

# An Analysis of Pacific Basin Trade Utilizing the Taste-Similarity Hypothesis

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## I. Introduction

Gary Hufbauer's classic work [1970] laid out a comprehensive taxonomy of seven alternative economic theories explaining the nature and determinants of international trade. His preference similarity hypothesis, attributed to Linder, is unique in its inferences concerning trade patterns. Classical theories suggest that, since each country specializes in products reflecting its comparative advantage, trade will tend to be in dissimilar products. Linder, on the other hand, hypothesized that trade in manufactures is primarily demand driven, and would be in similar products. Since demand patterns are largely functions of per capita incomes, imports would be similar to overall domestic consumption. Exports would be similar since successful producers for domestic consumption would most easily find markets in countries with similar incomes and demand preferences.

Hufbauer found that the preference similarity hypothesis satisfactorily explained certain trade characteristics but failed to explain others. As will be argued in the following section, both the Linder hypothesis, and the particular methodology employed by Hufbauer to test it are of interest today, fifteen years later, especially in the context of the export driven growth experience of the Pacific Basin New Industrializing Countries (Henceforth NIC's). This paper updates and extends Hufbauer's test for the applicability of the Linder hypothesis.

Several important methodological modifications are the use of time-series data and the use of "panel" data sets or cross-section observations, rather than analysis at a single point in time. Like Hufbauer, we focus explicitly on the effects on export commodity com-

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positions rather than simply on the volume of trade, which latter practice has been the norm in this field, arguing that the commodity composition is the more appropriate test variable. Finally we introduce a measure of trade diversification into the model. It has been argued that higher per capita income tends to be associated with a more diversified trade which would, in turn, show higher commodity overlap with trading partners. Explicitly including trade diversification as well as commodity composition allows one to isolate the "Linder" effect.

## II. The Linder Hypothesis in the Pacific Basin Context

The past decade has witnessed major changes in patterns of international trade. One of the most noticeable developments has been the emergence of the NIC's primarily of the Pacific Basin, as major exporters of a broad new range of manufactured commodities. This caused a spate of protectionist reaction throughout the Organization for Economic Cooperation and Development (O.E.C.D.), including Japan. This remarkable growth both in volume and variety was slowed somewhat by the recent world wide recession (though not relative to overall world trade) and is already today demonstrating a renewed surge as O.E.C.D. economies recover.

To date, the emerging NIC export patterns have not been analyzed through the unique perspective of the preference similarity approach. And yet, there is a compelling reason why this hypothesis should be an especially interesting one in this context. The Linder hypothesis predicts that noticeable and systematic changes in the commodity composition of manufactured trade should be most apparent under circumstances of rapid economic growth and rapidly converging relative per capita incomes—precisely the situation descriptive of our sample countries during the sample period. Furthermore, much of the problem prompting the "new protectionism" lies in the growing similarity of NIC exports to those of the O.E.C.D., thus posing troublesome competition in increasingly broader product ranges. An examination of this hypothesis which explicitly explains such similarities should prove fruitful.

There has been numerous empirical examinations of Linder's hypothesis in the literature over the past two decades. These include Linder (1961), Grubel (1967), Haufbauer (1970), Fortune (1971, 1979), Sailors et al (1973), Hirsch and Lev (1973), Asai and Yoroza (1975), Hoftyzer (1975), Greytak and McHugh (1977), Kolhagen (1977), Kennedy and McHugh (1980, 1983), Arad and Hirsch (1981). Though these studies differ one from the other in methodology, sample and period coverage, and choice of specification; most find some, though at times ambiguous support for Linder's thesis.

### III. Commodity Composition

Linder posited that international trade in manufacturers primarily reflected reciprocal "representative" demand. In turn, these demand patterns are primarily imports tended to consist of the overall consumption. Exports also tended to consist of similar product categories, since successful export drives presupposed low-cost structures obtainable through learning-by-doing obtain scale economies associated with initially producing for the domestic market. It follows that countries tend to import and export essentially the same commodity groups. It further follows that countries' trade partners should tend to have similar per-capita income levels.

Linder was the first to test this hypothesis empirically. He proceeded by constructing an index of bilateral trade intensity (proportion of a country's national income spent on imports from a given country), and then examining its relationship at a point in time for 32 countries with the differences in per-capita incomes between the trading partners.

As noted earlier, there have been many subsequent empirical tests of the Linder hypothesis. Though differing among themselves in data coverage, and in the specifications of the relevant explanatory variable set, they all share a similar methodology with Linder's original empirical formulation—they use trade intensity as the operational dependent variable. Only Hufbauer (1970, p. 197–198) spelled out and tested an alternative corollary; one dealing not with the expected overall volume (intensity) of trade, but rather with the expected commodity *compositions* of the trade vectors. Since what a country exports (and imports) is uniquely determined by its economic structure, and since "similarity of average income levels could be used as an index of similarity of demand structures" (Linder, p. 94), it follows that the more similar are two countries' average per capita incomes, the more similar should be the commodity contents of their respective trade vectors, both imports and exports.

Thus, Hufbauer's work differed from both earlier and subsequent studies by examining not trade intensities, but rather trade commodity compositions. Although the two concepts are clearly related (e.g. as argued by Drysdale and Garnaut (1982)), they are by no means logically equivalent. We argue that the empirical verification (or negation) of Linder's hypothesis is more efficiently accomplished through an examination of the compositional patterns, as Hufbauer had done.

The heuristic argument may be illustrated by examining two hypothetical countries—poor but rapidly growing country A, and rich (but slow growing) B. At some initial point in time the divergence between their per-capita incomes (and hence their respective repres-

entative demands) is so great that no "Linder" trade exists between them. Over time, as A's per-capita income becomes progressively like B's, their taste patterns progressively converge and overlap. Since, in Linder's model, import and export commodity compositions both reflect domestic consumption patterns, the commodity-nature of A's exports will progressively approxim the commodity composition of B's imports. This will apply both to their bilateral trade as well as to their respective trade with the rest of the world.

One might suppose that as the commodity nature of A's exports match more closely the kinds of goods imported by B, then B will in fact import more from A. Hence a greater trade intensity will be observed between these two countries. However, this last step is not a logically necessary one. Even if the commodity composition of A's exports does come to resemble that of B's imports, the particular bilateral trade between these two particular countries need not increase in intensity. Country A may not be the low cost supplier to B's market; B may not be the most profitable market for A's products. Various preferential arrangements, voluntary export controls etc., may create such barriers between these two particular countries that while their overall trade commodity patterns are very much alike. This similarity is not reflected in enlarged bilateral flows between them. Conversely, it is quite possible that a growing trade intensity between A and B may in no way be related to a growing degree of homogeneity between their respective export and import vectors, e.g. it may reflect trade diversion associated with the establishment of some new preferential arrangement. It follows, therefore, that a test focusing on commodity compositional similarities (of respective overall trade vectors) is more basic to the Linder hypothesis, in the sense that trade intensity is but a derivative (and not a necessary) outcome of the Linder dynamic.

#### IV. The Hufbauer Model<sup>1</sup>

Hufbauer's empirical model is replicated below:

$$\text{Cos } X_i M_j = c_1 + a_1 A_j + b_1 A_i, \quad \text{where } A_j < A_i \quad (1)$$

$$\text{Cos } X_i M_j = c_2 + a_2 A_j + b_2 A_i, \quad \text{where } A_j > A_i \quad (2)$$

where Cos is cosine,

$X$  is the vector of  $n$  commodities exported by country  $i$ .

$M$  is the vector of the same commodities imported by country  $j$  (from the world).

$A$  and  $A$  are the average levels of per-capita income (\$) in countries  $i$  and  $j$ .

<sup>1</sup>This model is described in Hufbauer (1970), pages 197-206. It is summarized by his equations (7) and (8) page 201.

Hufbauer used cross-section data at the three-digit aggregation level of the Standard International Trade Classification (SITC) for 102 manufactured commodities for 24 countries in 1965. He estimated equation (1) for samples of trade flows where the exporter countries were richer (in terms of per capita GDP) than the importers. The opposite was true for the same utilized for equation (2).

He posited that the Linder hypothesis would gain support if in equation (1)  $a_1$  would be found to be negative and  $b_1$  positive. Since in equation (1),  $A_j < A_i$ , the higher the level of per capita income in an importing country, the greater the degree of similarity between the economic structures of exporters and importers. According to Linder's hypothesis, this should lead to a greater degree of similarity between the compositions of the respective trade flows ( $X_i$  and  $M_j$ ). The opposite signs in equations (2), i.e.  $a_2 > 0$  and  $b_2 < 0$  would, likewise, lend support to the Linder hypothesis.

Hufbauer's findings were inconclusive. The results, as summarized in his Table 13 (page 202) were that all four coefficients,  $a_1$ ,  $b_1$ ,  $a_2$ ,  $b_2$  were positive. He concluded that the results lent support neither to the Linder Hypothesis, nor to the "orthodox" comparative advantage explanation of international trade flows. He interpreted his findings as representing "nothing more than the diversification of exports and imports which accompanies greater affluence." (Hufbauer, p. 201). We shall explicitly examine the applicability of this assumption, which we term the "Hufbauer Effect", below.

## V. The Data and Samples

For the present study, values in \$ U.S. were obtained for exports of all 102 3-digit SITC (Rev 1) manufactured commodities (SITC 5 through 8) from five Pacific Basin exporters (U.S., Japan, South Korea, Singapore, and Hong Kong). Then the values of all imports of the same 102 manufactured commodities were obtained for each of these five countries plus those to the O.E.C.D. as a whole. In turn, this set of twenty five trade vectors (of 102 elements each) was obtained for separate years, 1965 through 1980.<sup>2</sup> Next, Hufbauer's equations were reestimated with the dependent variable measured by the Finger-Kreinin similarity index (S)<sup>3</sup>

<sup>2</sup> The trade value data were obtained from the International Trade Information Service of Data Resources, Inc. They are from the United Nation's Commodity Trade Statistics, Trade Series D. The income figures were obtained from D.R.I.'s Asian Service, Japan Service and U.S. Macro Service. Jeffrey Bergstrand, "Measurement and Determinants of Intra Industry International Trade", Federal Reserve Bank of Boston, Bulletin 1982 argues the 3-digit SITC level of commodity aggregation is indeed representative of an industry. He points out that extensive empirical work in this area suggest that disaggregating beyond the 3-digit level would yield less reliable and less representative data: and would not tend to significantly eliminate arbitrarily aggregated commodities from essentially different industries.

$$\ln(S(X_i M_j)) = c_1 + a_1 \ln(A_j) + b_1 \ln(A_i), \text{ when } A_j < A_i \quad (3)$$

$$\ln(S(X_i M_j)) = c_2 + a_2 \ln(A_j) + b_2 \ln(A_i), \text{ when } A_j > A_i \quad (4)$$

where  $A$  is the per capita income (in U.S.) of the exporting country, and  $A$  that of the destination.

## VI. Results: Annual Cross Section

The equations above were estimated for 1965 (the year used by Hufbauer) as well as for each subsequent year to 1980 for the same commodity sample tested by Hufbauer (All Manufactures). The resultant coefficients are summarized in Table 1.

The results in Table 1 generally agree with those of Hufbauer. The signs of both income coefficients are positive in 1965, and tend to generally remain so throughout the late 1960's and 1970's. It is in the levels of statistical significance assignable to these coefficients that the results tend to differ from Hufbauer's. He found all coefficients significant. Here this is true in only a few of the cases.

When one takes note of the significance levels, the findings tend to support Linder's explanation of the underlying determinants of international trade. On the left half of Table 1, which summarizes the income coefficients for that sample of trade flows linking importers with respectively richer exporters, no statistically significant relationship was found between the per-capita incomes of the exporting country and the similarity index. But positive association between the per capita incomes of the importers and the similarity between the respective trade vectors was statistically significant in the mid-1970's. Since in this set of countries, the importers were poorer, the greater the importers' income, the closer would be the incomes of the trade partners. Hence, this finding is in agreement with the Linder hypothesis.

Stronger statistical support is accorded the Linder hypothesis in the right portion of Table 1, which summarizes the findings for those trade flows where the importers were the richer countries. Here a statistically significant positive association between the exporters' per-capita incomes and the similarity index is found for each of the sixteen years examined. This is the relationship which would be inferred from Linder's hypothesis, since in this sample the richer the exporters, the more similar become the incomes of the trade partners, and hence the greater the expected taste overlap. Though not statistically significant, the

<sup>3</sup> The Finger Kreinin similarity index developed specifically for the International trade analysis is described in Finger and Kreinin (1975). Like the cosine used by Hufbauer, this index measures the degree of association between two trade vectors, ranging from 0 to 1. Some of its statistical and aggregation properties are described in Kellman and Shroder (1983).

**TABLE 1** The Coefficients of Per Capita Income on Trade Compositional Similarity 1965–1980: All Manufactures

	Exporters Richer		Importers Richer	
	a	b	a	b
1965	.03	.02	.04	.20*
1966	.04	.02	.03	.19*
1967	.04	.04	-.001	.20*
1968	.05	.06	-.02	.20*
1969	.05	.08	-.001	.19*
1970	.06	.09	.01	.20*
1971	.06	.08	.01	.20*
1972	.06	.05	.03	.18*
1973	.05	.03	.04	.15*
1974	.07	.03	.04	.17*
1975	.07*	.03	.06	.16*
1976	.07*	.02	.05	.15*
1977	.06	.03	.05	.15*
1978	.05	.04	.09	.14*
1979	.04	.03	.10	.15*
1980	.04	.04	.07	.15*

\* Significant at the .05 level.

only negative coefficients found in this set of trade flows were for the relationship between the incomes of (relatively richer) importers and the size of the trade similarity index of the late 1960's—again as would be inferred from the Linder hypothesis.

### VII. Results: Time Series Regression Analysis

In summarizing his own results, Hufbauer suggests that a resolution of alternative interpretations of his cross-section findings calls for detailed time series analysis. "The reconciliation requires . . . that the bilateral trade becomes more similar as trading partners become richer." (Hufbauer, p. 106)

There are many advantages to complementing our cross-section analysis with a time series perspective. In particular it has been noted in the literature<sup>4</sup> that distance between trading partners, and national income distributions tend to affect trade intensities and, presumably, compositions. The omission of these variables may thus cause unreliable results in the cross-sectionally estimated models due to a mis-specification bias. However, for any given country, variables such as geographic distance, or income distributions

<sup>4</sup> See the discussion in Kennedy and McHugh (1983), pp. 85–87 for a summary of the problems associated with the role of distance in empirical verifications of Linder's hypothesis.

would not be likely to change drastically over a sixteen year period. Hence their omission would not result in an underspecified model, when estimated over time.

As noted, Hufbauer felt that his own findings "represent nothing more than the diversification of exports and imports which accompanies greater affluence." (Hufbauer, 1970, p. 201) "... as a country get richer its export menu becomes rapidly more diversified." (p. 206) Although it was not explicitly tested, Hufbauer's explanation of his results makes sense. After all, "The United States and Germany offer a wider selection of exports than Mexico and India" (p. 206). Nevertheless, it should be obvious that in fact there is no general presumption that as countries grow or develop, they must always move away from product specialization. Indeed, this would be an absurd contradiction of the classical view of the relationship between trade and growth (i.e. increasing specialization as an "engine of growth"). The question is whether, for those countries studied, growing per-capita incomes were consistently associated with growing commodity diversification in their manufactured exports over the relevant period 1965 to 1980.

To examine this requires a measure or indicator of export specialization. The measure selected (SPECIALIZE) was the coefficient of variation of the respective export vectors. In our particular case, the measure reduces to the use of the respective vector standard deviations. This is so since all our trade vectors (X and M) were normalized to sum to unity, and all consist of an identical number of elements (102). Hence the respective means are the same for all vectors, and the coefficients of variation (which are merely the ratios of the standard deviations to their respective means) reduce to the standard deviations.

The greater the value of SPECIALIZE, the more highly specialized is the country in its exports. This may be demonstrated simply by noting that if a country were completely diversified (i.e. its exports were distributed exactly evenly among each of its  $n$  product categories), then  $X_i = \bar{X}$  for all  $i$  products, and SPECIALIZE would equal zero. As a country began to specialize, the standard deviation of its (normalized) export vector would increase, reaching a maximum value when reaching full specialization (i.e. all exports in one single product—category). By including this product specialization term in the time-series analysis described in the following section, its effect on the similary index is explicitly accounted for. This enables us to explicitly account for the "Hufbauer Effect" and isolate the "pure" Linder effect.

Table 2 displays the per-capita incomes and 1965 export vector coefficients of variations. The inverse relationship evident in the table lends credence to the validity of the CV as a trade-specialization indicator:

Hufbauer's intuitive thesis, that the manufactured exports of poorer countries tend to be concentrated in a smaller number of product groups (and hence, to be less diversified),

**TABLE 2** Coefficients of Variation and Per-Capita Incomes, 1965

	Coefficient of Variation	Per-Capita Income
U.S.	1.851	5986.00
Japan	1.643	2382.00
Singapore	1.888	939.00
Korea	3.076	272.00
Hong Kong	4.141	617.00

is reflected by the fact that the CV's of the U.S. and Japan are clearly lower than those of the poorer NIC's.

The following model was estimated for each of the twenty five trade flows (four destinations for each of the five exporters plus exports from each to all O.E.C.D.) for the period 1965-1980:

$$\ln(S(XM)) = a + b(ABS(A_i - A_j)) + c(\text{SPECIALIZE}) \quad (5)$$

The Linder hypothesis would be supported by a finding of a significantly negative *b* coefficient. The greater the difference between the trade partners' per-capita incomes becomes over time, the less compositional product overlap should be expected. The results are summarized in Table 3.

The results in the twenty five regressions do not lend support to the hypothesis that over the sixteen year period 1965-1980, Pacific Basin trade in manufactures followed patterns consistent with the Linder hypothesis. Of the 20 bilateral country examinations, only four were significantly negative.

The results for overall trade with the O.E.C.D. are noticeably different. In the first column of Table 3, though not statistically significant, each of the five coefficients had a negative sign. This suggests that the Linder hypothesis tends to explain overall trade patterns, if not on a country-by-country trade flow basis. That is, the smaller the per capita income gap between each own country and the O.E.C.D. average, the greater the commodity-composition similarity between their respective exports and total O.E.C.D. imports (from all sources).

### VIII. Conclusions

The methodology utilized in this study differs from practically all other empirical examinations of the Linder hypothesis to date in that it explicitly focuses on comparisons of trade vector compositional similarities between exporters and importers, rather than on the derivative measure of import propensity, or trade intensity. Like Hufbauer's pioneering

**TABLE 3** Regression Coefficients of Per-Capita Income Differentials and Trade Similarities Indices 1965 to 1980

Exporters	Importers					
	O.E.C.D.	U.S.	Japan	Korea	Singapore	Hong Kong
U.S.	-.19	—	-.40*	1.26	-.56	.03
Japan	-.10	.03	—	.46*	-.12	-.43
Korea	-.63	-.74	.79*	—	.16	.95*
Singapore	-.71	.01	.20	-.77*	—	-.001*
Hong Kong	-.46	.40	1.01*	-.95*	.02	—

\* Significant at 90% level.

study, this study examines the effects of intercountry per-capita income differentials on a measure of trade similarity. Here a different, updated sample of countries is studied with several methodological refinements over Hufbauer. The explicit addition of a time dimension to the analysis allows for at least an implicit examination of the Linder effect while netting out time invariant factors such as geographical distance between countries. The inclusion of a measure of export specialization (the coefficient of variation) helps distinguish between export diversification (the "Hufbauer Effect") and commodity overlap. In addition, this study examines the hypothesis both in a bilateral and multilateral trade framework.

The results found in the body of this paper lend support to the proposition that Pacific Basin countries' (both "North" and "South") compositional export patterns can be fairly well explained by a taste or preference similarity hypothesis.

The results for the all-manufactured trade vectors in the cross-country examinations are not overwhelmingly significant statistically. However, all of the statistically significant coefficients are in fact of the correct sign to support the Linder hypothesis. This is true not only for the first year of our sample, 1965 (the year examined by Hufbauer), but throughout the 15 year period studies.

The time series examination supports the proposition that the Linder preference similarity mechanism is operant on a multilateral basis for the Pacific Basin countries. The closer are the trade exporters' per-capita incomes to those of their markets, the more similar in composition are their exports to the overall imports by those markets.

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