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TO: Mr. Gustav Ranis

FROM: Alan M. Strout

SUBJECT: Summary of Recent Research on the Determinants of U.S. Exports

Since publication of the 1963 Brookings study on the U.S. balance of payments, considerably more work has been done on factors influencing U.S. exports. These studies can conveniently be divided into two groups: The first group deals with the differential impact of various kinds of foreign exchange receipts. Economic aid may be assumed to influence U.S. exports in a manner different from military grants, direct private investment, or ordinary earnings from trade. The second group of studies looks at the subsequent or "third country respending" effects of foreign exchange earnings. In these subsequent rounds of spending and respending, all convertible foreign exchange is added together, and the analysis looks at world-wide trading patterns and the reserve-accumulating behaviors of certain countries or blocks of countries.

Differential Foreign Exchange Impact: The Strout-Lynn Studies

I have analyzed the relationship between changes in U.S. exports to fifty developing countries and changes in various types of foreign currencies or resources.[1] Change was measured over the period 1957-58 to 1961-62. Type of foreign exchange or resources included:

(1) Net U.S. economic assistance, including AID, Ex-Im and PL-480

(2) Export earnings from commodity sales to the U.S.

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[1] Alan M. Strout, "Foreign Aid and U.S. Exports: A Statistical Analysis," Office of Program Coordination, April 1964 (processed), pp. 17-27.

((3) Export earnings from commodity sales to other trading partners

(4) Direct, private, long-term U.S. investment (net)

(5) Net financial flows, short and long term, from the U.S.

(6) Military expenditures by the U.S.

(7) Commodities transferred from the U.S. under military grants

(8) Net multilateral assistance expenditures

(9) Changes in reserves of gold and foreign exchange

The results suggested that a net dollar of economic aid to a particular country was associated, on the average, with 59¢ - 63¢ of U.S. merchandise exports (including Special Category items) to that particular country. For military grant commodities and direct private U.S. investment, the ratio was about 80¢ of exports per dollar. About 20¢ of each dollar of earnings from exports to the U.S. was respent on direct merchandise imports from the U.S. These factors accounted for 88 per cent of the country-to-country variation of change in U.S. merchandise exports during the sample period. The effect of other forms of foreign exchange was not statistically significant.

The effect on exports of changes in aid receipts appears low when it is recalled that 70% of the change in these receipts was accounted for by "100%-tied" commodity shipments under PL-480 and Export-Import Bank loans and that formal tying of AID funds had begun by the end of the period. The statistical results imply that even after making allowance for U.S. service exports, there was considerable "leakage" of aid dollars to third countries and possibly some substitution of PL-480 and Export-Import Bank goods for commercial U.S. exports. The aid coefficient nevertheless appears statistically sound, although it may have a possible error of plus or minus 10 percentage points.

Lawrence Lynn has made a parallel study differing in three important aspects: (1) Lynn has successfully been able to break out the independent effects of AID, PL-480 and Export-Import Bank disbursements, although he has not differentiated among private investment, military transfers, and other types of foreign exchange; (2) Lynn has used a procedure whereby an additional explanatory variable is the U.S. share of a particular market in a previous period; and (3) Lynn has employed "pooled" cross section and time series data covering 43 countries and the pre-aid-tying years, 1958-1960.[1] (The effect of this latter procedure is to give results representing behaviour for a 2-3 year period.) Lynn finds that U.S. merchandise exports (excluding special category items) associated with various classes of U.S. aid, and taking account of the market share effect, were:

	Dollars of U.S. Merchandise exports per dollar of U.S. assistance
AID & predecessors	.226
PL-480	.802, but "probably an understatement"
Export-Import Bank	.921

Weighing these factors by the changes in these forms of aid, as reflected in my 50-country sample, gives a combined average effect of about 54¢ of commodity exports for each dollar of aid. (See Annex A.)

This weighted coefficient is slightly below my results. It suggests that my estimates may reflect a slight impact of aid-tying on U.S. exports between 1957-58 and 1961-62.

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[1] Lynn's earlier work was reported in an unpublished document written for AID, "U.S. Foreign Economic Assistance and the Balance of Payments, 1954-1962," Dec. 1963 (mimeographed). This work has since been revised considerably and will be submitted to Yale University as a Ph.D thesis. The results discussed here are from the latest revision (Oct. 1965) of the thesis draft.

When Lynn applies similar statistical procedures to data for 1962 and 1963, he gets results quite different from those for the earlier period. Lynn attributes this to misspecification of the model once aid-tying becomes effective. He argues that aid-tying must be at least partially effective in a country where there exists some scope for tying. Scope for tying is certain to exist (although it may also exist under somewhat restrictive circumstances) when tied goods exceed the total imports from the U.S. which the country would normally have purchased in the absence of tying. Under these circumstances tying must increase U.S. exports (although usually by an amount less than the total magnitude of the tied aid.) In all other circumstances (i.e. when tied goods are less than the volume of imports from the U.S. which the country would normally buy in the absence of tying) it is possible for the country to substitute tied goods for normal imports.

Lynn uses his 1958-1960 regression results to represent "normal" import behavior in the absence of tying. He applies the appropriate coefficients to 1962-1963 data, and finds that scope for tying existed in the countries listed in Table 1.

TABLE 1

Scope for AID-Tying

(millions of dollars)

Country	Year	Normal Imports from U.S. in absence of aid-tying	Estimate of effectively tied AID expenditure*	Minimum effect of AID tying (Col. 4-3)
(1)	(2)	(3)	(4)	(5)
Ethiopia	1962	5.0	18.3	13.3
	1963	7.0	12.3	5.3
India	1963	266.9	311.3	44.4
Pakistan	1962	103.1	138.9	35.8
	1963	126.7	144.1	17.4
Sudan	1962	2.1	4.6	2.5
	1963	2.0	3.5	1.5
Viet Nam	1962	23.6	45.7	22.1
	1963	15.7	60.6	44.9
Bolivia	1963	15.2	20.7	5.5
Total	1962	133.8	207.5	73.7
	1963	433.5	552.5	119.0

Source: Based on Laurence E. Lynn, memorandum for Dr. Gustav Ranis, September 12, 1965, Tables 3-18 and 3-19.

* Equals total AID expenditures times proportion of AID commodities purchased in the U.S. times proportion of AID dollar which country would normally prefer to spend on non-US imports (from regression results).

These are minimum estimates of the aid-tying effect since they assume maximum possible substitution in all cases of tied-AID dollars for normal imports from the U.S. They nevertheless permit Lynn to identify those countries with maximum scope for effective tying. He then drops these six countries from his sample, reruns his 1962-1963 regressions, and this time he obtains results which give a larger AID coefficient than for 1958-60 (.28 as opposed to .23), but which are nevertheless statistically consistent with those for the earlier period. (The actual ratio to AID

expenditures of AID U.S. commodity procurement was .27 during the period 1958-60. About 44% of all AID-financed commodities were procured in the U.S.)

Lynn's results, in summary, suggest that the effect on U.S. commodity exports of gross, untied AID expenditures is quite low (about 23¢ of each AID dollar, but this might be 31¢ if service exports were included). He identifies six countries where AID-tying must of necessity increase U.S. exports by a minimum of $74 millions in 1962 and $119 millions in 1963. If this were the sole effect of AID-tying, the effect on U.S. exports of AID disbursements would have been only an additional 9¢ on the dollar in 1963. This would imply that the net first round effect of AID expenditures on U.S. exports for Lynn's sample of countries would have been about 40¢ on each dollar contrasted with a nominal 1963 AID-tying level of 78% (based on commodities only) for the same countries. At a nominal AID-tying level of 100%, Lynn's results would suggest a true, first round effect on U.S. exports of only 50¢. This contrasts with an estimated PL-480 effect of 80¢ and an Export-Import Bank effect of 92¢ on the dollar.

Two points should be emphasized about these results. The first is that they concern first round effects only. The final true impact on U.S. exports must include the effects of subsequent spending and respending of AID dollars (and of foreign exchange released by AID dollars) in third countries. The second is that the aid-tying effects are measured under the most conservative assumptions possible about the substitutability of AID-financed goods and services for commercially purchased goods and services. Using the basic Lynn coefficients, we can obtain an alternative estimate of aid-tying by contrasting actual exports from the U.S. to a country with those exports computed from Lynn's regression equation for the years 1958-60. The sum of these differences for all countries and for the years 1958-60 should be close to zero. For the years 1961 through 1964, the aggregate sum should

be positive and should increase year-by-year as tying effectiveness increases.

These additional calculations have been made both for Lynn's 43-country sample and for a slightly larger sample of 51 developing countries. In one alternative the "U.S. share" used as an explanatory factor in the 1961-1964 projections was that observed in the year 1960. This procedure implicitly gives aid-tying the credit for all changes in U.S. market shares over the 1961-63 period. In a second set of calculations, a hypothetical U.S. share was calculated for each year on the assumption that aid-tying had been totally ineffective. (See Annex A, D-2.) This procedure says that changes in the U.S. market share would have taken place even if there had been no aid-tying (through changes in total U.S. aid, other foreign exchange, and foreign exchange drawdowns) and this portion of market share change should be discounted in calculating the effect of aid-tying. The first procedure essentially gives an upper limit on our measurement of aid-tying effects; the second, a lower limit. The results are presented in Table 2.

TABLE 2

Effect of AID-Tying
($ millions)

	Average 1958-60	1961	1962	1963	1964
43 Country Sample					
Actual U.S. exports	5,283	5,822	6,084	6,389	7,134
Actual minus projected, using Lynn's 1958-60 regression results and:					
A. 1960 U.S. market share	-	11	42	178	441
B. Previous year's market share*	-30	11	74	26	316
51 Country Sample					
Actual U.S. exports	5,527	6,109	6,380	6,692	7,477
Actual minus projected, using:					
A. 1960 U.S. market share	-	68	89	219	490
B. Previous year's market share*	-31	68	47	174	556

Source: AID/PC/PPD, "Strout-Lynn Comparison" machine runs of 2/1/66.

*Actual (1957-1960) or estimated (1961-1963) market share.

Since the 1961-1964 projections assume no increase in aid-tying over that of the 1958-60 period, the differences shown above can partially be attributed to the increase in tying. ("Tying" of Export-Import Bank loans and PL-480 shipments was 100% during the entire period; the percentage of AID-financed commodities purchased in the U.S. increased from about 44% in 1958-1960 to 87% in fiscal year 1964.)

Both sets of calculations suggest an increase in aid-tying effects between 1961 and 1964. Almost all increases can be attributed to AID-tying, and the 1964, 51-country aid-tying effects amount to 47% to 54% of 1964 AID-financed U.S. exports to those countries.

The Irvine-FRB Calculations

Reed Irvine of the Federal Reserve Board has also studied changes over time in U.S. exports.[1] Irvine's general procedure has been to project to 1961-1964 the U.S. market share in individual countries based upon changes during the pre-aid-tying period, 1955-1960. Projection methods have been relatively simple, involving averages or linear extrapolation. Irvine has been particularly interested in those countries where actual U.S. exports during the latter period fell below those projected from extrapolated market shares. These "adverse" trade effects are observed in a number of countries, notably in Latin America and often in spite of considerable increases in U.S. aid.

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[1] Memorandum to Governor Robertson, September 13, 1965, and "The Impact of U.S. Foreign Aid on the Relative Demand for U.S. Goods in Aid-Receiving Countries" (draft outline of November 5, 1965).

The Irvine procedures identify a large number of countries where U.S. exports were smaller (or larger) than past U.S. market shares would have suggested. Since gross aid and time-trends are the sole explanatory variables examined, however, the explanatory power of the model is limited.

One difficulty with both the Irvine and the Lynn procedures is that U.S. market shares in the pre-1960 period do not represent untied conditions. As noted already, both ExIm Bank loans and surplus agricultural products were tied to U.S. sources during this period. Even if PL-480 sales are omitted, the sum of ExIm Bank merchandise plus non-PL-480 surplus sales (under AID and predecessor agencies) ranged from $446 millions in 1955 to $859 millions in 1958 to $566 millions in 1960. These figures averaged about 10% of U.S. exports to the developing countries and varied over this period by about four percentage points.

An alternative market share procedure, however, gives quite good projection results and permits an explicit measure of the "substitution" losses which accompany aid-tying. This approach is to calculate the base period U.S. market share after having excluded all aid-financed U.S. exports. This "commercial U.S. market share" is then used to project "commercial" or non-aid-financed U.S. exports in a later year. Total projected U.S. exports will equal the sum of the estimated non-aid-financed exports and the actual aid-financed exports. Since this procedure explicitly assumes no substitution losses in either the base or the later period, the projected exports will tend to exceed actual exports as aid-tying increases. The difference between actual and projected exports in this case will represent commercial export substitution losses from increased tying of aid.

This commercial market share procedure, using 1959-60 as the base, has been used to calculate 1963-64 U.S. exports to the same 51 countries discussed earlier. The projections themselves are quite good, on the average, and account for 90% of inter-country variations in U.S. export changes between 1959-60 and 1963-64. As anticipated, however, the general bias of the projections is to overstate actual exports. This difference in 1963-64, at least partly attributable to substitution losses, averaged $291 million. (Annex B, Table B-1, Col. 3.) This is slightly less than the apparent net gains from aid-tying. It suggests that about half of the possible gains from increased aid-tying may have been offset by increased substitution losses. The situation for these 51 countries is summarized in Table 3.

Maximum increase in U.S. exports from increased aid (mostly AID)-tying could have been $600 to $800 millions, but about one-half of this may have been offset by decreased U.S. commercial exports. Although 86% of 1963-64 AID-financed commodities were purchased in the U.S., the net direct effect may have initially been to increase U.S. exports by amounts

TABLE 3

Annual Average U.S. Exports, 1963-64
($ millions)

	Aid-financed	Non-aid-financed	Total
1. Actual, as reported	2,503	4,582	7,085
of which: AID	1,034	-	
PL 480 & ExIm, other	1,469	-	
2. Estimated assuming 1963-64 aid-tying but no increase in substitution losses over 1959-60			
(a) commercial market share model	2,503	4,873	7,376
(b) Lynn model	2,503	4,988	7,491
3. Estimated assuming no increase in aid-tying over 1958-60			
(a) total market share model	1,998	4,791	6,789
(b) Lynn model	1,743	4,988	6,731
4. Hence, maximum increase from aid-tying: (line 2a - line 3a)*			587
(line 2b - line 3b)*			760
Offset from increased substitution losses:			
(line 1 - line 2a)			-291
(line 1 - line 2b)			-406
net gain from aid-tying: (line 1 - line 3a)			296
(line 1 - line 3b)			354

*AID's procurement accounted for about $500 million of this increase through achieving a 86% U.S. procurement rate in 1963-64 in contrast to a 44% rate in 1959-60.

Source: PC/PPD machine run of 2/1/66.

Notes to Table 3

Line 2a: Estimated using equation (B-1), Annex B.

2b: AID-financed exports = actual reported;

Non-aid financed = constant element + attributions to changes in reserves and to "other foreign exchange," eq. (A-1), Annex A.

3a: AID-financed equals PL-480 and Ex-Im actual reported + 44% of AID-financed commodities; non-AID financed = a residual; total = same U.S. share of total import market as observed in 1958-60.

3b: Estimated using equation (A-1), Annex A; constant element in the estimating equation ($5.4 m. per country or $275 m. for all 51 countries) has been assigned to non-AID-financed" commodities.

equal to only 57-65% of AID's total commodity procurement.[1] The indirect effects of third country respending rounds, however, may well have increased the ultimate effect on worldwide U.S. exports to 82-85% of the AID commodity dollar.[2]

Third Country Respending Patterns: The Hicks-Lynn-IDA Studies

Foreign exchange earnings which are not spent for U.S. exports must by definition either be spent for imports from other, non-U.S. sources or they must be added to a country's foreign exchange reserves. If dollars are respent in third countries rather than added to reserves, there are again three options: further respending for imports from the U.S., for imports from non-U.S. sources, or addition to third country reserves. This chain can be traced through round after round of respending, and all dollars must eventually return to the U.S. which are not tied up in official or unofficial foreign exchange reserves.

This pattern of spending and respending can best be shown in a table or matrix of trade flows among countries. One of the first such tables was proposed by Richard Cooper of the Council of Economic Advisors

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[1] The $1,034 m. AID-financed commodities represent a nominal increase of $505 m. over the 1958-60 U.S. procurement level and a nominal increase of $695 m. over the true 1958-60 U.S. export effect as estimated from equation (A-1). The net aid-tying gain (from the previous table) equals 50% (296/587) in one case and 46% (354/760) for the Lynn model. This suggests that the true increase in AID-financed exports may have been from 44% to 65% ([1034-505+.50(505)] ÷ 1202) or from 28% (Lynn) to 55% ([1034-695+.46(695)] ÷ 1202).

[2] Assumes 58% of dollars leaked during first round spending eventually return to U.S. via third country respending. The 58% figure is derived from the IDA study cited below.

and calculated by Whitney Hicks of AID.[1] The Hicks calculations were based upon trade flows for a single year (1960) and upon the very conservative assumption that all additional dollars earned by European countries were not respent but were added to reserves. These calculations were subsequently adopted by Walter Salant, et al, for the Brookings study, The United States Balance of Payments in 1968 (Washington, D.C., August 1963) Chap. VI. They showed (p. 171 of the Brookings study) that after all rounds of spending and respending the following dollar amounts would be expected to return to the U.S. for each initially spent in one of the following regions:

Latin America	$ .55
Far East (excluding Japan)	.47
Near East and South Asia	.31
Africa	.15

These calculations can be criticized for their primary assumption that additional dollars would be spent according to average patterns observed in one particular year and for their overly restrictive assumption that there would be no feedback to the U.S. of a dollar spent in Europe. Lawrence Lynn, in the study already referred to, investigated the effect of the reserve behavior assumptions. He found the results quite sensitive to assumptions about the reserve accumulating behavior of Common Market countries (see Table 4a).

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[1] W. Whitney Hicks, "Estimating the Foreign Exchange Costs of Untied Aid," Southern Economic Journal, Vol. XXX, No. 2 (October 1963).

TABLE 4a

Total Impact of American Aid on U.S. Exports per Dollar of Initial Aid Expenditures in Each of Four Regions, Alternative Reserve Accumulating Assumptions, 1958-1961 (Preliminary)

Region of Initial Aid Expenditure	Common Market Countries add increased foreign exchange to reserves	No countries add increased foreign exchange to reserves
Latin America	.500	.899
Middle East	.328	.841
Africa	.230	.898
Asia	.375	.775

Source: Lawrence Lynn, communication to Alan Strout of May 5, 1965.

In neither case was trade with Soviet bloc countries and "miscellaneous countries elsewhere" included. United States imports were assumed unresponsive to increases in U.S. foreign exchange earnings. Trade flows were based upon average market shares for the period 1958-1961. First round respending was based upon independent cross-section estimates (as described above), and the trade matrix was used only for calculating the effects of subsequent respending rounds. During the subsequent rounds, Table 4b shows percentages of each initial dollar spent that is eventually returned to the U.S.

TABLE 4b

Region of Initial Aid Expenditure	Fraction of initial AID dollar returned to U.S. in first round	Fract to U.S. in subsequent respending. Reserve assumption: Countries which add increased foreign exchange to reserves	
		Common Market countries	No countries
Latin America	.336	.164	.563
Middle East	.127	.201	.714
Africa	.059	.171	.839
Asia	.113	.262	.662

This says that of dollars "leaked" from the initial aid-receiving region, about 18¢ to 30¢ might be expected to return to the U.S. via third country respending even if Common Market countries added to reserves each additional dollar coming their way. This respending effect might equal 75¢ to 89¢ of the leaked dollars (56¢ to 85¢ of the initial aid dollar) under the least restrictive reserve-accumulating assumption.

A recent study by the Institute for Defense Analysis has gone several steps further.[1] Instead of assuming average trade shares for a world trade flow matrix, the authors made explicit two-step estimates of how exports from one country to a second country might be expected to be affected by a change in foreign exchange earnings by the second country. Other variables taken into consideration were:

(1) A measure of domestic income (investment + consumption + government expenditures)

(2) Investment

(3) Industrial production

(4) Foreign exchange reserve level

(5) Foreign exchange reserve change

(6) Relative prices, lagged and unlagged

(7) Dummy variables dividing the observations into two time periods, 1950-1958 and 1959-1962

Other variables, such as long term capital imports and industrial production minus exports, were tried out but were not used in the final results.

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[1] Lois Ernstoff, Rolf Piekarz, and Elliot Wetzler, "United States Exports Induced by Department of Defense Expenditures in Europe," Institute for Defense Analysis, Study S-152, April 1965 (Classified "For Official Use Only").

The IDA study was limited to 12 developed countries accounting for two-thirds of world trade in 1963. Included in these countries were those whose reserve-accumulating behavior is most critical to estimates of third-country respending effects. Thus, where earlier "reflection matrices" were based on crude averages of past behavior, the ICA matrix was derived by isolating the effect of changes in foreign exchange earnings from a variety of other factors influencing a country's imports. The results showed that European countries would tend to reduce their total imports by a rough average of 60¢ to 70¢ for each dollar's decrease in their earnings from foreign trade. Of a dollar leaked from an aid-receiving country, about 58¢ could be expected to come back to the U.S. via further respending while the remaining 42¢, all other things being equal, would be added to dollar reserves somewhere in the world.[1]

The implications of this IDA analysis are profound. It suggests that even if we were to accept Lynn's low-sounding estimate of 23¢ of each untied AID dollar returning to the U.S. via first round effect (and were to increase this to 31¢ to include services as well as commodities), the total effect on U.S. exports after all spending rounds might be in the order of 71¢ on the dollar. Even if an 85% "nominal" aid-tying level were to increase the first round effect from 31¢ to only 55¢ - implying

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[1] Ernstoff, et al, op. cit., Tables C-1 and C-2. The 58¢ estimate is based on the indirect effect on U.S. exports of a direct increase in foreign exchange in "rest of the world". In the IDA calculations the direct effect of one dollar initial spent in the "rest of the world" would lead to increased U.S. exports of 9¢ (Table C-1). During subsequent respending rounds involving the 12 developed countries analyzed by IDA - but not allowing for any further respending among "rest of the world" countries - U.S. exports would be increased by a further 53¢ (Table C-2). The indirect effect on U.S. exports in relation to initial leakage from the "rest of the world" is thus 53/(100 - 9) = .58. (See Annex B)

that over half of the newly "tied" dollars were used to finance imports that otherwise would have been purchased commercially - the ultimate effect on U.S. exports, using the IDA results, would have been in the neighborhood of 81¢ of the initial aid dollar.

The combination of the Lynn and IDA results would appear to support AID's long-standing contention that while the "true" effect of aid on U.S. exports was not necessarily the same as the "nominal" or "accounting" effect, the two effects were nevertheless in rather close accord at nominal aid-tying levels near the present 85 per cent. To further increase our confidence in such an assertion, however, I would suggest the following steps:

1. Rerun the Lynn calculations for 1958-1960 using commercial (non-aid-financed) U.S. market shares and, in addition, U.S. direct private investment. In preliminary trials, commercial market shares are superior to the original Lynn formulation in projecting U.S. exports.

2. Encourage and support Lynn's current investigations of the effects on U.S. exports of (a) project as opposed to non-project aid and (b) of multilateral as opposed to bilateral aid.

3. Subject the IDA analysis to further critical appraisal and additional statistical tests. (See Annex C for a review of our appraisal to date.)

4. Construct a new world trade matrix with the incremental trade coefficients computed as suggested in the following diagram. This trade matrix, about size 43 x 43, can then be inverted and used to judge the total effects on U.S. exports of first round leakages from any of the principal aid-receiving countries or country groups.

TABLE 5

Scheme of an Incremental Trade Matrix Based on Various Data Sources, as Indicated

Exporting Country or Region		Importing Country of Region		
		Developed countries	Principal aid-receiving countries	Other regions
	No.	1-12	13-32	33-43
United States	1	A	B	B
Belgium Canada Denmark France Germany Italy Japan Netherlands Norway Sweden United Kingdom	2-12	A	C	C
20 largest recipients of U.S. aid	13-32	D	C	C
Rest of world, not elsewhere classified:		D	C	C
Other W. Eur. Latin America: Dollar Non-dollar Other W. Hemisphere New Zealand, So. Africa, Australia Africa: French Other Asia: Sterling Other	33-42	D	C	C
Other	43	E	C	C

(See notes on following pages)

Notes to Table 5

Code to Source of Incremental Trade Matrix Coefficients

A: Ernstoff, Piekarz, and Wetzler, "United States Exports Induced by Department of Defense Expenditures in Europe," IDA, op. cit., Table C-1, p. 87.

B: Derived from Lynn's regressions results. Coefficient for imports from U.S. not financed by aid equals (see Annex A, equation A-1):

$(-.039 + .961\ S_{ui \cdot t})$, where $S_{ui \cdot t}$ = the U.S. share in the market of country or region, i, in the year 1960.

C: Equals the change in imports (ΔM) from the exporting area divided by the total change in imports by the importing area between 1957-58 and 1961-62. Specifically, coefficient equals:

$$\frac{\Delta M_{ji}}{\Delta \sum_{i=1}^{43} M_{ji}}$$

where i = the exporting area
j = the importing area
Δ = 1961-62 average minus 1957-58 average

D: Equals marginal import coefficients similar to "C" but adjusted to include the affect on imports of income and other non-export earning variables. The adjustment factor for each importing country is derived from the IDA study already cited as described in Table 5-1.

E: Equals the residual necessary to give the same column sums of the coefficients as used in Table C-1 of the IDA study. These column sums are:

Belgium	.60	Japan	1.60
Canada	.85	Netherlands	.80
Denmark	1.40	Norway	.45
France	.70	Sweden	1.40
Germany	.65	United Kingdom	1.20
Italy	.65		

These column sums equal the coefficients shown in column (2) of the Table shown above under "D", except that they have been adjusted to compensate for having initially measured exports f.o.b. and imports c.i.f.

TABLE 5-1

	Marginal import/export coefficient		
	Before allowing for income effects (1)	After allowing for income and other effects (2)	Adjustment factor (3)
Belgium	.85	.65	.76
Canada	.95	.90	.95
Denmark	1.7	1.5	.88
France	.58	.75	1.3
Germany	1.1	.70	.64
Italy	1.3	.70	.54
Japan	2.2	1.8	.82
Netherlands	1.8	.85	.47
Norway	.51	.45	.88
Sweden	1.2	1.5	1.2
U.K.	1.9	1.3	.68

Source: Col. (1): Table A-2, p. 43. Equals coefficient a_2 in equation $\Delta M = a_1 + a_2 \Delta X$ where M = imports, X = exports of each country.

Col. (2): Table A-1, p. 42. Equals "reflection ratio" coefficient actually chosen for each country and includes as additional explanatory variables (a) some measure of country income, investment, or industrial production change, and (b) usually some measure of reserve level or change.

Col. (3): Equals column (2) divided by column (1).

A. Strout, PC/PPD
10/12/65

ANNEX A

Tests of Lynn Regression Results

A. Basic data compiled (all units are millions of current U.S. dollars)

Ag_{uit} = Gross economic aid disbursements from U.S. to country i (gross grants and loans, and not other assistance, from Foreign Grants and Credits), in year t, where t = 1957, 1958....1964.

Aa_{uit} = "American aid" to country i (gross grants and loans, including local currency, expenditures; For Grants and Credits). Excludes military loans, social progress trust funds, emergency relief, inter-American highway, and PL-480.

Axm_{uit} = Direct Export-Import Bank loans to country i, before allowing for reimbursements from private participants, but excluding loans made to finance U.S. exports for previous years (this definition varies from that used by Lynn, but Ex-Im reimbursements for previous year expenditures are a more serious problem in later years than in the 1958-60 period used by Lynn for his primary analysis; source is For Grants and Credits).

E_{uit} Total U.S. merchandise exports to country i, including re-exports but excluding Special Category goods, fob U.S. (U.S. Dept. of Commerce, Foreign Trade Statistics, as compiled by A.I.D. Statistics and Reports Div.) where t = 1956, ... 1964.

M_{iwt} = Total merchandise imports by country i, cif. (IMF, IFS, as compiled by A.I.D., Statistics and Reports Division), where t = 1956, ... 1964.

ΔR_{it} = Official reserve drawings in year t, including gold, foreign exchange and new drawings on the IMF (IMF, IFS, various issues). Reserve increases are shown as zero.

B. Data computed from compiled data

$Apl_{uit} = Ag_{uit} - Aa_{uit} - Axm_{uit}$ = Surplus farm product. Sales receipts minus disbursements for (a) economic grants and credits under Mutual Security Acts ("American" aid), (b) economic grants and credits to third countries, and (c) "other uses", including military and U.S. uses, plus military credits and miscellaneous other assistance such as Social Progress Trust Fund and Inter-American highway.

$S_{uit} = E_{uit} \div M_{iwt}$ = U.S. merchandise export "share" of market in country i.

$O_{it} = M_{iwt} - Ag_{uit} - \Delta R_{it}$ Other foreign exchange acquisitions by country i, including net flows of capital and probably including resources transferred under military grants.

C. Test of correspondence between Lynn and Strout results

1. Basic Lynn results for 43 country sample and pooled data for 1958-60 are:

(A-1) $$\hat{E}_{uit} = (-.005 + .734\, S_{ui(t-1)})\, Aa_{uit} + (-.039 + .961\, S_{ui(t-1)})\, O_{it} + (-.088 + 1.213\, S_{ui(t-1)})\, \Delta R_{it} + .921\, Axm_{uit} + .802\, Apl_{uit} + 5.4$$

2. For comparison with Strout results we compute estimated exports attributed to all three forms of aid in 1957, 1958, 1961, 1962. Thus:

(A-2) $$1957,58: \quad \hat{E}'_{uit} = (-.005 + .734\, S_{ui(t-1)})\, Aa_{uit} + .921\, Axm_{uit} + .802\, Apl_{uit}$$

(A-3) $$1961,62: \quad \hat{E}'_{uit} = (-.005 + .734\, S_{ui60})\, Aa_{uit} + .921\, Axm_{uit} + .802\, Apl_{uit}$$

3. These estimates, when summed over i for the 50 countries in the Strout study, gives an average coefficient, b*, where

(A-4) $$b^* = \frac{\sum_i \hat{E}'_{ui62} + \sum_i \hat{E}'_{ui61} - \sum_i \hat{E}'_{ui57} - \sum_i \hat{E}'_{ui58}}{\sum_i An_{ui62} + \sum_i An_{ui61} - \sum_i An_{ui57} - \sum_i An_{ui58}}$$

Where An_{uit} = U.S. economic aid disbursements to country i, net of authorization, as reported in For Grants and Credits and as compiled from Statistical Abstract of U.S., 1964.

We expect b* to be slightly less than the equivalent b computed by Strout because

a) Lynn believes his coefficient for Apl_{uit} may be biased downward.

b) Lynn's results apply to untied "American" aid only while tying of this aid was beginning to be felt in 1961 and 1962.

For these reasons, and because Strout's estimates of b turn out to be .59 ± .10 to .63 ± .13 we would expect b* ≅ .50 to .55. If b* is higher than this, it may mean that (1) the Strout result is too low, (2) aid-tying effects have been minor during this period, or (3) the Lynn results are biased upward.

D. Measuring the effect of aid tying

1. Without aid tying we expect equation (A-1) to do a fair job of predicting U.S. exports. We first test this equation therefore by calculating

$$\hat{E}_{uit}, \text{ and } (\hat{E}_{uit} - E_{uit}),$$

and $\sum_i \hat{E}_{uit}$ and $(\sum_i (\hat{E}_{uit} - E_{uit}))$, for t = 1957, 1958, ... 1961.

2. For the years 1962-1964 we run into difficulties measuring S_{uit} for untied conditions. We use S_{ui60}, therefore, in one set of computations of equation (A-1), and for an alternative set we compute and use:

$$\hat{S}_{ui61} = \frac{\hat{E}_{ui61}}{M_{iw61} - (E_{ui61} - \hat{E}_{ui61})}$$

$$\hat{S}_{ui62} = \frac{\hat{E}_{ui62}}{M_{iw62} - (E_{ui62} - \hat{E}_{ui62})}$$

where $\hat{E}_{ui62}$ has been computed using $\hat{S}_{ui61}$ and $(E_{uit} - \hat{E}_{uit})$ represents additional exports attributed to aid-tying

and similarly for $\hat{S}_{ui63}$

3. In each case the effect of tying "American" aid is estimated as

$$(\sum_i E_{uit} - \sum_i \hat{E}_{uit}), \text{ where } t = 1957, 1958, \ldots 1964.$$

We expect these aggregated differences (a) to be close to zero for t = 1957, 1958, ... 1960, and (b) to increase gradually for t = 1961, 1962, 1963, 1964.

4. This part of the analysis is made for these country samples:

   a. Maximum number for which data are available (n = 51)

   b. Original Strout sample (n = 50)

   c. Lynn sample (n = 43)

Condition D.3(a) may apply only to the Lynn sample, but hopefully it is applicable to the larger samples also.

E. Finally, we can adjust the b* calculations (eq. 4) for the apparent effect of aid-tying as follows:

$$b^{**} = b^{*} + \frac{\sum_i E_{ui61} - \sum_i \hat{E}_{ui61} + \sum_i E_{ui62} - \sum_i \hat{E}_{ui62} - \sum_i E_{ui57} + \sum_i \hat{E}_{ui57} - \sum_i E_{ui58} + \sum_i \hat{E}_{ui58}}{\sum_i An_{ui62} + \sum_i An_{ui61} - \sum_i An_{ui57} - \sum_i An_{ui58}} \qquad \text{(A-5)}$$

We expect b** for the 50-country sample to approximate .60.

F. Results

TABLE A-1

Lynn results vs. Strout results (Strout 50-country Sample)

t	$\sum_i E_{uit}$	$\sum_i An_{uit}$	$\sum_i (E_{uit} - \hat{E}_{uit})$
1957	1412	2141	703
1958	1490	2517	-111
1959	1307	2374	-154
1960	1446	2586	-122
1961	1808	3111	-285
1962	1929	3101	139

(Source: AID, PC/PPD, "Strout-Lynn Comparison" machine runs of 2-1-66.)

b* (eq. A-4) therefore equals .537. This is within the expected range of .50 to .55. The correction for aid-tying (see Section E) does not increase b* as expected, but reduces it drastically. This is because the Lynn calculations underestimate 1957 total U.S. exports by approximately 9% ($703 mil.) The higher than estimated exports in that year result not from aid-tying but from other causes, and the b* adjustments are thus invalid.

Annex A
Results (Continued)

TABLE A-2

The Effect of Aid-Tying (Lynn estimating equation A-1)

t	Lynn's 43-Country Sample $\sum_i E_{uit}$	Lynn's 43-Country Sample $\sum_i (E_{uit} - \hat{E}_{uit})$	51-Country Sample $\sum_i E_{uit}$	51-Country Sample $\sum_i (E_{uit} - \hat{E}_{uit})$
1957	6,148	687	6,384	699
1958	5,344	-152	5,571	-135
1959	4,895	-173	5,164	-135
1960	5,611	244	5,846	178
1961	5,822	11	6,109	68
Market share = S_{ui60}				
1962	6,084	42	6,380	89
1963	6,389	178	6,692	219
1964	7,134	441	7,477	490
Market share = $\hat{S}_{ui(t-1)}$				
1962	6,084	74	6,380	47
1963	6,389	26	6,092	174
1964	7,134	316	7,477	556

(Source: AID, PC/PPD, "Strout-Lynn Comparison" machine runs of 2-1-66.)

The results show the anticipated increase in "aid-tying" ($\sum_i E_{uit} - \sum_i \hat{E}_{uit}$) from 1961 to 1964. They also suggest much higher than estimated exports in the pre-aid-tying year (1957) and considerable variation in the years 1958-1960. This suggests that factors other than aid-tying may be important omissions from the Lynn model.

Table A-3

Estimates of Lynn Model Results, 1957-1964

51 Country Sample - Totals
[Source: "Strout-Lynn Comparison" machine runs of 2-1-66]

Variable	Symbol	1957	1958	1959	1960	1961	1962	1963	1964
Net Surplus Commodities	A_{pl}	657.8	420.7	549.2	869.5	837.4	1168.7	1341.7	1539.2
EX-IM Bank	A_{xm}	229.0	572.8	377.3	254.8	659.8	482.5	333.0	208.1
"Am. Aid"	A_a	1252.7	1332.9	1370.0	1424.7	1543.8	1566.8	3365.3	1603.6
Gross Aid	A_g	2139.5	2326.5	2296.5	2549.0	3041.0	3218.0	3457.0	3351.0
U.S. Exports	E_u	6383.9	5571.4	5163.6	5845.5	6109.2	6380.5	6692.2	7477.3
Aid-financed	E_{ua}	1234.7	1439.7	1272.2	1466.7	1916.0	2198.6	2468.8	2538.3
AID-financed	E_A		380.8	348.0	337.0	478.9	776.6	1034.3	1033.6
"Other" Foreign Exchange	0	16546.3	15216.5	15559.5	17888.3	17472.9	18248.4	18959.1	20844.7
Reserve Decreases	ΔR	1838.3	1302.8	879.9	913.5	1708.2	1051.5	767.9	743.3
Total Imports	M_w	20524.1	18845.8	18735.9	21350.8	22222.1	22517.9	23184.0	24939.0
Computations:									
	b_1A_a	322.5	329.1	295.2	288.7	296.8	307.2	356.5	320.8
	$.921A_{xm}$	210.9	527.9	347.5	234.7	607.7	444.4	306.7	191.7
	$.802A_{pl}$	527.8	337.4	440.5	697.3	671.6	937.3	1076.2	1234.4
Subtotal =	E_u	1060.9	1194.1	1083.2	1220.7	1576.0	1688.9	1739.4	1746.9
	$b_3\Delta R$	311.2	457.0	309.1	210.4	334.7	269.8	117.0	168.7
	$b_2 0$	4037.3	3779.6	3630.5	3961.3	3855.3	4057.1	4341.7	4796.3
	Constant	275.4	275.4	275.4	275.4	275.4	275.4	275.4	275.4
Total =	E_u	5684.8	5706.2	5298.2	5667.9	6041.4	6291.1	6473.4	6987.3

$= (-.005 - .734\ S_{ui(t-1)})$; $b_2 = .039 + .961\ S_{ui(t-1)})$; $b_3 = (-.088 + 1.213 S_{ui(t-1)})$

ANNEX B

Alternative Market Share Projection Models (Preliminary)

A. Basic data needed

Aa_{uit} = "American aid" to country i (see Annex A)

Axm_{uit} = Direct Import-Export Bank loans to i (see Annex A)

Apl_{uit} = Surplus farm product deliveries (net) (see Annex A)

Ea_{uit} = Apparent aid-financed U.S. exports to country i; Sum of Ex-Im, PL-480 and U.S. commodities directly paid for by AID funds

M_{iwt} = Total merchandise imports by country, cif (see Annex A)

E_{uit} = U.S. merchandise exports to country: (see Annex A)

B. Calculation of base-period U.S. commercial (non-aid-tied) market shar (Sc_{ui}):

$$Sc_{ui} = \frac{\sum_{t=58}^{60} \left(E_{uit} - Ea_{uit}\right)}{\sum_{t=58}^{60} \left(.89M_{iwt} - Ea_{uit}\right)}$$

where .89 = approximate world-wide ratio of imports f.o.b. to imports c.i.f.

Projection model

(B-1) $\hat{E}_{uit} = Sc_{ui} \left(.89\ M_{iwt} - Ea_{uit}\right) + Ea_{uit}$

$t = 1961, 62 \ldots 64$

Estimating model (not yet calculated)

(B-2) $E_{uit} = a + b_1\ Sc_{ui} \left(.89\ M_{iwt} - Ea_{uit}\right) + b_2\ Ea_{uit}$

$t = 1961, 62 \ldots 64$

Annex B
(Cont'd)

C. Calculation of base-period U.S. total market share (S_{ui}):

$$S_{ui} = \frac{\sum_{t=58}^{60} E_{uit}}{\sum_{t=58}^{60} M_{iwt}}$$

Projection model:

(B-3) $$\hat{E}_{uit} = S_{ui} \cdot M_{iwt}$$

D. Total aid-tying gain

$$\sum_i E_{uit} - \sum_i \hat{E}_{uit} \qquad t = 61...64 \text{ (from eq. B-3)}$$

E. Total substitution effect

1. $\sum_i E_{uit} - \sum_i \hat{E}_{uit}$ $\qquad t = 61...64$ (from eq. B-1)

2. $(1-b_2) \sum_i Ea_{uit}$ $\qquad t = 61...64$ (from eq. B-2)

F. Results - (See Table B-1)

Annex B
(Cont'd)

Table B-1

Results of Calculations for 51-Country Sample
(millions of U.S. dollars)

Year t	Estimates of Aid-tying gains: Lynn Model (1)	Estimates of Aid-tying gains: US Total Market Share Model (2)	Estimates of Substitution Effects: Lynn Modol (3)	Estimates of Substitution Effects: US Commercial Market Share Model (4)	Goodness of Fit of Alternative Models to Actual Data: Lynn Model (5)	Goodness of Fit of Alternative Models to Actual Data: US Market Share Models: Total (6)	Goodness of Fit of Alternative Models to Actual Data: US Market Share Models: Commercial (7)
1957	699	432	525	620	108,256	44,348	42,196
1958	-135	120	-380	89	19,604	26,183	9,021
1959	-135	-113	-324	-81	29,236	11,854	5,753
1960	178	-7	-68	-8	34,469	38,957	13,044
1961	68	86	-272	-126	63,510	18,519	22,461
1962	89	136	-420	-288	20,652	84,848	38,698
1963	219	216	-511	-391	61,338	158,672	36,933
1964	490	442	-301	-201	53,897	220,366	36,211

(Source: AID, PC/PPD "Strout-Lynn Comparison" machine runs of 2/1/66)

Notes: Col. (1) Difference between actual U.S. exports in year t and those projected using Lynn model (see Annex A, eq. A-1) based on "pre-tying" period 1958-1960.

Col. (2) Difference between actual U.S. exports in year t and those projected using the total market share model (see equation B-3). This model assumes maintenance of 1958-1960 total U.S. market shares regardless of changes in levels of aid-tying.

Col. (3) Difference between actual U.S. "commercial" (i.e. non-aid-financed) exports in year t and those projected using Lynn model. "Commercial" exports are represented as $E_{uit} - Ea_{uit}$ (actual) and $\hat{E}_{uit} - \hat{E}'_{uit}$ (projected; see Annex A).

Col. (4) Difference between actual U.S. exports in year t and those projected using commercial market share model (see equation B-1). This model assumes both maintenance of 1958-1960 U.S. commercial market shares and 100% effective aid tying.

Cols. (5)-(7) The sums of the squares of terms whose sums appear in Cols. (1), (2), and (4) respectively.

Annex B
(Cont'd)

Columns (1) and (2) of Table B-1 are alternative estimates of gains from aid-tying. In column (2) we assume a constant U.S. total market share for each year equal to that in 1958-1960. Any increase in this market share is attributed to increased aid-tying over that of 1958-1960. (The 1958-1960 aid-tying gains thus sum to zero.) Column (1) projects U.S. exports based upon various types of foreign exchange, the total U.S. market share of the preceding year (or the 1960 share when projecting 1962-1964), and 1958-1960 aid-tying levels.

Columns (3) and (4) are alternative estimates of losses from the substitution of aid-financed for commercial U.S. exports. Column (3), based upon the Lynn model, shows the difference between actual U.S. "commercial" (i.e. non-aid-financed) exports and those calculated from the model. Column (4) assumes a constant U.S. commercial market share for each year, equal to that of 1958-1960. Total U.S. exports are estimated assuming no increase in substitution losses over those of 1958-1960. (The 1958-1960 losses thus sum to zero.)

Taken together, columns (1) and (3) say that the maximum aid-tying gain in 1964 over 1958-1960 was $791 m. ($490 m. + 301 m.) but substitution losses reduced this by 38% to $490 m. Columns (2) and (4), alternatively, suggest that the 1964 maximum aid-tying gain was only $643 m. ($442 m. + $201 m.), of which 31% or $201 m. was offset by losses of commercial U.S. exports.

Columns (5), (6), (7) give the sum of the squares of the residuals (error terms) and thus reflect the goodness-of-fit of the three models. The commercial market share model performs quite well in every year.

Annex B
(Cont'd)

Note that the "maximum aid-tying gain" referred to above does not equal total aid-financed U.S. exports since a portion of these would be purchased in the U.S. even with no increase in aid-tying. Thus, aid-financed U.S. exports amounted to $2,538 m. in 1964, but only $791 m. of this represents possibilities for increasing U.S. exports through improving aid-tying effectiveness above that for 1958-60. This $791 m. can be divided as follows:

	Aid-financed U.S. Exports (total value)	Level of "Aid-Tying" in 1958-60		Net U.S. Exports at actual 1958-60 tying levels	Scope for Additional Tying
		Nominal	Actual (Lynn ests.)		
PL-480	$1,539 m.	100%	80%	$1,234	$305
ExIm Bank	194	100%	99%	192	2
Other (chiefly AID)	805	44%	18%	321	484
Total	$2,538 m.			$1,747 m.	$791

Annex C

Appraisal of the IDA Study, "United States Exports Induced by Department of Defense Expenditures in Europe"[1]

This study relates changes in a country's imports from a second country to income changes, export earnings, relative price changes and foreign exchange reserves. The statistical relationships are derived from year-to-year changes in these factors for one importing country at a time. Separate models are employed to explain (a) a country's total imports, and (b) the portion of a country's total imports which come from a particular exporting country.

The first of these models is noteworthy in that both domestic income and earnings from merchandise exports are employed as explanatory factors.[2] A change in income is conventionally presumed to affect imports

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[1] Ernstoff, Piefarz, and Wetzler, Institute for Defense Analysis, Study S-152, April 1965, op. cit.

[2] The general form of the model is:

$$(C\text{-}1) \quad \Delta M_j = a_1 + a_{j2}\,\Delta X_j + a_{j3}\Delta(C_j + I_j + G_j) + a_{j4}\,R_{j(t-1)}$$

where M_j = total merchandise imports by country j, c.i.f.
X_j = total merchandise exports by country j, f.o.b.
C_j = consumption
I_j = investment
G_j = government expenditures
R_j = foreign exchange reserves at end of previous time period

through the income demand elasticity. Exports, in turn, can affect imports in one of three ways:

(a) through their income-multiplier effect

(b) through the imports needed to produce the exported goods, and

(c) through their effect on reserve levels and hence on various government fiscal, monetary, and trade policies.

The difficulty of including both income and exports as explanatory factors lies in the fact that they are not independent of one another, since income increases may result from the multiplier effect of increasing export earnings.

When exports are used as the sole explanatory variable, a series of export coefficients are found which on the average are half again as large as the export coefficients from a model in which income changes and other factors are included as additional explanatory variables. There is a likelihood that the size of the export coefficient in the latter model is influenced in part by the time period chosen. This is because of lags between an increase in export earnings and the income effects leading to increased imports. As the time period increased, one might expect higher correlation between export and income changes and therefore greater instability in the respective coefficients. The particular model used for each country was chosen by the authors, however, to minimize the correlation among explanatory variables, and there is no reason to suspect that even where considerable intercorrelation exists, the export coefficient will be consistently too large or too small.

One way to judge the importance of alternative export coefficients is to derive 11-country weighted averages of these coefficients for the period 1958-1962.[1] With exports as the sole explanatory variable, the coefficient would be 1.3, implying an increase of $130 of imports (c.i.f.) for each $100 increase in exports (f.o.b.) The weighted average of the coefficients chosen

[1] The 11 countries were Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, U.K.

by the authors from assorted models with assorted combinations of explanatory variables was a smaller .96. If the lowest possible coefficient had been chosen without regard for other statistical considerations, the average coefficient would have been something less than .69.[1] It will be recalled that the implicit coefficient used in the Hicks-Brookings estimates of respending effects was zero for the European countries on the assumption that all incremental export earnings were added to reserves and had zero effect on imports.

In general, the results from the total import model appear to be statistically respectable. The amount of explained variance is generally high, with R^2's ranging from .63 to .96. A number of additional explanatory variables were tested (relative price changes, long term capital movements, and dummy variables dividing the period into the subperiods 1953-58 and 1959-62), but they did not improve or significantly affect the results. The results do suffer from the fact that the "best" model often differs significantly from country to country, and there seems to be little pattern to the results among countries. This suggests that there are significant differences in import behavior among countries, and the wide variety of possible country behavior gives little assurance that future behavior of a single country can be safely

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[1] This is based on the statistical results presented in Table A-3 of the IDA study. For the European countries alone the weighted average export coefficients were:

Exports sole explanatory variable	1.2
Coefficients chosen by authors	.85
Minimum coefficient reported	.68

predicted from the past.

ere are other technical matters that need clarification. It is not clear, for example, why the coefficients reported in Table A-1 differ in some instances from identical-appearing equations in Table A-3. This is a particular problem in the case of the Netherlands and Norway.

Another question concerns the rather large constant terms occurring in most of the estimating equations chosen. These terms represent changes in imports which are not associated with any of the explanatory variables but which nevertheless are constant from year to year. They could be interpreted, for example, as reflecting increased "import substitution" as economies slowly expand over time. For the twelve countries they add up to a decrease in imports of $3.3 billion annually, an amount equal in magnitude to 2/3 of the average annual increase in imports over the period 1958-62. (The largest constant term, -$1.8 billions occurs for Japan.) They suggest that the explanatory variables during a period such as 1958-1962 will indicate a large increase in imports but that a very large part of this increase (40% in this instance) will be cancelled by changes associated with the passage of time and which are not otherwise "explained" by the model.

The second model employed by the IDA authors in their two-step procedure relates the change in exports from one country to total imports by the importing country and a number of other explanatory variables. The general form of the model was:

$$\Delta M_{ji} = h_{j1} + h_{j2}\,\Delta M^{*}_{ji} + h_{j3}\,P_i + h_{j4}\,D \qquad (C\text{-}2)$$

where M_{ji} = country j's imports from country i

M_j = country j's total imports

$\Delta M^{*}_{ji} = \Delta M_j - \Delta M_{ji}$ = country's imports other than those from country

P_i = the change in relative prices of i with respect to world prices

D = dummy variable to divide observations into two periods, 1950-58 and 1959-62.

In addition to the specific price variable shown, several alternative forms were tested. The dummy variables were used both as independent variables and as weights for the total import variable.

The statistical results from this second model were not as good as those from the total import model. The price variable was used in 51 cases, but it was statistically significant in only 24 of the 110 cases tested. The dummy time variable was about equally useful and significant. Values of R^2, expressing the percentage of explained variation in ΔM_{ui}, ranged from .03 to .95, but only 13% were equal to or better than .80.

These statistical difficulties are of little concern, however, because the final combined effect on U.S. export estimates is not greatly sensitive to the results from this second model. This is because the marginal import share coefficient, b_{ji}, for the "rest of the world" is chosen so that the sum of the import share coefficients for each importing country equals 1.00. This means that even when the marginal share coefficients are replaced with average coefficients having quite different values, the U.S. export estimates are "very similar."[1]

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[1] Ibid., p. 26. The marginal import share coefficients were calculated from equation (C-2), as follows:

$$b_{ji} = \frac{h_{j2}}{1 + h_{j2}}$$

The average import share equals $\Delta M_{j.US}/\Delta M_{j}$.

The third step of the IDA study was to combine the two models described above in such a fashion that the total effect of a change in one country's earnings could be estimated on total exports from every other country. This was done by constructing a table or matrix which related a country's change in imports from each exporting country to the importing country's change in exports. The combined trade matrix coefficients, c_{ij}, were set equal to the product of coefficient r_j, derived from the coefficient a_{j2} in equation C-1, and coefficient b_{ji} from equation C-2.[1]

It is not completely clear why coefficient c_{ij} was derived using this two-step procedure rather than estimated directly. The two-step method does permit an independent investigation of factors influencing total import levels as opposed to import shares of various countries. But to the extent that these two effects may be interdependent, it might have been preferable to estimate c_{ij} from a single equation.

To complete the trade matrix, the authors had to find estimates for the c_{ij} coefficients for trade between the 12 countries investigated and the rest of the world. These were chosen in a fashion consistent with the rest of the model but nevertheless rather crude. Little more could have been done, however, without a great deal more work. The implication of the coefficients chosen is that the twelve developed countries will increase their imports from the rest of the world by about 38¢ for each dollar's

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[1] Coefficient r_j equalled a_{j2} times a factor (.88 in the case of Japan and the U.S., .95 for other countries) designed to adjust for the differences between f.o.b. and c.i.f. values.

increase in their own exports (based on a weighted average for 1958-1962). The "rest of the world," on the other hand, will spend about 80¢ of each dollar earned on exports to the remaining twelve countries on imports from these same 12 countries.[1] (Table C-1, p. 87) The assumption was made that U.S. imports were independent of U.S. export earnings. The trade matrix made no allowance for trade among the "rest of the world" countries, and assumed in effect that this trade was zero.

The final results of the IDA work suggest that for each dollar's increase in export earnings in one of the 9 European countries, total U.S. exports will rise by from 37¢ to 98¢, with a median value of 48¢. For a dollar increase in Canadian export earnings, the U.S. export increase would be 73¢; for Japan, $1.25. For an increase in export earnings by the rest of the world, U.S. total exports would increase by 62¢ on the dollar. Since direct U.S. exports to the rest of the world are estimated to equal only 8.8¢ for each dollar's increase in export earnings by the rest of the world, the direct leakage from a dollar of untied U.S. aid (for example) would be (1.000 - .088, or $.912). If the total direct and indirect effect on U.S. exports was 62¢, this implies that 53¢ (62¢-9¢) or 58% (53¢÷91¢) of the original leaked dollars came back to the U.S. during subsequent rounds of spending. The 62¢ estimate is about 60% greater than the mean of the Hicks-Brookings estimates cited in the main text. It falls about half way between the two Lynn estimates.

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[1] This last coefficient appears to be too low. It was reportedly based on the change between imports to the rest of the world and exports from the rest of the world over the period 1958-1962 (ibid, p. 14). Latest estimates (International Monetary Fund, International Financial Statistics, Supplement to 1965/66 issues), however, suggest that the average coefficient may have been closer to .90.

Conclusion

The IDA study has been criticized by others on the grounds that (1) the results do not agree with earlier studies which assumed no European import response to exports, (2) explicit estimates were not made of the reserve accumulating behavior of each country, and (3) the import response to earnings from U.S. miliary spending may differ from the response to other forms of export earnings.

The IDA results, however, stem directly from the finding that European imports are responsive to changes in European export earnings to the extent of about 90¢ of additional imports for each dollar of additional export earnings. The implied results for U.S. exports are therefore greater than earlier estimates which assumed no European import response to an increase in European exports. The apparent import response has been measured after allowing for income effects, a time trend effect, and other effects. The time trend effects appears rather large (and negative) in a number of countries but probably can be related to increasing import substitution.

The IDA results appear valid unless it can be shown that other factors, not investigated by the authors, are superior to export earnings in explaining a portion of the annual import changes. It is hard to imagine what these unknown factors might be. If anything, one might suspect that the export coefficients found by the authors may be understated since they may not fully reflect imports resulting from income changes which in turn result from an export-income multiplier effect.