IMPORT BARRIERS: AN ANALYSIS OF TIME-SERIES CROSS-SECTION DATA

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CONTENTS

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INTRODUCTION

The persistence of large current-account imbalances has focused attention on the role of restrictive trade practices. A number of recent studies have sought indirect evidence of the existence of trade barriers through the estimation of time-series cross-section equations explaining import penetration. Statistically significant disparities from average values for individual countries are taken as indicating unusual barriers to trade. This indirect approach is generally adopted because of the difficulties involved in calculating the extent and importance of non-tariff trade barriers.

Most of these studies have focused almost exclusively on Japan. Japan has a ratio of total imports of goods and services to GDP which is low compared to other OECD countries, with the single exception of the United States (Table 1). For manufactured goods only, Japanese imports relative to GDP are the lowest. This does not necessarily imply that trade practices are the main determinants of low import ratios: considerable variation exists across countries, part of which could be explained by economic factors. Furthermore, most countries engage in some sort of import restraint and the available, albeit inconclusive, direct evidence on Japanese tariff and non-tariff barriers does not suggest that they are substantially different from those of other trading partners. Indeed, average tariff levels in Japan after the Tokyo round of reductions are lower than the EEC or U.S. averages (OECD, 1985), while calculations based on the proportion of imports affected by non-tariff import barriers do not reveal significantly stronger recorded barriers on the part of Japan (Nogues, Olechowski and Winters, 1986).

The purpose of this note is to re-examine the underimporting issue for all OECD countries through the use of pooled time-series cross-section data. After a brief review of the recent literature, natural barriers to trade – distance and cost of transportation – are discussed. Subsequently, "normal" and deviations from "normal" import shares are estimated for all OECD countries. Finally, the issue of underimporting in sub-categories of total imports is addressed.

Table 1. **Import/GDP** ratios

Per cent

	Total				Manufactures			
	1970-84	1970.75	1976-80	1981-84	1970.84	1970-75	1976-80	1981-84
United States	10.9	10.1	11.3	11.6	4.7	3.8	4.6	6.0
Japan	15.1	15.5	15.7	13.8	2.3	2.0	2.4	2.7
Germany	24.4	22.2	25.5	26.4	10.8	8.6	11.8	13.0
France	20.3	18.0	21.8	21.7	9.2	7.5	9.7	11.1
United Kingdom	24.7	23.7	24.5	26.5	11.4	8.5	12.3	14.8
Italy	21.6	20.0	22.2	23.4	7.9	6.8	8.3	9.2
Canada	24.2	22.2	24.7	26.6	16.1	15.8	16.8	15.8
Australia	17.7	16.8	17.6	19.1	10.3	9.6	10.0	11.8
Austria	34.4	30.1	36.4	38.4	18.6	14.8	20.4	22.0
Belgium	59.7	55.5	62.5	62.4	34.6	31.1	37.5	36.4
Denmark	34.8	34.8	35.6	33.7	17.8	17.0	18.4	18.1
Finland	31.7	31.8	32.0	31.2	16.7	18.0	15.4	16.5
Greece	27.4	26.1	27.6	29.2	17.1	16.8	16.6	18.1
Iceland	38.4	40.3	37.6	36.7	21.7	23.1	21.1	20.2
Ireland	58.2	53.4	60.8	62.2	36.0	31.2	38.7	40.0
Netherlands	50.7	48.9	51.7	52.1	23.6	22.5	24.0	24.8
New Zealand	32.2	32.0	31.0	34.1	16.9	17.3	15.6	17.9
Norway	46.0	48.2	46.6	41.9	21.8	21.9	21.5	21.9
Portugal	43.2	46.5	40.1	42.0	18.4	17.8	17.6	20.2
Spain	16.6	15.5	17.2	17.4	5.8	5.6	5.8	6.1
Sweden	30.7	30.4	31.7	30.1	21.3	13.3	15.2	40.7
Switzerland	34.7	29.6	36.7	40.0	21.0	17.6	22.1	24.7
Turkey	19.9	19.4	20.9	19.4	7.8	7.3	8.3	7.8
Average	31.2	30.0	31.8	32.2	16.2	14.7	16.3	18.3
Standard deviation	13.1	12.9	13.4	13.4	8.4	7.8	8.9	10.0

Notes: Total = Total real imports of goods and services as a percentage of real GDP, 1980 prices.
Manufactures = Manufactured goods imports (SITC 5-9 minus 68) as a percentage of real GDP, 1980 prices.
Source: OECD, *National Accounts* and *Foreign Trade Statistics.*

I. IMPORT SHARES, DISTANCE AND TRANSPORTATION COSTS

A. Previous studies of import shares

The work of Chenery (1960) and others on the "stages of growth" model provided interesting results on the relationship between different economic aggregates or ratios, and indicators of economic development. While not explicitly

based on a format theoretical model, it did point to the existence of empirical regularities that can be interpreted as "normal" patterns of development over time. Briefly stated, the underlying "non-theoretical" model hypothesises that the degree of openness of a country, as proxied by the share of imports of goods and services in **GDP,** is related to indicators of structural characteristics such as population and gross national product, indicators of economic development such as ***per capita*** income, and impediments to trade.

Following the methodology pioneered by Chenery, Balassa concludes that "Japan shows the largest deviation of actual from predicted values [of the imports to **GDP** ratio] ... the results show Japan to be an "outlier" among industrial countries, irrespective of whether one considers imports from all sources, from the industrial countries, or from developing countries" (Balassa, **1986,** p. **750).** Balassa's inference is that, if Japan were to remove. informal trade barriers, this would contribute to a substantial reduction of bilateral and overall external imbalances.

This result has been challenged by others. Bergsten and Cline (1985), using a slightly different sample and specification of the equation estimated by Balassa, found no significantly negative effects for Japanese imports. Noland (1987) estimated a simple model consistent with current theories of intra-industry trade and found that the "studentised" residuals for Japan – which can be interpreted as country dummies estimated one at a time (Belsley, Kuh and Welsch, **1980)** – were not statistically significant. Lawrence (1987) addressed more specifically the issue of underimporting in manufactured goods and found evidence of underimporting in this category of goods on the part of Japan, although the impact of a removal of restrictions was estimated to reduce the surplus in manufactured goods by only 10 per cent. A somewhat different route was taken by Saxonhouse (1983) and Saxonhouse and Stern (1987), who estimated a disaggregated model of the determinants of net exports consistent with the Heckscher-Ohlin-Vanek theory. They found that Japan is a negative outlier in only an extremely limited number of cases, a result in line with earlier work by Leamer (1984). The three latter authors, however, considered net rather than gross trade flows and, as noted by Noland (1987), did not directly address the issue of barriers to imports.

B. Distance and transportation costs

Transportation costs create natural obstacles to trade, thereby reducing the range of traded goods. Physical distance between countries has been used by some authors as a measure of such natural obstacles to trade (Saxonhouse, 1983; Lawrence, **1987).** An alternative measure of transportation costs is the cif-fob (cost, insurance, freight – free on board) adjustment used to convert import values from customs to balance-of-payments basis, as reported by the international Monetary Fund.

Neither measure is immune from criticism. Cif-fob margins are, to a certain extent, endogenous in the sense that they reflect trade patterns which are themselves influenced by transportation cost. Physical distance, on the other hand, might be inappropriate because of economies of scale in transportation costs. The latter point was stressed by Balassa (1986), who attributed the difference between his results with respect to Japan and those of others to the use of cost rather than distance. The procedure chosen by Balassa to correct for the endogeneity of transportation costs (also adopted by Noland) is based on some rather arbitrary assumptions, in particular the way in which the contributions of manufactured and non-manufactured goods to total transportation costs are estimated'.

In order to estimate the potential cost of transportation facing a country, observed cif-fob margins from 23 OECD countries over the 1970 to 1984 period were regressed against average distances of import flows of manufactured and non-manufactured goods (for a total of 345 observations). The average distances were computed on the basis of a distance matrix among the economic centres of $3 trading partners (23 OECD countries and 60 non-OECD countries) weighted by the actual trade flows and a time trend[2]. A translog specification for the cost of transportation as a function of distance and composition of trade gave the following results (standard errors in parenthesis):

$$\begin{aligned} \ln(CIF/FOB) = {} & -30.02) - 0.0348T + 5.66 \ln DM^{\alpha} + 7.20 \ln DNM^{1-\alpha} \\ & (7.32) \quad (0.052) \quad (1.83) \quad (1.92) \\ & -0.28(\ln DM^{\alpha})^2 - 0.45(\ln DNM^{1-\alpha})^2 \\ & (0.11) \quad (0.12) \\ & -0.38(2 \ln DM^{\alpha} \ln DNM^{1-\alpha}) \\ & (0.12) \end{aligned} \qquad [1]$$

$$\begin{aligned} F &= 50.29 \\ SEE &= 0.410 \\ Adj R^2 &= 0.462 \end{aligned}$$

where *CIF/FOB* is the observed cif-fob margin, *DM* is the average trading distance for manufactured goods, *DNM* is the average trading distance for non-manufactured goods, α is the share of manufactured goods in total imports, and T is a time trend.

An indicator of economies of scale in transportation for manufactured and non-manufactured goods is the ratio of average to marginal cost (Helpman and Krugman, 1985)[3]. A value of this ratio greater than one signals the presence of economies of scale. On the basis of average values for the sample, this ratio for manufactured goods is 1.74 and for non-manufactured goods is 1.39. Thus the estimated coefficients confirm the existence of important scale economies, particularly for manufactured goods.

The above results permit the construction of a measure of "objective transportation cost" – transportation costs not influenced by the country-specific composition of trade – faced by countries. This is done by replacing the values of each country's average effective distances in the estimated equation with "objective distances" from foreign markets, i.e. with average distances weighted by total manufactured and non-manufactured goods imports of ***partner countries so*** as to remove the bias given by realised trading patterns[4]. Furthermore, as proposed by Balassa, each component is weighted for each country by the world average commodity composition of trade (for each year), in order to obtain a uniformly-based objective cost of transportation.

Because there are greater economies of scale in the transportation of manufactured goods, the computed "objective" cost of transportation is higher than the cif-fob margin for those countries that have a relatively high proportion of manufactured goods in total imports. The objective cost for Japan, for example, is lower than the cif-fob margin, about **7.5** per cent compared to **12.2** per cent over the period; while that of Canada rises from **2.7** to 7.3 per cent.

II. OWN-COUNTRY RESISTANCE TO TRADE

A. Total imports of goods and services

Given the estimates of barriers to trade due to transportation costs, the regression analysis of trade shares in GDP can provide a basis for assessing the impediments to trade, which include tariff and non-tariff barriers as well as "attitudes" *vis-à-vis* external trade and other country-specific effects. The estimates reported below are based on the following equations[5]:

$$MGS/GDP_{ti} = \alpha_0 + \alpha_{0i} + \alpha_1 (GDP/POP)_{ti} + \alpha_2 COST_{ti} + \alpha_3 (PGDP/PM)_{ti} + \alpha_4 (POP_{ti})^2 + \alpha_5 (GDP_{ti})^2 + \alpha_6 DEEC + \alpha_7 DEFTA \quad [2]$$

where MGS is national accounts imports of goods and services, GDP is gross domestic product (both at **1980** prices and exchange rates), PGDP and *PM* are the deflators of GDP and imports, POP is population, α_0 is a constant term (invariant with time and country), α_{0i} is a country-specific constant term (discussed below), COST is the objective cost of transportation defined in Note 4, *DEEC* and DEFTA are dummies for membership in the EEC and EFTA.

In this specification, real ***percapita*** income is a proxy for economic development, while population and absolute real income are intended to capture size effects. The introduction of the terms of trade between domestic output and imports allows for substitution effects due to relative price changes; to the extent that

changes in tariffs are incorporated in import prices, tariff barriers are reflected in this variable.

The constant term α_0 can be interpreted as the "average" import-to-GDP ratio not explained by other economic factors; implicitly α_0 incorporates the effect of non-tariff trade barriers other than cost of transportation. If the constant term is allowed to shift across countries, the deviations from the average (α_{0i}) can be interpreted as representing the extent to which trade barriers in a specific country differ from the average in the OECD area. Significant negative estimates of α_{0i} would indicate unusually high trade barriers; and significant positive estimates of α_{0i} would be indicative of unusually open markets. This interpretation requires the assumption that trade barriers be relatively stable over time for each country *vis-à-vis* the rest of the world, and that other influences affecting the value of the constant term be country-independent.

In order to estimate the individual dummies, a procedure must be chosen to obtain own-country estimates representing deviations from the overall average. As shown by Hsiao **(1986),** this involves simultaneously estimating dummies α_{0i} under the constraint that:

$$\Sigma_i \alpha_{0i} = 0, \text{ where } i = 1,...23 \qquad [3]$$

This procedureovecomes a problem common to a number of studies which include a dummy only for Japan, or where unusual barriers to trade were tested through a statistically questionable one-at-a-time procedure. The omission of significant country-specific dummy variables, when they exist, will bias the estimation of the remaining variables. As discussed below, there is evidence of significant deviations from the OECD norm for a number of countries other than Japan.

Table 2 reports estimates of equation [3] for real total imports of goods and services as a share of GDP, with and without country dummies. The functional forms have been chosen to capture non-linearities in the relationship between size, ***per capita*** GDP and import ratios, as a log-linear specification was rejected by the data. The equations are estimated by ordinary least squares on a pooled time-series cross-section of 23 OECD countries. Estimation has been limited to the period **1974-84** because tests for stability of coefficients reject the extension of the sample to years before **1974** (possibly an indication of structural change in the imports/GDP relationships after the first oil shock).

The estimated coefficients in the equation relating total imports of goods and services are of the expected sign and explain a large part of sample variance (the adjusted R^2 of 0.83 and **0.95** for the regressions without and with country dummies, respectively, are very high for time-series cross-section data, while standard errors are relatively low). The estimation results can be summarised as follows:

- Higher real ***per capita*** incomes lead to lower import shares in GDP, a result already noted in the literature. This may reflect the increasing range of

Table 2. **The ratio of imports to GDP results of pooled time-series, crosssection estimation**

Estimation period: 1974-1984
23 countries (total observations: 253)
Standard errors in parenthesis

Equation	C	*GDP/POP*	*COST*	*POP²*	*GDP²*	*TOT*	*EEC*	*EFTA*	*SEE*	Adj. R^2
I	17.30**	-2.91**	-5.26**	-0.097**	0.057**	-0.38**	0.32**	0.09*	0.178	0.83
	(1.19)	(0.24)	(0.86)	(0.008)	(0.005)	(0.10)	(0.04)	(0.04)		
II	17.95**	-2.95**	-4.73**	-0.097**	0.057**	-0.30**	0.22**	0.01	0.097	0.95
	(1.98)	(0.41)	(0.89)	(0.013)	(0.008)	(0.064)	(0.046)	(0.07)		
III	24.7**	-4.95**	-9.18**	-0.165**	0.099**	-0.80**	0.16**	-0.12	0.146	0.95
	(3.03)	(0.63)	(1.93)	(0.020)	(0.012)	(0.07)	(0.07)	(0.09)		
IV	9.34	-1.53**	-5.37**	-0.048**	0.026*	-0.71**	0.29**	0.02	0.125	0.91
	(2.58)	(0.55)	(0.77)	(0.017)	(0.011)	(0.037)	(0.061)	(0.085)		

Dependent variable; I = log of real **GDP** share of imports of goods and non-factor services (no country shift dummiesl.
II = log of real **GDP** share of imports of goods and non-factor services (with country shift dummiesl.
III = log of real **GDP** share of imports of manufactured goods (SITC 5.9 minus 68) (with country dummies).
IV = Log of real **GDP** share of imports of non-manufactured goods and services (with country dummies).

Definition of variables; ***COST*** = The estimated "objective" cost of transportation (see text).
PUP = Natural log of population.
GDP = Natural log of real **GDP,** 1980 prices and exchange rates.
TUT = Natural log of the terms of trade between total (goods and services, manufactured and non. manufactured goods, respectively) and domestic output.
EEC, EFTA = Dummies for participation in EEC or EFTA.
C = Constant term.

* Indicates significance at a 5 per cent confidence level.
** Indicates significance at a 1 per cent confidence level.

Data sources: OECD, ***National Accounts*** and ***Foreign Trade Statistics;*** **IMF,** ***International Financial Statistics.***

sophisticated products produced at home as income increases, or a higher income elasticity of demand for services, which are less traded than manufactures.

- A deterioration of the terms of trade of domestic output relative to imported goods leads to a substitution away from imports.
- The coefficient on population implies a negative relationship between size and import ratios, while increasing absolute levels of real income contribute positively.
- The measure of "objective transportation cost" has the expected negative effect on import shares.
- While the EEC dummy is positive and significant, the EFTA dummy is not significantly different from zero when allowance is made for individual country dummies. EEC membership results in ratios of imports to GDP about 22 per cent higher than in the case of non-membership.

B. Country dummies

As indicated, the main interest of the regressions lies in the information they give on the individual country dummies. Table 3 summarises the results for total imports of goods and services and for manufactured and non-manufactured goods, discussed below. Given the way the dummies have been specified, an estimated coefficient significantly different from zero indicates "unusually" high or low imports relative to GDP, which can be taken as an indicator of "unusually" high or low trade barriers. For total imports, nine of 23 OECD countries have statistically significant coefficients (positive or negative) for the shift dummy. The dummy variable for Japan is not significantly different from zero. Among the major seven OECD

Table 3. Estimated country dummies

Standard errors in parenthesis

	Total imports		Manufactured aoods		Nonmanufactured ooods	
United States	-0.027	(0.062)	0.163	(0.951)	-0.089	(0.080)
Japan	0.086	(0.051)	-0.764""	(0.078)	0.346""	(0.066)
Germany	0.043	(0.045)	0.061	(0.068)	0.103	(0.058)
France	-0.190""	(0.043)	-0.139"	(0.066)	-0.167""	(0.056)
United Kingdom	0.087	(0.045)	0.290""	(0.067)	0.065	(0.058)
Italy	-0.031	(0.046)	0.094	(0.070)	0.053""	(0.060)
Canada	0.013	(0.045)	0.220""	(0.067)	-0.140""	(0.057)
Australia	-0.247""	(0.05)	-0.180	(0.085)	-0.184""	(0.072)
Austria	0.024	(0.046)	0.121	(0.071)	0.012	(0.059)
Belgium	0.427""	(0.042)	0.464""	(0.064)	0.358""	(0.054)
Denmark	-0.277""	(0.047)	-0.323""	(0.07)	-0.214**	(0.060)
Finland	-0.121""	(0.044)	-0.150"	(0.068)	-0.037	(0.057)
Greece	-0.256""	(0.052)	-0.198"	(0.079)	-0.396""	(0.066)
Iceland	0.012	(0.090)	0.234	(0.136)	-0.179	(0.116)
Ireland	0.055	(0.056)	0.132	(0.084)	-0.178"	(0.069)
Netherlands	0.316""	(0.041)	0.190""	(0.062)	0.408**	(0.053)
New Zealand	0.033	(0.0641	-0.213	(0.097)	0.247""	(0.080)
Norway	0.229""	(0.044)	0.133	(0.068)	0.391""	(0.057)
Portugal	0.055	(0.070)	0.034	(0.105)	0.054	(0.0901
Spain	-0.197""	(0.044)	-0.393""	(0.066)	-0.040	(0.058)
Sweden	0.026	(0.0491	-0.033	(0.073)	0.045	(0.062)
Switzerland	-0.005	(0.047)	0.116	(0.073)	-0.048	(0.061)
Turkev	-0.060	(0.074)	0.063	(0.111)	-0.405"	(0.060)

* Indicates significance at a 5 per cent confidence level.
** Indicates significance at a 1 per cent confidence level.
Sources: Regressions reported in Table 2.

economies, only France has a significantly negative own-country dummy, which is consistent with Nogués et al. (1986) results showing France to have the most numerous recorded non-tariff barriers. The largest negative value for the dummy is for Denmark, followed by Greece, Australia and Spain. The significant positive dummies for Belgium, the Netherlands and Norway indicate higher ratios of imports to total GDP than average. For the first two countries this might be the result of their strategic location at the centre of Europe, which is not adequately captured by the regressors in the estimated equation.

The findings for Japan are similar to those of Bergsten and Cline (1985), who reported regression results for a pooled time-series cross-section for the United States, Japan, the EEC (excluding intra-EEC trade) and other non-EEC countries, and a shift dummy for Japan only. The results contrast with those of Balassa (1986), who reported significant negative values for the Japan dummy, even when allowing for the EEC and EFTA effects. The most important source of difference between the results reported in Table **3** and those of Balassa appears to come from the imposition of linearity in population and real income. Under these circumstances, the dummy for Japan turns out to be negative, albeit with a marginal level of significance. The linearity in the variables is, however, comfortably rejected by the data (with an *F*-statistic of over 20).

C. The composition of trade: manufactured and non-manufactured imports

Balassa (1986) and Lawrence (1987), using different methodologies, have also reported evidence of underimporting in manufactured goods for Japan. In principle, the methodology utilised in the estimation of normal patterns for total imports of goods and services can also be applied to sub-categories of imports. However, greater caution must be exercised in the interpretation of the values of country dummies. The "structural indicators" described above make little or no allowance for factors that can be expected to affect or reflect a country's comparative advantage, and thus the composition of its imports. Lack of natural resources in particular would lead to a specialisation in more highly processed goods exports and production: a negative dummy for a particular country in a subgroup might thus not be an indication of unusual trade barriers, but merely reflect comparative advantage. More specifically, the signs and significance of the country dummies for imports of manufactured and non-manufactured import shares can be compared with those for total imports and be interpreted as follows:

i) A significant (negative or positive) dummy for total imports, and a pair of significant dummies of the same sign in the sectoral equations can be interpreted as signalling the existence of unusual barriers to trade, or unusual degrees of openness, across all categories of imports.

ii) A significant (negative or positive) dummy in the equation for total imports, and only one significant dummy of the same sign in a sectoral equation might be interpreted as signalling the existence of unusual barriers to trade, or unusual degrees of openness, concentrated in one particular category.

iii) No significant dummy for total imports and a positive and a negative dummy in the two sectoral equations might be interpreted as indicating the area where the country enjoys a comparative advantage, while not displaying unusual barriers to trade.

iv) Other combinations would not allow inferences on patterns of trade to go beyond those established through the aggregate regressions.

Regressions III and IV reported in Table 2 utilise the definition of manufactured goods as SITC categories 5 to **9** minus 68[6]. Non-manufactured imports include all imports of goods and services minus manufactures. The point estimates of coefficients of the explanatory variables for both sub-categories of goods are relatively similar to those for total imports, with the notable higher value taken by the coefficient of the cost variable in the manufactured goods equation, which conforms to the expectation of a higher price sensitivity.

The estimated coefficients of the country dummies provide interesting insights (Table 3). Of the nine countries where the estimated coefficients of the country dummies are significantly different from zero for total imports, five (Denmark, France and Greece on the negative side, and Belgium and the Netherlands on the positive side) also have significant dummies of the same sign for both subgroups, indicating unusual trade behaviour across the import spectrum (case *i)* above). For Finland and Spain, the estimated negative coefficients for total imports are accounted for by a negative dummy on manufactured goods, thus suggesting that the unusual import barriers might be concentrated in that area. For Australia, on the other hand, a significant negative dummy is found for non-manufactured goods (case *ii)*). Japan has an estimated negative dummy for manufactured imports, suggesting a comparative advantage in manufacturing but no unusual barrier to imports overall (case *iii)*). Canada also displays the opposite pattern, as could be expected given the large resource endowment of the country. Other cases fall in category *iv)* and allow no inferences to be drawn.

CONCLUSIONS

This note has examined by indirect methods the extent of informal trade barriers for the OECD countries over the **1974** to **1984** period. Although the tests are heuristic, the evidence presented above lends support to the view that the trade

imbalance of Japan cannot be attributed to excessively closed domestic markets. The real import share of Japan does not appear to be out of line with other OECD countries, once adjustment is made for various economic and structural differences that can be expected to influence import behaviour.

While the estimates also show that Japan stands out as having an unusually low ratio of manufactured goods imports to GDP – as noted by other authors – the significance of this result, and the potential for an important increase in imports of manufactured goods in the future, is open to debate. The results regarding overall imports, in conjunction with the positive dummy for non-manufactured goods imports found for Japan, suggest that at least part of the explanation for the low share of manufactured imports in GDP is to be found in the comparative advantage of the country, rather than in the presence of unusually distortionary trade practices.

NOTES

1. According to Balassa (1987, p. 783):

   "... for individual countries, transportation costs of primary commodities have been derived from data on the cif-fob ratio for total imports and the share of primary commodities in these imports, assuming that transportation costs for manufactured goods were uniformly 2 per cent of average cif value. Finally, for each country, average transportation costs have been calculated by averaging the transportation cost for primary commodities so obtained and the assumed 2 per cent ratio for manufactured goods, using the Swiss commodity composition of trade as weights, so as to normalise the country data to a standard commodity composition."

2. The economic centre is calculated around 1980; I am grateful to Professor H. Linneman and to C. Leedman of the OECD for providing the basic data, originally used in Linneman (1966).

3. The index (8) can be calculated as

   $$\theta(x) = (C(DM, DNM, \alpha)/x)/C_x(DM, DNM, \alpha)$$

   where $x = DM, DNM$ and C_x indicates the partial derivative of the estimated cost function with respect to the argument x.

4. Thus, "the objective distance" for a country is equal to

   $$OD_i = \Sigma_j d_{ij} M_j/(\Sigma_j M_j)$$

   where d_{ij} is the physical distance between countries i and j, and M_j are total imports of j (of manufactured and non-manufactured goods). The objective transportation cost variable *COST* is then calculated by replacing in Equation [1] the values of *DM* and *DNM* with the corresponding "objective distances" and using, for each year, the average α for the sample, so as to ensure a uniform composition of trade.

5. The dependent variable has sometimes been estimated in per capita form (rather than as a share of GDP); and specifications have also varied as to the functional form of some of the explanatory variables. Balassa (1986) analyses the ratio of total visible trade to GDP, thus excluding trade in services; furthermore he does not specify whether he uses real or nominal shares. Bergsten and Cline (1985) regress real shares of total imports of goods and services. Both studies enter population linearly; neither one utilises the terms of trade between domestic output and imports.

6. This definition of manufactured goods, used in all the studies discussed above and generally adopted in the trade literature, is somewhat narrow in that it excludes many items (such as processed food, beverages and tobacco) which are "manufactured" just as many items in categories SITC 5 and 6. Exploratory regressions using the broader ISIC category 3 definition gave equivalent results, and the lack of a suitable price deflator for the ISIC 3 category suggested the utilisation of the narrower SITC definition.

BIBLIOGRAPHY

Balassa, B. (1986), "Japan's trade policies", ***Weltwirtschaftliches Archiv,*** Band 122, Heft 4, pp. 745-90.

Bergsten, C.F. and W.R. Cline (1985), "The United States-Japan economic problems", ***Policy Analyses in International Economics*** No. 13, Institute for International Economics (October).

Belsley, D.A., E. Kuh and R. Welsch (1980), ***Regression Diagnostics,*** Wiley, New York.

Chenery, H.B. (1960), "Patterns of industrial growth", ***American Economic Review*** (September), pp. 624-54.

Helpman, H. and P. Krugman (1985), ***Intra-Industry Trade,*** The MIT Press (Boston).

Hsiao, C. (1986), ***Analysis of Panel Data,*** Cambridge University Press (Cambridge).

International Monetary Fund, ***International Financial Statistics,*** various issues.

Lawrence, R.Z. (1987), "Does Japan import too little: closed markets or minds?", ***Brookings Papers on Economic Activity*** No. 2.

Learner, E.E. (1984), ***Sources of International Comparative Advantage — Theory and Evidence,*** MIT Press (Boston).

Linneman, H. (1966), ***An Econometric Study of International Trade Flows,*** Amsterdam, North Holland.

Nogués, J.J., A. Olechowski and L.A. Winters (1986), "The extent of non-tariff barriers to imports of industrial countries", ***World Bank Staff Working Papers*** No. 789.

Noland, M. (1987), "An econometric investigation of international protection", ***mimeo,*** Institute for International Economics (June).

OECD (1985). ***Costs and Benefits of Protection,*** Paris.

Saxonhouse, G.R. (1983), "The micro- and macroeconomics of foreign sales to Japan", in Cline (ed.), ***Trade Policy in the 1980s,*** Institute for International Economics, Washington D.C.

Saxonhouse, G.R. and R.M. Stern (1987), "An analytical survey of formal and informal barriers to international trade and investment in the United States, Canada, and Japan", Conference on U.S.-Canadian Trade and Investment Relations with Japan, Ann Arbor, Michigan.