



---

Comparative Advantage in Manufactured Goods: A Reappraisal

Author(s): Bela Balassa

Source: *The Review of Economics and Statistics*, Vol. 68, No. 2 (May, 1986), pp. 315-319

Published by: [The MIT Press](#)

Stable URL: <http://www.jstor.org/stable/1925512>

Accessed: 07/10/2013 00:27

---

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at  
<http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



*The MIT Press* is collaborating with JSTOR to digitize, preserve and extend access to *The Review of Economics and Statistics*.

<http://www.jstor.org>

- Countries' Experience," unpublished Ph.D. dissertation, Michigan State University, 1980.
- Hooper, Peter, and Steven W. Kohlhaugen, "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade," *Journal of International Economics* 8 (Nov. 1978), 483–511.
- International Monetary Fund (IMF), *Annual Report* 1979, Washington, D.C., 1979.
- , *Exchange Rate Volatility and World Trade*, Occasional Paper no. 28, Washington, D.C., July 1984.
- Kenen, Peter B., "Exchange Rate Instability: Measurement and Implications," International Finance Section Research Memorandum, Princeton University, June 1979.
- Kenen, Peter B., and Dani Rodrik, "Measuring and Analyzing the Effects of Short-term Volatility in Real Exchange Rates," Working Paper in International Economics (G-84-01), International Finance Section, Department of Economics, Princeton University, Mar. 1984.
- Rana, Radumna B., *ASEAN Exchange Rates: Policies and Trade Effects* (Singapore: ASEAN Economic Research Unit, Institute of Southeast Asian Studies, 1981).
- Richardson, J. David, "Some Issues in the Structural Determination of International Price Responsiveness," in Herbert Glejser (ed.), *Quantitative Studies of International Economic Relations* (Amsterdam: North-Holland, 1976).

## COMPARATIVE ADVANTAGE IN MANUFACTURED GOODS: A REAPPRAISAL

Bela Balassa\*

**Abstract**—The paper provides a text for the Heckscher-Ohlin theory by simultaneously introducing trade flows, factor intensities, and factor endowments in the framework of a multi-country and multi-product model. The findings show that differences in physical and human capital endowments explain a substantial part of intercountry differences in the pattern of trade in manufactured goods. It is further shown that the pattern of specialization is also affected by the extent of trade orientation, the concentration of the export structure, and foreign direct investment.

### I.

In setting out to explain the pattern of international trade by reference to interindustry differences in factor intensities and intercountry differences in factor endowments, the Heckscher-Ohlin theory posits the existence of a well-defined relationship among trade flows, factor intensities, and factor endowments. In his *Sources of International Comparative Advantage: Theory and Evidence*, Edward E. Leamer correctly notes that "the way to measure the accuracy of the theory is to obtain direct and independent measures of all three concepts . . ." (1984, p. 49).

Received for publication April 16, 1985. Revision accepted for publication July 31, 1985.

\* The Johns Hopkins University and the World Bank.

This paper was prepared in the framework of the World Bank's research project "Changes in Comparative Advantage in Manufactured Goods" (RPO 672-41). The author is greatly indebted to Luc Bauwens for suggesting the application of alternative econometric techniques and for making useful comments on the previous drafts of the paper. He is also grateful to Carl Christ, Tatsuo Hatta, and Masahiro Kawai for valuable comments and to the referees for helpful suggestions. Further thanks are due to Linda Pacheco and Marcus Noland for data collection, to Jerzy Rozanski for generating the trade data, and to Shigeru Akiyama for carrying out the arduous task of estimation. However, the author alone is responsible for the opinions expressed in the paper that should not be interpreted to represent the views of the World Bank.

Rather than introducing all three elements in their empirical investigations, a long list of researchers, including Baldwin (1971 and 1979), Branson (1973), Stern (1976), Branson and Monoyios (1977), Stern and Maskus (1981), Maskus (1983), and Urata (1983), attempted to infer the relative factor endowments of a single country vis-à-vis the rest of the world from the factor intensity of its trade. However, following on the work of Leamer and Bowen (1981), Aw (1983) has proved that inferences about relative factor abundance from cross-section results obtained for the trade of a particular country cannot be made, unless very stringent conditions are met.

An alternative approach, utilized by Leamer (1974), Bowen (1983), and, again, Leamer (1984), attempted to test the Heckscher-Ohlin theory by relating trade flows to factor endowments. However, as Bowen, as well as Leamer, has admitted, there is no necessary relationship between the coefficients estimated in regard to factor endowments and the factor intensity of trade. Correspondingly, this method will not provide an appropriate test for the Heckscher-Ohlin theory either.

Following an earlier study by the author (Balassa, 1979), the present paper sets out to test the Heckscher-Ohlin theory by simultaneously introducing trade flows, factor intensities, and factor endowments in an empirical investigation of the pattern of comparative advantage in manufactured goods in a multi-country model. Following Deardorff's theoretical analysis of the Heckscher-Ohlin theorem, the paper utilizes data on net exports to test the hypothesis that countries relatively well-endowed with capital (labor) will export relatively capital-intensive (labor-intensive) commodities.<sup>1</sup>

The paper makes use of a three-factor model (physical capital, human capital, and labor), with labor as the

<sup>1</sup> For a generalized formulation of the relationship among the three variables, see Deardorff (1982).

numeraire. Thus, factor intensities are expressed in terms of physical and human capital per worker while factor endowments are defined by relating the endowment of physical and human capital to the size of the labor force.

Section II of the paper describes the data used in the investigation. Section III provides the derivation of the estimating equation and the empirical results obtained. The effects of additional variables on the pattern of trade in manufactured goods are examined in section IV while section V contains a brief conclusion.

## II.

The investigation covers altogether 167 commodity categories in the manufacturing sector as defined by the United States Standard Industrial Classification (SIC), after the exclusion of natural resource products whose manufacture is importantly affected by the availability of natural resources in a particular country.<sup>2</sup> The classification scheme has been established by merging 4-digit SIC categories in cases when the economic characteristics of particular products have been judged to be very similar, the principal criteria being high substitution elasticities in production and in consumption. The individual commodity categories have further been matched against the 3- and 4-digit categories of the United Nations Standard International Trade Classification (SITC), which provides the breakdown for the trade data.

The net exports of individual countries in particular commodity categories had to be normalized in order to avoid size effects. Normalization has been done by expressing the net exports of country  $j$  in industry  $i$  ( $X_{ij} - M_{ij}$ ) as a ratio of the sum of country  $j$ 's exports and imports in industry  $i$  ( $X_{ij} + M_{ij}$ ).<sup>3</sup> This ratio, taking values between  $-1$  and  $1$ , is denoted by  $NNX_{ij}$ .

Physical ( $p_i$ ) as well as human ( $h_i$ ) capital intensity is defined in terms of both stocks and flows. The stock measures of physical and human capital intensity, respectively, are the value of the physical capital stock per worker and the discounted value of the difference between the average wage and the unskilled wage, using a discount rate of 10%. The corresponding flow measures are the non-wage value added divided by the number of

workers and the difference between the average wage and the unskilled wage.<sup>4</sup>

The use of the U.S. industrial classification scheme has involved utilizing U.S. input coefficients. As is well known, this will be appropriate if factor substitution elasticities are zero or they are identical for every industry. The nonfulfillment of this assumption introduces error possibilities in the estimation without, however, necessarily biasing the results.

The estimates have been made by utilizing trade data as well as data on capital intensities for the year 1971. They pertain to 38 countries, in each of which manufactured exports accounted for at least 18% of total exports and surpassed \$300 million in 1979.<sup>5</sup>

Physical capital endowments ( $G_j$ ) have been estimated as the sum of gross fixed investment over the preceding seventeen year period, expressed in constant prices and converted into U.S. dollars at the 1963 exchange rate. Investment values have been assumed to depreciate at an annual rate of 4% a year, so as to reflect the obsolescence of capital; such an adjustment was not made in the earlier paper. Physical capital endowments have been expressed in per capita terms.

The Harbison-Myers index of education has been used as a proxy for human capital ( $H_j$ ). This index, derived as the secondary school enrollment rate plus five times the university enrollment rate in the respective age cohorts, is a flow measure. It has been used with a six-year lag, as an indicator of the country's general educational level.

## III.

The estimating equation has been derived in the two-stage framework utilized in the earlier paper by the author. In (1) a positive (negative) coefficient is taken to indicate that a country has a comparative advantage in capital (labor) intensive industries while the numerical magnitude of the  $\beta$ -coefficient has been interpreted to express the extent of the country's comparative advantage in capital (labor) intensive industries. In turn, in (2) the hypothesis is tested that intercountry differences in the  $\beta$  coefficient can be explained by differences in relative factor endowments.

Estimating equation (3), used in the present paper, involves combining (1) and (2). This permits directly testing the hypothesis that relatively capital (labor)

<sup>2</sup> The sensitivity of the empirical results to the inclusion of natural resource industries is noted by Stern and Maskus, who suggest that "the results reported by Branson and Monoyios (1977) may reflect the importance of physical capital in some natural resource industries that were included in their cross sections" (1981, p. 212).

<sup>3</sup> Lack of data for the individual countries did not permit scaling by the value of shipment as done by Branson and Monoyios (1977) in their investigation of the determinants of the U.S. trade pattern. On the importance of scaling, see Stern and Maskus (1981), p. 211.

<sup>4</sup> This contrasts with the earlier paper, where the average wage was used to represent the flow coefficient of human capital. For a description of the data, the reader is referred to Balassa (1979), which also considers the advantages and disadvantages of the stock and flow measures of capital.

<sup>5</sup> While the trade data refer to 1971, the year 1979 has been chosen as the benchmark in determining the choice of countries for the present investigation in order to include all countries with a potential to export manufactured goods.

abundant countries tend to export relatively capital (labor) intensive commodities. A modified form of (3) has also been estimated by aggregating the two forms of capital, with  $k_i$  being the sum of  $p_i$  and  $h_i$ . This permits testing the hypothesis as to the appropriateness of aggregation, which assumes that the two forms of capital are perfect complements or substitutes (Branson, 1973).

$$NNX_{ij} = \alpha_j + \beta_{pj} \ln p_i + \beta_{hj} \ln h_i + u_{ij} \quad (1)$$

$$\beta_{pj} = a_p + b_p G_j + v_{pj} \quad (2a)$$

$$\beta_{hj} = a_h + b_h H_j + v_{hj} \quad (2b)$$

$$NNX_{ij} = \alpha_j + a_p \ln p_i + a_h \ln h_i + b_p G_j \ln p_i + b_h H_j \ln h_i + \epsilon_{ij}, \quad (3)$$

$$\epsilon_{ij} = v_{pj} \ln p_i + v_{hj} \ln h_i + u_{ij}.$$

A comparison of (2) and (3) shows that one can interpret the coefficients of  $\ln p_i$  and  $\ln h_i$  in one-pass estimation as the constants of the second-stage equation and the coefficients of  $G_j \ln p_i$  and  $H_j \ln h_i$  as the coefficients of  $G_j$  and  $H_j$  in the second-stage equation. Under certain assumptions the two sets of estimated coefficients will have equal values (Amemiya, 1978), although their levels of statistical significance will differ owing to differences in the number of observations.

In the equations,  $u_{ij}$  is the error term in (1),  $v_{pj}$  and  $v_{hj}$  are the error terms in (2),<sup>6</sup> and  $\epsilon_{ij}$  the error term in (3). The latter term will be heteroscedastic even if  $u_{ij}$ ,  $v_{pj}$ , and  $v_{hj}$  are assumed to be homoscedastic. In estimating (3) by ordinary least squares (OLS), adjustment has been made for heteroscedasticity by the use of a procedure proposed by White (1980).

In estimation by OLS,  $\alpha_j$  is considered as a country-specific intercept term. Alternatively,  $\alpha_j$  may be treated as a country-specific error term. One may further introduce an industry-specific error term ( $w_i$ ) to parallel the country-specific error term. This has been done in the present paper by making alternative estimates by applying the error component model (ECM) to (3). In making estimates by ECM, it can be assumed that  $\alpha_j$  and  $w_i$  are homoscedastic; for ease of estimation, the same assumption has been made in regard to  $\epsilon_{ij}$ .

The OLS results are reported in table 1. The regression coefficients of the capital endowment variables have the expected sign and all the coefficients, as well as the constants of the regression equations, are statisti-

<sup>6</sup> Attempts made to introduce cross-terms,  $H_j$  in (2a) and  $G_j$  in (2b) have not been successful due to multicollinearity between the two endowment variables.

TABLE 1.—EXPLANATION OF INTERCOUNTRY DIFFERENCES IN THE PATTERN OF SPECIALIZATION  
IN MANUFACTURED GOODS: BASIC MODEL  
(OLS estimates, corrected for heteroscedasticity with  $t$ -values in parentheses)

Equations	$\ln k_i$	$\ln p_i$	$\ln h_i$	$G_j \ln k_i$	$H_j \ln k_i$	$G_j \ln p_i$	$H_j \ln h_i$	$\bar{R}^2$	$\delta^2$
Stock	-0.47 (-18.74) <sup>a</sup>			0.68 (9.89) <sup>a</sup>	0.10 (3.72) <sup>a</sup>			.4704	.2619
Flow	-0.46 (-16.32) <sup>a</sup>			0.60 (8.05) <sup>a</sup>	0.12 (4.11) <sup>a</sup>			.4626	.2657
Stock		-0.21 (-12.64) <sup>a</sup>	-0.26 (-11.74) <sup>a</sup>			0.45 (10.28) <sup>a</sup>	0.17 (10.21) <sup>a</sup>	.4675	.2633
Flow		-0.21 (-9.16) <sup>a</sup>	-0.29 (-12.56) <sup>a</sup>			0.43 (7.80) <sup>a</sup>	0.18 (11.01) <sup>a</sup>	.4618	.2661

Note: For explanation of symbols, see text.  $\delta^2$  is the variance of the residuals of the estimating equation.

<sup>a</sup> Significant at the 1% level.

TABLE 2.—EXPLANATION OF INTERCOUNTRY DIFFERENCES IN THE PATTERN OF SPECIALIZATION  
IN MANUFACTURED GOODS: EXTENDED MODEL  
(ECM estimates, with  $t$ -values in parentheses)

Equations	$\ln k_i$	$G_j \ln k_i$	$H_j \ln k_i$	$BTO$ $\ln k_i$	$XCON$ $\ln k_i$	$FDI$ $\ln k_i$	$\delta^2$
Stock	-0.42 (-10.10) <sup>a</sup>	0.43 (7.55) <sup>a</sup>	0.08 (4.13) <sup>a</sup>	-0.02 (-1.34)	-0.45 (-2.23) <sup>b</sup>	0.01 (2.71) <sup>a</sup>	.2280
Flow	-0.42 (-9.51) <sup>a</sup>	0.37 (6.29) <sup>a</sup>	0.09 (4.56) <sup>a</sup>	-0.01 (2.71) <sup>a</sup>	-0.48 (-2.33) <sup>b</sup>	0.01 (2.71) <sup>a</sup>	.2303

Note: See table 1.

<sup>a</sup> Significant at the 1% level.

<sup>b</sup> Significant at the 5% level.

cally significant at the 1% level. Very similar results have been obtained with the error component model; in order to economize with space, they are not reproduced here. Rather, the ECM method is utilized in reporting the estimates obtained by the use of the enlarged model in table 2 below.

The aggregation of capital does not affect the statistical significance of the estimated coefficients; nor does aggregation affect the explanatory power of the regression equations, with the coefficients of determination being in the 0.46–0.47 range in both cases. This result contrasts with that obtained by several authors (Branson, 1973; Stern, 1976; Branson and Monoyios, 1977; and Stern and Maskus, 1981). However, in the latter studies differences in the signs of physical and human capital were shown for two industrial countries at the upper end of the distribution, the United States and Germany. Also, as noted above, the interpretation of the estimates of these authors is open to question because capital endowments were inferred from estimates pertaining to capital intensities.

#### IV.

The estimates reported in the preceding section aimed at explaining the pattern of international specialization in manufactured goods by reference to interindustry differences in capital intensities and intercountry differences in factor endowments. In the following, additional influences will be introduced that may explain why some countries export (import) more—and others less—capital-intensive products than may be expected on the basis of their physical and human capital endowments. These additional country-specific variables are introduced in (2) and are utilized in estimating an extended form of (3).

A possible explanatory factor is the trade policies applied by the individual countries. Following estimation done elsewhere by the author (1985), trade orientation has been measured in an indirect way, defining it as the difference between actual and hypothetical values of per capita exports. Hypothetical values have been derived from a cross-section regression equation that, in addition to the per capita income and population variables utilized in early work by Chenery (1960), includes variables representing the availability of mineral resources and propinquity to foreign markets.

Downward deviations from the regression line, with actual exports falling short of hypothetical exports, are considered as a manifestation of protectionist policies that tend to reduce imports as well as exports. Conversely, upward deviations, with actual exports exceeding hypothetical exports, are taken to reflect the application of liberal trade policies.

Deviations from the trade orientation regression, whether in an upward or a downward direction, are by

far the largest for the developing countries, where trade policies vary to a much greater extent than in the developed countries. Deviations from the regression line estimated by (3) are also considerably larger for the developing countries than for the developed countries.<sup>7</sup> In devising a statistical test, then, we will focus on the results obtained for the former group of countries.

In the case of the developing countries, upward (downward) deviations in the net export equations are expected to be associated with the application of protectionist (liberal) trade policies. This is because protectionist policies do not permit specialization according to comparative advantage, thereby raising the capital-intensity of exports, while the capital-intensity of exports is lowered as a result of the application of liberal trade policies. In fact, the largest upward deviations in the net export equations are shown for developing countries with relatively high protection, such as Argentina, Brazil, and Mexico, and the largest downward deviations in developing countries with relatively low protection, such as Hong Kong and Korea.

It is hypothesized, then, that upward (downward) deviations in the trade orientation equation will be associated with downward (upward) deviations in the net export equations. Correspondingly, in an extended form of (3), which includes the trade orientation variable, the sign of this variable is expected to be negative.

Deviations between the actual and the predicted capital intensity of trade may also depend on the commodity concentration of exports in the countries concerned. It is hypothesized that export concentration (diversification) will favor (retard) the exploitation of a country's comparative advantage. With protection in developing countries hindering specialization in products in which a country has a comparative advantage, it may be expected that export concentration would give rise to negative (positive) deviations in the net export equations.<sup>8</sup>

Another variable used to explain differences between actual and predicted values is foreign direct investment. It has been suggested that foreign direct investment in developing countries is biased towards capital-intensive activities. Correspondingly, it is hypothesized that foreign direct investment will give rise to positive deviations in the net export equations.<sup>9</sup> The foreign invest-

<sup>7</sup> In the trade orientation equation, the standard deviation of the unweighted residuals is three times, in the export equation two-and-a-half times, greater for the developing than for the developed countries.

<sup>8</sup> Export concentration has been measured for the 167 industries covered in the sample by utilizing the so-called Herfindahl index.

<sup>9</sup> While direct foreign investment is used here as an explanatory variable, Baldwin has attempted to explain the pattern of U.S. direct foreign investment using the same explanatory variables as those employed in explaining the U.S. pattern of trade (1979).



ment variable has been measured by cumulating balance-of-payments data deflated by the price index of world export unit values for a ten-year period preceding the year of estimation.

Table 2 reports the results obtained with the enlarged equations, incorporating the trade orientation (*BTO*), export concentration (*XCON*), and foreign direct investment (*FDI*) variables. The equations have been estimated by the use of ECM for the case when capital intensity is introduced in an aggregated form.

All three newly-introduced variables have the expected sign while their level of statistical significance varies. The trade orientation variable is significant at the 1% level in the flow but not in the stock equations, and the export concentration and the foreign direct investment variables are significant at the 5% and the 1% levels, respectively, in both equations. At the same time, the introduction of these variables in the estimating equation does not affect the statistical significance of the factor endowment variables or of the constants of the regression equations.

## V.

This paper has shown that differences in physical and human capital endowments explain a substantial part of the observed differences in the pattern of trade in an intercountry framework. This conclusion holds irrespective of whether capital intensity is introduced in an aggregated form or it is disaggregated into physical and human capital and whether a stock or a flow measure of capital is used.

In extending the basic equation, it has been shown that the pattern of specialization in manufactured goods is further influenced by the extent of trade orientation, the concentration of the export structure, and foreign direct investment. At the same time, their introduction in the estimation does not affect the statistical significance of the factor endowment variables.

This paper has provided a test for the Heckscher-Ohlin theory for manufactured goods by simultaneously introducing trade flows, factor intensities, and factor endowments in the framework of a multi-country and multi-product model. The findings confirm the hypothesis in indicating that relatively capital (labor) abundant countries export relatively capital (labor) intensive commodities. It has also been shown that the pattern of trade is further affected by the policies applied.

Transposing the results obtained in a cross-section into a time-series framework, it would appear that as countries accumulate physical and human capital their manufactured trade pattern correspondingly changes. At the same time, in interfering with international specialization according to comparative advantage, protec-

tion imposes an economic cost on the countries concerned. A cost also appears to be associated with foreign direct investment, which is biased towards capital-intensive activities, thereby reducing the benefits it otherwise provides.

## REFERENCES

- Amemiya, Takeshi, "A Note on a Random Coefficients Model," *International Economic Review* 19 (Oct. 1978), 793-796.
- Aw, Bee-Yan, "The Interpretation of Cross-Section Regression Tests of the Heckscher-Ohlin Theorem with Many Goods and Factors," *Journal of International Economics* 14 (Feb. 1983), 163-167.
- Balassa, Bela, "The Changing Pattern of Comparative Advantage in Manufactured Goods," this REVIEW 61 (May 1979), 159-166.
- , "Exports, Policy Choices, and Economic Growth in Developing Countries After the 1973 Oil Shock," *Journal of Development Economics* 18 (May-June 1985), 23-36.
- Baldwin, Robert E., "Determinants of the Commodity Structure of U.S. Trade," *American Economic Review* 61 (Mar. 1971), 126-146.
- , "Determinants of Trade and Foreign Investment: Further Evidence," this REVIEW 61 (Feb. 1979), 40-48.
- Bowen, Harry P., "Changes in the International Distribution of Resources and their Impact on U.S. Comparative Advantage," this REVIEW 65 (Aug. 1983), 402-414.
- Branson, William H., "Factor Inputs, U.S. Trade and the Heckscher-Ohlin Model," Seminar Paper No. 27, Institute for International Economic Studies, University of Stockholm, 1973.
- Branson, William H., and Nikolaos Monoyios, "Factor Inputs in U.S. Trade," *Journal of International Economics* 7 (May 1977), 111-131.
- Chenery, Hollis B., "Patterns of Industrial Growth," *American Economic Review* 50 (Sept. 1960), 624-654.
- Deardorff, A. V., "The General Validity of the Heckscher-Ohlin Theorem," *American Economic Review* 72 (Sept. 1982), 683-694.
- Leamer, Edward E., "The Commodity Composition of International Trade in Manufactures: An Empirical Analysis," *Oxford Economic Papers* 26 (Nov. 1974), 350-374.
- , *Sources of International Comparative Advantage: Theory and Evidence* (Cambridge, Mass., MIT Press, 1984).
- Leamer, Edward E., and Harry P. Bowen, "Cross-Section Tests of the Heckscher-Ohlin Theorem: Comment," *American Economic Review* 71 (Dec. 1981), 1040-1043.
- Maskus, Keith E., "Evidence on Shifts in the Determinants of the Structure of U.S. Manufacturing Foreign Trade, 1958-76," this REVIEW 65 (Aug. 1983), 415-423.
- Stern, Robert M., "Some Evidence on the Factor Content of West Germany's Foreign Trade," *Journal of Political Economy* 84 (Feb. 1976), 131-141.
- Stern, Robert M., and Keith E. Maskus, "Determinants of the Structure of U.S. Foreign Trade, 1958-76," *Journal of International Economics* 11 (May 1981), 207-224.
- Urata, Shujiro, "Factor Inputs and Japanese Manufacturing Trade Structure," this REVIEW 65 (Nov. 1983), 678-684.
- White, Halbert, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica* 48 (May 1980), 817-838.