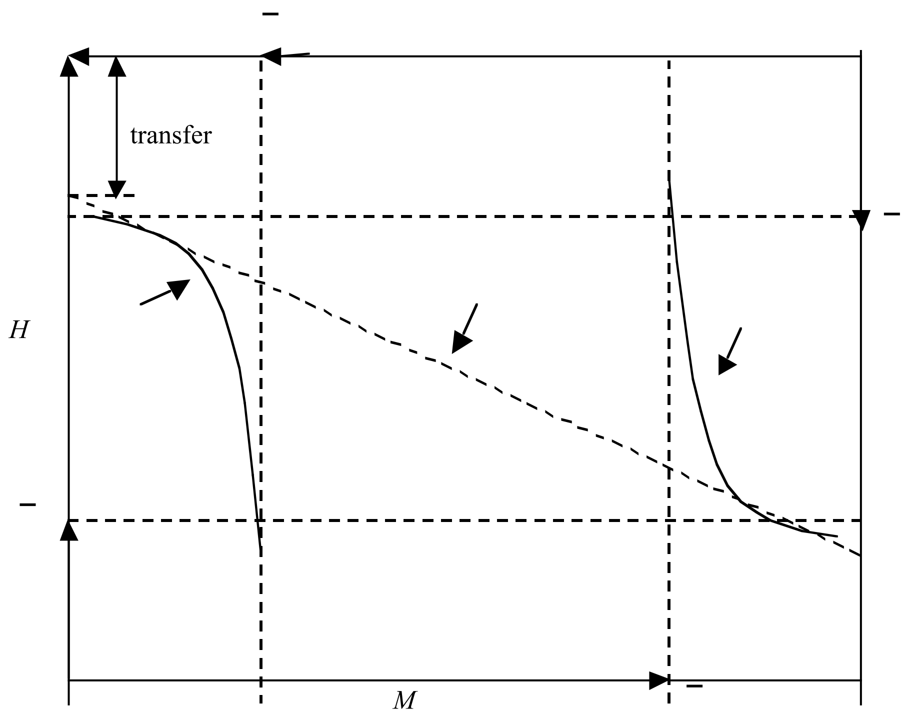

Figure 1: Impact of transfer when and

Table 1: Income Transfer and Gains from Trade

Variable	No Transfer	Transfer
	3	3
	23.77	22.60
	1.51 <	2.68
	46.88	46.88
	69.31	65.80
	2.54 <	6.05
	7.07	7.07
	0*	35.68
	0*	1.18
* The utility and consumption figures in this column cannot be sustained. Because the *M* sector cannot achieve subsistence consumption it will not trade. With no trade,		
Parameter values: .		

1. In the absence of trade, the autarky price (expressed as the relative price of the resource good) is importantly determined by the difference between domestic production and subsistence consumption levels. In the extreme, there may not be a viable autarky price, suggesting the absence of trade between the sectors.

2. If there exists a viable autarky price and if that price lies below the world price for the resource good, the resource sector gains and the non-resource sector loses from trade. At very high prices of the resource good, however, the non-resource sector may be unable to participate in either domestic or international trade. In that case, either the country, itself will not trade internationally or the resource sector will bypass the non-resource sector and trade directly in the international market.

3. If one of the goods is not produced in sufficient quantities to cover subsistence consumption, autarky exchange is not viable. Within a range of prices, however, trade can "pull the country out of poverty."

4. Outside of the price range in (3), above, trade that benefits both sectors may be feasible if one sector is permitted to transfer resources to the other.

5. The costs and benefits of alternative resource management approaches will depend on consumer preferences and production relationships in both sectors of the economy.

We intend to expand the model to permit us to examine in more detail the roles of

1. Resource management.

2. Labor-"leisure" choices (following Chichilnisky).

3. Foreign aid and investment from developed countries.

4. Different specifications of utility and productions functions, with particular attention to scale economies.

We also plan to initiate empirical tests of the major hypotheses advanced through our analysis.

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[1] See Neher (1990) for an excellent discussion of the issue.
[2] The Stone-Geary function can be formed by a logarithmic transformation of this function.
[3] We are also exploring the implications of fishery management in the cases where (1) domestic production of one of the goods is below that needed for subsistence and (2) the country participates in international trade. In

the discussions of (1) and (2) in later sections of this paper, we assume that all of the is employed in the production of *H*.)

[4] Note that this condition cannot be met if both are smaller than 2. Trade cannot address this problem of not meeting subsistence consumption levels of both goods.