November 4, 2005

The Heckscher-Ohlin Model: Features, Flaws, and Fixes*

Alan V. Deardorff
University of Michigan

The Heckscher-Ohlin (H-O) Model is a marvelous theoretical tool for understanding the world economy. It explains not only the sources of international comparative advantage, but also the effects that trade will have on patterns of specialization and on real returns to factors of production. In the simple and familiar 2-factor, 2-good, and often 2-country textbook version of the H-O Model, trade, production, and factor prices all respond simply and plausibly to the opening of trade and to changes in any barriers to trade. However, if we extend the model in obvious ways to include additional goods and/or additional countries, the model begins to display behaviors that are not so plausible. This series of lectures focuses on these "flaws" in the H-O Model and on various ways that the model might be, or has been, modified to remedy these flaws.

The 2×2×2 H-O Model has each country producing relatively more of the good that uses relatively intensively its relatively abundant factor, but unless factor endowments of the countries differ substantially, it permits both countries to continue to produce both goods. Furthermore, if trade costs such as transport costs are included in the model in a simple way (most simply, via Samuelson's (1952) "iceberg" assumption that the goods themselves are used up in trade), trade, production, and factor prices all vary continuously and smoothly with changes in these trade costs. If trade costs fall from a sufficiently high level, the countries move smoothly from not trading at all, through trading while incompletely specializing, and then (if factor endowments differ sufficiently) to trading even more while one or both countries specialize in producing a single good. Thus the model tells a very plausible story, and it describes behavior that seems roughly to match what we see in the world, except of course that the world has more than two factors and far more than two goods and countries.

Allowing for larger numbers of goods and/or countries, however, causes anomalies in the H-O Model. One of these has long been well known: that if free trade and other conditions for factor price equalization (FPE) are met, patterns of production and trade become indeterminate if the number of goods exceeds the number of factors (see Samuelson (1953) and Melvin (1968)). Thus the model that is intended to predict trade fails to do so in any precise way. This indeterminacy can easily be removed by precluding FPE, for example by assuming trade costs. But then the model predicts a degree of specialization, in either production or trade, that itself is more extreme than one might like. That is, only a limited number of goods can be both produced and traded by each country. And that becomes even more the case as the number of countries also expands. It can be shown that as the number of countries increases, the fraction of all possible bilateral trade flows that can be positive in equilibrium becomes very small, asymptotically approaching zero.

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* This is a summary of the Nottingham Lectures, delivered October 17-18, 2005.

A corollary of this specialization in trade, even with only two goods and three countries, is that the determination of *which* trade flows take place is extremely sensitive, or hypersensitive, to trade costs. That is, an arbitrarily small change in trade costs can cause a country to redirect a substantial trade flow from one partner country entirely to another. Thus trade flows depend discontinuously on trade costs. Likewise, if there are more goods than factors, the same linearity that would cause indeterminacy with FPE causes similar hypersensitivity to trade costs in the determination of which goods a country trades or in the direction of that trade (see Deardorff (1979)). These aspects of hypersensitivity, too, seem to undermine the ability of the standard H-O model to describe reality.

These problems are not new, and they have been addressed over the years, when necessary, by various sometimes *ad hoc* amendments to the H-O model to make it better behaved. Several such amendments are discussed here. Some of these "fixes" of the H-O Model have been widely used for years; others have only recently begun to appear in the literature; and some are currently no more than conjectures.

Space does not permit detailed explication of each of these fixes here. Suffice it to say that each has certain attractive features, but none apparently suffices alone to transform the H-O model into the well-behaved yet tractable tool of analysis that it would be nice to have.

The Ricardo-Viner, or Specific Factors, model of Samuelson (1971) and Jones (1971) is a plausible model of the short run, and it has been used routinely in computable general equilibrium (CGE) models, but it fails to explain trade more than tautologically. Armington (1969) preferences have also been used by CGE modelers for decades to reconcile their models with the data, but Armington preferences themselves are arbitrary and unjustified. Lumpy countries, as in Courant and Deardorff (1992), may be useful in limiting specialization to regions within a country, but just how helpful this can be is not yet known.

Monopolistic competition among firms producing differentiated products, a la Helpman and Krugman (1985), has become almost as standard a theoretical tool as the H-O Model itself. But while it eliminates the hypersensitivity of bilateral trade flows (see Romalis (2004)), it does not – at least in its standard form – change the H-O predictions about specialization. Melitz (2003) has added productivity heterogeneity of differentiated-product firms to smooth out the behavior of a Ricardian model, and Bernard, Redding and Schott (2004) have applied the same technique to a H-O Model, in what may perhaps turn out to be the solution to all of these problems, but that work is too new (at least to me) to judge its success.

There are two final alternative fixes that may hold some promise but have not yet been formally worked out. One would be to let trade costs be variable, rising with the amount of trade, a solution that I suggested in Deardorff (1984) but never thought very plausible. The second would be to take aggregation more seriously, recognizing that economic data inevitably combine as single goods and industries things that in our models ought to be distinct. This has been used somewhat loosely but successfully by Davis and Weinstein (2001) to motivate one of their empirical specifications.

No doubt there are other ways that the H-O model could be amended to make it a more useful descriptor of world production and trade. The challenge will be to find the

simplest such amendment that will serve this purpose while keeping the remarkable tractability and elegance of the H-O model.

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