Dixit
Norman

Theory of International Trade

THEORY OF INTERNATIONAL TRADE

A dual, general equilibrium approach

by

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PREFACE

An addition to the large stock of books on trade theory calls for strong justification. We believe we have one, although not in any novelty of basic aims. On the contrary, we claim that previous treatments fail, often in not pursuing their own avowed aims far enough, and almost always in not pursuing them by the most efficient means.

It is always said that trade theory is a showcase for the theory of general economic equilibrium. Too much of it, however, usually considers only a part of the whole equilibrium, namely the comparative statics of production in one country. This occurs in some discussions of the effects of changes in factor endowments or technologies and of tariffs, but most importantly in dealing with factor-price equalization. The usual way to pose that question is as one of determining factor prices given output prices, or assuming diversified production. Both of these assumptions should really be a part of the whole equilibrium being studied. It turns out that the usual partial insights are very misleading when it comes to such a complete equilibrium of trading countries.

Secondly, when generalizing the simple two-by-two model, trade theorists often forget the lessons to be learnt from general microeconomic theory as to the right questions to be asked. The long and fruitless pursuit of wrong questions has led to much pessimism about the use of the basic model of comparative advantage. General equilibrium theory should have told us long ago that it is pointless to expect general results concerning changes in individual prices and quantities, but that we can deduce simple and instructive correlations between price and quantity changes from revealed preference arguments.

Finally, there is the matter of technique. The use of 'dual' or 'indirect' functions has proved very useful in general equilibrium theory and its applications, notably public finance and growth theory. Trade theory has long used unit cost functions to examine whether output prices determine factor prices, but the gain from consistent use of dual methods has not been realized. The revenue

function, which is arguably the most natural way of modelling production in each country, has been rarely used.

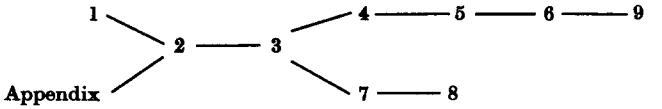
We offer progress in all these respects, without pretending to break totally fresh ground in any. In particular, it is a pleasure to acknowledge Samuelson's innovations in all three aspects. He pioneered the use of revealed preference in comparative statics long ago. He also used cost and revenue functions, and emphasized the importance of treating factor-price equalization in a truly general equilibrium setting. We hope that our consistent application of these ideas will be something of a tribute, coming so close to the silver jubilee of his important article on this subject.

We would like to emphasize in the strongest possible terms that our objective is not one of providing a comprehensive treatment of trade theory, so that 'the rest would be silence'. On the contrary, we only aim to show the readers the usefulness of the approach, and to give them some facility in handling the techniques, so that they can go on to develop the numerous extensions and generalizations that are conceivable. Notes at the end of each chapter point the way. We believe our aim will be best promoted by keeping the technical aspects as simple as possible, and have accordingly omitted all generality that would be spurious to each point being considered. Issues of welfare inherently need analyses with many consumers, and those of effective protection, many firms. But elsewhere we have often used models with one representative firm and one representative consumer, leaving the simple extensions to the readers.

Some knowledge of introductory trade theory will help the readers grasp the background to some issues, but the main pre-requisite is a working knowledge of modern micro-economics. Mathematical requirements are modest—multivariate calculus, elementary vector and matrix algebra, convexity, homogeneity, and constrained maximization—and are sketched in an Appendix. Readers familiar with the material can also benefit from a quick glance through the Appendix to get used to the notation.

The plan of the book is as follows. Chapter 1 contains a brief survey of introductory trade theory, with emphasis on issues and methodology. Chapter 2 establishes the basic properties of revenue and cost functions that are used throughout. In Chapters 3–5, we analyse trade in a Walrasian equilibrium, establishing its properties and deriving comparative static results. Chapter 6 is devoted to issues of taxation and trade policy. In Chapters 7 and 8 we discuss questions relating to exchange rates and the balance of payments, using a model of temporary equilibrium with and without flexible prices. Finally, Chapter 9 considers trade with imperfect competition.

The interrelations among the chapters are shown below:



Vidar Christiansen discussed most of the issues with us in the formative stages of the work. Richard Cornes gave us very detailed comments on an earlier draft, and brought to our attention a great deal of previous work. Frank Hahn, the editor of the series, also provided very detailed comments, and proved a most valuable taskmaster in trying to make us improve the exposition. We are happy to thank all three, and also Peter Neary, Geoff Renshaw, Agnar Sandmo, Alasdair Smith and Knut Sydsæter for comments on earlier drafts. We are also grateful to Jan Haaland for his help in preparing the bibliography and the index. The work began when Victor Norman was visiting the University of Warwick, and he would like to thank the department for its hospitality. Finally, Grethe Didrichsen, Kirsten Herstad, Ann Sampson, and Liz Thompson deserve our gratitude for their prompt and efficient typing.

July 1979

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CHAPTER 1

THE THEORY OF INTERNATIONAL TRADE

There are two broad themes in the theory of international trade. One is qualitative, being concerned with the pattern of trade, i.e. which country will export which good. The standard theory relates this to comparative advantage, i.e. to international differences in relative opportunity costs, and then tries to explain comparative advantage in terms of differences in technologies, factor supplies, etc. This theme is also concerned with the way in which trade in return affects such determinants of comparative advantage. The other theme is more quantitative, and seeks to explain the terms of trade, i.e. relative prices of exports and imports in a trading world. It also examines how they are affected by changes in data such as factor supplies or technology, and policies such as tariffs. While we have stated the themes as descriptive, it is clear that normative analyses will have to be based on, and will benefit from, a proper understanding of them. Questions of the state of the balance of payments, or of determination of exchange rates, can also be seen as elaborations and extensions of the same basic ideas.

In developing these themes, one should bear in mind two important points. The first is that the very concepts of trade theory—relative costs and relative prices—call for consistent use of general equilibrium analysis. This need not always be Walrasian competitive analysis, but in a problem with several goods and factors, and several producing and consuming units, an approach which constantly reminds us of their mutual relationships is essential if errors of oversight are to be avoided. While obvious, this is sometimes forgotten. We shall see that two important debates in trade theory—the one about the impact of tariffs on domestic income distribution, and the discussion of how trade affects domestic factor prices when there are more goods than factors—arose because some of the discussants forgot that a trading equilibrium is a general, rather than a partial, equilibrium. The second point is that micro-economic theory tells us a great deal about general equilibria, and we should simplify our task in trade theory by making full use of such knowledge. For example, consider a Walrasian competitive case, which will be the focus of the first five chapters. We can regard each country as being

in a general equilibrium, treating its trade pattern as if it were a fixed vector of endowments and liabilities. Such an equilibrium is known to be Pareto efficient. In particular, treating market prices as parametric, (a) the production vector maximizes the value of net output, (b) the value of consumption equals that of net output, and (c) subject to this budget constraint, the consumption vector maximizes some increasing function of the consumers' utilities. This information can, and should, be used when we develop the themes. It points the way ahead, and helps us avoid sidetracks, by suggesting parallels from other applications of general micro-economic theory. This simplifies the analysis of a trading equilibrium to the extent that further *ad hoc* simplifications, such as an assumption of two goods and two factors, are in most cases unnecessary. It also suggests the techniques best suited to the purpose, but that is anticipating the work of later chapters.

In this chapter we give a brief summary of the major themes of trade theory, from a micro-economic point of view. In fact only the most basic concepts and tools are used—budget lines, revealed preference, input coefficients and price–cost relations. Even less previous knowledge of trade theory is assumed—the chapter or two on comparative advantage and on effects of tariffs that can be found in any good elementary economics textbook should suffice. If readers with this minimal knowledge are sometimes left wondering why the debates we mention should ever have arisen, so much the better.

In subsequent chapters we will develop more sophisticated techniques, and use them to treat in greater depth these and other issues. The basic insights gained from this introduction will prove useful in grasping that material more easily.

1. COMPARATIVE ADVANTAGE

Although perhaps the area of economics least understood by laymen (and, alas, many undergraduates), the theory of comparative advantage is essentially very simple: If two countries engage in trade, each will have incentives to increase production, and reduce consumption, of goods in which it has the lower *relative* marginal cost *prior to trade* than the other. Thus we may conjecture that in a free trade equilibrium, each country will export such goods. That is the first, oldest, and most basic proposition in the theory of international trade.

A quick recapitulation will provide a gentle beginning. Suppose Britain in isolation has competitive equilibrium prices of £300 per

television set and £4 per bottle of whisky, and let the corresponding magnitudes for Japan be 100,000 and 2,000 yen respectively. For expository convenience, neglect complications like excise taxes. Then prices equal marginal costs. If Britain were to produce one television set less, this would release a package of resources that could be redeployed to produce another (300/4=) 75 bottles of whisky. Similarly, Japan could produce one more television set by diverting resources engaged in making 50 bottles of whisky. It is clearly to their mutual advantage to do both these things, and achieve an extra output of 25 bottles of whisky. In technical terms, the pre-trade relative price of a television set is 50 bottles of whisky in Japan, and 75 bottles in Britain. Thus Japan has an inducement to expand television production and export sets to Britain, importing whisky in return. The presumption is that after trade has commenced, the common relative price will settle somewhere between 50 and 75; the extent of trade depends on other aspects like demand conditions and the sizes of the countries.

Note that the above argument is valid irrespective of any absolute productivity levels: Japan may be better at making both goods than Britain, but it still benefits from trade, and its overall superiority is simply reflected in its higher standard of living. Likewise, the exchange rate, i.e. the price of a pound in terms of yen, is immaterial for the validity of the basic gain from trade. The sole purpose of the exchange rate is to translate comparative advantage into an actual lower cost for consumers in the other country. For example, at an exchange rate of 500 yen to the £, Japan will be able to undersell Britain in TV sets while matching them in whisky; at $333\frac{1}{3}$ yen/£, Britain will be able to undersell Japan in whisky and just compete in TV sets. For equilibrium in trade, the exchange rate must settle somewhere between these extremes.

We must next ask why relative marginal costs in autarky should differ between countries. In principle, such differences could arise from any differences in the underlying exogenous entities in the equilibrium of each: consumers' tastes, production technologies, or factor supplies. The first does not produce any particularly interesting analyses in competitive equilibrium models; the observation that, other things being equal, a country will import goods for which domestic consumers have stronger preferences than foreign consumers, is rather trivial. With imperfect competition and product diversity, however, consumer tastes could have a more important effect on trade. We consider this case in Chapter 9. The second aspect—differences in production technology—is at the heart of Ricardo's model with one input, which is expounded at length in

elementary textbooks. Beyond illustrating in a simple way how comparative, rather than absolute, advantage matters for trade, the simple Ricardo model is not very enlightening. A modification of it —the Ricardo–Viner model—is very instructive in that it embodies both differences in technology and differences in factor endowments as determinants of trade.

That brings us to the last aspect, namely differences in factor endowments. This has proved the most enlightening explanation of comparative advantage, in that it yields the greatest variety of testable propositions. The idea is that in each country, the factor which is relatively abundant will be relatively cheaper, and then the good which uses this factor relatively more intensively in its production will be relatively cheaper, too. Therefore we should expect a country to have its comparative advantage in goods relatively intensive in the use of those factors which are in relatively abundant supply there. This proposition is associated with the names of Eli Heckscher and Bertil Ohlin. We shall reserve the term 'the Heckscher–Ohlin model' for the special case of two goods and two factors, and shall refer to the general proposition more simply as the factor-abundance hypothesis. It is the second important hypothesis regarding comparative advantage.

In our example, we would say that whisky is relatively more capital-intensive than television sets (remember all the time it takes to mature whisky, as against all the labour it takes to rig up the connections to a silicon chip). Therefore comparative advantage in making whisky resides with the country where capital is cheaper, being relatively more abundant, than labour. We have taken this to be the case in Britain.

The third proposition is, in a sense, a corollary to the first two. If trade is due to the existence in autarky of differences in relative costs, then free trade should eliminate such differences, so that, at the margin, no country has a comparative advantage anywhere. In the case where comparative advantage derives from differences in factor endowments, therefore, one should expect the manifestations of such differences, namely the differences in domestic factor prices, to be eliminated by trade. This conjecture is the factor price equalization hypothesis.

Let us illustrate this using our simple example again. As Britain expands whisky production at the expense of television production, the relative factor demands shift in favour of capital, which is used relatively more intensively in the expanding industry, and against labour. This acts to relieve the scarcity of labour in Britain, which by assumption was the more acute. Wage rates fall relative to

interest rates, and Britain's comparative advantage in whisky production diminishes. The opposite changes take place in Japan, reducing its comparative advantage in television production. In the final trading equilibrium, there is nothing to be gained from a further shift in production, i.e. there is no comparative advantage left at the margin. Note that the relative factor scarcities could be relieved directly by Britain exporting capital or importing labour from Japan, but the same object is being indirectly promoted by the trade in goods.

Even though these three propositions are simple and plausible in the light of elementary economic intuition, it is far from trivial to establish them rigorously. In part, this is because the concepts involved are imprecise. Only the first proposition is immediately meaningful; the other two involve notions of factor intensity and factor abundance that have yet to be defined precisely. Further difficulties arise from the fact that none of these propositions are valid without qualifications. Even within the context of reasonably simplified models, the propositions are only valid over a limited range of parameter values, or only in a vague general sense.

To see the nature of the problems involved, let us look back on the three propositions and sum up their basic content. The first asserts a relation between pre-trade product prices and the pattern of trade. The second goes further, and relates the pre-trade product price differences to factor price or factor supply differences. The third conjectures a particular property for different countries' prices of factors when they trade goods. We know from general microeconomic theory that such detailed characterizations or comparative statics of general economic equilibria are very hard to come by. Some such results need restrictive assumptions concerning demand (e.g. homotheticity) or supply (e.g. constant returns and no joint production); others are valid only in simple models with two or three commodities. So it is with trade. To acquire a preliminary understanding of what is possible, it is instructive to look at traditional cases with two goods or two factors or both, emphasizing questions rather than answers, and trying to see why the results may fail to generalize. An added advantage is that it is possible to do so with minimum use of mathematics. We therefore devote much of the rest of this chapter to this programme.

2. THE PATTERN OF TRADE

The first of the above propositions, stating that the pattern of trade is governed by differences in relative product prices in pretrade

Walrasian equilibria, is generally true in the two-good case. To see this, consider a one-consumer economy producing and trading two goods at a price ratio (p_1/p_2). If the economy is competitive, we know that the allocation of resources will be such as to maximize the consumer's utility, given production constraints and the condition that there be no trade deficit. (We do allow for free disposal, and thus for a trade surplus; but a non-satiated consumer will never leave consumption possibilities unused.) As the no-trade allocation satisfies this condition, autarky is always a feasible choice; so any relative prices that generate foreign trade must give an allocation that is at least as attractive to the consumer as the autarky allocation. By the same token, of course, the no-trade equilibrium must be preferred to any other allocation that is feasible given the relative prices in autarky. Let the slope of the line $b^a b^a$ in Figure 1.1 indicate relative prices in autarky, so that the set S^a gives the feasible trades given autarky prices. Then the origin must correspond to an allocation which is preferred to allocations corresponding to any other point in S^a, and (in the absence of satiation) the origin must be strictly preferred to any allocation not on the frontier of S^a. This means that for relative prices above $(p_1/p_2)^a$, such as the relative price $(p_1/p_2)^1$ and the corresponding trade-balance line $b^1 b^1$, trades in the south-east quadrant are ruled out, as all such trades are inferior to the no-trade situation. It follows that for $(p_1/p_2) > (p_1/p_2)^a$, the country will export good 1 and import good 2, and conversely for $(p_1/p_2) < (p_1/p_2)^a$.

The relationship between comparative advantage and trade is then immediate. Consider two countries with different autarky price ratios. Any relative prices below the lower of the two autarky price ratios, or above the higher of the two, must be ruled out as candidates for equilibrium prices, as such price ratios would make both countries export the same good. The equilibrium price ratio must therefore lie between the two autarky price ratios; in which case it is obvious that the country with the lower relative price of good 1 in autarky will export that good, and vice versa.

The underlying line of reasoning here is obviously not dependent on there being only two goods, so it should be possible to establish a similar result for the general case. Such a general result must, however, be weaker than the two-good case might suggest. An example illustrates why. Suppose there are three goods, with prices p_1, p_2, and p_3; and with quantities imported to the country in question of m_1, m_2, and m_3. Let good 3 be the numeraire, i.e. let all prices be reckoned in units of good 3. Letting superscript 'a' denote autarky value, the kind of result one could establish through the line of

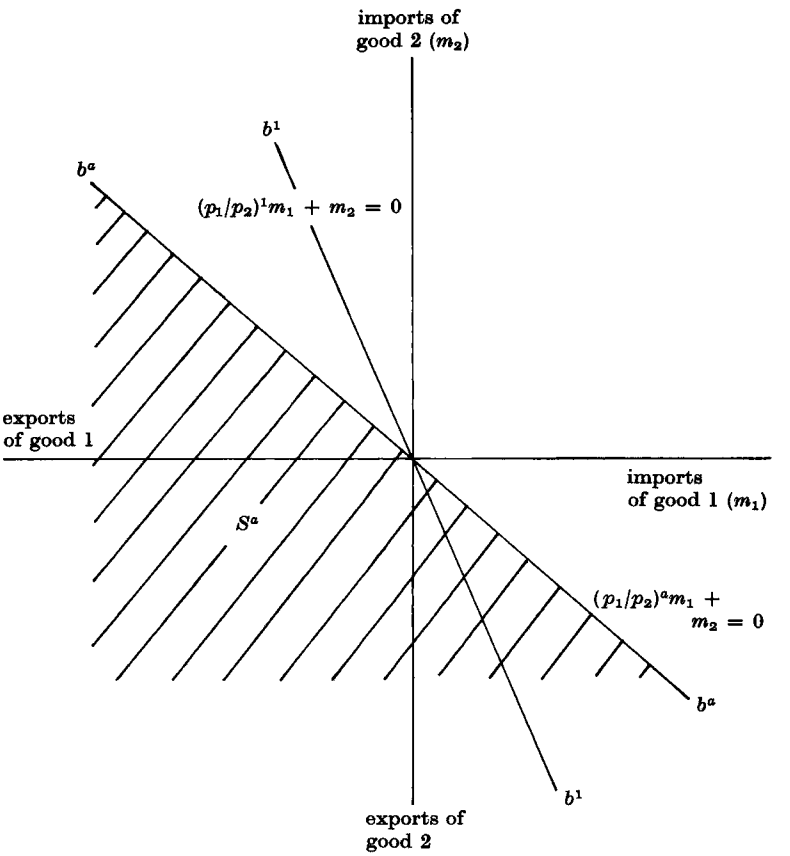

Figure 1.1

reasoning employed in the two-good case, would be that trades such that

$$p_1^a m_1 + p_2^a m_2 + m_3 \leq 0 \tag{1}$$

could be excluded—i.e. that trades that would be feasible given autarky prices could be ruled out. At the same time, we would know that actual trades, evaluated at actual prices, would balance—i.e.

$$p_1 m_1 + p_2 m_2 + m_3 = 0 \tag{2}$$

So, subtracting (2) from (1), we should have excluded trades with the property

$$(p_1^a - p_1)m_1 + (p_2^a - p_2)m_2 \leq 0 \tag{3}$$

Thus, if both relative prices are below the relative prices in autarky, we can rule out the possibility that *both* goods 1 and 2 will be imported—but we cannot rule out the possibility that *one* of them will be imported. In other words, once we leave the two-good case, we cannot establish detailed predictive relations saying that if the relative price of a traded good exceeds the relative price of that good in autarky, then that good will be exported by the country in question. It follows that any search for a *strong* theorem along the lines of our first proposition earlier is bound to fail. The most one can hope for is a *correlation* between the pattern of trade and differences in autarky prices.

Factor abundance

The factor abundance hypothesis is a much more restrictive proposition. In its pure form, where it sets up factor supply differences as the sole explanation of comparative advantage, it must begin by ruling out other possibilities. All countries must be assumed to have access to the same technology. Further, differences in taste patterns must be ruled out, and this amounts to assuming identical homothetic preferences for all countries. Let us make both these assumptions for the rest of this section. In a trivial sense, it is then obvious that a country's exports must use more of the country's abundant factors than its imports. With uniform, homothetic preferences, a country's consumption will equal world consumption times the country's share in world income. As world consumption equals world production, this means that a country's consumption will embody a fraction of world factor endowments equal to its share in world income. At the same time, its production will obviously embody its own factor endowments. As its net exports equal its production less its consumption, this means that its net exports will embody domestic factor endowments less its income share times world factor endowments. Thus, if the country is abundantly endowed with a particular factor, in the sense that its share of the factor exceeds its share of world income, its exports must embody more of that factor than its imports.

If it is to provide insight into the characteristics of a trading equilibrium, however, the factor abundance hypothesis must be something more than an accounting triviality. In particular, if it

is to have any predictive content, it must be capable of establishing a relationship between relative factor abundance and pre-trade relative output prices. It has already been suggested that a link might be provided through the concept of relative factor intensities. In fact there are two ways to proceed, for we might interpret the idea of relative factor abundance in its physical sense of quantities or in its economic sense of scarcity values, i.e. prices. The vague, intuitive treatment of the previous section treated these as one and the same. However, we have just seen how problems can arise in relating prices to quantities for outputs, and the same is true for factors. There are some important cases where factor supply differences can be negatively correlated with factor price differences, but this is not strong enough save in the case of two factors. We shall therefore investigate the two notions separately. From an empirical point of view, factor quantities are more easily observed than autarky factor prices. From a conceptual point of view, too, factor quantities can be seen as primary data while factor prices are merely endogenous variables in the full equilibrium system. However, relations between product prices and factor prices are easy to establish, and provide useful techniques for later use.

Product prices and factor prices

We begin with such relations in the case of two factors producing two goods. We will assume that there are constant returns to scale, and no joint production. To start with, we will also suppose that the technology defines fixed input coefficients. Let (p_1, p_2) be the output prices, (w_1, w_2) the factor prices, and b_{ij} the input coefficients denoting the amount of factor j required for unit output of good i, for i and j ranging over (1, 2). In a competitive equilibrium, each output price must equal its marginal cost, which under constant returns to scale equals the average cost. Therefore we have the equations of production equilibrium:

$$\begin{aligned} p_1 &= b_{11}w_1 + b_{12}w_2 \\ p_2 &= b_{21}w_1 + b_{22}w_2 \end{aligned} \tag{4}$$

Now define the relative prices $\pi = p_1/p_2$ and $\omega = w_1/w_2$. Dividing the first of the above equations by the second, we have a functional relation between relative output prices and relative factor prices:

$$\pi = (b_{11}\omega + b_{12})/(b_{21}\omega + b_{22}) \tag{5}$$