Panel Discussion
Inherent Conflict in International Trade

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I should like to address the impact of economic development in technically backward countries on economic welfare in the industrialized nations, a topic of great concern to many policy makers. As countries that have been underdeveloped improve their industrial capabilities, they can become significant contributors to the total world economy. From a purely national perspective, however, their industries also are new competitors to existing national industries. What is the net effect of this change on the already industrialized countries?

It seems natural to take the classical Ricardo model of international trade and see if it has something to say about this question. William Baumol and I have done this in two recent papers (Gomory and Baumol 1995a, 1995b), summarized briefly here. We find that the model points clearly to the possibility of conflict in the interests of the trading partners. Outcomes that are very good for one country may not be good for its trading partner, and the strengthening of one country often will come at the expense of the welfare of the other.

Model and Method

We work with the classical linear Ricardian model of international trade. We assume single-input linear production functions $e_{ij}l_{ij}$ for good i in Country j and Cobb-Douglas utility U_j for Country j. We will fix the sizes L_j of each country's labor force and the demand parameters d_{ij} of the two countries as well as n, the number of industries. A model is then specified by the vector of average labor productivities $\varepsilon = \{e_{ij}\}$. *However,*

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instead of dealing with one model, we will discuss the equilibrium outcomes of a family of models. Specifically we will consider all possible productivity values ε restricted only by a maximum productivity condition[1] in each industry in each country $e_{ij} \leq e_{ij}^{max}$. Different productivities ε lead to different equilibria and therefore to different utility outcomes. This approach will enable us to analyze the effect of different productivities ε on the welfare of the two countries.

For any particular choice of ε with $e_{ij} \leq e_{ij}^{max}$, there is at equilibrium a resulting national income Y_j and a utility U_j for each country. From the Y_j we compute the relative national income $Z_j = Y_j/(Y_1 + Y_2)$, which we also refer to as *share*. We can then plot the equilibrium associated with that choice of ε as a point in a share versus utility (Z_1, U_1) diagram for Country 1. This is done in Figure 1, which shows a few randomly chosen equilibria. We can do the same for Country 2. Figure 2 shows the same equilibria as points in a (Z_1, U_2) diagram. Note that in both diagrams Z_1, which is Country 1's share, is measured from the left vertical axis and Z_2, which is Country 2's share and is therefore $1 - Z_1$, is the distance from the right vertical axis.

Alternatively, we could plot each point in a (Z_1, Y_1) diagram instead of a (Z_1, U_1) diagram. This would be a plot of share versus national income. The graphs in both cases look much the same and have the same economic consequences. Our theory has been developed with utility rather than national income, and most of the calculations have in fact used utility as the vertical axis rather than national income. However, the use of national income sometimes makes the results more intuitive, as we will see below.

In either plot, each possible ε gives us a single equilibrium point in the Country 1 diagram and another point in the Country 2 diagram. The ensemble of all such equilibrium points gives us a *region* of equilibria in each diagram. Figure 3 shows the region of equilibria for Country 1. The dark line is the approximate upper boundary[2] of the region and every point below it is an equilibrium for some choice of ε. This region of equilibria has a definite shape whose main characteristics are the same for all choices of maximal productivities e_{ij}^{max}. This shape can be shown to emerge from the model by a careful mathematical analysis as is done in Gomory and Baumol (1995b), but it also has a very intuitive basis, which we will describe below. Figure 4 shows the region for Country 2.

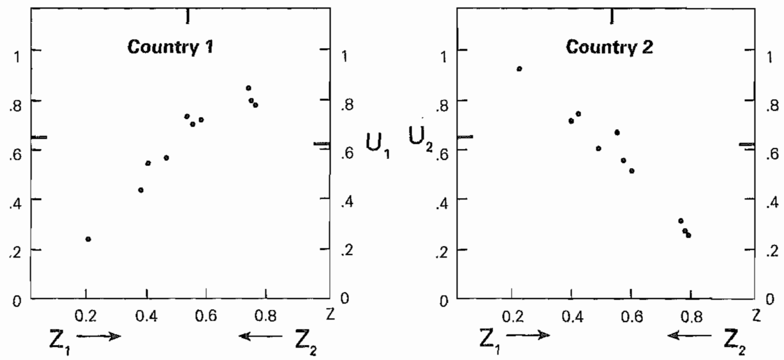
Since $Z_2 = 1 - Z_1$, we can combine the two diagrams as in Figure 5. U_1 is read from the right vertical axis and U_2 from the left vertical axis. The two points representing the same equilibrium are now vertically above

[1] It is easy to amend this restriction to allow for the increase of the maximum productivity over time.

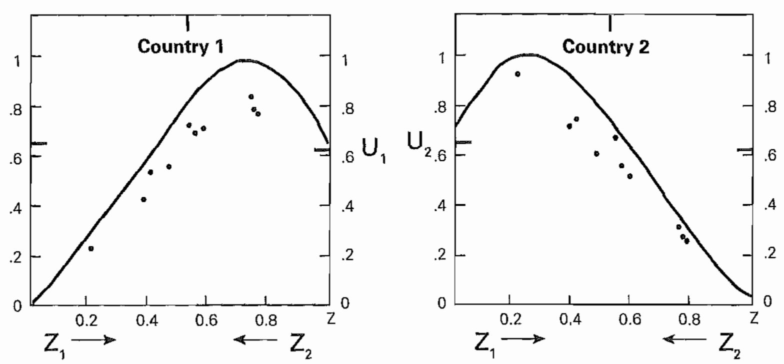
[2] The boundary has some fine structure. It is not a smooth curve but instead rather jagged. As n, the number of industries, increases, however, the jaggedness decreases in scale and the curve rapidly becomes indistinguishable from the one in the figure.

Figures 1 to 4

Equilibria Associated with Randomly Chosen Productivity Values on a Share versus Utility Diagram for:



Region of Equilibria for:



each other but they have different heights, representing the different utility outcomes for the two countries. The highest point in Country 1's equilibrium region always lies to the right of that for Country 2. We can see from Figure 5 that the best outcome for Country 1 is always a poor outcome for Country 2 and vice versa. Thus, the regional shape suggests the following:[3]

[3] These results tend to resemble those of the new trade theory, based on economies of scale, to which recent writings have contributed so much (Helpman and Krugman 1985; Krugman 1979 and 1990). There is in fact a close inherent connection between the regions

1. There is inherent conflict in the interests of two trading partners in the sense that the best outcomes for one country usually are poor outcomes for the other.
2. While in parts of the region improvements in productivity in Country 2 (which easily are shown to increase its share) will produce improvement in welfare in both Country 2 and Country 1, in other parts of the region improvements in productivity (and hence share) in Country 2 will strictly decrease the utility of Country 1.[4]

Intuitive Explanation of the Regional Shape

The shape of the region can be derived in a purely mathematical way. The boundaries in many industry problems can even be very closely approximated by a very simple linear programming calculation. However, there is also a direct intuitive explanation.

For this intuitive explanation we will use the plot of national income versus share. Let us imagine two countries that are roughly equivalent.[5] Their maximal productivities e_{ij}^{max} are near to each other, their labor forces are roughly the same size, and their demand structures are similar. Let us ask what a plot of *world* output, the sum of both countries' output, looks like under these circumstances. Intuitively, we would expect it to peak in the middle of the diagram as it does in Figure 6. Certainly, toward the right-hand end of the diagram Country 1 has a share of almost 100 percent, so it does almost all the producing. At these equilibrium points the productivities of Country 2 are very small in almost all industries. At these points total world output is only slightly in excess of what Country 1 can produce in autarky. As we move toward the middle and Country 2's share increases, world output increases because at these equilibria the productivity in Country 2 is much greater; it is the producer in more and more industries. This argument can be replicated starting from the extreme left of the diagram where Country 2 is the producer in almost every industry. So by intuitive means we come to the conclusion that the peak in total world output should be roughly in the middle.

If we now consider that Country 1, at each equilibrium, gets its share

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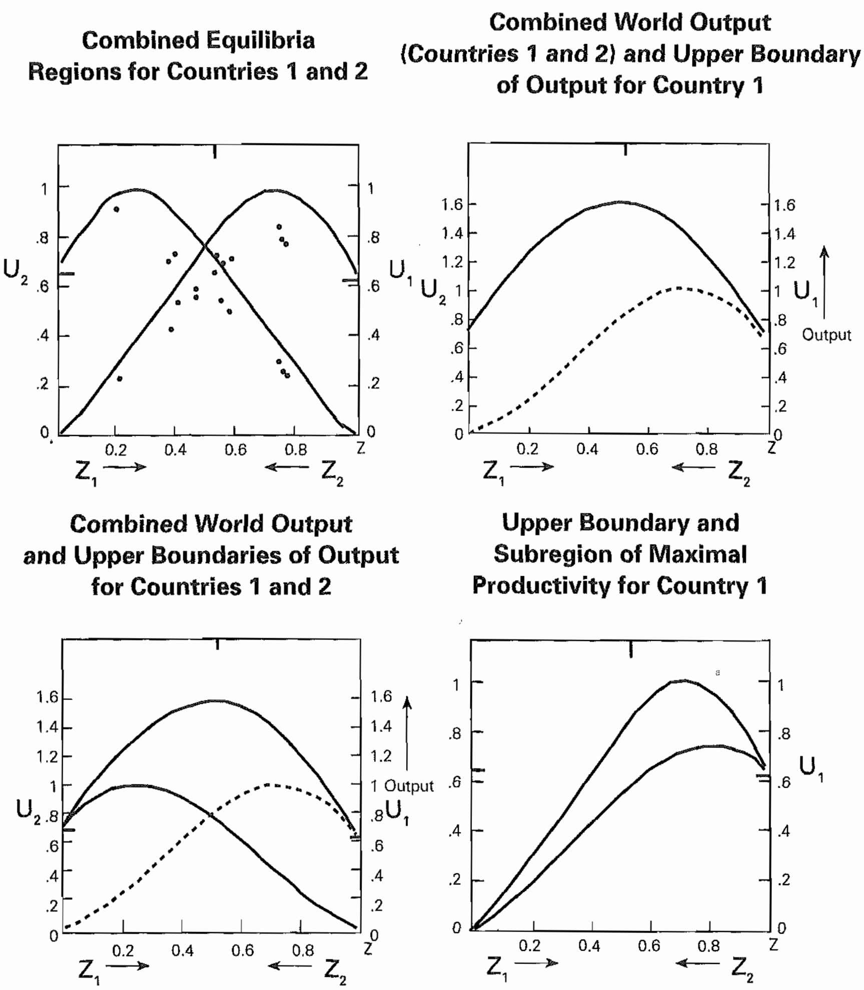
of equilibria that are obtained in the linear models and the regions of equilibria introduced in Gomory (1994) for economies of scale models. The shape of these regions has been elucidated in Gomory and Baumol (1994). This connection between the linear family and the economies of scale models is explained in Gomory and Baumol (1995b).

[4] The important possibility that an increase in the productivity in one country can be harmful to another in linear Ricardo models first was pointed out in Hymans and Stafford (1995) and Johnson and Stafford (1993).

[5] These assumptions are made only to simplify the intuitive explanation. Equivalent reasoning can be carried through for countries that are completely different, but the explanation becomes more elaborate and less intuitive.

Figures 5 to 8

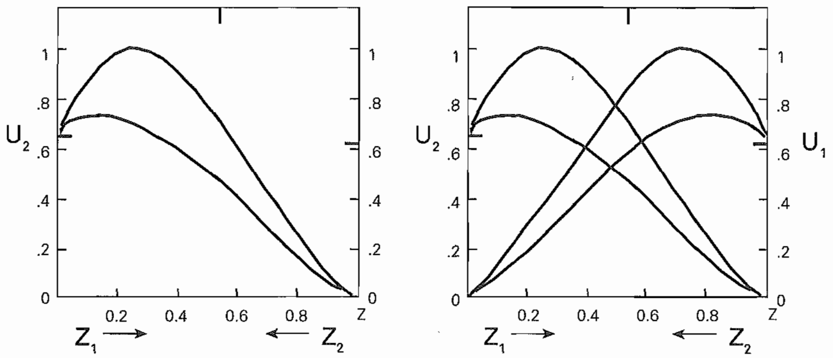


of total world output, then the Country 1 income at the 50 percent share point is one-half the total world income, at the 75 percent share mark is three-fourths of the world income, and so on. If we plot in all these points, we will get the upper boundary for Country 1 as it is shown in Figure 6. Thus, the upper boundary curve for Country 1 is easily derived from the world curve.

Figures 9 and 10

Upper Boundary and Subregion of Maximal Productivity for Country 2

Upper Boundaries and Subregions of Maximal Productivity for Countries 1 and 2



Exactly the same reasoning applies to Country 2. If we derive Country 2's upper boundary from the world curve, we obtain Figure 7, which shows the regions for both countries. Thus we arrive in an intuitive way at the shapes of both countries' regions and at the relation of the two regions to each other. We can see that Country 1's peak is to the right because although world output is decreasing, Country 1's share of it is increasing. Similarly, Country 2's peak is to the left, because as we move to the left from the middle, world output decreases but Country 2's share increases. It is the role of *share* that introduces the element of conflict between the two trading partners.

The Region of Maximal Productivity

If at an equilibrium the producing country in each industry is using its maximal productivity, we will call this a maximal productivity equilibrium. All maximal productivity equilibria lie in the subregion of maximal productivity, whose shape is illustrated for Country 1 in Figure 8, for Country 2 in Figure 9, and for the two together in Figure 10. The approximate boundary of this subregion also can be calculated by linear programming methods. When the producing countries are practicing something near the best possible technology (for that time), the resulting equilibria always will lie in the region of maximal productivity.

The Ideal Trading Partner

If Country 1 has productivities ε_1, which of Country 2's many possible parameter values make Country 2 the ideal trading partner for Country 1 in the sense of maximizing its utility? Based on the regional shape, a rough answer can be summarized as follows: For countries of roughly the same size, the ideal trading partner for Country 1 is one whose productivities allow Country 1 to make most of the world's goods while Country 2 produces at maximal productivity in the smaller set of goods it does make. A high-technology country making most things for itself but trading for a few goods with an agricultural country is an illustrative example. This outcome, while the most desirable one for Country 1, is not a good outcome for Country 2. Note that if Country 2 is the ideal trading partner for Country 1, then *any* change in Country 2's production parameters, whether an increase or a decrease, will be detrimental to Country 1.

Summary and Conclusions

We have described the existence of a well-defined region of possible equilibria that has a robust characteristic shape. One consequence of the shape is that the best equilibria for one country are generally poor ones for its trading partner, so that a successful national policy aimed at attaining or retaining such a position involves inherent conflict in the interests of the two countries.

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