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A 'STAGES' APPROACH TO COMPARATIVE ADVANTAGE

This paper has investigated the changing pattern of comparative advantage in the process of economic development. Comparative advantage has been defined in terms of relative export performance, thus neglecting the composition of imports which is greatly affected by the structure of protection.

The empirical estimates show that inter-country differences in the structure of exports are in large part explained by differences in physical and human capital endowments. The results lend support to the 'stages' approach to comparative advantage, according to which the structure of exports changes with the accumulation of physical and human capital.

These findings have important policy implications for the developing countries. Firstly, they warn against distorting the system of incentives in favor of products in which a country has a comparative disadvantage. Secondly, the results can be utilized to gauge the direction in which a country's comparative advantage is moving. Finally, the results permit to dispel certain misapprehensions as regards the foreign demand constraint for developing country exports. Thus as, in progressing on the comparative advantage scale, one developing country replaces another in exporting particular commodities to developed countries, the problem of adjustment in the latter group of countries will not arise.

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The author has benefited from comments on an earlier version of the paper by T. N. Srinivasan and other participants of a seminar held at the World Bank. The paper will be presented at the 5th World Congress of the International Economic Association to be held in Tokyo on August 29 - September 3, 1977.

A 'Stages' Approach to Comparative Advantage

Bela Balassa

This paper will examine intercountry differences in export structure, with a view to indicating the changing pattern of comparative advantage in the process of economic development. The investigation will be limited to exports, since the commodity pattern of imports is greatly influenced by the system of protection in the importing countries. And, as trade in natural resource products depends to a considerable extent on the country's resource endowment, we will deal with comparative advantage in manufactured goods alone.

Section I of the paper will consider the relevance for the developing countries of explanations of international specialization based on factor proportions and technological variables. Section II will describe the product classification schemes and country characteristics used to evaluate comparative advantage. The empirical results on the changing pattern of comparative advantage will be presented in Section III; they will be further analysed in Section IV. Section V will indicate the policy implications of the results.

I

Hufbauer (1970) was the first to introduce the distinction between the neo-factor proportions and the neo-technological explanations of comparative advantage. The former combines human capital with physical capital and relates the sum of the two to (unskilled) labor. In turn, the latter emphasizes the role of technological change, the product cycle, and economies of scale in determining the pattern of international specialization.

According to Hufbauer, if technological factors "were somehow combined into a single characteristic, that characteristic might prove as powerful as Lary's single measure (value added per man) of human and physical capital in explaining trade flows" (1970, p. 196). While such a single characteristic has not been established, it has been suggested that "there appears to be a new consensus emerging concerning the power of the neo-technology theory over the neo-factor proportions theory" (Goodman-Ceyhun, 1976, p. 551).

The results of several recent studies on U.S. trade tend to support this conclusion. Goodman and Ceyhun have found that "the variables describing different facets of the technology phenomena are singularly the most important variables, which suggest the importance of the neo-technology hypothesis in the explanation of international trade in manufactures" (*op. cit.* p. 547). Similar results have been reached by Baldwin (1971) and by Branson and Junz (1972).

These authors have shown that net U.S. exports are negatively correlated with physical capital intensity. Baldwin also finds that general measures of human capital, such as the average cost of education, average years of education, and average earnings, are not statistically significant[1/] in explaining U.S. trade. And, while the human capital variable is positively correlated with net exports in the Branson-Junz study, its level of statistical significance is greatly reduced once technological variables are introduced in the equation.

1/ This conclusion applies also in U.S. trade with Canada, Western Europe, the developing countries, and the rest of the world other than Japan, although statistically significant results were obtained for U.S. trade with Japan, (1971, p. 140).

Among technological variables, R&D expenditure performs the best in the Branson-Junz study whereas Baldwin finds the number of engineers and scientists to be the most important explanatory factor, adding further that "probably of even more importance is the fact that a significant part of this labor group is engaged in research and development activities" (1971, p. 142). Finally, Morall concludes that "the United States' comparative advantage in skill intensive products must be due to mechanisms such as the product cycle model, the government subsidy of R&D explanation, the economies of scale in R&D arguments, or the dynamic shortage theory" (1972, p. 120).[1/]

The results obtained for the United States, however, have limited relevance for our inquiry into the changing pattern of comparative advantage for the developing countries. These countries are at the other end of the spectrum from the United States and engage in research and development to a very small degree, if at all.[2/] Accordingly, we will next consider the determinants of trade between developed and developing countries.

Postulating that light manufactures are relatively labor intensive and heavy manufactures capital intensive, Kojima (1970) has concluded that the factor proportions explanation is valid to trade between developed and developing countries. Defining capital intensity in terms of value added per man,

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1/ A dissenting voice is that of Harkness and Kyle (1975). However, the results of these authors were obtained by replacing a continuous variable (net exports or export-import ratios) with a binary variable, classifying industries into two groups according to whether exports exceed, or fall short of, imports. This choice brings into question the validity of the results, in part because of the error possibilities involved in a binary classification and in part because large and small export-import balances are given equal weight.

2/ This conclusion also applies to Leamer's findings as to "the clear superiority of the research and development variable" (1974, p. 369) in determining export-import ratios for two-digit SITC categories in a group of twelve developed countries including the United States, who carry out much of their trade with each other.

taken to reflect the use of physical as well as human capital, Lary has also found that developing countries tend to export labor-intensive manufactures (1968, ch. 4). This conclusion has been reinforced as regards U.S. imports from developing countries by Mahfuzur Rahman (1973), who defined capital in physical terms, and for German imports from developing countries by Fels (1972), who defined capital as the sum of the value of the (physical) capital stock and the discounted value of the difference between average wages and unskilled wages in particular industries, taken as a proxy for human capital.

In examining trade between developed and developing countries, however, these authors have divided a continuum more-or-less arbitrarily into two segments, hence their estimates cannot be used to indicate changes in the pattern of comparative advantage in the process of economic development. Continuous variables as regards country characteristics have been used by Hufbauer in attempting to explain intercountry differences in the average values of particular product characteristics.[1/] But, in his sample of 24 countries, Hufbauer has included only 9 countries which may be considered developing, and most of these belong to the semi-industrial group (1970, p. 157).[2/]

In turn, Hirsch (1974) has classified 18 industry groups in three categories, according to whether the correlation between export performance and value added per worker in the nonagricultural sector, estimated in an intercountry framework, was positive, zero, or negative. Hirsch has also made estimates for individual countries by regressing export-output ratios in the

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1/ E.g. the average physical capital intensity of exports was related to intercountry differences in physical capital per man.

2/ On the definition used, see Section III below.

18 industry breakdown on the skill, physical capital, scale, and natural resource characteristics of these industries, and has grouped the results obtained for the 29 countries studied into four categories according to their per capita incomes (high income, medium high income, medium low income and low income groups). No attempt has been made, however, to establish a relationship between the two sets of estimates. Considering further the low level of significance of the estimated regression coefficients in the country equations, the crudeness of the fourfold country classification scheme, and the high degree of commodity aggregation[1/], the results have remained rather impressionistic.

Finally, Herman and Tinbergen (1970) and, subsequently, Herman (1975) have classified countries into eleven categories on the basis of their physical and human capital endowments. However, the sources cited provide no information that would permit estimating physical capital endowments and the proxy used for human capital (the cost of educating professional, technical, and related workers classified in Group 0/1 in the International Standard Classification of Occupations used by the ILO) includes personnel in liberal occupations, such as jurists, preachers, artists, and athletes while excluding production supervisors, foremen, and skilled workers that are of considerable importance in the developing countries. Also, the results derived regarding comparative advantage have not been subjected to statistical testing.

1/ An even greater level of aggregation (1-digit Standard International Trade Classification categories) is used by Banerji who distinquishes among four commodity categories and has not been successful in introducing variables directly expressing comparative advantage in the regression equations (1975, Ch. III).

II

We have briefly reviewed recent efforts made to examine the pattern of comparative advantage,[1/] with emphasis on the relevance of the results for the developing countries. It has been shown that applications of the neo-technological theory largely pertain to U.S. trade, particularly with the developed countries. In turn, in statistical investigations that have included developing countries, these countries have been considered as a group or, alternatively, they have been classified on the basis of a single criterion, such as per capita incomes or average value added per employee in the nonagricultural sector.

In the latter case, intercountry regressions have been estimated by relating average product characteristics for all manufactured exports or for aggregate industry-groups to a particular country characteristic. A considerable degree of commodity aggregation has been employed also in examining the relationship between product characteristics and the export structure of the individual countries in an interindustry framework. At the same time, no linkage has been established between the intercountry and interindustry estimates.

A different approach has been followed in the present study. Thirty-six countries have been chosen for the investigation, of which 18 are developed and 18 developing. For each country, regression equations have been estimated relating their "revealed" comparative advantage in 184 product categories in the year 1972 to various product characteristics. The regression

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1/ For an excellent review of earlier contributions the reader is referred to Stern (1975).

coefficients thus obtained have in turn been correlated with particular country characteristics in inter-country regressions so as to indicate the effects of these country characteristics on international specialization.

The first question concerns the choice of product characteristics for the investigation. Harry Johnson has suggested to extend the concept of capital to include human capital as well as intellectual capital in the form of production knowledge, noting that, "such an extension is fully consistent with Irving Fisher's approach to the relation between capital and income" (1970, p. 17). However, as Branson observes, the aggregation of various forms of capital assumes that they are perfect complements or perfect substitutes in production[1/] (1973, p. 11).

In the present study, we have experimented with an aggregate measure of capital as well as with separate variables for physical and human capital.[2/] Investment in research and development has been subsumed under the two, as this is in part embodied in physical capital (e.g. laboratories) and in part in human capital (scientists and engineers engaged in R&D). This procedure appears appropriate in an investigation of the changing pattern of comparative advantage in the process of development since, as noted above, developing countries carry out hardly any R&D, so that little is lost in combining

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1/ On the complementarity of physical and human capital, see Fallon and Layard, 1975.

2/ Physical and human capital have also been separated in a recent article by Hirsch, which has come to the author's attention after this paper was completed. Hirsch makes a distinction between high-skill and low-skill industries, further separating (physical) capital and (unskilled) labor-intensive industries within each. For each group, export performance is related to incomes per head, taken as a proxy for physical *and* human capital (Hirsch, 1975). Thus, in contradistinction with the present study, an aggregated commodity classification scheme is used and capital endowment variables are not introduced in the analysis. Also, the human capital intensity of the different product categories is defined in terms of skill intensity, which was criticized in connection with the Herman-Tinbergen study above.

intellectual capital in the form of production knowledge with physical and human capital.

Capital intensity may be defined in terms of flows (Lary's measure of value added per worker) or stocks (the value of the capital stock plus the discounted value of the difference between average wages and the unskilled wage, divided by the number of workers). The latter approach was used by Kenen (1965) and, recently, by Fels (1972) and by Branson (1973)

The stock measure of capital intensity (k^s) is expressed in (1)

$$(1) \qquad k_i^s = p_i^s + h_i^s = p_i + \frac{\bar{w}_i - w_i^u}{r^h}$$

for industry i, where p_i and h_i respectively, refer to physical and human capital per man, $\bar{w}_i$ is the average wage rate, w_i^u the wage of unskilled labor, and r^h the discount rate used in calculating the stock of human capital. This approach implicitly assumes that the rental price of physical capital, i.e. the risk-free rate of return and the rate of depreciation, is the same in all industries. This assumption is made explicit in expressing the flow equivalent (FE) of the stock measure of capital intensity as in (2), where r^p is the

$$(2) \qquad (FE)\ k_i^s = p_i(r^p + d)+(\bar{w}_i-w_i^u)$$

discount rate for physical capital and d is the rate of depreciation.

In turn, the flow measure of capital intensity (k^f) can be expressed as in (3) where va refers to value added per man. Now, nonwage value added

(3) $$k_i^f = va_i = p_i^f + h_i^f = (va_i - \bar{w}_i) + \bar{w}_i = (va_i - \bar{w}_i) + \left[(\bar{w}_i - w_i^u) + w_i^u \right]$$

per man $(va_i - \bar{w}_i)$ is taken to represent physical capital intensity and wage value added per man $(\bar{w}_i)$ human capital intensity.

As far as physical capital intensity is concerned, the two measures will give the same result in risk free equilibrium, provided that product, capital, and labor markets are perfect and nonwage value added does not include any items other than capital remuneration. However, production is subject to risks that vary among industries and assuming risk aversion, profit rates will include a risk premium that will differ from industry to industry. Also, the situation in a particular year will not represent an equilibrium position and this fact, as well as imperfections in product, capital, and labor markets, will further contribute to interindustry variations in profits. Moreover, nonwage value added may include items other than capital's remuneration, such as advertising.

Finally, while the stock measure imputes differences between average wages and the unskilled wage to human capital, the flow measure includes the entire wage value added under this heading, thus overestimating human capital intensity by the amount of the unskilled wage. This would not give rise to problems if the unskilled wages were the same in every industry. However, unskilled wages may differ among industries due to factors such as the disutility of work and the power of labor unions.

The existence of interindustry differences in risk, market imperfections, the inclusion of items other than capital's remuneration in non-wage value added, and the inclusion of unskilled wages in wage value added represent deficiencies of the flow measures of capital intensity. In turn, the lack of consideration given to interindustry differences in depreciation rates and in the extent of obsolesence of existing equipment, as well as the use of historical rather than replacement values for physical capital, represent disadvantages of the stock measure.

The implications of the described shortcomings of the two measures of capital intensity for the results will depend on the particular circumstances of the situation. The usefulness of the stock measure would be greatly impaired in an inflationary situation where historical and replacement values differ and the magnitude of their differences varies with the age of equipment. This is not the case in the present study since the benchmark years used for estimating capital intensity (1969 and 1970) are part of a long noninflationary period. By contrast, the usefulness of the flow measure is limited by reason of the fact that profit rates show considerable variation over time and interindustry differences in profit rates cannot be fully explained by reference to risk factors.[1/]

These considerations tend to favor the use of the stock measure of capital intensity. Nevertheless, given the error possibilities involved, interest attaches to making estimates by the use of both measures[2/], which also permits us to examine the stability of the results derived under alternative assumptions. This has been done in the present study, with emphasis given to the estimates obtained by the use of the stock measure in evaluating the results.

1/ Reference is made here to U.S. data which were used in the calculations as noted below.

2/ Fels has employed both measures in correlating net German exports with capital intensity in a nineteen industry sample (1972, Table 3). In turn, Lary has used Hufbauer's data to calculate the rank correlation coefficient between country averages of value added per employee in exports and per capita incomes (1970).

For purposes of the calculations, we have attempted to obtain data on the capital intensity of the production process for Japan, the factor intensities of which may be presumed to lie in-between the relevant magnitudes for highly-developed and less-developed countries. However, for lack of information on physical capital and on unskilled wages in a sufficiently detailed breakdown, this attempt had to be abandoned and we have had to have recourse to U.S. data.

The use of U.S. data in the investigation will be appropriate if factor substitution elasticities are zero or they are identical for every product category. While this assumption is not fulfilled in practice, Lary has shown variations in capital intensity to be small in U.S. - U.K., U.S. - Japan, and U.S. - India comparisons as regards his value added measure (1968, Appendix D). For lack of data, similar comparisons could not be made for the stock measure and the further investigation of this question had to be left for future research.

In defining the manufacturing sector for purposes of the present investigation, we have taken the concept used in the U.S. Standard Industrial Classification (SIC) as our point of departure. We have excluded from this category (SIC 19 to 39), foods and beverages (SIC 20) and tobacco (SIC 21), where the high cost of transportation and the perishability of the basic material give an advantage to primary-producing countries. We have further excluded primary nonferrous metals (SIC 333) where transportation costs account for a high proportion of delivered price of the basic material, and ordnance (SIC 19) where comparable trade data are not available. In turn, given the relatively low cost of transporting the raw material (Cornwall, 1972) and the prevalence of exports based on imported materials, we have retained petroleum products and wood products in the manufactured product category.

We have also retained nonmetallic mineral products by reason of the ubiquity of the basic materials.

Defining the manufacturing sector as SIC industry groups 22 to 39 less 333, the product classification scheme used in this study has been established on the basis of the 4-digit SIC categories. Particular 4-digit categories have been merged in cases when the economic characteristics of the products in question were judged to be very similar and when comparable data did not exist according to the U.N. Standard International Trade Classification, which has been used to collect trade figures. Appendix Table 1 provides information on the capital intensity of the 184 product categories chosen, using the stock as well as the flow measure of capital, and further separating physical and human capital. In turn, Appendix Table 2 shows the SIC and SITC categories corresponding to these product categories.

Data on the capital stock, employment, value added, and wages used in calculating capital intensity originate from the U.S. Census of Manufacturing. In turn, the data for unskilled wages have been taken from the *Monthly Labor Review*, published by the U.S. Bureau of Labor Statistics; they relate to 2-digit industries, thus involving the assumption that unskilled wages are equalized at this level.

In order to reduce the effects of variations due to the business cycle and nonrecurring events, we have used simple averages of data for the two latest years (1969 and 1970) for which information was available. Finally, we have estimated the value of human capital under the stock measure by discounting differences between the average wage and the unskilled wage for the individual product categories at a rate of 10 percent.[1/]

1/ This is in-between the discount rates of 9.0 and 12.7 percent used by Kenen (1965); the same discount rate was used by Fels (1972) and by Branson (1973).

As noted earlier, the study covers altogether 36 countries. The sample is evenly divided between developed and developing countries; the countries in the first group had per capita incomes exceeding $1800 in 1972; incomes per head were below $1400 in the second group. The variability of per capita incomes is 1:3 in the developed country subsample, 1:13 in the developing country subsample, and 1:56 in the entire sample. Thus, the sample, and, in particular the developing country subsample, exhibits considerable variability, which permits indicating the changing pattern of comparative advantage in the process of economic development.

The distinction between developed and developing countries has been introduced in the econometric analysis through the use of a dummy variable for developed countries. At the same time, we have used continuous variables to denote country characteristics, including physical and human capital endowment. These are shown in Table 1 together with per capita incomes.[1/]

In the absence of data on the physical capital stock in the individual countries, we have used the sum of gross fixed investment over the period 1955-71, estimated in constant prices and converted into U.S. dollars at 1963 exchange rates, as a proxy for capital endowment. The data have been derived from the *World Tables, 1976*, published by the World Bank; they have been expressed in per capita terms.

A similar procedure has been employed by Hufbauer, except that he used data for the period 1953-64 and included manufacturing investment only (1970, p. 157). The choice of a longer period in the present study reflects the fact that capital equipment is used beyond eleven years; also,

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1/ On the use of per capita incomes as one of the explanatory variables, see Section IV below.

Table 1

Country Characteristics and Regression Coefficients
Obtained in Estimates for Individual Countries

	Country Characteristics					Regression Coefficients					
	DUMMY	GNPCAP	GDICAP	HMIND	SKILLS	β_j^{s}	β_j^{f}	β_j^{sp}	β_j^{sh}	β_j^{fp}	β_j^{fh}
Argentina	0	1139.65	2013.68	122.0	8.76	.32**	.19*	.25	-.04	.60*	-1.49
Australia	1	3271.69	6675.24	183.3	10.93	.34*	.78*	.23*	.12	.50*	.09
Austria	1	2741.26	5129.79	112.9	10.08	-.31	-.93	-.33*	.04	-.64*	.03*
Belgium	1	3701.15	5441.70	140.5	11.62	.11*	.04*	.24	-.11	.51**	-1.30
Brazil	0	511.27	1016.00	29.3	8.57	-.69*	-1.48*	-.35*	-.42	-.74	-.80*
Canada	1	4691.51	7970.65	179.9	14.92	.75*	.87*	.46	.25*	-.22	2.25*
Colombia	0	357.08	751.59	32.3	7.41	-1.31*	-2.48	-.06*	-1.31	-.33	-3.82
Denmark	1	4187.67	6259.56	139.2	13.63	-.40	-.12*	-.44	.05**	-.15	.08
Finland	1	2877.73	6999.27	109.9	14.89	-.26	-.62	.08	-.37	-.32	-.34**
France	1	3841.68	7211.24	138.8	13.46	-.07*	-.08*	-.06	-.002*	.11	-.50*
Germany	1	4218.84	7102.15	114.3	10.71	.20	.43*	-.05	.26	.05	.69*
Greece	0	1407.20	2196.43	93.7	9.60	-.27*	-1.05*	.11*	-.49**	-.08*	-1.90*
Hong Kong	0	1048.88	1370.61	60.7	5.09	-2.30*	-2.84*	-1.83*	-.52	-.94	-3.15*
India	0	102.03	214.25	50.2	9.64	-1.10*	-2.30*	-.93*	-.09	-.19**	-4.58
Ireland	1	1840.20	2701.89	110.7	12.53	-.48**	-.80*	-.44	-.04**	-.39	-.66*
Israel	1	2416.28	4280.96	148.9	19.19	-.37*	-.70*	-.02**	-.41	.27**	-2.02
Italy	1	2176.52	3366.47	91.3	7.05	-.33**	-.46*	-.20*	-.12	-.29*	-.06**
Japan	1	2740.95	4765.11	146.2	8.26	-.31*	-.52*	-.42	.11*	-.70**	.86*
Korea	0	301.03	402.89	66.7	6.15	-1.67*	-3.02*	-.46	-1.24**	-.69	-3.91*
Malaysia	0	408.62	494.56	34.5	9.53	-.88*	-2.32*	-.26	-.63*	-.56	-3.65*
Mexico	0	745.41	1067.02	41.1	9.22	-.91*	-1.48*	-.17	-.80*	-.40	-2.38*
Morocco	0	279.13	293.08	27.9	8.23	-1.18*	-2.95*	-.18*	-1.06	-.23*	-6.10*
Netherlands	1	3466.90	5375.15	158.6	11.62	.28	.44	.22*	.07	.55	-.67
Norway	1	3786.91	7806.11	107.4	13.91	.22*	.01*	.44*	-.25	-.05	.18*
Pakistan	0	104.11	197.76	33.1	4.63	-1.56*	-3.11*	-.93	-.63*	-.51	-5.78*
Philippines	0	223.50	448.72	134.2	10.98	-1.34*	-2.28*	-.07	-1.39*	-.53*	-3.03*
Portugal	0	1084.26	1154.43	68.1	5.09	-.81*	-2.09*	-.01*	-.90	-.82*	-1.80*
Singapore	0	1354.41	1189.84	97.6	8.00	-1.47*	-2.35*	-1.11	-.38*	-1.03	-2.01**
Spain	0	1333.76	2049.09	63.4	7.28	-.43	-.56	-.03	-.42*	-.12*	-.82*
Sweden	1	5141.10	9452.90	129.6	20.87	.21	.15	-.16*	.39*	-.44	1.50
Switzerland	1	4810.02	8852.63	112.6	13.13	.04*	-.10*	-.44*	.50*	.08*	-.23*
Taiwan	0	481.94	629.88	103.5	7.06	-1.56	-2.61*	-.68	-.87	-.98	-2.45*
Turkey	0	431.16	581.22	37.5	10.32	-.42	-1.62*	-.06**	-.42*	-.36	-2.01
U.K.	1	2765.25	4844.68	136.2	11.44	.13*	.46*	-.18**	.34*	.19	.31*
U.S.A.	1	5679.47	7616.20	325.0	14.21	.84**	1.47*	.24	.62	.23*	2.22
Yugoslavia	0	798.30	1162.06	110.0	13.73	-.47	-1.41	-.29	-.20	-.81	-.60

Country Characteristics: DUMMY -- 1 for developed, 0 for developing countries; GNPCAP = GNP per capita in 1972, $US;
GDICAP = Cumulated gross fixed investment per capita, 1955-71, $US;
HMIND = Harbison-Myers index;
SKILLS = share of professional, technical and related workers in the total non-agricultural labor force.

Regression Coefficients have been obtained by regressing for each country the ratio of 'revealed' comparative advantage, estimated for 184 product categories, on measures of capital intensity. The coefficient β^{s} has been estimated by regressing the comparative advantage ratio on the stock measure of total capital intensity as in (4), while β_j^{sp} and β_j^{sh} have been obtained by regressing this ratio on physical and human capital intensity, introduced simultaneously in the estimating equation as in (5), again using the stock measure of capital. β_j^{f}, β_j^{fh}, and β_j^{fh} are the corresponding regression coefficients estimated by substituting the flow measure of capital in the place of the stock measure in (4) and (5).

Regression coefficients that are significant at the 5 percent level have been denoted by * and those significant at the 10 percent level by **.

we have considered all capital, and not only that used in the manufacturing sector.[1/] In turn, in using value added per worker (1974, p. 542) as a proxy for capital endowment, Hirsch does not separate physical and human capital and neglects intercountry differences in profit rates and in unskilled wages.

Hufbauer has taken the ratio of professional, technical and related workers to the labor force in manufacturing as a proxy for human capital endowment (1970, p. 158). As noted earlier, the use of this measure is objectionable, because it includes various liberal occupations while excluding production supervisors, foremen, and skilled workers that are of considerable importance in the developing countries.

A more appropriate procedure appears to be to make use of the Harbison-Myers index of human resource development.[2/] While this index is a flow measure,[3/] the use of estimates pertaining to 1965 (Harbison, Maruhnic, and Resnick, 1970, pp. 175-6) permits us to provide an indication of a country's general educational level, and thus its human capital base, in 1972, the year for which trade data have been obtained. Nevertheless, we have also experimented with the skill ratio employed by Hufbauer, utilizing the data reported in the ILO *Yearbook of Labor Statistics*.

1/ This choice can be rationalized on the grounds that, *ex ante*, capital can be allocated to manufacturing as well as to other sectors. And while adjustments would need to be made if there was complementarity between capital and natural resources in certain uses, such as mining information on the sectoral composition of investment was not available for a number of the countries under study.

2/ This index has also been used in a study of world trade flows by Gruber and Vernon (1970).

3/ It is derived as the secondary school enrollment rate plus five times the university enrollment rate in the respective age cohorts.

III

As noted in the introduction, the investigation is limited to exports since the commodity pattern of imports is greatly influenced by the system of protection. Following earlier work by the author (1975), a country's relative export performance in the individual product categories has been taken as an indication of its 'revealed' comparative advantage.

For this purpose, we have calculated the ratio of a country's share in the world exports of a particular commodity to its share in the world exports of all manufactured goods. Thus, a ratio of 1.10 (.90) means that the country's share in a particular product category is 10 percent higher (lower) than its share in all manufactured exports.[1/] These ratios can be considered to express a country's comparative advantage in manufactured goods that are characterized by product differentiation and are hence exported by a variety of countries.

For each of the 36 countries, the ratio of 'revealed' comparative advantage, calculated for the individual product categories, has been regressed on variables representing the capital intensity of the individual product categories. Separate equations have been estimated using the stock and the flow measures of (total) capital intensity, as well as by simultaneously introducing physical and human capital under the two definitions of capital intensity.

The estimating equation is shown in (4) for total capital intensity

$$\log x_{ij} = \log \alpha_j + \beta_j^{s} \log k_i^{s} \tag{4}$$

1/ An alternative measure would involve relating exports to output in each country. In the absence of output figures, however, this measure could not be utilized in the present study. At any rate, it would require adjusting for country size (Balassa, 1968) while the measure used here does not require such an adjustment.

and in (5) for physical and human capital intensity for the case when the stock measure of capital is used. The same equational forms have been used in conjunction with the flow measure of capital.

The equations have been estimated in a double-logarithmic form,

$$(5) \qquad \log x_{ij} = \log \alpha_j + \beta_j^{sp} \log p_i^s + \beta_j^{sh} \log h_i^s$$

so that the value of the β coefficient for country j indicates the percentage change in the country's comparative advantage ratio (x_{ij}) associated with a one percent change in capital intensity.1/ A positive (negative) β coefficient thus shows that a country has a comparative advantage in capital (labor) intensive products while the numerical magnitude of the β coefficient indicates the extent of the country's comparative advantage in capital (labor) intensive commodities.2/ The estimated β coefficients are reported in Table 1.

In the regression equations utilizing the stock measure of (total) capital intensity, the β coefficient is statistically significant at the 5 percent level for 22 countries and at the 10 percent level for 26 countries. In turn, in regression equations utilizing the flow measure, the coefficient is significant at the 5 percent level for 29 countries, with no additional countries included at the 10 percent level. Note further that the β coefficients that have values near to zero have an economic interpretation even if they are not significantly

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1/ Since the logarithm of zero is undefined, in the estimating equations, an export ratio of .001 has been used to represent cases when the exports of a country in a particular product category were nil. We have also experimented with the use of a .01 ratio and have obtained practically the same results. Nor are the results materially affected if we drop the zero observations from the regressions. This and other estimates not reported in the paper are available from the author on request.

2/ Alternatively, use may be made of non-parametric tests involving the calculation of the Spearman rank correlation coefficient between the 'revealed' comparative advantage ratio and the individual factor intensity measures. This test has the disadvantage, however, that it cannot handle more than one explanatory variable and that it does not permit indicating the implications of the intercountry results for a country's future comparative advantage (on the last point, see the concluding section).

different from zero; they indicate that a country is at the dividing line as far as comparative advantage in capital and labor-intensive products is concerned.

The β coefficients estimated by using the stock and the flow measures of capital intensity are highly correlated, with a Spearman rank correlation coefficient of .956. In turn, in estimates obtained by disaggregating capital into its physical and human capital components, a high degree of correspondence has been obtained in regard to the β coefficients pertaining to human capital intensity (Spearman rank correlation coefficient of .841) but not for physical capital intensity (Spearman rank correlation coefficient of .650). These differences are explained if we consider that human capital intensity was defined in a similar way under the stock and the flow measure of capital while this was not the case for physical capital intensity.

The level of statistical significance of the coefficients, too, is lower if we disaggregate capital into its physical and human capital components. The β coefficients are significant at the 5 (10) percent confidence level in 14 (17) cases for the physical capital intensity variable and in 13 (17) cases for the human capital intensity variable if we use a stock measure of capital. The corresponding figures are 11 (15) for the physical capital intensity variable and 21 (24) for the human capital intensity variable under the flow measure.1/

1/ The results contrast with those obtained by Helleiner who found total (physical and human) capital intensity to have lower explanatory power than skill intensity alone. But, Helleiner's results pertain to the trade of the LDCs taken as a whole; he did not employ a stock measure of capital; and he used the average wage as a measure of skill intensity (1976).

Helleiner also used some additional variables, of which scale economies was statistically significant in trade between developing and developed countries (1976, p. 512). However, comparative advantage in products subject to scale economies is related to the size of the domestic market (Balassa, 1968) and, with developing countries having smaller markets, Helleiner's results raise problems of identification.

Next, we have tested the hypothesis that intercountry differences in the β coefficients can be explained by differences in country characteristics that determine the pattern of comparative advantage. This test has been carried out by regressing the β coefficients estimated for the individual countries on variables representing their per capita physical and human capital endowments and the level of economic development in an intercountry framework. (6) shows the estimating equation for the case when per

$$\text{(6)} \qquad \beta_j = f(\mathrm{GDICAP}_j, \mathrm{HMIND}_j, \mathrm{DUMMY})$$

capita physical capital endowment (GDICAP) and human capital endowment (HMIND) are introduced simultaneously in the equation[1/] and a 0-1 variable (DUMMY) is used to indicate whether a country belongs to the developing or developed group. In this way, we test the hypothesis that the two capital endowment variables independently affect comparative advantage.

Statistically significant results have been obtained in estimating equation (6) for both the physical and the human capital endowment variables, regardless of whether the dependent variable originated in country regressions utilizing the stock or the flow measure of capital intensity. In both regressions, the physical as well as the human capital endowment variables are significant at the 1 percent confidence level, while the coefficient of determination is .65 using the stock measure and .77 using the flow measure of capital intensity (equations 1.6 and 2.6 in Table 2).[2/]

The level of statistical significance of the regression coefficients for the physical capital endowment variable is however much lower if it is used in conjunction with the human capital intensity variable without

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1/ In order to minimize problems related to heteroscedasticity, the data for the individual countries have been weighted by the inverse of the standard error of the β coefficients. While in this way greater weight is given to the β coefficients obtained in (4) and (5) that have a higher degree of statistical significance, broadly similar results have been obtained by using unweighted data.

2/ Regressing the rank correlation coefficients on factor endowment variables has generally confirmed the reported results, although the level of statistical significance of the coefficients was somewhat lower.

TABLE 2

INTERCOUNTRY REGRESSION EQUATIONS FOR THE TOTAL CAPITAL INTENSITY MEASURE

(Weighted Regressions Using Reciprocals of Standard Errors of the Dependent Variable as Weights)

Dependent Variable	Equation Number	Coefficient of Determination	Explanatory Variables				
			GDICAP	HMIND	DUMMY	SKILLS	CONSTANT
β_j^s	1.1	.53	.78 (6.13)				-2.85(-7.12)
	1.2	.60		1.32 (7.15)			-3.33(-8.24)
	1.3	.62	.27 (1.27)	.96 (2.85)			-3.32(-9.31)
	1.4	.53	.97 (2.90)		-.14 (-.62)		-2.83(-7.02)
	1.5	.60		1.39 (3.96)	-.03 (-.24)		-3.33(-8.12)
	1.6	.65	.67 (2.21)	1.17 (3.38)	-.37 (-1.80)		-3.38(-9.72)
	1.7	.53	.67 (1.82)			.008(.32)	-3.00(-4.74)
	1.8	.53	.83 (1.91)		-.17 (-.72)	.01 (.50)	-3.09(-4.36)
	1.9	.62	.36 (1.02)	.99 (2.81)		-.007(-.32)	-3.19(-5.50)
	1.10	.65	.67 (1.74)	1.17 (3.27)	-.37 (-1.74)	.0005(.02)	-3.40(-5.91)
β_j^f	2.1	.61	1.42 (7.30)				-3.59(-8.86)
	2.2	.73		2.45 (9.69)			-4.20(-11.49)
	2.3	.75	.39 (1.32)	1.94 (4.23)			-4.21(-11.62)
	2.4	.61	1.46 (2.81)		-.02 (-.06)		-3.59(-8.71)
	2.5	.73		2.46 (5.19)	-.009(-.05)		-4.21(-11.30)
	2.6	.77	.88 (2.07)	2.18 (4.60)	-.45 (-1.56)		4.26(-11.97)
	2.7	.61	1.32 (2.35)			.008(.21)	-3.69(-5.79)
	2.8	.61	1.36 (2.03)		-.05 (-.12)	-.009(.23)	-3.71(-5.64)
	2.9	.75	.69 (1.46)	2.04 (4.28)		-.03 (-.82)	-3.91(-7.53)
	2.10	.77	1.05 (1.97)	2.22 (4.57)	-.42 (-1.41)	-.02(-.53)	-4.06(-7.77)

Note: for explanation of symbols, see Table 1 introducing a dummy to represent the level of economic development. This result indicates that the effects of physical capital endowments but not those of human capital endowments on international specialization depend on the level of economic development.

We have also experimented with the ratio of professional, technical, and related workers to the total in the place of, and together with, the Harbison-Myers index. The skill-ratio variable (SKILLS) is not statistically significant at even the 10 percent level and it fails to raise the coefficient of determination. It can thus be rejected on statistical grounds.

It will be recalled that the level of statistical significance of the β coefficients for the physical capital intensity variable in the country regressions has been generally low. Statistically poor results have been obtained also in regressing these coefficients on variables representing physical and human capital endowment in an intercountry framework as in (6). The explanatory power of the regressions is very low as is the level of statistical significance of the coefficients in cases when the physical and the human capital endowment variables are introduced simultaneously in the estimating equation, However, the coefficients are statistically significant when these variables are introduced separately (Table 3).

The explanatory power of the regressions is relatively high in cases when the β coefficients obtained in (5) in regard to human capital intensity are used as the dependent variable. Also, both the physical and the human capital endowment variables are highly significant when introduced simultaneously in the equations. The level of significance is somewhat lower in cases when the stock measure of capital intensity is used instead.

TABLE 3

REGRESSION EQUATIONS FOR PHYSICAL AND HUMAN CAPITAL INTENSITY MEASURES

(Weighted Regressions Using the Reciprocals of the Standard Errors of the Dependent Variable as Weights)

Dependent Variable	Equation Number	Coefficient of Determination	Explanatory Variables			
			GDICAP	HMIND	DUMMY	CONSTANT
β_j^{sp}	1.1	.13		.41 (2.29)		-1.40 (-3.46)
	1.2	.07	.19 (1.65)			-1.13 (-2.98)
	1.3	.14	-.08 (-.39)	.52 (1.56)		-1.40 (-3.42)
	1.4	.16	.15 (.49)	.64 (1.81)	-.21 (-1.02)	-1.44 (-3.50)
β_j^{sh}	2.1	.58		.98 (6.86)		-1.98 (-6.90)
	2.2	.60	.62 (7.14)			-1.75 (-6.89)
	2.3	.64	.37 (2.38)	.49 (1.99)		-1.98 (-7.35)
	2.4	.65	.49 (2.14)	.56 (2.11)	-.12 (-.74)	-1.99 (-7.34)
β_j^{fp}	3.1	.26		.64 (3.43)		-1.36 (-4.26)
	3.2	.18	.35 (2.71)			-1.13 (-3.63)
	3.3	.26	-.006(-.02)	.65 (1.87)		-1.36 (-4.19)
	3.4	.26	-.10 (-.31)	.61 (1.65)	.09 (.39)	-1.35 (-4.10)
β_j^{fh}	4.1	.50		3.07 (5.86)		-2.76 (-6.76)
	4.2	.48	1.95 (5.55)			-2.47 (-6.38
	4.3	.53	.91 (1.47)	1.91 (2.02)		-2.78 (-6.93)
	4.4	.58	2.14 (2.38)	2.44 (2.55)	-1.10 (-1.83)	-2.82 (-7.27)

Note: For explanation of symbols, see Table 1

IV

We have further examined deviations from the relationships estimated in an intercountry context. Upward deviations from the regression line are shown with respect to the physical capital endowment, but not with regard to the human capital endowment, of Argentina and the United States. The results indicate that the actual capital intensity of the exports of these countries much exceeded expected values based on their physical and human capital endowments.

The results for Argentina are explained if we consider that, during the period under study, this country represented an extreme case among the developing countries as far as distortions due to the application of protective measures are concerned. These distortions, in turn, have affected the pattern of exports and imports; in particular, with the implicit subsidy to capital goods through the overvaluation of the exchange rate associated with high protection, exports have been biased in a capital-intensive direction.

The results for the United States are somewhat of a puzzle as the findings of other authors would have led us to expect that actual U.S. exports are less, rather than more, physical-capital intensive than the hypothetical exports derived from intercountry relationships. And while the solution to the puzzle may well be that the ratio of physical to human capital intensity is even higher for the imports than for the exports of the United States, our results conflict with those of Hufbauer which show the U.S. to be below the regression line (1970, p. 169). Note, however, that Hufbauer's results pertain to an earlier year and he provides evidence that U.S. exports have become increasingly physical-capital intensive over time. Finally, our calculations using direct input coefficients are preferable to earlier estimates derived by the use of direct plus indirect coefficients once we admit international trade in intermediate products.

In turn, the exports of Hong Kong are less capital-intensive than expected on the basis of its physical capital endowment. It would appear that Hong Kong's export structure does not yet fully reflect the large investments in physical capital carried out during the period under consideration. Finally, deviations from the regression line are relatively small in regard to human capital endowment.

Next we have estimated a matrix of Spearman rank correlation coefficients for pairs of country characteristics in the 36 country sample. From Table 4 it is apparent that the extent of the correlation is the weakest in regard to the skill ratio reinforcing our conclusion as to the inappropriateness of this variable.

In turn, the correlations between per capita GNP on the one hand, and per capita GDI and the Harbison-Myers index on the other, indicate the effects of investment in physical and in human capital on incomes per head. The existence of this correlation also explains that the inclusion of all three variables in the regression equation raises the standard error of the coefficients to a considerable extent.[1/] Nevertheless, the fact that the level of statistical significance of the physical and human capital endowment variables much exceeds that for incomes per head may be taken as an indication of the "primacy" of the former.

We have seen that the intercountry regressions provide the same general results, irrespective of whether we use a stock or a flow measure of capital intensity. This finding may be explained by the relatively high degree of correspondence in the ranking of the product categories by the two

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1/ The relevant regression results with t-values in parentheses are

$$\underset{}{\beta_j^s} = \underset{(8.25)}{-3.41} - \underset{(.14)}{.13}\text{ GNPCAP} + \underset{(.98)}{.77}\text{ GDICAP} + \underset{(2.45)}{1.22}\text{ HMIND} - \underset{(1.77)}{.37}\text{ DUMMY} \qquad R^2 = .65$$

$$\beta_j^f = \underset{(11.20)}{-4.24} + \underset{(.22)}{.28}\text{ GNPCAP} + \underset{(.60)}{.66}\text{ GDICAP} + \underset{(3.01)}{2.07}\text{ HMIND} - \underset{(1.53)}{.45}\text{ DUMMY} \qquad R^2 = .77$$

Table 4

Spearman Rank Correlation Coefficients for Country Characteristics

in the 36 Country Sample

	GNPCAP	GDICAP	HMIND	SKILLS
GNPCAP	1.000	.984	.754	.674
GDICAP	.984	1.000	.730	.697
HMIND	.754	.730	1.000	.660
SKILLS	.674	.697	.660	1.000

For explanation of symbols, see Table 1.
All coefficients are statistically significant
at the 1 percent level.

measures of capital intensity that is shown by the estimated Spearman rank correlation coefficient of .782.[1/] (Table 5)

The rankings of the 18 two-digit industry groups, too, are rather similar under the two measures of capital intensity. Among the individual industry groups, Apparel and other textile products, Leather and leather products, and Stone, clay and glass products are relatively labor intensive while Petroleum and coal products, Chemicals,and Paper and paper products are relatively capital intensive (Table 6). At the same time, the results vary to a considerable extent within each industry group. For example, fur goods are very capital intensive although they belong to the highly labor= intensive Apparel and other textile products industry group. In turn, explosives are relatively labor intensive although they belong to the capital-intensive Chemicals industry group.

Moreover, substantial differences are observed among individual product categories in terms of their factor intensity. At one extreme, we find woolen yarn and thread with (total) capital per worker of $3215, followed by earthenware food utensils ($3520), footwear ($3757), leather bags and gloves ($5483), vitreous china food utensils ($7221), costume jewellery ($8589), and games and toys ($8654), which are the most labor intensive among the 184 product categories. At the other end of spectrum, petroleum products ($191739), wood pulp ($135474), organic chemicals ($124198), synthetic rubber ($120631), carbon black ($101161), inorganic chemicals ($92762), and paper ($89089) are the most capital intensive (Appendix Table 1).[2/]

1/ Some major exceptions are various textile fabrics, reclaimed rubber, aluminum castings, ball bearings, and railroad cars where the stock measure, and toilet articles, paints, electric housewares, electric lamps, and motor vehicles where the flow measure, shows a considerably higher degree of capital intensity than the other measure of capital intensity.

2/ The results obtained by the use of the flow measure of capital intensity are broadly comparable, although they differ in regard to particular commodities.

Table 5

Spearman Rank Correlation Coefficients

for Alternative Measures of Capital Intensity

	(PC+HC)/L	VA/L	PC/L	HC/L	(VA-W)/L	W/L
(PC+HC)/L	1.000	.782	.758	.907	.680	.835
VA/L	.782	1.000	.636	.685	.951	.809
PC/L	.758	.636	1.000	.488	.604	.562
HC/L	.907	.685	.488	1.000	.565	.839
(VA-W)/L	.680	.951	.604	.565	1.000	.631
W/L	.835	.809	.562	.839	.631	1.000

For explanation of symbols see Table 1.
All coefficients are statistically significant at the 1 percent level.

TABLE 6

AVERAGE FACTOR INTENSITIES FOR 18 AGGREGATED PRODUCT CATEGORIES
(DOLLARS)

NO.	SIC NO.	PRODUCT CATEGORY	WEIGHT	p_i^s	h_i^s	k_i^s	p_i^f	h_i^f	k_i^f	w_i^u
1.	22.	TEXTILE MILL PRODUCTS	75,38	9404.	17814.	27219.	3885.	5919.	9804.	4222.
2.	23.	APPAREL + OTHER TEXTILE PRODUCTS	22,98	2024.	11967.	13991.	3583.	5165.	8748.	3968.
3.	24.	LUMBER + WOOD PRODUCTS	31,75	11266.	12184.	23449.	4452.	6431.	10883.	5213.
4.	25.	FURNITURE + FIXTURES	9,80	4520.	21678.	26198.	4431.	6669.	11100.	4505.
5.	26.	PAPER + ALLIED PRODUCTS	43,30	57609.	40126.	97735.	11467.	10397.	21864.	6382.
6.	27.	PRINTING + PUBLISHING	13,54	8417.	36191.	44607.	8962.	8941.	17903.	5323.
7.	28.	CHEMICAL + ALLIED PRODUCTS	117,73	41417.	33031.	74448.	19485.	9882.	29367.	6580.
8.	29.	PETROLEUM + COAL PRODUCTS	24,45	126110.	65629.	191739.	31310.	11910.	43220.	5342.
9.	30.	RUBBER + PLASTIC PRODUCTS	24,11	10188.	18579.	28766.	6406.	7784.	14190.	5922.
10.	31.	LEATHER + LEATHER PRODUCTS	7,75	5860.	17281.	23142.	4420.	6824.	11244.	5096.
11.	32.	STONE,CLAY + GLASS PRODUCTS	13,96	11843.	10003.	21846.	5571.	6742.	12313.	6082.
12.	33.	PRIMARY METAL + ALLIED PRODUCTS	99,91	32937.	30130.	63066.	6774.	10385.	17159.	7373.
13.	34.	FABRICATED METAL PRODUCTS	16,99	9073.	27860.	36933.	7330.	8715.	16045.	5927.
14.	35.	NONELECTRICAL MACHINERY	148,36	10045.	29011.	39056.	7326.	9704.	17030.	6831.
15.	36.	ELECTRICAL EQUIPMENT + SUPPLIES	96,98	7122.	30836.	37958.	5808.	8916.	14724.	5834.
16.	37.	TRANSPORTATION EQUIPMENT	190,14	11602.	27067.	38669.	11090.	10824.	21914.	8114.
17.	38.	INSTRUMENTS + RELATED PRODUCTS	28,34	11147.	41230.	52376.	13530.	9619.	23150.	5495.
18.	39.	MISC. MANUFACTURED PRODUCTS	24,71	5667.	17761.	23428.	6228.	9319.	15547.	5436.
		ALL CATEGORIES	1000,00	20518.	28278.	48796.	9645.	9308.	18953.	5831.

NOTE: The table shows average capital-labor ratios in a two-digit industry breakdown. The average capital-labor ratios for the individual product categories have been derived by weighting by the share of exports of the product category concerned in the total exports for all the 184 categories aggregated over the 36 countries. For explanation of the definitions and symbols used, see equations (1) to (3) in the text.

There is less of a correspondence in the rankings of product categories by their physical and their human capital intensity. The Spearman rank correlation coefficient between these indicators is .488 under the stock measure of capital and .631 under the flow measure. In turn, the correlation coefficient is .604 between the two measures of physical capital intensity and .839 between the two measures of human capital intensity. These differences are explained by the fact that the flow measure of capital intensity is sensitive to inter-industry differences in profits that do not affect the stock measure whereas both measures of human capital intensity are affected by average wages in the various product categories.

Among the individual product categories, organic chemicals, cellulosic man-made fibers, dyeing and tanning extracts, fertilizers, carbon black, and petroleum refining and products have relatively high physical as against human capital intensity, regardless of whether we use the stock or the flow measure of capital. The opposite result has been obtained for canvas products, radio and TV equipment, aircraft, ships and boats, and scientific instruments and control equipment. The first group includes product categories where the ratio of physical to human capital was between 1.5 and 5 using the stock measure of capital intensity and exceeded 1.2 using the flow measure. In turn, product categories in the second group had a ratio of physical to human capital of between .1 and .2 under the stock measure of capital and less than .6 under the flow measure (Appendix Table 1).

Summary and Conclusions

This paper has investigated the changing pattern of comparative advantage in the process of economic development. Comparative advantage has been defined in terms of relative export performance, thus neglecting the composition of imports which is greatly affected by the structure of protection.

For each country, export performance has been related to the capital intensity of the individual product categories, using a stock as well as a flow measure of capital, with further distinction made between physical and human capital. Next, the intercountry differences in the regression coefficients thus obtained have been correlated with country characteristics, such as physical and human capital endowment and the level of economic development.

The empirical estimates show that intercountry differences in the structure of exports are in a large part explained by differences in physical and human capital endowments. The results lend support to the 'stages' approach to comparative advantage according to which the structure of exports changes with the accumulation of physical and human capital.[1/] This approach is also supported by intertemporal comparisons for Japan, which indicate that Japanese exports have become increasingly physical capital and human capital intensive over time (Heller 1976).

These findings have important policy implications for the developing countries. To begin with, they warn against distorting the system of incentives in favor of products in which the country has a comparative disadvantage. The large differences shown among product categories in terms of their capital intensity point to the fact that there is a substantial penalty for such distortions in the form of the misallocation of productive factors.

1/ The expression 'stages' is used here to denote changes over time that occur more-or-less continuously rather than to discrete, stepwise changes. It is thus unrelated to economic stages described by Marx, the exponents of the German historical school, and Rostow.

Possible magnitudes of the economic cost of distortions are indicated in Table 7. This provides comparisons between production costs in the United States, assuming that pre-tax returns and depreciation amount to 30 percent of the gross value of physical capital, and production costs in a hypothetical developing country where unskilled wages are one-third of U.S. wages 1/ and the cost of capital is commensurately higher. 2/ In the latter country, the estimated cost of capital-intensive products is 15 to 32 percent higher, and that of labor-intensive products 38 to 52 percent lower, than in the United States, so that differences in relative costs between capital and labor-intensive products range from 1.87 to 2.76. 3/

The economic cost of policy-distortions may be especially high in countries that bias the system of incentives in favor of import substitution in capital-intensive industries and against exports in labor-intensive industries. Costs will also be incurred if capital-intensive exports are artificially promoted.

The results can further be utilized to gauge the direction in which a country's comparative advantage is moving. For this purpose, use may be made of the regression estimates obtained as regards total capital intensity. As a first step, we substitute projected future values of a country's physical and human capital endowments in the intercountry regressions, so as to estimate the prospective values of the β coefficients. 4/ Next, we derive the hypothetical

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1/ In 1974, average wages in manufacturing in Korea were 9 percent, and in the Philippines 6 percent, of U.S. wages (ILO, *Yearbook of Labor Statistics*).

2/ The difference in the cost of capital has been estimated at 43.3 percent under the assumption that value added in the manufacturing sector was the the same in the two cases. It has further been assumed that the absolute difference between skilled and unskilled wages remained the same.

3/ As elsewhere in the paper, the calculations do not allow for factor substitution in response of intercountry differences in factor prices.

4/ In line with the stages approach to comparative advantage, this is done on the assumption that new countries exporting manufactured goods will enter at the lower end of the spectrum.

Table 7

Hypothetical Production Costs
Calculated under Alternative Assumptions

(U.S. Dollars)

Product Category	United States				Developing Country				Ratio of
	Physical Capital	Human Capital	Unskilled Labor	Total Costs	Physical Capital	Human Capital	Unskilled Labor	Total Costs	Total Costs
Capital-Intensive									
1. Petroleum refining & products	37833	6563	5342	49738	54215	9405	1781	65401	1.315
2. Wood pulp	26400	4747	6382	37529	37831	6802	2127	46760	1.246
3. Organic chemicals	22635	4875	6632	34142	32436	6986	2211	41633	1.219
4. Synthetic rubber	20826	5121	6632	32579	29844	7338	2211	39393	1.209
5. Carbon black	18669	3893	6632	29194	26753	5579	2211	34543	1.183
6. Inorganic chemicals	16044	3928	6632	26604	22991	5629	2211	30831	1.159
7. Paper	14778	3983	6382	25143	21177	5707	2127	29011	1.154
Labor-Intensive									
8. Games & toys	1521	359	5436	7316	2180	514	1812	4506	.616
9. Vitreous china food utensils	1608	186	6082	7876	2304	267	2027	4598	.584
10. Costume jewelry	978	533	5436	6947	1401	764	1812	3977	.572
11. Leather bags & purses	711	311	5096	6118	1019	446	1699	3164	.517
12. Earthenware food utensils	1056	0	6082	7138	1513	0	2027	3540	.496
13. Woollen yarn & thread	486	160	4228	4874	696	229	1409	2334	.479
14. Footwear	660	156	5450	6266	946	224	1817	2987	.477
All Categories	6155	2828	5831	14815	8818	4052	1944	14815	1.000

Note: U.S. production costs have been calculated by adding 30 percent of the gross value of physical capital, assumed to reflect pre-tax earnings and depreciation, to observed labor costs. In turn, for the hypothetical developing country it has been assumed that unskilled wages are one-third of U.S. wages and the cost of capital is correspondingly higher. The latter has been estimated to exceed U.S. costs by 43.3 percent under the assumption that value added in the entire manufacturing sector is the same in the two cases. All data are expressed per worker.

structure of exports corresponding to the estimated β coefficients, which are taken to reflect the country's future physical and human capital endowments. Comparing the projected export structure with the actual structure of exports, one can then indicate prospective changes in export flows.

The regression estimates obtained in regard to physical and human capital intensity can also be used in the manner described above so as to indicate the relative importance of physical and human capital intensive products in a country's future export structure. Given the poor statistical results of the regressions for physical capital intensity, however, one should utilize directly the data reported in Appendix 1 which show the physical and the human capital intensity of individual product categories.

The stages approach to comparative advantage also permits one to dispel certain misapprehensions as regards the foreign demand constraint under which developing countries are said to operate. With countries progressing on the comparative advantage scale, their exports can supplant the exports of countries that graduate to a higher level. Now, to the extent that one developing country replaces another in the imports of particular commodities by the developed countries, the problem of adjustment in the latter group of countries does not arise. Rather, the brunt of adjustment will be borne in industries where the products of newly graduating developing countries compete with the products of the developed countries.

A case in point is Japan whose comparative advantage has shifted towards highly capital-intensive exports. In turn, developing countries with a relatively high human capital endowment, such as Korea and Taiwan, can take Japan's place in exporting relatively human capital-intensive products, and countries with a relatively high physical capital endowment, such as Brazil and Mexico, can take Japan's place in exporting relatively physical capital-intensive products. Finally, countries at lower levels of development can supplant the middle-level countries in exporting unskilled labor-intensive commodites.

The prospects of economic growth through exports thus appear much brighter once we understand the character of the changing pattern of comparative advantage. Further work on the experience of individual countries over time would be necessary, however, in order to study this process in more depth.

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APPENDIX TABLE 1

SECTORAL CHARACTERISTICS FOR 184 PRODUCT CATEGORIES
(IN DOLLARS)

SECTOR	PRODUCT CATEGORY	p_i^s	h_i^s	k_i^s	p_i^f	h_i^f	k_i^f	p_i^s/h_i^s	p_i^f/h_i^f
1.	COTTON FABRICS(GREY)	11770.	15906.	27676.	2871.	5819.	8690.	,740	,493
2.	SYNTHETIC FABRICS	11690.	22165.	33855.	3734.	6446.	10180.	,527	,579
3.	WOOLLEN FABRICS	9490.	20229.	29719.	3792.	6248.	10040.	,469	,607
4.	NARROW FABRICS	6820.	15092.	21912.	3778.	5742.	9520.	,452	,658
5.	HOSIERY + KNIT FABRICS	6930.	10406.	17336.	4501.	5269.	9770.	,666	,854
6.	KNIT OUTERWEAR	4410.	12826.	17236.	2609.	5511.	8120.	,344	,473
7.	KNIT UNDERWEAR	4330.	6864.	11194.	2083.	4917.	7000.	,631	,424
8.	COTTON FABRICS(FINISHED)	13170.	23804.	36974.	3349.	6611.	9960.	,553	,507
9.	WOVEN CARPETS + RUGS	11550.	23188.	34738.	4995.	6545.	11540.	,498	,763
10.	NONWOVEN CARPETS + RUGS	10400.	24937.	35337.	9569.	6721.	16290.	,417	1,424
11.	YARN + THREAD, EXCEPT WOOL	11710.	11396.	23106.	3652.	5368.	9020.	1,028	,680
12.	WOOLLEN YARN + THREAD	1620.	1595.	3215.	799.	1221.	2020.	1,016	,654
13.	FELT GOODS	13280.	38588.	51868.	6985.	8085.	15070.	,344	,864
14.	LACE + EMBROIDERY	4530.	28545.	33075.	4853.	6787.	11640.	,159	,715
15.	TEXTILE PADDINGS	9460.	24145.	33605.	6336.	6644.	12980.	,392	,954
16.	COMBED FIBERS + PROCESSED TEXTILE WASTE	9240.	14905.	24145.	4080.	5720.	9800.	,620	,713
17.	NONRUBBERIZED COATED FABRICS	12370.	44198.	56568.	7024.	8646.	15670.	,280	,812
18.	CORDAGE + TWINE	9100.	19327.	28427.	4880.	6160.	11040.	,471	,792
19.	TEXTILE GOODS NES	11640.	29568.	41208.	7247.	7183.	14430.	,394	1,009
20.	MENS AND BOYS OUTER APPAREL	1680.	9450.	11130.	3181.	4869.	8050.	,178	,653
21.	NONKNIT UNDERWEAR	1920.	7320.	9240.	3042.	4648.	7690.	,262	,655
22.	TIES,CORSETS + GLOVES	1990.	15577.	17567.	4324.	5476.	9800.	,128	,790
23.	WOMENS AND CHILDRENS CLOTHING	2070.	12453.	14523.	3383.	5167.	8550.	,166	,655
24.	HATS + CAPS	2050.	11217.	13267.	3405.	5045.	8450.	,183	,675
25.	FUR GOODS	5320.	46677.	51997.	11051.	8589.	19640.	,114	1,287
26.	LEATHER CLOTHING	1860.	7783.	9643.	2739.	5211.	7950.	,239	,526
27.	CURTAINS + DRAPERIES	3220.	12276.	15496.	3605.	5145.	8750.	,262	,701
28.	TEXTILE BAGS + SACKS	5810.	11581.	17391.	3592.	5078.	8670.	,502	,707
29.	CANVAS PRODUCTS	2410.	19684.	22094.	3306.	5684.	9190.	,122	,562
30.	PRESERVED WOOD	11820.	8618.	20438.	5618.	6072.	11690.	1,372	,925
31.	SAWMILL PRODUCTS	10940.	10586.	21526.	4058.	6272.	10330.	1,033	,647
32.	PREFABRICATED WOOD	5990.	22740.	28730.	4596.	7484.	12080.	,263	,614
33.	VENEER + PLYWOOD	11850.	21362.	33212.	4370.	7350.	11720.	,555	,594
34.	WOODEN BOXES + CRATES	5570.	3358.	8928.	4131.	5549.	9680.	1,659	,744
35.	COOPERAGE PRODUCTS	7880.	15868.	23748.	3935.	6805.	10740.	,497	,578
36.	WOOD PRODUCTS NES	9450.	8952.	18402.	4925.	6105.	11030.	1,056	,807
37.	FURNITURE + FIXTURES	4520.	21678.	26198.	4431.	6669.	11100.	,209	,664
38.	WOOD PULP	88000.	47474.	135474.	16028.	11132.	27160.	1,854	1,440
39.	PAPER, EXCEPT FOR CONSTRUCTION	49260.	39829.	89089.	8651.	10369.	19020.	1,237	,834
40.	PAPERBOARD	42830.	35581.	78411.	13657.	9943.	23600.	1,204	1,373

APPENDIX TABLE 1 (CONTINUED)

SECTOR	PRODUCT CATEGORY	p_i^s	h_i^s	k_i^s	p_i^f	h_i^f	k_i^f	p_i^s/h_i^s	p_i^f/h_i^f
41.	STATIONERY	8460.	20604.	29064.	6941.	7869.	14810.	.411	.882
42.	PAPER BAGS + CONTAINERS	11950.	16255.	28205.	5366.	8004.	13370.	.735	.670
43.	PAPER PRODUCTS NES	16340.	22431.	38771.	13600.	8620.	22220.	.728	1.578
44.	BUILDING PAPER+ PAPER PRODUCTS	30400.	27341.	57741.	8656.	9114.	17770.	1.112	.950
45.	NEWSPAPERS + PERIODICALS	8490.	34984.	43474.	7946.	8494.	16440.	.243	.935
46.	BOOKS	7820.	38557.	46377.	12964.	8856.	21820.	.203	1.464
47.	MISCELLANEOUS PUBLISHING	8780.	36563.	45343.	5313.	8647.	13960.	.240	.614
48.	ENGINEERING + PRINTING	8870.	33713.	42583.	7047.	9513.	16560.	.263	.741
49.	INORGANIC CHEMICALS	53480.	39282.	92762.	19675.	10556.	30230.	1.361	1.864
50.	ORGANIC CHEMICALS	75450.	48748.	124198.	25581.	11509.	37090.	1.548	2.223
51.	PLASTIC MATERIALS + PRODUCTS	17790.	14789.	32579.	8559.	7911.	16470.	1.203	1.082
52.	SYNTHETIC RUBBER	69420.	51211.	120631.	26251.	11759.	38010.	1.356	2.233
53.	CELLULOSIC MANMADE FIBERS	34300.	8002.	42302.	8746.	7434.	16180.	4.287	1.176
54.	SYNTHETIC FIBERS	40820.	28863.	69683.	13757.	9523.	23280.	1.414	1.445
55.	BIOLOGICAL + MEDICINAL PRODUCTS	17670.	42256.	59926.	28068.	10862.	38930.	.418	2.584
56.	SOAP + CLEANSERS	18830.	30622.	49452.	34207.	9693.	43900.	.615	3.529
57.	TOILET PREPARATIONS	8770.	17967.	26737.	39617.	8433.	48050.	.488	4.698
58.	PAINTS	11650.	26604.	38254.	12644.	9296.	21940.	.438	1.360
59.	DYEING + TANNING EXTRACTS	27530.	9239.	36769.	12141.	7559.	19700.	2.980	1.606
60.	FERTILSERS	39710.	10748.	50458.	11543.	7707.	19250.	3.694	1.498
61.	MISC. AGRICULTURAL CHEMICALS	30560.	24698.	55258.	29967.	9103.	39070.	1.237	3.292
62.	ADHESIVES + GELATIN	18500.	34856.	53356.	14986.	10124.	25110.	.531	1.480
63.	EXPLOSIVES	6760.	26423.	33183.	1887.	9273.	11160.	.256	.204
64.	PRINTING INK	10810.	29033.	39843.	8726.	9534.	18260.	.372	.915
65.	CARBON BLACK	62230.	38931.	101161.	30489.	10521.	41010.	1.598	2.898
66.	MISC. CHEMICAL PREPARATIONS	17820.	26071.	43891.	17251.	9239.	26490.	.684	1.867
67.	PETROLEUM REFINING + PRODUCTS	126110.	65629.	191739.	31310.	11910.	43220.	1.922	2.629
68.	ASBESTOS + ASPHALT PRODUCTS	19810.	43088.	62898.	11119.	9651.	20770.	.460	1.152
69.	TIRES + TUBES	23050.	45124.	68174.	11792.	10958.	22750.	.511	1.076
70.	FOOTWEAR	2200.	1557.	3757.	3360.	5611.	8970.	1.413	.599
71.	RECLAIMED RUBBER	21620.	22534.	44154.	4059.	8691.	12750.	.959	.467
72.	MISC. RUBBER PRODUCTS	10280.	20621.	30901.	5413.	8507.	13920.	.499	.636
73.	LEATHER	7470.	23815.	31285.	4840.	7480.	12320.	.314	.647
74.	INDUSTRIAL LEATHER BELTING	5130.	25564.	30694.	6324.	7656.	13980.	.201	.826
75.	LEATHER UPPERS	3250.	8041.	11291.	4144.	5896.	10040.	.404	.703
76.	LEATHER BAGS + PURSES	2370.	3113.	5483.	3509.	5401.	8910.	.761	.650
77.	MISC. LEATHER GOODS	2890.	7623.	10513.	2567.	5863.	8430.	.379	.438
78.	FLAT GLASS	35560.	49700.	85260.	12076.	11054.	23130.	.715	1.092
79.	GLASS CONTAINERS	9980.	7366.	17346.	5710.	6260.	11970.	1.355	.912
80.	CEMENT + CONCRETE	41110.	31110.	72220.	11447.	9193.	20640.	1.321	1.245
81.	BRICK + STRUCTURAL CLAY TILES	14700.	8708.	23408.	4252.	6948.	11200.	1.688	.612
82.	REFRACTORIES	22060.	30907.	52967.	8609.	9171.	17780.	.714	.939
83.	VITREOUS PLUMBING FIXTURES	11810.	24748.	36558.	7498.	8562.	16060.	.477	.876
84.	VITREOUS CHINA FOOD UTENSILS	5360.	1861.	7221.	3390.	6260.	9650.	2.880	.541
85.	EARTHENWARE FOOD UTENSILS	3520.	0.	3520.	764.	5606.	6370.	R	.136
86.	PORCELAIN PRODUCTS	9620.	11122.	20742.	3743.	7197.	10940.	.865	.520
87.	CONCRETE + BRICK PRODUCTS	11980.	20101.	32081.	6702.	8088.	14790.	.596	.829
88.	LIME	46700.	28313.	75013.	8969.	8911.	17880.	1.649	1.006

APPENDIX TABLE 1 (CONTINUED)

SECTOR	PRODUCT CATEGORY	p_i^s	h_i^s	k_i^s	p_i^f	h_i^f	k_i^f	p_i^s/h_i^s	p_i^f/h_i^f
89.	GYPSUM PRODUCTS	49070.	33163.	82233.	12184.	9396.	21580.	1.480	1.297
90.	CUT STONE PRODUCTS	7100.	7783.	14883.	3072.	6858.	9930.	.912	.448
91.	ABRASIVE PRODUCTS	15580.	29249.	44829.	8467.	9013.	17480.	.533	.939
92.	ASBESTOS PRODUCTS	13320.	23891.	37211.	6199.	8471.	14670.	.558	.732
93.	MINERAL WOOL	21330.	32757.	54087.	11098.	9362.	20460.	.651	1.185
94.	MISC. NONMETALLIC MINERAL PRODUCTS	12330.	22278.	34608.	4827.	8313.	13140.	.553	.581
95.	STEEL + STEEL PRODUCTS	37850.	31089.	68939.	6729.	10631.	17360.	1.217	.633
96.	IRON FOUNDRIES	11460.	23994.	35454.	4569.	9511.	14080.	.478	.480
97.	STEEL FOUNDRIES	11440.	14716.	26156.	4112.	9208.	13320.	.777	.447
98.	WROUGHT COPPER	23400.	30342.	53742.	8544.	10036.	18580.	.771	.851
99.	WROUGHT ALUMINIUM	32930.	30085.	63015.	5647.	10013.	15660.	1.095	.564
100.	NONFERROUS METALS NES	19760.	25371.	45131.	9154.	9546.	18700.	.779	.959
101.	ALUMINIUM CASTINGS + STAMPINGS	13160.	37694.	50854.	4745.	10025.	14770.	.349	.473
102.	BRASS,BRONZE + COPPER CASTINGS	10260.	21309.	31569.	4502.	9138.	13640.	.481	.493
103.	IRON + STEEL FORGINGS	13070.	34100.	47170.	4765.	11145.	15910.	.383	.428
104.	PRIMARY METAL PRODUCTS NES	15840.	18649.	34489.	6554.	9476.	16030.	.849	.692
105.	METAL CONTAINERS	18720.	39734.	58454.	10848.	9902.	20750.	.471	1.095
106.	CUTLERY	10100.	20473.	30573.	13694.	7976.	21670.	.493	1.717
107.	HAND + EDGE TOOLS	8650.	29390.	38040.	7959.	8871.	16830.	.294	.897
108.	HANDSAWS + SAWBLADES	7780.	18343.	26123.	6609.	7761.	14370.	.424	.852
109.	HARDWARE NES	10200.	28076.	38276.	6925.	8735.	15660.	.363	.793
110.	SANITARY + PLUMBING FIXTURES	10560.	25764.	36324.	6391.	8509.	14900.	.410	.751
111.	NONELECTRIC HEATING EQUIPMENT	7070.	24427.	31497.	7057.	8373.	15430.	.289	.843
112.	STRUCTURAL METAL PRODUCTS	6930.	27283.	34213.	5264.	8656.	13920.	.254	.608
113.	PLATEWORK + BOILERS	9010.	34228.	43238.	7293.	9347.	16640.	.263	.780
114.	BOLTS + NUTS	11800.	36358.	48158.	6527.	9563.	16090.	.325	.683
115.	SAFES + VAULTS	6110.	38511.	44621.	13432.	9778.	23210.	.159	1.374
116.	FABRICATED METAL PRODUCTS NES	10120.	26116.	36236.	6257.	8543.	14800.	.388	.732
117.	STEAM ENGINES + TURBINES	13460.	45537.	58997.	7183.	11257.	18440.	.296	.638
118.	INTERNAL COMBUSTION ENGINES	15990.	24173.	40163.	8019.	10411.	18430.	.661	.770
119.	FARM MACHINERY	10230.	20823.	31053.	6930.	8810.	15740.	.491	.787
120.	CONSTRUCTION + DRILLING MACHINERY	10600.	35814.	46414.	6483.	10287.	16770.	.296	.630
121.	CONVEYING + CARRYING EQUIPMENT	6610.	30535.	37145.	7443.	9757.	17200.	.216	.763
122.	INDUSTRIAL TRUCKS + TRACTORS	7110.	26440.	33550.	7309.	9351.	16660.	.269	.782
123.	MACHINE TOOLS	11620.	41454.	53074.	5639.	10851.	16490.	.280	.520
124.	METAL + WOODWORKING MACHINERY	9320.	23959.	33279.	6747.	9103.	15850.	.389	.741
125.	FOOD PRODUCTS MACHINERY	7570.	29204.	36774.	6928.	9622.	16550.	.259	.720
126.	TEXTILE + LAUNDRY MACHINERY	9440.	21364.	30804.	7610.	8550.	16160.	.442	.890
127.	PAPER MAKING MACHINERY	10960.	31110.	42070.	5966.	9814.	15780.	.352	.608
128.	SPECIAL INDUSTRY MACHINES NES	8540.	30941.	39481.	6868.	9802.	16670.	.276	.701
129.	AIR COMPRESSORS + PUMPS	8880.	27219.	36099.	7770.	9430.	17200.	.326	.824
130.	BALL + ROLLER BEARINGS	15800.	30400.	46200.	4714.	9746.	14460.	.520	.484
131.	INDUSTRIAL FURNACES + OVENS	2760.	8020.	10780.	2566.	4004.	6570.	.344	.641
132.	GENERAL INDUSTRIAL MACHINERY NES	7910.	24793.	32703.	6738.	9182.	15920.	.319	.734
133.	TYPEWRITERS	10250.	25301.	35551.	12402.	9238.	21640.	.405	1.342
134.	COMPUTERS	7400.	41578.	48978.	9217.	10863.	20080.	.178	.849
135.	CALCULATING + ACCOUNTING MACHINES	7560.	20586.	28146.	8275.	8765.	17040.	.367	.944
136.	SCALES + BALANCES	4870.	23451.	28321.	6893.	9047.	15940.	.208	.762

APPENDIX TABLE 1 (CONTINUED)

SECTOR	PRODUCT CATEGORY	p_i^s	h_i^s	k_i^s	p_i^f	h_i^f	k_i^f	p_i^s/h_i^s	p_i^f/h_i^f
137.	OFFICE MACHINERY NES	9210.	26824.	36034.	9625.	9385.	19010.	.343	1.026
138.	AUTOMATIC MERCHANDISING MACHINES	7190.	7716.	14906.	6431.	7479.	13910.	.932	.860
139.	REFRIGERATION MACHINERY	8320.	20541.	28861.	8307.	8753.	17060.	.405	.949
140.	NONELECTRICAL MACHINERY NES	7950.	22605.	30555.	5102.	8968.	14070.	.352	.569
141.	ELECTRIC MEASURING INSTRUMENTS	5670.	30040.	35710.	6232.	8838.	15070.	.189	.705
142.	TRANSFORMERS,MOTORS + GENERATORS	8500.	28378.	36878.	5660.	8670.	14330.	.300	.653
143.	CARBON + GRAPHITE PRODUCTS	24760.	29715.	54475.	10636.	8804.	19440.	.833	1.208
144.	HOUSEHOLD COOKING EQUIPMENT	6690.	22527.	29217.	6044.	8086.	14130.	.297	.748
145.	HOUSEHOLD REFRIGERATORS + FREEZERS	8870.	33611.	42481.	8603.	9197.	17800.	.264	.935
146.	ELECTRICAL HOUSEWARES + FANS	6240.	10702.	16942.	9004.	6906.	15910.	.583	1.304
147.	SEWING MACHINES	10810.	38991.	49801.	6884.	9736.	16620.	.277	.707
148.	ELECTRIC LAMPS	9830.	13094.	22924.	10608.	7142.	17750.	.751	1.485
149.	LIGHTING FIXTURES	6650.	19563.	26213.	7006.	7794.	14800.	.340	.899
150.	RADIO + TV EQUIPMENT	5450.	42988.	48438.	4951.	10129.	15080.	.127	.489
151.	PHONOGRAPHIC RECORDS	6250.	9939.	16189.	8232.	6828.	15060.	.629	1.206
152.	TELEPHONE + TELEGRAPH APPARATUS	9360.	37508.	46868.	6941.	9579.	16520.	.250	.725
153.	ELECTRONIC COMPONENTS + ACCESSORIES	7910.	22078.	29988.	3909.	8041.	11950.	.358	.486
154.	STORAGE BATTERIES	9940.	34723.	44663.	7780.	9310.	17090.	.286	.836
155.	PRIMARY BATTERIES	7750.	14431.	22181.	12803.	7277.	20080.	.537	1.759
156.	XRAY APPARATUS + TUBES	5860.	42854.	48714.	7132.	10118.	17250.	.137	.705
157.	AUTOMOTIVE ELECTRICAL EQUIPMENT	8440.	34409.	42849.	7764.	9276.	17040.	.245	.837
158.	MOTOR VEHICLES + BODIES	13210.	25855.	39065.	13616.	11064.	24680.	.511	1.231
159.	TRAILERS	3720.	6420.	10140.	4832.	7338.	12170.	.579	.659
160.	AIRCRAFT	6820.	41483.	48303.	5339.	12121.	17460.	.164	.440
161.	AIRCRAFT ENGINES + EQUIPMENT	8830.	35132.	43962.	4268.	11482.	15750.	.251	.372
162.	SHIPS + BOATS	5730.	32125.	37855.	1538.	9392.	10930.	.178	.164
163.	LOCOMOTIVES + PARTS	11780.	50318.	62098.	18106.	11204.	29310.	.234	1.616
164.	RAILROAD CARS	9660.	36258.	45918.	1771.	9799.	11570.	.266	.181
165.	MOTORCYCLES,BICYCLES + PARTS	5940.	15325.	21265.	4381.	7709.	12090.	.388	.568
166.	SCIENTIFIC INSTRUMENTS + CONTROL EQUIP.	6040.	35157.	41197.	5394.	9016.	14410.	.172	.598
167.	OPTICAL INSTRUMENTS	6600.	43467.	50067.	5965.	9845.	15810.	.152	.606
168.	MEDICAL APPLIANCES + EQUIPMENT	6470.	25155.	31625.	8762.	8008.	16770.	.257	1.094
169.	OPTHALMIC GOODS	6020.	15288.	21308.	6438.	7022.	13460.	.394	.917
170.	PHOTOGRAPHIC EQUIPMENT + SUPPLIES	17720.	57378.	75098.	21716.	11234.	32950.	.309	1.933
171.	WATCHES + CLOCKS	3840.	17270.	21110.	6386.	7224.	13610.	.222	.884
172.	JEWELRY + SILVERWARE	4680.	24708.	29388.	6119.	7911.	14030.	.189	.773
173.	LAPIDARY WORK	6370.	29030.	35400.	8507.	8343.	16850.	.219	1.020
174.	MUSICAL INSTRUMENTS + PARTS	5250.	17739.	22989.	4287.	7213.	11500.	.296	.594
175.	GAMES + TOYS	5069.	3585.	8654.	3922.	13408.	17330.	1.414	.293
176.	CHILDRENS VEHICLES	6860.	10903.	17763.	4554.	6526.	11080.	.629	.698
177.	MISC. SPORTING GOODS	5180.	8676.	13856.	5205.	6305.	11510.	.597	.826
178.	WRITING INSTRUMENTS + MATERIALS	6630.	15678.	22308.	6327.	7003.	13330.	.423	.904
179.	COSTUME JEWELRY	3260.	5329.	8589.	4988.	5972.	10960.	.612	.835
180.	BUTTONS	5120.	11302.	16422.	4470.	6570.	11040.	.453	.680
181.	NEEDLES,PINS + FASTENERS	6560.	11756.	18316.	6765.	6615.	13380.	.558	1.023
182.	BROOMS + BRUSHES	5800.	5540.	11340.	5336.	5994.	11330.	1.047	.890
183.	HARD FLOOR COVERINGS	28460.	38547.	67007.	15684.	9296.	24980.	.738	1.687
184.	MISCELLANEOUS MANUFACTURES NES	4920.	8842.	13762.	4484.	6316.	10800.	.556	.710

NOTE: ON THE CORRESPONDENCE OF THE PRODUCT CATEGORIES WITH THE US STANDARD INDUSTRIAL CLASSIFICATION AND THE UN STANDARD INTERNATIONAL TRADE CLASSIFICATION, SEE APPENDIX TABLE 2

FOR AN EXPLANATION OF THE DEFINITIONS AND SYMBOLS USED, SEE EQUATIONS (1) AND (3) IN THE TEXT

Appendix Table 2

Correspondence of the Sector Classification Scheme with the Standard Industrial Classification and the Standard International Trade Classification

Sector	SIC	SITC
001	2211	652.1
002	2221, 2262	653 less 653.2, 653.3, 653.4, 653.9
003	2231	653.2
004	2241	655.5, 655.9
005	2251, 2252, 2256, 2259	841.4 less 841.43, .44
006	2253	841.44
007	2254	841.43
008	2261	652.2
009	2271	657.5
010	2272, 2279	657.6, 657.8
011	2281, 2282, 2284	651 less: 651.2,.5, .8, .9
012	2283	651.2
013	2291	655.1
014	2292, 2395, 2396, 2397	654.0
015	2293	655.8
016	2294, 2297	262,6, .7, .8, .9; 263.4, 266.23
017	2295	611.2, 655.4
018	2298	655.6
019	2299	651.5, 651.9, 653.3, 653.4, 653.9
020	2311, 2321, 2327, 2328, 2329	841.11
021	2322, 2341	841. less: 841.11, 841.12
022	2323, 2342, 2381, 2389	841.2
023	2331, 2335, 2337, 2339 2361, 2363, 2369	841.12
024	2351, 2352	655.7, 841.5
025	2371	842
026	2386, 3151	841.3
027	2391, 2392	656.6, 656.9, 657.7
028	2393	656.1
029	2394	656.2
030	2411, 2491	242

Sector	SIC	SITC
031	2421, 2426, 2429	243, 631.8
032	2431, 2433	632.4
033	2432	631.1, 631.2; 631.4 less 631.42
034	2441, 2442, 2443	632.1
035	2445	632.2
036	2499	244, 631.42, 632.7, 632.8, 633
037	25	821, 895.1
038	2611	251
039	2621	641 less; 641.5, 641.6
040	2631, 2641	641.5
041	2642, 2645, 2649, 2761, 2782	642.2, 642.3
042	2643, 2651, 2652, 2653, 2654	642.1
043	2646, 2647, 2655	642.9
044	2661	641.6
045	2711, 2721	892.2
046	2731, 2732	892.1, 892.3
047	2741, 2751, 2752, 2771	892.4, 892.9
048	2753, 3555	718.2
049	2812, 2813, 2816, 2819	513 less 513.27, 514, 515, 533.1, 561.1
050	2815, 2818	321.8, 512, 521, 531, 532.3, 551.2
051	2821, 3079	581, 893
052	2822	231.2
053	2823	266.3
054	2824	266.21, 266.22
055	2831, 2833, 2834	541 less 541.9
056	2841, 2842, 2843	554
057	2844	553
058	2851	533.3
059	2861	241.2, 532 less: 532.3, 599.6
060	2871, 2872	561 less 561.1
061	2879	599.2
062	2891	599.5
063	2892	571.1, 571.2
064	2893	533.2
065	2895	513.27

Sector	SIC	SITC
066	2899	551.1, 571.3, 599.7
067	2911, 2992, 2999	331 less: 331.01; 332
068	2951, 2952	661.8
069	3011	629.1
070	3021, 3141, 3142	851
071	3031	231.3
072	3069	621, 629 less: 629.1, 841.6
073	3111	611 less 611.2
074	3121	612.1
075	3131	612.3
076	3161, 3171, 3172	831
077	3199	612.2, 612.9
078	3211	644.3, 664.4, 664.5
079	3221, 3229, 3231	651.8, 664 less: 664.3, 664.4, 664.5; 665
080	3241, 3273	661.2
081	3251, 3253, 3259	662.4
082	3255, 3297	662.3, 663.7
083	3261	812.2
084	3262	666.4
085	3263	666.5
086	3264, 3269	663.9, 666.6, 723.2
087	3271, 3272	663.6
088	3274	661.1
089	3275	273.2
090	3281	661.3
091	3291	663.1, 663.2, 697.9
092	3292, 3293	663.8, 719.94
093	3296	663.5
094	3299	663.4
095	3312, 3313, 3315, 3316 3317, 3566, 3481, 3493	693.2, 693.3, 694.1, 698.3, 698.6, 719.93, 67 less: 671.3, 678.1, 678.5, 679
096	3321, 3322, 3494, 3497	678.1, 678.5, 679.1, 719.92
097	3323	679.2
098	3351	682 less: 682.1
099	3352	684 less: 684.1
100	3356, 3357	681, 683.2, 685.2, 686.2, 687.2, 688, 689 less: 689.31, 693.1, 723.1

Sector	SIC	SITC
101	3361, 3461	697.2
102	3362, 3369, 3392	698.9
103	3391	679.3, 698.4
104	3399	671.3
105	3411, 3491, 3496	692.2
106	3421	696
107	3423	695.1, 695.22, 695.23
108	3425	695.21
109	3429	698.1
110	3431, 3432	812.3
111	3433	719.13, 812.1
112	3441, 3442, 3444, 3446, 3449	691, 693.4
113	3443	692.1, 692.3, 711,1, 711.2, 711.7
114	3452	694.2
115	3492	698.2
116	3499	719.66, 729.91
117	3511	711.3, 711.6, 711.8
118	3519, 3714	711.5
119	3522	712, 719.64
120	3531, 3532, 3533, 3544, 3545	695.24, 695.25, 695.26, 718.4, 718.51, 719.91, 719.54
121	3534, 3535, 3536	719.31
122	3537	719.32
123	3541, 3542	715.1
124	3548, 3553	715.22, 715.23; 729.6, 719.52, 719.53
125	3551	718.3, 719.62
126	3552, 3582, 3633	717.1 less: 717.14, 725.02
127	3554	718.1
128	3559	715.21, 717.1 less all but 717.14, 717.2, 718.5 less: 718.51, 719.19, 719.51, 719.61, 719.8
129	3561, 3564, 3586	719.21, 719.22
130	3562	719.7
131	3567, 3623	719.14, 729.92
132	3569	719.11, 719.23
133	3572	714.1
134	3573	714.3
135	3574	714.2

Sector	SIC	SITC
136	3576	719.63
137	3579	714.91
138	3581	719.65
139	3585	719.12, 719.15
140	3599	719.99
141	3611	729.5, 729.99
142	3612, 3621	722.1
143	3624	729.96
144	3631	697.1
145	3632, 3639	719.4, 725.01
146	3634, 3635	725 less: 725.01, 725.02
147	3636	717.3
148	3641	729.2, 729.42
149	3642	729.94, 812.4
150	3651, 3662	724 less: 724.91, 729.7, 729.93, 891.1
151	3652	891.2
152	3661	724.91
153	3671, 3672, 3673, 3674, 3679	722.2, 729.3, 729.95, 729.98
154	3691	729.12
155	3692	729.11
156	3693	726
157	3694	729.41
158	3711, 3712, 3713	732 less: 732.9
159	3715, 3791, 3799	733.3
160	3721	734 less: 734.92
161	3722, 3723, 3729	711.4, 734.92
162	3731, 3732	735
163	3741	731.1, 731.2, 731.3
164	3742	731 less: 731.1, 731.2, 731.3
165	3751	732.9, 733.1
166	3811, 3821, 3822	861.8, 861.9 less: 861.92, 861.94
167	3831	861.1, 861.3
168	3841, 3842, 3843	541.9, 733.4, 861.7, 899.6
169	3851	861.2
170	3861	861.4, 861.5, 861.6, 862
171	3871	864

Sector	SIC	SITC
172	3911, 3912, 3914	897.1
173	3913	667
174	3931	891 less: 891.1, 891.2
175	3941, 3942	894.2
176	3943	894.1
177	3949	894.4
178	3951, 3952, 3953, 3955	895 less 895.1
179	3961	897.2
180	3963	899.5
181	3964	698.5
182	3991	899.2
183	3996	657.4
184	3999	613, 861.92, 861.94, 894.5, 899 less: 899.2, 899.5, 899.6

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