INTERNATIONAL TRADE AND THE EQUALISATION OF FACTOR PRICES

I. Introduction

CLASSICAL trade theory always took it for granted that free mobility of factors of production between different regions would tend to equalise the relative and absolute prices of productive services in the different regions. Thus, migration of labor from crowded Europe to less crowded America would result, through the law of diminishing returns, in a drop in America's wage rates relative to America's land rents and relative to commodities; at the same time, European land rents would fall and European real wages would rise. Migration of labor would cease only when absolute and relative factor prices had been finally equalised.

An important addition to this classical doctrine of factor-price equalisation has been supplied by Professor Bertil Ohlin. In his weighty *Interregional and International Trade* (1933), Ohlin has developed the highly interesting result that (1) *free mobility of commodities in international trade can serve as a partial substitute for factor mobility* and (2) *will lead to a partial equalisation of relative (and absolute) factor prices*. This important result, which we may call the Ohlin–Heckscher theorem, since Ohlin attributes it to a 1919 Swedish article by Professor E. F. Heckscher, has some foreshadowings in the literature of the last century [1]; but not until the highly original work of Ohlin was it made a central part of the theory of international trade.

II. Full or Partial Factor Price Equalisation?

The present paper is concerned primarily with one aspect of this theorem—namely, the assertion that, while free factor movements *fully* equalise factor prices, nevertheless free commodity movements equalise them only *partially*. Factor prices

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[1] See Ohlin's references to Longfield and Sismondi in *Interregional and International Trade* (Cambridge : Harvard University Press, 1933), pp. 31–32. All references to Ohlin hereafter will be page references to this book. See also J. Viner, *Studies in the Theory of International Trade* (New York : Harper and Brothers, 1937), pp. 500–507, for further references.

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are moved in the direction of equality, but the process is believed to be necessarily an incomplete one.

Like, no doubt, many others, I have been teaching this theorem to classes in international trade for a number of years. When recently a student [1] challenged this result, I availed myself of the usual teacher's prerogative of referring him to the text-book, in this case Professor P. T. Ellsworth's excellent work, *International Economics*. But doubt once provoked is not so easily lulled; neither the class nor its instructor found the relevant passages quite satisfactory, which is not to be wondered at since an intermediate text is not the place to dwell on minute fine points of theory.

What is more surprising, careful perusal of Ohlin's treatise nowhere reveals an adequate proof of the partial equalisation theorem. Not only is the logic incomplete, but at places it seems actually to go off the track. At the least, therefore, it would seem desirable to plug a gap in the theoretical literature, to provide a rigorous proof of the theorem if it is true, or to disprove it if it is false.

III. THE OHLIN ANALYSIS

The present note attempts to throw light on the matter under the simplifying assumptions most suited to the Ohlin analysis : two regions, say Europe and America, each endowed with different proportions of two perfectly immobile factors of pro- duction, say land and labor. For convenience, we may assume but two commodities, say food and clothing, each commodity obeying common technological production functions in the two regions. We may suppose that each production function shows constant return to scale as a result of proportional increases in both land and labor; diminishing returns is involved only in the sense that as we change the proportions of one input relative to another, then the marginal productivity of factors will be affected.

So long as we stick to Ricardian or Taussigian simple- arithmetic comparative-cost examples involving only one labor factor of production, we must assume as axiomatic, and unex- plained, differences in labor effectiveness in different regions. Ohlin's proportions-of-the-factors analysis, on the other hand, explains why differences in comparative advantage will exist and deduces the resulting pattern of productivities and specialisation. Thus instead of relying upon such crypto-explanations as

[1] Mr. Nathaniel Davis, formerly of the Fletcher School of Law and Diplomacy, and now of the United States Foreign Service.

" Yankee ingenuity " to explain patterns of comparative advantage, Ohlin would attribute America's comparative advantage in food production—a land-intensive industry—to the fact that each unit of American labor has relatively much land to work with. Similarly, the relative abundance of labor in Europe relative to land would result in a pattern of low wages relative to land rents and would encourage the production of clothing, which requires a greater proportion of labor to land than does food.[1]

In short, each country will tend to specialise (either partially or wholly) in the production of the commodity using much of its most abundant factor. But producing more food in America will increase the demand for land and tend to reduce its cheapness there; and producing more clothing in Europe will alleviate the demand there for land and increase the demand for labor so as to raise European wages. The pre-trade differences in the factor prices between the two countries will be partially reduced as a result of specialisation and trade according to comparative advantage. In Ohlin's words : " *Thus, the mobility of goods to some extent compensates the lack of interregional mobility of the factors* " (p. 42) . . . " [The] tendency towards equalisation also of the prices of the factors of production . . . means a better use of them and thus a reduction of the disadvantages arising from the unsuitable geographical distribution of the productive factors " (p. 49).

IV. THE ELLSWORTH PROOF

So far, so good. Something important has been added to the usual classical exposition. But why should there be only a *tendency* towards factor price equalisation ? Why should the equalisation be only *partial* and *incomplete* ? Why should free commodity movements be only a *partial* substitute for free factor movements ? This is the crucial question now at issue.

Professor Ellsworth has more clearly addressed himself to this issue than Ohlin, and his discussion is worth reproducing at some length :

> One might conclude that complete equalisation of the prices of the various productive factors would result [from

[1] When land and labor are substitutable in the production of both goods, it is a little ambiguous to say that food requires relatively more land to labor than does clothing, since there are varying possible proportions of the factors. What must be meant is that at the same ratio of wages to rent, it will be optimal to hire a greater ratio of land to labor in food production than in clothing production.

free commodity trade].   This, however, is highly improbable
if not impossible.   It could only occur if the demand for the
various kinds of labor could be concentrated largely on
those areas where each kind was most abundant, thereby
raising wages there to a parity with wages in scarce-labor
areas.   Likewise, the demand for land would have to be
concentrated on abundant land areas, and the demand for
capital on districts well supplied with capital.   Such a
wholesale localisation of demand is, however, quite impossible,
owing to the technical requirements of production, which in
the case of practically all commodities calls, not for labor,
land, or capital alone, but for combinations of all three of
these major groups of factors.   Complete equalisation of
factor prices would require an unattainably perfect adapta-
tion of demand to the highly varying local supplies of the
different agents.   *Moreover, did any such price equalisation
occur, it would contain the seeds of its own destruction.   For
when all factor prices were everywhere the same, there would
no longer be any reason for trade, and with the cessation of
trade, and therewith the extinction of the demands which brought
about the price equalisation, the original disparities in factor
equipment would immediately reassert themselves.*[1]   (Italics
mine.)

Until his last two sentences, the argument is a little vague
and the author seems to oscillate between a belief that factor-
price equalisation is (a) impossible, and (b) possible, but highly
improbable under realistic technological conditions.   However,
we do not have to worry about which of these views he holds,
because in the last two lines, which I have italicised, it is clear
that Ellsworth does believe after all that factor-price equalisation
involves a logical contradiction and is therefore impossible.

However, upon careful examination, I do not believe we can
accept the Ellsworth proof by contradiction.   Indeed, if it were
logically valid, we could at each stage substitute commodity
prices for factor prices, and by exactly comparable reasoning
prove the absurdity of commodity-price equalisation as a result
of perfectly free trade—a proposition which no one is likely to
question.[2]

[1] P. T. Ellsworth, *International Economics* (New York :   The Macmillan
Company, 1938), pp. 119–20.

[2] This type of *reductio ad absurdum* indirect reasoning has been used widely
by many writers other than Ellsworth.   Note, for example, the following
quotation from Viner dealing with a quite different topic :   " When a central
bank . . . raises its discount rate or engages in [open market] selling operations,
the resultant rise in the market rate of interest tends to attract foreign funds.
It has become the custom to say that [such] an inflow of short-term funds may
offset the efforts of the central bank to bring about [monetary] contraction, but
this overlooks the fact that the foreign funds will flow in only as the market rate

The flaw in the argument is not hard to find.   Equalisation of factor prices would imply that *no further* profitable trade could take place.   At the margin, trade would be indifferent—that being the reason why the margin is the margin !   On the intramarginal units, trade could continue to take place indefinitely.

V.   Proofs in Ohlin

When we turn to Ohlin's book, matters are even less satisfactory.   Ellsworth at least meets the question head-on, while Ohlin—like a murderer who returns again and again to the scene of his crime—repeatedly comes back to the point only to leave it elusively hanging in air.   There is almost something Freudian in the vehemence with which he asserts the proposition to be true and with which he employs the phrases " clearly," " of course," " obviously," " as a matter of fact," and similar phrases —as if subconsciously he is really a little uneasy about the proposition's validity.

At one point he even goes so far as to say, " It is not worthwhile to analyse in detail why full eq ialisation does not occur; for, when the costs of transport and other impediments to trade have been introduced into the reasoning, such an equalisation is in any case obviously impossible " (pp. 38–39).

This is hardly cricket.   The question is not whether imperfect mobility of goods leads to perfect factor-price equalisation, but whether perfect goods mobility does so.

Actually, in more than half a dozen places, primarily in Chapter II, Ohlin definitely asserts the impossibility or improbability of complete factor-price equalisation, usually as if the proposition were so obvious as to require little explanation. Only one example need be cited :

> A complete local adaptation of production through interregional factor movements and the resulting complete price equalisation would make prices just the same as if there were only one region and no geographical distribution of the industrial agents.   These would be used and combined just as it is explained in the one-market theory.   Space would be of no consequence.   In such a state prices would be different from what they are, when we have a number of isolated regions.   Clearly, the state of prices caused by interregional trade, under the assumptions in Part I, lies somewhere between these two extremes.   The tendency is

becomes higher than it was previously . . . the market rate must rise *somewhat* . . .." Viner, *op. cit.*, p. 406.   I do not mean to imply that such arguments are never valid, but they must be used with delicacy.

to push prices from the complete independence state to the complete equalisation state, but it is not carried through. The price differences as regards the productive factors are reduced, but they do not disappear (pp. 39–40).

Why " clearly " ?   At least to me, this argument appears as a complete *non sequitur*. If we were to insert before Ohlin's word " clearly," the clause " which is absurd," the argument would seem to be almost identical with the already discredited Ellsworth *reductio ad absurdum*.

But even this interpretation will not do, since on the previous page Ohlin explicitly rejects such an argument [1] in the following sentence that I have italicised.

> We have seen that trade tends to counteract the original price inequality and bring about a more uniform price formation. One might ask if trade cannot in this way make prices in the various regions coincide exactly. *In that situation trade would not disappear, as one might be inclined to think at first sight, for then the old price inequalities would immediately reappear.* On the contrary, the price equality assumes a certain adaptation of demand to the supply of factors, *i.e.*, the maintenance of a certain interregional division of labour and trade (p. 38).

Since we are thus barred from attributing to Ohlin the Ellsworth-type argument, what are we finally left with ? As far as I can tell, only with the following line of demonstration, which Ohlin appends after the above quotation :

> Such a result is, however, almost unthinkable and certainly highly improbable. The localisation of industry and thereby the · demand for production factors cannot completely adapt themselves to the equipment with them in each region, *chiefly because the industrial demand is always the " joint demand " for several factors.* Their combination cannot be varied at will; on the contrary, the most economical combination is determined by the prices of the factors and the physical conditions. Consequently, the best adaptations of production to the geographical distribution of industrial agents, which would be the result of trade under the simple assumption of these first three chapters, cannot lead to a complete interregional price equalisation; some factors will still command higher prices in one region and lower in the others, and vice versa (p. 38).

[1] On pp. 560–1 of the mathematical appendix, Ohlin almost seems to be endorsing the proposition that completely equal factor prices are incompatible with any trade.   But we can interpret him to mean " equal factor prices *in the pre-trade situation* is incompatible with any trade's subsequently taking place," and avoid falling into this difficulty.

The new element here is the emphasis on " jointness," in the lines that I have italicised. Unfortunately, this residual explanation upon which we are finally thrown back does not—to me at least—make sense as a proof or suggestion of a proof of the issue in question.

VI. THE TRUE THEOREM CONCERNING EQUALISATION

It would not be fruitful to stretch out further this already tedious critical exegesis. It is sufficient to note that there does not appear to be in the literature a satisfactory demonstration of the necessarily partial and incomplete character of factor-price equalisation. Having arrived at this conclusion, the present writer—still not doubting the essential truth of the proposition in question—hoped to outline a satisfactory proof. Intuitively, I suspected that the nub of the matter lay in a careful development of a line of reasoning frequently met in economic theory, according to which " secondary reactions to initial changes offset but do not wipe out those initial changes." In particular, I had in mind reasoning of the type quoted earlier from Viner, and also of the type involved in H. D. Henderson's classical exposition of the elementary beginner's error whereby a tax on a commodity appears not to lead to a rise in price.[1]

But in attempting to devise a rigorous proof of the partial character of factor-price equalisation, I made a surprising discovery : the proposition is false. It is not true that factor-price equalisation is impossible. It is not true that factor-price equalisation is highly improbable.

On the contrary, not only is factor-price equalisation possible and probable, but in a wide variety of circumstances it is inevitable. Specifically :

(1) *So long as there is partial specialisation, with each country producing something of both goods, factor prices will be equalised, absolutely and relatively, by free international trade.*

(2) *Unless initial factor endowments are too unequal, commodity mobility will always be a perfect substitute for factor mobility.*

(3) *Regardless of initial factor endowment even if factors were*

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[1] H. D. Henderson, *Supply and Demand* (London and Cambridge : Nisbet and Cambridge University Press, 1922), p. 27. Incidentally, without detracting from the significance of Henderson's argument, we should note that in the limiting case of inelastic supply, it is not literally true that a tax will raise market prices. But to invoke such a limiting case against Henderson (or Viner) would be a mere quibble; the present criticism of the Ohlin proposition is based on something more fundamental.

mobile they would, at worst, have to migrate only up to a certain degree, after which commodity mobility would be sufficient for full price equalisation.[1]

(4) *To the extent that commodity movements are effective substitutes for factor movements, world productivity is, in a certain sense, optimal ; but at the same time, the imputed real returns of labor in one country and of land in the other will necessarily be lower, not only relatively but also absolutely, than under autarky.*[2]

Propositions (3) and (4) follow in a fairly straightforward fashion from (1) and (2). All of the propositions are essentially valid whatever the number of commodities, regions, and factors of production, but the empirical probability or improbability of price equalisation would be altered in a complex manner by such complications. I shall confine the proof of (1) and (2) to the two-region, two-commodity, two-factor case previously described.

VII. THE NEO-CLASSICAL PRESENTATION OF
COMPARATIVE ADVANTAGE

Figure 1*a* shows the now familiar production-possibility (or transformation) curve for America : *i.e.*, the maximum amounts of clothing that can be attained when land and labor 'resources are shifted in an optimal fashion away from food production. Knowing the production functions of the two goods and knowing the original proportions of labor and land in America, we can move out to this optimal locus only by making sure that the ratios of the marginal physical productivities of land and labor are the same in both food and clothing production, in each case being equal to the ratio of market wages to rents.[3]

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[1] In his *The Economics of Control* (New York : The Macmillan Company, 1946), p. 349, Professor A. P. Lerner says, " If some of the factors cannot move, this is of no consequence provided the co-operating factors can be moved to these factors. Similarly if either the consumer goods or the consumer can move all is well. It does not matter that the mountain will not go to Mahomet as long as Mahomet is able to go to the mountain." In some cases it is more nearly right to say : it is necessary for the mountain to come some of the distance to Mahomet, after which Mahomet can go to the mountain.

[2] The real-income deterioration of these groups could theoretically be compensated out of the real-income improvements of the other groups. This is not the place to go into the intricacies of the so-called " new welfare economics." See P. A. Samuelson, *Foundations of Economic Analysis* (Cambridge : Harvard University Press, 1947), Ch. 8, for a discussion of this problem and for references to the important contribution of Professor T. Scitovsky.

[3] Geometrically, an Edgeworth box-type diagram, the respective sides of which are equal in length to the total American labor and land, can best be used to indicate the exact derivation of the optimal production-possibility curve. Any point inside the box represents, when its co-ordinates are measured from the lower

Figure 1*b* shows the corresponding production-possibility curve of Europe. Because labor—the factor used most intensively in clothing production—is plentiful in Europe, we naturally expect a relative abundance there of clothing production. This is confirmed by the relatively steep slopes of the European curve.

Where each country will end up in the absence of trade depends, of course, upon the interplay of tastes and effective
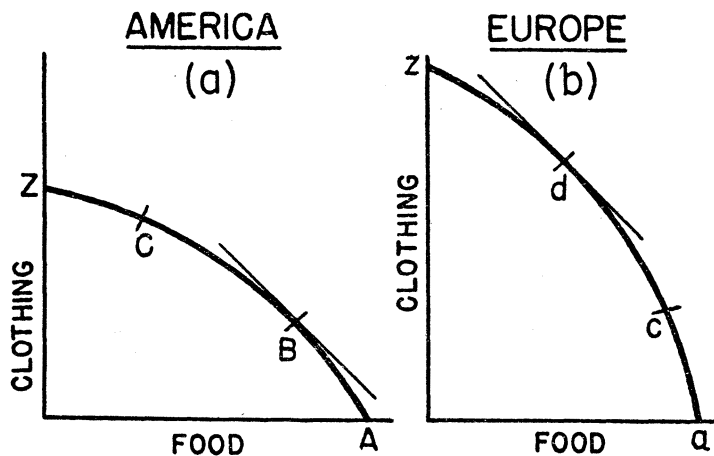

Fig. 1

DOMESTIC PRODUCTION-POSSIBILITY CURVES OF AMERICA AND EUROPE : Without trade America is at *C* and Europe at *c*. With free trade they end up at the points of common slope, *B*, and *d*.

demand. Unless Europeans in general, or rich landlords in particular, happen to have a special liking for food rather than clothing, we should expect that the pre-trade price ratio of food to clothing would be higher in Europe and lower in America. This is shown by the pre-trade points *C* and *c* in the diagram, the respective slopes of which differ in the indicated way.[1]

left-hand corner, the amounts of labor and land used in food production. Similarly, from the upper right-hand corner, we measure off the factors used for clothing. For fixed food, we are forced to move along an equal food-product curve until we are tangent to the highest equal clothing-production curve. The locus of these points of equal-product tangencies is a kind of an Edgeworth " production contract curve," and along it we can read off the optimum clothing for each food, and vice versa. Any other point in the box, gives food and clothing *inside* the production-possibility curve. See W. F. Stolper and P. A. Samuelson, " Protection and Real Wages," *Review of Economic Studies,* Vol. IX, No. 1, November 1941, pp. 58–74.

[1] It is quite possible to imagine a case where the difference in tastes would more than offset the difference in factor endowments, thereby reversing our normal price expectations.

Now suppose we strip away all barriers to commodity trade, to the barter of food and clothing. There can no longer be two different food–clothing price ratios; and at any price ratio different from that under autarky, each country will no longer wish to be self-sufficient. It follows that the new world price ratio must be somewhere in between the limiting price ratios prevailing in each country under autarky. The relative price of food falls in Europe and rises in America. This causes America to move in the direction of increased food production and decreased clothing production (from C to B), and to barter food exports for clothing imports. In Europe, the opposite shift from c to d takes place. The final equilibrium price ratio settles down between the initial limits at just that level where there is a perfect quantitative meshing of international reciprocal demands. Note the equality of slopes at B and d.

So far this differs in only one important respect from John Stuart Mill's completion of the Ricardian comparative cost theory. We have dropped the assumption of *constant returns* (or of a single labor theory of value). At the new equilibrium price ratio, both countries are shown producing something of both goods. Differences of comparative advantage on the intra-marginal units have given rise to trade; when relative marginal costs in each country have become adjusted to the prevailing market price, trade has reached its equilibrium rate and further specialisation ceases.[1]

VIII.   PROOF OF FACTOR-PRICE EQUALISATION

We are now face to face with the important question : Can we go behind the two production-possibility curves to show that wherever their slopes (or marginal-cost ratios) are equal then the ratio of internal factor prices must also be equal? The answer is yes.

We might try going behind the scenes of the production-possibility curves by means of the Edgeworth box diagram discussed in footnote 3 on page 170. A better way for our purpose is to utilise Figure 2. This diagram is independent of the scale of production and can be utilised for both countries.

On the horizontal axis is measured off the ratio of labor to

[1] Haberler, Lerner, Leontief and Viner have elaborated upon these matters. For references, see Viner, *op. cit.*, p. 520. These results are quite consistent with Ohlin's formulations.

land. On the vertical axis is measured off the ratio of (real) wages to (real) rents, or what is the same thing, the ratio of the marginal physical productivity of labor to the marginal physical productivity of land. There will be a different technological dependence of this wage–rent ratio or marginal rate of substitution for each commodity, and hence we have two curves : *FF* for food, and *CC* for clothing.   In either case the physical substitution ratio depends only upon the proportions of the factors employed in each use; this is because of our assumption of constant returns *to scale*, the only assumption possible if we are not to have to
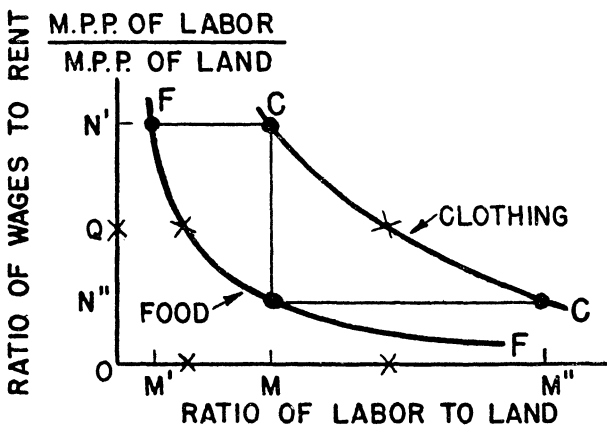

FIG. 2

investigate the composition of industry output among firms and enter upon other lengthy digressions. Because we assume the classical law of diminishing returns (as one factor at a time varies) both curves are necessarily declining ones with wage productivity dropping relative to rent productivity as labor is more intensively applied to land.

Now let us suppose that in one of the countries the factor endowment of labor relative to total land is given by the distance *OM* on the lower axis. Without further knowledge we can be sure of but one thing : a greater labor–land ratio than *OM* will be used in clothing production; a lesser ratio than *OM* in food production. At uniform wages and rents, it is never proper to use the factors in the same proportions because of the basic technological differences between food and clothing production.

The ratio of total labor to total land, *OM*, is a weighted average which falls between the labor–land ratios in each industry, the exact weights being the relative proportions of total land

being applied to each use.[1]   At any given wage–rent ratio, such as shown by the cross at Q, we move over horizontally to the two curves to read off the proper labor–land ratios in food and clothing.   These are indicated by crosses on the curves and also on the lower axis; and it will be noted that the total labor–land ratio, M, always falls in between the two lower crosses.

What different factor-price ratios are possible ?   Clearly, if something of both goods is to be produced Q can only range between N'' and N'.   When the wage–rent ratio falls to as low as N'', clothing production must cease entirely if the total labor demanded is not to exceed the available supply.   With only food produced, and with unemployment always ruled out, food must be using labor and land in the ratio OM.[2]   In short, as Q falls to N'', the pair of crosses march rightward until they reach M and M'' respectively.

By the same reasoning, we establish the fact that the price ratio will never rise above N' so long as both commodities are still being produced.   As Q approaches N', less and less of food is being produced and more and more of clothing; until finally at N'' itself, all factors are being used for clothing, their ratio being that of the whole community's endowment, OM.   The crosses on the horizontal axis have moved leftward to M' and M respectively.

To recapitulate :   As the factor-price ratio rises from N'' to N', the production of clothing grows and that of food declines so that in Figure 1a (or 1b) we are moving from A (or a) up to Z (or z) and the price of food is declining relative to that of clothing.   The limits N' and N'', or M' and M'' are determined by the light step-like formation around the initial community factor ratio, OM.   If this initial endowment were pushed in the direction of more labor to land, M would move rightward, and so would M' and M''; N' and N'' would move downward;   the production-possibility curve would be twisted into a more vertical shape, because food production, the land-using process, would be suffering more from the relative land shortage than would clothing production.

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[1] Since total land = food land + clothing land
total labor = food labor + clothing labor,
it follows arithmetically that
$$OM = \frac{\text{total labor}}{\text{total land}} = w_1 \frac{\text{food labor}}{\text{food land}} + w_2 \frac{\text{clothing labor}}{\text{clothing land}}$$
where $w_1 = \dfrac{\text{food land}}{\text{total land}}$ and $w_2 = \dfrac{\text{clothing land}}{\text{total land}} = 1 - w_1.$

[2] No clothing is being produced, so that the labor-to-land ratio in clothing is " zero."   But this is a determinate quantity in the limit, being equal to OM'' for the little unit of clothing " about to be produced."

With zero transport costs, free trade makes demand completely non-localised. The votes of European consumers have the same pull on American production as those of Americans. The final pattern of international effective demand is of no consequence for the problem of factor-price equalisation *so long as neither country is forced beyond the point of complete specialisation.* With each producing something of both goods, the common international price ratio is equal to the resulting slopes of the production possibility curves in both countries. Thus

$$\frac{\text{price of food}}{\text{price of clothing}} = \left(\frac{\text{marginal cost of food}}{\text{marginal cost of clothing}}\right)_{\text{America}} = \left(\frac{\text{marginal cost of food}}{\text{marginal cost of clothing}}\right)_{\text{Europe}}$$
$$= \text{absolute slope at } D = \text{absolute slope at } b.$$

Now, it is also true that so long as the marginal rate of factor substitution in the two industries are equal, as they must be if we are to be on the optimal production-possibility curve, the slope at any point of the production-possibility curve will be exactly equal to the ratio of labor's marginal productivity in clothing to labor's marginal productivity in food; or to what will be the same thing at such an optimum point, to the corresponding ratio of the marginal physical productivities of capital.

If, as we have earlier seen, the price slopes are equal in the two countries, this can only have resulted from the fact that factor-price ratios were equal [1] and that hence the same factor proportion patterns had to emerge. Were the factor-price ratios different—say at Figure 2's Q in one country and above Q in the other—the two countries would have to use different factor proportions; and with different factor proportions, there would have had to result different relative marginal labor productivities in the two lines, and finally different price or marginal cost slopes on the production-possibility curve. Hence, equal slopes must imply equal factor prices. This completes the proof of our fundamental theorem concerning factor-price equalisation.

IX. ARITHMETIC ILLUSTRATION

An arithmetic example may help to dispel any remaining vestige of the paradox about the plausibility of complete factor-price equalisation. Let us suppose that the two continents are

[1] The only exception is where the FF and CC curves happened always to coincide; *i.e.*, where the two commodities had substantially identical production functions. This would imply identical straight-line production-possibility curves in both countries, and trade would never take place.

differently endowed with land and labor : suppose that America has 100 units of land and 100 units of labor, but that Europe has only 55 units of land to 100 units of labor.

Now if factors were perfectly mobile, labor would migrate from Europe to America; and after about one-third of all European labor had moved to America the factor proportions would be equal. Europe would be left with about 71 units of labor to 55 units of land, and America with about 129 units of labor to 100 units of land, and the world as a whole with about a 4 : 3 ratio of labor to land (200 : 155, to be exact).

Depending upon technology and effective demand, there would also have to emerge some definite allocation of world resources between clothing and food : let us suppose that 28 units of world labor and 112 units of world land would be used for food, and the rest (172 units of labor and 43 units of land) for clothing. The exact figures do not matter, but it is important to notice that everywhere production would be carried on in the same way and no geographical trade would be necessary. World output would be, in a certain sense, optimal. Native American laborers would have lost their pre-trade privileged positions and would have lower real incomes (measured in *either* food or clothing); the same would be true of European land-owners.

Now we must drop the assumption that factors are mobile. Can free commodity trade alone offset the fact that population is twice as dense in Europe as in America? Yes, if America allocates 20 units of labor and 80 units of land to food and the rest (80 units of labor and 20 units of land) to clothing; and if at the same time Europe were to allocate 8 units of labor and 32 units of land to food, with 92 units of labor and 23 units of land going to clothing production. The accompanying Table I summarises these figures.

Under free commodity trade it is possible for world-factor combination to be exactly the same as under perfect factor-mobility conditions. No one needs to migrate if food can be cheaply carried from America to Europe in exchange for clothing. Farmers all over the world will be using exactly the same methods and will be receiving exactly the same pay; the same is true of land or labor in clothing production. World productivity is again " optimal."

It is perhaps not so obvious, but it is none the less true that free trade has had the same harmful effects upon the vested interests of the whole laboring class in America (and land-owning class in Europe) as would the removal of all immigration barriers.

TABLE I

Comparison of Factor Mobility and Goods Mobility

	Labor.		Land.	
Original Factor Endowments of Regions				
America	100		100	
Europe	100		55	
World	200		155	
Situation if Factors were Mobile				
America	129 [1]		100	
Europe	71 [2]		55	
World	200		155	
Food Input . .		28		112
Clothing Input . .		172		43
Situation if only Goods are Mobile				
America . . .	100		100	
Food Input . .		20		80
Clothing Input . .		80		20
Europe	100		55	
Food Input . .		8		32
Clothing Input . .		92		23

[1] More exactly, $\frac{100}{155} \times 200 = 129\frac{5}{155}$
[2] More exactly, $\frac{55}{155} \times 200 = 70\frac{150}{155}$.

What maximises world or national output will in this case lower the absolute real returns to even so " important " and " versatile " a factor as (American) " labor." [1]   Under the broad conditions here assumed, free trade must have no less profound effects than free movements of population.

  Advocates of freer trade—and I consider myself in this class —must not overstate their case.   Protection can help special groups; it can even help special large groups.   Only in the simple Ricardian labor-theory-of-value examples of comparative cost is it correct to say that " wages are not the *cause* of trade : they are the *result*." [2]   Only if labor is to receive 100% of national

  [1] Ohlin on p. 44 incorrectly argues that relative factor-price equalisation will take place without lowering the absolute share of labor in terms of goods : " Wages are such a substantial part of the total income that it is almost unthinkable that a considerable rise of the latter could fail to raise total wages also, even if the percentage going to the laborers became somewhat reduced."   Not only is this result " thinkable "—it inevitably follows from the Ohlin–Heckscher analysis, as Professor Stolper was the first to point out.   See Stolper and Samuelson, *op. cit.*   For a position similar to Ohlin's, see G. Haberler, *Theory of International Trade* (London : W. Hodge and Co., Ltd., 1936), Ch. XII.   In his *Studies, op. cit.*, p. 533, Viner takes a more guarded position.
  [2] See Lionel Robbins, " Economic Notes on Some Arguments for Protection," *Economica*, No. 31, February .1931, p. 49.

income will maximisation of income necessarily maximise real wages. And if labor should customarily receive a large share of total income this fact itself would—in a simple Ohlin world— restrict the possible gains in income resulting from international trade and limit the explanatory value of the proportions-of-the-factors analysis.

X. THE CASE OF COMPLETE SPECIALISATION

But have we not perhaps proved too much ? At times in the historic past tariff barriers were relatively minor, and within many regions free trade was virtually achieved. Yet important differences in wages and other factor prices have persisted. How shall we account for this ?

First, there is the important fact that commodities are never perfectly mobile. Transportation costs always exist and serve as obstacles to profitable trade. The whole theory of location of industry is based upon this basic fact.

The second reason for persisting factor-price differences in the face of commodity mobility is more difficult to describe, being rather complex and technical. If, (a) different regions of the world are extremely different in factor endowments, or (b) the different commodities use factors of production in almost the same proportions, *complete* (rather than only partial) *geographical specialisation of production may result*. In this case factor prices need not be equalised.

The remainder of this section will be devoted to a brief discussion of the case of complete specialisation. The next section will discuss a third important reason why factor prices are not equalised—namely, the inadequacy of the simplified Ohlin proportions-of-the-factors analysis of the pattern of international division of labor.

So long as a country is producing something of both goods, the competitive price ratio must be equal to the ratio of domestic marginal costs. But if one product is not being produced at all— e.g., no clothing in America—then its (relative) price may fall short of the (relative) marginal cost of producing a first unit of the product. Thus, at the point A in Figure 1a, the price ratio of food to clothing can be anything in excess of the absolute slope of the curve at A. Similarly, when Europe produces all clothing, the price ratio can be anything less than the absolute slope at z.

Depending upon available factor proportions, there will be in each country only a definite range of price ratios at which some-

thing of both goods will be produced.   In America this range is between the numerical slope at Z and the numerical slope at A. In Europe the slopes at z and a determine a corresponding range. These ranges are not identical unless the two countries have identical total-factor ratios.   If America has more land relative to labor, its production-possibility curve will be flatter than that of Europe and its limiting marginal-cost ratios will each be less than the corresponding limits of Europe.   But there will still be some overlapping of their ranges, unless their respective factor endowments are very far apart compared to the technological differences in factor intensities of food and clothing production.   (A visual comparison of Figures 1a and 1b will show that their production-possibility curves have about the same slopes except around Z in Figure 1a and around a in Figure 1b, where the ranges cease to overlap.[1]

So long as the final pattern of equilibrium is within the common relative price range, all of our previous analysis applies. But if the final pattern of equilibrium leads to complete specialisation on the part of one or both countries, then their production-possibility slopes need not be equal, even though market-price ratios must still coincide.   Production in the different countries may be taking place with different factor proportions, and relative factor prices will usually not be at equality.   Even in a limited sense of the word optimal, we can no longer expect world productivity to be optimal; however, in a still more limited sense —*as of a given immobile pattern of world resources*—total " productivity " cannot be made better.

The effect upon American real wages or European real rents can no longer be unambiguously ascertained.   American real wages in terms of food must certainly have deteriorated; similarly European land rents in terms of real clothing must fall. This much can be inferred from production considerations alone, *i.e.*, from the classical law of diminishing returns.   But if the final price ratio of food to clothing becomes much steeper than the critical limiting slope at A, American real wages in terms of imported clothing can begin to exceed the pre-trade real wage in clothing.   In such a case the final effect of trade upon a worker's welfare would depend upon the particular pattern of his tastes for food and clothing.

The classical constant-cost arithmetical analysis of compara-

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[1] If the " step formations " for each country are drawn into Figure 2, the steps will partially overlap unless initial factor endowments are extremely far apart.

tive advantage happens to fall into the extreme category of complete specialisation. Almost by chance, so to speak, certain rather special relations result. Thus, as Viner has pointed out,[1] the Taussigian dictum that " productivity in the export industries sets the pace for real wages " is only half a truth (or less than 360° of a circular truism) since it ignores mutual interdependence. But, worse than that, under the partial specialisation of increasing cost it would not even be true.

The limitations upon factor-price equalisation of complete specialisation can be made more comprehensible if we revert back to the arithmetical data of Table 1. Suppose that under free labor migration the world finally settled down to the use of 100 units of labor and 77 units of land in clothing production, and to 100 units of labor and 78 units of land in food production. The relative intensities of land and labor in the two industries is now very similar. It must follow, therefore, that free com- modity trade is unable to compensate for complete factor immobility. Even when the United States has specialised com- pletely in food production and Europe in clothing production, there will still not be achieved the same methods of production as under freely mobile factor conditions. Labor in Europe will have too little land to work with, land in America too little labor.

If we superimpose on the free commodity trade situation, free factor movements, labor will begin to migrate. But it certainly will not have to migrate until full factor proportionality has been achieved in both regions. Short of that condition, the regions will become enough alike in factor endowments so that free trade can equalise factor prices—so that each country only partially specialises and by a judicious weighting of the relative importance of different industries achieves the common optimal world pattern of production.[2]

XI. LIMITATIONS OF FACTOR-PROPORTIONS ANALYSIS

In addition to the fact of transport cost, we have found a second impediment to complete factor-price equalisation in the

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[1] J. Viner, " Professor Taussig's Contribution to the Theory of International Trade," *Explorations in Economics : Notes and Essays Contributed in Honor of F. W. Taussig* (New York : McGraw-Hill Book Co., Inc., 1936), p. 11.

[2] The exact conditions for partial specialisation and complete factor price equalization are as follows : the labor–land ratio in each country must lie between the labor–land ratios that would spring up in each line of production under freely mobile factors. This much can be deduced from Figure 2 or from the arithmetical consideration that the weighted average of two numbers must lie between them.

possibility of complete specialisation. There remains a third, and perhaps more fundamental, reason why factor prices need not be equalised : the Ohlin proportions-of-the-factors analysis of international trade has fundamental inadequacies and limitations.

The Ohlin analysis explains much; but there is much that it fails to explain; and if adhered to inflexibly, there is much that it can obscure. Its two central tenets are open to grave doubt : Is it reasonable and useful to set up the hypothesis that production functions are the same the world over? Is it possible to find reasonably homogeneous and commensurable factors of production in diverse parts of the world, so that relative proportions can be defined and compared?

Certainly no strong affirmative answers to these two questions can be given—as Ohlin himself has pointed out in a number of places.[1] The laws of nature may be the same " everywhere," but the laws of nature and the economically relevant production function relating maximum output obtainable from specified concrete inputs are two quite different things. Effective knowledge (" know-how ") is probably as important a variable in understanding economic history and geography as is specific factor endowment. The " same " (biological) labor working in one city of the United States with the " same " kind of equipment and other resources produces substantially different output. The " effective organisation " is different.

It would be artificial in the extreme to explain any such empirical case by saying that " knowledge " is " scarce " in the one place relative to the other. At best this is a crypto-explanation; at worst it ignores the play on words involved in the fact that the term " factor of production " is used in two or more quite different senses : (a) as a concrete input item, such as fertiliser, purchasable in divisible units in the market place; and (b) as a condition which has a bearing upon production such as the factor of technological knowledge.[2] Knowledge is *not* an input such that the more you use of it, the less there is left.

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[1] Ohlin recognises (p. 562) that international trade theory need not assume any commensurability of factors between regions. He also devotes a lengthy discussion (Chapter V) to qualitative differences of factors. But if one is forced ultimately to work with dozens of grades of labor, hundreds of grades of land and innumerable grades of capital equipment, the explanations become rather *ad hoc* and not very helpful.

[2] In between (a) and (b) there is a category of such non-appropriable factors of production as " humidity," which are free in the sense that nothing is paid for them, but not in the sense that they can be unlimitedly augmented.

Effective knowledge is even more important than knowledge, and
it unfortunately cannot be acquired by reading a book or by
editorial exhortation.

When we turn to the question of defining significantly com-
parable categories of productive factors, we run into similar
difficulties. " A man's a man for a' that," but is a jungle pigmy
to be equated to an Eskimo ?   An illiterate " hill-billy " to his
cousin working in the Detroit factories and " broken " to an
industrial regime ?   Even if we are sympathetic to the eighteenth-
century view of the plasticity of human nature, so that all men
(and women) are regarded as *potentially* alike, we must not
overlook the important environmental differences that have
conditioned their industrial effectiveness.

The commensurability of natural resources involves similar
problems.   No one will deny the importance of iron, coal, power,
rainfall and fertile plains as localising factors.   But there is little
that the proportions-of-the-factor analysis can add to our under-
standing of the matter.   We would be giving the show away if
we were to descend to such fatuities as : the tropics grow tropical
fruits because of the relative abundance there of tropical
conditions.[1]

Space does not permit further elaboration on this important
topic.   We may conclude by saying that factor proportions

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[1] In a sense, the comparison of productivities of the same factors between
countries is a backward step in formal international trade analysis.   To-day
it is widely recognised that it is never necessary—even in the simple Ricardian
examples—to make such productivity comparisons; it is only necessary to
make inter-commodity comparisons.   The proudest moment in the classical
analysis, when it is shown that trade is still possible between two countries
where one is less " efficient " in the production of all goods, is something of an
irrelevancy.   These remarks do not mean that opportunity cost doctrine (where
the cost of goods is only to be measured in terms of goods) is correct in the neo-
Austrian form.   Professor Viner has steadfastly maintained the more general
equilibrium approach of Walras, Pareto and Marshall against his opponents
Knight, Haberler and Robbins.   And one by one they have either had to
maintain an empirically gratuitous position (that all factors must be perfectly
inelastic in total supply and indifferent between different uses) or else have had
to reformulate the opportunity cost doctrine so that it becomes not only a rather
awkward mumbo-jumbo, but loses all novelty and distinctiveness as well.   See
Viner, *Studies, op. cit.*, Ch. VIII, for references.   But when Viner seems to argue
that normative propositions in international trade cannot be deduced from a
full general equilibrium analysis in much the same way that they can be from
the inadmissably simple classical real costs comparative advantage, I part
company with him.   Cf. my " The Gains from International Trade," *Canadian
Journal of Economics*, Vol. 5, No. 2, May 1939, pp. 195–205, and " Welfare
Economics and International Trade," *American Economic Review*, Vol. XXVIII,
No. 2, June 1938, pp. 261–66.   Also, Viner seems unusually gentle in his
criticism of the circuitous and rather feeble Taussigian real cost doctrines.

explain only part of the facts of international economics.   We must still set up hypotheses of differences in international production and productivity, differences in effectiveness which are to be accepted as empirical facts even if not simply explainable. Thus, it may be a crypto-explanation to explain events of economic history by " Yankee ingenuity."   But whatever we think of the explanatory value of the label, we must not deny the important fact described.   Indeed, from the deeper standpoint of sound methodology, all " explanations " are really nothing but simplifying descriptive hypotheses which unify diverse facts.

XII.   Policy Implications Concerning Migration

In conclusion, I should like to venture upon the dangerous task of drawing a practical moral from an abstract theoretical argument.   The United Kingdom is a densely populated region. In the post-war period it has suffered from loss of overseas investment income, from high food prices and adverse terms of trade, from a certain disorganisation of production and internal division of labor.

Is widespread emigration the way out ?   Perhaps it is.   But despite numerous qualifications, the gist of the present discussion has been to show that relatively free commodity trade is a better substitute for mobility of factors of production than was hitherto thought to be the case.

So long as raw material can be carried to the United Kingdom by relatively cheap ocean transport, the law of diminishing returns is largely robbed of any particularly immediate local effects.   The question arises :   What can English industrial workers do for themselves in the remote parts of the empire that they cannot do in England ?   What can they do for the present generation of Australians and Canadians after migration that they cannot do in England ?

Obviously, no simple answers can be given to such complex questions.   Undoubtedly industry is in many parts of the world asleep, and new catalytic agents would contribute towards a better and more suitable long-run equilibrium.   But to have asked the questions in the above form shows that the favourable effects of migration are by no means automatic and cannot be simply taken for granted.

They would be so only if it were proposed that Englishmen migrate in order to go on the land as primary food producers. This, few experts would propose on a large scale, even now when

the terms of trade are abnormally favourable to agricultural
production.   Without venturing upon rash prophecy, one can
venture scepticism that this abnormal trend of the terms of
trade, counter to historical drift, will continue.   And even if the
trend towards relatively higher food and raw-material prices
should continue to develop, it would have to go a long way before
comparable labor effort on the land could anywhere in the world
be expected as a matter of cold fact to yield the material real
incomes of industrialised labor.

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