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Recently, in <u>this journal</u>, H. Peter Gray [6] developed a model designed to explain the existence of two-way trade in differentiated products.[2] While Gray's analysis provided some interesting hypotheses concerning the determinants of two-way trade, as of yet, no attempt has been made to test these propositions for empirical content. In addition, the magnitude of this phenomenon has not been studied in reference to United States trade. The purpose of this paper, therefore, is to provide estimates of the quantitative importance of two-way trade in U. S. manufactures and to utilize these estimates to present an empirical test of the analytical arguments developed by Gray. In Section I we briefly review the Gray model. Section II describes the data and estimates

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of two-way trade for U. S. manufacturing. In Section III we present the model and empirical results and finally Section IV discusses our conclusions.

I

One obvious explanation for the existence of two-way trade is the aggregation of commodities in order to arrive at "meaningful" industry categories in the compilation of international trade statistics. For example, in the United Nations' Standard International Trade Classification system (SITC) each industry category is comprised of a number of sub-classes of products which are similar, but nonetheless not perfectly homogeneous. Moreover, an industry may often contain products which have quite distinct input requirements. Furnitures made of wood and steel, for instance, are classified in a common industry category (SITC: 821) even though the inputs required are substantially different. To the extent, therefore, that either goods which are not homogeneous or are produced with dissimilar factor inputs are included in the same industry category, two-way trade may represent only a statistical illusion.

While the aggregation problem may explain two-way trade in some instances, Gray [6] contends that it does not represent a complete explanation of the phenomenon.[3] Rather, the explanation is to be found in the presence of product differentiation in international trade, since trade flows in differentiated goods competing in imperfectly competitive markets may no longer be primarily determined by the orthodox factors of price and cost differentials.[4]

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[3]Empirical evidence reported by Grubel and Lloyd [9] indicates that two-way trade is evident even at the 7-digit level of disaggregation in Australian foreign trade.

[4]Perfectly homogeneous products, except under special conditions, will not be exported and imported simultaneously. These special conditions include situations where transportation costs are of overriding importance, where countries import and re-export goods or when seasonal factors dictate the direction of trade flows [8, pp. 36-37].

Gray presents a formal model to examine international trade in differentiated products which are both produced and consumed in each of two countries. Since the products under consideration are differentiated, producers in each country are assumed to face a downward sloping demand curve for their product in both the home and foreign market. The shape and position of the foreign demand curve is dependent upon the level and distribution of income in the foreign country, the tastes and preferences of foreign buyers, the prices of the foreign competing differentiated products and the selling effort expended by the firm in the foreign market. Given this demand and the landed cost of supplying the product in the foreign country, a firm will export its product if a price exists which yields the firm economic rent over time. When such a condition occurs, a "positive export price range" (EPR) is said to exist. In order for producers in each country to export and import each other's products simultaneously, it is necessary that reciprocal EPRs exist for the competing differentiated products in each of the two countries. If reciprocal EPRs for the differentiated products do not exist, then the more traditional factors of comparative advantage are likely to provide an adequate explanation of resulting international specialization.

Utilizing the analytical framework of this model, however, it is possible to isolate factors which affect the probability of the existence of reciprocal EPRs and hence two-way trade. It is interesting to note that, in general, the model suggests that two-way trade in differentiated products is predicated upon similarities in economic conditions (factor prices, incomes, etc.) between countries rather than differences which are emphasized in more traditional international trade models. More specifically, Gray suggests that the following factors are important in determining the volume of two-way trade. The greater is the probability of two-way trade:

1. the more similar per capita incomes and by extension demand patterns between countries.

2. the more similar factor prices and the cost of production of the differentiated products.

3. the lower and more similar the tariff and non-tariff barriers imposed by countries on the differentiated product.

4. the smaller transportation cost and hence the further the distance the differentiated goods can be profitably shipped. And finally,

5. the more differentiated are the country's competing products.

The above conclusions, however, are testable propositions. If two-way trade is indeed a real phenomenon and is influenced by the factors suggested by Gray it should be possible to demonstrate this with empirical evidence. The remaining part of this paper will examine the empirical magnitude of two-way trade in U. S. manufactures and provide an empirical test to determine how well these factors perform in explaining the observed volume of two-way trade.

II

In this section empirical estimates of the magnitude and importance of two-way specialization in the commodity structure of U. S. international trade in manufactures over the 1963-67 time period. Since this phenomenon has not been studied with reference to the U. S., the results should supplement those already available for the EEC [1,7,12] and Australia [9].

The sample consisted of 102 SITC industry groups at the three-digit level of aggregation. The empirical estimates of two-way trade in each industry were obtained utilizing a measure suggested by Grubel and Lloyd [9].[5] This measure is provided in expression (1) below, where X_i and M_i refer to the value of exports of commodity i from the U. S. to the rest of the world and imports

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[5] For a critical discussion of alternative measures of two-way trade, see Grubel and Lloyd [9, p. 496, note 3].

of the same commodity i to the U. S. from the rest of the world respectively. Two-way trade is, thus, measured as the value of total trade in commodity i minus the absolute value of net exports of commodity i as a percentage of total U. S. international trade in commodity i.

$$(1) \quad B_i = \frac{(X_i+M_i) - |X_i-M_i|}{(X_i+M_i)} \text{ X } 100$$

The above measure will vary between 0 and 100. When two-way trade does not exist (i.e., a commodity is exported but not imported, or vice versa) the measure has a value of 0. It reaches its maximum value of 100 when the value of exports of a commodity are exactly offset by imports of the same commodity.

Expression (1) was calculated for each industry in the sample and then averaged across all industries in order to obtain aggregate estimates of the volume of two-way trade. The results obtained indicate that two-way trade accounted for 47.9% of total U. S. trade in manufactures in 1963. Furthermore, two-way specialization has become increasingly important over time accounting for 50% of total trade in 1965 and 54.1% by 1967. Two-thirds of the industries in the sample experienced increasing levels of two-way trade over the 1963-67 period. It is also noteworthy that in slightly over one-half of the industries studied, two-way trade accounted for 50% or more of total industry international trade. These results for the U. S. closely parallel those obtained for other countries in suggesting that two-way trade is quantitatively important and indeed becoming more so over time.

Wide variation, however, does exist in the volume of two-way trade among individual industries. This is illustrated in Table 1 which presents the estimates for the fifteen industries experiencing the highest volume of two-way trade and the fifteen experiencing the lowest. The estimates in the Table

Table 1: Two-Way Trade Specialization in United States Manufacturing Industries, 1963-67

Industries Experiencing High Levels of Two-Way Trade			Industries Experiencing Low Levels of Two-Way Trade			
SITC	Industry Description	B_i(%)	SITC	Industry Description	B_i(%)	Net Exports (X) or Imports (M)
266	Synthetic, regenerated Fibers	99.3	046	Meal, flour of wheat	0.0	X
654	Tulle, lace, embroidery	99.0	111	Non-alcoholic beverages	0.0	X
893	Plastic Articles	97.7	091	Margarine	1.5	X
062	Sugar Confectionery	97.5	112	Alocholic beverages	4.1	M
571	Explosives and Pyrotechnic Products	97.3	061	Sugar and honey	5.9	M
664	Glass	96.8	666	Pottery	6.1	M
678	Tubes, pipes and fittings	96.7	731	Railway vehicles	8.1	X
652	Cotton fabrics, woven	93.5	685	Lead	8.8	M
053	Preserved fruit	92.1	122	Tobacco manufactures	9.0	X
733	Road vehicles, non motor	91.7	851	Footware	9.3	M
724	Telecommunications apparatus	90.1	687	Tin	9.9	M
655	Special textile fabrics	89.9	013	Canned prepared meat	12.4	M
717	Textile and leather machinery	89.6	554	Soaps, cleansing, polishing preparations	14.1	X
553	Perfumery and cosmetics	89.1	691	Finished structural parts	15.1	X
723	Equipment for distributing electricity	87.3	533	Pigments, paints, varnishes	16.3	X

range from a high 99.3 for synthetic and regenerated fibers (SITC: 266) to a low of 0 for meal and flour of wheat (SITC: 046) and non-alcoholic beverages (SITC: 111). Inspection of the industries in the Table does provide some casual evidence in support of the contention that product differentiation by style, quality and specific performance characteristics is an important factor in affecting the volume of two-way trade. For example, with minor exceptions, the high group is dominated primarily by consumer good industries in which differentiation of the types mentioned above can be achieved. Within the low group, however, the industries are characteristically producer goods in which differentiation is difficult, if not impossible.

While the general conclusions of this section are that two-way trade is a quantitatively important phenomenon in U. S. foreign trade and that product differentiation appears to be an important factor in explaining the phenomenon, a more formal analysis of the data is presented in the next section to account for the influence of product differentiation as well as other factors on the observed volume of two-way trade.

III

To empirically test the hypotheses proposed by Gray we first accumulated additional data to arrive at quantitative estimates of the factors such as tariff differentials, similarity of income, etc., which were suggested as important in affecting the level of two-way trade. These data were then utilized as inputs into a multivariate regression model in which two-way trade (B_i), as measured in the previous section, was the dependent variable. The data sources used and construction of each of the independent variables included in the model are provided below.

Number of SITC Industries

Since two-way trade can arise from the aggregation of distinct commodities into common industry categories, a measure of the degree of industry aggregation was included in the regression model. This measure ($SITC_i$) is defined as the number of four-digit SITC sub-industries comprising a given three-digit industry. The greater the number of distinct four-digit industry groupings which can be broken out of a three-digit industry, the more aggregated is the industry considered to be, and the greater the possibility of intra-industry specialization. Two-way trade should, thus, be higher in industries which are more aggregated.

Similarity of Income

Gray suggested that similarity in per-capita income should exert a positive influence on the level of two-way trade. If such is the case, then two-way trade should be most intensive within industries that trade primarily with countries having similar income levels to that in the U. S. To test for this effect, a variable (IS_i) defined as industry exports plus imports to and from O.E.C.D. countries as a percentage of total U. S. industry exports and imports was included in the model.[6] Since O.E.C.D. countries have similar income levels to that in the U. S., industries that engage in trade primarily with these countries should experience higher levels of two-way trade.

Tariffs and Non-tariff Barriers

The height and similarity of international trade barriers are factors which also are predicted to affect the volume of two-way trade. More specifi-

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[6]Data for the construction of this variable were obtained from available OECD foreign trade statistics [13].

cally, the lower and more similar the trade barriers between countries the higher should be the level of two-way trade. Since the model is cross section, ideally, one would desire data on barriers imposed by the U. S. vis a vis some weighted average of industry specific barriers imposed by the rest of the world. Unfortunately, such information is not readily available. As a result, comparative data on tariffs and non-tariff barriers for the U. S. and EEC countries was utilized.[7] The height of tariff barriers (HTB_i) was estimated as the average of U. S. and EEC nominal tariff rates for each of the industries in the sample. The height of non-tariff barriers ($HNTB_i$) was estimated as the average of indexes of non-tariff barriers imposed by the U. S. and the EEC for each of the industries. The similarities in tariff (TD_i) and non-tariff barriers ($NTBD_i$) were estimated from the same data utilizing the expression (2) below.

$$(2) \qquad TD_i = \frac{T_i^{US}+T_i^{EEC} - |T_i^{US}-T_i^{EEC}|}{(T_i^{US}+T_i^{EEC})} X\ 100$$

This is the same expression as used to measure two-way trace and again varies between 0 and 100. When tariff or non-tariff barriers are identical the expression has a value of 100. The greater the disparity in tariffs or non-tariff barriers the closer the index is to 0.

Distance Shipped

Two-way trade is expected to be higher for commodities which have a small transportation cost. In order to account for cross industry differentials in transportation cost, a measure developed by Weiss [16] was utilized. This

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[7]The data for nominal tariffs were obtained from [5] and the data about non-tariff protection from [15].

variable (MDS_i) is calculated as the mean distance (in miles) the products of an industry were shipped in U. S. markets. The implicit assumption for the use of this proxy is that the further a product can be profitably shipped (i.e., the greater the mean distance shipped) the less important are transportation costs relative to other factors. Two-way trade is, thus, expected to be higher for industries that can profitably ship further distances.

Product Differentiation

Finally, the greater the degree of product differentiation, the higher should be the level of two-way trade. Measurement of the degree of product differentiation is difficult in domestic markets, let alone world markets. Typical measures, such as the advertising to sales ratio, are neither easily accessible nor particularly useful in the context of world markets since this type of differentiation cannot be expected to transcend national boundaries. In addition, it takes no account of differentiation created by national origin of products. Recently, however, Hufbauer [11, pp. 190-193] has constructed a measure of product differentiation defined as the coefficient of variation in U. S. export unit values for shipments of the product to various importing countries. The smaller the variation, the more standardized the product is likely to be, whereas the larger the variation presumably the greater is the degree of differentiation. As a proxy for differentiation, a dummy variable was constructed on the basis of Hufbauer's measure. This dummy variable (PDD_i) assumes the value 1 for all industries experiencing above average coefficients of variation in unit export values to denote differentiated products and assumes the value 0 for below average values.

The model to be estimated, thus, includes the major factors cited earlier as important determinants of two-way trade and is presented in equation (3) below:[8]

(3) $B_i = f(TD_i, NTBD_i, HTB_i, HNTB_i, IS_i, SITC_i, MDS_i, PDD_i)$

where B_i = the value of two-way trade for industry i (i=1,...,102), TD_i = the U. S.-EEC tariff differential, $NTBD_i$ = the non-tariff barrier differential, HTB_i = the average height of tariff barriers, $HNTB_i$ = the height of non-tariff barriers, IS_i = a proxy for income similarity, $SITC_i$ = the number of 4-digit SITC industries in a 3-digit commodity category, MDS_i = the mean distance shipped and PDD_i = a product differentiation dummy.

Equation (3) was estimated for a cross-section of 102 United States industries at the three-digit SITC classification and for 1965 and 1967. A double log-linear form of this model was estimated with multiple regression because of the interactive nature of the factors included.

The regression results are presented in Table 2. The coefficient of determination (R^2) and F value is provided for each estimated equation. The "t" values for the individual estimated coefficients are given in the parenthesis below them. Given that these are cross-section estimates, the equations seem to provide a reasonable fit to the data. In addition, an examination of the correlation matrix of independent variables failed to provide evidence that multi-collinearity was a problem.

The coefficients presented in Table 2 all display the signs that would be expected from the Gray model. The coefficients for the similarity in tariff and non-tariff barriers display the expected positive sign, and the tariff

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[8]One factor not accounted for explicitly is similarity in factor prices. Gray [6, pp. 25], however, suggests that equality of factor prices is most likely to occur in countries which have similar per capita incomes. This factor may then be accounted for by our income similarity variable.

TABLE 2: Determinants of U. S. Intra-Industry Trade (B_i) at the 3-digit S.I.T.C. Level of Aggregation[a/]

Year	Intercept[b/]	Tariff Differential (TD_i)	Non-Tariff Barrier Differential ($NTBD_i$)	Height of World Tariff Barriers (HTB_i)	Height of Non-Tariff Barriers ($HNTB_i$)	Income Similarity (IS_i)	4-digit SITC ($SITC_i$)	Mean Distance-Shipped (MDS_i)	Product Differentiation Dummy (PDD_i)	R^2	F
1965	-3.81 (2.52)***	.376 (2.72)***	.049 (1.03)	-.352 (2.53)***	-.075 (.883)	.695 (3.92)***	.215 (2.01)**	.596 (2.79)***	.031 (.174)	.36	6.45
1967	-3.67 (2.54)***	.450 (3.35)***	.059 (1.27)	-.361 (2.66)***	-.986 (1.20)	.621 (3.76)***	.229 (2.21)**	.592 (2.85)***	.047 (.272)	.40	7.59

a/ Where we define $B_i = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \times 100$ for industry i.

b/ The significance of the coefficients was tested by using a one-tail t test, where:

*significant at .90 level
**significant at .95 level
***significant at .99 level

coefficient was significant at the 1% level. The coefficients for the height of tariff and non-tariff barriers possess the expected negative signs, but again only the tariff coefficient was significant at a 1% level or better. The coefficient for the income similarity variable is positive and significant at the 1% level suggesting that similarity in income is indeed an important factor in influencing the volume of two-way trade. The positive and statistically significant coefficient for the mean distance shipped variable indicates that transportation considerations are also an important factor in affecting two-way trade. The coefficient for the SITC variable was also positive and statistically significant at the 5% level. This suggests that some of the observed two-way trade is simply a result of the aggregation of commodities into common industry categories.

The results obtained for the product differentiation dummy, however, were not impressive. Although the coefficient for this variable has the expected positive sign, it was not statistically significant. This could be accounted for by the crude construction of the variable and the difficulty of defining product differentiation in an international context. But recent studies in the area of multi-national corporations [3,4] provide an alternative explanation. This research suggests that direct foreign investment of a horizontal nature has been undertaken by U. S. firms primarily in oligopolistic industries characterized by product differentiation. The argument is, that due to the need of (1) adapting the product and marketing strategy to local conditions, (2) providing specialized customer services and (3) overcoming trade barriers, firms have adopted a strategy of substituting direct investment for exports. This process of substitution, thus, could reduce the observed volume of U. S. two-way trade in differentiated products. To test for this possibility we ran additional regressions in which a proxy (MN_i) for the degree of multi-national activity of leading U. S. firms within each industry obtained from [2] was included as an explanatory variable. The results for the 1965 equation are presented below.[9]

$$B_i = \underset{(2.40)^{***}}{-3.61} + \underset{(3.01)^{***}}{.418\ TD} + \underset{(1.01)}{.052\ NTBD} - \underset{(2.94)^{***}}{.424\ HTB} - .068\ HNTB$$

$$+ \underset{(3.91)^{***}}{.687\ IS} + \underset{(1.98)^{**}}{.209\ SITC} + \underset{(2.78)^{***}}{.588\ MDS} + \underset{(.355)}{.063\ PDD} - \underset{(1.68)^{**}}{.113\ MN}$$

$R^2 = .38$

$F = 6.16$

Indeed, the coefficient for the multi-national variable (MN) was negative as expected and it was significant at the 5% level, thus, lending some support to the explanation suggested. With the data at hand, though, no unambiguous conclusion about the results for the product differentiation variable can be made.

IV

This paper has examined the magnitude of two-way trade in U. S. manufactures and provided an empirical test of Gray's hypotheses designed to explain this phenomenon. The results of the statistical analysis indicate that two-way trade is an important component of U. S. international trade and provide considerable support for the predictions of the Gray model. This suggests that two-way trade is not only the result of data aggregation, but that other factors, such as product differentiation, tariff differentials, income similarity, the height of tariff barriers and transportation costs, significantly contribute to the explanation of the simultaneous export and import of the same commodity. Furthermore, in confirming that two-way trade is a real phenomenon, rather than just an aggregation problem, this paper emphasizes the importance of market

[9] Similar results were obtained for the 1967 data.

imperfections in any future re-examination of traditional international trade models.

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