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LOCATION THEORY AND TRADE THEORY:
SHORT-RUN ANALYSIS

By WALTER ISARD

In an article published jointly with Mr. M. J. Peck in the previous issue of this *Journal*[1] (1) empirical material was presented on the flow of commodities over different distances, and (2) the logical interrelations of location theory and *long-run* international and interregional trade theory were examined.[2] I now turn to the interrelations of trade and location theory for short-run analysis.

I. SOME SHORTCOMINGS OF TRADITIONAL TRADE DOCTRINE AND THE CONCEPT OF INCOME POTENTIAL

It is in short-run analysis that classical and neoclassical trade theory has played its largest part and consequently has had its greatest impact. Location theory, on the other hand, has played little part in short-run analysis, and that limited part has been closely associated with regional analysis. However, it is with respect to short-run analysis that the empirical data on geographic flows are most suggestive in the examination of the interrelations of trade and location theory.

First, the data presented in the previous issue of this *Journal*[3] unmistakably reveal the attenuating influence of distance upon physical volume of trade. Yet, examine any of the current trade literature for a bare, if any, explicit recognition of this relation. In surveying this literature in 1948 Metzler observed: "The classical theory, in its rigorous form, dealt only with the problem of two countries trading in two commodities, and subsequent revisions or refinements of the classical theory have seldom gone beyond this simple framework."[4] Typical of that part of the literature which deals with

1. W. Isard and M. J. Peck, "Location Theory and International and Interregional Trade Theory," this *Journal*, LXVIII (Feb. 1954), 97.
2. The findings of the first article are summarily presented in the first two paragraphs of the concluding section of this paper.
3. Isard and Peck, *op. cit.* In particular, see Figures I and II, pp. 101, 103.
4. L. A. Metzler, "The Theory of International Trade" in *A Survey of Contemporary Economics*, ed. Howard S. Ellis (Philadelphia, 1948), p. 238.

the theory of employment, income and balance of payments is a division of the world into two parts: one country (country A) and the rest of the world (country B). One investigates the effects upon the balance of payments between countries A and B when a primary or spontaneous disturbance has worked out all its secondary "multiplier" effects upon the incomes, expenditures, imports and exports of both countries. Throughout such a customary analysis it generally makes no difference in which part of the rest of the world (country B) an increase in effective demand arises (whether it is due to an increase in income, to a financial transfer from A to B, or to some other cause); the induced increase of imports from A is unaffected.[5] Yet, all evidence suggests that the increase of imports from A will tend to be smaller the more distant from A is the part of the world in which the increase in effective demand takes place.

Consider also some of the recent work of Haberler[6] which typifies the modern literature on the pure (primarily price and value) theory of international trade and which has both short-run and long-run aspects. The analysis again is usually of the two-country type, but here with the use of transformation and product substitution curves. Without question this analysis is useful as far as it can go. Certain basic principles for a theoretical world are unearthed, and these are of value in suggesting policies for the real world. But such analysis does not proceed very far in explaining *actual* trade.

It is our contention that a major drawback to the usefulness of traditional pure trade theory is the two-country abstraction with either zero or fixed transport costs assumed; hence the distance variable[7] is neglected when in actuality trade is of a multilateral

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5. For example, Chang states that "variations in the quantity of exports of a country may be correlated with, and explained by, changes in several predominant determinants": changes in the level of world real income, changes in the country's export prices, and changes in the prices of substitutes supplied by competitors in the world market. (T. C. Chang, "A Statistical Note on World Demand for Exports," *Review of Economics and Statistics*, XXX (May 1948), 106.) Yet, it seems fairly obvious (and Chang is not unaware of this) that where prices remain fairly stable Swedish exports in general, or, more specifically her exports of iron ore, will be much more affected if a given increase in world income is primarily an increase in northern European income, than if it is primarily an increase in western United States and Canadian income.

6. G. Haberler, "Some Problems in the Pure Theory of International Trade," *Economic Journal*, LX (June 1950), 223–40.

7. It is interesting to note that, of the five reasons listed by Samuelson in explaining why in fact men receive lower wages in some countries than in others when in theory a simple two-country, zero transport cost model guarantees equal wages, one is the existence of transport costs and a second is the failure to develop full economies of scale because of a limited market, which reason is only valid if

character, and encounters different spatial resistances for different pairs of nations or regions.   It seems self-evident for example that protection and infant industry arguments can take on an entirely different hue with respect to a developing economy depending upon whether within its spatial spectrum of potential markets major industrial nations are distant or near.   Failure to recognize such realities in general analysis, whether of the pure theory or income-multiplier type, can lead to erroneous policy recommendations and harmful repercussions.

Without question then current trade analysis is deficient in failing to consider the impact of distance.   But how can it be taken into account?

Let the reader re-examine Figures I and II presented in the previous issue of this *Journal*.[8]   The "falling-off-with-distance" effect is most regular in Figure I on total state-to-state Class I railroad shipments of all commodities in the United States.   Except by distance zones, this Figure carries aggregation as far as it can meaningfully be carried, and at the same time it is based on what is probably the most reliable source of comprehensive geographic flow data we possess.   Observe the straight line form of the shipment configuration on a double log scale (the straight line has been drawn in free-hand).   Note the resemblance to the Pareto income distribution and other important distributions (as on rank and size of city) unearthed by Stewart[9] and Zipf.[1]

This statistical regularity of interregional trade in the United States is indeed a striking one.   That such regularity does not characterize the data on world trade by water in Figure II is to be expected.   First, the basic data are themselves very crude.   Second, they are available only after having been aggregated for twenty-three areas.   Third, even if the data were of high quality, the fact that political factors and other noneconomic disturbances are so much more intense internationally than intranationally forcefully suggests irregularities in world trade data and a less clear perception of the impact of the

transport costs are not zero.   (P. A. Samuelson, "International Factor-Price Equalization Once Again," *Economic Journal*, LIX (June 1949), pp. 196–97).

8. Isard and Peck, *op. cit.*, pp. 101, 103.

9. J. Q. Stewart, "Empirical Mathematical Rules Concerning the Distribution and Equilibrium of Population," *Geographical Review*, XXXVII (July 1947), 461–85; "Demographic Gravitation: Evidence and Applications," *Sociometry*, XI (Feb.–May 1948), 31–58.

1. G. K. Zipf, *National Unity and Disunity* (Bloomington, Indiana, 1941); *Human Behavior and the Principle of Least Effort* (Cambridge, Mass., 1949); and other studies cited in the latter work.

distance variable. Nonetheless, there is at least some presumption for anticipating "distributional stability" (as Vining has put it) in the flow of commodities over various distances for the world and for large areas of the world.[2]

Much more empirical and theoretical analysis must be applied to the determination of the exact nature of these regularities with space. However, the data of Figure I, the statistical findings of Stewart, Zipf, Vining and Ullman, among others, tentatively suggest that in some ways the distance variable acts in much the same manner with respect to the social world as to the natural world.

Accordingly one may adapt the *potential* concept in widespread use in the physical sciences in much the same way as Stewart has done in his demographic research. Since in short-run international trade theory income is a critical variable, one may employ (as developed elsewhere)[3] the concept of income potential, $_iV$:

$$(1) \qquad _iV = \sum_{j=1}^{n} {_iV_j} = \sum_{j=1}^{n} k \frac{Y_j}{d_{ij}^a}$$

where Y_j = income of nation (region) j;

   d_{ij} = the average effective distance (i.e., distance adjusted for level of transport rates) between nations i and j;[4]

   a = a constant power to which d_{ij} is raised;

   k = a constant similar to the gravitational constant;

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2. R. Vining, "The Study of the Spatial Structure of an Economic System," (paper presented at the December, 1951, meetings of the American Economic Association, unpublished).

   Vining's conception of spatial structure "refers to a complex of density configurations: (1) a spatial density configuration of economic units describing the pattern formed by the spatial distribution of units within the system; and (2) density configurations of a second sort that describe the spatial dispersion of (a) the destinations of the economic flows emanating from any given concentration of units and (b) the originations of the economic flows terminating within any given concentration of units" (*op. cit.*, p. 1).

   According to Vining, though there may be much instability with respect to the pattern of geographic origins and destinations of individual commodities, there nonetheless can be stability (and this Vining intuitively suspects) with respect to the total pattern of flows for all commodities. Such a phenomenon could be explained in terms of probability theory (stochastic processes).

   3. W. Isard and G. Freutel, "Regional and National Product Projections and Their Interrelations," section 3 in *Long-Range Economic Projection, Studies in Income and Wealth, Vol. XVI,* forthcoming. A more adequate development of the concepts which follow is available in this paper.

   4. In converting actual distance into effective (economic) distance, one must also consider the relative movement of commodities over the different transport media. In determining the value for d_{ii}, one must follow a special procedure. As an instance, see Stewart, "Empirical Mathematical Rules . . . ," *op. cit.*, p. 477.

$_iV_j$ = income potential produced by nation j upon nation i; and
$_iV$ = income potential produced by all nations upon nation i.

The income potential produced by any given nation upon nation i varies inversely with the intervening distance, *ceteris paribus*. Of two nations with similar resources, and industrial and institutional structures, the one closer to nation i would have stronger bonds with nation i. This would be reflected in the higher income potential it produces upon nation i.

To register the simultaneous impact of changes in the incomes of the several nations of the world upon nation i, it is necessary to consider the change in the income potential produced by all nations upon nation i. One convenient way to do this is to employ the associated concept of *relative income potential*: $\dfrac{_iV_{t+1}}{(1+\rho)_iV_t}$ where $_iV_t$ and $_iV_{t+1}$ represent the total income potential produced by all nations on nation i in two successive time periods, and where ρ represents the rate of change of world income from one time period to the next. The factor $(1 + \rho)$ is introduced into the denominator in order to yield a relative income potential of unity in the theoretical case (useful as a guidepost) where the incomes of all nations of the world rise by the same per cent. Hence, when the rise in world income is concentrated in nations relatively close to i, the relative income potential for i is greater than unity; when concentrated in nations relatively distant from i, the relative income potential for i is less than unity. In the first instance i's interregional economic position within the world has improved; in the second instance, deteriorated.

It is premature, and would be presumptuous, to suggest that these concepts as stated are in their most useful forms for international trade analysis. More and finer empirical research is required. Concomitantly, there should be forthcoming hypotheses and theories to explain the role of the distance variable. To what power should the distance variable be raised and why? In brief, we hold that it would be fruitful to explore these and similar concepts; and, more important, that it is no less harmful to use such concepts *along with accepted ones* (with the appropriate qualifications such as have been suggested elsewhere), than to proceed along traditional lines with the naive, implied assumption that the distance variable is of little, if any, significance in determining the course and volume of international trade.[5]

5. It is certainly appropriate to suggest that Chang (*op. cit*) might have obtained "better" results had he been able to employ in the estimating equation

II. INTERREGIONAL INPUT-OUTPUT ANALYSIS
AND INTERNATIONAL TRADE

Despite the traditional preoccupation in short-run analysis of trade theory with two-country schema, there has emerged in recent years in the works of Machlup, Frisch, Polak, Chipman, Meade, Metzler, Samuelson and others significant theoretical thinking in the realm of multi-country trade.[6] This development, already much

of exports for each nation an additional term (such as relative income potential) indicating the over-all geographic shift of world income toward or away from each nation in terms of effective economic distance.

6. Fritz Machlup, *International Trade and the National Income Multiplier* (Philadelphia, 1943). Machlup fully recognizes that all foreign countries cannot "be rolled into one and regarded as *the* foreign country" (p. 90). However, when he does engage in multi-country analysis, algebraic complexities force him to adopt the debilitating symmetry assumption that all countries are of equal relative importance as to their shares in the exports and imports of any given country.

Ragnar Frisch ("On the Need for Forecasting a Multilateral Balance of Payments," *American Economic Review*, XXXVII (Sept. 1947), 535–51; and "Outline of a System of Multicompensatory Trade," *Review of Economics and Statistics*, XXX (Nov. 1948), 265–71, sets up a trade matrix for many nations but only in a framework which is rather sterile from the standpoint of understanding the economic bases of international flows of commodities. He proposes that import and export items be adjusted by government authorities to yield a balance of the aggregates, exports and imports, for each nation with comparatively little, if any, attention paid to the underlying comparative cost and productivity structure of each commodity flow.

J. J. Polak ("Projections of the International Sector of Gross National Product," in *Long-Range Economic Projection, Studies in Income and Wealth, Vol. XVI*, forthcoming), in attempting to project exports of the United States discards the concept of *the rest of the world* as "an amorphous aggregate about the behavior of which no useful statement can be made" (p. 44). Correlating income of the world outside of the United States with United States exports is considered unsatisfactory, "if for no other reason than that the 'marginal propensity to import from the U. S.' of different countries is so widely different that the aggregation of their national income for this purpose is not permissible" (p. 26). Polak proceeds to develop a multi-country scheme for long-run projection of the $n(n-1)$ flows between n countries in which the value of imports into country i from any country j is dependent upon the total value of its exports, its capital imports and an associated investment expansion ratio, its international reflection ratio which is allied to its marginal propensity to import and its marginal propensity to save, its use of excess reserves, and finally a coefficient which Polak claims has a certain degree of constancy and which refers to the fraction of country i's imports which is purchased from country j.

John S. Chipman (*The Theory of Inter-Sectoral Money Flows and Income Formation*, Baltimore, 1951), and J. E. Meade (*The Balance of Payments*, New York, 1951), develop multi-country models closely resembling that of Lloyd A. Metzler ("A Multiple-Region Theory of Income and Trade," *Econometrica*, XVIII (Oct. 1950), 329–54, and "A Multiple-Country Theory of Income Transfers," *Journal of Political Economy*, LIX (Feb. 1951), 14–29), which will be briefly described below. Among other multi-country studies see K. E. Hansson, "A Theory of the System of Multilateral Trade," *American Economic Review*, XLII

more satisfying and useful than traditional analysis, promises, if
logically extended into an interregional input-output type framework,
to bridge much of the gap between short-run trade theory and loca-
tion doctrine.

Metzler, whose approach is fairly representative here, conceives
of an n-country world. A given country's "national income *equals*
expenditures on consumers' goods and services *plus* net investment
plus exports of goods and services *less* imports of goods and services."[7]
Imports from each country as well as total imports are for any given
country a function of its income. Since one country's exports are
the imports of other countries, the global pattern of trade between
various nations may be described in terms of import functions alone.
As Metzler indicates the pattern of trade may be represented by a
matrix similar to the Leontief input-output table, where countries
replace industries, and imports and exports substitute for inputs and
outputs. Since in equilibrium each country's output must equal the
demand for this output, a general system of n equations is obtained
through which the level of income in each country, and hence its
imports from each of every other country, is determined. It is thus
possible to investigate problems of comparative statics, such as the
effects of an increase in investment in one country, or an income
transfer from one country to another.

Though such an n-country model as the above does not treat the
distance variable explicitly, it does represent a significant advance
over the "one country and the rest of the world" type. The function,
whether linear or nonlinear, relating exports from any nation j to
nation i need not, and usually will not, be the same as that relating
exports from any other nation k to nation i, though exports in each
case will depend on the same variable, namely, the income of nation i.
The effect of the different distances separating the two pairs of
nations may thus be reflected in the two different functions. The
impact of the distance variable may be implicitly contained in the
different marginal propensities of nation i to spend in each of the
other nations, this marginal propensity tending, *ceteris paribus*, to be

(Mar. 1952), 59–68, and the suggestive and stimulating older general equilibrium
work of T. Yntema, *A Mathematical Reformulation of the General Theory of
International Trade* (Chicago, 1932); also J. L. Mosak, *General Equilibrium
Theory in International Trade* (Bloomington, Indiana, 1944). Ohlin (*Inter-
regional and International Trade*, Cambridge, Mass., 1933), of course, has a much
superior conception of multilateral trade with the distance variable actively
affecting the localization of industry and the volume of trade among nations.

7. "A Multiple-Region Theory . . . ," *op. cit.*, p. 333.

low where the other nation is remote from nation i and high where contiguous to nation i.

However, the location theorist would make two suggestions for improvement.   One stems from a fundamental difference in approach between the location and the trade theorist.   The former has traditionally viewed his problem in terms of individual industries; the latter, in terms of aggregates such as total value of exports, total value of imports, national income, etc.   Hence, it is not surprising that the location theorist would suggest that imports from (and thus exports to) each nation be broken down by type, the aggregates of imports and exports still being explicitly considered.   Gross national product or national income, too, should be broken down by constituent item.   Such breakdowns of aggregates within a framework which explicitly recognizes and derives the magnitudes of the aggregates is afforded by the interregional input-output scheme which has been developed elsewhere.[8]

The second suggestion for improvement touches upon locational shift.   Although Metzler's model does implicitly consider the distance variable to some extent, it does so insufficiently and at no point does it consider substitution between distance inputs, or between outlays on distance inputs and outlays on other inputs (or revenues on products).   It is only by taking account of such substitutions, whether in the large or the small, that a good part of the process of economic development within any nation or region can be understood as well as the associated changes in trade relations.   To some extent, such substitutions, whether induced by exogenous or endogenous forces, can be brought into an interregional input-output framework.

If interregional input-output analysis has more appeal to the location theorist on certain grounds, what are its limitations on other grounds?   Can it be said that such analysis is superior to a multi-country approach of the type of Metzler's?   As will be seen below, no unequivocal answer to the second question is possible.   Nonetheless, it is possible to make some firm statements.   In what follows we shall present only sketchily the structure of interregional input-output models, and shall assume that the reader is familiar with the concepts, technical details and associated terminology and limitations of such models.

8. W. Isard, "Interregional and Regional Input-Output Analysis: A Model of a Space-Economy," *Review of Economics and Statistics*, XXXIII (Nov. 1951). See also W. W. Leontief et al., *Studies in the Structure of the American Economy* (New York, 1952), Part II; and Chipman, *op. cit.*, pp. 50–53.

In an n-country world, in which m commodities can be produced, we can have nm equations:

$$(2) \qquad {}_kX_i - \sum_{l=1}^{l=n} \sum_{j=1}^{j=m} {}_{kl}a_{ij}\, {}_lX_j = {}_kY_i$$

$$i = 1, 2, \ldots, m$$
$$k = 1, 2, \ldots, n$$

where ${}_kX_i$ represents the output of industry i in nation k; ${}_lX_j$, the output of industry j in nation l; ${}_{kl}a_{ij}$, the coefficient indicating the amount of the output of industry i in nation k required per unit output of industry j in nation l; and ${}_kY_i$, the final (bill of goods) demand of all nations for the output of industry i in nation k. Each of equations (2) traces for any given base year the distribution of the output of any given industry in any given region to every industry in the same and every other region and to the bill of goods sector. On the assumption that the structure as described by the ${}_{kl}a_{ij}$ does not change, for any new ${}_kY_i$ the set of equations can be formally solved to yield the required ${}_kX_i$.[9]

However, to obtain meaningful international analysis this formal presentation in terms of equations must be improved on two scores. One is associated with the difficulty of obtaining the ${}_{kl}a_{ij}$. These coefficients must be derived primarily from actual data on commodity flows, desirably supplemented by technical information. Ideally we should possess for any given base year a complete knowledge of commodity flows, interindustrial and international. In practice the available information falls far short of the ideal. For a few countries, such as the United States, there are excellent internal data on interindustrial relations in terms of a finely detailed classification of industries. For most countries, there are not. Hence it is necessary to adjust the framework, which is indeed flexible, to fit available data. Corresponding to each country there should be as many sectors or industrial categories as existing data permit. At one extreme the United States might have as many as 200 sectors, while at the other extreme an undeveloped country lacking a census might be sliced into a half dozen at most. As a consequence there are no longer mn equations, but rather as many as the total of industrial categories for all countries.[1] It should be noted that even though paucity of

9. See Isard, "Interregional and Regional Input-Output . . .," *op. cit.*, pp. 320–21; and W. W. Leontief, "Output, Employment, Consumption and Investment," this *Journal*, LVIII (Feb. 1944), 294–97. The reader is referred to the former article for the tabular form in which base year data can be presented.

1. The required data would thus indicate flows of a particular commodity produced in a given nation to each of a large number of fine industrial categories

data limits disaggregation for certain nations to a few broad cate-
gories only, whatever disaggregation can be achieved is to be desired
except insofar as it introduces instability into the system (to be
discussed below).[2]

A second basic modification of the model represented by equa-
tions (2) and the mathematically derived $_kX_i$ is required. The
$_{kl}a_{ij}$ are much less likely to be stable internationally than intra-
nationally. Obviously, extra-economic forces condition international
trade considerably more than they do intranational trade among
regions. As a consequence any international projection based on the
use of an inversion of a matrix of constant $_{kl}a_{ij}$ would be considerably
less significant than an intranational one.   In fact, such an inter-
national projection might have little, if any, value since it would
relate to an hypothetical world of strictly economic forces.

However, the alternative, iterative approach toward projection
does not lose validity for international models since it can allow
changes in the $_{kl}a_{ij}$ from one round to the next. The equation form
is not required. The relevant coefficients for the particular base
period can be simply recorded in a typical input-output table; and
given a change in the bill of goods, a first-round impact can be com-
puted. If, because of political expediency, or capacity limitation, or
some other factor, it is not feasible for a particular country to produce
a certain output of a good, one can re-examine and change relevant
coefficients so as to yield a feasible output of that good for that
country.   Likewise, in computing second-round requirements (to
support the first-round levels of outputs), in computing third-round,
fourth-round requirements, etc., one can alter coefficients to yield
outputs for each nation consistent with its political, resource and
cultural structures.   Thus, one is not tied to a postulate of constant

in the United States, on the one hand, and to each of a few broad sectors in the
undeveloped nation, on the other.   The input-output table would have many
rows and columns for the United States, and relatively few for the undeveloped
nation, and in this sense would be asymmetrical.

2. Since data on commodity exports and imports from country to country
are in general superior to those from region to region within a nation, international
analysis has in this respect a firmer basis. However, for international analysis
as well as interregional analysis within a nation there is still the difficult problem
of identifying the industry of destination (given the currently available data).
Resort must be had to location and market area analysis and various estimating
procedures.   (See Isard, "Interregional and Regional Input-Output . . .," *op. cit.*,
pp. 326–28, for a fuller discussion.)   Obviously, this problem does not arise when
each commodity a nation exports is used by only one industry in each of the
importing nations. Such may in actuality characterize the export situation of
several nations.

resource use or fixed supply channels per unit of output of a given industry in a given region, as one would be in using an inverted matrix.[3]

Put otherwise, we are suggesting that the more or less "average" coefficients for a particular base period are not so useful and significant for international projections as the more or less "marginal" coefficients which are encountered from round to round. This, because the variations of noneconomic forces as the levels of outputs in the diverse nations change are too marked to be ignored.[4]

It is appropriate to return to the question: Can it be said that interregional (international) input-output analysis is superior to a multi-country approach of the type of Metzler's? Consider first a multi-country framework containing a backward country, say, nation i. As of a given base year it may export one commodity, say, bauxite which is absorbed by a single industry (aluminum) in an industrialized country, nation j. It imports in turn several commodities from several nations.

According to Metzler's framework, change in the magnitude of shipments from i to j would be dependent on the marginal propensity of country j to import from country i, i.e., it would be tied to change in j's income. Yet it is clear that change in the magnitude of bauxite shipments from i to j is related only to change in the level of aluminum production in j,[5] which level may very well move at variance with the level of j's income. Similarly, if country i exported several commodities, the shipments of each being directly linked to the output of one or more industrial sectors in other countries, changes in the magnitude of i's exports would be much more dependent on changes in the level of output of these industrial sectors, than upon the marginal propensities of these other countries to import from i. Clearly,

3. The reader unfamiliar with these computational problems is referred to F. V. Waugh, "Inversion of the Leontief Matrix by Power Series," *Econometrica*, XVIII (Apr. 1950), 142–54; and J. L. Holley, "A Dynamic Model: I. Principles of Model Structure," *Econometrica*, XX (Oct. 1952), 616–42.

4. In my "Interregional and Regional Input-Output . . .", *op. cit.*, I stated that the interregional input-output model was in general not applicable at an international level, except "where it is restricted to national (regional) economies tied to a single currency (as the sterling bloc), or to national economies which maintain stability of exchange rates among themselves" (p. 323). This statement was made with reference to a model using an inverted matrix. With an iterative approach we can account (partially at least) for the effects upon supply channels of changes in exchange rates, quantitative restrictions on imports and exports, and other institutional interferences. Hence, I no longer subscribe to the statement quoted above.

5. Assuming no abrupt shifts in the tapping of bauxite sources and in technology.

such meaningful disaggregation by sector — which in essence involves a breakdown of any nation's propensities to import from other nations into propensities of the sectors of that nation to import from sectors of other nations, i.e., into a relevant series of $_{kl}a_{ij}$ — in general is desirable and leads to better results.

Further, suppose nation i experiences increased income owing to increased shipments of bauxite to j's aluminum industry which is expanding rapidly to meet a mounting world demand for aircraft. And as a result suppose nation i reaches a stage where her domestic demand for textiles justifies domestic production of textiles. Her imports then take on a new pattern, those of textiles from nation k falling, those of textile machinery from h and of other consumption goods from g rising, etc. Again the Metzler framework fails to catch such an effect since in this framework country i's imports from each of countries k, h and g are functions of country i's income and not of her industrial structure.[6] In contrast, an interregional input-output framework explicitly handles industrial structure and directly links change in the pattern of imports to change in industrial structure, the resulting variation in aggregate income reflecting changes in the level of activity of the various sectors.[7]

However, it should be borne in mind that the interregional input-output framework, as well as the Metzler scheme, casts little light upon the underlying resource structures which condition the path of economic development within any region. Traditional comparative cost, location and market area studies are required here. For example, imagine two industrialized nations A and B. A mines ore which is shipped to B where the ore is processed with B's coal to meet B's demand for steel. Suppose technological progress makes possible the use of inferior coals near A's ore deposits when these coals are blended with relatively small amounts of superior coal from B. Whether or not substitution among the several distance inputs takes place involving a shift of steel location from B to A depends upon comparative costs, some of which cannot be estimated reliably until production with blended coals is actually attempted. In any case by altering the relevant interarea-interindustry coefficients one can inject such a substitution into an interregional input-output frame-

6. In a sense this comparison is unfair to the Metzler approach which is less concerned with growth problems than with problems associated with conditions of unemployment and excess capacity and of elastic supply.

7. The resulting changes in the commodity balances of payments with each nation and the rest of the world also are derivable and reflect changes in the level of activity of the various sectors.

work to estimate roughly what its impact would be; whereas one could treat such a substitution at best only implicitly in the Metzler framework.

On the other hand, in depicting industrial and consumer requirements of the outputs of various industries to meet a given bill of goods[8] (inclusive of certain exports), the interregional input-output framework furnishes valuable information on whether or not domestic demand for the output of a particular industry does warrant its establishment within a region. For example, in using the iterative approach, one might find in estimating the effects of the increased shipments of bauxite from i to j that after the second-round impact was computed the total domestic requirements of cement were of sufficient magnitude to justify cement manufacture in nation i, the basic raw materials being locally available. In this case one would have to alter the $_{kl}a_{ij}$ to be consistent with changes in the interregional flow of the commodity cement, and begin computations anew.[9]

The establishment of a cement plant in nation i to serve the domestic market represents a substitution of outlays on all inputs except distance inputs for outlays on distance inputs. This is a type of substitution associated with the scale factor in a typically market-oriented operation. It is in the anticipation of this type of substitution in developing economies, which the Metzler framework cannot handle explicitly, that interregional input-output analysis is most useful.

Despite these arguments it should not be inferred that interregional input-output analysis at the international level is superior to the Metzler type in all respects. To the extent that disaggregation

8. Reparation payments, official loans and grants, foreign capital lending, private capital movements and so forth are explicitly considered in an interregional input-output framework in the bill of goods sectors of the several nations. For example, a capital movement into nation i to finance an investment program is depicted in i's bill of goods sector as the set of requirements of the outputs of the various sectors of the several nations to carry through the program. This set of requirements is not easy to anticipate and estimate quantitatively.

9. Conceivably, too, country j's demand for bauxite might outrun the supply available from exploiting at a maximum rate country i's bauxite deposits. Hence, after a certain point, the flow of bauxite from i to j fails to increase while a new flow with a second source of bauxite is established. Given data on bauxite resources, this shift in supply channels can be allowed for in an interregional input-output framework.

Of course, one cannot foresee all the many minor changes in supply channels and hence must assume that a large part of the coefficient matrix remains constant from round to round.

yields meaningful and stable structural relations, it is in general to be desired. However, there may very well be sets of interarea-interindustry relations where each relation of a set is unstable; yet where taken as a whole the relations of a set may be stable. This justifies aggregation.[1] In fact when each sector of several nations tends to exhibit instability with respect to its input supply channels and simultaneously any given nation as a whole exhibits stability with respect to total inputs from each of every other nation per unit of the given nation's aggregate output, a Metzler-type framework is much to be preferred. Furthermore, the Metzler-type framework is considerably less cumbersome and involves considerably less expenditure on research. Where general theoretical questions are to be answered similar to the ones Metzler has posed, or where it is desirable to anticipate only the general directions of the effects of changes, the Metzler-type framework has a decided advantage.

In brief, the multi-country framework involving aggregate propensities to import and the interregional input-output scheme which in essence represents in certain directions an extension and generalization of location analysis are to be viewed as complementary techniques for international analysis, rather than substitutes. Both merit further exploration. Finally, the reader is cautioned against the use of the interregional input-output framework for the prediction of actual trade in a real world. Rather it should be used as a framework for anticipating changes *under the given set of assumptions*[2] (which, of course, rarely if ever duplicate reality), and for studying and weighing the effects of alternative policies.

III. Conclusions[3]

1. Statistical evidence on commodity flows clearly indicates the pervasive, attenuating influence of distance, and the importance of an explicit consideration of distance as a variable in trade analysis.

1. See the interesting discussion by Chipman, *op. cit.*, pp. 53–57.

2. For example, one adopts the postulate that prices and exchange rates are for the most part stable. In actuality, they are variables. Nonetheless, it is useful to investigate hypothetical effects of certain events or changes in the bill of goods under the above postulate, and such study might even throw some light on how exchange rates ought to be varied to achieve a balance of payments for one or more countries and so forth.

However, if we are able to foresee certain definite exchange rate and price changes, and if we can assess their direct effects upon supply channels through altering comparative cost conditions, they can be introduced into the framework by changing the $_{kl}a_{ij}$.

3. These conclusions contain, by way of summary, brief restatements of conclusions reached in the previous article.

2. There are several logical interrelations of trade and location theory. For long-run analysis it has been shown how with the concept of distance inputs transport orientation and the opportunity cost doctrine can be fused to yield a superior set of tools. This involves not only an extension of location theory (through reformulation in terms of opportunity costs) and of trade theory (through treatment of commodities sensitive to transport cost differentials) but also paves the way for each type of theory to take over many of the sound doctrines of the other.

3. For short-run analysis, the logical interrelations of trade and location theory are again easily perceived, though considerable development of both types of theory is required to effect a fusion. To eschew the customary but unrealistic two-country analysis, often unproductive and misleading, and to consider explicitly in an *aggregative*, multi-country framework the impact of the distance variable upon trade and income and employment in the several nations, the concept of *relative income potential* is suggested. Much more theoretical and empirical research, however, is required before one can determine the most useful definition of this concept in order to catch the "falling-off-with-distance" effect.

More satisfactory, currently, for short-run analysis are the interregional input-output techniques when they are employed in an iterative fashion and when their frameworks are suitably adapted to existing data. These techniques represent a major advance in agglomeration theory, particularly in anticipating derived demand in the process of economic development. Nonetheless they must rely upon the cost analysis of location and trade theory to determine a feasible and likely pattern of supply channels and resource use. Too, these techniques represent an extension of the Metzler-type multi-country trade model — an extension achieved through the disaggregation of nations into sectors and through the linking of these sectors. However, the interregional input-output techniques do not supplant but rather complement the aggregative multi-country trade models. These techniques are useful when intersectoral relations are, or can be assumed to be, meaningful and stable; and they provide a scaffolding for both location and short-run trade analysis.

4. Clearly a general and comprehensive location theory and a general and comprehensive trade theory are one and the same. The past narrow and partial outlooks of both location and trade theory must and can be broadened. With an increasing sensitivity to their interrelations future research should lead to a superior general doc-

trine and at the same time permit a superior attack upon problems which have customarily been considered as peculiar to each theory.[4]

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4. We do not disagree with Viner's contention that there are problems which fall within the domain of international trade and which distinguish it from domestic and intranational trade, particularly those associated with monetary phenomena (*op. cit.*, pp. 594–99). Nonetheless, we feel that Viner unduly restricts the scope of international trade and the field of forces which affect it. His failure to treat adequately the distance variable and to employ the more useful tools of location and of regional theory is a case in point. If the trade theorist should confine his analysis to Viner's restricted framework, then it can be said with Ohlin that trade theory is a special case of general location theory, since the location theorist is generally willing to consider the effect of balance of payments, exchange rate and other monetary and political phenomena upon international location (even though he has not yet *successfully* done this).