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Improving the Estimation Methodology of Monthly Data in Direction of Trade Statistics

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Abstract

The quality of the estimated data in DOTS depends on the availability and accuracy of direction of trade reports and the estimation methodology. Because of the low coverage of monthly reporting, the estimating procedure plays a role of increased importance. This study, however, reveals two deficiencies in current DOTS estimation methodology: The information on total trade in IFS is not efficiently used, and the assumed uniform 10 percent CIF/FOB factor is inappropriate. Accuracy would be improved if IFS total trade were allocated, when available, according to the shares of total trade derived from partner data; and the uniform 10 percent CIF/FOB factors were replaced by adjustment factors derived from historical data.

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Contents

Summary

As one of the Fund's major statistical publications, Direction of Trade Statistics (DOTS) has been widely used within and outside the Fund. Compared with collections of similar data provided by other international agencies, DOTS is well recognized for its coverage and currentness. Its high coverage of world trade and currentness of statistical information are based in large measure on estimation of the direction of trade for late-reporting and nonreporting countries from their trade partners' data on a monthly basis. The accuracy of the DOTS database thus depends on two factors: the availability and quality of the trading partners' data and the estimating procedures incorporated in the system. Because of the low coverage of monthly reporting, the estimating procedure plays a role of increased importance in the compilation of DOTS.

This paper reports the results of an assessment of the estimating procedures and proposes improvements in the underlying methodology. Two questions are analyzed: How efficient is the current DOTS estimation methodology in using the reported information in the form of total trade in International Financial Statistics (IFS); and how can the effectiveness with which DOTS estimates a country's trade data by its partners' reports be improved? In the process of pursuing answers to these questions, the study sheds light on the outlines of a simpler, more efficient, data-driven, and algorithmic estimation methodology for DOTS.

Some of the basic findings are as follows: DOTS reported trade data agree more closely with IFS in total trade than DOTS estimated data. The current uniform 10 percent CIF/FOB factor is significantly different from the actual discrepancies between a country's reported exports and imports and the respective imports and exports reported by its trade partners. Therefore, applying these factors to estimate trade values for late-reporting and nonreporting countries by use of their partners' data is misleading and inaccurate. This study also shows that in obtaining the estimates of the bilateral trade between DOTS nonreporting countries, the current methodology makes too little use of cross-sectional information in the form of total trade figures from IFS. An analysis of variance of the total trade between DOTS and IFS reveals that there is a systematic bias in DOTS estimation against the IFS standard.

Three ways to improve the DOTS estimates are proposed. First, where possible, the IFS reported total trade figures should be distributed among the trading partners on the basis of shares of trade derived from partner reports. Second, the uniform 10 percent CIF/FOB factor should be replaced by the actual historical difference between the FOB value of exports and the CIF value of imports, when using the trade partner's data for the estimation. The third improvement applies to the situation when reported partner data are insufficient for partner estimation but IFS total trade figures are available. In this case it is proposed that raking methods such as the so-called RAS procedure be applied, in concert with estimates of bilateral trade from time-series cross section models that make use of past information.

I. Introduction

There is extensive use of Direction of Trade Statistics (DOTS) 1/ both within and outside the Fund, including regular use inside the Fund for analysis in World Economic Outlook (WEO) and for publication of some countries' DOTS trade totals in International Financial Statistics (IFS). A preliminary survey of journal citations outside the Fund shows there are more than 159 research articles during the period from 1972 to March 1994 using DOTS as their statistical data sources and/or references in journals of economics and business. The figure does not include the enormous use of DOTS tapes and books by governments, research institutions, and international organizations. Each month there are about 125 subscribers for DOTS magnetic tapes, and each year approximately 5,400 subscribers for the quarterly and annual books.

Maintaining the quality of the DOTS database is clearly important. DOTS is unique in its coverage and currentness compared to similar data provided by other international agencies. 2/ Its high coverage of world trade and currentness of statistical information is based in large measure on estimation of the direction of trade for late-reporting and nonreporting countries from their trade partners' data on a monthly basis. The accuracy of the DOTS database depends on two factors: the availability and quality of the trading partners' data and the estimating procedures incorporated in the system. The latter is the focus of this paper. The low coverage of monthly reporting for DOTS emphasizes the role of the estimating procedure in the accuracy of the trade flows appearing in the publications and tapes, notwithstanding the profound issues of the reliability and quality of reported direction of trade data, especially from and among developing countries. 3/

More specifically, this paper addresses the following question: Given the quality of the official reported and/or published data, how should the estimating procedure be designed in DOTS in order to produce more accurate estimates for late-reporting or nonreporting countries? Following the same presupposition, the data eventually reported by late reporting countries are taken as the criteria for measuring the accuracy of the estimates. This is consistent with the conventional DOTS practice of overwriting estimated

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1/ DOTS was first published in 1950 jointly by the United Nations, the World Bank, and the Fund. Since May 1976 it has been published by the Fund alone. (International Monetary Fund, A Guide to Direction of Trade Statistics (Washington, D.C.: International Monetary Fund, 1993), p.1.).

2/ Such as trade statistics publications of the U.N. (International Trade Statistics Yearbook and Commodity Trade Statistics) and the OECD (Statistics on International Transactions).

3/ The issue of the quality of trade data has been the subject of numerous articles, official documents, scholarly conferences and arguments, and the studies of international working groups. For example, see reference list for citations of U.N. studies (1971, 1974, 1981, 1982, 1983, 1986, 1987) and Yeats (1978, 1990), among others.

figures by the official reported or published data when they become available. An estimate for a specific country is accurate only if its value is very close to the figure eventually reported by the country itself.

A thorough and systematic description of the compilation and presentation of DOTS is provided by the Fund in its A Guide to Direction of Trade Statistics (1993). It reports the methodology and procedures applied in DOTS production and the concepts and terminology used in designing the system. In addition, a study by K. D. Zieschang (1994) (see reference list) gives insight into the structure of DOTS in matrix algebra.

The present study investigates the accuracy of DOTS monthly estimates by applying statistical inference techniques on the empirical trade data in the DOTS database. The innovative feature of this paper is to clearly address the long-standing problems. These problems, which may have been ambiguous in the past, are rigorously illustrated by quantitative analysis in the current study. Two ultimate questions will be analyzed: How efficient is the current DOTS estimation methodology in using the reported information in the form of IFS trade totals, and how can the effectiveness with which DOTS estimates a country's trade data by its partners' reports be improved? In the process of pursuing answers to these questions, the study sheds light on the outlines of a simpler and more efficient estimation procedure for DOTS.

The basic findings are as follows: DOTS reported trade data agree more closely with IFS in total trade than DOTS estimated data, and the current uniform 10 percent CIF/FOB factor (hereafter called "the uniform factor") is significantly different from the actual discrepancies between a country's reported exports and imports and the respective imports and exports reported by its trade partners. Therefore, applying the uniform factor to estimate trade values for late-reporting and nonreporting countries by use of their partners' data is misleading and inaccurate. An analysis of variance between DOTS and IFS of the total trade reveals that there is a systematic bias in DOTS estimation.

Two ways to improve the DOTS system are proposed. First, derive the shares of total trade, by source and destination, rather than the value of the trade from the trade partner's data. Then apply the total trade in IFS as the boundary and distribute it among the trade partners based on these shares. 1/ Second, replace the uniform factor by the actual historical difference between the FOB value of exports and the CIF value of imports as the adjustment factor when using the trade partner's data for the estimation.

1/ A comparison of the currentness of reports between IFS and DOTS shows: (i) there are significantly more countries reporting the figures of total exports and imports in IFS than the detailed direction of trade data in DOTS; and (ii) the period of data reported in DOTS could be three to twelve or more months later than that in IFS. See Tables 9 and 10 in Appendix III.

More difficult is the estimation of bilateral trade for nonreporting countries that is currently estimated by extrapolation, because no partner records exist. This study shows that the current methodology makes too little use of cross-sectional information in the form of total trade figures from IFS. The data, as depicted by the matrix structure in Appendix IV, could be used as control totals with so-called RAS (or raking) methods to estimate the missing cells in respect of the available total trade figures.

Two directions for future research in improving the estimation methodology are proposed. The first is research on estimation of the adjustment factors using time series and/or cross-section methods from statistics and econometrics with the objective of significantly enhancing the accuracy of partner-based estimates. The second is research on the use of RAS (or raking) methods (preferably combined with time series techniques) to provide an improved, algorithmic, and data-driven alternative to estimates now obtained by extrapolation.

In the next section, the quality of monthly data in DOTS is evaluated in terms of coverage of reported data through a comparison with the annual data. Section III presents the statistical inference methods used in this study and the results of the assessment of the accuracy of the estimates. Section IV draws conclusions and offers thoughts for improvement. Appendix I illustrates how to decompose the estimating errors into systematic and random errors. Appendix II demonstrates the significance and efficiency of a revised estimation system based on the methodology proposed in this paper.

II. Current Quality of DOTS Data

Coverage by data reported annually for the DOTS yearbook (DOTSY) is reflected in Table 1, found in Appendix III and in the introduction to the DOTSY. The term "reported data" refers to exports and imports either reported directly by countries or collected by the staff in the Fund's Real Sector Division from the official publications of the national governments or other international organizations. Table 1 shows the number of countries with reported data and the percentage they hold in the total value of world trade. The "percent of world trade" is calculated as the ratio of reported exports (imports) to the world total of exports (imports), while the world total is the sum of both the reported and the estimated data. For 1987, 98 percent of exports and 96 percent of imports were covered by the reported data in the DOTS database, which left only two to four percent of the data to be estimated. Corresponding numbers in 1992 are 87 percent for exports and 88 percent for imports. The decreasing percentage of the coverage from the earlier years to the later is explained by the time lag in the availability of data. Generally speaking, the quality of the DOTSY data is quite high on the basis of the coverage of world trade by reported data.

As for the DOTS quarterly books and monthly tapes, it is equally important to ensure the quality of DOTS monthly data. Because there are

comparatively few quarterly data reported during the year, and the estimated monthly data are consolidated with the reported monthly data into quarterly and annual figures, DOTS monthly data are the basis for the production of DOTS quarterly books and monthly tapes. Table 2 (Appendix III) is analogous to Table 1 for DOTS monthly data. Created on March 4, 1994, just before the production of the 1994 yearbook, the table can be used to assess the quality of monthly DOTS before and after the yearbook, that is, the 1994 yearbook in this case. Because the reported data for some countries may first become available during the yearbook production, the monthly DOTS coverage ratio normally will be higher immediately after the yearbook is finished.

Several facts emerge from these tables. First, as mentioned above, the number of countries with reported monthly data decreases as more recent periods are considered. The average number of reporting countries in 1992 is 40, whereas the average number of countries in 1993 is less than 30. The coverage of world trade is more than 80 percent in 1992 but is lower than 70 percent in 1993. Second, before the annual update, the coverage ratio decreases sharply from the earlier months to the later months during the year. The coverage ratios are more than 67 percent for the months in the first quarter of 1993 but become less than 46 percent at the end of the year. Third, because of the low coverage ratio of reported data, the monthly and, thus, quarterly products of DOTS (including both books and tapes) have to rely heavily on the estimating procedures. For example, for the latest months in 1993, about 55 percent of the data are estimated. The estimating procedure is therefore more important for monthly DOTS data than for annual, because the annual data have higher coverage.

III. Problems with the Estimating System

Data and Methodology

DOTS is designed to use three sources of data for the estimation of the trade flows of nonreporting countries: 1/ (1) lower frequency (quarterly and annual) data of trade with partner countries from the country's own sources; (2) monthly data on total exports and imports reported by the country for IFS; and, (3) combinations of reported and derived partner countries' data and extrapolated data. In cases in which partner data are used to derive estimates, such data are first adjusted, to allow for the cost of freight and insurance, by a uniformly applied percentage assumed to be 10 percent of the FOB value of exports. The second and third estimation methods specified above are examined in this study. First, statistical tests comparing the country's total trade between DOTS and IFS raise the question whether more efficient use could be made of IFS total trade data. Second, the test results concerning the arbitrary character of the assumption on the uniform factors call for the need to examine whether more effective methods can be developed for the purpose of DOTS estimation.

1/ IMF, A Guide to Direction of Trade Statistics (1993), pp. 9-11.

In fact, there are always discrepancies and asymmetries in trade statistics between the country of origin and the country of destination for any given time period. For instance, Yeats (1978) verifies that (in addition to shipping costs) diversion en route, re-export, time or transit lag, differences in classification of commodities, differences in valuation procedures, and multiple exchange rates may all be responsible for disparities in the data. Discrepancies in bilateral trade statistics can be decomposed into a transport-insurance factor (normally called "CIF/FOB factor" for short) and a residual element, according to his study. Therefore, to obtain an accurate estimate, which means to be very close to the reported data by the country itself, the residual element needs to be counted. In other words, the entire discrepancy rather than the CIF/FOB factor only should be employed in DOTS estimation when using the trade partner's data. 1/ For this purpose, we call the difference between exports FOB reported by the country of origin and imports CIF reported by the country of destination as the "adjustment factor."

A group of 48 countries and areas was selected for analysis as shown in Appendix III, Table 3. 2/ Each generated at least 0.1 percent of the world trade, based on the reported data in the last three years from 1990 to 1992. As a whole, they account for 95 percent of world trade valued in U.S. dollars of the current year. Table 3 also provides detailed information about the reporting and updating of trade data for this group of countries and areas in DOTS. Among them, 28 updated all 12 months of data, one updated four quarters of data, and six updated annual data for 1992. This information is extremely useful in practice. Once the trade structures are clarified and the problems associated with this group of 48 countries and areas are resolved, the problems facing the complete system of DOTS will be more easily understood.

Three tests are conducted. First, equalities between the country's total exports or imports derived from the DOTS estimating system and those reported in IFS are tested by the method of *analysis of variance*. The objectives of this test are twofold, to assess the accuracy of the estimating results and the efficiency of the current DOTS system in using the available statistical information. Then, the *t-test* and the *correlation coefficient* test are applied to investigate the reliability of the uniform factors. Finally, a test is run examining the stability of the adjustment factors calculated from the reported data for the past three years by using the methods of the t-test and the correlation coefficient test. The purpose of this test is to examine the possibility that time series information in

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1/ By the same argument, the CIF/FOB factors provided in IFS are not appropriate candidates for the specific needs of the estimation in DOTS.

2/ The term "country," as used in this paper, does not, in all cases, refer to a territorial entity that is a state as understood by international law and practice. The term also covers some nonsovereign territorial entities for which statistical data are maintained and provided internationally on a separate and independent basis.

the DOTS database might be more effectively exploited to estimate the adjustment factors.

The Analysis of Variance: To investigate the accuracy of the estimated country total trade in DOTS, we compare the closeness of DOTS total trade with IFS total trade in each month between two subgroups of countries: countries with both reported DOTS and IFS total trade, and countries with reported IFS total trade and estimated DOTS total trade. All these countries are from the group of 48 defined above. The sample standard deviation (STD) is computed as follows:

$$s=\sqrt{\frac{\sum (x_i-\bar{x})^2}{n-1}} \tag{1}$$

where n is the sample size, and x_i is the standardized difference of the total trade between DOTS and IFS, such that

$$x_i=\frac{Tr_D-Tr_{IFS}}{Tr_{IFS}} \tag{2}$$

where Tr_D and Tr_{IFS} are the country's total of exports or imports in DOTS and IFS, respectively. $\bar{x}$ is the simple mean of x_i. Tr_D is the estimated figure in one subgroup and reported figure in another. The difference is standardized relative to the country's IFS total exports (or imports).

Because of the timing of receipt of data and revisions incorporated by reporters late in the year, there are always discrepancies between the trade totals in DOTS and IFS, no matter whether the figures for DOTS are reported or estimated. This reflects the fact that random errors are inevitably associated with statistical data. Therefore, the standardized difference between DOTS and IFS total trade (x_i) in both subgroups can be different from zero. The value of the STD (the standard deviation) is applied to measure the dispersion of x_i. While STD is expected to be very small for the subgroup with both reported DOTS and IFS trade totals, a low STD in the subgroup of the estimated DOTS total with the reported IFS total is also a desirable one. A rise of STD indicates the deterioration of the accuracy of the estimation.

The Paired-Comparison T-Test: When the paired-comparison t-test is applied to test whether the two groups with a natural pairing are the "same," a new variable is needed to contain the standardized differences between the paired variables. The t-test then tests the hypothesis that the mean of this new variable is equal to zero. The t-test statistic has the form:

$$t=\frac{\bar{x}}{s} \tag{3}$$

where s is defined as in equation (1).

In this study, the t-test is employed to test two hypotheses.

Hypothesis One: Uniform factors and adjustment factors are the same. Accordingly, the new variable has the form:

$$x_i = \frac{factor_{UNI} - factor_{ADJ}}{factor_{ADJ}} \tag{4}$$

where $factor_{UNI}$ is the uniform factor derived by multiplying 10 percent of the FOB value of exports reported by the trade partner country; $factor_{ADJ}$ is the adjustment factor as the difference between the import CIF reported by the country itself and the export FOB reported by its partner country. The difference is standardized relative to the adjustment factor.

Hypothesis Two: The adjustment factors are the same in different years. Thus,

$$x_i = \frac{factor_{ADJ,YEAR2} - factor_{ADJ,YEAR1}}{factor_{ADJ,YEAR1}} \tag{5}$$

where $factor_{ADJ,\ YEAR2}$ is the adjustment factor in the later year and $factor_{ADJ,\ YEAR1}$ is the adjustment factor in the previous year. The difference is standardized relative to the adjustment factor in the previous year.

The Correlation Coefficient Test: The correlation coefficient test measures the strength of the linear relationship between two variables. If variable x can be expressed exactly as a linear function of another variable, y, then the correlation is 1 if the variables are directly related or -1 if the variables are inversely related. A correlation of 0 between two variables means that each variable has no linear predictive ability for the other. If the values are normally distributed, then a correlation of 0 means that the variables are independent of one another.

The sample correlation coefficient estimating the true Pearson product-moment correlation, is computed as

$$r_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} \tag{6}$$

which can be applied to test the two hypotheses presented above. The related variables are defined as follows. We have: x_i = $factor_{UNI}$ and y_i = $factor_{ADJ}$ for hypothesis one; x_i = $factor_{ADJ,\ YEAR1}$ and y_i = $factor_{ADJ,\ YEAR2}$ for hypothesis two.

To pass the pair-comparison t-test requires a more rigid condition than to pass the correlation coefficient test, although in this study the predictions of the two tests are quite similar. Intuitively, the *paired-comparison t-test* checks whether IFS and DOTS trade totals are identical in levels. The correlation coefficient test checks the less stringent condition whether the two series have a similar trend in changes, if not necessarily the same level. Two variables with a small correlation coefficient, which implies only weak linear predictive ability between them, evidently cannot be the same.

Test Results

The Accuracy of DOTS Estimates: The results of the analysis of variance are presented in Table 4. STD, under the header "estimated," stands for the sample standard deviation for the standardized difference of total trade between estimated DOTS and reported IFS, called "the estimated STD"; STD, under the header "reported," is for the standardized difference between DOTS and IFS, both reported, called "the reported STD." The average of the estimated STD is 0.139 for exports and 0.126 for imports; the average of the reported STD is 0.034 for exports and 0.039 for imports. To the greatest extent, the estimated STD can be as much as eight times bigger than the reported STD.

Because STDs for reported DOTS total export and import data are very low, we conclude that there is essentially little difference between reported DOTS and reported IFS figures. We would expect to obtain higher STDs for estimated DOTS total trade figures relative to IFS, precisely because these figures are estimated rather than reported. STDs for DOTS estimates are, in effect, substantially higher than those for the reported data. However, it is of some interest in assessing the quality of estimation to know not only the level of STDs, which are the mean squared errors of DOTS total export and import estimates against IFS standards, but also what part of the mean squared error arises from random versus systematic errors. This can be seen as an exercise in assessing the variance and squared bias components of the mean squared error. In fact, recent data show that more than 90 percent of the STD for estimated DOTS total trade figures results from systematic rather than random errors. 1/ On this basis, development of estimators that reduce systematic error components will be most effective in improving the accuracy of DOTS total trade and, we would argue, direction of trade estimates.

The Uniform and Adjustment Factors: The results of the t-test and the correlation coefficient test for comparing the uniform factors and the adjustment factors are provided in Tables 5 and 6. Tables 5 and 6 reveal strong evidence for rejecting the hypothesis that the uniform factors and

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1/ This is shown in Appendix I by decomposing the total error of DOTS estimates for total trade into random and systematic components, and estimating the size of these components using recent DOTS data.

the adjustment factors are the same. Rather, in order to get an appropriate estimation of the trade figures, we should abandon the use of the uniform factors.

The capital letter T is used in the result of calculation to represent the t statistic for testing the null hypothesis of the mean difference equal to zero. Prob > |T| gives the probability of a greater absolute value of t under the null hypothesis. This is the two-tailed significance probability. If the associated p-value is very small, that is, less than .05, we would reject the null hypothesis and consider the average difference is significantly different from zero. In other words, the paired variables are significantly different.

A symbol "N" indicates that the null hypothesis, that the standardized difference between the uniform factors and the adjustment factors equals zero, is rejected at a significance level of 0.05. Table 5 shows that 15 out of 32 observations of countries are rejected for 1990, 19 of 32 are rejected for 1991, and 17 of 32 are rejected for 1992. Generally speaking, about half of the uniform factors are rejected. It implies that about half of the factors used to estimate the trade figures in the current system are inappropriate. The conclusion of the t-test is consistent with the results of the correlation coefficient test in Table 6. Most of the time, there are no linear correlations between the two series of the uniform and the adjustment factors, on the basis of correlation coefficients greater than 0.5 marked by "Y" in the table. Table 6 shows there are very few observations with correlation coefficients greater than 0.5.

The Adjustment Factors in Different Years: The results of a t-test and a correlation coefficient test comparing the adjustment factors in different years are supplied in Tables 7 and 8. The adjustment factor, which is the actual difference between a country's reported exports (and imports) and the respective imports (and exports) reported by its trade partner, provides an alternative method for DOTS to conduct the partner-based estimates. The purposes of Tables 7 and 8 are to explore the consistency and stability of these adjustment factors over time. These characteristics are the necessary conditions for applying time series analysis or other statistical techniques to derive these factors from the historical data for each country.

The results strongly support the premise. Specifically, they show that the following hypotheses cannot be rejected by most of the observations: The difference of the adjustment factors in different years is equal to zero, and there are strong linear correlations between the adjustment factors in different years. For example, according to the t-test, 29 observations out of 32 sample countries for 1990/91, 30 out of 32 sample countries for 1990/92, and 31 out of 32 sample countries for 1991/92 cannot be rejected under the hypothesis that there are no significant differences between the adjustment factors in different years. In addition, the outcomes in Table 8, applying the same correlation coefficient test as in Table 6, confirm the above conclusion by showing that the adjustment factors are highly correlated in different years. The symbol of "Y" indicates the

corresponding correlation coefficient is greater than 0.5, which has applied to almost all the observations in Table 8.

IV. Conclusions and Suggestions

Appendix IV provides a diagram of the DOTS system in terms of the availability of trade data. All countries in the world have been divided into two groups, countries with and without reported data. They are labeled as C_1, ..., C_i and C_1', ..., C_j', respectively. Countries with reported data are located in Quadrant I. Quadrants II and III are the intersections between the countries with and without reported data. Quadrant IV represents the trade between nonreporting countries. Exports are represented in the horizontal rows and imports in the vertical columns. 1/ The last column contains the total of exports, and the last row holds the total of imports for every country.

The DOTS system can be considered as a monthly time series of such matrices. The size in terms of the rows and columns of the whole matrix is fixed by the number of countries in the world. However, the area of the various quadrants vary from one period to the other. The area of Quadrant I increases or decreases, depending on the coverage of the reporting countries. For example, as in Table 2, the number of countries with reported exports declined from 28 in January 1993 to 12 in November 1993; consequently, the rows of Quadrant I decline from 28 to 12 for the corresponding month. At the same time, the coverage ratio of the reported data for exports drops from 69.0 percent to 25.8 percent, which would be depicted by a shrinkage in the area of Quadrants I and II. 2/

In general, the more countries' data included, the larger the area of Quadrant I. However, the marginal degree of the expansion of Quadrant I by each updated country is determined by the percentage of that country's trade in the total of world trade. The work load in processing DOTS data is equal for almost every country, regardless of its weight in the world total. Therefore, when the degree of difficulty in obtaining data for two countries is the same, attention should be focused on the country with the larger percentage of the world total trade. Table 3 provides a sample listing of target countries.

Quadrants II and III are the intersections between the reporting and nonreporting countries. Therefore, in these quadrants, imports of late- and nonreporting countries can be estimated in Quadrant II, and exports of late- and nonreporting countries can be estimated in Quadrant III. The area of

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1/ Strictly, the cell of the matrix should distinguish between FOB and CIF value; however, the difference is ignored here for simplification.

2/ The fall in the coverage ratio of the reported data of imports would be depicted by a shrinkage in the area of Quadrants I and III (see Appendix II).

Quadrant IV is the bilateral trade between nonreporting countries that is currently estimated by extrapolation. Because of nonexistent partner records, the structures of this part in the DOTS matrix are vague. The area of Quadrant IV will be large if the coverage ratio of the reported data in Quadrant I is low. 1/

This study has shown that two imperfections in the estimating techniques of the current DOTS system cause it to measure incorrectly the values in Quadrants II and III. First, the way that DOTS estimates the components of each nonreporting country's trade figures from its trade partner's data has generated the difference of the total trade between DOTS and IFS. Second, using 10 percent of the FOB value of exports for estimation has generated a systematic bias, as measured against total trade reported in IFS, in the estimates of the trade figures by using the trade partners' data.

Total trade figures, in principle, should be the same in IFS and DOTS. The study confirms this by showing the fact that the differences between trade data reported in DOTS and in IFS are not significant. For the purpose of compiling DOTS data, IFS provides supplementary information in the form of total trade which is especially useful for nonreporting and late reporting countries in DOTS. In such cases, since total trade requires only two figures of export and import, apparently less complicated than the direction of trade consisting of flow with all trade partners, total trade data in IFS tend to be comparatively more easily obtained and more currently available.

Table 9 and Table 10 show the availability and currentness of reports in DOTS and IFS where the same group of countries and areas, as in Table 3, are selected. Because of a five-month time lag for data used in its publication, DOTS reports for January data received before June, for instance, would be on time for the DOTS June issue update. Table 9 exhibits that data for only about 14 countries of this group of 50 countries for January 1993 were available before June 1993, while most countries reported their IFS 60r Report Form regularly, as demonstrated in Table 10, with total trade data in about a four-month lag for most of the countries.

It is suggested that (1) instead of using 10 percent of the FOB value of exports as the uniform factors, an estimate should be derived based on the adjustment factors from the difference between the CIF value of imports reported by the country of destination and the FOB value of exports reported by the country of origin from the historical records. Techniques of time-series analysis provide various ways that can be applied to derive the adjustment factors. Adjustment factors are the basis for estimating Quadrant II and III for late- and nonreporting countries; and (2) IFS total trade should be used as the controls in DOTS, when available. The estimating procedure would be to (a) estimate the shares of the ratio of

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1/ A more detailed description is provided in Appendix II.

total trade between a country and its partner countries using the partners' data, rather than the value of trade as in the current system, then (b) apply IFS total trade data as controls and distribute them among partner countries according to the ratios derived above. In this way, world and regional total trade in DOTS would be closer to the actual flows.

There are, however, two technical constraints to the implementation of the recommendations. The first is the lack of well-designed computational facilities in the current system. Due to the huge size of the DOTS database, this study was conducted with the aid of SAS statistical analysis software on the mainframe. Because SAS resides under CMS at the World Bank side of the shared IBM system, DOTS data must be transferred from the IMF side of the system (TSO). The indispensable procedure of data transformation caused certain inconveniences. 1/ Second, additional statistical and econometrical studies are needed to realize the seemingly obvious objectives proposed in this paper, particularly in implementing the improvements in estimation of the CIF/FOB factors. Once that stage is completed, it should be less difficult to run the system in production because fewer interventions will be needed. Nonetheless, by implication we are confronted with the task of estimation matrices of "adjustment factors" of dimension around 180x180 to replace the current 10 percent uniform CIF/FOB factors.

Finally, future research should also put more emphasis on the estimation of Quadrant IV. A rich literature on the technique of RAS 2/, used in updating input-output tables, provides a promising direction for the development of DOTS. The essence of RAS (or extended RAS) is to combine the known boundaries with the estimates of the structural coefficients of Quadrant IV in the matrix of trade flows by fully utilizing the information available over time or over space. This information would include the historical data of the country's own trade with its trade partners and the trade structure of some other country with an economy similar to the one under consideration.

1/ Useful computer programs and procedures, and some other outstanding issues associated with DOTS can be found in Gong (1994).

2/ As described by Taylor (1984), "the RAS technique is a biproportional matrix adjustment technique. It entails the adjustment of rows and columns of an existing matrix in an iterative manner such that it sums simultaneously to predetermined row and column control totals." For recent developments in the RAS technique, it is worthwhile to refer to Antille (1990) and Snower (1990), among others. RAS also goes by the term "raking ratio estimation" (RRE) in the survey statistics literature, and is a member of a larger class of techniques for adjusting the cells of matrices minimally to meet the border or "control" totals (see Oh and Scheuren, 1983). Another promising candidate in this group is the generalized least squares (GLS) estimator, which is often computationally more efficient than RRE (see Zieschang, 1990).

Decomposing the Mean-Square Errors

If we assume: $x_i = \frac{\hat{Tr}_D - Tr_{IFS}}{Tr_{IFS}}$ and $y_i = \frac{Tr_D - Tr_{IFS}}{Tr_{IFS}}$, that is, x_i is the difference between estimated DOTS total trade and reported IFS total trade, and y_i is the difference between DOTS and IFS, both are reported.

Then, the mean-square error $\frac{1}{n}\sum(x_i-y_i)^2$ can be decomposed into three terms: $\frac{1}{n}\sum(x_i-y_i)^2=(\bar{x}-\bar{y})^2+S_x^2-2rS_xS_y+S_y^2$

and reorganized as: $\frac{1}{n}\sum(x_i-y_i)^2=(\bar{x}-\bar{y})^2+(S_x-rS_y)^2+(1-r^2)S_y^2$,

where $\bar{x}$ and $\bar{y}$ are the means, and S_x and S_y are the estimated standard deviations of the x_i and y_i series respectively, and r, the correlation coefficient between x_i and y_i. Clearly, S_x is equivalent to our estimated STD and S_y to our reported STD. Further, to define:

$$U^M=\frac{(\bar{x}-\bar{y})^2}{\frac{1}{n}\sum(x_i-y_i)^2}, \quad U^R=\frac{(S_x-rS_y)^2}{\frac{1}{n}\sum(x_i-y_i)^2}, \quad U^D=\frac{(1-r^2)S_y^2}{\frac{1}{n}\sum(x_i-y_i)^2},$$

we have: $U^M + U^R + U^D = 1$.

To characterize x by the model x=a+by+e, then U^M is the squared bias due to prediction of the mean; U^R is the squared bias due to the regression slope; and U^D is the variance of the random disturbance. 1/ Good estimators should be able to eliminate systematic errors: With U^M and U^R close to zero and U^D to one.

Thus:

(i) The systematic errors can be characterized by:

$$U^M+U^R=\alpha(\bar{x}-\bar{y})^2+\alpha(S_x-rS_y)^2>\alpha(S_x-rS_y)^2>\alpha(S_x-S_y)^2 \quad \because -1\le r\le 1 \text{ and}$$

$S_x \gg S_y$ according to Table 4 and where $\alpha=\frac{1}{\frac{1}{n}\sum(x_i-y_i)^2}$.

Applied to Table 4, it yields

$U^M+U^R>\alpha(S_x-S_y)^2=\alpha(0.139-0.034)^2=0.011\alpha$ for exports and:

1/ Theil (1970) p. 34.

$U^M+U^R>\alpha(S_x-S_y)^2=\alpha(0.126-0.039)^2=0.008\alpha$ for imports.

(ii) The random errors can be characterized by:

$U^D=\alpha(1-r^2)S_y^2<\alpha S_y^2=\alpha(0.034)^2=0.0012\alpha \quad \because -1\leq r\leq 1$ for exports and:

$U^D=\alpha(1-r^2)S_y^2<\alpha S_y^2=\alpha(0.039)^2=0.0015\alpha \quad \because -1\leq r\leq 1$ for imports.

It becomes clear that the systematic errors are about ten times greater than the random errors in the estimators of DOTS. In other words, more than 90 percent of the mean-square errors result from the systematic errors. The large systematic errors exhibit a serious problem in the current estimating system in DOTS.

The Importance of an Accurate Estimating Procedure with Partners' Data

A good estimating procedure using trade partners' data would improve the quality of DOTS even without high coverage of the reported data.

Suppose that the percentage coverage ratio of the reported data for a specific period is p for exports and q for imports. In Appendix IV, Quadrants I and II cover p percent of exports, leaving the area of Quadrants III and IV with (1-p) percent indeterminate; similarly, Quadrants I and III cover q percent of imports, leaving Quadrants II and IV with (1-q) percent ambiguous for imports.

If the estimating procedure using trade partners' data is highly accurate, an additional area will be added to the above area covered by the reported data. Because the exports of nonreporting countries can be derived from their trade partners' data in Quadrant III, the new area of exports after the estimation will be Quadrants I, II, and plus III, with percentage: p+q(1-p). Similarly, because the imports of nonreporting countries can be derived from their trade partners' data in Quadrant II, the new area of imports become Quadrants I, III, and plus II, with percentage: q+p(1-q). On the other hand, the area of Quadrant IV is (1-p)(1-q) for both exports and imports. The uncertain part of the DOTS matrix shrinks significantly.

As an example, the coverage ratio of reported data for January 1993 was 69 percent for exports and 67.3 percent for imports (Table 2). The coverage of the reported data combined with the estimated data from the trade partners would be:

$$\text{Exports}_{\text{Quadrant I,II,III}} = p + q(1-p)$$

$$= 69.00\% + 67.30\%(1 - 69.00\%) = 89.86\%;$$

$$\text{and, Exports}_{\text{Quadrant IV}} = (1-p)(1-q) = (1 - 69.00\%)(1 - 67.30\%) = 10.14\%.$$

$$\text{Imports}_{\text{Quadrant I,II,III}} = q + p(1-q)$$

$$= 67.30\% + 69.00\%(1 - 67.30\%) = 89.86\%;$$

$$\text{and, Imports}_{\text{Quadrant IV}} = (1-q)(1-p) = (1 - 67.30\%)(1 - 69.00\%) = 10.14\%.$$

In summary, an accurate estimating procedure using the trade partners' data could cover about 90 percent of the world trade data correctly with only 65 to 70 percent reported.

Table 1. DOTS Coverage by Reported Data, 1987-92

		Complete Data	
		Number of Reporting Countries	Percent of World Trade
Exports	1987	115	97.8
	1988	109	96.9
	1989	104	97.3
	1990	94	96.3
	1991	81	93.7
	1992	62	86.5
Imports	1987	116	96.1
	1988	111	96.2
	1989	104	96.1
	1990	93	95.5
	1991	80	94.1
	1992	61	88.1

Source: DOTS Data Tape, March 1994.

Table 2. DOTS Coverage by Reported Data, Monthly 1992-93

		1992		1993	
		Number of Reporting Countries[a/]	Percent of World Trade	Number of Reporting Countries[a/]	Percent of World Trade
Exports					
	Jan	41 (20)	83.9	28 (13)	69.0
	Feb	40 (19)	85.0	28 (13)	71.4
	Mar	41 (20)	85.2	29 (13)	72.0
	Apr	41 (20)	84.7	28 (13)	69.9
	May	39 (20)	83.0	27 (11)	71.2
	Jun	41 (20)	84.6	26 (11)	60.7
	Jul	41 (20)	84.5	22 (10)	51.1
	Aug	41 (20)	82.5	22 (10)	48.4
	Sep	40 (19)	84.1	18 (9)	44.8
	Oct	38 (17)	84.1	17 (6)	45.2
	Nov	38 (17)	83.2	12 (4)	25.8
	Dec	37 (16)	82.9		
Imports					
	Jan	43 (22)	83.4	28 (13)	67.3
	Feb	42 (21)	82.9	28 (13)	68.7
	Mar	41 (20)	82.6	29 (13)	69.4
	Apr	40 (19)	82.7	28 (13)	67.8
	May	38 (19)	81.5	27 (11)	69.3
	Jun	39 (18)	82.0	27 (12)	60.0
	Jul	38 (17)	82.1	22 (10)	47.6
	Aug	39 (18)	82.3	22 (10)	49.1
	Sep	38 (17)	82.4	17 (8)	43.8
	Oct	37 (16)	82.0	15 (4)	43.8
	Nov	37 (16)	81.7	11 (4)	22.4
	Dec	37 (16)	80.3		

a/ The figures in parentheses indicate the number of developing countries that reported data for the respective months.

Source: DOTS Data Tape, March 1994.

Table 3. List of Countries Comprising 95 Percent of World Trade, 1990-92

Code	Country	Monthly Report (93)		Update (92)			% of World Trade (Avg. of 90-92)	
		Exp.	Imp.	Mon.	Qt.	Ann.	Exp.	Imp.
111	United States	Y	Y	12			12.1	14.6
112	United Kingdom	Y	Y	12			5.4	6.0
122	Austria	Y	Y	12			1.2	1.4
126	Belgium-Luxembourg			12			3.4	3.4
128	Denmark			11		Y	1.0	0.9
132	France	Y	Y	12			6.4	6.5
134	Germany	Y	Y	12			11.9	10.5
136	Italy	Y	Y	12			5.0	5.1
138	Netherlands			12			3.9	3.5
142	Norway	Y	Y	12			1.0	0.7
144	Sweden	Y	Y	12			1.6	1.4
146	Switzerland	Y	Y	12			1.8	1.9
156	Canada	Y	Y	12			3.7	3.5
158	Japan	Y	Y	12			9.0	6.5
172	Finland	Y	Y	12			0.7	0.6
174	Greece	Y	Y	12			0.3	0.6
178	Ireland			12			0.7	0.6
182	Portugal			12			0.5	0.8
184	Spain	Y	Y	12			1.7	2.6
186	Turkey			12			0.4	0.6
193	Australia	Y	Y	12			1.2	1.2
196	New Zealand	Y	Y	11		Y	0.3	0.3
199	South Africa						0.8	0.5
213	Argentina					Y	0.4	0.2
223	Brazil					Y	0.9	0.6
228	Chile	Y	Y	12			0.3	0.1
273	Mexico						1.0	1.3
299	Venezuela					Y	0.5	0.2
429	Iran, I.R. of						0.5	0.6
436	Israel	Y	Y	12			0.4	0.5
456	Saudi Arabia						1.3	0.8
466	United Arab Emirates						0.7	0.4
469	Egypt						0.1	0.3
528	Taiwan, Pro of China			12			2.1	1.7
532	Hong Kong	Y	Y	12			2.9	2.8
534	India						0.5	0.6
536	Indonesia			7			0.8	0.7
542	Korea					Y	2.0	2.1
548	Malaysia	Y	Y	12			1.0	1.0
564	Pakistan	Y	Y	12			0.2	0.2
566	Philippines			2			0.3	0.4
576	Singapore						1.5	1.9
578	Thailand	Y	Y	12			0.8	1.0
694	Nigeria						0.2	0.1
612	Algeria						0.3	0.2
924	China, People's Rep.	Y	Y	12			2.1	1.8
944	Hungary				4		0.1	0.2
964	Poland						0.4	0.4

Source: DOTS Data Tape, March 1994.

Table 4. The Difference Between DOTS and IFS in Countries' Total Trade, Monthly 1992

		Estimated		Reported		Ratio of STD of Estimated to Reported
		N[a/]	STD	N[a/]	STD	
Exports	Avg	10	0.139	25	0.034	4.1
	Jan	8	0.139	25	0.033	4.2
	Feb	10	0.117	26	0.016	7.4
	Mar	10	0.144	26	0.017	8.4
	Apr	10	0.138	26	0.019	7.3
	May	11	0.121	25	0.020	6.2
	Jun	10	0.148	26	0.039	3.8
	Jul	10	0.168	25	0.043	4.0
	Aug	11	0.145	25	0.083	1.7
	Sep	11	0.131	25	0.023	5.8
	Oct	10	0.114	25	0.027	4.3
	Nov	10	0.118	25	0.017	7.0
	Dec	10	0.188	25	0.067	2.8
Imports	Avg	13	0.126	28	0.039	3.2
	Jan	11	0.123	30	0.033	3.7
	Feb	12	0.145	29	0.039	3.7
	Mar	11	0.062	29	0.025	2.5
	Apr	12	0.111	29	0.035	3.2
	May	15	0.101	27	0.079	1.3
	Jun	14	0.157	28	0.031	5.1
	Jul	13	0.140	28	0.026	5.3
	Aug	13	0.124	29	0.057	2.2
	Sep	14	0.155	28	0.021	7.5
	Oct	13	0.122	28	0.029	4.2
	Nov	14	0.140	28	0.034	4.1
	Dec	14	0.132	27	0.056	2.3

a/ The number of observations.

Source: DOTS Data Tape, March 1994.

Table 5. Paired-Comparisons T-Test: Adjustment and Uniform Factors

Country Code	1990			1991			1992		
	T	Prob>|T|	>.05	T	Prob>|T|	>.05	T	Prob>|T|	>.05
111	-0.84	0.4040		-1.58	0.1232		0.73	0.4735	
112	-1.59	0.1194		-0.81	0.4207		-0.42	0.6759	
122	0.87	0.3908		-1.31	0.1970		-1.65	0.1103	
126	-2.06	0.0465	N	-3.06	0.0040	N	-3.37	0.0021	N
128	0.62	0.5385		-1.05	0.2983		0.37	0.7162	
132	-2.13	0.0394	N	-3.12	0.0034	N	-2.53	0.0167	N
134	-2.61	0.0127	N	-1.75	0.0882		0.96	0.3441	
136	-3.26	0.0023	N	-1.35	0.1855		-1.47	0.1511	
138	-5.80	0.0001	N	-2.11	0.0417	N	-4.34	0.0002	N
142	-2.69	0.0104	N	-3.83	0.0005	N	-4.58	0.0001	N
144	-0.45	0.6525		-0.59	0.5617		-1.74	0.0928	
146	-1.72	0.0942		-3.48	0.0013	N	-2.55	0.0163	N
156	-1.25	0.2194		-4.97	0.0001	N	-2.86	0.0076	N
158	-1.42	0.1639		1.11	0.2734		-1.16	0.2540	
172	0.34	0.7374		-1.25	0.2179		0.29	0.7758	
174	-3.03	0.0045	N	-3.42	0.0016	N	-0.19	0.8480	
178	-1.73	0.0927		-4.71	0.0001	N	-2.35	0.0259	N
182	-1.75	0.0877		-2.10	0.0428	N	-0.99	0.3322	
184	-3.18	0.0029	N	-4.32	0.0001	N	-2.10	0.0443	N
186	-2.40	0.0215	N	-2.79	0.0084	N	-3.42	0.0025	N
193	0.52	0.6076		-3.86	0.0004	N	-2.74	0.0103	N
196	-3.90	0.0004	N	-6.91	0.0001	N	-14.0	0.0001	N
213	-2.44	0.0206	N	-4.99	0.0001	N	0.59	0.5623	
228	-1.29	0.2084		0.66	0.5129		-0.86	0.3975	
299	-0.90	0.3769		-2.06	0.0473	N	-2.65	0.0133	N
436	-1.42	0.1660		-2.02	0.0528		-3.40	0.0023	N
532	-2.47	0.0181	N	-0.82	0.4202		-0.79	0.4376	
542	-1.66	0.1054		-0.46	0.6464		-0.49	0.6264	
548	-3.08	0.0040	N	-5.23	0.0001	N	-4.75	0.0001	N
578	-2.39	0.0219	N	-3.32	0.0020	N	-4.70	0.0001	N
924	-1.76	0.0875		-2.84	0.0075	N	-2.69	0.0117	N
944	-7.38	0.0001	N	-4.45	0.0001	N	-4.00	0.0004	N

Source: DOTS Data Tape, March 1994.

Table 6. Correlation Coefficients Test Between the Adjustment and Uniform Factors

Country Code	1990		1991		1992	
	Corr.	>.5	Corr.	>.5	Corr.	>.5
111	-0.038		-0.064		-0.099	
112	0.419		0.395		0.217	
122	-0.732		-0.809		-0.841	
126	-0.225		-0.207		-0.253	
128	-0.473		-0.551		-0.592	
132	-0.694		-0.686		-0.725	
134	0.178		0.311		0.378	
136	0.478		0.476		0.358	
138	-0.665		-0.442		-0.419	
142	-0.127		-0.430		-0.347	
144	0.018		0.172		-0.023	
146	-0.400		-0.693		-0.597	
156	-0.071		-0.625		-0.636	
158	0.603	Y	0.674	Y	0.619	Y
172	0.058		-0.082		-0.275	
174	0.182		0.405		-0.109	
178	-0.636		-0.677		-0.670	
182	0.207		-0.299		0.171	
184	-0.122		-0.294		-0.423	
186	-0.469		-0.602		-0.622	
193	0.817	Y	0.777	Y	0.636	Y
196	0.409		0.167		0.030	
213	-0.752		-0.613		0.319	
228	-0.642		-0.621		-0.705	
299	-0.022		0.956	Y	0.906	Y
436	-0.061		-0.294		-0.428	
532	0.844	Y	0.818	Y	0.869	Y
542	0.739	Y	0.675	Y	0.804	Y
548	-0.151		-0.152		0.956	Y
578	0.377		0.586	Y	0.891	Y
924	-0.743		-0.824		-0.868	
944	-0.957		-0.299		-0.513	

Source: DOTS Data Tape, March 1994.

Table 7. Paired-Comparisons T-Test: Adjustment Factors Between Two Years

Country Code	1990 and 1991			1990 and 1992			1991 and 1992		
	T	Prob>|T|	>.05	T	Prob>|T|	>.05	T	Prob>|T|	>.05
111	1.01	0.322		0.53	0.603		-0.61	0.544	
112	-1.32	0.196		-2.76	0.010	N	-1.86	0.072	
122	-0.01	0.995		0.99	0.329		1.54	0.133	
126	-0.90	0.378		-1.77	0.087		-1.44	0.160	
128	1.30	0.205		-0.52	0.607		-0.84	0.407	
132	0.05	0.963		0.07	0.948		0.08	0.940	
134	0.66	0.516		1.07	0.295		1.16	0.257	
136	1.14	0.265		0.20	0.841		-1.29	0.206	
138	-1.29	0.207		-1.15	0.259		-0.37	0.712	
142	-0.05	0.959		-1.76	0.089		-1.38	0.179	
144	0.18	0.861		0.65	0.519		0.64	0.526	
146	0.21	0.834		1.00	0.326		2.12	0.043	N
156	0.98	0.337		-1.57	0.126		-1.29	0.207	
158	-1.19	0.244		-1.39	0.174		0.09	0.933	
172	-0.65	0.524		1.01	0.320		1.04	0.305	
174	0.65	0.524		-0.15	0.886		-0.67	0.506	
178	0.17	0.867		-1.01	0.319		-1.05	0.303	
182	1.77	0.087		1.08	0.288		0.77	0.449	
184	0.60	0.553		-0.72	0.475		-1.13	0.269	
186	-1.20	0.243		-1.53	0.142		-1.54	0.137	
193	-0.69	0.499		0.94	0.355		0.98	0.334	
196	1.19	0.245		-0.47	0.645		-1.31	0.199	
213	1.65	0.111		3.72	0.001	N	-0.22	0.824	
228	-2.89	0.008	N	-0.24	0.812		0.82	0.423	
299	3.48	0.002	N	1.39	0.174		-1.12	0.271	
436	0.47	0.642		0.50	0.620		-0.03	0.977	
532	-0.30	0.763		0.08	0.934		0.31	0.761	
542	0.71	0.487		-0.66	0.517		-0.94	0.355	
548	1.43	0.163		1.30	0.203		0.38	0.710	
578	2.31	0.028	N	1.21	0.235		-1.63	0.114	
924	0.13	0.900		-1.67	0.107		-1.59	0.123	
944	1.01	0.321		-0.03	0.979		-0.99	0.329	

Source: DOTS Data Tape, March 1994.

Table 8. Correlation Coefficients Test Between the Adjustment Factors in Different Years

Country Code	1990 and 1991		1990 and 1992		1991 and 1992	
	Corr.	>.5	Corr.	>.5	Corr.	>.5
111	0.980	Y	0.979	Y	0.985	Y
112	0.904	Y	0.907	Y	0.936	Y
122	0.963	Y	0.917	Y	0.969	Y
126	0.678	Y	0.596	Y	0.825	Y
128	0.992	Y	0.939	Y	0.949	Y
132	0.965	Y	0.943	Y	0.991	Y
134	0.932	Y	0.911	Y	0.982	Y
136	0.959	Y	0.936	Y	0.982	Y
138	0.863	Y	0.703	Y	0.793	Y
142	0.904	Y	0.753	Y	0.668	Y
144	0.897	Y	0.918	Y	0.959	Y
146	0.694	Y	0.687	Y	0.968	Y
156	0.889	Y	0.871	Y	0.665	Y
158	0.538	Y	0.695	Y	0.865	Y
172	0.935	Y	0.116		0.087	
174	0.530	Y	0.491		0.600	Y
178	0.985	Y	0.606	Y	0.711	Y
182	0.677	Y	0.275		0.626	Y
184	0.792	Y	0.936	Y	0.829	Y
186	0.825	Y	0.556	Y	0.515	Y
193	0.845	Y	0.175		0.201	
196	0.727	Y	0.420		0.520	Y
213	-0.014		0.873	Y	-0.003	
228	0.832	Y	0.334		0.355	
299	0.346		0.262		0.457	
436	0.706	Y	0.703	Y	0.676	Y
532	0.875	Y	0.782	Y	0.840	Y
542	0.013		0.019		0.295	
548	0.632	Y	0.317		0.378	
578	0.515	Y	0.613	Y	0.687	Y
924	-0.008		0.207		0.206	
944	0.917	Y	0.142		-0.155	

Source: DOTS Data Tape, March 1994.

Table 9. DOTS Report Received for 1993

Code	Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
111	U.S.A.												
112	U.K.	12*	12*	12*	12*	12*	12*	4~	4~	4~	4~	4~	4~
122	Austria	4*	5*		6*	7*	9*		10*	11*	12*	4~	
124	Belgium	5~	5~	5~	6~	6~	6~	7~	7~	7~			
128	Denmark							9*					
132	France	5*	6*	7*	8*	9*	10*	11*	12*	12*	1~	2~	
134	Germany	10*	10*	11*	11*	11*	2~	2~	2~	2~	2~	3~	4~
136	Italy	8*	8*	8*	11*		10*	11*	2~	2~	2~	3~	
137	Luxembourg												
138	Netherlands	7*			9*	10*	12*	2~	2~		4~	5~	6~
142	Norway	3*		5*	6*	7*	8*			11*	12*	1~	2~
144	Sweden	5*	5*	6*	7*	8*	9*	10*	11*	12*	1~	2~	3~
146	Switzerland	4*	4*	5*	6*	7*		10*	10*	10*	11*	1~	3~
156	Canada	3*		5*	6*	7*	8*	9*	10*	11*		1~	
158	Japan	3*		5*	6*	7*	8*	8*	10*	11*	12*	1~	4~
172	Finland	3*	6*	7*	7*	8*	8*	9*	10*	11*	1~	1~	2~
174	Greece	6*	6*	7*	9*	10*	11*	12*	1~	2~	2~	3~	7~
176	Iceland												
178	Ireland	6~	6~	6~	6~	6~	6~	6~	6~	6~			
182	Portugal	6*	6*							5~			
184	Spain	5*	6*	7*		9*	9*					2~	2~
186	Turkey												
193	Australia	3*		6*	7*	7*	8*	9*		11*	12*	1~	
196	New Zealand	4*	4*	5*	6*	7*	8*	8*	10*	11*			
199	South Africa												
213	Argentina												
223	Brazil		5*										
228	Chile	2~	2~	2~	2~	2~	2~	2~	2~	2~	2~	2~	2~
273	Mexico												
299	Venezuela									11*			
429	Iran												
436	Israel	5*	5*	5*	6*	7*	8*	8*	10*	10*	12*	1~	1~
456	Saudi Arabia												
466	U.A.E.												
469	Egypt												
528	Taiwan (China)												
532	Hong Kong	3*	4*	5*	6*	7*	8*	9*	10*	11*	12*	1~	2~
534	India	5~		5~	5~	5~	5~	5~	5~	5~	5~	5~	5~
536	Indonesia												
542	Korea												
548	Malaysia	6*	6*	7*	7*	8*	10*	11*	11*	2~			4~
564	Pakistan	4*	5*	6*	7*	7*	9*	10*	11*	12*	1~	2~	3~
566	Philippines	2~	2~	2~	2~	2~	2~	2~	2~	2~	2~	2~	
576	Singapore	3~	3~	3~	3~	3~	3~	3~					
578	Thailand												
694	Nigeria												
612	Algeria												
924	China	5*	5*	5*	6*	7*	7*	8*	10*	10*	12*	2~	
944	Hungary												
964	Poland												

Notes: The figure indicates the month when the report form was received. Sign * represents in 1993 and ~ in 1994.

Table 10. 60r Report Forms and Cables Reported for IFS in 1993

Code	Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
111	U.S.A.												
112	U.K.	Y	Y	Y		Y	Y			Y	Y		Y
122	Austria	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
124	Belgium	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
128	Denmark	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
132	France	Y	Y	Y	C	Y	Y	Y	Y	Y	C	Y	Y
134	Germany	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
136	Italy	Y	Y	Y					Y	Y	Y	Y	Y
137	Luxembourg	Y		Y	Y								
138	Netherlands	Y	Y	Y	Y		Y				Y	Y	Y
142	Norway	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	
144	Sweden	Y	Y						Y		Y		
146	Switzerland	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y
156	Canada		Y	Y		Y	Y		C	Y	Y	Y	
158	Japan	Y	Y	Y	Y	Y	Y	C	Y	Y	Y		Y
172	Finland	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
174	Greece	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y
176	Iceland	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	C	Y
178	Ireland	Y	Y	Y	Y	Y		C	Y	Y	Y	Y	Y
182	Portugal	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y
184	Spain	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
186	Turkey												
193	Australia	Y	C	Y	C	Y	Y	C	Y	Y	Y	Y	Y
196	New Zealand	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
199	South Africa	Y	C	Y	Y	Y	Y	Y	Y	Y	C	Y	
213	Argentina		Y	Y			Y	Y		C			
223	Brazil		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
228	Chile	Y	Y	Y	Y	C	Y	Y	Y	Y	Y		Y
273	Mexico	Y	Y		Y	Y	Y	Y	Y		Y		Y
299	Venezuela	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
429	Iran	Y		Y		Y			Y	Y	Y	Y	Y
436	Israel					Y		Y	Y	Y	Y	Y	Y
456	Saudi Arabia	C	C	Y	C		Y	C	C	Y	Y	Y	C
466	U.A.E.			Y					Y				Y
469	Egypt	Y	Y	Y	Y	Y	Y	C	Y	Y	Y	Y	Y
528	Taiwan (China)												
532	Hong Kong	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
534	India	Y	Y	Y	Y	C	Y	C	Y	Y		Y	
536	Indonesia	Y		Y	Y	Y		Y		Y	Y	Y	Y
542	Korea	Y	Y	Y	Y	Y	Y	Y	Y			Y	
548	Malaysia		Y					Y					
564	Pakistan	Y	C	Y	Y	Y	Y	Y	Y	Y	C	Y	Y
566	Philippines	Y	C	Y	Y	Y	Y	Y		Y		Y	
576	Singapore	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
578	Thailand	Y	Y	Y		Y	Y		Y	Y	Y	Y	
694	Nigeria	Y	Y		Y	Y		Y	Y	Y	Y		Y
612	Algeria							Y	Y			Y	
924	China	Y	Y	Y		Y	Y	Y	Y	Y	Y		
944	Hungary					Y							
964	Poland	Y	Y		Y		Y	Y		Y	Y	Y	

Notes: Symbol "Y" for 60r report form and "C" for cable, received for the corresponding month.

Matrix of DOTS Flows

Countries of Destination

	DOTS	C1 Ci	C1' ..... Cj'	Total Exports
Countries of Origin	C1 : : : Ci	I	II	X1 : : : Xi
	C1' : : : Cj'	III	IV	X1' : : : Xj'
	Total Imports	M1 ..... Mi	M1' ..... Mj'	

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