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Cambridge University Press
978-0-521-06874-1 - International Trade and Finance: Frontiers for Research
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PART I

TRADE, PROTECTION, AND DOMESTIC PRODUCTION

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TESTING TRADE THEORIES*

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International trade theory is mainly concerned with determining what goods and services countries will buy and sell in foreign trade, the gains from trade, and how the gains are divided within and among the trading countries. These concerns are of course positive and normative. In theorizing about such matters, we construct abstract models with the presumption that these models will be coherent, logical, interesting, and relevant. While empirical considerations have some bearing on model construction, they obviously become more crucial when a model is to be confronted by observation. At this juncture, what counts most are empirical specification and interpretation of results. These considerations will constitute the primary focus of this paper.

Section 1 begins with a brief discussion of the various theoretical models that purport to explain the commodity composition and direction of trade. Sections 2 to 5 contain a review of the major recent developments in the empirical testing of these models.[1] Some suggestions for future research are then given in section 6. Section 7 deals with empirical investigation of the relations between international trade and returns to factors, and section 8 with economic expansion and trade.[2] Some concluding remarks are made in section 9.

1. THEORIES OF THE COMMODITY COMPOSITION AND DIRECTION OF TRADE

The classical determination of what goods and services countries will buy and sell in foreign trade is based on the theory of

* I am indebted to B. Balassa, J. N. Bhagwati, A. V. Deardorff, P. S. Heller, E. E. Leamer, J. D. Richardson, G. Saxonhouse, H. T. Shapiro, C. P. Staelin, and members of the Research Seminar in International Economics at the University of Michigan for helpful comments on earlier versions of this paper.

1 My focus will be primarily on developments from about 1968 onward. Accounts of prior research efforts are to be found especially in Bhagwati (1964, 1969) and the references cited therein.

2 In order to reduce the scope of the paper, I shall not discuss several important areas for research, for example, the theory and measurement of trade creation and diversion in the context of customs-union and other preferential arrangements, computational models for assessing the effects of multilateral trade liberalization, and the microfoundations of macroeconometric models of trade and the balance of payments. Nor shall I deal systematically with the effects of international labor migration and direct foreign investment upon trade.

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comparative advantage. As formulated by Ricardo and subsequently further elaborated and refined by the neoclassicists, the theory identified and arrayed goods in each country according to their unit costs. The precise pattern of specialization in production and trade depended on comparative costs, with the dividing line between imports and exports determined by reciprocal demand, subject to monetary equilibrium in the balance of trade. As simple as it is, the comparative-cost principle has profound implications for maximizing economic efficiency and welfare.[3]

From the empirical standpoint, the hypothesis suggested by the Ricardian model is that the observed composition of trade can be explained by intercountry variations in comparative costs. The information on trade patterns needed to test this hypothesis can generally be obtained from official published sources. However, the cost data required have to be searched out or specially constructed for the occasion. Since labor is the key productive factor in the Ricardian model, measures of comparative labor productivity have been designed to serve as a proxy for comparative costs. Given the existence of other productive factors and the fact that, in actuality, trade is determined by differences in absolute money prices among countries, the question becomes: How good is comparative labor productivity as an approximation of comparative total factor productivity and of comparative selling prices? As we shall note below, empirical testing of the Ricardian model has foundered on this particular issue, and interest has increasingly focused on more comprehensive measures of intercountry differences in efficiency, especially in the context of estimating production functions.

But even supposing that an empirical relationship is established between specialization in trade and variations in comparative costs, this does not answer the more fundamental question of what determines these variations in costs. The Ricardian model is not of much help here, since it presumes that comparative-cost differences are a fact of life and thus do not require separate investigation.

It is concern for a more complete understanding of the sources of comparative advantage that distinguishes the Heckscher–Ohlin model from its forebears. In the form of the model that was popularized especially by Samuelson and others, intercountry variations in comparative costs were determined by differential endowments of productive factors, with the quality of factors and

3 While we shall not be concerned directly with the gains from trade, welfare considerations will of course be implicit throughout the discussion.

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production functions for given goods taken to be the same everywhere. Two well-known theorems have emerged from the Heckscher–Ohlin model: (1) countries will tend to export goods embodying their relatively most abundant factors and import goods embodying their relatively most scarce factors; and (2) under certain specified conditions, international trade will result in the equalization of returns to factors among countries.

As noted below, empirical work on the Heckscher–Ohlin model has been confined mainly to testing the factor-endowments hypothesis. Because information on factor endowments is not gathered systematically in most countries, researchers have had to rely especially upon data compiled from national input–output tables and on their own special constructs for the investigation at hand. Lacking internationally comparable data, tests of the factor-endowments hypothesis have typically been concentrated on individual nations. The early tests by Leontief and others, conducted within the framework of a two-factor version of the model, estimated the capital and labor requirements of exports and imports, but often yielded results that suggested incorrect or incomplete specification and measurement. Some of these difficulties were subsequently dealt with by redefining and expanding the number of factors in order to distinguish physical capital, human capital, raw (uneducated) labor, and natural resources.

While the foregoing line of research has enhanced significantly our understanding of the sources of comparative advantage, the subject has by no means been exhausted; there are apparently other important influences on comparative advantage that lie outside the Heckscher–Ohlin model. These other influences relate mainly to technological differences, which the model assumes away, economies of scale, and market imperfections of various kinds. Moreover, the model has come under increasingly critical scrutiny because it does not offer an explanation of what determines a country's initial factor endowment and how this endowment may change through time.

Since phenomena like technological influences, scale economies, and market imperfections cannot be readily observed, they have to be approximated. Technological influences have been represented by such measures as R & D expenditures, the employment of scientists and engineers, and total and per capita GNP. Scale economies have been approximated on the basis of value added per man in different-sized establishments and on the basis of GNP measures. Market imperfections, such as tariffs, have been represented by averages of nominal and effective rates.

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As we shall see, a wide latitude has been used in the selection of these proxy measures, depending upon the data available and the framework in which the hypotheses are posed for investigation. This makes it difficult at times to evaluate and compare the results of particular studies. In addition, most of the studies relate to specific points in time, thus affording only limited insight into the initial determination of comparative advantage and the process of change through time.

It should be clear from this discussion that inquiry into the determinants of comparative advantage has progressed considerably beyond the frameworks of the simplified Ricardian and Heckscher–Ohlin models. In particular, technological and other phenomena not embraced by the traditional models have been found to be important. At the same time, much of the work emphasizing these "newer" forces appears ad hoc in character. This is due, in part, to data problems, but it also reflects deficiencies especially in the theoretical analysis of the process and the impact of technical change and factor accumulation upon production and trade.

2. TESTING THE RICARDIAN–NEOCLASSICAL MODEL OF COMPARATIVE COSTS

The early empirical tests of the Ricardian model of comparative costs were markedly simplistic.[4] Assuming a Ricardian world in which labor was the only factor of production, it was hypothesized that the relative export performance of the United States and United Kingdom in third markets depended upon differences in output per man by industry, which in turn would be reflected successively in differences in unit wage costs, unit value added, and unit prices.

In his 1964 survey of trade theory, Bhagwati (pp. 4–17) examined the logic and underlying assumptions of the Ricardian model and the empirical procedure whereby the hypothesis was tested in successive steps. He argued that the procedure was defective insofar as relative export prices could not necessarily be approximated by labor productivities and the other measures. He went on to demonstrate this point using correlation methods and concluded (p. 16) that "there is yet no evidence in favor of the Ricardian hypothesis."

In subsequent reflection on this issue, Daly (1972) attributed

4 These tests were conducted by MacDougall, Stern, and Balassa. The precise references are given in Bhagwati (1964, 1969).

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the lack of relationship between labor-productivity and export-price ratios in part to the fact that the labor-productivity calculations were based on measures of net value added, thus excluding intermediate inputs, while the export-price ratios were derived from measures conceptually closer to gross output. In his reaction to Daly's interpretation, Bhagwati (1972, p. 136) reiterated his skepticism about the labor-productivity approach to comparative advantage and expressed reservations as to whether the productivity data were in fact calculated on a net-value-added basis. On this same occasion, Balassa (1972, pp. 128–129) took issue with Bhagwati's contention about labor productivities and export prices, arguing that the unit values used as proxies for export prices reflected quality differences and were thus not good measures of price, and that, in any case, the hypothesis presupposed the existence of intercountry productivity differences.

A separate empirical investigation would be required to evaluate Balassa's assertion concerning the appropriateness of unit values. But even if they are appropriate, prediction based on the Ricardian model may be of limited interest, since, as Bhagwati (1964, pp. 16–17) and Johnson (1968, p. 28) have noted, it does not shed much light on the nature and sources of comparative advantage.

The foregoing discussion brings out the limitations of treating labor productivity as exogenous and as the most important determinant of comparative-cost differences.[5] It would be no less arbitrary, as Bhagwati (1972, p. 134) noted, to focus on the productivity of capital as the crucial factor, especially in view of the importance of human capital and capital inputs into natural resources. What this suggests, therefore, is that we should adopt a multifactor view of the world and premise the Ricardian–neoclassical model on the existence of intercountry differences in total factor productivity, that is, on intercountry differences in production functions for given goods.

Thus, the model could be tested by fitting production functions for industries in different countries, with the expectation that a country's exports would be concentrated in its relatively most efficient industries and its imports in its least efficient ones. The

5 For a study in which essentially negative conclusions were reached concerning the hypothesis that changes in labor productivity governed changes in export performance, see Kreinin (1969). Glejser (1972) has examined relative prices and market shares prior and subsequent to the formation of the European Common Market and concluded that relatively high elasticities of substitution between competitors served to confirm the theory of comparative costs. His interpretation of the theory, however, is quite different from what we are discussing.

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problem is, however, that the model offers no guide in choosing the most appropriate production function for estimating purposes. Since different production functions exhibit different properties, the choice of any particular type may well color the results. In order to illustrate these points and to provide some indication of possible directions for future research, it may be fruitful to review some recent work that has been done on intercountry efficiency differences.[6]

Intercountry Efficiency Differences

Stryker (1968), using a Cobb–Douglas framework, constructed a model to explain differences over time in the growth of exports for the United States and Canada in twenty-four manufacturing industries in terms of differing rates of technological progress, scale effects, and factor-price changes. While his results were suggestive, they were not particularly strong for a variety of reasons, such as the framework chosen, the assumption that technological change was disembodied and could be approximated by a linear time trend, and the application of U.S. industry coefficients to industries in Canada. There may have been some problem, moreover, in making Canadian–U.S. comparisons for manufactured exports, since the United States is dominant in Canadian markets, and the countries do not compete extensively in exports to third markets. Despite these qualifications, Stryker's work was certainly a marked improvement on the earlier simplistic tests of the one-factor Ricardian model.

Several other studies have dealt with intercountry differences in efficiency per se, although they have not related these differences to observed differences in the commodity composition of trade. In this sense, these efforts amount to testing one of the major differences between assumptions of the Ricardo–neoclassical and Heckscher–Ohlin models: Are production functions for given goods and industries different or the same among countries? Some investigators, however, have been asking how important different factor endowments are in comparison with technological differences, scale economies, and other influences upon the commodity composition of trade. We shall review these latter efforts after we have discussed the various empirical tests of the Heckscher–Ohlin model.

6 Perhaps of greatest influence is the pioneering research on the CES production function by Arrow *et al.* (1962), in which Hicks–neutral efficiency scalars were estimated for certain comparable U.S. and Japanese industries.

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Among the investigations of efficiency differences among countries, the efforts of Clague (1967), Nelson (1968), Daniels (1969), Gehrels (1970), and Hayami and Ruttan (1970) are worthy of note. Clague's work involved fitting a CES production function to a cross-section of eleven manufacturing industries in the United States and Peru. The question he asked was: What would the productivity of Peruvian labor be relative to U.S. labor if Peru had the same capital–labor ratio as the United States, with allowance being made for economies of scale? The various observations on labor and capital inputs were centered around 1960. Subject to caveats concerning the fact that the Peruvian observations were drawn from the urban–industrial sector only, the possibility of substitution between labor and other inputs, differences in economic environment, and differences in the average age of equipment in the two countries, Clague observed that Peruvian efficiency was substantially less than that of the United States.[7] The smallest differences were found in the more capital-intensive industries such as raw sugar, cement, and chemicals, and the largest differences in the less capital-intensive industries such as leather tanning, cotton textiles, and glass containers.

Nelson's point of departure was similar to Clague's in that only about one-third of the observed differences in labor productivity in manufacturing industry between Colombia and the United States could be explained by differences in the capital–labor ratio alone. In order to comprehend these vast differences in productivity, Nelson invoked the role that technology and new-product development play, especially in developed countries. He suggested that one should view technological change dynamically as a diffusion process, with the economic system adapting over time toward (but not reaching) equilibrium. Firms would therefore exhibit different efficiency characteristics within as well as between countries in terms of the technology they were using. By comparing cross sections of Colombian and U.S. value added by firm size in 1958 and examining the composition of employment and output by firm size within Colombia in 1958 and 1964, Nelson concluded that the largest firms in Colombia were closest in terms of productivity to their U.S. counterparts and more favorably situated than smaller firms within Colombia.

Gehrels investigated efficiency differences in a cross section of manufacturing for the United States and Germany in 1962 and

7 Clague's (1969) estimates of the elasticities of substitution for Peruvian manufacturing were challenged by Witte (1971) on the grounds that they excluded the traditional sector. See Clague (1971) for a defense of his results.

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for the United States and the United Kingdom in 1958, again trying to determine the extent to which differences in relative labor-input coefficients were due to differences in capital per man or in resource effectiveness. He estimated that somewhat less than half the German–U.S. labor-productivity differences were due to differences in resource effectiveness, whereas most of the U.S.–U.K. productivity differences were attributable to such differences. Daniels's objective was to estimate efficiency differences in seventeen 2-digit SIC manufacturing industries for eight less developed countries, using aggregated and disaggregated national cross-section data from the 1950s and early 1960s. He employed a CES production function and assumed constant returns to scale. For want of better data, he chose as a proxy for capital input the rated horsepower capacity of installed prime movers and electric motors in operation. Testing the significance of the calculated efficiency scalars across industries by country, he concluded that Spain was the most efficient of the group and Paraguay the least efficient, but that it was not possible to make efficiency distinctions among El Salvador, Argentina, Korea, Chile, and Peru.

Finally, Hayami and Ruttan sought to explain agricultural productivity differences among countries. They fitted a Cobb–Douglas production function to three separate cross sections of thirty-eight developed and less developed countries for averages of years centered on 1955, 1960, and 1965. In contrast to the studies noted immediately above, Hayami and Ruttan did not seek to measure directly intercountry differences in agricultural efficiency. They nevertheless conceived of their model in the same sense as Nelson's model of the diffusion process, arguing that the full range of technological alternatives was only partially available to individual producers and countries. While such an observation may be correct, their production-function estimates did not test this contention directly. It might be interesting, accordingly, to conduct explicit cross-country studies of differences in agricultural efficiency.

While these various studies offer numerous insights, they are difficult to compare because of intercountry differences in the stage of development, the time periods covered, and the empirical proxies used. Furthermore, these studies offer little guidance in selecting for estimation one production function over another, and, from the standpoint of the international-trade models that concern us here, they have not yet been connected systematically with the observed composition and direction of trade. Granted all

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these limitations, there nevertheless appears to be substantial evidence of intercountry efficiency differences, as posited by the Ricardian–neoclassical model. As will be noted below, this conclusion is further borne out by the "newer" explanations of comparative advantage in which technological factors play a substantial role.

3. TESTING THE HECKSCHER–OHLIN FACTOR-ENDOWMENTS MODEL

Following the unveiling of Leontief's paradox in his test of the Heckscher–Ohlin factor-endowments model for U.S. trade, the literature was filled with both theoretical and empirical efforts to resolve the paradox and to determine whether it applied to other countries. The thrust of these efforts was directed in large measure at the simplicity of Leontief's test and to the nature of the production conditions subsumed in the model. In particular, the empirical specification of the explanatory variables was expanded beyond just capital and labor to include the natural-resource content of trade and to distinguish human capital from physical capital and raw (uneducated) labor. Also, as noted above, a great deal of work on production functions has been generated out of concern with the empirical foundations of the Heckscher–Ohlin model. The foregoing and certain other issues connected with the factor-endowments model will occupy our attention in this section.

Natural Resources

The composition of trade includes, of course, both primary commodities and manufactures at different stages of processing. Most observers have asserted that, since trade in primary commodities is so obviously dependent upon differences in natural endowments, there is no need to test the Heckscher–Ohlin theory for this component of trade. In a formal sense, this is not correct, because both capital and labor are required to improve natural resources to give them economic value, and countries may certainly combine these factors in somewhat different proportions when producing natural-resource products. Moreover, since primary commodities move in raw and processed form, there may be a need to explain the basis for such specialization.

Because of the importance of natural-resource products, it is difficult to know where to draw the line in defining industries for

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