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Econometric Analysis of Industrial Country Commodity Exports

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Abstract

This paper examines the composition of primary commodity exports by industrial countries and contrasts this composition with that of the exports by developing countries. Both the share of industrial countries' commodity exports in world commodity exports, as well as in their own total merchandize exports, is examined over time and across different commodities and geographical areas. The paper then specifies and empirically estimates an econometric model of the demand for and the supply of commodity exports by industrial countries. The model is estimated for five groups of industrial countries and the parameters of the model are compared with those available for the developing countries.

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Summary

This paper provides systematic evidence on the structure and evolution of primary commodity exports by industrial countries and undertakes an econometric analysis of the determinants of these exports. In recent years, there has been increasing recognition of the fact that for several primary commodities, industrial countries are also significant exporters. This recognition has, however, been reflected mainly in a discussion of the role played by industrial country subsidies in their agricultural sectors. While an analysis of agricultural subsidies plays a key role in any discussion of international agricultural policies, relatively much less work has been done on the structure, evolution, and determinants of the aggregate of primary commodity exports of industrial countries.

This paper tries to complement the emerging literature on industrial countries' influence on commodity markets and focuses on two main areas. First, it analyzes the structure of commodity exports by industrial countries during the period 1965-87 and compares this structure with that of commodity exports by developing countries. Second, it specifies and estimates an econometric model of the demand for, and the supply of, industrial country commodity exports. The model is estimated at a broad commodity group level and disaggregated into five groups of industrial countries: the United States, Canada, the European Economic Community, other European countries, and Australia and New Zealand.

The results show that the industrial countries account for nearly half of all world commodity exports, about the same share as they accounted for in the late 1960s. As a proportion of their total merchandise exports, however, commodity exports account for around 20 percent, compared with nearly 50 percent for the developing countries. "Intra-regional" commodity exports have shown a secular decline since the mid-1960s. As a share of world non-fuel commodity exports, industrial countries account for over 60 percent. While their share of food exports exceeds 70 percent, industrial country exports of agricultural raw materials and metals and minerals also account for nearly 65 percent of world exports.

The econometric results show that the price elasticities of supply of major commodity exports by industrial countries appear to exceed the comparable elasticities for the developing countries. This, it is suggested, could reflect availability of resources for better inventory management, as well as the possibility of increasing production relatively more quickly. The price and income elasticities of demand for industrial country commodity exports are also somewhat higher than those for the developing countries. This could reflect, in part, some differences in the composition of commodity supplies from the industrial and developing countries. There are a number of important policy implications of the results discussed in the paper.

I. Introduction

It is customary to view developing countries as primary commodity exporters, and indeed despite considerable diversification over the last three decades, a majority of these countries still rely heavily for their foreign exchange earnings on commodity exports. Changes in the volume and unit values of these exports continue to exercise a major influence on the growth of their economies and more generally on the process of development. It is not surprising, therefore, that over the last three decades a large amount of theoretical and empirical literature has been devoted to analyzing the determinants of world commodity prices and exports. In this literature, and in the associated policy prescriptions, the role of industrial countries has been regarded as crucial, but this role has been seen in large part in terms of industrial countries' demand for developing country exports. More recently, there has been increasing emphasis on the fact that for several primary commodities, industrial countries are also significant exporters; this emphasis has, however, usually been reflected mainly in a discussion of the role played by industrial country subsidies to their agricultural sectors. While an analysis of agricultural subsidies plays a key role in any discussion of international agricultural policies, there has been relatively much less work done on the structure, evolution and determinants of the aggregate of industrial country primary commodity exports.

This paper tries to complement the emerging literature on industrial countries' influence on commodity markets and focusses on two main areas: First, it analyzes the structure of commodity exports by industrial countries (DCs) during the period 1965 to 1987 and compares this structure with that of commodity exports by developing countries. Both the share of DCs commodity exports in world commodity exports, as well as in their own total merchandise exports is examined over time and across different commodities and geographical areas. This is undertaken in Sections II and III.

Secondly, the paper specifies and estimates an econometric model of the demand for, and the supply of, industrial country commodity exports. The model is estimated at a broad commodity group level, and disaggregated according to five groups of DCs: the United States, Canada, the European Economic Community, other European countries, and Australia and New Zealand. The parameters of the supply and demand functions are then compared with those available for the developing countries and the significance of the differences in the parameters is discussed. This is undertaken in Section IV.

The paper concludes with a summary of the main findings and some conclusions regarding their implications.

II. World Commodity Trade

Before examining the trends in world primary commodity trade, it is worth noting the main characteristics of commodity trade which distinguish it from trade in manufactures. One major difference between the two types of trade arises from the relative homogeneity of any given primary commodity product which means that intracommodity trade is generally less significant than intraindustry trade in manufactures. Typically, in the case of manufacturing trade a country will both export and import products within any given quite narrowly defined industry grouping, whilst for any given narrowly defined commodity group a country is seldom both an exporter and an importer. The relative homogeneity of commodities means, that except in the case of a dominant producer or a cartel, a commodity exporter faces a perfectly elastic demand curve, compared to the downward sloping demand curve for the exporter of manufactures. 1/

A second distinguishing characteristic of commodity trade is that it is subject to considerably greater trade restrictions than trade in manufactures. These restrictions are particularly marked in the case of trade in food products and imply that the actual quantum of commodity production and exports is probably quite different from what would be the case if these restrictions were relaxed or removed altogether. Thirdly, the production of commodities is in general more natural resource specific than manufactures. However, as discussed below, this characteristic does not necessarily mean that the pattern of commodity trade cannot vary significantly spatially and over time.

The above three distinguishing features of commodity trade underline the case for analyzing commodity trade separately from total trade. Table 1 provides an indication of the importance of primary commodity exports in total world merchandise exports during the last two decades. 2/ The commodities share in world trade has fluctuated considerably since the mid 1960s when it accounted for nearly 40 percent of all exports. This share declined steadily up to 1973, reflecting mainly a proportionately much larger increase in the volume of manufacturing exports relative to commodity exports. From 1974 onwards, however, the trend in the share was significantly affected by changes in the volume and unit value of fuel

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1/ The above, of course, does not imply that commodities are perfectly homogenous in an absolute sense. For many commodities, there can be significant differences in the quality and other characteristics which reduce the degree of substitutability amongst different units of the same commodity. See, for instance, Radetzki (1990). (This is one of the reasons for using the "imperfect substitutes" framework in the econometric analysis undertaken in Section IV below). However, it is generally the case that in relative terms commodities are more homogenous than manufactured goods.

2/ These data are obtained from the UNCTAD yearbooks, supplemented, or cross-checked, with data from the World Bank's TARS Databank. At the time of writing, 1987 was the last year for which detailed data were available.

Table 1. Relative Shares of Commodity and Manufactures Exports in Total World Exports, 1966-87

(In percent)

	1966-69	1970-73	1974-77	1978-81	1982-85	1986-87
All primary commodities	39.1	34.9	41.0	40.8	38.2	28.4
Non-fuel commodities	30.0	26.1	21.1	19.3	18.0	17.2
Fuel commodities	9.1	11.3	20.0	22.8	20.2	11.2
Manufactures	60.9	65.1	59.2	59.3	61.8	71.6

Source: UNCTAD Commodity Yearbooks and TARS Databank.

exports. The share of commodities in world trade increased sharply in 1974 following the increase in the unit value of fuel exports. When fuel prices increased again during 1979-81, the share remained constant in part because of an accelerated substitution away from imported fuel in industrial countries and a slow down in growth in these countries, both leading to a decline in the volume of oil imports. However, the constancy in the shares also reflected a decline in the unit values of non-fuel commodities relative to those of manufactures.

After 1983 when fuel prices began to decline relative to the price of manufactures, as well as in absolute terms, the share of commodities began to decline. The sharpest decline in this share occurred after 1985 with a steep decline in the price of oil which itself followed a precipitous decline in the prices of a wide range of non-fuel commodities. At the end of the period under consideration, fuel exports accounted for a similar proportion of world merchandise exports as they did at the beginning of the period, but the share of non-fuel commodities in the total was nearly halved. This means that fuel exports had increased sharply in relative importance and accounted for nearly 40 percent of all world commodity exports.

Non-fuel commodity exports consist of three major groups of commodities: food products, agricultural raw materials, and mineral ores and metals. An indication of the relative importance of these three groups of is provided in Table 2. 1/ The share of each of these groups displays a considerable degree of constancy over 22 years since 1966. Food products which include cereals, meat products, vegetable oils and beverages accounted for 57 to 58 percent of all non-fuel commodity exports from 1966 to 1981. Following an increase in the price of cereals in the early 1980s, due largely to global shortfalls in supply, the share of food products increased somewhat during 1982-1985 but in the last two years edged back to trend. 2/

Minerals, including metals and ores, constituted the next largest group, accounting for around 23 percent of the world non-fuel commodity exports. The share of this group increased marginally between 1974 and 1981 reflecting a relative increase in the unit value of metal exports, itself due largely the result of an increase in the price of fuel, an important cost in the extraction of metals. The share of the third group, agricultural raw materials including fibers, timber and natural rubber, has fluctuated around 18 percent over the last two decades. This constancy reflects both a slow growth in the volume of fiber exports, the largest

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1/ These data are derived from United Nations (1990) which provides data on world non-fuel commodity exports and world merchandise exports. The subgroups of commodities corresponds to the categories used by the International Monetary Fund. See IMF (1990).

2/ For detailed analysis, see IMF (op.cit).

Table 2. Relative Shares of Commodity Group Exports in Non-Fuel Commodity Exports, 1966-87

(In percent)

	1966-69	1970-73	1974-77	1978-81	1982-85	1986-87
Food products	57.2	58.1	57.5	57.8	61.3	58.9
Agricultural raw materials	20.3	19.2	19.0	16.1	17.3	18.0
Minerals, ores, and metals	23.0	23.2	24.4	26.1	22.2	23.1

Source: As for Table 1.

element in this group accounting for nearly two-thirds of exports, as well as relatively slow trend changes in the unit values of both fibers and rubber.

III. Commodity Exports by Industrial Countries

1. Industrial countries aggregate shares

There are two measures which can be used to gauge the relative importance of commodity exports of industrial and developing countries respectively. The first one, corresponding to the commodity shares noted above, is earnings from commodity exports as a proportion of total merchandise export earnings for each of the two groups of countries. A second measure is the share in commodity export earnings of each of the two groups respectively in world commodity export earnings. These two measures are complementary: the first measure gives an indication of the importance of commodity exports from the point of view of each groups of countries; the second provides an indication of the relative influence on world commodity exports of the two groups of countries. The complementarity between these two measures can be seen from the following:

Let x_1 and X_1 denote commodity exports and total merchandise exports by industrial countries, and x_2 and X_2 denote commodity and total exports by developing countries. Denote the two measures described above by μ_1 and λ_1 for industrial countries and μ_2 and λ_2 for developing countries
That is,

$$\mu_1 = \frac{x_1}{X_1} \quad \text{and} \quad \mu_2 = \frac{x_2}{X_2} \tag{1}$$

$$\lambda_1 = \frac{x_1}{x_1 + x_2} \quad \text{and} \quad \lambda_2 = \frac{x_2}{x_1 + x_2} \tag{2}$$

Substituting for x_1 and x_2 in (2) yields

$$\lambda_1 = \frac{1}{1 + \frac{\mu_2 X_2}{\mu_1 X_1}} \quad \text{and} \quad \lambda_2 = \frac{1}{1 + \frac{\mu_1 X_1}{\mu_2 X_2}} \tag{3}$$

In words, the share of commodity exports of industrial countries in total world commodity exports can be disaggregated into two factors: first, their commodity exports as a proportion of their total exports, relative to the developing countries; (that is, $\frac{\mu_2}{\mu_1}$); secondly, their total exports

relative to developing countries' total exports. If industrial countries total exports increase faster than those of the developing countries', then even for any given μ_1 and μ_2 their share in world commodity exports would increase. If at the same time μ_1 increases relative to μ_2, the industrial countries share would increase even faster.

Some estimates for μ_1 and λ_1, as well as μ_2 and λ_2 are provided in Table 3. During 1986-87, μ_1 was around 20 percent, while μ_2 was around 50 percent. 1/ The evolution of this indicator over the preceding two decades for the two groups of countries had also been quite different. For industrial countries, it was remarkedly stable at 25 percent for nearly two decades and only declined during 1986-87, reflecting the worldwide weakness in commodity prices including oil. For developing countries, there was a trend decline over the two decades, which from 1974 to 1981 was offset by the sharp increase in the international price of crude oil.

With regard to λ_1 and λ_2 (industrial and developing countries' commodity exports as a share of world commodity exports, respectively) the ratios are surprisingly similar for the two group of countries. Furthermore, for the period 1966 to 1987 as a whole, there was no marked trend in this measure. However, in the decade ending 1986-87, it is quite clear that the share of industrial country primary products exports in total such exports has been increasing while that of the developing countries has been declining.

The increase in the last decade in the industrial countries' share of commodity exports was due to two factors: first, a proportionately smaller decline, relative to the developing countries, in the share of commodity exports in their total exports; 2/ secondly, the industrial countries' total exports grew at a faster rate than exports of the developing countries; that is, $\frac{X_2}{X_1}$ declined. A measure of the decline can be obtained from (3) by substituting for μ_1, μ_2 and λ_1, from which it appears that $\frac{X_2}{X_1}$ declined from 0.58 in 1978-81 to 0.42 in 1986-87. In other words, developing counties' exports as a proportion of industrial countries' exports fell from 58 to 42 percent. This is supported by the fact that the growth in exports in nominal terms of industrial countries over this period exceeded that of developing countries; while industrial countries' exports

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1/ The coverage of industrial and developing countries corresponds to the coverage in the International Financial Statistics.

2/ For industrial countries the share declined from 25 percent to 19 percent, while for developing countries it declined from 68 to 49 percent.

Table 3. Relative Shares of Commodity Exports

	As a Percentage of 1/ World Commodity Exports		As Percentage of 2/ Groups' Own Total Merchandise Exports	
	Industrial	Developing	Industrial	Developing
1966-69	46	54	26	66
1970-73	49	51	25	58
1974-77	39	61	25	68
1978-81	39	61	25	68
1982-85	42	58	25	60
1986-87	48	52	19	49

Source: As for Table 1.
1/ This corresponds to λ_1 and λ_2 respectively in the text.
2/ This corresponds to μ_1 and μ_2 respectively in the text.

doubled over the 10 years 1978 to 1987, developing countries' exports increased by only about 75 percent. 1/

It is revealing to examine through a simulation exercise what would have happened if the ratio of developing to industrial countries' total exports had remained unchanged around 0.52. Substituting for λ_1 in (3) it can be seen that in that case, λ_1 would have been 0.40, that is, virtually unchanged from the late 1970s. In other words, the decline in the world commodity share of developing countries in the 1980's was due largely not to their diversification away from primary commodity exports, but rather to a decline in the share of their exports in total world exports. This is quite an interesting finding and suggests modification of the oft-voiced view concerning the impact of developing countries' diversification away from primary commodities. 2/

2. Intra-regional commodity trade

It has often been noted that a considerable share of commodity exports of industrial countries may be intra-regional, such as commodity trade within the EC itself, or commodity exports to and from adjoining countries, such as between the United States and Canada. 3/ Such a pattern of trade would be quite different from that of developing countries. As is well documented, in the latter group of countries, exports to each other are of considerably less importance than exports to the industrial countries. 4/ It would further mean that the direct supply impact of industrial country commodity exports on the world markets may be somewhat different than that suggested by the preceding analysis. However, the demand effect, by making industrial countries as a group relatively more self-sufficient in commodities and hence relying less on imports from the developing countries, may still be substantial.

In order to obtain an indication of the magnitude of the intra-regional trade in commodities, trade within the EC, and the trade between the United States and Canada was examined. Table 4 gives the share of commodity exports in total exports of the United States, Canada, and the EC, as well as the intra-regional export shares. The first row for each area shows total commodity exports to the world as a share of total exports to the world:

1/ According to the UNCTAD data, total industrial country exports in 1978 amounted to $854.4 billion whilst developing countries' amounted to $445.8 billion. By 1987 exports had increased to $1710.7 and $783.3 billion for the two groups respectively. See UNCTAD (1990) Table 1.

2/ A recent study by Redetzski (1990) supports the finding of this paper. According to this view, it is primarily the diversification of developing country commodity exports which has led to a decline in their share of world commodity exports.

3/ See, for instance, Goodwin and Mayall (1982).

4/ See, for instance, Redetzski (1990).

Table 4. Intra-Regional Commodity Exports

(As a percentage of merchandise exports)

	1966-67	1972-73	1978-79	1984-85
United States	29.7	29.4	28.1	22.9
With Canada 1/	14.3	11.4	10.6	8.1
Excluding Canada 2/	34.0	34.8	32.1	26.9
Canada	53.1	44.6	39.7	30.3
With United States 1/	40.4	31.4	27.9	18.7
Excluding United States 2/	72.7	70.8	63.5	65.3
EC	19.1	17.8	16.5	16.7
Intra-EC 1/	25.4	21.9	21.4	20.8
Excluding EC 2/	13.4	11.7	10.9	12.3

1/ These are commodity exports to Canada, the United States, or EEC, respectively, of total merchandise exports to Canada, the United States or EEC.

2/ These are commodity exports to the world excluding Canada, or the United States, or EC, respectively, as a proportion of total exports to the world excluding Canada, or the United States, or the EEC.

That is, $\frac{x_i^w}{X_i^w}$ where i denotes the exporting country or region.

The second row shows intra-regional commodity exports as a share of total exports--denote these by x_i^j and X_i^j, and the third row shows the difference between these two sets of ratios, that is,

$$\frac{x_i^w - x_i^j}{X_i^w - X_i^j}$$

Consider, for instance, the United States' commodity exports as a share of its total exports which had fallen from nearly 30 percent in 1966-67 to around 23 percent in 1984-85. During 1984-85 total commodity exports to Canada as a proportion of total merchandise exports to Canada amounted to just over 8 percent; this contrasts with United States' commodity exports to the world, excluding Canada, relative to its total world exports of nearly 27 percent. Furthermore, the relative share of commodity exports to Canada had declined more sharply than the relative share of commodity exports to the world. This decline reflects sharp increase in the manufacturing trade with Canada, due in part to the significant increase in the intra-firm trade between the two countries.

In the case of Canada, in 1984-85 commodity exports to the world accounted for nearly 30 percent of its total exports while commodity exports to the United States amounted to around 19 percent of its total exports to that country. The share of Canada's commodity exports to the world in its total exports was nearly halved between 1965 and 1985. However, most of the decline in this share was due to the decline in the commodities' share in total exports to the United States. In 1966-67, excluding the United States, Canada's exports of commodities amounted to nearly 73 percent of its total exports to the rest of the world; by 1984-85 this ratio had only fallen to 65 percent, illustrating the continuing importance of commodities in Canada's exports to the rest of the world.

Finally with regard to the European Community, the share of commodity exports in its total world exports was around 17 percent in 1984-85, down from nearly 20 percent in 1966. This relative decline in the commodities share underlines the relatively much faster growth in the manufacturing exports and it is all the more noticeable given the sharp growth and diversification which has taken place in the EC's commodity exports,

particularly agricultural exports, over the last two decades. 1/ Excluding intra-EC commodity total exports, the share of commodities was around 12 percent indicating that the relative share of intra-regional commodity trade was considerably higher than commodity trade with the rest of the world.

3. Composition of commodity exports

The above discussion has provided an overview of the total commodity exports of industrial countries without examining the composition of those exports. Of course, both for analytical purposes and for any policy analysis the composition is important. Table 5 shows the share in world commodity exports in 1985 of each of the five industrial country regions for the four major commodity groups noted earlier: foods, beverages, agricultural raw materials, metals and minerals. 2/ Consider first the food commodities. In 1985 the industrial countries' share of world food exports stood at 70 percent and, as the Appendix Tables show, the share had fluctuated narrowly around this value since 1965. Within the group of industrial countries, the EC and the United States accounted for nearly 80 percent of the total industrial country food exports, with the EC alone accounting for nearly half the total. 3/ The EC's share increased substantially during the 1970s while there was a small decline in the shares of the other four regions. EC's share had increased due both to an increase in the exports of its traditional food commodities such as cereals as well as a very sharp increase in new commodities such as oil seeds.

Consider next the exports of beverages, which include tea and coffee as well as beer, wine and other alcoholic beverages. Given the climatic conditions required for the cultivation of non-alcoholic beverages, industrial countries' production and exports of these is negligible. However, their exports of other beverages account for nearly 80 percent of total world exports. Since these other beverages account for over half of all beverage exports, the industrial countries' share of total world beverage exports is, in turn, also nearly 50 percent. Within the industrial countries, the EC accounts for the bulk of beverage exports, followed by the United States and Canada. Although the EC has always been the dominant exporter in this area, reflecting the sharp increase in resources devoted to viticulture and the phenomenal increase in the yields over the last two decades, the EC's share of the world beverage exports has increased even more over this period. Given the composition of exports, it

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1/ For a detailed discussion of this, see Rosenblatt et al (1988). For a discussion of the implications of support prices for price volatility, see Appendix.

2/ Detailed information on the evolution of these shares over the period 1965 to 1985 is available from the author, the last year for which detailed data were available at the time of writing..

3/ This is based on U.S. and EC's share of 55.5 relative to the total of 70.1.

Table 5. Share of Industrial Countries in Specific Commodity Exports 1985

(As a percentage of world commodity exports)

	United States	Canada	EC	Other European Countries	Australia and New Zealand	Total
Food	17.3	5.2	38.2	2.8	5.6	70.1
Of which:						
Cereals	33.8	10.3	29.4	1.6	8.6	84.0
Oil seeds, kernels, vegetable fats	28.5	4.4	23.9	1.5	0.0	60.0
Meat, products, animal feeds, miscellaneous	8.8	3.5	44.6	3.6	5.6	67.4
Beverages	8.3	1.5	36.1	1.6	0.0	48.1
Of which:						
Wine, beer, other beverages	17.3	2.8	58.2	1.6	0.0	81.1
Agricultural raw materials	16.2	13.9	17.2	10.7	8.1	66.6
Of which:						
Rubber, hides, pulp, etc.	16.0	12.5	28.6	10.3	2.6	71.8
Wood, lumber, corks	15.4	25.7	8.1	16.7	1.7	67.6
Metals and minerals	8.6	10.9	27.5	7.2	8.0	64.7
Of which:						
Crude, fertilizer, minerals	12.4	17.7	25.1	3.3	1.2	61.0
Metal ores, scraps, non-ferrous metals	8.1	9.9	27.9	7.7	9.0	65.3

Source: Based on data from the TARS Databank.

is, of course, unlikely that in industrial country supplies would have any appreciable influence on prices of beverages such as tea or coffee.

The third major commodity group consists of agricultural raw materials which includes three main subgroups of products: natural fibers, including cotton, wool, jute and sisal; natural and synthetic rubber; and wood products including lumber and cork. Industrial countries are significant exporters for each of these three groups of commodities so that their share of the world exports of agricultural raw materials as a whole is over 65 percent. After increasing considerably during the late 1960s and early 1970s the share has fluctuated around the above value for nearly fifteen years. Each of the three subgroups of products displays remarkably similar structure and evolution over the last two decades: each accounts for around 65 to 70 percent of world exports and its share has fluctuated around these values for the last two decades. Different industrial country regions, however, account for significantly different types of exports: major exporters of lumber products have been Canada, 'other European countries including mainly Sweden and Norway, and the United States; fibers have been exported mainly by Australia and New Zealand, and the United States; and synthetic rubber products by the EC.

With regard to the exports of metals and minerals, industrial countries' share of world exports has fluctuated around 65 percent. This group of commodities consists mainly of two subgroups of products: crude fertilizer minerals and metal and metal ores which respectively account for nearly a third and two thirds of the total value of exports. The EC accounts for the largest portion of both these products whilst the USA and Canada both account for around 10 percent. Both Australia and New Zealand, and other European countries account for a sizable share of the world metal markets. The share in metal exports of industrial countries have marginally increased over the last two decades due in part to the increasing efficiency and cost competitiveness of extraction and refining in the industrial countries. 1/

IV. A Model of Industrial Country Commodity Exports

In this section a two-equation model of the determinants of commodity exports is specified and estimated. The model is estimated separately for the United States, Canada, and each of the three groups of industrial countries noted above, that is, the EC, other European countries, and Australia and New Zealand. It is also disaggregated by the three major commodity groups discussed in Section III: food products, agricultural raw materials and metals and minerals. The economic framework for the model is based on that elaborated by Goldstein and Khan (1978). Since the analysis is conducted for broad commodity groups, the composition of which differs

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1/ There is a voluminous literature in this area. For a recent summary, see Radetzski.

significantly across regions, it is appropriate to use an 'imperfect-substitutes' framework. (See Goldstein and Khan (1985) for a detailed discussion of this framework). 1/ This framework consists of a structural model with a demand and a supply equation for each of the major commodity groups; supply is a function of capacity, relative prices (export price of a commodity group relative to domestic price level), productivity trends and exogenous shocks; demand is a function of real world income and relative prices (export price of a commodity group relative to average world market price of the commodity group).

The empirical specification of the equations is somewhat similar to that used by Bond (1987) in a study of commodity trade of developing country regions. However, given the differences in commodity composition and the differing importance of commodities in the economies of developing and industrial countries, the estimation procedures does differ from that used by Bond. Nevertheless there is sufficient similarity in the specification which allows a fairly direct comparison of the elasticities of trade with respect to prices, capacity and income between the industrial and the developing countries. The precise formulation of the equations is as follows:

a. Export supply equation

The supply of exports of commodity i from region j is specified as a log-linear function of current and lagged ratios of the export price of commodity i to domestic price in region j, an index of productive capacity in region j, and supply shocks2/ :

$$\ell n\, XS_j^i = \alpha_0 + \alpha_1 \ell n(PX_j^i/P_jE_j) + \alpha_2 \ell n(PX_{j-1}^i/P_{j-1}E_{j-1}) + \alpha_3 \ell nY_j^i + \alpha_4 t + \alpha_5 SS_t^i + u_t \quad (4)$$

where

XS_j^i = the volume of exports of commodity group i supplied from region j;

PX_j^i = the export price of commodity group i from region j; 3/

P_j = the domestic price level in producing countries in region j,

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1/ See also Kolstad and Burris (1986) and de Grorter and Meiebe (1987)

2/ For certain agricultural commodities, it might appear more appropriate to use a longer lag structure than the one year lag employed here. A preliminary analysis using two and three year lags did not, however, lead to any significant changes in the results reported below.

3/ It is important to note that given the differing composition of commodity groups across different regions, their export prices will also differ.

in local currency;

E_j - the exchange rates of currencies of producing countries (US$/local currency);

Y_j^i - an index of productive capacity in region j for commodity group i;

t - trend term reflecting long-run changes that affect the the supply of exports of commodity i; and

SS_t^j - supply shocks in region j; these supply shocks are proxied using two dummy variables for the two oil stocks.

Normalizing the equations for the price of exports in region j yields the following estimating equation 1/:

$$\ell nPX_j^i = a_0 + a_1 \ell nXS_j^i + a_2 \ell nP_j E_j + a_3 \ell n(PX_{j-1}^i / P_{j-1} E_{j-1}) + a_4 \ell nY_j^i + a_5 t + a_6 SS_j + \nu_t \quad (5)$$

Structural parameters can be obtained from these normalized coefficients using the following expressions:

$$a_0 = \frac{-\alpha 0}{\alpha_1} \qquad a_1 = \frac{1}{\alpha_1} \qquad a_2 = \frac{\alpha_1}{\alpha_1} \qquad a_3 = \frac{-\alpha_2}{\alpha_1}$$

$$a_4 = \frac{-\alpha_3}{\alpha_1} \qquad a_5 = \frac{-\alpha_4}{a_1} \qquad a_6 = \frac{-\alpha_5}{\alpha_1}$$

Since α_1, α_2, and α_3 are postulated to be positive, the null hypothesis is that a_1, and $a_2 > 0$, and a_3 and $a_4 < 0$.

There are a number of different methods for obtaining an index of productive capacity in a given region j. The method adopted here is to estimate the following trend function for an index of output for each of the commodity group in the given region:

Let Y_t^i = index of output for commodity group i in region j.

1/ It should be noted that since a simultaneous-equation technique is used for estimation, the choice of equation to be normalized would not have a bearing on the results.

Then an index of productive capacity is

$$\ell n\hat{Y}_t^i = a + bt + ct^2 \qquad (6)$$

where $\hat{}$ denotes the predicted value of Y_t^i.

This is somewhat more general than the conventional method in that it allows for acceleration or deceleration in growth rates. For the United States and Canada, the index of output for each of the commodity groups was used. For the EC, other European countries, Australia and New Zealand, a weighted average was used with the weights being the constituent countries' relative commodity shares.

b. Export demand equation

The demand for commodity exports is a function of world income and relative prices. More precisely,

$$\ell nXD_j^i = b_0 + b_1(PX_j^i/PW^i) + b_2\ell nYW + v_t \qquad (7)$$

where

XD_j^i = the volume of exports of commodity i demanded from region j;

PX_j^i = the export price of commodity i from region j;

PW^i = the average price in international markets; 1/

YW = real income in importing countries;

b_1 = elasticity of world demand for region j's exports of the i^{th} commodity with respect to the divergence between region j's export price of the i^{th} commodity and the average world price;

b_2 = elasticity of export demand for commodity i with respect to world income.

The null hypothesis is that $b_1 < 0$ and $b_2 > 0$.

The supply demand functions were estimated for the period 1965 to 1985 using annual data. Two estimation techniques were used--OLS with adjustment for auto-correlation, and a system estimation allowing for non-linear estimation (MINDIS). As noted earlier, a system estimation technique is

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1/ As noted earlier, given the significant differences in quality, the average world price for any commodity group can differ markedly for the price of a commodity group from a given region.

more appropriate for the specification; in any case, in general it was found that the system estimation yielded more stable parameter estimates than the single equation method, and only these are discussed below.

c. The results

The results are presented in Tables 6 to 10. These tables provide the estimated coefficients and their respective t-statistics, together with coefficient of determination, R^2, the standard error of the estimates, SEE, and the computed elasticities. 1/ It can be seen that the model performs quite well in the sense that parameter estimates have in general the expected signs and are statistically significant. In the export supply equation (Table 6) for most regions and commodities, parameters a_1, a_2, and a_3 have the expected sign and are statistically significant. The capacity variable has the expected sign in 12 out of the 15 equations. The time trend was removed from most of the equations because of collinearity with the capacity variable. With regard to the supply shocks, only the dummy for the second oil shock appeared to have any impact, and was the only one retained in the final estimation.

Perhaps the most interesting findings are for the computed price elasticities of supply, which range from 0.90 for food, 0.78 for agricultural raw materials and 0.61 for metals. (Table 7) These exceed considerably the comparable elasticities for developing countries. (For instance, Bond (op.cit.) for average price elasticities of supply of 0.70 for food, 0.43 for agricultural raw materials, and 0.24 for minerals). There can be two complementary explanations for these results: first, it could be that producers in industrial countries are likely to be less constrained in changing production following changes in world prices of commodities; secondly, industrial country exporters are more likely to be able to change supplies rapidly due to higher inventories and more efficient inventory management. Both these factors in turn may be due to relatively efficient functioning factor and financial markets. For instance, industrial country producers, compared to developing country producers, may find it easier to obtain capital etc. to increase production, as well as run down existing stocks quickly, in response to an increase in prices.

The estimated price coefficients in the exports demand equation have the expected negative sign for most of the commodity groups and are significantly different from zero at the 5 percent level of significance in most of estimated equations. (Table 8) In nearly all the equations, the estimated price elasticity is less than unity, a result implying a fairly limited short-term response of demand for exports to changes in relative prices.

1/ The interpretation of the last two statistics is, however, ambiguous in simultaneous equation models. The R^2 statistics is bounded $(-\infty,1)$ rather than (0,1), so that low values do not necessarily indicate a 'poor' fit; (see for instance, Maddala (1977)).

Table 6. Estimate of Supply Functions

Group	a_0	a_1	a_2	a_3	a_4	a_5	a_6	S.E.E.	R^2
United States									
Food	1.58	1.18	-0.51	-0.65	-0.32	0.40	0.15	0.07	0.98
	(2.25)	(6.66)	(-1.41)	(9.98)	(-2.17)	(5.91)	(2.54)		
Agricultural materials	-1.06	1.21	1.15	0.52	0.40	-	-0.10	0.06	0.96
	(-1.29)	(1.85)	(3.01)	(2.12)	(1.36)		(-1.36)		
Metals	-2.93	-0.43	2.42	-0.13	1.08	-	-0.27	0.09	0.96
	(-2.17)	(-0.39)	(2.93)	(-0.45)	(2.05)		(-2.35)		
Canada									
Food	-1.39	1.03	1.34	-0.42	-0.47	0.43	-0.16	0.12	0.95
	(-1.10)	(0.81)	(1.26)	-(2.15)	(1.32)	(3.51)	(-0.98)		
Agricultural materials	3.87	1.69	-1.61	-0.40	-2.19	-	0.18	0.16	0.95
	(-1.56)	(3.31)	(-0.89)	(-1.93)	(1.95)		(0.65)		
Metals	-2.97	1.28	2.87	(-1.07)	-1.67	-0.37	-0.37	0.07	0.98
	(-3.19)	(1.61)	(3.74)	(-0.07)	(3.27)	(-3.14)	(-3.14)		
European Community									
Food	-.78	1.19	0.30	-0.77	2.34	-	-0.03	0.07	0.98
	(-0.67)	(0.30)	(0.37)	(-2.76)	(1.04)		(-0.22)		
Agricultural materials	3.28	-1.12	-1.58	-0.83	-1.65	-	0	0.10	0.92
	(-1.68)	(-0.15)	(-1.39)	(-2.24)	(1.94)		(-0.01)		
Metals	-7.2	2.0	1.18	-0.18	-1.32	0.20	-0.09	0.08	0.96
	(-0.67)	(1.30)	(0.97)	(-0.62)	(0.64)	(2.00)	(-0.69)		
Other European									
Food	-.27	-0.72	0.95	0.24	-1.02	-	-0.20	0.13	0.94
	(-1.59)	(-1.03)	(0.77)	(0.77)	(2.06)		(-1.11)		
Agricultural materials	-4.34	1.19	1.41	-0.11	-1.35	0.30	-0.34	0.17	0.95
	(-2.74)	(1.77)	(0.62)	(-0.31)	(2.63)	(1.89)	(-1.91)		
Metals	-1.84	1.49	2.42	0.12	-0.36	-	-0.23	0.07	0.98
	(-2.57)	(0.41)	(3.46)	(0.35)	(2.13)		(-2.59)		
Australia & New Zealand									
Food	1.23	1.28	0.40	0.29	-1.82	0.10	-0.08	0.13	0.85
	(1.20)	(1.18)	(0.56)	(1.08)	(1.64)		(-0.74)		
Agricultural materials	-20.28	0.92	0.18	-0.79	-0.25	0.31	-0.14	0.20	0.83
	(-1.06)	(1.65)	(0.14)	(-1.67)	(1.49)	(-0.70)	(0.70)		
Metals	-7.79	1.75	0.27	-0.50	-2.71	0.06	-0.01	0.05	0.97
	(-1.98)	(2.15)	(0.47)	(1.60)	(2.70)	(0.19)	(-0.11)		

Note: These are estimates of equation 4 in the text; R^2 is coefficient of determination; SEE is the standard error of estimate; numbers in parentheses are t-statistics.

Table 7. Estimates of Export Price Elasticity of Supply (α_1)

Region	Food	Agricultural Raw Materials	Metals
United States	0.85	0.83	-2.32
Canada	0.97	0.59	0.78
EC	0.84	0.89	0.50
Other Europe	-1.39	0.84	0.67
Australia and New Zealand	0.78	1.09	0.57
Average[a]	0.90	0.78	0.61

Note: *, ** denote significance at 90 and 95 percent level respectively.

a. Weighted average of 5 regions (excluding negative elasticities).

Table 8. Estimate of Demand Functions

Group	b_0	b_1	b_2	b_3	b_4	S.E.E.	R^2
United States							
Food	-2.05 (-2.46)	-0.68 (-0.38)	1.43 (7.52)	-0.01 (-0.08)	0.08 (0.51)	0.15	0.83
Agricultural materials	-1.01 (-0.73)	-0.95 (-3.89)	1.19 (4.04)	0.15 (1.34)	0.13 (1.11)	0.11	0.96
Metals	9.24 (3.91)	-0.78 (-1.43)	1.18 (1.8)	0.01 (0.03)	0.80 (2.28)	0.31	0.93
Canada							
Food	-0.38 (-0.38)	-0.36 (-0.33)	1.08 (4.81)	-0.25 (-1.16)	-0.01 (-0.03)	0.21	0.62
Agricultural materials	-2.87 (-2.10)	-1.79 (-4.22)	1.64 (5.69)	-0.19 (-1.18)	-0.08 (-0.45)	0.15	0.69
Metals	4.00 (5.05)	-0.35 (-0.66)	1.13 (0.73)	0.09 (0.69)	0 (-0.04)	0.11	0.81
European Economic Community							
Food	-6.98 (-21.43)	-0.18 (-1.78)	2.51 (4.52)	-0.04 (-0.59)	0.05 (0.81)	0.06	0.99
Agricultural materials	0.32 (0.24)	-0.77 (-3.07)	0.93 (3.12)	0.18 (1.53)	0 (-0.01)	0.11	0.94
Metals	-2.95 (-3.49)	-0.56 (-0.32)	1.62 (8.85)	-0.01 (-0.08)	0.10 (0.64)	0.14	0.88
Other European countries							
Food	-1.02 (-1.95)	-0.62 (-2.12)	1.25 (10.63)	-0.12 (-1.02)	-0.14 (-1.27)	0.11	0.88
Agricultural materials	0.08 (0.09)	-0.85 (-5.09)	0.92 (4.71)	0.24 (2.29)	0.27 (2.32)	0.10	0.98
Metals	0.17 (0.42)	-0.68 (-3.40)	1.00 (13.61)	-0.01 (-0.17)	-0.15 (-2.03)	0.07	0.89
Australia and New Zealand							
Food	-2.46 (-1.88)	-0.50 (-1.79)	1.50 (5.21)	-0.15 (-0.88)	0.17 (1.11)	0.14	0.92
Agricultural materials	4.85 (6.18)	-0.56 (-1.49)	-0.02 (0.12)	-0.12 (-1.02)	-0.16 (-1.33)	0.11	0.95
Metals	-14.17 (-6.53)	-1.33 (-1.77)	4.18 (3.71)	0.11 (0.21)	-0.48 (-1.00)	0.43	0.86

Note: These are estimates of equation 7 in the text; R^2 is the coefficient of determination; SEE is the standard error of estimate; number in parentheses are t-statistics. b_3 and b_4 are estimates of parameters for trend and demand shock variables.

The estimated price elasticity of demand for commodity groups have been computed as follows: food, -0.43; agricultural raw materials, 0.99; metals, -0.68; (Table 9). These estimated price elasticities, therefore, differ significantly across commodities. As the results for individual regions show they also differ markedly across different regions. An important finding is that the average elasticity for the industrial countries also differs somewhat from the average obtained for developing country regions (Bond, op.cit. Table 8). In general the demand elasticities for the industrial countries are higher than the values obtained by Bond. This could be due to some extent to the different composition of commodity groups; it is also, however, likely to be due to the differing destination of exports.

The position of industrial countries vis-à-vis developing countries is somewhat different as far as the estimated income elasticities of demand are concerned. The elasticities have the expected positive signs and are significantly different from zero at the 5 percent level in 13 of the 15 equations. (Table 10). The average income elasticities are as follows: food, 1.96; agricultural raw materials, 1.07; metals, 1.54. These results support the hypothesis that exports of agricultural raw materials and metals are less sensitive to short-term fluctuation in world demand than food exports, such as metals. For both food and agricultural raw materials the income elasticities are markedly higher compared to those for the developing countries; for metals and minerals, however, the elasticities are considerably lower.

V. Summary and Conclusions

This paper has provided systematic evidence on the structure and evolution of primary commodity exports by industrial countries, and undertaken an econometric analysis of the determinants of these exports. The main empirical results of the paper are as follows:

1) The share of primary commodities in total world exports has fluctuated markedly over the last two decades, rising after the first world oil price rise, but declining markedly during the 1980s.

2) The share of non-fuel commodity exports in total world exports has shown a secular decline since the mid-1960s; this decline has been general, with the relative share of major commodity groups remaining virtually constant.

3) Industrial countries account for nearly half of all world commodity exports, about the same share as they accounted for in the late 1960s. As a proportion of their total merchandise exports, however, commodity exports account for around 20 percent compared to nearly 50 percent for the

Table 9. Estimated Price Elasticities of Demand (b_1) by Commodities and Region

Region	Food	Agricultural Raw Materials	Metals	Total[a]
United States	-0.68	-0.95**	-0.78	-0.74
Canada	-0.36	-1.79**	-0.35*	-0.73
EC	-0.18**	-0.77**	-0.56	-0.27
Other Europe	-0.62*	-0.85**	-0.68**	-0.77
Australia and New Zealand	-0.50*	-0.56	-1.33*	-0.68
Average[b]	-0.43	-0.99	-0.68	-0.51

Note: * denotes significance at the 90 percent level; ** denotes significance at the 95 percent level.

a. A weighted average of the three commodity groups. The weights of each commodity group's exports in 1985 as a percentage of total commodity exports for each region were used to obtain this total elasticity.

b. A weighted average of the 5 regions. The weight of each region's exports in 1985 as a percentage of total exports for each commodity were used to obtain this average elasticity.

Table 10. Estimated Income Elasticities of Demand (b_2)

Region	Food	Agricultural Raw Materials	Metals
United States	1.43**	1.19**	1.18*
Canada	1.08**	1.64**	1.13
EEC	2.51**	0.93**	1.62**
Other Europe	1.25**	0.92**	1.0**
Australia and New Zealand	1.50**	0.62	1.18**
Average[a]	1.96	1.07	1.54

Note: *, ** denote significance at 90 and 95 percent level respectively.

a. Weighted average of the 5 regions.

developing countries. "Intra-regional" commodity exports have shown a secular decline since the mid 1960s.

4) As a share of world non-fuel commodity exports, industrial countries account for over 60 percent of world exports. While the share of food exports exceeds 70 percent, agricultural raw materials and metals and minerals also account for nearly 65 percent of world exports.

5) The price elasticities of supply of major commodity exports by industrial countries appear to exceed the comparable elasticities for the developing countries. This it was suggested could reflect availability of resources for better inventory management, as well as possibility for increasing production relatively more quickly.

6) The price and income elasticities of demand for industrial country commodity exports are also somewhat higher than those for the developing countries. This could reflect, in part, some differences in the composition of commodity supplies from the industrial and developing countries.

There are a number of implications of the above results. First, the results reinforce the notion that industrial country commodity trade and pricing policies, in particular their agricultural policies, are likely to have an important influence on the commodity exports of developing countries. In other words, macro-economic policies which affect the industrial countries' demand for developing country exports, or affect international interest rates are not the only channels through which industrial country policies affect the developing countries.

Secondly, and related to the above, the results suggest that the "stylized fact" of industrial countries being exporters of manufactures and developing countries being the exporters of commodities should be used with some caution. It is valid when considering the relative share of commodity exports in total exports of the two groups of countries, although commodities account for less than half of exports of developing countries. The "stylized fact" is not, however, valid if applied to the share of world commodity exports accounted for by the industrial countries. This is particularly so in aggregate econometric models of the world economy which rely on the assumption of developing countries as commodity exporters.

Finally, the higher price elasticities of supply suggest that any exogenous shocks which affect world prices, and to the extent that the changed prices are transmitted to the industrial country producers, are likely to lead to a greater response from industrial rather than from the developing countries. Differences in the speed and magnitude of the responses, reflecting differences in the efficiency of factor and product markets, are thereby likely to have an impact on the relative share of commodity exports by the two groups of countries.

Appendix 1

Commodity Support Prices and Price Volatility

There have been two main issues concerning the impact of support prices. The first has been that by leading to an excessive increase in production they have led to a decline in the world commodity prices, which in turn has had an adverse effect on the foreign exchange earnings of developing countries exporting these commodities. The second issue has been that support prices have led to an excessive volatility in many of the world commodity markets. These two issues can be examined analytically in terms of a wedge which is driven between prices faced by the producers and consumers of the commodity. The following model can clarify the two propositions:

Suppose that the demand for the commodity depends on its current world price P_t:

$$x^D_t = a_0 - a_1 P_t \tag{8}$$

But the supply depends on the support price $\bar{P}$ in the previous period, since it was this price which determined present supply;

$$x^s_t = b_0 + b1\bar{P}_{t-1} \tag{9}$$

Since the support price will be significant only if it is greater than the market price, it is reasonable to assume that

$$\bar{P}_{t-1} = \delta P_{t-1} \text{ where } \delta < 1 \tag{10}$$

Suppose that each year's supply is sold, i.e.,

$$x^D_t = x^{st}.$$

Then using (10) the equilibrium price P_e would be given by substituting

$$P_t = P_{t-1} = P_e \text{ in}$$

$$a_o - a_1 P_t = b_0 + b_1 \bar{P}_{t-1}. \tag{11}$$

This gives

$$a_0 - a_1 P_e = b_0 + \delta b_1 P_e \tag{11a}$$

$$\text{giving } P_e = \frac{a_0 - b_0}{a_1 + \delta b_1} \tag{12}$$

If we assume that $b_1 > 0$ (the supply curve slopes up) and also $a_1 > 0$ (the demand curve slopes down), (12) indicates that the world equilibrium price would be lower compared to a case where there was no support price (i.e., $\delta=1$).

Suppose next we want to examine the time path of prices, starting at $P=P_0$. For this we take the first-order linear difference equation (11a) and find its solution which indicates the price in period t as a function of the price in period 0. The solution is

$$PT = \frac{a_0 - b_0}{a_1 + \delta b_1} + \left(\frac{-\delta b_1}{a_1} \right)^t < \left(P_0 - \frac{a_0 - b_0}{a_1 + b_1} \right)$$

$$= P_e + \left(\frac{-\delta b_1}{a_1} \right)^t < (P_0 - P_e) \tag{13}$$

suppose that $P_0 > P_e$, then the price will converge on P_e only if

$$\left(\frac{-\delta b_1}{a_1} \right)^t < 0$$

as $t \to \infty$ i.e., if elasticity of supply is less than that of demand. This is a standard result. However, $\delta > 1 \left| \delta \frac{b_1}{a_1} \right| > \left| \frac{b_1}{a_1} \right|$ which means that the the oscillations in price would be greater than would have been the case had there been no support price.

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