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THE UNITED NATIONS BILATERAL EXTERNAL TRADE DATA: CAN IT BE SAVED?

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Abstract

Empirical research in international trade is constrained by the absence of a reliable, exhaustive data base on bilateral trade flows among regions. The United Nations data base on bilateral merchandise trade flows among countries is the most complete source of such data. However, it is notably unreliable. The purpose of this paper is to report on a statistical procedure for estimating systematic reporting biases, by region, for this particular data base. This serves two purposes. First, it offers a concrete quantification of one dimension of the reporting problem. Secondly, with these reporting biases in hand, it is possible to "adjust" the data. That is, one can create a set of bias-corrected trade flows.

The proposed procedure capitalizes on the fact that the UN bilateral trade data base contains two observations on every trade flow, at any point in time. Our statistical model seeks to explain the discrepancy between reported exports from country i to country j at time T, and reported imports by j from i at T. Systematic discrepancies are attributed to c.i.f./f.o.b. margins and reporting biases by the two countries in question. We estimate the model using trade flows among OECD countries over the period 1962-1987. Merchandise trade is grouped into eight categories.

Preliminary results indicate that the reporting of Japanese import flows and U.S. export flows are unbiased. Both exports from, and imports to Australia exhibit statistically significant reporting biases. In particular, exports are systematically underreported (by 11.5%), while imports are systematically overreported (by 4.4%). A similar pattern exists for New Zealand, while the opposite is true of the European Community. Canada, on the other hand, appears to overreport both exports and imports. Some of these results may be due to the simple approach which we have taken to modeling the transportation and insurance margins. Future research will attempt to improve this aspect of the model. We will also attempt to estimate reporting biases for non-OECD regions.

INTRODUCTION

Empirical research in international trade is constrained by the absence of reliable, exhaustive data on bilateral trade flows among regions. The United Nations data on bilateral merchandise trade among countries is the most complete source of such data. However, it is notably unreliable. The purpose of this paper is to report on a statistical procedure for estimating systematic reporting biases, by region, for this particular data base. This serves two purposes. First, the presence of significant, systematic biases is of interest for its own sake. Second, with estimates of reporting biases available, it is possible to "adjust" the data. That is, one can create a set of bias-corrected trade flows.

PREVIOUS RESEARCH

There is a rather long history of attempts to explore, and sometimes correct for, the sources of inconsistency in world trade statistics. Parniczky provides a useful overview of the history of these attempts. He traces them back to Zuckermann (1920) and the League of Nations (1935-38), with more recent efforts to reconcile trade statistics being initiated by Canada and the U.S. (Bureau of the Census, 1970) and the U.N. Statistical Office (1974). Hiemstra and Mackie (1985) outline an ongoing effort by USDA to reconcile disaggregated agricultural trade data from the U.N.

Parniczky identifies the following major sources of inconsistency in reported trade:

(1) Time lags between the date of an export transaction and observation of the corresponding import.

(2) Differential administrative attention. In particular, he notes the incentive for governments to keep better records on items where quantitative controls or tariff revenues are involved.

(3) "Misclassification" of commodities, or discrepancies in the way the same commodity is mapped from domestic to Standard International Trade Classification (SITC) codes.

(4) Transportation and insurance costs.

(5) Transshipment. In particular he notes (p. 45) that: "Frequently the exporter is not aware of the final destination of the merchandise and the importer has multiple choices in identifying the country of provenance." Even where such uncertainties do not exist, the coexistence of two competing procedures for identifying trading partners introduces problems when a commodity is transshipped. The "general trade system" reports all goods entering (leaving) the national territory as imports (exports), whereas the "special trade system" records only those imports destined for home use, with the country of origin being the producer. Parniczky notes that while trade statisticians recommend the former procedure, the majority of countries use the latter, as it is of greater interest to trade policy makers.

Other authors have used statistical methods to explore specific hypotheses. For example DeWulf explores the possibility of conscious underinvoicing of imports to circumvent quotas or tariffs, or overinvoicing to take advantage of rationed foreign exchange. The correlation of trade data discrepancies with the incentive to smuggle has also been examined (McDonald). Neither of these studies finds much explanatory power in these variables. Yet the evidence of persistent discrepancies in reported exports and imports for a given transaction is overwhelming--as will be shown below. Are these discrepancies purely random, or is there a systematic component to them? The object of our paper is to answer this question.

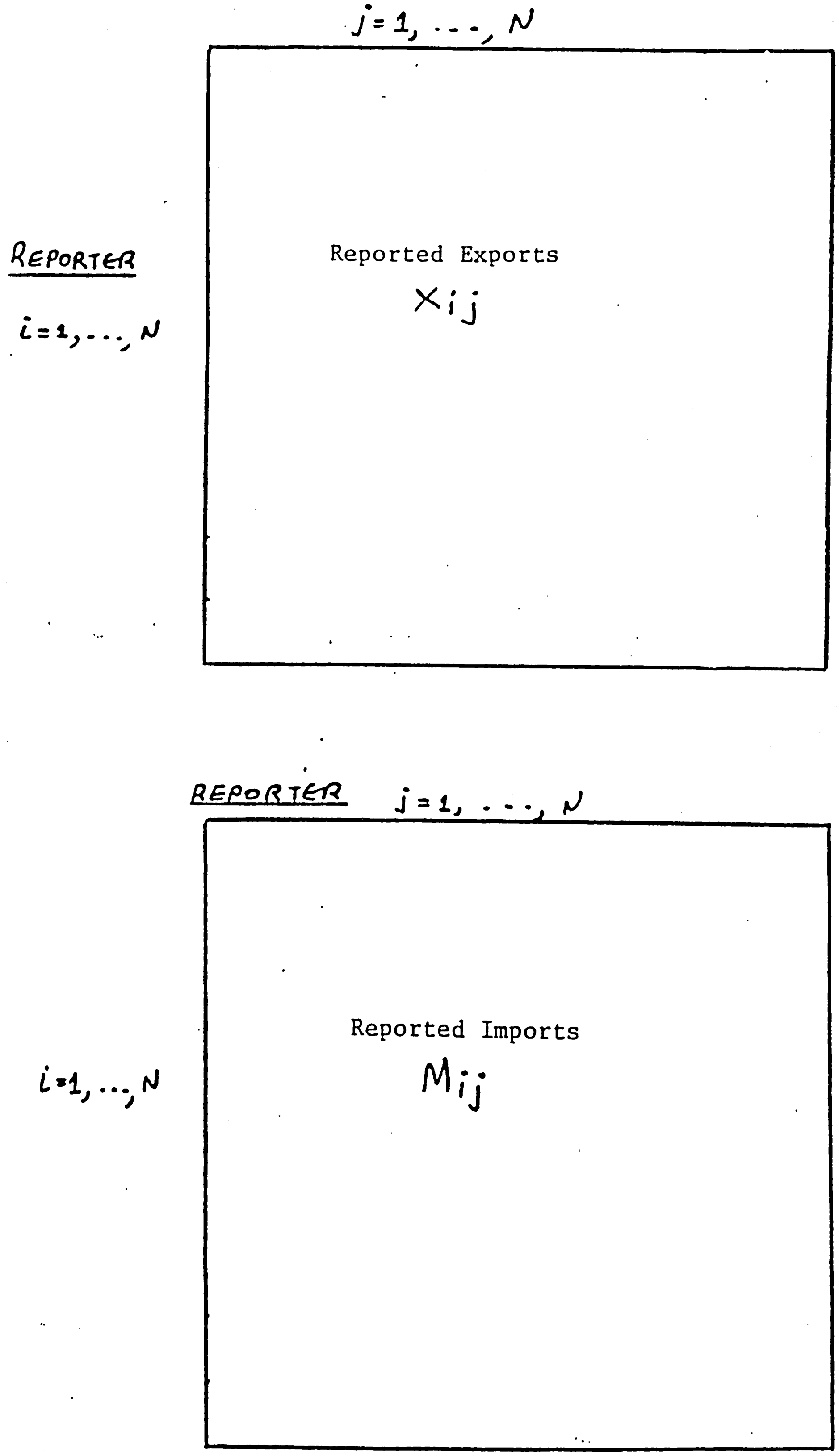
STRUCTURE OF THE DATA

Figure 1 provides a "picture" of one year's data available from the U.N. for each of the K traded commodities, from 1962 to the latest year, as reported by the N countries which together exhaust the list of all reporters, or potential reporters in the data base. The top matrix (X_{ij}) captures exports from country i to j as reported by i. The bottom matrix in figure 1 shows import flows among the N countries (M_{ij}) as reported by country j.

As noted above, there are numerous problems with the U.N. bilateral trade data. Countries may report inaccurately, or they may fail to report altogether. Unlike with some trade data bases, the U.N. statistical office does not attempt to estimate values for missing observations, or to correct obviously erroneous data. Thus, if we were to simply use the data in its raw form we would dramatically understate the role of some countries (e.g., the centrally planned economies--many of whom do not report at all) in international trade, and others may be given excessive importance.

In an attempt to improve upon the quality of this data, we formulate a model of the data generation process, which we subsequently estimate. In this manner we are able to bring the full time series of import and export data matrices, for all K commodities, to bear in our effort to specify a single benchmark trade data set.

Figure 1. The Structure of the United Nations External Trade Data for a Given Commodity in a Single Year



A MODEL OF DATA GENERATION

We hypothesize that the value of the shipments data is measured and reported with systematic errors. At any point in time, the error free values (denoted with an asterisk) are:

(1) $M_{ij}^{k*} = (M_{ij}^{k})\ \theta_{ij}^{k,m}$, and $X_{ij}^{k*} = (X_{ij}^{k})\ \theta_{ij}^{k,x}$

where: k is the index for commodities,

i,j are indexes for origin and destination of shipment,

M_{ij}^{k} is c.i.f. value of imports reported by j,

X_{ij}^{k} is f.o.b. value of exports reported by i,

$\theta_{ij}^{k,m}$ is the reporting error associated with the value of the import of commodity k, from country i, as reported by j, and

$\theta_{ij}^{k,x}$ is the reporting error associated with the value of the export of commodity k, to country j, as reported by i.

We assume that these errors are systematic, and may be modeled as being specific to the reporting region, although different for exports, than for imports. In other words:

(2) $M_{ij}^{k*} = \alpha_j^m \cdot M_{ij}^{k}$, and $X_{ij}^{k*} = \alpha_i^x \cdot X_{ij}^{k}$

where α_j^m and α_i^x are systematic reporting biases associated with imports to, and exports from, countries j and i. A value of $\alpha_j^m > 1$ indicates that country j systematically underreports imports, and similarly for i's reporting of exports when $\alpha_i^x > 1$.

At the most disaggregate level, data on X_{ij}^{k} and M_{ij}^{k} are available in quantity terms. However, for purposes of the present paper, where we seek to analyze all merchandise trade simultaneously, such detail is not possible. Consequently data are available only in value terms. This means that unbiased imports and exports will generally differ as a result of transportation and insurance costs.[1] Formally:

$$(3) \quad \mu_{ij}^{k} = \frac{M_{ij}^{k*}}{X_{ij}^{k*}} ,$$

where we expect μ_{ij}^{k} to be greater than 1, with $(\mu_{ij}^{k} - 1)$ representing the c.i.f.-f.o.b. margin.

Singularity prevents us from estimating both sets of reporting biases and flow-specific margins simultaneously. Thus we postulate a common value of μ for each commodity k, so that:

$$(4) \quad \mu^{k} = \frac{\alpha_{j}^{m}}{\alpha_{i}^{x}} \frac{M_{ij}^{k}}{X_{ij}^{k}} , \text{ for all i, j.}$$

Letting: $y_{ij}^{k} = \dfrac{M_{ij}^{k}}{X_{ij}^{k}}$, we may rewrite (4) in a manner which uses knowledge of the c.i.f.-f.o.b. margin and the reporting biases together to predict the ratio of reported imports to reported exports between i and j for a given commodity k:

$$(5) \quad y_{ij}^{k} = \mu^{k} \frac{\alpha_{i}^{x}}{\alpha_{j}^{m}} , \text{ or } \ln (y_{ij}^{k}) = \ln (\mu^{k}) + \ln (\alpha_{i}^{x}) - \ln (\alpha_{j}^{m}).$$

This is the model we wish to estimate, using time series data for an exhaustive grouping of merchandise trade, $k = 1,\ldots,K$.

The regression model becomes:

$$(6)\quad \ln y^k_{ijt} = \sigma + \sum_{\ell \neq bc}^{K} \gamma^\ell D^c_\ell + \sum_{\ell \neq bx}^{N} \beta^x_\ell D^x_\ell + \sum_{\ell \neq bm}^{N} \beta^m_\ell D^m_\ell + \epsilon^k_{ijt},$$

where the error ϵ^k_{ijt} is independently and identically distributed, the D's are indicator variables; $k = 1,\ldots,K$; i and $j = 1,\ldots,N$; and $t = 1, \ldots, T$. The first set of indicator variables in (6), D^c_ℓ, take on a value of 1 when $\ell = k$ and 0 otherwise. Thus γ^ℓ picks up the departure of the $k^{\underline{th}}$ c.i.f./ f.o.b. ratio (in logarithms) from that of the ratio for the good which has been chosen as the "base" commodity and is thus a component of the intercept term (γ^{bc}). The second and third sets of indicator variables, D^x_ℓ and D^m_ℓ, take on a value of one and minus one when their indices equal i and j, respectively, and zero otherwise. As a result, β^x_ℓ and β^m_ℓ measure the departure of exporter and importer biases from β^x_{bx} and β^m_{bm}, the base reporters, which also appear in the intercept. Thus: $\sigma = \gamma^{bc} + \beta^x_{bx} - \beta^m_{bm}$. Notice these effects cannot be separated by having a dummy variable for every commodity, importer and exporter, since, for example, the sum of the commodity dummies would always equal the sum of the exporter dummies.

If we happen to have selected unbiased base reporters, such that $\beta^x_{bx} = \beta^m_{bm} = 0$, then the intercept simplifies to $\sigma = \gamma^{bc}$ and so $\mu^{bc} = e^\sigma$. The remaining margins may be derived as departures from this, i.e.: $\ln \mu^k = \sigma + \gamma^k$ or $\mu^k = e^{(\sigma + \gamma^k)}$. Since the natural logarithm of the base biases is zero, the remaining biases are easily derived. For example: $\ln \alpha^x_i = \beta^x_i$ or $\alpha^x_i = e^{\beta^x_i}$. Of course, when β^x_{bx}, and $\beta^m_{bm} \neq 0$ then the intercept contains three terms, and we cannot extract these individual components.

Since the OLS estimates of the differences between the bias of two countries are invariant to the choice of base reporters, the effect of choosing a different base for one of the reporter biases (e.g., changing bx to bx′) may be captured by simply manipulating the fitted parameters: add $\beta^x_{bx'}$ to the intercept, and subtract it from β^x_i, i = 1, ..., N. Thus the new value of the intercept becomes:

$$\sigma' = \gamma^{bc} + (\beta^x_{bx} + \beta^x_{bx'}) - \beta^m_{bm}.$$

By systematically varying the base reporters, bx and bm, and examining the value of $\mu^k = e^{\sigma}$, one can study the implications of a given choice of base reporter for the implied margins under the assumption of unbiased base reporters. This suggests one means of discriminating among base reporters, namely vary the combinations of bx and bm until the predicted margins match the evidence from other sources. However, this is a rather ad hoc procedure, and one might suspect that estimates of the c.i.f./f.o.b. margins from these other sources may not be free of the problems introduced by correlation with reporting biases.[2] (This issue will be explored in detail below.)

Capitalizing on f.o.b. Import Reporters

There is one idiosyncracy of the U.N. trade data base that may be turned to advantage. Because a few countries report imports on an f.o.b. basis, the model in (6) may be modified as follows:

$$(7)\quad \ln y^k_{ijt} = \sigma + \sum_{\ell=1}^{K} \gamma^{\ell} D^c_{\ell} + \sum_{\ell\neq bx}^{N} \beta^x_{\ell} D^x_{\ell} + \sum_{\ell\neq bm}^{N} \beta^m_{\ell} D^m_{\ell} - \sum_{\ell\in fob}^{K} \gamma^{\ell} D^c_{\ell'} + \epsilon^k_{ijt}.$$

As long as there exist some f.o.b. reported imports for each of the K commodities, then need for a "base commodity" is eliminated. If a country reports imports on an f.o.b. basis, there is no margin, and any discrepancy between reported imports and exports is due to systematic bias or stochastic error. That is, the f.o.b. observations introduce zeroes into the data set, which break the pattern of singularity in the indicator variables, D^c_{ℓ}. Thus the intercept is now comprised solely of the two biases: $\sigma = \beta^x_{bx} - \beta^m_{bm}$. Thus, this idiosyncratic pattern of reporting permits us: (a) to obtain estimates of the c.i.f.-f.o.b. margin which are independent of the base reporters chosen, and (b) to test statistically for biased pairs of reporters. In particular, we are interested in testing: H_o: $\sigma = 0$ against H_A : $\sigma \neq 0$. This in turn has important implications for the manner in which we aggregate reporters, which is the subject of the next section.

COUNTRY AND COMMODITY AGGREGATION

Due to the immense size of the U.N. trade data base, considerable aggregation is necessary before an operational data set may be obtained. The total number of observations in a given bilateral trade data set may be calculated as N x (N-1) x K x T x 2, where N is the number of countries, K is the number of commodities, T is the length of the time series (in years) and there are two observations on each flow (i.e., reported imports and exports).

Given our underlying interest in trade modeling, we specified an exhaustive grouping of countries. Furthermore, it was important to break out the major f.o.b. reporters of imports. This, combined with a special interest in North American and Pacific trade, led to the grouping of countries or areas into the nineteen regions eight of which are single countries displayed in table 1. A complete description of regions appears in appendix table 1.

The commodity aggregation scheme which we employed was based on ongoing trade research conducted in the Agricultural and Trade Analysis Division of the Economic Research Service of USDA, which provided the data for this project. It is summarized in the second part of table 1. Note that there are three natural resource-based commodities: food and agricultural products, forestry products, and commodities based on mining and resource extraction. Manufactured products, exclusive of those linked with the natural resource-based commodities, are divided into five groups. The basic intermediate category includes capital intensive products (e.g., primary metals, manufactured fertilizers and electricity) which are used in the further manufacture of other goods. Light industry includes products such as furniture, leather goods and clothing, and the high technology category consists of products such as scientific equipment and electrical machinery. The remaining two categories are intermediate manufactures (e.g., metal manufactures, office supplies, printing and publishing) and finished capital goods such as motor vehicles.

The data set was obtained from the U.N. tapes, and it reflects data availability as of March 1989. It includes observations over the period 1962-1987. After aggregation, there is a possible total of 146,848 reported trade values. From this data set we exclude 4,576 values which refer to inter-regional trade (e.g., exports or imports among the twelve countries comprising the European Community) which arise due to aggregating over countries. This leaves us with 142,272 trade values from which we may potentially compute 71,136 values for variable y(=M/X).

Table 1. Aggregation Scheme: UN External Trade Data

A. Country or Area Aggregation

Eleven Regions	Eight Countries
Communist Asia	Australia (f.o.b. reporter)
Eastern Europe	Brazil
E.C.	Canada (f.o.b. reporter)
Latin America	Japan
Middle East and North Africa	Mexico
New Asian NICs	New Zealand
Old Asian NICs	USA (f.o.b. reporter prior to 1974)
Other Southeast Asia	USSR (f.o.b. reporter)
Other Western Europe	
South Asia	
Subsaharan Africa	

B. Commodity Aggregation

Aggregate Commodity	UNSITC Codes Included
Food, Agriculture and Fisheries	00-02, 03, 04-23, 29, 41-43
Basic Intermediate	266,267, 35, 52-53, 55-59, (\5595), 62-64, 66-68
Mining and Resource Extraction	27-28, 32-34
Light Industry	61, 65, 82-85
Forestry Products	24, 25
Finished Capital Goods	71, 73, 95, 96
High Technology	51, 54, 72, 86
Intermediate Manufactures	69, 81, 89

A CLOSER LOOK AT THE DATA

In this section we examine the data in more detail. There are several cases in which one of the trade partners does not report trade (exports or imports) for that particular commodity and year. For example, the USSR does not report at all into this data base. For reporting purposes, this in effect reduces the number of regions from nineteen to eighteen. Furthermore, there are 4,166 observations in which the exporter does not report trade (i.e., there is no value for X) whereas the importer reported trade (i.e., there is a value for M). About 52% of these observations involve Communist Asia as reporter of exports. (The People's Republic of China is also a nonreporter.)

There are also 2,547 observations in which the importer does not report trade (i.e., there is no value for M) yet the exporter reported trade (there is a nonzero value for X). Again, about 56% of these observations involve Communist Asia as a reporter of imports. These three sets of observations represent extreme cases of the problem we are trying to address. For purposes of this paper, we exclude them from further consideration, since it is meaningless to quantify the reporting bias of a non-reporter.

Finally, there are 2,769 observations with both partners not reporting trade values. These carry no information and are excluded. The final data set consists of 54,166 observations and it covers trade in all eight commodities and all 306 (= 18 x 17) trade routes, excluding trade with the U.S.S.R.

Table 2 presents a summary of the final data set in two dimensions. Observations have been grouped according to the size of variable y and reported trade value (which we take as the maximum of reported exports or imports). There are 44,051 observations with a ratio value between 0.25 and 4. We argue that anything outside of this range is an extreme value, and may warrant special attention. Of the remaining observations, 6,341 have y values

Table 2. Distribution of Observations by Size of Trade Flow and Variable y

Ratio	Size of Max(X,M)										
	a01	a02	a03	a04	a05	a06	a07	a08	a09	a10	a11	Row Total
a01	10	28	23	24	20	11	1	.	.	.	.	117
a02	23	29	17	4	8	6	.	.	.	.	.	87
a03	52	37	29	8	5	7	.	.	.	.	.	138
a04	52	44	43	22	14	14	3	3	.	.	.	195
a05	201	102	80	64	44	44	12	1	.	.	.	548
a06	265	140	110	59	38	67	10	5	.	.	.	694
a07	623	351	363	221	146	208	40	42	1	.	.	1995
a08	7811	6618	7565	5359	3952	7291	2200	2635	403	213	4	44051
a09	999	610	473	271	162	249	39	59	11	5	1	2879
a10	422	249	202	136	75	82	21	13	5	5	.	1210
a11	322	187	142	68	52	60	11	9	.	1	.	852
a12	136	98	54	44	22	26	12	4	4	.	.	400
a13	80	68	52	48	16	14	10	4	1	3	.	296
a14	60	71	63	32	20	13	4	.	.	.	.	263
a15	15	111	143	85	51	33	2	1	.	.	.	441
Column Total	11071	8743	9359	6445	4625	8125	2365	2776	425	227	5	54166

Definition of Classes for Max(X,M)

a01: 0 <=Max(X,M)< 1000
a02: 1000 <=Max(X,M)< 5000
a03: 5000 <=Max(X,M)< 20000
a04: 20000 <=Max(X,M)< 50000
a05: 50000 <=Max(X,M)< 100000
a06: 100000 <=Max(X,M)< 500000
a07: 500000 <=Max(X,M)< 1000000
a08: 1000000 <=Max(X,M)< 5000000
a09: 5000000 <=Max(X,M)< 10000000
a10: 10000000 <=Max(X,M)< 50000000
a11: 50000000 <=Max(X,M)< 100000000

Note: Exports and Imports are measured in current US $1,000.

Definition of Classes for Ratio of M/X

a01: 0 < ratio < 0.002
a02: 0.002<= ratio < 0.005
a03: 0.005<= ratio < 0.01
a04: 0.01 <= ratio < 0.02
a05: 0.02 <= ratio < 0.05
a06: 0.05 <= ratio < 0.1
a07: 0.1 <= ratio < 0.25
a08: 0.25 <= ratio < 4
a09: 4 <= ratio < 10
a10: 10 <= ratio < 20
a11: 20 <= ratio < 50
a12: 50 <= ratio <100
a13: 100 <= ratio <200
a14: 200 <= ratio <500
a15: 500 <= ratio

which are larger than four. Looking at the other dimension of table 2, there are 11,071 observations with trade values below the U.S. $1,000,000 level. There are also five observations with trade values above the U.S. $50 billion level. Casual observation of table 2 suggests a general tendency for the proportion of extreme values of y to fall, as the size of the flow increases. Also, in the case of the largest flows, the extreme values all involve reported imports in excess of exports (i.e., $y > 1$).

Table 3 shows the mean of the variable $y(=M/X)$ (over all commodities and years) for each one of the 306 trade routes in the data set. Rows in table 3 represent regions which reported the export value (i.e., origin of a flow), and the columns represent regions which reported the import value (i.e., destination of a flow). (The number of flows observed, and their standard deviations are reported in a similar table in appendix table 5.) By far the largest mean values involve Communist Asia as reporter of exports. For example, the mean of variable y for trade from Communist Asia to Australia is about 888. Again, this is due to the absence of the PRC as a reporter in all years, except 1984. On the other hand, trade routes among single country regions have consistently small means for y. The same is true for the European Community and Other Western Europe.

The information in table 3 suggests that the bias coefficients β_ℓ^x and β_ℓ^m in (7) consist of two components. One component captures the effect of not reporting trade at all. When this arises at the individual country level, we obtain a zero observation. These data points have been excluded. When it occurs within a region, the consequence is a dramatic value for y. The latter case arises for Communist Asia, due to non-reporting by the People's Republic of China. Since there are countries in these regions which report trade, these observations are retained in the data (i.e., neither X nor M is zero).

Table 3. Means of Variable y (=Mij/Xij) by Route

Origin	Destination																	
	AUST	BRAZ	CAN	COAS	EC12	EEUR	JAPA	LATA	MEX	MIDE	NNIC	NZ	OtSE	OtWE	ONIC	SASI	SUBS	USA
AUST	.	5.36	32.69	1.77	1.36	10.07	1.73	2.52	1.95	1.50	4.00	1.16	0.67	2.76	1.59	1.16	7.28	2.12
BRAZ	1.79	.	1.50	11.67	1.22	5.42	30.55	0.83	0.98	2.51	4.17	2.87	1.43	1.66	1.30	2.58	4.01	1.11
CAN	1.02	1.29	.	0.62	1.08	0.62	1.22	0.70	0.88	0.70	1.26	1.26	0.97	1.31	1.08	1.00	4.27	1.06
COM ASIA	888.3	5.83	1225	.	1169	869.5	1324	140.7	76.50	1367	1062	156	313.6	1334	4488	511.4	2041	823.9
EC12	1.08	1.18	1.09	1.19	.	0.47	1.27	0.87	1.17	0.76	1.73	1.49	1.14	1.01	1.38	1.00	0.79	1.12
EEUR	71.63	120.4	99.46	40.79	3.84	.	91.49	18.29	36.89	4.95	86.50	19.71	29.31	3.33	64.20	73.66	64.51	30.58
JAPAN	1.08	1.30	4.57	0.84	1.11	0.48	.	1.39	2.46	0.72	1.38	1.68	0.74	2.06	1.03	1.18	2.78	1.29
LAT AMER	5.98	1.97	27.41	7.00	2.06	4.37	23.22	.	4.68	63.58	4.32	9.25	4.78	10.70	83.93	5.13	7.71	1.79
MEX	4.55	1.52	5.04	3.31	1.51	2.82	5.27	0.87	.	2.55	31.67	17.42	3.80	2.46	12.51	10.65	4.84	2.18
MID EAST	4.56	13.09	7.34	2.52	1.99	0.75	53.80	3.09	12.05		5.27	3.67	113.3	1.72	11.31	8.54	6.92	1.42
NEW NICs	1.18	4.46	1.54	4.49	1.49	20.97	1.38	2.36	18.22	1.59	.	1.44	0.99	8.02	1.15	5.29	1.10	1.84
NZ	1.17	2.44	1.25	1.57	1.78	1.35	1.65	1.29	2.07	4.37	1.88	.	0.77	4.12	6.50	1.44	9.47	3.61
OtSEASIA	18.85	5.24	6.40	97.81	17.51	275.4	6.07	7.54	8.25	3.45	13.69	5.85	.	15.86	3.97	4.83	23.16	3.77
OtWEur	1.10	1.22	2.81	2.29	1.03	0.54	1.33	0.98	2.14	0.90	2.28	1.39	0.94	.	2.66	0.98	1.35	2.62
OLDNICs	0.93	2.05	1.47	3.27	1.19	3.07	1.27	1.48	1.87	0.96	0.68	1.26	1.55	3.36	.	0.87	0.63	1.08
SASIA	5.70	29.14	14.16	1.45	4.74	69.53	4.07	7.57	6.22	0.86	4.98	4.17	17.32	5.95	2.90	.	2.45	74.84
SUBSAH	14.81	246.9	1391	5.40	8.05	477.6	2256	21.44	161.2	10.81	107.2	20.28	82.01	156.7	1270	142.4	.	24.73
USA	1.07	1.10	1.13	29.35	1.15	0.82	1.22	0.86	0.87	0.83	1.52	1.32	0.93	1.26	1.06	0.94	1.31	.

But clearly this type of bias can easily give rise to extreme values for y. The second component in the reporting biases in (7) captures the effect of not reporting accurate trade values. This happens with all regions, and it will be the focus of our statistical analysis below.

We hypothesize that, due to these two components, reporting biases for multi-country regions will be significantly different from reporting biases for single countries with the latter being close to zero. Furthermore, we suspect that our simple model in (7) will not be able to sort out all of these effects. We thus choose to concentrate on a subset of regions. Specifically we select the European Community (EC), Other Western Europe (OWE), Australia, New Zealand, Japan, the USA, and Canada. We call this the OECD data set, although Turkey (a member of OECD) has not been included (Turkey has been aggregated into the Middle East and North Africa region). While the OECD data set does include two regions, namely the EC and OWE, we have been able to verify that most of the countries in these regions regularly report their trade data into the U.N. data base.[3] Thus we believe the influence of the first source of bias, noted above, has been minimized.

Table 4 organizes the OECD data in a similar fashion to table 2. There are 8,529 observations in this data set with about 97% of them (i.e., 8,279 observations) having y values in the range from 0.25 to 4. Yet there remain several observations (250) with inexplicably extreme values for y. About 76% of these extreme value observations involve Australia (to a large extent) and New Zealand (to a lesser extent) as a trade partner. Table 5 shows the means for y by route for this subset of (250) observations. (A complete listing of extreme y values associated with Australia and New Zealand are presented in

Table 4. Distribution of Observations by Size of Trade Flow and Variable y for the OECD Data

Ratio	Size of Max(X,M)										
	a01	a02	a03	a04	a05	a06	a07	a08	a09	a10	Row Total
a04	1	.	.	.	.	.	.	.	.	.	1
a05	3	.	.	.	.	.	.	.	.	.	3
a06	4	1	1	2	.	.	.	.	.	.	8
a07	10	6	7	4	1	.	.	.	.	.	28
a08	752	857	1132	965	823	1663	686	1044	219	138	8279
a09	50	23	11	7	11	14	1	1	.	.	118
a10	13	4	2	4	19	5	8	.	.	.	55
a11	9	3	1	1	1	1	3	1	.	.	20
a12	4			.				1			5
a13	2	.	1	1	.	.	.	1	.	.	5
a14	1	.	2	1	.	.	.	.	.	.	4
a15	.	.	.	1	2	.	.	.	.	.	3
Column Total	849	894	1157	986	857	1683	698	1048	219	138	8529

Table 5. Means of Variable y for Subset of Extreme Values

A. Means of Very Low Ratios (less than 0.25) by Route

Origin	Destination					
	CAN	EC12	JAPA	NZ	OtWE	USA
AUST	0.15	.	0.16	.	0.20	0.25
EC12	0.20	.	.	.	.	.
JAPA	0.12	0.07	.	0.13	0.07	.
NZ	0.12	.	0.11	.	0.08	0.15
OtWE	0.04	.	.	.	.	.

B. Means of Very High Ratios (greater than or equal to 4.00) by Route

Origin	Destination						
	AUST	CAN	EC12	JAPA	NZ	OtWE	USA
AUST	.	311.10	4.43	9.21	.	9.48	14.36
CAN	.	.	.	.	5.01	4.12	.
EC12	.	4.53	.	.	6.42	.	.
JAPA	6.50	74.19	.	.	19.51	12.32	5.66
NZ	4.66	9.67	8.83	16.12	.	17.93	35.43
OtWE	.	59.47	.	11.61	20.77	.	37.08

appendix tables 2 and 3.) It is not clear why this happens but distance does not appear to play a role. For example the mean of y for trade from New Zealand to Other Western Europe is 4.12, whereas the mean of y for trade from Other Western Europe to New Zealand is only 1.39 (see table 3). The presence of these extreme values will show up in the statistical results below, at which point we will provide further discussion.

STATISTICAL RESULTS

In this section, we report on the results obtained by estimating the model given in (7), using the OECD data set. Two sets of issues are explored. First, we test the null hypothesis that all OECD reporting pairs are unbiased. Since we do find statistically significant evidence of biased reporting, we proceed to compute point estimates of each region's import and export reporting biases. The second issue to be examined relates to the estimated c.i.f.-f.o.b. margins. Here we examine whether the model proposed above generates different estimates than does the customary approach of simply summing imports and exports and considering their ratio.

Testing for Unbiased Reporting

Table 6 reports the estimates, $\hat{\sigma}$, along with the associated t statistics (second entry), for each of the 49 combinations of base reporters. An asterisk indicates that the associated intercept estimate is significantly different from zero, thus causing us to <u>reject</u> $H_o : \sigma = 0$, for that pair of reporters. This occurs in 26 of the 49 possible cases. For example, with Australia and New Zealand as base reporters of exports and imports, respectively, the estimate of σ is 0.1376 and it is significantly different from zero. This suggests that they are not "good" base reporters.

Table 6. Intercept Estimates in Model (7) by Base Pair of Reporters.

Exporter	Importer						
	EC12.	OWEur.	Austr.	N.Z.	Japan	USA	Canada
EC12	-0.0824*	0.0869*	0.0184	-0.0115	-0.0375	-0.0169	0.0530*
	-2.3429	2.5351	0.9569	-0.3354	-1.0956	-0.6873	2.7453
OWEur.	-0.0279	0.1414*	0.0729*	0.0430	0.0171	0.0376	0.1076*
	-0.8155	4.0069	3.8007	1.2540	0.4992	1.5278	5.5701
Austr.	0.0667	0.2359*	0.1674*	0.1376*	0.1116*	0.1321*	0.2021*
	1.9496	6.8767	8.0035	4.0086	3.2632	5.3638	10.4413
N.Z.	0.0605	0.2297*	0.1612*	0.1314*	0.1054*	0.1259*	0.1959*
	1.7454	6.5708	8.1935	3.6691	3.0402	4.9999	9.6905
Japan	-0.0594	0.1099*	0.0414*	0.0115	-0.0145	0.0060	0.0760*
	-1.7371	3.2058	2.1547	0.3350	-0.4108	0.2470	3.9281
USA	-0.0425	0.1268*	0.0583*	0.0284	0.0024	0.0230	0.0929*
	-1.2418	3.6973	3.0380	0.8276	0.0719	0.8846	4.8121
Canada	-0.0979*	0.0714*	0.0028	-0.0270	-0.0529	-0.0324	0.0375
	-2.8636	2.0836	0.1500	-0.7866	-1.5485	-1.3164	1.7822

Notes: First-line entry shows the intercept estimate, and second-line entry shows the corresponding t-statistic.
A asterisk indicates a significant from zero estimate.

It is important to note that, while rejecting H_o implies that the pair of reporters in question is a biased pair, failing to reject H_o does <u>not</u> imply the opposite. This is due to the fact that $\hat{\sigma} = (\beta^x_{bx} - \beta^m_{bm}) = (\ell n\ \alpha^x_{bx} - \ell n\ \alpha^m_{bm})$, which can also be zero when $\alpha^x_{bx} = \alpha^m_{bm} \neq 1$. That is, if a consistent overreporter of exports is paired with a consistent overreporter of imports, the resulting biases will cancel out of the ratio used to construct y. Thus it is possible to mistakenly infer from this model that a given pair of reporters is unbiased. For this reason, it is important to consider the full set of combinations, because examining all models provides further clues as to whether a given reporter is in fact unbiased.

Examination of the columns of table 6 indicates that Other Western Europe shows up as a biased reporter of imports, regardless of the exporter with which it is paired. Canada is always found to be a biased reporter, except when paired with itself. Australia also shows up as a frequently biased importer. Similarly, row-by-row perusal of table 6 highlights the presence of Australia and New Zealand as biased reporters of exports, except when paired with the E.C.

Table 7 concentrates on the subset of 13 base reporter combinations for which the t-statistic associated with $\hat{\sigma}$ is less than one in absolute value. It reports estimates of σ, along with the 2-standard-deviation confidence interval bracketing this estimate, and the t-statistic. It also shows the implied estimates of reporting biases [parameters α^m_j and α^x_i in (2)]. They illustrate the fact that the point estimates of each region's reporting biases depend on the reporters chosen to be the unbiased base pair. Despite this fact, there are some clear patterns in these biases. For example, Australia

Table 7. Least Significant Intercept Estimates in Model (7) with Associated Bias Estimates

Intercept				Export Biases							Import Biases						
Estimate	Low	Upper	t	EC12	OWEu	Aust	NZ	Jap	USA	Can	EC12	OWEu	Aust	NZ	Jap	USA	Can
-0.028	-0.096	0.040	-0.82	0.95	.	1.10	1.09	0.97	0.99	0.93	.	0.84	0.90	0.93	0.96	0.94	0.87
-0.027	-0.098	0.042	-0.79	1.02	1.07	1.18	1.17	1.04	1.06	.	1.07	0.91	0.97	.	1.03	1.01	0.94
-0.017	-0.066	0.032	-0.69	.	1.06	1.16	1.15	1.02	1.04	0.98	1.07	0.90	0.97	0.99	1.02	.	0.93
-0.014	-0.085	0.056	-0.41	0.98	1.03	1.13	1.13	.	1.02	0.96	1.05	0.88	0.95	0.97	.	0.98	0.91
-0.012	-0.080	0.057	-0.34	.	1.06	1.16	1.15	1.02	1.04	0.98	1.07	0.91	0.97	.	1.03	1.01	0.94
0.002	-0.068	0.071	0.07	0.98	1.01	1.12	1.11	0.98	.	0.95	1.05	0.88	0.95	0.97	.	0.98	0.91
0.003	-0.035	0.041	0.15	1.02	1.07	1.18	1.17	1.04	1.06	.	1.11	0.93	.	1.03	1.06	1.04	0.97
0.008	-0.043	0.055	0.25	0.98	1.03	1.13	1.13	.	1.02	0.96	1.07	0.90	0.97	0.99	1.02	.	0.93
0.011	-0.057	0.080	0.34	0.98	1.03	1.13	1.13	.	1.02	0.98	1.07	0.91	0.97	.	1.03	1.01	0.94
0.017	-0.051	0.085	0.50	0.95		1.10	1.09	0.97	0.99	0.93	1.05	0.88	0.95	0.97	.	0.98	0.91
0.018	-0.020	0.057	0.96	.	1.06	1.16	1.15	1.02	1.04	0.98	1.11	0.93	.	1.03	1.06	1.04	0.97
0.023	-0.029	0.075	0.88	0.96	1.01	1.12	1.11	0.98	.	0.95	1.07	0.90	0.97	0.99	1.02	.	0.93
0.028	-0.040	0.097	0.83	0.96	1.01	1.12	1.11	0.98	.	0.95	1.07	0.91	0.97	.	1.03	1.01	0.94

and New Zealand always appear as underreporters of exports. On the other hand, Australia and New Zealand are found to be overreporters of imports, unless Australia is the base reporter of imports. Furthermore, on average, the USA and Japan are the least-biased reporters.

The sixth row in table 7 corresponds to the model with both the smallest and most insignificant estimate of σ. Furthermore, it pairs USA with Japan as base export and import reporters respectively. (The full set of parameters associated with this model are provided in the appendix table 4.) The next smallest t-value appears in the seventh row in table 7, with Canada and Australia as base export and import reporters, respectively. However, it is hard to accept this given the fact that Australia shows up as biased in its reporting of imports when paired with 5 of the 7 exporters. Indeed, since the estimates of $\alpha^{m}_{\text{Australia}}$ and $\alpha^{x}_{\text{Canada}}$ shown in table 7 are roughly equal in size, we may infer that this is an instance of offsetting biases.

Estimating Margins

Table 8 shows estimates of the margin parameters i.e. the ratios of imports to exports, corrected for bias. The first row of estimates are obtained from the regression model. (Recall that these estimates are invariant to the choice of base reporter in this model.) Seven of the eight γ^{k} parameters underlying μ^{k} are significantly different from zero. Of these, the implied share of the traded product's value expended on transportation and insurance ranges from 5.8%, in the case of capital goods, to 51.2% in the case of mining and natural resource-based products. The former category involves high-value products, which are relatively easy to ship (e.g., automobiles and trucks), while the latter involves bulky, low value products. [We hypothesize that the relatively high (25.4%) estimated margin on high technology products may arise due to insurance costs.]

Table 8. Margin Estimates for Model (7) and Two Alternative Models.

Model	Agr.	Basic Inter	Cap. Goods	Forst	High Tech	Inter Manuf	Light Ind	Mining Resources
Model (7)	1.127*	1.164*	1.058*	1.367*#	1.254*	1.095*	1.017	1.512*
No Biases	1.178	1.216	1.105	1.421	1.311	1.146	1.064	1.573
No Biases ignoring fob info.	1.130	1.145	1.057	1.278	1.237	1.106	1.038	1.561

Notes for first row:
A * denotes underlying parameter estimate is significantly different from zero at 10%.
A # denotes that underlying parameter estimate in first row is significantly different from underlying parameter estimate in third row.

The statistically insignificant margin associated with light industry products presents an interesting puzzle. This product category includes items such as apparel and leather goods, which may indeed exhibit a small margin. However, when non-OECD regions are included in the sample, this margin actually becomes negative! We hypothesize that the presence of extensive tariffs and quantitative controls on these products results in a systematic tendency to underinvoice imports. This would account for the insignificant, or possibly negative margin. It is certainly an issue which deserves further exploration.

An interesting question, alluded to above, is whether or not our explicit model of data generation results in improved estimates of the c.i.f.-f.o.b. margins. The standard procedure for coming up with these margins is quite simple. Sum the total value of imports for a given commodity, and similarly for exports. Then examine the ratio of these two, possibly taking an average over the sample period. Indeed, if the bias parameters are eliminated from the regression equation, we have a model which does precisely that--for transactions involving non-f.o.b. reporters of imports. If, furthermore, we dropped the last summation in (7), that is, if no accounting is taken of the fact that f.o.b. imports include no margins, then the corresponding OLS estimates would lead to the average of M^k_{ijt}/X^k_{ijt} for each of the K commodities over all transactions (including observations with f.o.b. valued imports).

The second and third rows of table 8 report these "naive" estimates of μ^k, by commodity. Comparison of the first two rows of this table indicates that omission of the bias parameters results in inflated estimates of the margins. However, none of the γ^k parameters underlying the second-row μ^k is significantly different from its first-row counterpart at the 5% level. Nor are these estimates distinct when taken as a group, at the 5% level.

Comparison of the second and third rows in table 8 indicates that, as expected, if we ignore the fact that some countries report imports f.o.b., the subsequent margin estimate falls. Ironically, in this case the two "wrongs" tend to be offsetting and all but one of the margin parameters in row three is now closer to that in row one! However, in the case of forestry products, ignoring the fact that Canada and Australia (and the U.S. prior to 1974) are f.o.b. import reporters is a costly error and the associated third-row parameter is significantly different from its first-row counterpart. Furthermore, this difference is large enough to cause the entire set of third-row margin parameters in model three to be different, at the 5% level, from those in the first-row.

SUMMARY AND CONCLUSIONS

Trade modelers often require information on bilateral trade flows among countries/regions. The only source which supplies this information for all regions, at a significant level of commodity disaggregation is the United Nations external trade data base. However, researchers are reluctant to use this data set because of its notoriety for data discrepancies. Examination of the eight commodity-19 region data set used in this paper does little to reassure such researchers. Differences due to f.o.b. and c.i.f. valuations account for some of these discrepancies. Shipping lags, misclassification of commodities and countries, and smuggling have been suggested as other contributing factors.

In this paper, we describe and implement a statistical methodology which provides systematic estimates of country-specific reporting biases and commodity-specific c.i.f./f.o.b. margins. Among OECD countries, Australia and New Zealand stand out as biased reporters of trade data, particularly with regard to exports. The estimated model also suggests that the least biased pair of reporters involves the combination of Japan for imports and the U.S. for exports.

In summary, we believe that this approach to modeling systematic trade reporting biases offers some promise for "saving" the U.N. bilateral trade data set. For example, the estimated biases may be applied to the raw data to obtain "bias-corrected" trade flows. Furthermore, they suggest a relative ranking of reporters for purposes of reconciling the remaining discrepancies in reported trade. In particular one might assign priority to the data as reported by the reporter with the lower systematic bias. Ultimately these discrepancies in reported imports and exports must be reconciled if this data base is to be used for trade modeling purposes.

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Footnotes

[1] A subset of countries reports imports on an f.o.b. basis (see table 1 and appendix table 1). This information greatly facilitates the estimation of reporting biases, as will be shown below.

[2] For example, if exporters of a given commodity tend to underreport exports, then the inferred value of μ will be excessively large.

[3] The countries/areas which do not report are: Austria and Finland did not report data for 1962; Greenland did not report data for 1962-75; and Andora and Gibraltar have never reported data.

Appendix Table 1. Countries or Areas Comprising Regions

1. <u>Subsaharan Africa</u>
   Angola, Benin, Botswana, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Djibouti, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Madagasgar, Malawi, Mali, Mauritania, Mauritius, Niger, Nigeria, Republic of South Africa, Reunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, St. Helena, Sudan, Swaziland, Tanzania, Togo, Uganda, Upper Volta, Zaire, Zambia, Zanzibar-Pemba, Zimbabwe.

2. <u>Latin America</u> (excluding Mexico and Brazil)
   Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, U.S. Virgin Islands, Venezuela.

3. <u>Middle East and North Africa</u>
   Algeria, Bahrain, Cyprus, Egypt, Gaza, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Mozambique, Oman, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirates, Democratic Yemen, Yemen.

4. <u>South Asia</u>
   Afganistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sikkim, Sri Lanka.

5. <u>Old Asian NICs</u>
   Hong Kong, Singapore, South Korea, Taiwan.

6. <u>New Asian NICs</u>
   Malaysia, Peninsula Malaysia, Sabah, Sarawak, Thailand.

7. <u>Other Southeast Asia</u>
   American Samoa, Brunei, Christmas Island, Fiji, French Polynesia, Guam, Indonesia, Kiribati, Macau, New Caledonia, Norfolk Islands, Papua N.G., Philippines, Pitcairn Island, Ryukyu Island, Solomon Islands, Tokelau Islands, Tonga, Vanuatu, Wake Island, Wallis and Futuna, Western Samoa.

8. <u>EC</u>
   Andorra, Belgium, Denmark, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom, West Germany.

9. <u>Eastern Europe</u> (f.o.b. except Hungary and Czech.)
   Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, Yugoslavia.

10. <u>Other Western Europe</u>
    Austria, Faeroe Islands, Finland, Gibraltar, Greenland, Iceland, Norway, Sweden, Switzerland.

11. <u>Communist Asia</u>
    Burma, Kampuchea, Laos, Mongolia, North Korea, People's Republic of China, Vietnam.

Appendix Table 2. Data for Australia with Extreme Ratio Values

A. Australia is exporter

OBS	YEAR	Orig	Dest	Com	X	M	RATIO
1	85	AUST	EC12	HiTe	46034	192144	4.1740
2	86	AUST	EC12	HiTe	57745	253419	4.3886
3	87	AUST	EC12	HiTe	75679	358298	4.7344
4	63	AUST	OtWE	BsIn	267	1562	5.8502
5	64	AUST	OtWE	BsIn	270	1249	4.6259
6	77	AUST	OtWE	BsIn	1497	6867	4.5872
7	79	AUST	OtWE	BsIn	2559	13591	5.3111
8	80	AUST	OtWE	BsIn	3034	18870	6.2195
9	82	AUST	OtWE	BsIn	936	7400	7.9060
10	67	AUST	OtWE	Fors	1	10	10.0000
11	86	AUST	OtWE	Fors	60	620	10.3333
12	68	AUST	OtWE	HiTe	465	3349	7.2022
13	76	AUST	OtWE	HiTe	4880	74227	15.2105
14	77	AUST	OtWE	HiTe	4608	65873	14.2954
15	78	AUST	OtWE	HiTe	4377	51684	11.8081
16	79	AUST	OtWE	HiTe	8734	91104	10.4310
17	80	AUST	OtWE	HiTe	19072	124483	6.5270
18	81	AUST	OtWE	HiTe	11805	109817	9.3026
19	82	AUST	OtWE	HiTe	6831	82428	12.0668
20	83	AUST	OtWE	HiTe	5130	122634	23.9053
21	84	AUST	OtWE	HiTe	6220	98976	15.9125
22	85	AUST	OtWE	HiTe	6742	94217	13.9746
23	86	AUST	OtWE	HiTe	8281	89705	10.8326
24	87	AUST	OtWE	HiTe	12987	95400	7.3458
25	82	AUST	OtWE	LiIn	2977	606	0.2036
26	74	AUST	OtWE	MnnR	3756	24509	6.5253
27	75	AUST	OtWE	MnnR	6202	35742	5.7630
28	76	AUST	OtWE	MnnR	4953	64077	12.9370
29	77	AUST	OtWE	MnnR	4669	62743	13.4382
30	78	AUST	OtWE	MnnR	10954	84684	7.7309
31	79	AUST	OtWE	MnnR	10564	83351	7.8901
32	80	AUST	OtWE	MnnR	13135	104821	7.9803
33	81	AUST	OtWE	MnnR	14622	99639	6.8143
34	82	AUST	OtWE	MnnR	13811	86777	6.2832
35	83	AUST	OtWE	MnnR	9784	84394	8.6257
36	84	AUST	OtWE	MnnR	16881	87799	5.2011
37	69	AUST	JAPA	K	723	8339	11.5339
38	80	AUST	JAPA	K	54882	7128	0.1299
39	77	AUST	JAPA	Fors	4	79	19.7500
40	81	AUST	JAPA	Fors	61	1072	17.5738
41	82	AUST	JAPA	Fors	370	1777	4.8027
42	70	AUST	JAPA	HiTe	2046	23464	11.4682
43	71	AUST	JAPA	HiTe	3888	36776	9.4588
44	72	AUST	JAPA	HiTe	5841	41877	7.1695
45	76	AUST	JAPA	HiTe	13554	86440	6.3775
46	77	AUST	JAPA	HiTe	16982	133599	7.8671
47	78	AUST	JAPA	HiTe	18762	126309	6.7322
48	79	AUST	JAPA	HiTe	22274	143388	6.4375
49	80	AUST	JAPA	HiTe	37590	187500	4.9880
50	81	AUST	JAPA	HiTe	34323	193252	5.6304
51	79	AUST	JAPA	LiIn	22966	5447	0.2372
52	80	AUST	JAPA	LiIn	22923	4366	0.1905
53	81	AUST	JAPA	LiIn	19489	3176	0.1630
54	82	AUST	JAPA	LiIn	22115	2937	0.1328
55	83	AUST	JAPA	LiIn	14798	2577	0.1741
56	84	AUST	JAPA	LiIn	16709	2336	0.14
57	85	AUST	JAPA	LiIn	19165	2603	0.14
58	62	AUST	USA	K	3340	826	0.25
59	70	AUST	USA	HiTe	4155	70771	17.03
60	71	AUST	USA	HiTe	4922	70434	14.31
61	72	AUST	USA	HiTe	6732	72873	10.82
62	76	AUST	USA	HiTe	20559	300292	14.61
63	77	AUST	USA	HiTe	24437	344267	14.09
64	78	AUST	USA	HiTe	29186	452961	15.52
65	79	AUST	USA	HiTe	37158	529400	14.25
66	80	AUST	USA	HiTe	42817	749228	17.50
67	81	AUST	USA	HiTe	43487	685129	15.75
68	82	AUST	USA	HiTe	38787	822200	21.20
69	83	AUST	USA	HiTe	40443	704026	17.41
70	84	AUST	USA	HiTe	57914	792569	13.69
71	85	AUST	USA	HiTe	52798	747590	14.16
72	86	AUST	USA	HiTe	45185	624807	13.83
73	87	AUST	USA	HiTe	53252	613193	11.51
74	76	AUST	USA	MnnR	27163	112950	4.16
75	85	AUST	CAN	K	6205	26445	4.26
76	75	AUST	CAN	Fors	5	1	0.20
77	68	AUST	CAN	HiTe	6991	1406	0.20
78	73	AUST	CAN	HiTe	31106	2762	0.09
79	74	AUST	CAN	HiTe	45278	3166	0.07
80	75	AUST	CAN	HiTe	29005	2939	0.10
81	78	AUST	CAN	HiTe	3471	64807	18.67
82	79	AUST	CAN	HiTe	4520	72765	16.10
83	80	AUST	CAN	HiTe	7436	70723	9.51
84	81	AUST	CAN	HiTe	6279	64769	10.32
85	82	AUST	CAN	HiTe	4145	53796	12.98
86	83	AUST	CAN	HiTe	5063	51639	10.20
87	84	AUST	CAN	HiTe	6584	64176	9.75
88	85	AUST	CAN	HiTe	7369	42205	5.73
89	86	AUST	CAN	HiTe	7653	80337	10.50
90	87	AUST	CAN	HiTe	10581	140532	13.28
91	78	AUST	CAN	LiIn	4015	563	0.14
92	79	AUST	CAN	LiIn	5825	833	0.14
93	80	AUST	CAN	LiIn	5079	1132	0.22
94	84	AUST	CAN	MnnR	257	2248	8.75
95	68	AUST	CAN	MnnR	2466	11014	4.47
96	69	AUST	CAN	MnnR	636	12950	20.36
97	70	AUST	CAN	MnnR	1343	44024	32.78
98	72	AUST	CAN	MnnR	196	38111	194.44
99	73	AUST	CAN	MnnR	96	32529	338.84
100	74	AUST	CAN	MnnR	46	48923	1063.54
101	75	AUST	CAN	MnnR	66	86380	1308.79
102	76	AUST	CAN	MnnR	28	96066	3430.93
103	77	AUST	CAN	MnnR	11313	108891	9.63

B. Australia is importer

OBS	YEAR	Orig	Dest	Com	X	M	RATIO
1	68	NZ	AUST	MnnR	624	2647	4.24199
2	84	NZ	AUST	MnnR	2600	13226	5.08769
3	86	JAPA	AUST	Fors	2	13	6.50000

Appendix Table 3. Data for New Zealand with Extreme Ratio Values

A. New Zealand is exporter

OBS	YEAR	Ori	Dest	Com	X	M	RATIO
1	68	NZ	EC12	K	629	2519	4.005
2	65	NZ	EC12	Fors	1	29	29.000
3	74	NZ	EC12	Fors	29	259	8.931
4	76	NZ	EC12	Fors	41	191	4.659
5	62	NZ	EC12	HiTe	95	641	6.747
6	70	NZ	EC12	MnnR	470	2057	4.377
7	87	NZ	EC12	MnnR	1201	4935	4.109
8	70	NZ	OtWE	BsIn	2	9	4.500
9	72	NZ	OtWE	BsIn	8	54	6.750
10	73	NZ	OtWE	BsIn	8	61	7.625
11	75	NZ	OtWE	BsIn	10	63	6.300
12	85	NZ	OtWE	BsIn	20	122	6.100
13	67	NZ	OtWE	K	4	32	8.000
14	69	NZ	OtWE	K	18	292	16.222
15	73	NZ	OtWE	Fors	1	11	11.000
16	80	NZ	OtWE	Fors	4	58	14.500
17	82	NZ	OtWE	Fors	1	65	65.000
18	85	NZ	OtWE	Fors	252	6	0.024
19	66	NZ	OtWE	HiTe	1	6	6.000
20	69	NZ	OtWE	HiTe	6	35	5.833
21	79	NZ	OtWE	HiTe	119	780	6.555
22	84	NZ	OtWE	HiTe	789	3586	4.545
23	66	NZ	OtWE	InMa	4	71	17.750
24	72	NZ	OtWE	InMa	90	12	0.133
25	74	NZ	OtWE	InMa	26	130	5.000
26	75	NZ	OtWE	InMa	20	141	7.050
27	70	NZ	OtWE	LiIn	1	126	126.000
28	71	NZ	OtWE	LiIn	3	92	30.667
29	72	NZ	OtWE	LiIn	10	77	7.700
30	75	NZ	OtWE	LiIn	55	313	5.691
31	76	NZ	OtWE	LiIn	62	381	6.145
32	66	NZ	OtWE	MnnR	2	101	50.500
33	71	NZ	OtWE	MnnR	7	35	5.000
34	68	NZ	AUST	MnnR	624	2647	4.242
35	84	NZ	AUST	MnnR	2600	13228	5.088
36	65	NZ	JAPA	K	1	7	7.000
37	77	NZ	JAPA	K	205	957	4.668
38	64	NZ	JAPA	HiTe	4	202	50.500
39	84	NZ	JAPA	HiTe	2199	22981	10.451
40	69	NZ	JAPA	InMa	214	29	0.136
41	72	NZ	JAPA	InMa	483	42	0.087
42	62	NZ	JAPA	LiIn	5	40	8.000
43	70	NZ	USA	Fors	367	29	0.079
44	62	NZ	USA	HiTe	4	294	73.500
45	64	NZ	USA	HiTe	20	148	7.400
46	65	NZ	USA	HiTe	57	236	4.140
47	68	NZ	USA	HiTe	66	515	7.803
48	77	NZ	USA	HiTe	2028	467	0.230
49	65	NZ	USA	MnnR	1	4	4.000
50	67	NZ	USA	MnnR	16	154	9.625
51	71	NZ	USA	MnnR	5	22	4.400
52	73	NZ	USA	MnnR	1	21	21.000
53	76	NZ	USA	MnnR	4	16	4.000
54	81	NZ	USA	MnnR	43	186	4.326
55	84	NZ	USA	MnnR	16	5406	337.875
56	85	NZ	USA	MnnR	11	75	6.8182
57	86	NZ	USA	MnnR	13	87	6.6923
58	87	NZ	USA	MnnR	16	72	4.5000
59	65	NZ	CAN	BsIn	40	4	0.1000
60	67	NZ	CAN	BsIn	15	2	0.1333
61	64	NZ	CAN	HiTe	3	32	10.6667
62	65	NZ	CAN	HiTe	1	7	7.0000
63	82	NZ	CAN	MnnR	1	14	14.0000
64	84	NZ	CAN	MnnR	1	7	7.0000

B. New Zealand is importer

OBS	YEAR	Orig	Dest	Com	X	M	RATIO
1	64	EC12	NZ	Fors	17	73	4.2941
2	65	EC12	NZ	Fors	12	59	4.9167
3	66	EC12	NZ	Fors	15	108	7.2000
4	67	EC12	NZ	Fors	15	129	8.6000
5	68	EC12	NZ	Fors	22	149	6.7727
6	69	EC12	NZ	Fors	30	150	5.0000
7	82	EC12	NZ	Fors	26	309	11.8846
8	84	EC12	NZ	Fors	89	382	4.2921
9	77	EC12	NZ	MnnR	4196	20088	4.7874
10	74	OtWE	NZ	Fors	22	457	20.7727
11	76	JAPA	NZ	Fors	41	1048	25.5610
12	77	JAPA	NZ	Fors	640	45	0.0703
13	78	JAPA	NZ	Fors	34	847	24.9118
14	84	JAPA	NZ	Fors	6	1	0.1667
15	62	JAPA	NZ	MnnR	3	44	14.6667
16	64	JAPA	NZ	MnnR	1	27	27.0000
17	65	JAPA	NZ	MnnR	647	12	0.0185
18	66	JAPA	NZ	MnnR	60	248	4.1333
19	77	JAPA	NZ	MnnR	217	4513	20.7972
20	78	JAPA	NZ	MnnR	3339	823	0.2465
21	72	CAN	NZ	InMa	1007	5050	5.0149

Appendix Table 4. Regression Results for Model (7)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	20	170.99257	8.54962859	34.847	0.0001
ERROR	8508	2087.40806	0.24534650		
C TOTAL	8528	2258.40063			

ROOT MSE	0.4953246	R-SQUARE	0.0757
DEP MEAN	0.1673357	ADJ R-SQ	0.0735
C.V.	296.0066		

Parameter Estimates

Parameter	Parameter Estimate	Standard Error	t statistic
Intercept	0.002459493	0.03421448	0.072
Margin Coefficients			
MRG Agr	0.11938111	0.03332065	3.583
MRG BasInt	0.15222420	0.03334762	4.565
MRG KGoods	0.05598974	0.03334778	1.679
MRG Forest	0.31228117	0.03345890	9.333
MRG HiTech	0.22636446	0.03333139	6.791
MRG IntMan	0.09117839	0.03332605	2.736
MRG LiInd	0.01709759	0.03332597	0.513
MRG MinRes	0.41358247	0.03342824	12.372
Export Bias Coefficients			
XB EC12	-0.03991743	0.02017960	-1.978
XB OWEur	0.01460673	0.02018572	0.724
XB Austr	0.10914343	0.02021348	5.400
XB NZ	0.10293993	0.02080329	4.948
XB Jap	-0.01691354	0.02020114	-0.837
XB Can	-0.05539608	0.02018535	-2.744
Import Bias Coefficients			
MB EC12	0.04493848	0.02020452	2.224
MB OWEur	-0.12432388	0.02042134	-6.088
MB Austr	-0.05581345	0.03479519	-1.604
MB NZ	-0.02595301	0.02036578	-1.274
MB USA	-0.02053690	0.02398411	-0.856
MB Can	-0.09048562	0.03490818	-2.592

Appendix Table 5. Statistics for Variable y by Trade Route.
(N=number of observations, STD= mean standard deviation)

Flow Origin	Flow Destination: Australia RATIO N	Australia MEAN	Australia STD	Brazil RATIO N	Brazil MEAN	Brazil STD	Canada RATIO N	Canada MEAN	Canada STD	RD: Communist Asia RATIO N	Communist Asia MEAN	Communist Asia STD	EC12 RATIO N	EC12 MEAN	EC12 STD
Australia	.	.	.	152.00	5.36	29.61	206.00	32.69	268.42	118.00	1.77	3.44	208.00	1.36	0.57
Brazil	192.00	1.79	2.81	.	.	.	206.00	1.50	1.29	29.00	11.67	34.51	208.00	1.22	0.38
Canada	208.00	1.02	0.22	208.00	1.29	1.88	.	.	.	110.00	0.62	0.88	208.00	1.08	0.18
Communist Asia	62.00	888.30	2128.84	7.00	5.83	13.40	36.00	1224.96	3695.87	.	.	.	123.00	1168.85	7570.32
EC12	208.00	1.08	0.14	208.00	1.18	0.41	208.00	1.09	0.40	132.00	1.19	4.83	.	.	.
E. Europe	177.00	71.83	404.81	166.00	120.40	920.19	182.00	98.46	820.38	103.00	40.79	342.52	208.00	3.84	4.60
Japan	208.00	1.06	0.43	190.00	1.30	1.79	205.00	4.57	30.28	131.00	0.84	1.61	208.00	1.11	0.34
Latin America	205.00	5.96	40.21	208.00	1.97	2.61	208.00	27.41	153.99	48.00	7.00	23.50	208.00	2.08	1.56
Mexico	172.00	4.55	23.24	181.00	1.52	1.21	190.00	5.04	15.92	25.00	3.31	6.27	208.00	1.51	1.42
Mid. East & N. Africa	183.00	4.58	25.15	168.00	13.09	71.10	182.00	7.34	53.78	101.00	2.52	11.82	208.00	1.99	2.47
New Asian NICs	208.00	1.18	1.57	96.00	4.48	12.85	184.00	1.54	5.80	128.00	4.49	19.66	208.00	1.49	1.60
NZ	200.00	1.17	0.48	61.00	2.44	8.07	158.00	1.25	1.50	61.00	1.57	3.67	199.00	1.78	2.17
Other SEast Asia	204.00	18.85	96.55	88.00	5.24	10.18	191.00	8.40	19.29	74.00	97.81	591.43	205.00	17.51	148.37
Other W. Europe	208.00	1.10	0.25	208.00	1.22	2.08	208.00	2.81	18.81	127.00	2.29	12.73	208.00	1.03	0.11
Old Asian NICs	208.00	0.93	0.45	157.00	2.05	3.08	202.00	1.47	1.82	131.00	3.27	5.03	208.00	1.19	0.82
South Asia	199.00	5.70	27.95	137.00	29.14	260.94	202.00	14.16	80.95	132.00	1.45	1.95	207.00	4.74	19.41
Subsaharan Africa	153.00	14.81	53.18	91.00	246.92	1492.43	187.00	1390.90	18063.39	57.00	5.40	17.88	208.00	8.05	23.28
USA	208.00	1.07	0.18	208.00	1.10	0.22	208.00	1.13	0.17	128.00	28.35	168.95	208.00	1.15	0.10

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RO	RD: E. Europe RATIO N	E. Europe MEAN	E. Europe STD	Japan RATIO N	Japan MEAN	Japan STD	Latin America RATIO N	Latin America MEAN	Latin America STD	Mexico RATIO N	Mexico MEAN	Mexico STD	MIDE RATIO N	MIDE MEAN	MIDE STD
Australia	151.00	10.07	58.08	208.00	1.73	2.31	182.00	2.52	6.27	170.00	1.95	5.79	205.00	1.50	3.35
Brazil	157.00	5.42	32.50	205.00	30.55	278.13	208.00	0.83	0.27	195.00	0.98	0.83	202.00	2.51	10.59
Canada	199.00	0.82	0.65	208.00	1.22	0.42	208.00	0.70	0.30	208.00	0.88	0.42	208.00	0.70	0.37
Communist Asia	50.00	889.51	5242.92	115.00	1324.45	5713.73	28.00	140.68	306.59	7.00	76.50	155.33	70.00	1366.76	3103.13
EC12	208.00	0.47	0.18	208.00	1.27	0.25	208.00	0.87	0.24	208.00	1.17	0.87	208.00	0.76	0.27
E. Europe	.	.	.	184.00	91.49	380.90	204.00	18.29	74.30	144.00	36.89	143.32	208.00	4.95	11.95
Japan	178.00	0.48	0.62	.	.	.	205.00	1.39	8.16	186.00	2.46	13.94	208.00	0.72	0.77
Latin America	187.00	4.37	18.15	208.00	23.22	211.83	.	.	.	208.00	4.68	14.84	208.00	63.58	559.89
Mexico	127.00	2.82	8.69	208.00	5.27	18.37	201.00	0.87	0.65	.	.	.	180.00	2.55	7.40
Mid. East & N. Africa	204.00	0.75	1.49	204.00	53.80	474.23	198.00	3.09	11.58	174.00	12.05	117.58	.	.	.
New Asian NICs	124.00	20.97	116.81	207.00	1.38	4.20	171.00	2.38	6.29	99.00	18.22	140.73	200.00	1.59	6.55
NZ	88.00	1.35	2.32	195.00	1.65	3.88	167.00	1.29	2.04	74.00	2.07	7.19	153.00	4.37	17.08
OtSE	87.00	275.45	1752.44	205.00	6.07	23.00	172.00	7.54	45.74	92.00	8.25	23.22	188.00	3.45	8.99
OtWE	208.00	0.54	0.28	208.00	1.33	1.17	208.00	0.98	1.23	207.00	2.14	4.20	208.00	0.90	0.64
ONIC	121.00	3.07	20.35	208.00	1.27	0.69	200.00	1.48	3.83	170.00	1.87	7.24	208.00	0.98	3.28
SASI	198.00	89.53	783.17	207.00	4.07	18.50	185.00	7.57	39.44	151.00	6.22	20.14	208.00	0.86	1.37
SUBS	169.00	477.56	3824.08	198.00	2256.27	27325.88	194.00	21.44	104.10	73.00	161.18	887.25	207.00	10.81	49.53
USA	207.00	0.82	0.81	208.00	1.22	0.15	208.00	0.88	0.28	208.00	0.87	0.28	208.00	0.83	0.25

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Appendix Table 5. (continued)

	RD											
	New Asian NICs			NZ			OtSE			OtWE		
	RATIO			RATIO			RATIO			RATIO		
	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
RO												
Australia	207.00	4.00	18.51	200.00	1.18	0.28	208.00	0.87	0.51	202.00	2.76	3.41
Brazil	151.00	4.17	18.78	143.00	2.87	5.18	152.00	1.43	1.80	208.00	1.66	1.42
Canada	208.00	1.28	0.74	200.00	1.28	0.44	208.00	0.97	0.84	208.00	1.31	0.57
Communist Asia	104.00	1061.52	2471.58	20.00	155.97	347.72	58.00	313.62	771.86	71.00	1334.35	5308.41
EC12	208.00	1.73	0.92	200.00	1.49	1.22	208.00	1.14	1.48	208.00	1.01	0.07
E. Europe	172.00	86.50	292.44	138.00	19.71	83.15	161.00	29.31	179.26	208.00	3.33	3.38
Japan	208.00	1.38	0.43	198.00	1.68	3.47	208.00	0.74	0.57	208.00	2.06	3.70
Latin America	172.00	4.32	9.11	175.00	9.25	39.83	186.00	4.78	17.67	208.00	10.70	28.28
Mexico	133.00	31.67	285.86	132.00	17.42	89.84	159.00	3.80	12.02	202.00	2.46	5.75
Mid. East & N. Africa	181.00	5.27	17.91	168.00	3.87	8.63	182.00	113.28	1345.33	208.00	1.72	1.80
New Asian NICs	.	.	.	190.00	1.44	2.15	208.00	0.99	2.69	202.00	8.02	68.67
NZ	198.00	1.88	3.77	.	.	.	200.00	0.77	0.48	157.00	4.12	12.12
OtSE	208.00	13.69	80.86	178.00	5.85	23.16	.	.	.	191.00	15.86	64.29
OtWE	208.00	2.28	3.81	200.00	1.39	1.41	207.00	0.94	0.67	.	.	.
ONIC	208.00	0.68	0.30	197.00	1.28	2.75	208.00	1.55	1.72	208.00	3.38	8.31
SASI	195.00	4.98	20.69	179.00	4.17	20.68	183.00	17.32	128.11	206.00	5.96	31.99
SUBS	133.00	107.18	338.65	100.00	20.28	111.78	133.00	82.01	478.45	207.00	156.71	645.65
USA	208.00	1.52	0.58	200.00	1.32	0.28	208.00	0.93	0.40	208.00	1.28	0.27

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	RD											
	ONIC			SASI			SUBS			USA		
	RATIO			RATIO			RATIO			RATIO		
	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD	N	MEAN	STD
RO												
Australia	208.00	1.59	2.44	195.00	1.18	1.04	197.00	7.28	37.28	208.00	2.12	3.71
Brazil	178.00	1.30	2.11	156.00	2.58	9.47	181.00	4.01	21.06	208.00	1.11	0.34
Canada	208.00	1.08	0.61	208.00	1.00	1.13	204.00	4.27	37.23	208.00	1.06	0.18
Communist Asia	121.00	4487.86	18486.05	89.00	511.38	1388.30	78.00	2041.49	5569.20	93.00	823.89	3960.71
EC12	208.00	1.38	1.25	208.00	1.00	0.54	208.00	0.79	0.39	208.00	1.12	0.25
E. Europe	161.00	64.20	198.25	202.00	73.68	312.08	202.00	64.51	787.18	198.00	30.58	151.37
Japan	208.00	1.03	0.23	207.00	1.18	2.11	199.00	2.78	14.12	208.00	1.29	0.99
Latin America	200.00	83.93	885.86	174.00	5.13	18.17	187.00	7.71	27.14	208.00	1.79	1.15
Mexico	179.00	12.51	31.62	117.00	10.65	40.21	140.00	4.84	13.29	208.00	2.18	2.58
Mid. East & N. Africa	198.00	11.31	72.51	201.00	8.54	38.69	201.00	6.92	43.00	207.00	1.42	1.14
New Asian NICs	208.00	1.15	0.45	207.00	5.29	50.59	205.00	1.10	1.17	207.00	1.84	4.55
NZ	200.00	6.50	46.82	184.00	1.44	2.48	142.00	9.47	77.78	193.00	3.61	24.81
OtSE	208.00	3.97	21.51	175.00	4.83	13.48	158.00	23.18	213.38	208.00	3.77	11.72
OtWE	208.00	2.86	12.78	208.00	0.98	0.76	208.00	1.35	3.25	208.00	2.62	11.52
ONIC	.	.	.	208.00	0.87	0.83	208.00	0.63	0.51	208.00	1.08	0.48
SASI	207.00	2.90	8.38	.	.	.	201.00	2.45	13.23	208.00	74.84	867.08
SUBS	171.00	1269.84	7898.94	165.00	142.43	583.93	.	.	.	208.00	24.73	137.70
USA	208.00	1.06	0.27	208.00	0.94	0.37	207.00	1.31	2.28	.	.	.

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