Factor Inputs and U.S. Manufacturing Trade Structure: 1963–1980

By

Farhang Niroomand

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I. Introduction

This study investigates the determinants of the structure of U.S. foreign trade in manufactures. It does this by analyzing the structure of U.S. trade with respect to inter-industry variations in net exports and sectoral factor use, verifying thereby the factors underlying United States comparative advantage (See e.g., Baldwin [1971], Branson and Monoyios [1977], Harkness [1978; 1983], Stern and Maskus [1981], and Maskus [1983]; for Japan see Urata [1983]). Specifically, the study first follows some of the above-mentioned earlier work and updates the empirical results. Using a modified multifactor proportions model, it measures the simultaneous impact of human capital, physical capital, and labor on U.S. net exports in manufacturing. Additionally a measure of economies of scale in production within industries is introduced and tested in a multiple regression model.

Second, unlike the studies by Branson and Monoyios [1977] and Stern and Maskus [1981], which focused on the factor content of U.S. trade vis-à-vis the rest of the world, this study disaggregates total U.S. trade into bilateral trade with six economically distinctive countries or country groupings. Although the assumptions required for factor proportions theory to be logically true regarding a nation's total trade do not necessarily imply that the theory must apply on a bilateral basis, a regional analysis is beneficial in uncovering additional infor-

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mation on the factors influencing the commodity pattern of U.S. bilateral trade flows [Baldwin, 1971]. On the other hand, Hilton [1984] showed that factor proportions theory is much more suitable for explaining bilateral trade flows than multilateral trade. Irrespective of the point of view adopted, a study of U.S. bilateral trade flows should provide further insights into U.S. comparative advantage with other trading partners.

Third, the study also examines the possible structural changes in these bilateral trade flows over the period 1963–80. While other approaches have also been used to explain the structure of trade [Bowen et al., 1987],[1] the approach used in this study has the advantage of allowing comparison with the vast majority of empirical work previously done on the determinants of U.S. foreign trade.

Section II of the paper covers methodology and the estimating equation and describes the data and scaling procedure used in the investigation. Section III provides the empirical results obtained. Structural changes in the determinants of U.S. trade pattern are examined in Section IV, while Section V contains a brief summary.

II. A Multifactor Proportions Model: Specifications and Data

Since the emergence of the "Leontief Paradox" in 1953, there have been many empirical studies based on what is often called the neofactor proportions theory of internationl trade. In addition to capital and labor, these studies introduce other factors such as human capital and technology.

The basic model adopted here for analysis is a variant of the Heckscher-Ohlin model involving four direct factor inputs:

$$NX_{it} = (K_{it}, H_{it}, L_{it}, S_{it}), \tag{1}$$

where NX_{it} = net exports (the difference between exports and imports, $NX_{it} = X_{it} - M_{it}$) of the ith three-digit SITC commodity group at time t, K_{it} = stock of physical capital, H_{it} = stock of human capital, L_{it} = industry employment, S_{it} = scale economies measure.

[1] Of the other approaches, the first developed by Leontief [1953] compares the relative total (direct and indirect) factor intensities of exports and imports. Tatemoto and Ichimura [1959] and Heller [1976] used this method to analyze the Japanese trade structure. The second involves regression of net exports of a single commodity for many countries on measures of country factor endowments [Bowen, 1983; Chenery and Syrquin, 1975; and Leamer, 1974; 1984].

Although the signs of the variables cannot be determined a priori, the results obtained by Branson and Monoyios [1977], and Stern and Maskus [1981] suggest a negative sign for K_{it} illustrating the Leontief Paradox; a positive sign for H_{it}, reflecting the relative abundance of human capital in the United States; a negative sign for L_{it}, indicating the relative scarcity of unskilled labor; and a positive sign for S_{it} reflecting the influence of scale economies as a determinant of manufacturing net exports.

In addition to the standard assumptions, it is assumed that the model applies across all industries and that indirect inputs can be ignored.[2] According to the scale economy thesis, because of easier access to a home market, a large nation will specialize in goods produced with increasing returns to industry size. Specifically, industries capable of achieving high increases in value-added per worker as the size of the firm increases should give countries with a large domestic market, like the United States, a competitive export advantage over smaller countries in those industries. Therefore, U.S. industries with high values for scale should have large export shares and scale economies might be a source of comparative advantage.[3] Despite the obvious importance of scale economies in international trade, only a few empirical studies [Hufbauer, 1970; Baldwin, 1971; Branson and Junz, 1971; Weiser and Jay, 1972; and Katrak, 1973] have been done on the subject. All of these empirical research were conducted in the early 1970s and their findings were conflicting. This paper uses a multiple regression model to test a measure of economies of scale in production which was developed earlier by the author [see Niroomand and Sawyer, 1989].

Estimating Equation

The basic estimating equation is of the form[4]

$$NX_i = b_0 + b_1 K_i + b_2 H_i + b_3 L_i + b_4 S_i + U_i \,. \tag{2}$$

[2] In empirical tests of the factor proportions hypothesis sometimes direct and sometimes total factor intensities are used. Investigators have disagreed on this. Ignoring indirect inputs implies that total factor content of a product is not adequately measured. Although Deardorff [1982] suggests the use of total measure (indirect and direct inputs) for analysis, the lack of input-output tables at the required disaggregation level for the years examined in this study necessitated the use of data on direct inputs only.

[3] For the extent of scale economies in U.S. foreign trade see Niroomand and Sawyer [1989].

[4] The application of this form of equation is traditional in the literature. See, for example, Baldwin [1971], Branson and Monoyios [1977], and Stern and Maskus [1981].

Using the ordinary least squares (OLS) estimation technique, the correlation between net exports of U.S. industries and different economic characteristics is examined for several years (1963, 1967, 1977, and 1980). The model is applied to U.S. manufacturing trade in the aggregate as well as to bilateral trade with Japan, Canada, Western Europe (DCWE) and the less developed countries (LDCs). The latter are divided into two groups, the New Industrial Countries (NICs) and the Rest of the Less Developed Countries (RLDCs). The New Industrial Countries or NICs include: Hong Kong, Taiwan, South Korea, Yugoslavia, Singapore, Brazil, India, Mexico, Argentina, Malaysia, and Pakistan. In 1975 more than 77 percent of manufacturing exports from developing countries originated in these eleven semi-industrial LDCs [Keesing, 1979, p. 27]. RLDCs here are defined as all the non-OECD countries of the world excluding NICs and socialist countries. European countries also are divided into two groups. The first (DCWE1) includes: Switzerland, Sweden, Denmark, West Germany, Norway, and Belgium-Luxembourg, all of which have income per capita equal to or higher than that of the United States.[5] The second group (DCWE2) includes Italy, the United Kingdom, Finland, Austria, France and the Netherlands, whose per capita GNP is lower than that of the United States [World Bank, 1980].

The Data

The Standard International Trade Classification (SITC) is used as a common basis of classification necessary for relating the trade and production data sets. Full description is provided in the Appendix, and Table A-I lists the industries and shows the concordance between the SITC and the Standard Industrial Classification (SIC), which serves as a basis for the U.S. Census containing production characteristics for years after 1972; in 1972, SIC was revised.[6]

Following Branson and Monoyios, the measurement of physical capital is based on gross book value, and the stock of human capital is calculated as the discounted industry wage differential:

$$H_{it} = (\bar{W}_{it} - W_t^*) L_{it}/0.10, \quad (3)$$

[5] The income per capita comparison between the United States and the European countries is based on exchange rate calculation and not purchasing power.

[6] There was a substantial redefinition of SIC industries in 1972, details of which are available in the 1972 *Census of Manufactures*, Vol. 1. I attempted to maintain continuity in the industry definitions for the entire period, but some changes in coverage could not be satisfactorily resolved so that the results before and after 1972 may not be strictly comparable.

where H_{it} is the stock of human capital for group i at time t, $\bar{W}_{it}$ is the average annual wage for each industry at time t, W_t^* is the median wage for workers with eight years education at time t, L_{it} is industry employment, and the discount rate used is 10 percent. For estimating the scale economy factor, the procedure used here is the one used by Niroomand and Sawyer [1989] who adopted the following equation formalized by Hufbauer [1970]:

$$V = a N_i^s, \tag{4}$$

where V is the ratio between value-added per employee in a particular size plant and the average value-added per worker for all establishments in that industry. N_i is the number of employees in establishment i. S is the scale economy measure for production of that SITC commodity and a is a constant.[7] This measurement procedure is adopted because of its broad coverage of industries, wide range of plant sizes, and clear indication of relationship between size and productivity. Use of the scale elasticity parameters implies that increases in value-added per worker due to increased plant size are passed on in the form of lower prices. The 1963 and 1977 scale elasticity coefficients for the three-digit SITC commodity groups were reported in Niroomand and Sawyer [1989] and are used for estimating equation (2). These coefficients for 1967 are available from the author upon request.

The Effect of Industry Size on the Volume of Trade: Scaling to Size

It is assumed here that comparative cost is the only determinant of the commodity composition of trade and that, in turn, comparative cost is entirely determined by differences in factor intensities among commodities. Other things being equal, when comparative cost is the only determinant of commodity trade, the smaller an industry's comparative cost, the greater its exports and the smaller its imports. Other things are not equal, however, even under our very restrictive assumptions. Perhaps the most important variable which differs across industries and needs to be taken into consideration is industry size. There is also the possibility that the variance of the disturbance term (U_i) in estimating equation (2) may increase with industry size. The reason is that the volume of trade is also related to other variables, in particular on the demand side. Therefore, in estimating equation (2) demand

[7] For discussion of estimating equation (4) see Niroomand and Sawyer [1989, pp. 138–139].

conditions are incorporated into the error term, and heteroscedasticity may be present in the data sample [Harkness and Kyle, 1975].

Using the generalized least squares method, the heteroscedasticity problem is corrected following the Goldfeld and Quandt procedure outlined in Johnston [1972] by regressing the absolute value of the calculated ordinary least squares residuals on alternative size measures such as Z_{it} (the value of shipments), $Z_{it}^{\frac{1}{2}}$, and Z_{it}^2 with a constant term.[8] The equation that gives the largest multiple correlation coefficient (R^2) is then used as a weight for the generalized least squares regression.[9]

III. Cross-Section Results at the Three-Digit SITC Level for 1963 and 1980

The multiple regression relating net exports by SITC commodity groups to production characteristics was performed for the years 1963, 1967, 1977, and 1980. These years were chosen because of the availability of data. Table 1 shows the summary results of weighted regressions only for 1963 and 1980 since the main interest is to detect what changes, if any, might have occurred. The results for the other years are available from the author. The variable $Z_{it}^{-\frac{1}{2}}$ in the regressions corresponds to the constant term of the unscaled regression.[10]

Overall the results are consistent with prior studies in that human capital is an important determinant of U.S. comparative advantage. Regression analysis applied here suggests that the factor intensity of U.S. net exports is not uniform across the country groupings and over time. In some cases the multi-factor proportions theory appears to perform well in explaining U.S. trade patterns while in other cases it does not receive much support due to lack of any degree of significance of association between factor intensity and trade pattern.

U.S. – World Trade – It is evident that all variables have the expected signs based on previous studies. Regression results in most cases and especially for the earlier years (1963 and 1967) confirm both the Leontief Paradox and his explanation for it which emphasize the

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[8] Z_{it} is the volume of shipments for commodity group i at time t, which is used as a proxy for the industry size. *U.S. Census of Manufactures* is the source of data.

[9] See Branson and Monoyios [1977, p. 118 and Appendix B] for a more complete description of this method.

[10] Stern and Maskus [1981] and Urata [1983] correctly pointed out that the inclusion of a constant term in addition to $Z^{-\frac{1}{2}}$ as was done by Branson and Monoyios [1977] is inappropriate.

Table 1 – *Cross-Section Regressions Explaining U.S. Global and Bilateral Trade (Net U.S. export of manufactured goods 3-digit SITC)*

Dependent variable	Independent variable					R^2	N
	$Z^{-\frac{1}{2}}$	K	L	H	S		
1963 NX_w	−32.76 (2.15)[b]	−0.027 (1.70)[c]	−0.54 (1.90)[c]	0.02 (2.20)[b]	149.9 (2.21)[b]	.22[b]	90
1980 NX_w	−242.71 (2.43)[b]	−0.01 (0.16)	−1.60 (0.69)	0.04 (1.10)	−132.10 (1.85)[c]	.10[c]	89
1963 NX_{Japan}	−9.78 (3.93)[a]	0.001 (0.046)	−0.15 (2.80)[a]	0.005 (2.94)[a]	13.72 (2.24)[b]	.23[a]	90
1980 NX_{Japan}	−23.76 (0.75)	0.047 (2.19)[b]	1.24 (1.70)[c]	−0.05 (3.88)[a]	−60.60 (0.27)	.16[b]	89
1963 NX_{Canada}	−10.58 (1.62)	−0.006 (1.98)[b]	0.08 (0.52)	0.001 (0.32)	51.79 (1.80)[c]	.10[c]	90
1980 NX_{Canada}	−61.14 (1.99)[b]	−0.094 (4.56)[a]	0.84 (1.18)	0.027 (2.16)[b]	−306.60 (1.40)	.26[a]	89
1963 NX_{DCWE1}	−5.84 (2.54)[b]	0.001 (0.45)	0.015 (0.30)	−0.0003 (0.22)	15.40 (2.72)[a]	.05	90
1980 NX_{DCWE1}	45.42 (1.39)	−0.014 (0.64)	0.25 (0.33)	−0.013 (0.96)	298.62 (1.28)	.04	89
1963 NX_{DCWE2}	−5.19 (2.30)[b]	0.006 (2.60)[a]	−0.17 (3.37)[a]	0.005 (3.37)[a]	11.07 (1.99)[b]	.17[a]	90
1980 NX_{DCWE2}	27.95 (1.24)	−0.005 (0.31)	−0.40 (0.77)	0.01 (1.12)	59.17 (0.37)	.03	89
1963 NX_{NICs}	−9.89 (2.51)[b]	0.01 (2.61)[a]	−0.14 (1.99)[b]	0.005 (1.94)[b]	18.78 (1.93)[c]	.23[a]	90
1980 NX_{NICs}	−75.87 (2.18)[b]	0.035 (1.48)	−3.65 (4.55)[a]	0.042 (3.03)[a]	−801.34 (3.22)[a]	.33[a]	89
1963 NX_{RLDCs}	8.73 (0.89)	0.012 (1.28)	−0.14 (0.65)	0.006 (0.94)	10.71 (0.44)	.02	90
1980 NX_{RLDCs}	−153.14 (3.37)[a]	0.024 (0.77)	0.049 (0.47)	0.02 (1.98)[b]	−345.54 (1.06)	.13[b]	89

Note: The number of 3-digit SITC commodity groups is given by *N*. The t-values are in the parentheses. The three different significance levels are denoted by [a] (1 percent), [b] (5 percent), and [c] (10 percent level).

role of human capital as a source of U.S. comparative advantage. The scale economy is positively significant in determining the U.S. pattern of trade for 1963, but not for later years.

Trade with Japan – Regression analysis for U.S. bilateral trade with Japan shows that only in 1963 a significant positive relationship existed between net export, human capital, and the scale intensity factor. The United States was a net importer of labor-intensive commodities from Japan in 1963 and 1967. The results of the estimated equation for 1977 indicate that there was no significant relationship between the net export of U.S. manufactures to Japan and any of the economic characteristics under consideration.

It can be hypothesized that since the two countries have become more similar in per capita incomes over time and therefore, presumably also in factor endowments, a good deal of trade has taken place within rather than between industries. In a recent study using the same trade data Niroomand [1988] shows that U.S. trade both in aggregate and in bilateral flows (especially in the case of Japan) has become increasingly intra- rather than inter-industry in nature.

The results obtained for U.S.-Japanese trade in 1980 show a negative and significant coefficient for (H) and a positive and significant coefficient for (K). This indicates that while the United States was a net exporter to Japan of goods that were physical capital intensive, it was the net importer from Japan of commodities intensive in human capital.

Trade with Canada – The physical capital factor in an industry appears as a significant variable negatively correlated with that industry's export surplus. This indicates that the Leontief Paradox does exist with respect to trade between the United States and Canada. This was not unexpected. Considering the strong complementarity between capital and natural resources in the two countries and given Canada's abundant supply of natural resources, it is not surprising that Canada is the net exporter of capital-intensive commodities to the United States. Wahl [1961] and Postner [1975] studied Canadian trade patterns and found that Canada, the most important single trading partner of the United States, exports goods with higher capital/labor ratios than its import substitutes. According to Postner's findings, human capital appears to be scarce. He also found that Canadian exports are most strongly intensive in natural resources, which is not contrary to expectations. Their results agree with the findings of this study in regard to U.S. bilateral trade with Canada.

Other factors, such as the nature of Canadian protectionism and production relationships, also influence U.S.-Canadian trade. After the elimination of all tariffs on shipments of auto parts between the two countries by the 1965 agreement, the two economies basically have since maintained a common automobile industry. The role of multinational corporations and U.S. subsidiaries also cannot be ignored. Almost 60 percent of Canadian industry is foreign controlled, and more than 80 percent of that control is based in the United States. U.S. subsidiaries account for a substantial amount of Canadian manufacturing exports. By employing U.S. capital (through subsidiaries), Canada has become relatively capital abundant and thereby producing and exporting capital-intensive goods.

Trade with Europe – The results pertaining to U.S. trade with DCWE1, (countries with GNP per capita higher than or roughly equal to that in the United States) indicate that none of the regression coefficients are significant. The only exception here is the scale economy variable which has a significantly positive relationship with net exports of the United States to DCWE1, but only in 1963. For U.S. trade with DCWE2 (European countries having lower GNP per capita than the United States), the regression coefficients for the independent variables are statistically significant and have the theoretically correct sign for 1963. With net exports as the dependent variable, U.S. pattern of trade with DCWE1 cannot be readily explained by the orthodox factor proportions theory of international trade, even in its multiple-factor version. Since these countries share similar per capita income and factor endowments with the United States, perhaps factor proportions should not be expected to account for U.S.-DCWE1 trade. The same conclusion can be reached with respect to the 1980 U.S.-DCWE2 trade. Recent developments in trade theory show that the more similar is the per capita income between trading partners, the greater is the share of intra-industry trade in total trade [e.g., Helpman, 1984; and Bergstrand, 1990]. Using the same data set, Niroomand [1988] showed that trade between the United States and Europe is mainly intra-industry.

Trade with the NICs – In this case, it is obvious that the U.S. disadvantage is centered in unskilled labor. The U.S. derives an advantage from human capital but surprisingly not from physical capital, as might be expected given its relatively high capital endowments. The four-factor approach used here revealed the United States to be relatively more human capital abundant than physical capital abundant. This implies that the U.S. strength from human capital does in fact "swamp" the U.S. physical capital advantage.

Trade with RLDCs – It is evident from the regression results that all the variables, with the exception of labor for 1963, have the expected signs. However, only the regression coefficients for human capital in 1980 is statistically significant. Evidently, the U.S. comparative advantage is not derived from physical capital but from human

Table 2 – *Estimates of Regression Equations for the 1963–80 Period*

Dependent variable	Independent variable									R^2
	$Z^{-1/2}$	K	DK	L	DL	H	DH	S	DS	
NX_w	−32.7	−0.027	0.017	−0.54	−1.02	0.02	0.02	149.9	−282.3	.28[b]
	(2.32)[b]	(1.81)[c]	(1.43)	(1.99)[b]	(1.31)	(2.41)[b]	(1.48)	(2.53)[b]	(2.01)[b]	
NX_{Japan}	−9.8	0.001	0.035	−0.15	1.40	0.005	−0.056	13.72	−74.1	.31[a]
	(4.16)[a]	(0.21)	(1.03)	(2.91)[a]	(2.44)[b]	(3.06)[a]	(3.32)[a]	(2.33)[b]	(1.21)	
NX_{Canada}	−10.6	−0.006	−0.09	0.08	0.76	0.001	0.017	51.79	408.1	.14[c]
	(1.81)[c]	(2.11)[b]	(3.51)[a]	(0.71)	(0.94)	(0.38)	(1.16)	(1.92)[c]	(1.73)[c]	
NX_{DCWE1}	−5.9	0.001	−0.014	0.015	0.13	−0.0003	−0.013	15.41	282.9	.06
	(2.59)[a]	(0.62)	(0.55)	(0.34)	(0.31)	(0.23)	(0.78)	(2.81)[a]	(1.59)	
NX_{DCWE2}	−5.2	0.006	−0.011	−0.17	−0.22	0.005	0.005	11.07	48.1	.24[a]
	(2.41)[b]	(2.73)[a]	(1.47)	(3.44)[a]	(1.43)	(3.41)[a]	(1.59)	(2.09)[b]	(0.97)	
NX_{NICs}	−9.9	0.01	0.025	−0.14	−3.52	0.005	0.037	18.78	−820.12	.26[a]
	(2.55)[b]	(2.69)[a]	(1.32)	(2.20)[b]	(3.91)[a]	(2.17)[b]	(2.52)[b]	(1.98)[b]	(3.17)[a]	
NX_{RLDCs}	8.7	0.012	0.012	−0.14	0.19	0.006	0.014	10.71	−356.1	.04
	(1.03)	(1.32)	(0.54)	(0.76)	(1.21)	(1.13)	(1.05)	(0.52)	(0.83)	

Note: The t-values are in parentheses. The three different significance levels are denoted by [a] (1 percent), [b] (5 percent), and [c] (10 percent level).

capital. Furthermore, and contrary to expectations, there is no significant negative correlation between U.S. net exports and unskilled labor intensity.

IV. Structural Changes in the Determinants of U.S. Trade Patterns

In order to examine whether any structural changes have occurred in U.S. manufacturing trade with the world and the selected group of countries, the procedure outlined by Gujarati [1970b] was followed. A dummy variable specification of the scaled regressions with 1963 = 0 and 1980 = 1 were estimated. Table 2 shows the results. *DK, DL, DH,* and *DS* are dummy variables for *K, L, H,* and *S* respectively. The differences in the estimated coefficients between 1963 and 1980 presented in Table 1 suggest that the structure of U.S. trade changed during the 1963–80 period. For all industries, the null hypothesis that there was no change in the coefficients is accepted for *K, L,* and *H*, but is rejected for *S*. These results suggest that U.S. global net exports of manufactures neither made more nor less direct use of human capital, physical capital, or labor in 1980 compared to 1963. Compared to 1963 values, the coefficients on scale economy in 1980 are significantly lower for net exports to the world as a whole, to Canada, and to the NICs. For U.S.-Canadian bilateral trade, the coefficient on *K* is significantly more negative in 1980 compared to 1963, indicating even less direct use of physical capital in U.S. net exports of manufactures to Canada.

While no structural changes were detected in U.S. trade with either group of European countries, significant changes in the regression coefficients were confirmed between 1963 and 1980 for the net exports of manufactures to Japan. The coefficient on *H* is significantly more negative in 1980 than it is in 1963, while the coefficient on *L* is more positive, revealing a less direct use of (*H*) human capital (as measured by the discounted wage differentials) and a more direct use of labor (as measured by industry employment) over the period. The opposite picture emerges for U.S. trade with the NICs. U.S. net exports of manufactures to these countries made increasingly less direct use of (*L*) labor and more direct use of (*H*) human capital throughout the period.

The results pertaining to U.S. trade with other developing countries (RLDCs) showed that all of the regression coefficients are identical. This suggests that net U.S. exports in manufactured products to the RLDCs have made neither more nor less direct use of human capital or any other production factor in 1980 compared to 1963. This is perhaps because RLDCs exported manufactured products basically in the same commodity groups during this period, although those exports have grown over time.[11]

V. Summary and Conclusion

This study applies multiple regression analysis to determine factor intensity in U.S. net exports in bilateral trade with other countries or group of countries. The results suggest that there is no consistent pattern of comparative advantage in U.S. bilateral trade with any particular country or group of countries. In all of the four years studied, the United States implicitly exported human capital to the NICs and imported labor. The same was true of U.S. trade in earlier years with the DCWE2 group of Western European countries. A surprising result is that in its trade with all regions the U.S. does not derive an advantage from physical capital, as might be expected given the relatively high U.S. ranking in capital endowment. In fact, the estimated coefficient of physical capital was negative in most regressions. In particular, it was highly significant in the case of U.S. trade with Canada, supporting Baldwin's [1971] assertion that the source of paradox is the pattern of U.S. trade with Canada.

The regression results for 1963 clearly demonstrated the importance of scale economy influences on U.S. trade in manufactures. In later years this variable became less important, perhaps due to the relatively more rapid expansion of internal markets in the rest of the world. Although it was discovered that there were no changes in U.S. trade patterns with Western Europe, significant structural changes have taken place in U.S. trade in manufactured goods with Japan, Canada, and the NICs over the period of the study.

These changes in the factor intensity of U.S. bilateral net exports are consistent with the available information on trends in U.S. relative factor abundance [Bowen, 1983]. Particularly, there was an increase in the U.S. endowment of skilled labor relative to capital and unskilled

[11] Given the limited domestic production of manufactured goods in most of developing countries, in 1963 these countries, as a group, had export surpluses in 15 manufacturing commodity groups (3-digit SITC). In 1980, this group of countries had export surpluses in the same 15, as well as 6 additional commodity groups (total of 21 commodity groups).

labor during the period 1963–75. Although other developed countries have improved their relative skilled-labor position vis-à-vis the United States, the U.S. has maintained a substantial advantage in this endowment relative to the NICs, taken as a group. Thus, U.S. comparative advantage continues primarily to be in commodities which are intensive in human capital, while its comparative disadvantage lies in goods intensive in unskilled labor.

The analysis given above is basically informative in nature. However, it may be possible to make some tentative inferences concerning international trade policy. The abnormally large trade deficits of the 1980s, which have been partly due to manufacturing trade with Japan and the NICs [GATT, 1989] have obscured the fact that the underlying comparative advantage of the U.S. has not changed substantially. In the early 1960s, the U.S. had a comparative advantage in human capital and scale economy intensive goods and a comparative disadvantage in labor-intensive goods. The role of scale economies in U.S. comparative advantage has seemingly diminished but the role of human capital is relatively unchanged. As before, the U.S. still has a comparative disadvantage in the production of labor-intensive goods. The role of capital in U.S. comparative advantage seems to be somewhat clearer on a bilateral basis as opposed to a multilateral basis. It seems clear that capital intensity does not always reduce U.S. exports of capital-intensive goods. The results given above indicate that the recent narrowing of the U.S. trade deficit is probably a reassertion of the underlying U.S. comparative advantage in certain product categories. A realignment of exchange rates has led to an unsurprising increase in U.S. exports.

On the other side of the trade balance, the 1980s have seen a trend in protectionism via the use of Voluntary Export Restraints (VERs) which have been negotiated with LDCs outside of the GATT framework. The results presented above indicate that the comparative disadvantage of the U.S. in the production of labor-intensive products is long standing. This underlying comparative disadvantage has been exacerbated in the 1980s by the overvaluation of the dollar and the improvement of the competitive position of the LDCs and particularly the NICs. The fact that the U.S. has reacted to this structural change by pursuing trade policy options outside the GATT threatens the integrity of GATT. This problem becomes more obvious in an international trade environment which now includes a major multilateral trade negotiation (the Uruguay Round) which is on the brink of failure.

Appendix

This appendix describes the source of data and the method of developing a concordance [between SIC and SITC] which were employed in relating the production characteristics with trade data. Data for exports and imports for each of the four years (1963, 1967, 1977, and 1980) were obtained from OECD, *Trade by Commodities, Series C,* for 102 three-digit SITC commodity groups in categories 5–8. For 1980, the SITC Revision 2 is utilized by this source as opposed to Revision 1 which was used for 1963, 1967, and 1977. In order to maintain comparability in the definition of commodity groups (at three-digit level), among the four years under observation some three-digit SITC (Revision 2) for 1980 had to be aggregated.

The data on factor inputs (with the exception of scale economy measures) for 1963 and 1967 were provided by Branson and Monoyios (B-M) to whom I am grateful for making their Appendix A-data available. The basic source for data on employment, wages, capital expenditures, volume of shipments, and value-added per employee in different size establishments is the *U.S. Census of Manufactures* and the *Annual Survey of Manufactures.* These sources provide data by industry group (SIC categories) rather than by commodity (SITC categories), thus requiring the use of concordance tables. The conversion from four-digit SIC to three-digit SITC groups was done by following the concordance developed by Hufbauer [1970, Table A-1] for 1963 and 1967, and by the concordance developed by the author in Table A-1 of this Appendix for the years 1977 and 1980. There is no one-to-one correspondence between the two schemes. The same four-digit SIC industry frequently contributes to more than one three-digit SITC commodity, while some three-digit SITC groups find no counterpart in four-digit industry. Both concordance tables were used in estimating physical capital, human capital, labor and scale economies for three-digit SITC groups.

Hufbauer included the total figures for certain four-digit SIC industries in more than one three-digit SITC commodity group. For example: SIC 3399 (Primary Metal Products, N.E.C.) was included in SITC groups 682, 683, 684, 685, 686, 687. This resulted in serious over-statement of factor inputs primarily within the two-digit SITC group 68 (Nonferrous Metals).

To avoid this distortion following the suggestion by B-M, I allocated the figures of those SIC industries that were included in more than one SITC group according to the percentage of exports that each

Table A-1 – *Concordance Between the Three-Digit Standard International Trade Classification (SITC) (top number in bold face) and United States Four-Digit Standard Industrial Classification (SIC)*

512	**571**	**642**	2394	3312	**684**	3495
2869	2892	2641	2395	3313	3334	3496
		2642	2396	3321	3353	
513	**581**	2643	2397	3322	3354	**694**
2812	2821	2645	2399		3355	3452
2813		2646		**672**	3398	
2895	**599**	2647	**657**	3312	3399	**695**
	2861	2648	2271	3324	3497	3423
514	2891	2649	2272	3325		3425
2819	2899	2651	2279		**685**	3429
		2652	3996	**673**	3332	
515	**611**	2653		3312	3356	**696**
nil	3111	2654	**661**		3398	3421
		2655	3241	**674**	3399	
521	**612**	2661	3274	3312		**697**
2865	3131		3281	3316	**686**	nil
	3199	**651**			3333	
531		2281	**662**	**675**	3356	**698**
2869	**613**	2282	3251	3312	3398	3411
	3999	2283	3253	3316	3399	3463
532		2284	3255			3361
nil	**621**		3259	**676**	**687**	3362
	nil	**652**		3312	3339	3369
533		2211	**663**		3356	3499
2816	**629**	2261	3271	**677**	3398	3493
2851	3011		3272	3312	3399	3993
2893	3041	**653**	3291	3315		3964
	3069	2221	3292		**688**	2591
541		2231	3295	**678**	3339	
2831	**631**	2262	3296	3317		**711**
2833	2431	2269	3297		**689**	3511
2893	2434	2296	3299	**679**	3339	3519
	2435			3462		
551	2436	**654**	**664**		**691**	**712**
2087	2439	2241	3211	**681**	3441	3523
		2292		3339	3442	3524
553	**632**		**665**		3444	
2844	2441	**655**	3221	**682**	3446	**714**
	2449	2291	3229	3331	3448	3573
554	2492	2295		3341	3449	3576
2841	2499	2298	**666**	3351	2542	3579
2842	2541	3999	3262	3398		
2843			3263	3399	**692**	**715**
	633	**656**			3443	3541
561	nil	2299	**667**	**683**	3412	3542
2874		2391	nil	3339		3544
2875	**641**	2392		3398	**693**	3545
2879	2621	2393	**671**	3399	3357	3546
	2631					

(Table continued on next page)

(Table A-1 continued)

3547	**724**	**733**	2251	3823	3951
3549	3621	3751	2252	3824	3952
	3652	3792	2253	3829	3953
717	3661	3799	2254	3832	3955
3552	3662	2451	2257	3841	
	3671		2258	3842	**896**
718	3674	**734**	2259	3843	nil
3531	3675	3721	2311	3851	
3532	3676	3724	2321		**897**
3533	3677	3728	2322	**862**	3911
3534	3678	3764	2323	2793	3914
3535	3679	3769	2327	3861	3915
3536			2328		3961
3537	**725**	**735**	2329	**863**	
3551	3631	3731	2331	nil	**899**
3554	3632	3732	2335		3199
3555	3633		2337	**864**	3962
3559	3634	**812**	2339	3873	3963
2794	3635	3231	2341		3991
	3636	3261	2342	**891**	3999
719	3639	3264	2351	3931	
3553		3269	2352		
3561	**726**	3431	2361	**892**	
3562	3693	3432	2363	2711	
3563		3433	2369	2721	
3564	**729**	3494	2381	2731	
3566	3622	3498	2384	2732	
3567	3623		2385	2751	
3568	3624	**821**	2386	2752	
3569	3629	2511	2387	2753	
3581	3641	2512	2389	2754	
3582	3642	2514	3151	2761	
3585	3691	2515		2771	
3586	3692	2517	**842**	2782	
3589	3693	2519	2371	2789	
3592	3694	2521		2795	
3599	3699	2522	**851**		
		2531	3021	**893**	
722	**731**	2599	3142	3079	
3612	3743		3143		
3613		**831**	3144	**894**	
3621	**732**	3161	3149	3942	
	3713	3171		3944	
723	3715	3172	**861**	3949	
3643	3711		3811		
3644	3714	**841**	3822	**895**	

SITC group contributed to the total. In the example mentioned above, SITC group 682 accounted for 22.7 percent of the exports of groups 682–687 in 1977 so I allocated to it 22.7 percent of the capital, labor, wages and shipments of industry 3399. The choice of exports rather than output for computing the allocation factors as noted by B-M, was dictated by the fact that exports and imports were the only data available on a SITC basis. They noted that having an imperfect allocation seems more acceptable than multiple counting. However, there are a few cases in which a SITC group has exports so low that only a very small percentage of the corresponding SIC industry figures was allocated to it. In some instances this resulted in a SITC group with exports larger than the volume of shipments. These groups were excluded from the analysis.[12] Furthermore, the 1963 data provided by B-M who borrowed it from Hufbauer did not include any data on the inputs for eight SITC groups so these were also excluded from the analysis leaving only 90 three-digit SITC groups in 1963; 92 groups in 1967 and 1977; and 89 groups in 1980, for which both trade and factor input data were available.[13]

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[12] The groups excluded were 681, 688, 689 and 726 in 1963, and 688 and 726 in 1967 and 1977.

[13] Groups 515, 532, 621, 633, 667, 697, 863, 896.

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Zusammenfassung: Faktoreinsatz und Struktur des US-Handels mit Industrieprodukten 1963–1980. – Der Autor analysiert die Determinanten für die Struktur des US-Handels mit verschiedenen Handelspartnern und untersucht, welche strukturellen Änderungen dieser Beziehungen zwischen 1963 und 1980 stattgefunden haben. Er benutzt ein modifiziertes Faktorproportionen-Modell mit mehreren Produktionsfaktoren und schätzt die simultanen Wirkungen von Humankapital, Realkapital, Arbeit und Skalenerträgen auf die Nettoexporte der USA von Industriegütern. Die Ergebnisse der Regressionen bestätigen in den meisten Fällen – und besonders für die früheren Jahre – das Leontief-Paradoxon und Leontiefs Erklärung, die die Bedeutung des Humankapitals als Quelle komparativer Vorteile hervorhebt. Ermittelt werden strukturelle Veränderungen sowohl für den Globalhandel der USA als auch für den bilateralen Handel mit Japan, Kanada und den Schwellenländern, da diese Länder alle zwischen 1963 und 1980 bedeutende Handelspartner der Vereinigten Staaten geworden sind.

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Résumé: Emploi des facteurs de production et la structure du commerce industriel des Etats Unis: 1963–1980. – Dans cette étude l'auteur analyse les déterminants du commerce des Etats Unis avec de plusieurs partenaires commerciaux et examine quels changements structurels ont eu lieu dans ces relations entre 1963 et 1980. En utilisant un modèle des proportions multi-facteurs, ce modèle mesure l'effet simultané du capital humain et physique, du travail et des économies d'échelle sur les exportations nettes américaines des produits industriels. Dans la plupart des cas et particulièrement pour les années antérieures, ce modèle confirme le «Leontief Paradox» et son explication qui souligne le rôle du capital humain comme source de l'avantage comparatif.

L'auteur découvre des changements structurels dans le commerce global des Etats Unis et aussi dans le commerce bilatéral avec le Japon, le Canada et les nouveaux pays industrialisés parce que tous sont devenus des partenaires importants avec les Etats Unis entre les années 1963 et 1980.

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Resumen: Contenido de factores y la estructura del comercio manufacturero de los EE UU: 1963–1980. – En este trabajo se analiza el perfil del comercio de los EE UU con diferentes países y también se examina qué cambios estructurales tuvieron lugar en estas relaciones entre 1963 y 1980. Utilizando un modelo modificado de proporción de factores múltiples se mide el impacto simultáneo de capital humano, capital físico, trabajo y de economías de escala sobre las exportaciones manufactureras netas de los EE UU. Los resultados de regresiones confirman casi siempre y especialmente para años lejanos la paradoja de Leontief y la explicación para ella, que enfatiza el papel del capital humano como una fuente de ventajas comparativas. Se detectan cambios estructurales en el comercio global de los EE UU y en el comercio bilateral de los EE UU con el Japón, el Canadá y los NICs, al haber alcanzado todos ellos un importante tráfico comercial con los EE UU entre 1963 y 1980.