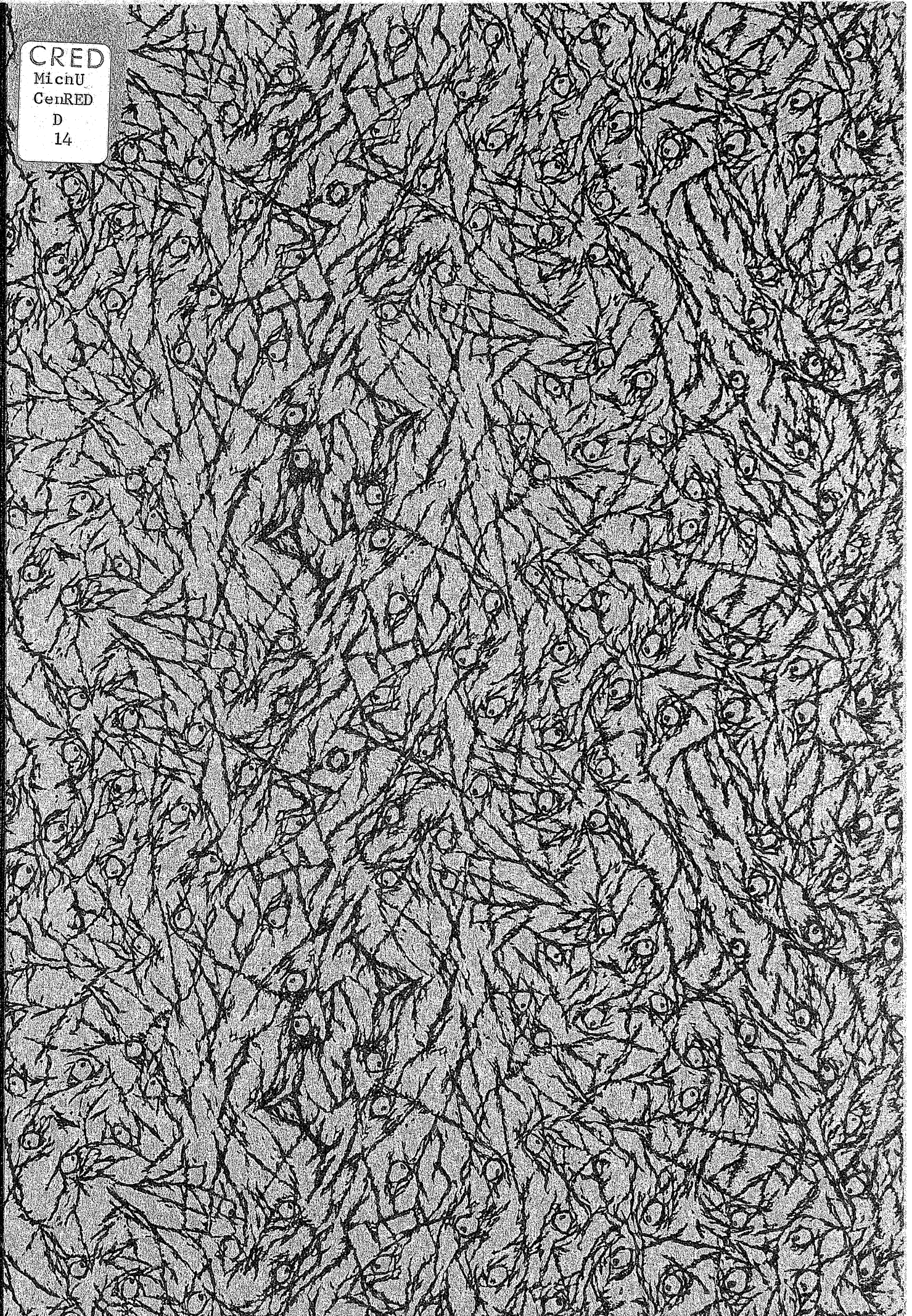

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The Cost of Tying Aid:
A Method and Some Colombian Estimates

by

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Discussion Paper No. 14

January, 1971

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Leave out my name from the gift
if it be a burden,
but keep my song.
Tagore, Fireflies

Contents:

I. Introduction

In an ever more determined effort to prevent its foreign economic aid from hurting its balance of payments, the United States placed increasing restrictions during the 1960's on the manner in which its aid could be spent. Although the tying techniques are rarely precise and the results are difficult to measure, it is now generally conceded that the U.S. balance-of-payments goal has been essentially achieved.[1] Inevitably, however, the very success of policies directed at changing the preferred expenditure patterns of the aid-receiving less developed countries (i.e., LDCs) has imposed costs on them. It is toward the identification and measurement of these costs that this paper is directed.[2]

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[1]"... in 1963-64, the substitution of AID goods for commercial imports was about 10 percent. In 1966-67, the last year for which we have satisfactory figures, substitution seems to have fallen to about 2 percent." Statement of W. S. Gaud, AID Administrator, in (Hearings, 1969) p. 87.

[2]For a general analysis of these distortions and welfare losses, see (Bhagwati, 1968) pp. 41-46. The model to be developed here is more specific, being aimed at empirical implementation.

By "cost" we mean the fraction by which the aid could be reduced, and the recipient left just as well off, if restrictions on the use of the aid were completely removed. Measurement of the cost, so defined, permits us to make statements like: a dollar of aid tied in such-and-such a way is the equivalent (to the recipient) of so many cents of untied aid. Unfortunately, this measurement is not easy. It requires knowledge not only of how the tied aid was actually used but also of how different amounts of untied aid would have been used.

Our methodology differs from previous efforts in that it does not require the assumption that the varieties of a product supplied from different sources are homogeneous. Nevertheless, it is convenient to begin the exposition by assuming that the U.S. and the least-cost third-country varieties of a product are indeed perfect substitutes to the aid-recipient.

Consider the use of a given volume of aid on two products, x and y. Because of the assumption of perfect substitutability, we may choose the quantity units so that one unit of the U.S. variety (of either product) always equals, in worth to the aid-recipient, one unit of the least-cost third-country variety (of that product). Good y is assumed to be cheaper in the United States, good x to be cheaper in some third country. If the LDC's importers have (and/or its import-licensing authorities reflect) a convex preference function between goods x and y, completely unrestricted aid would be allocated at some such point as A in Figure 1, where the axes represent the quantities of x and y purchased[1] and the line, BAC, is the budget constraint.[2]

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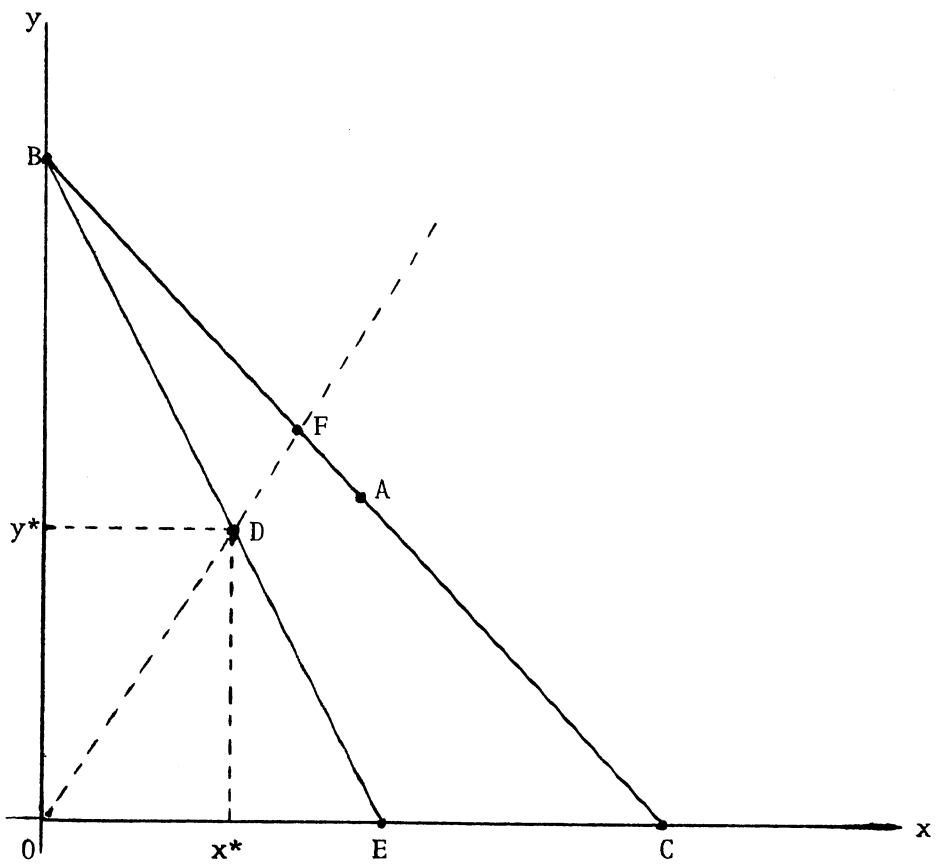
[1]For simplicity, we neglect any quantities of x or y that would have been purchased in the absence of aid.

[2]The slope of the budget constraint, BAC, is $-P_{xr}/P_{yu}$, where P_{yu} is the price of the product y in the United States (i.e., u for U.S.) and P_{xr} is the price of product x in the least-cost third country (i.e., r for rest of world). The intercepts are the amount of aid divided by the relevant price of the product on that axis.

Figure 1



The costs of tying are now readily identified. If the United States required that this same amount of aid be used only to purchase U.S. varieties of products, the LDC would allocate the aid at some such point as D, on a different budget constraint, BDE.[1] On the other hand, the LDC might be constrained not as to the source but as to the product in which it can utilize the aid. If only good y could be purchased, the LDC would move to point B, which would be inferior to A; but the additional restriction, that good y be bought in the United States, would impose no further loss in welfare (since the United States is already the least-cost source for good y). Similarly, if the aid were tied to use on good x, purchases would occur at point C, also inferior to A. Now, however, if it were also required that good x be purchased in the United States, there would be a further welfare loss as purchases were deflected to point E. Thus, source-tying without product-tying moves the LDC from point A to point D. Product-tying without source-tying moves it from A to B or C. Source-tying and product-tying forces it to B or E. When the United States limits an aid-recipient to purchase in the United States of particular products (of which the United States is not the least-cost source), it imposes double costs on the LDC, what we shall call the variety-distortion cost (i.e., the movement from A to D) and, in addition, the product-distortion cost (i.e., the movement from D to E).

The product-distortion cost of tied aid is not susceptible to measurement without knowledge of the LDC indifference curves between goods x and y.[2] But the variety-distortion cost requires no such elusive information. In terms of Figure 1, the LDC would be just as well off as at point D with a fraction, DF/OF,

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[1] With slope of $-P_{xu}/P_{yu}$. BDE is steeper than (and lies within) BAC since $P_{xu} > P_{xr}$.

[2] More precisely, knowledge is needed about the shape of the indifference curve through point E in Figure 1.

less aid if that reduced amount of aid were not tied to U.S. purchase.[1] We can also write this variety-distortion cost (i.e., the fraction, DF/OF) as the excess cost (over least-cost sources) of purchasing in the United States the actual bundle of point D.

Viewed in this way, the variety-distortion cost (hereafter VDC) is:

$$(1) \qquad VDC = \frac{(P_{xu} - P_{xr})\, x^*}{P_{xu}\, x^* + P_{yu}\, y^*}$$

or:

$$(2) \qquad VDC = \frac{P_{xu} - P_{xr}}{P_{xu}} \cdot \frac{P_{xu}\, x^*}{P_{xu}\, x^* + P_{yu}\, y^*}$$

Formula (2) is easily generalized to the case where many source-tied products are purchased:

$$(3) \qquad VDC = \sum_i \frac{P_{iu} - P_{ir}}{P_{iu}}\, c_i$$

where P_{iu} is written equal to P_{ir} when the United States is the least-cost source and c_i is the fraction of the total (source-tied) aid that is spent on the i-th product.[2]

It is essentially this formula (3) that was developed by (Haq, 1967) in his pioneering effort to measure (for Pakistan) the cost of tied aid, and it is this same formula that has been since used in various other studies. The results

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[1] The statement is not quite accurate. Untied aid reduced by the fraction, DF/OF, would permit the LDC to purchase the same bundle of goods (i.e., x* and y*, at point D, in Figure 1) as it did previously when the aid was source-tied. It is able to become better off by adjusting the bundle (see [Bhagwati, 1967] Annex III) We ignore for now this difference on the grounds that, for generally small price differentials (between the United States and least-cost sources), the size of the over-compensation implied by the statement of the text is small. Our treatment in Section IV is precise.

[2] Note the denominator of formula (3). If P_{ir} is mistakenly used, the result will be a slight overestimate of the excess cost (unless the weights are also adjusted).

of such investigations suggest an excess cost in the range of 12% to 24% (see Table 1).[1] Unfortunately, studies of this kind suffer from serious inadequacies. To begin with, it is necessary to assume that the same arbitrary quantity-unit of each product is delivered by all potential sources. By "same," it is of course not necessary to imply identical, but the different varieties are assumed to be equally satisfactory to the LDC. In short, they are assumed to be perfect substitutes. The researcher has leeway – in the case of machinery, for example, he may choose (if the data permit) the more sensible unit among number of machines, tons of machinery, horsepower-potential of machinery, etc. But in the end, only the crudest kind of adjustment can be made for quality differences between the various varieties. Moreover, quality is not always even potentially measurable on a linear scale; for a particular "product," the variety delivered by a particular country may be better for some purposes and worse for others. The dilemma is clear, given the necessary assumption of perfect substitutability. In order to avoid the risk of being embarrassed to discover that he has attributed excess cost to U.S.-tied imports of the very products that are being preferred, partly or totally, under commercial license, the researcher must take care "to compare only such items of equipment as have similar specifications, capacity and quality."[2]

Since there are but a limited number of products for which it can be reasonably claimed that the varieties available from different sources are indeed perfect substitutes to the user, studies such as those in Table 1 give a meaningful estimate of the overall excess cost of tied aid only if variety-

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[1]Other studies have estimated the percentage excess of highest-cost over least-cost source where international bidding has occurred. Such estimates are of course higher (see, for example [Bhagwati, 1967] pp. 33-34) but represent only upper limits to potential excess cost as defined above.

[2](Haq, 1967) p. 327.

Table 1

Findings on Excess Cost of Tied Aid

Nation	Source	Estimate of Excess Cost[1]
Pakistan	(Haq, 1967)	12%
Chile	(UNCTAD, 1967a)	12.4%
India	(Lal, 1968)	14.9%
Iran	(Eshag, 1967a)	15%
Tunisia	(Eshag, 1967)	20%
Various Latin American	(Tokman, 1969)[2]	24%

Notes: 1. Methodologies vary somewhat among these studies, but the general procedure is described in (UNCTAD, 1967).

2. The Tokman article reports results of an OAS study (p. 93) that includes excess costs due to freight and project preparation.

heterogeneous products are comparable to variety-homogeneous products insofar as aid-tying costs are concerned. The methodology we will develop instead treats the different varieties of a particular "product" as heterogeneous – in essence, more as if[1] they were themselves different products. As a result, we are unable to calculate the excess cost of the truly variety-homogeneous product, but there are few of these under our definition of "product";[2] in any case, our results offer a useful complement to earlier findings.

The organization of the remaining sections is as follows. An historical review of aid-tying measures from the U.S. viewpoint is first presented (Section II). There follows a description of the U.S.-Colombian aid negotiations and of the administrative reactions of the Colombian government – and especially of the import-licensing agency – to restrictions on the use of aid (Section III). Constraints on the use of aid and the aid-recipient's reactions to them are then examined theoretically within a variety-heterogeneous model (Section IV). In the final two sections (V and VI), the data of actual Colombian imports over 1955-68 are analysed in an effort to assess the nature, extent, and costs of the variety-distortion imposed on Colombia in 1967 and 1968 through U.S. aid-tying restrictions and sub-optimal Colombian responses to these restrictions.[3]

The empirical findings – although no more than suggestive – indicate most importantly that: 1) the typical variety-distortion costs to Colombia were far from negligible, and 2) the Colombian administrative reaction to the aid-restrictions may have been sub-optimal. For a sample from all products which were eligible for U.S. purchase under the U.S. program loan, the variety-

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[1]The phrase "more as if" will be made clear later.

[2]Defined in this study from detailed tariff classifications.

[3]There are two appendices. In the first (A), the samples, data, and statistical operations are detailed; and in the second (B), the exact variety-distortion-cost formula is developed.

distortion costs averaged above 10% in 1967 and above 30% in 1968.[1] Furthermore, the absence of such costs in another sample (of similar Colombian imports that were not eligible for purchase through U.S. aid) suggests that the Colombian import-licensing procedures failed completely to adapt to the U.S. aid-restrictions and thereby may have contributed to these 10% and 30% estimates.

II. Tying: U.S. Ends and Means

There are many reasons for the practice of aid-tying by source — such as internal (donor) politics, reduction of the resource cost (to the donor) of aid, and the desire for increased leverage over the direction of the recipient's use[2] — and the issue is indeed not simple. But the very date of the initiation of source-tying of U.S. aid, 1959, reflects the fact that U.S. tying is primarily directed at the balance of payments and its concomitant, the promotion of exports.[3] Before the discovery, in 1959, that the "dollar gap" had been closed, there had been little concern for the effect of U.S. aid on its balance of payments. On those few occasions when the question had been raised, reassuring answers had been offered; even the now staunch proponent of tying, the Department of Commerce, had then estimated that:

> of more than $5,000 million in gross grants and credits extended by the United States Government in 1958 all but $300 million "consisted of equivalent transfers from the United States."[4]

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[1] The median is the measure of average (for reasons that will later become clear). Since the variety-distortion costs of the major Colombian imports were much smaller, a weighted average would be lower than these 10% and 30% figures.

[2] For fuller lists, see (Mikesell, 1968) pp. 246-251 and (Bhagwati, 1967) pp. 17-19.

[3] The two are not quite the same even in the U.S. situation, and for other countries, that tie aid despite a balance-of-payments surplus, the export-promotion reason can exist quite independently. AID likes to separate the two reasons, especially before Congress (e.g., see [AID, 1967] pp. 72-76), and the Department of Commerce appears to visualize tying as a device to "provide current and prospective exporters with opportunities to demonstrate the quality of U.S. products ..." (Dept. of Commerce, 18 Jan. 1965) p. 47. Nevertheless, for present purposes, the two aspects can be viewed as essentially identical, as concerns the United States in the 1960's.

[4] (Asher, 1961) p. 43; the internal quotation is from a Dept. of Commerce publication.

Once tying was introduced, the method of calculating the impact of aid on the U.S. balance of payments changed. Where the Department of Commerce estimate for 1958 had been 94%, the official figure for 1960 was only 41% (see Table 2). The percentage rose throughout the 1960's as tighter tying was implemented. But as nominal source-tying became ever more (and by 1969 almost completely) effective, it was increasingly recognized that the U.S. share of expenditures financed by U.S. aid was not necessarily a measure of, or even related to, the impact of aid on the balance of payments.

Table 2

U.S. Share of AID-Financed Commodity Expenditures

Fiscal Year	% Purchased in U.S.
1960	41%
1961	44
1962	66
1963	79
1964	87
1965	92
1966	90
1967	96
1968	98
1969	99

Source: (Foreign Assistance Program, 1968) p. 75 and (Foreign Assistance Program, 1969) p. 23.

Although we are not here concerned with this impact on the U.S. balance of payments, we must nevertheless glance over the measurement difficulties involved in order to recognize the extent of the uncertainty and ignorance in which U.S. tying policy was being created and conducted during the 1960's. Only this ignorance and uncertainty (together with the strong and growing concern for the U.S. balance of payments) can explain the frenetic pace of tying

activity in the U.S. Treasury, AID, and the Department of Commerce during the late 1960's. Aside from any macroeconomic issues involved,[1] it was soon recognized that aid-dollars that were not returned directly to the United States through a U.S. purchase were not irrevocably lost. This meant, first, that the AID contributions to international organizations could not be treated automatically as a balance-of-payments drain but required calculations about the probable ultimate (advanced-country) destination of the dollars.[2] Furthermore, even untied bilateral U.S. aid could return to the United States by way of third countries. The use of an average (and implicitly assumed equal to marginal) propensity-to-import matrix permitted the estimation of "feedback" or "reflection" effects and hence the ultimate impact of untied bilateral aid on the U.S. payments.[3] In short, feedback considerations reduce the perceived contribution of aid to the U.S. deficit but require tenuous estimation procedures.

It has also been increasingly recognized that aid-dollars that do return directly to the United States may nevertheless contribute to the U.S. deficit. If the aid-recipient would have purchased that product (in the United States) in the absence of aid, then the aid has freed some of its own foreign exchange. To the extent that this freed exchange is not spent in the United States, "substitution" or "switching" occurs, and the aid-dollar in effect contributes to the U.S. deficit. Here too, calculations are tenuous, essentially requiring an extrapolation, estimate, or assumption about the "normal" U.S. share of the

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[1] I.e., that the U.S. balance-of-payments deficit must be viewed as the obverse side of an excess of investment over saving.

[2] The traditional example of the failure of this "accounting" approach was the treatment of the U.S. contributions to the Indus Basin Development Fund as a drain. While the United States was providing an untied 44% of the foreign exchange, U.S. firms were receiving 54% of the (foreign exchange component of the) contracts. See (Treasury, 1968) pp. 150-151.

[3] See (Salant, 1963) and (Hicks, 1963).

aid-recipient's non-aid-financed imports.[1]

Finally, it has recently become fashionable to calculate the U.S. exports to LDCs which are attributable to the aid-induced income increases of these countries.[2] In addition to being methodologically suspect, the resulting estimates are again tenuous. Thus, Congressmen, economists, bureaucrats; AID, Treasury, Commerce; each has been able to pursue his instincts — about the "need" for and efficacy of augmented aid-tying measures — largely unfettered by indisputable facts.[3]

The tying history of the 1960's can be divided into two stages. Up to 1965, AID was chiefly concerned with getting its aid tied tightly to use in the United States on U.S. products.[4] By 1965, this goal had been essentially achieved (see Table 2), but U.S. officials were beginning to worry officially about the substitution, or switching, issue. The question was raised in terms of "additionality": to what extent does aid result in a net addition to U.S. exports? This concern for additionality was almost entirely directed at those LDCs which received program (or more generally, non-project) aid from the United States although substitution is, in theory at least, as much a possibility with project aid,[5] and internal research in AID was strongly suggesting that, among U.S. aid

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[1]Many of the estimates are found only in internal AID memoranda, but the interested reader should see (Lynn, 1966) and (Hyson and Strout, 1968).

[2]Gaud in (Hearings, 1969) pp. 95-96. See also (Hyson and Strout, 1968).

[3]Though one of these necessarily tenuous estimates by AID, that all the tying efforts beyond nominal source-tying "only save us about $35 million a year" (Gaud in [Hearings, 1969] p. 94) was in the end influential in the 1969 announcements of an easing of Latin American restrictions.

[4]The definition of a U.S. "product" inevitably caused some difficulty; also (after 1963) aid could no longer be used on products of which the United States was a net importer.

[5]Some substitution will occur whenever the donor finances a project i) that would have been undertaken in the absence of the aid and ii) some of the foreign exchange components of which would have been bought from the donor. The irony should not be overlooked: the additionality of project aid is best ensured by funding low-priority projects that are most economically contracted in third countries.

recipients, failure to achieve additionality was unrelated to the project-versus-program composition of the assistance. Nevertheless, after 1965, new aid restrictions were concerned entirely with the non-project component of U.S. aid.

In order to understand U.S. policies, it is important to understand the extent to which normal economic factors and/or nominal source-tying can bring about additionality. If an aid-recipient's imports from the United States are normally a fraction, Ψ, of his total imports,[1] then the United States can expect, without any tying restrictions, that a fraction, Ψ, of its aid will return directly to the United States.[2] Thus, full additionality is more nearly achieved, the larger is the normal U.S. share (Ψ).

Nominal source-tying, on the other hand, is more effective the lower is the normal U.S. share of imports. In the extreme, where U.S. goods are never purchased in normal commercial channels, the aid-recipient must develop new incentives or import-licensing procedures to fulfill the aid restrictions — and will, in the process, automatically achieve full additionality. If the ratio of the U.S. aid to total normal commercial imports is Φ, it can be readily deduced that nominal source-tying will raise the total U.S. import share above its expected normal level (Ψ) as long as $\Psi < \Phi/(1+\Phi)$. Thus, the larger is the aid contribution to the recipient's imports (Φ) and/or the smaller its normal U.S. share (Ψ), the more effective is nominal source-tying in achieving additionality.[3]

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[1]For simplicity, we here assume identity between the average and the marginal.

[2]We are here ignoring indirect feedback and growth-induced imports.

[3]Provided the recipient can and does adequately alter its import incentives and/or licensing procedures. If not, nominal source-tying will only result in a slow utilization of the program loan. The classic example of this is Morocco in the mid-1960's. With a normal U.S. import share below 10% and strong traditional trade ties to France (reinforced by an exemption — later withdrawn — of French imports from the need for prior license), the Moroccan Government was simply unable to utilize its U.S. aid. We return in Section III to this problem as it affected Colombia.

These two factors are shown in Figure 2, where the vertical axis represents the ratio of additional (net) U.S. exports to the aid-recipient to its total U.S. assistance. If this ratio is one, full additionality has been achieved; if it is zero, complete substitution has occurred (i.e., zero additionality). The shaded region of Figure 2 indicates the extent to which additionality is less than full when normal economic factors and nominal source-tying are relied upon. It is on this shaded region that AID, Treasury and Commerce intensified their various attentions between 1965 and 1968.

Unfortunately — from the viewpoint of U.S. additionality — it is no easy matter to ensure fuller additionality. While nominal source-tying is generally accepted by aid donors and recipients, further steps are not. "Additionality teams" were sent to the major non-project aid-recipients in search of means to raise "additionality factors." While a number of jawbone devices were developed,[1] the principal new restriction applied was the "positive list." AID had always, under its broadest and most permissive program loans, insisted on a "negative list" — namely, goods on the import of which (from any source) the aid could not be used. Usually consumer goods, and especially luxury items, were excluded in order to encourage the employment of the aid for development purposes.[2] In 1966, negative lists began to be used for additionality purposes, and in 1967, positive lists (i.e., goods on the import of which the aid could be used) were introduced.[3] Although the substitution of a complementary positive list for a negative list is not necessarily more than a semantic step, the resulting positive lists were kept short and were selected with an eye to U.S. exports as well

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[1] Including the implied threat that an aid-recipient's share of the pie might be reduced if it were unable to raise its additionality. For example, "discussions have been held with assisted countries concerning difficulty of maintaining current assistance levels in the face of the U.S. balance of payments deficit" (Foreign Assistance Program, 1967) p. 19.

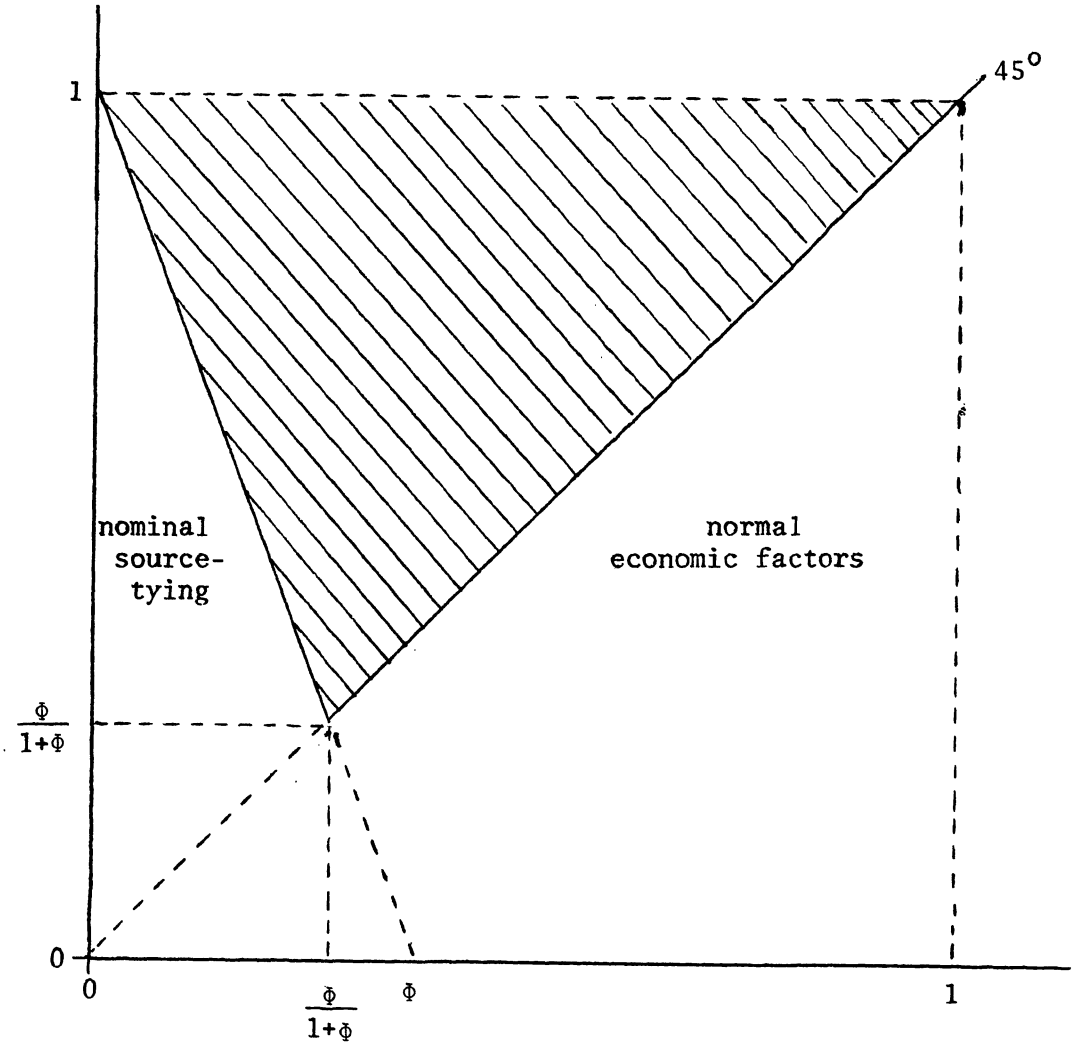
[2] And to prevent subsequent embarrassment before Congress.

[3] Gaud in (Hearings, 1969) p. 92.

Figure 2

Net Additional U.S. Exports

Total Amount of U.S. Aid



as the LDC's development needs.

The positive list restricted the aid-recipient in two ways: one, the number of eligible goods was limited, and two, the eligible goods were restricted to those "in which U.S. commercial exports were generally less than a commanding share of the market."[1] That these two restrictions could be effective in reducing the maximum possible commercial substitution is easily shown. The size of the positive list was restricted by a condition that the total (U.S. and other) imports (in some recent past year) of all eligible products not exceed a certain multiple of the program aid being offered. Since this multiple was usually fixed no higher than 1.5, this meant that no more than a small fraction of the LDC's imports could be put on the list.[2] Furthermore, the LDC was not permitted much voice in the selection of the eligible products. In the official words of the United States:

> AID is paying increasingly close attention to balance of payments considerations in selecting...commodities that it will or will not finance:
>
> --AID is placing greater emphasis on...products which will ensure not only immediate U.S. exports but also "follow on" orders for such items as parts or specialized intermediate materials.
>
> ...
>
> --Another device A.I.D. uses is to refuse to finance items, such as spare parts or goods in which the United States is strongly competitive, which a recipient will buy from the United States in any event since they are available at reasonable cost only in this country.
>
> --Still another method is to limit the list of goods eligible for A.I.D. financing to those in which the United States does not have a price advantage.[3]

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[1] J. R. Fowler, Jr., Deputy U.S. Coordinator, Alliance for Progress, AID in (Hearings, 1970) p. 1733.

[2] Where, for example, the ratio of the program aid to the base-year total of all imports from all sources was .10, only 15% of those total imports were eligible for the positive list.

[3] (Treasury, 1968) p. 153.

In practice, all these criteria seemed to have boiled down to a condition that the pre-program-loan U.S. share of a product should not much exceed one-half if the product were to be eligible for the positive list. Although in any actual positive list numerous exceptions are found, the selection of the list essentially began with the U.S.-share-of-one-half products and worked down through the lower-share products until the 1.5 size-of-list constraint was reached. Thus, the potential extent of substitution was limited by the fact that the U.S. imports (which were subject to possible switching) were never a "commanding" share of the total.[1] By this means, limitation of the positive list to relatively few goods which the United States "would otherwise be unlikely to export in any great volume,"[2] the United States was able to guarantee that no more than a limited amount of substitution could occur.[3]

Of course, the very size and nature of the positive list also guaranteed that the aid-recipient would not be able to utilize the aid without drastic revision of its import-licensing procedures and/or dramatic increases in its incentives to purchase U.S. varieties of eligible products.[4] Some aid-recipients

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[1]The United States was not the sole perpetrator of such devices: see, for example (Dept. of Commerce, 23 Aug. 1965) p. 25 and (Dept. of Commerce, 29 Aug. 1966) p. 28. It is ironic that the United States once complained in Colombia about "trade policies which discriminate against U.S. imports" (Dept. of Commerce, 8 Feb. 1965) p. 23, when the positive lists asserted by third countries included goods in which the U.S. share was commanding.

[2]Gaud in (Hearings, 1969) p. 92.

[3]Notice the words, "limited" and "could." Although the list concept may appear quite restrictive, if the average U.S. share of the eligible products is as high as one-third, half of the aid might end up as substitution. Thus, the maximum amount of switching that could occur is not very "limited." It is ironic that so much effort should have gone into positive lists that cannot force additionality without complementary measures. We return to this problem in Sections III and IV.

[4]Unless its currency were so over-valued that there was sufficient excess demand for the eligible higher-cost U.S. varieties even without special incentives or altered licensing. This may have been the case in some countries; in Pakistan, for example:

> Domestic price tends to be set (given domestic demand) by the total

chose to cease (or reduce) licensing eligible imports from non-U.S. sources;[1] others offered a variety of incentives to private importers to induce the selection of U.S. varieties — incentives ranging over tariff cuts, exemption from advance deposits, lower exchange rates, tax exemptions, special credits, and direct subsidies.[2] Drastic measures — and often "unpopular"[3] ones — are needed to induce or force businessmen to buy U.S. products that are priced "10 to 40% more than comparable goods from other suppliers."[4] It is a perverse tribute to the hunger of aid-recipients for foreign exchange that so many LDCs were willing and able to satisfy so much of the U.S. additionality effort of the late 1960's.

Other problems arose. Positive lists were sometimes so restrictive that the aid could not be utilized at the pace envisaged. Negotiations became prolonged and embittered as LDCs became increasingly aware of AID's apparently greater interest in U.S. exports than in LDC development. AID was withheld until the recipient could erect or expand a system of import controls capable of

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> amount imported from all sources, not by the cost of the higher-priced U.S. imports that dominate the supply side of the market. Prices to the import licensee are higher due to the higher landed cost of the U.S. items. The profit over lowest landed cost is so high, however, that total quantity imported remaining the same, a rise in price to the importer is paid out of licensees' profits... (Pal, 1964, pp. 606-607).

[1]Which further reduced the competitiveness of U.S. varieties since U.S. producers were now able to ignore third-country competition. In some cases, prices rose even above internal U.S. levels since U.S. manufacturers were permitted to collude, under the Webb-Pomerene Act, in their export dealings. Open collusion to raise prices of AID-financed products was declared illegal in November 1968. See (Curry, 1968) pp. 138-139.

[2]See (Eshag, 1967) pp. 7-8, (Díaz-Alejandro, 1969) pp. 21-23, (Dept. of Commerce, 28 June 1965) p. 42, (Dept. of Commerce, 9 Aug. 1965) p. 15, (Dept. of Commerce, 20 Dec. 1965) p. 30, and (Dept. of Commerce, 6 March 1967) p. 25. The list of incentives in the text is probably not exhaustive.

[3](Foreign Assistance Program, 1969) p. 25.

[4]Gaud in (Hearings, 1969) p. 95.

guaranteeing additionality (while AID was sermonizing over the virtues of free markets). By the time Rockefeller made his Latin American junkets in 1969, additionality had become not only a serious practical impediment to the distribution of authorized U.S. non-project aid, but also a new symbol of gringo imperiousness.

In fairness to AID, it should be noted that at no time did it fully succumb to the balance-of-payments arguments of Treasury and Commerce. But AID's "running conflict"[1] with those departments was a losing one until Rockefeller's mission and report.[2] In June 1969, President Nixon directed the elimination of additionality requirements. Though there was at first some confusion about what this meant, the passage of time suggests that little more than an expansion of the positive lists will result.[3] More time must pass before the extent of this expansion is clear.

III. Tying: Colombia's Reactions and Adjustments

Between 1962 and early 1967, Colombia received US$205 million in program loans from the United States, and had spent all but US$4 million of this. While the heated negotiations of these loans had often been fueled with disagreements between AID and the Government of Colombia on export performance, administrative and tax reform, and devaluation, there is no evidence that additionality had been an issue in the early discussions. Nevertheless, under terms of the 1964 program loan (hereafter just PL), AID had changed from a negative list to a positive list of goods eligible for PL use. By late 1965, imports of the U.S. goods

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[1]The words of a newspaper article ("AID Program," 1969).

[2](Rockefeller Report, 1969).

[3]Latin American aid has been "untied" in that it may now be utilized not only in the United States but also in other countries — of Latin America!

financed by AID were slightly favored over other goods in three ways. First, the importer received 120 days grace between payment to the U.S. exporter and the beginning of interest on credit on the goods. Second, the rate of interest was 12%, while ordinary bank lending was above that rate.[1] And third, AID-financed imports of goods subject to prior license (the majority) were free from advance-deposit obligations, which lowered their cost as much as 12% of the CIF value.[2]

In negotiating the US$100 million PL of May 1967, two important changes were made in the administration of the Colombia loan. First, the list of goods eligible for AID finance was tightened by removing all goods whose historic U.S. share was above one-half. Second, imports were divided into two classes, capital goods and "regular" goods (all the rest). All imports of capital goods had to be approved by the Industrial Development Agency (Instituto de Fomento Industrial, or IFI) and were eligible for three-year to five-year loans at 5% to 7% interest on the dollar value (with a US$20,000 minimum application). The corresponding terms on "regular" goods were 4% for 120 days, also on the dollar value. US$10 million of the US$100 million PL was allocated to capital goods. These measures were taken, with AID approval, specifically to stimulate imports from the United States of the goods on the list.

Use of the first tranche (i.e., allotment) of the PL was brisk, becoming exhausted slightly before the first quarterly review was completed in September.[3] It was noted that additionality was one of the "most troublesome problems" in

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[1]At this time 14% was the legal maximum for bank lending but redeposit requirements raised the effective rate above this.

[2]Advance deposits vary between 30% and 130% of CIF value. They remain on deposit on average of 6 months. A conservative nominal opportunity cost of capital would be 18% per year; this applied to 130% for 6 months means 12% of CIF value.

[3]The quarterly review is an AID procedure which examined Colombian "performance" before release of each tranche.

this quarterly review.[1] The U.S. non-AID-financed share of total imports fell to 21% during the last quarter of 1967; the share for all 1967 was 29% against an historical share of 39%. The third quarterly review of February 1968 again raised the additionality question, "the biggest issue between AID and the Government of Colombia."[2] The "issue" was not over additionality as such since Colombian authorities recognized AID's problem; rather there was disagreement over the means to achieve it. Colombia wanted a large list within which financial incentives and light administrative pressure could work. AID insisted, in part due to pressure from the U.S. Departments of Treasury and Commerce, on a small list. As a result, AID again reduced the list of goods on which the PL could be used, "to give greater emphasis to capital and other goods for which the U.S. share of the market had been traditionally small."[3] The extent of the tightening of the list is easily seen; in 1967, the value of the historic U.S. share of the positive-list goods was US$135 million; whereas this value in 1968 was only US$42 million.

The reduction in the list and the agreement by the Colombian Government to force an additional US$3.9 million onto commercial financing for January and February caused a near crisis. For the first time it became difficult to utilize the PL. In the early months of 1968 the loan was being used at only US$3-4 million per month compared to the projected rate of US$8 million. Although the list was expanded twice between February and September, the problem persisted throughout the year. By November, the Institute of Foreign Trade (Instituto Colombiano de Comercio Exterior, or Incomex) was exhorting importers to use the PL, but importers insisted "that the list is very tight, that being the reason

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[1] (Senate Committee, 1969) p. 51.

[2] Ibid., p. 55.

[3] Ibid., p. 55. Also, U.S. flag shipment of more goods was required.

for the meagre use of the credit."[1]

The final tranche of the PL was not released until May 1968, when the Colombian Government, under pressure from AID, moved a substantial number of items from the prior-license list to the "free" list. This had an unintended effect of reducing the incentive for U.S. purchase of these goods since goods on the free list were not exempt from advance deposit (though imported with AID financing). In August, Colombia reduced the advance deposits on such AID-financed goods to 40% of their previous level, and in November reduced them again to 10%. In September 1968, Colombia tried to accelerate the use of the PL by raising the percentage of credit to importers of AID-financed "regular" goods from 80% to 100%. Minimum loans were also lowered from US$2500 to US$2000 for "regular" goods and from US$20,000 to US$10,000 for capital goods.

This chronology suggests the following interpretation of events:

1. AID did not become very seriously concerned about Colombian additionality until May 1967.
2. Incomex made only marginal efforts to divert purchases to U.S. goods in 1967, principally by licensing U.S. goods on the list somewhat more freely.
3. The attempt to use a large amount of aid during 1967 — part untied (IBRD) and part with additionality barely in force — caused a sharp drop in the U.S. non-AID-financed share of total imports.
4. When AID realized that additionality was not being achieved, it tried to enforce it by greatly reducing the size of the positive list. This list was so tight that the PL could not be utilized at the projected rate.

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[1] (Legislación, 30 Nov. 1968) p. 314. This refers to a new PL for US$73 million signed in July 1968.

5. Only when faced with the inability to move the aid did Incomex begin to take stronger measures to divert purchases toward U.S. products. But these expanded incentives were now working on a reduced list of goods. By the same token, given that Incomex's efforts were directed at the goods on the list, these efforts had to be greater than if they had been working with a larger list.[1]
6. There is no evidence that either AID or the Colombian authorities ever analyzed exactly what measures would have been necessary to achieve additionality (not to mention in an optimal way).

IV. Theory and Method

We will now employ a model which incorporates imperfect substitutability between U.S. and third-country varieties (labeled u and r, respectively). The optimal allocation of import purchases when the LDC's own foreign exchange is supplemented by a program loan (or PL) is the result of a simple maximization problem, the results of which depend upon the constraints imposed in the use of the PL. We recognize constraints of three kinds: 1) the usual foreign exchange budget constraint; 2) "tying" constraints imposed by the donor; and 3) self-imposed LDC constraints which are due to domestic (i.e., non-donor) political pressures or organizational failings. In this section we will develop hypotheses about the behaviour of certain ratios of U.S. to third-country varieties of goods under the operation of various constraints. As a benchmark we begin with the allocation of import purchases in the absence of a PL and then proceed to consider the allocation when the use of a PL is constrained in the

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[1] Instead of having to divert a few thousand dollars to U.S. varieties of each of thousands of goods, they now had to divert tens of thousands of dollars to U.S. varieties of each of hundreds of goods.

following ways:

Case I. The PL is unrestricted.

Case II. The use of the PL is tied by source, including "additionality" as a special form of source-tying.

Case III. The PL is source-tied and product-tied, this latter in the sense that a limited number of products are eligible for PL use.

Case IV. A self-imposed constraint, that the licensing of rest-of-world imports (of all products) remain unchanged from the pre-PL situation.

Case V. Another self-imposed constraint, that the licensing of all imports other than of the U.S. variety of PL-eligible products remain unchanged from the pre-PL situation.

Allocation of import purchases in the absence of a PL is the simple maximization problem:

$$(4) \qquad \text{Max } W = W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] - \lambda_1 (P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - E)$$

where the P's and Q's represent prices and quantities (for expository simplicity, only two products are considered), W is social welfare; E is the (exogenously given, pre-PL) foreign exchange availability, and λ_1 a Lagrangian multiplier.[1] Necessary conditions for the maximization are:

$$(5) \qquad \frac{W_{1u}}{W_{1r}} = \frac{P_{1u}}{P_{1r}} \; ; \; \frac{W_{2u}}{W_{2r}} = \frac{P_{2u}}{P_{2r}}$$

where the W subscripts indicate the relevant partial derivatives of the (assumed convex) welfare function. If we further assume a homothetic welfare function among varieties,[2] then the variety-ratio of each good (i.e., Q^o_{1u}/Q^o_{1r} and Q^o_{2u}/Q^o_{2r}) is a function only of the price ratio of the varieties:

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[1] And where brackets represent functions and parentheses multiplication.

[2] Homotheticity implies, essentially, equal "income" elasticities among the different imported varieties of each good.

$$(6) \qquad Q^{o}_{1u}/Q^{o}_{1r} = f_1[P_{1u}/P_{1r}]$$

$$Q^{o}_{2u}/Q^{o}_{2r} = f_2[P_{2u}/P_{2r}]$$

where the f's represent (for now unspecified) functions (with f' negative and f'' positive) and the superscript zeros refer to the benchmark, pre-PL case. Throughout, the W function is assumed to be convex in goods and varieties, and homothetic as well in varieties. We recognize that the assumption of homotheticity would be totally unjustified for products themselves, but for different countries' varieties of a particular product, it seems reasonable. Especially for the intermediate and capital goods on which we (and foreign aid) focus is the assumption plausible — income elasticities of U.S. and French nitric acid are much more likely to be equal than those of U.S. and French wine.

We now consider the maximization problem after the LDC receives a PL (of amount L) to supplement its foreign exchange budget (i.e., Cases I through V):

Case I. The PL is completely untied. Clearly the foreign exchange constraint is relaxed, and there results a pure income-effect expansion in all import purchases. Without further assumptions, nothing can be said about the relative expansion of purchases of goods 1 and 2, but, from the homotheticity assumption, it follows that the variety-ratios of each good will remain unchanged.

$$(7) \qquad Q^{I}_{1u}/Q^{I}_{1r} = Q^{o}_{1u}/Q^{o}_{1r}$$

$$Q^{I}_{2u}/Q^{I}_{2r} = Q^{o}_{2u}/Q^{o}_{2r}$$

Case II. The PL is subject to source-tying; it may be spent only on U.S. goods. The form of the constraint may range from nominal source-tying to full additionality. Nominal source-tying means that total imports from the United States must be at least L; full additionality means that imports from the United

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[1] The Roman superscripts refer to the case under consideration.

States must rise L above what they would have been in the absence of the PL (i.e., above $P_{1u}Q^{o}_{1u} + P_{2u}Q^{o}_{2u}$). Optimal exchange allocation becomes a problem of the form:

$$(8) \quad \text{Max } W = W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] - \lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - E - L) - \lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q^{o}_{1u} + P_{2u}Q^{o}_{2u}) + L)$$

where λ_1 represents the value of the foreign exchange budget constraint (including the PL) and λ_2 the source-tying constraint. For nominal source-tying, $z = 0$; for full additionality, $z = 1$.[1] The necessary conditions for maximization are:[2]

$$(9) \quad \frac{W_{1u}}{W_{1r}} = \frac{P_{1u}}{P_{1r}}\left(1 - \frac{\lambda_2}{\lambda_1}\right); \quad \frac{W_{2u}}{W_{2r}} = \frac{P_{2u}}{P_{2r}}\left(1 - \frac{\lambda_2}{\lambda_1}\right)$$

$$(10) \quad Q^{II}_{1u}/Q^{II}_{1r} = f_1\left[\frac{P_{1u}}{P_{1r}}\left(1 - \frac{\lambda_2}{\lambda_1}\right)\right]$$

$$Q^{II}_{2u}/Q^{II}_{2r} = f_2\left[\frac{P_{2u}}{P_{2r}}\left(1 - \frac{\lambda_2}{\lambda_1}\right)\right]$$

For a country like Colombia with an historically high share of imports from the United States, nominal source-tying would not be a binding constraint unless the PL became a very high portion of total foreign exchange availability. In contrast, a country with a relatively large PL and different historical trading preferences (e.g., Pakistan or Morocco) might find nominal source-tying

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[1] When binding, λ_1 and λ_2 are positive. Logically z can take on other values. AID might try to impose only partial additionality or the recipient might be able to partially evade additionality. On the other hand, AID's definition of additionality may not include allowance for price or trend changes, so more than 100% additionality could be imposed.

[2] Note that $\lambda_1 > \lambda_2$ since, if $\lambda_2 > \lambda_1$, the marginal dollar of PL used would cause a decrease in welfare. This cannot occur so long as LDCs may refuse aid.

a binding constraint. On the other hand, the evidence of Section III suggests that full additionality has been a binding constraint in Colombia.

In summary, the source-tying constraint, when binding for whatever reason, raises the opportunity cost of buying non-U.S. varieties of goods and thereby leads to substitution, within each product, toward U.S. varieties, i.e.:

$$(11) \qquad \frac{Q_{1u}^{II}}{Q_{1r}^{II}} > \frac{Q_{1u}^{I}}{Q_{1r}^{I}} = \frac{Q_{1u}^{o}}{Q_{1r}^{o}} \; ; \; \frac{Q_{2u}^{II}}{Q_{2r}^{II}} > \frac{Q_{2u}^{I}}{Q_{2r}^{I}} = \frac{Q_{2u}^{o}}{Q_{2r}^{o}}$$

It should be noted, however, that without more precise knowledge about the shape of the W function, we cannot know whether the substitution in favor of U.S. varieties is greater for good 1 or good 2.

Case III. The PL is subject not only to source-tying, as in Case II, but also is restricted to use on a limited number of eligible goods. Here, we shall treat good 1 as eligible. The allocation problem:[1]

$$(12) \qquad \text{Max } W = W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}]$$

$$-\lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - E - L)$$

$$-\lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q_{1u}^{o} + P_{2u}Q_{2u}^{o}) + L)$$

$$-\lambda_3(-P_{1u}Q_{1u} + L)$$

And the solution:[2]

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[1] At first glance, it might appear that the addition of the third constraint makes the second superfluous (i.e., $\lambda_2 = 0$), and indeed this was partly the intention of the United States in imposing it. Reflection, however, shows that only in special circumstances is $\lambda_2 = 0$; the constraints are in general not identical. The third constraint simply requires the LDC to spend at least \$L on eligible goods in the United States (i.e., on Q_{1u}), not to increase expenditures on eligible goods in the United States by \$L. In general it is true that the imposition of the third constraint will lower the value of λ_2, especially if the goods included are those which would have a very low U.S. share otherwise.

[2] As long as the marginal worth of the PL is positive, we know: $\lambda_1 > \lambda_2 + \lambda_3$.

$$(13) \qquad Q^{III}_{1u}/Q^{III}_{1r} = f_1\left[\frac{P_{1u}}{P_{1r}}\left(1 - \frac{\lambda_2 + \lambda_3}{\lambda_1}\right)\right]$$

$$Q^{III}_{2u}/Q^{III}_{2r} = f_2\left[\frac{P_{2u}}{P_{2r}}\left(1 - \frac{\lambda_2}{\lambda_1}\right)\right]$$

Although there may now exist differential distortions in the purchases of goods 1 and 2, still nothing is certain about the relative extent of the variety-ratio changes without more precise knowledge about the shape of the W function. Nevertheless, it is clear that the relative quantity of the U.S. variety is raised for good 1 and not lowered for good 2, i.e.:

$$(14) \qquad \frac{Q^{III}_{1u}}{Q^{III}_{1r}} > \frac{Q^{o}_{1u}}{Q^{o}_{1r}} \; ; \; \frac{Q^{III}_{2u}}{Q^{III}_{2r}} \geq \frac{Q^{o}_{2u}}{Q^{o}_{2r}}$$

It should be noted that constraint 3 is not likely to be binding if the U.S. share of good 1 is large, good 1 comprises a large and income-elastic portion of the aid-recipient's imports, and/or if the PL is relatively small. If constraint 3 is not binding it cannot "help" enforce additionality. Intuitive recognition of this fact has meant to U.S. negotiators, that the eligibility list must be kept small relative to the PL if it is not to become irrelevant. Furthermore, if the purpose of this constraint is to enforce additionality and not to help particular U.S. exporters, it is clearly an inefficient way to do so unless the aid-recipient cannot be otherwise prevented from evading constraint 2.

Mention should be made of an even stronger version of Cases II and III, where the United States insists that full additionality be achieved in the eligible goods alone (i.e., $L \leq P_{1u}Q_{1u} - P_{1u}Q^{o}_{1u}$). Such a constraint leaves Q_{2u}, Q_{1r}, and Q_{2r} at their pre-PL levels. The result of the "maximization" in this case is indistinguishable from Case V, a fact to which we shall refer later.

It should be noted that this "strong version" of Case III is inefficient, in that the United States is made no better off (unless exports of good 1 are somehow preferred to exports of good 2) and the aid-recipient is made worse off.

A valid objection to the analysis thus far would be that instituting the optimal responses in Cases II and III may be an impossible task. A mere list of the instruments available in LDCs to induce imports of U.S. varieties suggests this.[1] Therefore, we now analyze two cases of sub-optimal response by the aid-recipient.

Case IV. Suppose that, due to inertia, economic pressure from third countries, or the LDC's own importers' insistence, no reductions are made in any third-country purchase below normal licensing;[2] The only changes are that increased licenses are issued to those who want to import U.S. varieties of both eligible and non-eligible goods. If there is sufficient excess demand for imports at the current exchange rate, tariff and advance deposit levels, the PL can be utilized and additionality clearly fulfilled. For comparability with previous cases, we note that this case is equivalent to the following allocation problem:

$$
\begin{aligned}
(15) \qquad \text{Max } W = {} & W\,[Q_{1u},\ Q_{2u},\ Q_{1r},\ Q_{2r}] \\
& - \lambda_1 (P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - E - L) \\
& - \lambda_2 (-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q^{o}_{1u} + P_{2u}Q^{o}_{2u}) + L) \\
& - \lambda_3 (-P_{1u}Q_{1u} + L) \\
& - \lambda_4 (P_{1r}Q_{1r} - P_{1r}Q^{o}_{1r}) \\
& - \lambda_5 (P_{2r}Q_{2r} - P_{2r}Q^{o}_{2r})
\end{aligned}
$$

---

[1] In Colombia, for example, import licenses granted by Incomex, prior deposits fixed by the Monetary Board (Junta Monetaria), special credits granted by the IFI and the central bank (Banco de la República), tariffs set and changed by the tariff board (Consejo de Política Arancelaria), and exchange rates determined by a high-level council made up of the President, director of the central bank and the economic ministers.

[2] With "normal" assumed to be the pre-PL levels (i.e., Q^{o}_{1r} and Q^{o}_{2r}).

It should be noted that constraints 4 and 5 with the budget constraint imply that constraint 2 is automatically fulfilled. When constraint 3 is operative, the solution requires no maximization process. Even when constraint 3 is not effective, the ratio of Q^{IV}_{iu}/Q^{IV}_{ir} to Q^{o}_{iu}/Q^{o}_{ir} is clearly greater than one for both goods, though it cannot be known which of the two ratios is the greater.

Case V. As a final case of sub-optimal adjustment, we consider extreme bureaucratic inertia in the face of source-tying and limited product-eligibility; in effect, no allocative adjustments are made. All imports except those of PL-eligible U.S. goods are licensed exactly as before,[1] and the entire loan is used to purchase additional quantities of U.S. PL-eligible goods.[2] This implies that not only Q_{1r} and Q_{2r} but also Q_{2u} remain at "normal" levels. This implies another constraint:

$$
\begin{aligned}
(16) \qquad \text{Max } W = {} & W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] \\
& - \lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - E - L) \\
& - \lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q^{o}_{1u} + P_{2u}Q^{o}_{2u}) + L) \\
& - \lambda_3(-P_{1u}Q_{1u} + L) \\
& - \lambda_4(P_{1r}Q_{1r} - P_{1r}Q^{o}_{1r}) \\
& - \lambda_5(P_{2r}Q_{2r} - P_{2r}Q^{o}_{2r}) \\
& - \lambda_6(P_{2u}Q_{2u} - P_{2u}Q^{o}_{2u})
\end{aligned}
$$

Again the solution is trivial; constraints 4, 5, and 6 together with 1 determine the solution. Clearly, Q^{V}_{1u}/Q^{V}_{1r} is greater than Q^{o}_{1u}/Q^{o}_{1r}, and Q^{V}_{2u}/Q^{V}_{2r} equals Q^{o}_{2u}/Q^{o}_{2r}. It should be noted that the resulting variety-ratios in this case are identical to those derived under the "strong version" of Case III (where

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[1] Again, we arbitrarily assume that "as before" means the pre-PL levels (i.e., Q^{o}_{1r}, Q^{o}_{2u}, and Q^{o}_{2r}).

[2] Provided there is sufficient excess demand for these. If there is not, the PL will not be fully used.

$\lambda_2 = 0$).

Although the discussion so far has been restricted to the more realistic and interesting cases, the results are not yet operational in the sense of helping us to decide, empirically, which case best describes any actual aid-tying experience. For that, a further assumption about the shape of the W function is necessary. A sufficient, plausible assumption — and one consistent with the earlier assumption of homotheticity between varieties — is that there exists a constant-elasticity-of-substitution (CES) relationship between U.S. and the rest-of-world varieties for any particular ($i^{\underline{th}}$) good, although this constant elasticity (σ_i) may be different for the varieties of different goods. Since we are interested only in the shape of W, and attach no meaning to levels, we may write the welfare derived from the U.S. and rest-of-world varieties of the $i^{\underline{th}}$ good as:

$$(17) \qquad W_i = (\alpha_i Q_{iu}^{-\beta_i} + (1 - \alpha_i) Q_{ir}^{-\beta_i})^{-1/\beta_i}$$

where the elasticity of substitution (σ_i) equals $1/(1 + \beta_i)$, and α_i is some positive fraction. The allocation of any amount of foreign exchange will, provided it is subject to neither distorting constraints nor non-optimizing decision rules, always result in a variety-ratio, Q_{iu}/Q_{ir}, such that:

$$(18) \qquad Q_{iu}/Q_{ir} = \left(\frac{\alpha_i}{1-\alpha_i}\right)^{\sigma_j} \left(\frac{P_{iu}}{P_{ir}}\right)^{-\sigma_i}$$

The CES welfare function implies that the optimal variety-ratio of any product is uniquely (and log-linearly) determined by the relative prices of the varieties (i.e., by P_{iu}/P_{ir}).

By comparing this optimal Q_{iu}/Q_{ir} ratio with the ratio that appears under the various constraints, we are able to distinguish operationally between the different cases outlined above. For Case I, a completely untied PL, we have:

$$(19) \qquad \ln \left[\frac{Q^I_{iu}/Q^I_{ir}}{Q^o_{iu}/Q^o_{ir}}\right] \Big/ \sigma_i = 0$$

for all goods, where the $o^{\underline{th}}$ case refers to the variety-ratio in the absence of a PL (and ln refers to the natural log). For Case II, when source-tying is imposed, however, we have:

$$(20) \qquad \frac{Q^{II}_{iu}}{Q^{II}_{ir}} = \left(\frac{\alpha_i}{1-\alpha_i}\right)^{\sigma_i} \left(\frac{P_{iu}}{P_{ir}}\right)^{-\sigma_i} \left(1 - \frac{\lambda_2}{\lambda_1}\right)^{-\sigma_i}$$

for all goods. Hence,

$$(21) \qquad \ln \left[\frac{Q^{II}_{iu}/Q^{II}_{ir}}{Q^o_{iu}/Q^o_{ir}}\right] \Big/ \sigma_i = -\ln\left[1 - \frac{\lambda_2}{\lambda_1}\right] > 0$$

for all goods. By similar substitution in each of the five cases, we arrive at Table 3 (where the subscript 1 refers to all goods for which U.S. varieties are eligible for PL use, and the subscript 2 to goods for which U.S. varieties are not eligible).

The task of the next section will be to examine the empirical evidence in the light of Table 3 in order to discover which case most accurately describes the Colombian aid experience. Although we know (for 1967 and 1968, the years of the subsequent tests) that Colombia's PL was indeed subject to source-tying and product-eligibility restrictions, this does not in itself indicate which case is appropriate for two reasons. One, it is not known a priori whether Colombia's allocative response was optimal, or, if not, in what way it was sub-optimal. And two, it is not clear a priori whether the nominal imposition of source-tying and restricted product-eligibility were indeed effective in distorting Colombian import allocations or were mere window-dressing for the U.S. Congress and/or administration.[1]

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[1]They could have turned out as window-dressing either because AID intended to undermine the policies of other agencies of the U.S. government or because Colombia managed to.

Table 3

Variety-Ratio Differences in the Five Cases

Case	Description	Expectation
I.	Untied PL, optimal use	$\ln \left[\frac{Q^{I}_{1u}/Q^{I}_{1r}}{Q^{o}_{1u}/Q^{o}_{1r}}\right] \Big/ \sigma_1 = \ln \left[\frac{Q^{I}_{2u}/Q^{I}_{2r}}{Q^{o}_{2u}/Q^{o}_{2r}}\right] \Big/ \sigma_2 = 0$
II.	PL subject to source-tying, optimal use	$\ln \left[\frac{Q^{II}_{1u}/Q^{II}_{1r}}{Q^{o}_{1u}/Q^{o}_{1r}}\right] \Big/ \sigma_1 = \ln \left[\frac{Q^{II}_{2u}/Q^{II}_{2r}}{Q^{o}_{2u}/Q^{o}_{2r}}\right] \Big/ \sigma_2 > 0$
III.	PL subject to source-tying, limited eligibility, optimal use[1]	$\ln \left[\frac{Q^{III}_{1u}/Q^{III}_{1r}}{Q^{o}_{1u}/Q^{o}_{1r}}\right] \Big/ \sigma_1 > \ln \left[\frac{Q^{III}_{2u}/Q^{III}_{2r}}{Q^{o}_{2u}/Q^{o}_{2r}}\right] \Big/ \sigma_2 \geq 0$
IV.	PL subject to source-tying, limited eligibility, no-reductions pressure	$\ln \left[\frac{Q^{IV}_{1u}/Q^{IV}_{1r}}{Q^{o}_{1u}/Q^{o}_{1r}}\right] \Big/ \sigma_1 \gtrless \ln \left[\frac{Q^{IV}_{2u}/Q^{IV}_{2r}}{Q^{o}_{2u}/Q^{o}_{2r}}\right] \Big/ \sigma_2$; both > 0
V.	PL subject to source-tying, limited eligibility, inertial response	$\ln \left[\frac{Q^{V}_{1u}/Q^{V}_{1r}}{Q^{o}_{1u}/Q^{o}_{1r}}\right] \Big/ \sigma_1 > \ln \left[\frac{Q^{V}_{2u}/Q^{V}_{2r}}{Q^{o}_{2u}/Q^{o}_{2r}}\right] \Big/ \sigma_2 = 0$

Note: [1]Assuming constraint 3 in equation (12) is in fact constraining; otherwise Case III is the same as Case II. Also, in the "strong version" of Case III, the final $\geq$ sign becomes an = sign (i.e., indistinguishable from Case V).

V. Empirical Evidence

By 1967, the U.S. PL to Colombia represented a sizable fraction of Colombia's foreign exchange availability and "additionality" was being (supposedly) strictly enforced; moreover, 1967 was the first full year in which a restricted list of PL-eligible products was formally applied. Since these restrictions were maintained and even tightened in 1968, it should therefore be possible, for 1967 and 1968, to distinguish which of the five theoretical cases (developed in Section IV) most closely describes the Colombian experience. There is, of course, no difficulty in calculating the actual variety-ratio in 1967 or 1968 for the various PL-eligible and non-PL-eligible goods (written, for the $i^{\underline{th}}$ good, Q^A_{iu}/Q^A_{ir}); the difficulty arises in estimating the optimal variety-ratio (written Q^o_{iu}/Q^o_{ir}) in 1967 or 1968. We shall do it in the following manner. One, for the years 1955-64, we assume the U.S. aid program was sufficiently small and/or its tying to U.S. purchase was sufficiently mild (or avoidable) that Colombia was not prevented from choosing optimal variety-ratios for all goods in those years. Two, we assume Colombia in fact licensed its imports so as to achieve optimal variety-ratios over 1955-64 (for those years in which licensing was used).[1] And three, we assume that the Colombian social welfare function (W) was of the CES form for varieties of goods, i.e.,

$$W = W\,[W_1,\ W_2,\ \ldots]$$

$$W_i = \left(\alpha_i (Q_{iu})^{-\beta_i} + (1 - \alpha_i)(Q_{ir})^{-\beta_i}\right)^{-\frac{1}{\beta_i}} \quad \text{for } i = 1,\ 2,\ \ldots\ . \tag{22}$$

Optimal allocation between varieties of a particular good then requires, for the $i^{\underline{th}}$ good:

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[1] For those early years in which licensing did not exist or was extremely liberal, we assume that the importers selected the profit-maximizing variety-ratio and that the private and social welfare curves (between varieties of any product) have the same shape.

$$(23) \qquad \frac{Q^o_{iu}}{Q^o_{ir}} = \left(\frac{\alpha_i}{1-\alpha_i}\right)^{\sigma_i} \left(\frac{P_{iu}}{P_{ir}}\right)^{-\sigma_i}$$

There is one further complication that requires discussion before equation (23) can be used to estimate the optimal variety-ratio function.[1] Even the most casual inspection of Colombian import data indicates that there was a trend away from U.S. varieties during the late 1950's and early 1960's (see Table 4).

Table 4

U.S. Share of Colombian Imports

	Year			
	1957	1958-60	1961-63	1964
U.S. share of total Colombian imports	60%	59%	52%	48%
U.S. non-aid-financed share of Colombian non-aid-financed imports	59%	55%	46%	41%

Source: (Senate Committee, 1969) p. 168.

This trend can be attributed only partially to relative-price phenomenon — more important are the (exogenous for our purposes) increases in ALALC trade, bilateral coffee agreements imports, and Japanese and West European marketing pressures. Thus, the final statistical estimating equation is based upon equation (23) with the addition of a trend term:

$$(24) \qquad \ln \left[\frac{Q_{iu}}{Q_{ir}}\right] = a_{io} + a_{i1} T + a_{i2} \ln \left[\frac{P_{iu}}{P_{ir}}\right] + v_i .$$

---

[1] Often called a "substitution function" in the trade literature. See (Leamer and Stern, 1970) Chaps. 3 and 7.

where the a's are coefficients to be estimated, T is the year of the observation (1955 = 1, 1956 = 2, etc.), and v_i the error term.

Four regressions were fitted for each product considered. One was a free (i.e. unconstrained) regression in which all three parameters (i.e., a_{io}, a_{i1}, and a_{i2}) were estimated. Whenever, for this regression, the sign of a_{i2} was correct (i.e., negative) and the R^2 was significant at the 10% level, the regression was considered acceptable for estimating the optimal variety-ratios of 1967 and 1968. This method is hereafter referred to as the "free" estimate. The other three regressions fitted were constrained; the price-elasticity (i.e., $-a_{i2}$) was held, in turn, at 1/2, 1, and 2. These are the "constrained" estimates, and the one with the lowest standard error is the "best-constrained" estimate.[1]

These regressions were then used to estimate the optimal variety-ratio of each product (i.e., Q^o_{iu}/Q^o_{ir}) for 1967 and 1968, inserting the 1967 or 1968 values of T and the relative-price ratio (i.e., P_{iu}/P_{ir}). The assumptions (and presumptions) underlying this estimate of the optimal 1967 and 1968 variety-ratios should be repeated. We assume an efficient, undistorted importing system over the period 1955-64 and an unchanging (correctly specified) structure of the import welfare function over the period 1955-68.[2] These are pretty strong, and the subsequent results must accordingly be treated with caution.

The critical variable (for looking at the cases described in Section IV) can now be estimated for each product, namely:

$$(25) \qquad \ln \left[\frac{Q^A_{iu}/Q^A_{ir}}{Q^o_{iu}/Q^o_{ir}} \right] \Big/ \sigma_i$$

---

[1]For fuller discussion of the regressions, see Appendix A.

[2]More accurately, since the regressions include time (T), we are assuming an unchanging rate of change in the structure.

For none of the products — whether PL-eligible or not — do we expect this variable (i.e., (25)) to be negative, since the PL constraints should never induce Colombia to distort purchases away from U.S. varieties. Nevertheless, the estimates of this variable (25) are negative almost as often as they are positive, over the entire sample of 121 products.[1] This result is hardly surprising, considering the naivety of the variety-ratio model and the assumptions needed to obtain estimates of optimal variety-ratios. Despite the degree of error that must be involved, a closer examination of this variable (25) is not without value.

We shall deal with three groupings of products.[2] One, a sample of 63 PL-eligible products; two, a sample of 41 non-PL-eligible products; and three, a sample of 24 major PL-eligible products.[3] None of these samples are random. The first includes the statistically traceable and usable survivors of an originally random sample; the second a collection of products adjacent (and usually similar) to the first group[4] but not eligible for PL use; and the third is a complete collection of the traceable and usable major imports eligible for PL use.

The means and standard deviations of the estimates of variable (25) (i.e., $\ln [...]/\sigma_i$) for each of the three samples in 1967 and 1968 are given in Table 5. Aside from the fact that, to varying degrees, none of the three samples are truly random and hence significance tests are not warranted, the variance of this

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[1]The actual variety-ratio in 1967 is less than the optimal for 44% of the 121 products when the "best constrained" estimate of the variety-ratio is considered.

[2]For details, see Appendix A.

[3]By "major" is meant that the total Colombian imports, of all countries' varieties, exceeded US$500,000 in 1967.

[4]I.e., nearby in the tariff classification.

Table 5

Estimates of $\ln \left[\frac{Q^A_{iu}/Q^A_{ir}}{Q^o_{iu}/Q^o_{ir}} \right] \Big/ \sigma_i$

	Sample	Year	"Free" Estimates[1] Mean	S. Dev. of Mean	No. of Observ.	"Best Constrained" Estimates Mean	S. Dev. of Mean	No. of Observ.
1.	PL-Eligible Products	1967	+1.595	0.628	29	+0.663	0.472	63
		1968	+1.583	0.741	27	+0.704	0.618	59
2.	Adjacent Non-PL-Eligible Products	1967	-0.598	0.976	19	+0.089	0.642	41
		1968	+0.214	0.660	16	+0.521	0.554	37
3.	Major PL-Eligible Products[2]	1967	+0.505	0.744	9	-0.125	0.597	24
		1968	+0.714	0.706	9	+0.894	0.962	24

Notes: [1]Only those "free" estimates are considered for which the estimated σ_i is positive and R^2 is significant at 10% confidence.

[2]Includes seven products also in "PL-Eligible Products" sample.

critical variable (i.e., ln $[...]/\sigma_i$) is such that, as we expected, little can be inferred with much confidence. Nevertheless, the results are suggestive. For the first sample, of PL-eligible products, the mean is positive and larger than its standard deviation for both the "free" and the "best constrained" estimates of both 1967 and 1968. On the other hand, for the second sample, of similar but not eligible products, the mean is in all cases smaller (than the mean of the PL-eligible products sample) and is less than one standard deviation away from zero. While none of the five theoretical cases discussed in Section IV can be confidently rejected, these means are highly suggestive of Case V.[1]

At first glance, the evidence of the third sample, especially in 1967, would appear to counter the above. The 24 major PL-eligible products look more like the sample of adjacent non-PL-eligible products than the sample of PL-eligible products. But this result is less disturbing once one recognizes that there is something special about these major imports. First of all, the very fact that imports in these classifications are large suggests that their licensing is typically generous relative to the Colombian demand for such imports. If indeed, there is little excess demand (over traditional licenses) any increased generosity in approving U.S.-variety applications will result in few increased U.S.-variety imports, and the critical variable for these products (i.e., ln $[...]/\sigma_i$) will not rise much above zero. A second possible explanation of the third sample findings lies with the power of importers. Since these are major imports (and appear to be largely purchased by few firms), the private costs of variety-distortion will be large. To the extent that these importers have greater ability to bring pressure on the licensing authorities and the benefits to them of successfully pressing against variety-distortion are greater,

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[1]Or the statistically indistinguishable "strong version" of Case III.

the actual results seem probable. For major imports, despite Incomex's desire to augment the licenses only of U.S. varieties, the excess demand for U.S. varieties may have been small and/or the pressures put on them may have forced a liberalization of rest-of-world-variety licenses as well. As for the latter, to the extent that untied foreign exchange is increasingly available over time, Incomex may be able to augment the rest-of-world licenses for some products (such as these major imports) without having to reduce rest-of-world licenses elsewhere in the import spectrum.

In short, the statistical evidence is suggestive of, and consistent with, the hypothesis that (for minor imports at least) the Colombian import licensing agency distorted importers' choices toward U.S. varieties along the lines of Case V or the "strong version" of Case III.

VI. The Cost of Tying

As was seen earlier, the cost to Colombia of a PL whose use is restricted by source-tying and a limited product-eligibility list, can be allocated to two components: the costs due to the allocation distortions between eligible and non-eligible products (i.e., the product-distortion cost), and the costs due to the allocation distortions between U.S. and rest-of-world varieties of particular products (i.e., the variety-distortion cost). In this section we again neglect the first of these costs and seek a rough estimate of the variety-distortion cost. Because of this neglect of the product-distortion cost — necessary because we have no estimates of the degree of inter-product substitutability from a welfare viewpoint — we may focus, on a product-by-product basis, on the costs to Colombia of the distortion away from the optimal variety-ratio,[1] Q_u^o/Q_r^o, to the actual, sub-optimal ratio, Q_u^A/Q_r^A. We further assume that the

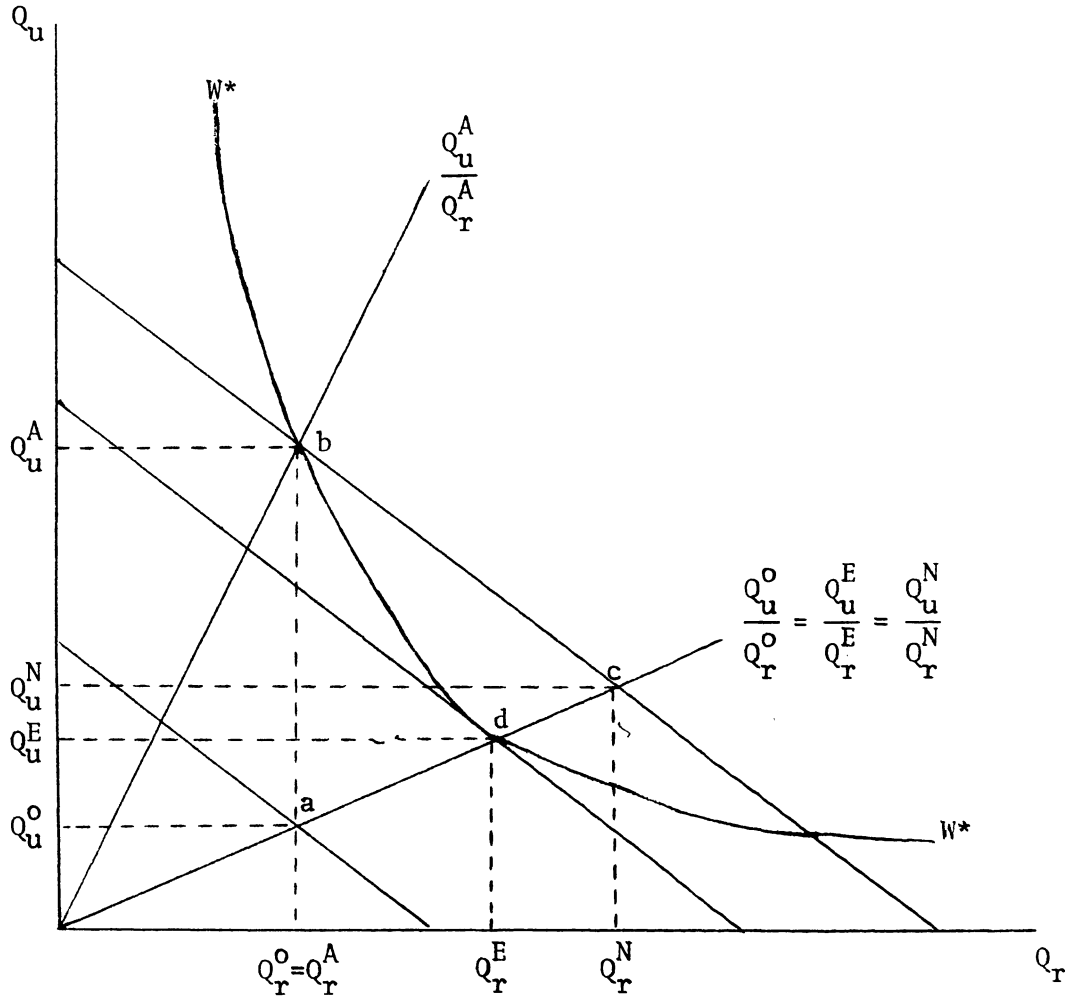
[1]Throughout this section, the i subscript is omitted but implied.

observed purchase of rest-of-world varieties, for each product, whether eligible or not for PL use, is equal to what would have been purchased in the absence of the PL. In symbols, we assume $Q_r^A = Q_r^o$ for each product. This is consistent with the "strong version" of Case III and with Cases IV and V, but not with the other cases. To the extent that $Q_r^A \gtrless Q_r^o$ as a result of the PL, the resulting estimate of the variety-distortion cost is biased, but since $\sum_i P_{ir}Q_{ir}^A$ must equal $\sum_i P_{ir}Q_{ir}^o$ for the total of all products (if additionality is enforced), any bias for one product will tend to be offset elsewhere. To the extent that Colombia managed to evade some part of the additionality pressures (i.e., $0 < z < 1$), then the measure of the excess cost is only that of the tying actually achieved.

We are now in a position to define more exactly this variety-distortion cost. This cost, for a particular product, is the fraction of Colombia's PL expenditure on that product which Colombia would not have needed to make, and still be just as well-off, if it had not been forced to make the entire expenditure on the U.S. variety of the product. This cost, and the means of measuring it, can be more clearly seen with the aid of Figure 3. The quantities (for the $i^{\underline{th}}$ product) purchased from the United States (Q_u) and from the rest of the world (Q_r) are represented on the vertical and horizontal axes. The superscripts carry the following meanings:

Q_u^o, Q_r^o	the quantities purchased before, or in the absence of, the PL (i.e., o for original)
Q_u^A, Q_r^A	the quantities actually purchased (i.e., A for actual). Since we assume no change in the rest-of-world purchase following the PL, $Q_r^A = Q_r^o$.
Q_u^N, Q_r^N	the quantities that would have been purchased if the same total expenditure (i.e., pre-PL plus PL) were to have been made with no tying of the PL (i.e., N for no tying).

Figure 3



Method of Calculation of Variety-Distortion Cost:

1. Observed b and estimated optimal ratio (Q_u^o/Q_r^o) yield point a.
2. Budget constraint through b and estimated optimal ratio yield point c.
3. Estimated parameters of welfare function and b yield point d.
4. Variety-distortion cost = cd/ac.

Q_u^E, Q_r^E — the quantities that would have been necessary at the optimal variety-ratio, to make Colombia equally well-off as with the actual purchases, Q_u^A and Q_r^A (i.e., E for equally well-off).

From our assumption of a homothetic welfare function (for varieties of a particular good), it follows[1] that $(Q_u^O/Q_r^O) = (Q_u^E/Q_r^E) = (Q_u^N/Q_r^N)$; this ray from the origin is drawn. Moreover, if there is a variety distortion, the actual variety-ratio (Q_u^A/Q_r^A) will be above the optimal; this ray is also drawn, steeper than the optimal variety-ratio.

The intersection of the budget line through a (with slope, $-P_r/P_u$) with the optimal variety-ratio (with slope, Q_u^O/Q_r^O) ray from the origin indicates the original (i.e., pre-PL) purchase pattern, Q_u^O and Q_r^O. Q_r^O is observed, since we assume it is equal to the actual rest-of-world purchase (i.e., $Q_r^A = Q_r^O$); and Q_u^O, while not observed, can be calculated from our estimate of the optimal variety-ratio[2] and the observed Q_r^O (= Q_r^A). Thus point a in Figure 3 can be located. Point b is also readily located, being the actually purchased (in 1967 or 1968) quantities (Q_u^A and Q_r^A). Drawing the budget line through b yields point c, the intersection of this budget line with the optimal variety-ratio ray. The quantities at point c, Q_u^N and Q_r^N, represent the quantities of each variety Colombia would have chosen to purchase if it had spent the same total amount on the product as at point b and if its variety choice had not been restricted. Finally, with knowledge of the shape of the iso-welfare curve[3] (W*) passing through point b, we can find its intersection at d with the optimal variety-ratio ray; the quantities at point d, Q_u^E and Q_r^E, represent the quantities of each variety that Colombia would have needed, with the optimal variety-ratio, to achieve a position equally well-off as at point b, the actual quantity

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[1]For the given 1967 or 1968 price ratio (i.e., P_u/P_r).
[2]Based on data of earlier years (i.e., 1955-64) and 1967 or 1968 prices.
[3]The level of welfare is irrelevant

position. Since the (CES) welfare shape is yielded by the statistical estimates of the relation between Q_u/Q_r and P_u/P_r, point d can in fact be estimated. Thus, the variety-distortion cost, as a fraction of the total PL expenditure on this product, is seen to be the distance, cd, divided by the distance, ac. In other words, Colombia would have been just as well off with an untied, optimally-allocated PL of ad/ac as much as the actual PL used on this product. For any given product, this cost (i.e., cd/ac) can now be estimated.[1]

Before doing this, however, one last problem must be treated. It will be recalled that, in Section V, for a great many products, the estimated optimal 1967 (or 1968) variety-ratio (Q_u^o/Q_r^o) exceeded the actual ratio (Q_u^A/Q_r^A). In that section, this fact "merely" reduced confidence in our procedures and results; here however, it negates the very concept of the variety-distortion cost. Negative "costs" simply have no meaning in our present context.[2] Thus, we do not calculate a variety-distortion cost whenever $Q_u^o/Q_r^o > Q_u^A/Q_r^A$ but simply note that it is "negative," (or more correctly, meaningless). As a result, means of the costs cannot be reported for the various samples. For variety-distortion costs therefore, medians are reported.

The distributions of the variety-distortion costs are reported in Table 6, for the three samples, for the two years (1967 and 1968), and for each of the two regression approaches. Since these are simply a variation of the earlier $\ln [...]/\sigma_i$ calculations, the results are qualitatively similar. For 1967, the medians of the variety-distortion-cost distributions indicate that no general variety-distortion occurred in the sample of adjacent non-PL-eligible products or the sample of major PL-eligible products. For the sample of PL-eligible products, however, a median cost of 10-15% is indicated. For 1968, the median

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[1] See Appendix B for the precise formula and its derivation.

[2] Except to show up the errors in our estimates of optimal variety-ratios.

Table 6

Distribution of Variety-Distortion Costs

Sample	Year	No. of Observ.	Variety-Distortion Costs				
			Negative	0 to 30%	30 to 60%	Above 60%	Median
1. PL-Eligible Products							
"Free" Estimate	1967	29	9	10	3	7	16.4%
	1968	27	9	4	7	7	30.8%
"Best Constrained" Estimate	1967	63	27	14	8	14	9.5%
	1968	59	20	7	14	18	35.7%
2. Adjacent Non-PL-Eligible Products							
"Free" Estimate	1967	19	12	2	2	3	negative
	1968	16	8	5	1	2	negative
"Best Constrained" Estimate	1967	41	19	10	6	6	3.8%
	1968	37	16	9	7	5	4.6%
3. Major PL-Eligible Products							
"Free" Estimate	1967	9	4	4	0	1	0.0%[1]
	1968	9	2	4	1	2	11.4%
"Best Constrained" Estimate	1967	24	12	5	4	3	negative
	1968	24	10	5	3	6	8.2%

Note: [1]Median is positive but less than 0.05%

variety-distortion cost of the sample of PL-eligible products rose to 30-35%; even for the sample of major PL-eligible products a cost of around 10% appeared; but the medians continue to imply that no variety-distortion cost can be attributed to the non-PL-eligible products. These results support the historical, institutional evidence of Section III that the additionality "crunch" applied to Colombia worsened between 1967 and 1968. The median variety-distortion costs of the sample "positive list" goods more than doubled in 1968 over 1967, and the 1968 squeeze even began to cause variety-distortion for the major "positive list" goods.

It cannot be too strongly emphasized that these results cannot be considered as much more than suggestive. Even for the "best constrained" estimates of the 1968 PL-eligible products sample (where the median cost is 35.7%), for approximately one-third of the products no variety-distortion cost is found and for another one-third, costs above 60% are estimated. Such high sample variances mean that, even if significance tests were warranted and possible, one might not be able to confidently reject the null hypothesis of zero medians for all samples.

Nevertheless, there remain the "point estimates" of variety-distortion costs above 10% in 1967 (for at least the minor "positive list" products) and ranging into the 30% region in 1968. Let us look again at what these 10-30% cost estimates imply: if Colombia had been able to spend the 1967 or 1968 PL on an optimal variety-ratio within each good-category, even without any ability to reallocate the PL differently among goods, it would have been just as well-off with 10-30% less total dollars of PL. The costs of any distortions due to inefficient allocations of foreign exchange between goods would have to be added to this 10-30% to arrive at a total distortion cost.

A nun who was searching for enlightenment made a statue of Buddha and covered it with gold leaf. Wherever she went she carried this golden Buddha with her.

Years passed and, still carrying her Buddha, the nun came to live in a small temple in a country where there were many Buddhas, each one with its own particular shrine.

The nun wished to burn incense before her golden Buddha. Not liking the idea of the perfume straying to the others, she devised a funnel through which the smoke would ascend only to her statue. This blackened the nose of the golden Buddha, making it especially ugly.

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Appendix A: Samples, Data, and Regressions

After 1964, Colombian imports were classified according to the Brussels (eight-digit) tariff nomenclature (BTN, or in Colombia, NABALALC). According to this classification, Colombia actually imported (in 1967) nearly 3,000 different "products," of which about 1,000 were on the list of commodities eligible for purchase under the U.S. Program Loan (PL). It was decided not to work with the entire list of 1,000 actually imported PL-eligible commodities but rather with a random sample of these; approximately one out of every 5.5 PL-eligible commodities was selected (i.e., each product had a .18 probability of being selected). This yielded 180 products (as classified by the BTN, at the eight-digit level).

Unfortunately, the random character of the sample ends at this point. Before Colombia switched to the Brussels tariff classification, in accordance with a decision by the ALALC countries, it had used the very different (six-digit) SITC classification (or in Colombia, CUCI). Since, in order to estimate the optimal 1967 and 1968 mixes of U.S. and rest-of-world varieties of the $i^{\underline{th}}$ good (i.e., Q^o_{iu}/Q^o_{ir}), import data before 1965 is used, products must be traced from the BTN to the SITC classification. For some products this was hopeless, for some it was clearly defined, and for the remainder, there were problems of overlapping classifications.[1] The rule applied was: whenever a single SITC classification could be traced closely to an eight-digit BTN classification, the product was retained in the sample. By closely, is meant as follows. When a relevant eight-digit BTN classification comprised two or more SITC classifications, a one-to-one mapping between the BTN and a single SITC classification was considered to have been achieved if 90% of the 1964 imports (of all the

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[1] For a general discussion of the comparability of SITC and BTN, see (Tariff, 1968).

relevant SITC groups) fell in a single SITC class. When a single SITC classification comprised two or more eight-digit Brussels classifications, a one-to-one mapping between a single BTN and the SITC classification was considered to have been achieved if 90% of the 1967 imports (of all the relevant Brussels groups) fell in a single eight-digit Brussels class.

A second problem forced the elimination of further products from the sample. Whenever there are zero imports from the United States or from the rest of the world in a particular year, it is of course impossible to calculate relative prices from unit values. Accordingly, whenever for the 180 (originally selected) PL-eligible commodities, imports from the United States or from the rest of the world were zero in 1967, the product was discarded.[1] Finally, since historical import data was needed for statistical estimates of the degree of substitutability between U.S. and rest-of-world varieties of goods, products were eliminated from the sample whenever there were not four usable observations over the period, 1955-64. By a usable observation is meant simply that imports were non-zero for both the United States and the rest of the world in a particular year.[2]

Once the inability to trace products through the change-over in tariff classification and the problems of 100% or 0% imports of U.S. varieties (in 1967 or in too many years over 1955-64) were considered, there remained a sample of 63 PL-eligible products.[3] Thus the sample of "PL-eligible products" discussed

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[1]For the 1968 samples, eight more products had to be discarded for this reason.

[2]Where import data were differently classified in some of the earlier years of the 1955-64 period, it was sometimes impossible to trace imports in those years. In such (few) cases, the observation was treated as if it contained zero U.S. (or rest-of-world) imports.

[3]For 1967. The sample consists of 59 products in 1968.

in the paper consists of 63 of the roughly 1,000 PL-eligible commodities. These 63 are clearly a non-random sample of the original random sample of 180 PL-eligible commodities.[1]

For purposes of comparison, a sample of commodities which were not eligible for PL use was also needed. Since the PL-eligible (i.e., "positive") list was certainly not a random sample of all intermediate and capital goods, we decided not to choose a random sample of non-PL-eligible products — such a random sample would have included many goods whose historical price and U.S. share patterns and Colombian licensing priorities had changed quite differently over the period from the PL-eligible products. We preferred to examine comparable non-PL-eligible commodities — i.e., goods not eligible but which were as similar as possible to goods which were eligible. Since the PL-eligible products were closely bunched in particular tariff-classification regions, it was not always easy to find similar non-PL-eligible products. Accordingly a random sub-sample of the sample of 63 PL-eligible commodities was chosen; for each of the 41 PL-eligible commodities in the sub-sample, we located the nearest non-PL-eligible commodity in the tariff classifications (which could be closely traced through the SITC-BTN tariff change and which fulfilled the requirements of non-zero imports from both the United States and the rest of the world in 1967 and in at least four years over 1955-64). These 41 products comprise the sample of "adjacent non-PL-eligible products" discussed in the body of the paper.[2]

Finally, since there were indications that the PL affected major imports differently from minor imports, it was decided to draw another non-random

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[1]Moreover, it is not easy to guess the net direction of any bias the various ejections may have caused. In order to accept the conclusions of the text, it is necessary to assume that no serious bias has been introduced.

[2]For 1967. The sample consists of 37 products in 1968.

sample of the important imports into Colombia which were eligible for PL use. All PL-eligible commodities of which Colombian imports (classified by the eight-digit BTN) totaled over 500,000 U.S. dollars (in 1967, from everywhere in the world) were included in this sample initially. Again, those products were eliminated for which it was impossible to trace through the change in tariff classifications, for which there were zero imports from the United States or the rest of the world in 1967, or for which there were fewer than four such non-zero observations over the period 1955-64. This left a third sample of 24 products, referred to in the body of the paper as the sample of "major PL-eligible products."[1]

For each of the products in the three samples, we traced the quantity and value (and hence unit price) of imports from the United States and from the rest of the world for each of the years 1955 through 1964 and for 1967 and 1968. These data are found, for 1955-64, in the annual volumes of (DANE, various years) and for 1967 and 1968, in unpublished DANE print-outs.

The first step in the statistical work was to fit equation (24) for each of the 121 (PL-eligible and non-PL-eligible) products. The distributions of the coefficients of the relative price term (i.e., of $\ln P_{iu}/P_{ir}$) and of the time trend (i.e., of T) are shown in Tables A-1 and A-2. Three-fourths of the estimated values of $\sigma_i (= -a_{i2})$ have the expected sign, and only 3% of the estimates have a significant (at 10% confidence) incorrect sign. The importance of including a trend term is shown by the fact that one-third of the trend coefficients are significant (and the secular decline over 1955-64 in the U.S. share is shown, at the micro level, by the fact that two-thirds of the trend coefficients are negative).

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[1]Seven of the products in this sample are also present in the "PL-eligible products sample." No products were lost from this third sample in 1968.

Table A-1

Distribution of Relative Price Coefficients (a_{i2})

Sample	$a_{i2} < 0$		$a_{i2} > 0$	
	significant at 10%	not significant	not significant	significant at 10%
1. PL-Eligible Products	20	26	16	1
2. Adjacent Non-PL-Eligible Products	15	16	8	2
3. Major PL-Eligible Products[1]	9(6)	10(8)	4(2)	1(1)
Total	41	50	26	4

Table A-2

Distribution of Trend Coefficients (a_{i1})

Sample	$a_{i1} < 0$		$a_{i1} > 0$	
	significant at 10%	not significant	not significant	significant at 10%
1. PL-Eligible Products	20	22	20	1
2. Adjacent Non-Pl-Eligible Products	9	17	9	6
3. Major PL-Eligible Products[1]	7(4)	10(9)	6(3)	1(1)
Total	33	48	32	8

Note: [1]Figures in parantheses exclude those seven products which are also included in the sample of "PL-Eligible Products."

Incidentally, these results are paradoxical in their implications about how the United States selected the PL-eligible (i.e., "positive list") products. Presumably, the prime candidates from the U.S. view would be those goods 1) with secular trends away from U.S. varieties, 2) with high substitutability between U.S. and rest-of-world varieties, and 3) with rising (over 1955-64) U.S. prices relative to third-country varieties. But Table A-3 shows little distinction between the PL-eligible products and the non-PL-eligible products in any of these respects. Partly, this should reduce the confidence with which we may view the regressions, but chiefly it suggests that the criteria used by the United States in its "positive list" negotiations were less subtle and more static than the above considerations imply.

Considering that these regressions use three of the (from four to ten) observations available for each product, the results are quite satisfactory. Nevertheless, we are left with relative-price-elasticity estimates that are of incorrect sign for 30 products and are not significantly different from zero at a 10% confidence level (though of correct sign) for another 50. Accordingly it was decided to fit further regressions in which the relative-price-elasticity coefficient (i.e., σ_i or $-a_{i2}$) was constrained a priori to its theoretically expected ballpark. These "constrained" regressions were made for values of σ_i equal to 1/2, 1, and 2, the data being left the job only of determining the constant term (a_{io}) and the trend coefficient (a_{i1}). The "best constrained" regression is considered to be the one of these three for which the standard error of estimate is smallest.

Table A-3

Comparisons of PL-Eligible and Non-PL-Eligible Products

	PL-Eligible Products	Non-PL-Eligible Products
Total No. of Products	80	41
Percentage of total for which:		
1. elasticity of substitution greater than one ($a_{i2} < -1$)	50%	54%
2. trend negative ($a_{i1} < 0$)	69%	63%
3. (P_{iu}/P_{ir}) higher in 1964 than in 1955[1]	51%	44%

NOte: [1]Or for the nearest year to 1964 or 1955 for which data were available.

Appendix B: The Variety-Distortion-Cost Formula

Colombia's actual expenditure on a particular product which is eligible for PL use is:[1]

(B-1) $P_u Q_u^A + P_r Q_r^A$

while the amount it would have spent in the absence of PL expenditure on the product is:

(B-2) $P_u Q_u^o + P_r Q_r^o$

Finally, the amount it would need to spend on the product to be equally well-off as with its actual PL expenditure, were its expenditure on this product in no way restricted as to variety composition, is:

(B-3) $P_u Q_u^E + P_r Q_r^E$

The variety-distortion cost is the fraction of the actual PL (spent on this product) that Colombia would not have needed (to be equally well-off) were it not subject to variety-distorting restrictions. In symbols, the variety distortion cost (VDC) is:

$$\text{(B-4)} \qquad VDC = \frac{P_u(Q_u^A - Q_u^E) + P_r(Q_r^A - Q_r^E)}{P_u(Q_u^A - Q_u^o) + P_r(Q_r^A - Q_r^o)}$$

By use of the iso-expenditure budget lines and proportional triangles in Figure 3 of the text, (B-4) is seen to be equal to:

$$\text{(B-5)} \qquad VDC = \frac{Q_r^N - Q_r^E}{Q_r^N - Q_r^o}$$

In expression (B-5), neither Q_r^N nor Q_r^E are observable,[2] but each can be expressed in terms of observable and estimated quantities. First, the regression

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[1] For definitions of symbols, see text, Section VI.

[2] Q_r^o is, because we assume $Q_r^A = Q_r^o$, and actual 1967 (or 1968) import volumes are observed.

estimates of the variety-ratio relation to time and prices[1] is used to estimate the optimal 1967 (or 1968) variety-ratio (i.e., inserting the 1967 or 1968 values of T and P_{iu}/P_{ir}). Let us write this optimal variety-ratio (i.e., Q_u^o/Q_r^o) as q_o, the actual variety-ratio (i.e., Q_u^A/Q_r^A) as q_A, and the 1967 (or 1968) price ratio (i.e., P_u/P_r) as p. Since the total actual expenditure on the product is the same, by definition, as the expenditure at (Q_u^N, Q_r^N),[2] we can derive:

$$\text{(B-6)} \qquad \frac{Q_r^N}{Q_r^o} = \frac{pq_A + 1}{pq_o + 1}$$

Also by definition, the welfare of the actual expenditure pattern is equal to that at (Q_u^E, Q_r^E). Thus, from the assumed CES welfare function (equation (17), omitting the i subscripts):

$$\text{(B-7)} \qquad \left(\alpha(Q_u^A)^{-\beta} + (1-\alpha)(Q_r^A)^{-\beta}\right)^{-\frac{1}{\beta}} = \left(\alpha(Q_u^E)^{-\beta} + (1-\alpha)(Q_r^E)^{-\beta}\right)^{-\frac{1}{\beta}}$$

or, simplifying:

$$\text{(B-8)} \qquad \frac{Q_r^E}{Q_r^o} = \left(\frac{\alpha(q_A)^{-\beta} + (1-\alpha)}{\alpha(q_o)^{-\beta} + (1-\alpha)}\right)^{-\frac{1}{\beta}}$$

Substituting (B-6) and (B-8) into (B-5) yields the following expression for the variety-distortion cost:

$$\text{(B-9)} \qquad VDC = \frac{(1 + pq_A) - (1 + pq_o)\left(\frac{\alpha(q_A)^{-\beta} + (1-\alpha)}{\alpha(q_o)^{-\beta} + (1-\alpha)}\right)^{-\frac{1}{\beta}}}{p(q_A - q_o)}$$

All the variables in (B-9) are known or estimated. The regression yields estimates of α and β, the 1967 (or 1968) data include q_A and p, and insertion of the 1967 (or 1968) value of p in the variety-ratio regression yields an estimate of q_o.

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[1] See Equation (24) and Appendix A.

[2] I.e., at points b and c in Figure 3.

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