

PRINCETON STUDIES IN INTERNATIONAL FINANCE NO. 30

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

Thomas L. Hutcheson

and

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INTERNATIONAL FINANCE SECTION
DEPARTMENT OF ECONOMICS
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PRINCETON STUDIES
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THE COST OF TYING AID: A METHOD AND SOME COLOMBIAN ESTIMATES

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

Tagore, *Fireflies*

I. INTRODUCTION

The tying of aid is one of the means by which a country may avoid or postpone a devaluation when suffering a deficit in its balance of payments. In its efforts to prevent foreign economic aid from hurting the 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 aid no longer has any substantial impact on the balance of payments.¹ Inevitably, however, the very success of policies directed at changing the preferred expenditure patterns of the less developed countries (LDCs) receiving aid has imposed costs on them. It is toward the identification and measurement of these costs that this paper is directed.² It should be noted that the point of comparison, for the costs identified below, is the undervalued dollar. No attempt is made to estimate

A preliminary version of this paper was presented to the Harvard Development Advisory Service conference in Dubrovnik. While some of the work on this study was done in Colombia, it represents neither an official output nor an official position of the Government of Colombia. The authors wish to acknowledge the help provided by many officials of the Government of Colombia and of the U.S. Agency for International Development.

¹"... in 1963-1964, 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 before the Subcommittee on International Exchange and Payments of the Joint Economic Committee* (Jan. 13, 14, and 15, 1969), p. 87.

²For a general analysis of these distortions and welfare losses, see Jagdish N. Bhagwati, *The Theory and Practice of Commercial Policy: Departures from Unified Exchange Rates*, Princeton Special Papers in International Economics, No. 8 (January 1968), pp. 41-46. The model to be developed here is more specific, being aimed at empirical implementation.

the differential costs imposed by the tying of aid in relation to untied aid and an openly devalued dollar.

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 the following: 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 method 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 varieties of a product supplied by the United States and by the least expensive producer in the rest of the world are indeed perfect substitutes to the recipient of the aid.

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 units for quantities such that one unit of the variety (of either product) from the United States always equals, in worth to the recipient of the aid, one unit of the least expensive variety (of that product) from the rest of the world. Good y is assumed to be cheaper in the United States, good x to be cheaper in some other 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 purchased³ and the line BAC is budget constraint.⁴

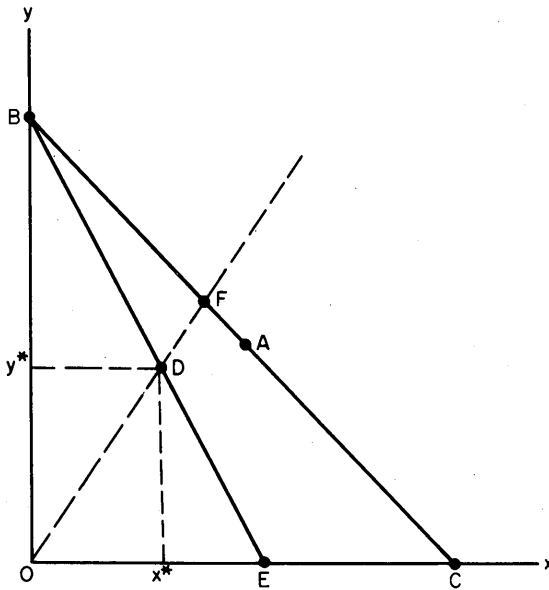
The costs of tying are now readily identified. If the United States required that this same amount of aid be used only to purchase its varieties of products, the LDC would allocate the aid at some such point as D , on a different budget constraint, BDE .⁵ On the other hand, the LDC might be constrained not as to the source but as to the product on which it can utilize the aid. If only good y could be purchased, the LDC would move to

³ For simplicity, we neglect any quantities of x or y that would have been purchased in the absence of aid.

⁴ The slope of the budget constraint, BAC , is $-P_{xy}/P_{yu}$, where P_{yu} is the price of product y in the United States (i.e., u for United States) and P_{xr} is the price of product x in the least expensive 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.

⁵ With a slope of $-P_{xu}/P_{yu}$, BDE is steeper than (and lies within) BAC , since $P_{xu} > P_{xr}$.

FIGURE 1
ALLOCATION OF AID WHEN VARIETIES ARE PERFECT SUBSTITUTES



point B , which would be inferior to A , but the additional restriction—that good y be bought from the United States—would impose no further loss in welfare (since the United States is already the least expensive 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 from the United States, there would be a further loss of welfare 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 force it to B or E . When the United States limits a recipient of its aid to purchase from the United States of particular products (of which the United States is not the least expensive 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 indifference curves of the LDC between

goods x and y .⁶ 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 , less aid if that reduced amount of aid was not tied to purchase from the United States.⁷ This variety-distortion cost (i.e., the fraction DF/OF) can also be seen as the excess cost (over least expensive sources) of purchasing from the United States the actual bundle represented by point D .

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

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

or

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

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

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

where P_{iu} is written equal to P_{ir} when the United States is the least expensive source, and c_i is the fraction of the total (source-tied) aid spent on the i^{th} product.⁸

It is essentially this formula (3) that was developed by Haq in his pioneering effort to measure (for Pakistan) the cost of tied aid,⁹ and it is this same formula that has been since used in various other studies. The results of such investigations suggest an excess cost in the range of 12 to

⁶ More precisely, knowledge is needed about the shape of the indifference curve through point E in Figure 1.

⁷ 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 Jagdish Bhagwati, "The Tying of Aid," United Nations Conference on Trade and Development [UNCTAD], mimeographed [Nov. 1, 1967], Annex III). We ignore for now this difference on the grounds that, for generally small price differentials (between the United States and least expensive sources), the size of the overcompensation implied by the statement of the text is small. Our treatment in Section IV is precise.

⁸ 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).

⁹ Mahbub Haq, "Tied Credits—A Quantitative Analysis," in John H. Adler, ed., *Capital Movements and Economic Development* (New York: Macmillan, 1967).

TABLE 1
FINDINGS ON EXCESS COST OF TIED AID

<i>Nation</i>	<i>Source</i>	<i>Estimate of Excess Cost^a</i>
Pakistan	Mahbub Haq, "Tied Credits—A Quantitative Analysis," 1967.	12 %
Chile	"Report on Tied Credits: Chile" (Dec. 8, 1967). ^b	12.4
India	Deepak Lal, "A Quantitative Analysis of Aid—Financial Imports of Certain Chemicals into India" (Dec. 3, 1968). ^b	14.9
Iran	Eprime Eshag, "Study on the Excess Cost of Tied Economic Aid Given to Iran in 1966/67" (Dec. 13, 1967). ^b	15
Tunisia	Eprime Eshag, "Study of Tied Economic Aid Given to Tunisia in 1965 (Nov. 30, 1967). ^b	20
Various Latin-American	V. E. Tokman, "An Evaluation of Foreign Aid: The Chilean Case" (May 1969). ^c	24

^a Methods vary somewhat among these studies, but the general procedure is described in "The Costs of Aid-Tying to Recipient Countries," UNCTAD, mimeographed (Nov. 21, 1967).

^b UNCTAD, mimeographed.

^c In *Bulletin of Oxford University Institute of Economics and Statistics*, p. 93. This article reports results of an OAS study that includes excess costs due to freight and project preparation.

24 per cent (see Table 1).¹⁰ Unfortunately, studies of this kind suffer from serious inadequacies. To begin with, it is necessary to assume that the same product is delivered by all potential sources. By "same," it is of course not necessary to imply identical, but the varieties delivered by different countries 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

¹⁰ Other sources have estimated the percentage excess of most expensive over least expensive source where international bidding has occurred. Such estimates are of course higher (see, for example, Bhagwati, "The Tying of Aid," pp. 33-34) but represent only upper limits to potential excess cost as defined above.

machinery, horsepower potential of machinery, and so forth. But, in the end, only the crudest kind of adjustment can be made for differences in the quality of 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 the very imports that are being preferred, partly or totally, under free commercial license, the researcher must take care "to compare only such items of equipment as have similar specifications, capacity and quality."¹¹

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 heterogeneous products are comparable to homogeneous products insofar as costs of tied aid are concerned. The method we will develop instead treats different varieties of a particular "product" as heterogeneous—in essence, more as if they were different products.¹² As a result, we are unable to calculate the excess cost of the truly homogeneous product, but there are few of these under our definition of "product";¹³ in any case, our results offer a useful complement to earlier findings. The reader should note that the technique developed here is a general method for measuring the costs of distortions in relative prices and is especially superior to the measurement of "little triangles" when a particular product (or variety) has an obvious alternative.

The organization of the remaining sections is as follows. An historical review of aid-tying measures from the viewpoint of the United States is first presented (Section II). There follows a description of the aid negotiations between the Governments of the United States and Colombia and of the administrative reactions of the Colombian Government—especially of its import-licensing agency—to restrictions on the use of aid (Section III). Constraints by the donor on the use of aid and the reactions of the donee to them are then examined theoretically within a model allowing heterogeneity of varieties (Section IV). In the final two sections (V and VI), the data of actual Colombian imports over 1955–68 are analyzed in an effort to assess the nature, extent, and costs of the variety distortion

¹¹ Haq, *op. cit.*, p. 327.

¹² The phrase "more as if" will be made clear later.

¹³ Defined in this study from detailed tariff classifications.

imposed on Colombia in 1967 and 1968 as a result of the tying of aid from the United States and suboptimal Colombian responses to these restrictions.¹⁴

The most important empirical findings—although no more than suggestive—indicate that (1) the typical variety-distortion costs to Colombia were far from negligible, and (2) the Colombian administrative reaction to the restrictions on the use of aid may have been suboptimal. For a sample from all products eligible for purchase from the United States under the program loan of the United States, the variety-distortion costs averaged above 10 per cent in 1967 and above 30 per cent in 1968.¹⁵ Furthermore, the absence of such costs in another sample (of similar Colombian imports that were not eligible for purchase under aid from the United States) suggests that the Colombian import-licensing procedures failed completely to adapt to the restrictions and thereby may have contributed to these 10 and 30 per cent estimates.

¹⁴ There are two appendixes: In the first (A), the samples, data, and statistical operations are detailed; in the second (B), the exact formula for variety-distortion cost is developed.

¹⁵ 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 per cent figures.

II. TYING: ENDS AND MEANS OF THE UNITED STATES

There are many reasons for the practice of tying aid by source, such as internal politics in the donor country, reduction of the resource cost (to the donor) of aid, and the desire for increased leverage over the direction of the recipient's use;¹ the issue is indeed not simple. But the very date of the initiation of such tying of United States aid, 1959, reflects the fact that it was primarily directed at the balance of payments and its concomitant, the promotion of exports.² Before the discovery, in 1959, that the "dollar gap" had been closed, there had been little concern for the effect of the aid of the United States 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."³

Once tying was introduced, the method of calculating the impact of aid on the balance of payments of the United States changed. Where the Department of Commerce estimate for 1958 had been 94 per cent, the official figure for 1960 was only 41 per cent (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 share of aid spent in the

¹ For fuller lists, see Raymond F. Mikesell, *The Economics of Foreign Aid* (Chicago: Aldine, 1968), pp. 246-251, and Jagdish Bhagwati, "The Tying of Aid," UNCTAD, mimeographed (Nov. 1, 1967), pp. 17-19.

² The two are not quite the same even for the United States, and for other countries where aid is tied despite a balance-of-payments surplus, the export-promotion reason can exist quite independently. The Agency for International Development (AID) likes to separate the two reasons, especially before Congress (e.g., see *Proposed Foreign Aid Program, FY1968* [Washington: 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 . . ." (*International Commerce* [Jan. 18, 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.

³ Robert E. Asher, *Grants, Loans, and Local Currencies* (Washington: The Brookings Institution, 1961), p. 43. The internal quotation is from a U.S. Dept. of Commerce publication.

TABLE 2
 SHARE OF AID-FINANCED COMMODITY
 EXPENDITURES PURCHASED IN THE
 UNITED STATES

<i>Fiscal Year</i>	<i>Per Cent Purchased in the United States</i>
1960	41
1961	44
1962	66
1963	79
1964	87
1965	92
1966	90
1967	96
1968	98
1969	99

SOURCE: *The Foreign Assistance Program, Annual Report to Congress* (Washington: Government Printing Office, 1968), p. 75; *ibid.* (1969), p. 23.

United States was not necessarily a measure of, or even related to, the impact of aid on the balance of payments.

Although we are not here concerned with this impact on the balance of payments, we must nevertheless glance over the various difficulties of measurement in order to recognize the extent of the uncertainty and ignorance in which the tying policy of the United States was being made and carried out during the 1960's. Only this ignorance and uncertainty (together with the strong and growing concern for the 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,⁴ it was soon recognized that aid that was not returned directly to the United States through a purchase was 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

⁴ That is, that the balance-of-payments deficit must be viewed as the obverse side of an excess of investment over saving.

destination of the dollars (in advanced countries).⁵ Furthermore, even untied bilateral aid from the United States could return 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 balance of payments.⁶ In short, feedback considerations reduce the perceived contribution of aid to the deficit but require some tenuous estimation procedures.

It has also been increasingly recognized that aid that *does* return directly to the United States may nevertheless contribute to the deficit. If the recipient of the aid would have purchased that product in the United States even 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 indeed contributes to the deficit. Here, too, calculations are tenuous, essentially requiring an extrapolation, estimate, or assumption about the "normal" share of the United States products in the recipient's commercial imports.⁷

Finally, it has also become fashionable to calculate the United States exports to LDCs that are attributable to the aid-induced growth of these countries.⁸ In addition to being conceptually suspect, the resulting estimates are again tenuous. Thus, Congressmen, economists, bureaucrats; AID, Treasury, Commerce; each has been able to pursue his instincts—

⁵ The traditional example of the failure of this "accounting" approach was the treatment of the contributions of the United States to the Indus Basin Development Fund as a drain. While the United States was providing an untied 44 per cent of the foreign exchange, firms based in the United States were receiving 54 per cent of the foreign exchange component of the contracts. See *Maintaining the Strength of the United States Dollar in a Strong Free World Economy* (Washington: U.S. Treasury Department, January 1968), pp. 150-151.

⁶ See Walter S. Salant *et al.*, *The U.S. Balance of Payments in 1968* (Washington: The Brookings Institution, 1963) and W. Whitney Hicks, "Estimating the Foreign Exchange Cost of Untied Aid," *Southern Economic Journal* (October 1963).

⁷ By "commercial imports" we mean those not financed by aid. Many of the estimates of switching are found only in internal AID memoranda, but the interested reader should see Lawrence Lynn, Jr., "An Empirical Analysis of U.S. Foreign Economic Aid and the U.S. Balance of Payments, 1954-1963," Ph.D. thesis (New Haven: Yale University, 1966) and Charles D. Hyson and Alan M. Strout, "Impact of Foreign Aid on U.S. Exports," *Harvard Business Review* (January-February 1968).

⁸ W. S. Gaud, in *Hearings before the Subcommittee on International Exchange and Payments of the Joint Economic Committee*, Jan. 13, 14, and 15, 1969, pp. 95-96. See also Hyson and Strout, *op. cit.*

about the "need" for and efficacy of measures to increase the tying of aid—largely unfettered by indisputable facts.⁹

The history of tying in the 1960's can be divided into two stages. Up to 1965 AID was chiefly concerned with getting its aid tied tightly to use on products from the United States.¹⁰ By 1965 this goal had been essentially achieved (see Table 2), but government officials were beginning to worry publicly 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 exports from the United States? This concern for additionality was almost entirely directed at those LDCs which received program (or, more generally, nonproject) aid from the United States, although substitution is, in theory at least, as much a possibility with project aid,¹¹ and internal research in AID was strongly suggesting that, among recipients of aid, 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 nonproject component of United States aid.

In order to understand the policies of the United States, 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 its total imports,¹² then the United States can expect, without any tying restrictions, that a fraction, Ψ , of its aid will return directly to the United States.¹³ Thus, the larger the normal import share of the United States (Ψ) is, the more nearly is full additionality achieved.

Nominal source tying, on the other hand, is more effective the lower the normal share of imports from the United States. In the extreme, where goods are never purchased from the United States through normal com-

⁹ 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, *op. cit.*, p. 94) was in the end influential in the 1969 announcement of an easing of Latin-American restrictions.

¹⁰ The meaning of "from the United States" inevitably caused some difficulty; also (after 1963), aid could no longer be used on products of which the United States was a net importer.

¹¹ Some substitution will occur whenever the donor finances a project (1) that would have been undertaken in the absence of the aid and (2) 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.

¹² For simplicity, we here assume identity between the average and the marginal.

¹³ We are here ignoring indirect feedback and growth-induced imports.

mercial channels, the recipient of the aid 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 aid from the United States to total normal commercial imports is Φ , it can be readily deduced that nominal source tying will raise the total import share of the United States above its expected normal level (Ψ) as long as $\Psi < \Phi/(1 + \Phi)$. Thus, the larger the aid contribution to the recipient's imports (Φ) and/or the smaller its normal share from the United States (Ψ), the more effective is nominal source tying in achieving additionality.¹⁴

These two factors are shown in Figure 2, where the vertical axis represents the ratio to the total aid of additional (*net*) exports from the United States to the aid recipient. If this ratio is 1, full additionality has been achieved; if it is 0, 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 attention between 1965 and 1968.

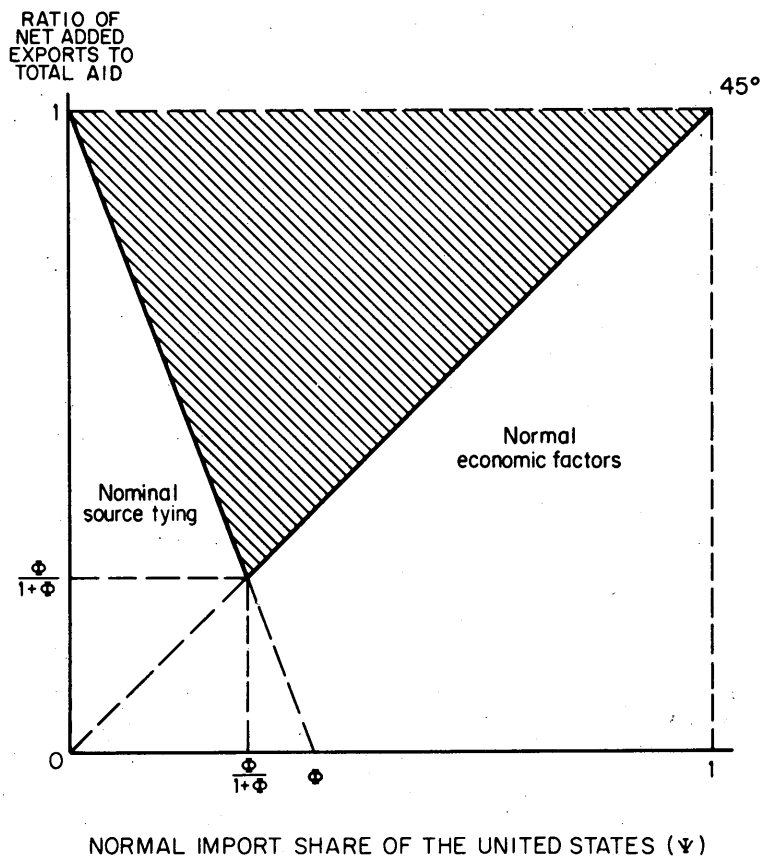
Unfortunately—from the viewpoint of those trying to impose it—additionality is no easy matter to ensure. While nominal source tying is generally accepted by donors and recipients of aid, further steps are not. “Additionality teams” were sent to the major recipients of nonproject aid in search of means to raise “additionality factors.” While a number of jawbone devices were developed,¹⁵ 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 on the negative list in order to encourage the use of the aid for development purposes.¹⁶

¹⁴ Provided the recipient can and does adequately alter its import incentives and/or licensing procedures. If not, nominal source tying will result only in a slow utilization of the program loan. The classic example of this is Morocco in the mid-1960's. With a normal share of imports from the United States below 10 per cent and strong traditional trading 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 aid from the United States. We return in Section III to this problem as it affected Colombia.

¹⁵ Including the implied threat that an aid recipient's share of the pie might be reduced if it was 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 of deficit” (*The Foreign Assistance Program, Annual Report to Congress* [Washington: Government Printing Office, 1967], p. 19).

¹⁶ And to prevent subsequent embarrassment before Congress.

FIGURE 2
RATIO OF NET ADDITIONAL EXPORTS FROM THE UNITED STATES
TO TOTAL AMOUNT OF AID



In 1966 AID began to use negative lists for additionality purposes, and in 1967 positive lists (i.e., goods on the import of which the aid *could* be used) were introduced.¹⁷ Although the substitution of a complementary positive list for a negative list is not necessarily more than a semantic step, the positive lists were kept short and were selected with an eye to

¹⁷ Gaud, *op. cit.*, p. 92.

increasing exports from the United States as well as to encouraging the LDC's development.

The positive list restricted the recipient in two ways: (1) the number of eligible goods was limited, and (2) the eligible goods were restricted to those "in which commercial exports from the United States were generally less than a commanding share of the market."¹⁸ 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 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.¹⁹ Furthermore, the LDC was not permitted much voice in the selection of the eligible products. In the official words of the United States:

A.I.D. is paying increasingly close attention to balance of payments considerations in selecting . . . commodities that it will or will not finance:

—A.I.D. 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.²⁰

In practice, all these criteria seem to have boiled down to the condition that, for a product to be eligible for the positive list, purchase of that product from the United States before the program loan should not have exceeded much more than half the total imports of the product. Although in any actual positive list numerous exceptions are found, the selection of the list essentially began with the one-half-share products and worked down through the lower-share products until the 1.5 constraint on the size of the list was reached. Thus, the potential extent of substitution was

¹⁸ J. R. Fowler, Jr., Deputy U.S. Coordinator, Alliance for Progress, AID, in *Hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, Part 2* (June-July 1969).

¹⁹ Where, for example, the ratio of the program aid to the base-year total of all imports from all sources was .10, only 15 per cent of those total imports were eligible for the positive list.

²⁰ *Maintaining the Strength of the United States Dollar in a Strong Free World Economy, op. cit.*, p. 153.

limited by the fact that the imports from the United States (which were subject to possible switching) were never a "commanding" share of the total.²¹ 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"²²—the United States was able to guarantee that no more than a limited amount of substitution could occur.²³

Of course, the very size and nature of the positive list also guaranteed that the recipient of aid would not be able to utilize it without drastic revision of its procedures for licensing of imports and/or dramatic increases in its incentives to purchase varieties of eligible products from the United States.²⁴ Some recipients chose to cease (or reduce) licensing eligible imports from sources other than the United States;²⁵ others offered a variety of incentives to private importers to induce the selection of varieties from the United States—devaluing, in effect, the aid dollar. The incentives ranged over tariff cuts, exemption from advance deposits, lower exchange rates, tax exemptions, special credits, and direct sub-

²¹ The United States was not the sole perpetrator of such devices (see, for example *International Commerce* [Aug. 23, 1965], p. 25, and *International Commerce* [Aug. 29, 1966] p. 28). It is ironic that the United States once complained in Colombia about "trade policies which discriminate against U.S. imports" (*International Commerce* [Feb. 8, 1965], p. 23), when the positive lists asserted by third countries included goods in which the position of the United States was commanding.

²² Gaud, *op. cit.*, p. 92.

²³ Notice the words "limited" and "could." Although the concept of the list may appear quite restrictive, if the average share of the eligible products from the United States is as high as one-third, *half* 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.

²⁴ Unless its currency were so overvalued that there was sufficient excess demand for eligible expensive varieties from the United States 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 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 . . ." (M. L. Pal, "The Determinants of the Domestic Prices of Imports," *Pakistan Development Review* [Winter 1964], pp. 606-607).

²⁵ This further reduced the competitiveness of United States varieties since the potential competition was removed. In some cases, prices rose even above the internal levels of the United States, since 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 only in November 1968 (see Robert L. Curry, Jr., "International Monopolistic Practices by U.S. Firms," *Journal of Law and Development* [Fall 1968], pp. 138-139).

sides.²⁶ Drastic measures—and often “unpopular”²⁷ ones—are needed to induce or force businessmen to buy products from the United States when they are priced “10 to 40% more than comparable goods from other suppliers.”²⁸ 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 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 increasing the exports of the United States than in LDC development. Aid was withheld until the recipient could erect or expand a system of import controls capable of guaranteeing additionality (while AID was sermonizing over the virtues of free markets). By the time Rockefeller made his Latin-American tour in 1969, additionality had become not only a serious practical impediment to the distribution of authorized nonproject 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”²⁹ with those departments was a losing one until Rockefeller’s mission and report.³⁰ 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.³¹ More time must pass before the extent of this expansion is clear.

²⁶ See Eprime Eshag, “Study of Tied Economic Aid Given to Tunisia in 1965,” UNCTAD, mimeographed (Nov. 30, 1967), pp. 7–8; Carlos F. Díaz-Alejandro, “Some Aspects of the Brazilian Experience with Foreign Aid,” Yale University Economic Growth Center, Discussion Paper No. 77 (October 1969), pp. 21–23; *International Commerce* (June 28, 1965), p. 42; *International Commerce* (Aug. 9, 1965), p. 15; *International Commerce* (Dec. 20, 1965), p. 30; and *International Commerce* (Mar. 6, 1967), p. 25.

²⁷ *The Foreign Assistance Program, Annual Report to Congress* (1969), p. 25.

²⁸ Gaud, *op. cit.*, p. 95.

²⁹ The words of a newspaper article (“AID Program Hurt by Tight Controls?” *Ann Arbor News* [Mar. 17, 1969], p. 5).

³⁰ *The Rockefeller Report on the Americas* (Chicago: Quadrangle Books), 1967.

³¹ 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!

III. TYING: REACTIONS AND ADJUSTMENTS BY COLOMBIA

Between 1962 and early 1967 Colombia received U.S.\$205 million in program loans (hereafter, PL) from the United States and spent all but U.S.\$4 million of this. While the heated negotiations of these loans were often 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 was an issue in the early discussions. Nevertheless, under terms of the 1964 PL, AID changed from a negative list to a positive list of goods eligible for PL use. By late 1965 imports of the goods from the United States financed by AID were slightly favored over other goods in three ways. First, the importer received 120 days grace between payment to the exporter and the beginning of interest on credit on the goods. Second, the rate of interest was 12 per cent, 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 per cent of the c.i.f. value.²

In negotiating the PL of May 1967, for U.S.\$100 million, two important changes were made in the administration of the Colombian loan. First, the list of goods eligible for AID finance was tightened by removing all goods whose historic share of purchases from the United States 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) but were eligible for three- to five-year loans at 5 to 7 per cent interest on the dollar value (with a U.S.\$20,000 minimum application). The corresponding terms on "regular" goods were 4 per cent for 120 days, also on the dollar value. U.S.\$10 million of the U.S.\$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 (allotment) of the PL was brisk, becoming

¹ At this time 14 per cent was the legal maximum for bank lending, but redeposit requirements raised the effective rate above this.

² Advance deposits vary between 30 and 130 per cent of c.i.f. value. They remain on deposit an average of six months. A conservative nominal opportunity cost of capital would be 18 per cent per year; this applied to 130 per cent for six months means 12 per cent of c.i.f. value.

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 this quarterly review.⁴ The United States share in total Colombian imports not financed by AID fell to 21 per cent during the last quarter of 1967; the share for all 1967 was 29 per cent against an historical share of 39 per cent. The third quarterly review of February 1968 again raised the additionality question, "the biggest issue between AID and the Government of Colombia."⁵ 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 owing 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."⁶ The extent of the tightening of the list is easily seen; the value of the share of goods from the United States on the positive list went from U.S.\$135 million in 1967 to only U.S.\$42 million in 1968.

The reduction in the list and the agreement by the Colombian Government to force an additional U.S.\$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 U.S.\$3 to \$4 million per month compared with the projected rate of U.S.\$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 for the meagre use of the credit."⁷

The final tranche of the PL was not released until May 1968, when the Colombian Government, under pressure to "liberalize" from AID, moved a substantial number of items from the prior-license list to the "free" list.

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

⁴ *Colombia—A Case History of U.S. Aid* (Washington: U.S. Senate, Committee on Foreign Relations, 1969), p. 51.

⁵ *Ibid.*, p. 55.

⁶ *Ibid.*, p. 55. Also, shipment of more goods in vessels of the United States was required.

⁷ *Legislación Económica* (Bogotá: Nov. 30, 1968), p. 314. This refers to a new PL for U.S.\$73 million signed in July 1968.

This had an unintended effect of reducing the incentive to purchase these goods from the United States, 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 per cent of their previous level, and in November reduced them again to 10 per cent. 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 per cent. Minimum loans were also lowered from U.S.\$2,500 to U.S.\$2,000 for "regular" goods and from U.S.\$20,000 to U.S.\$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 toward the United States in 1967, principally by licensing these goods somewhat more freely.

3. The attempt to use a large amount of aid during 1967—part untied (International Bank for Reconstruction and Development) and part with additionality barely in force—caused a sharp drop in the share of the total imports not financed by AID which were purchased in the United States.

4. When AID realized that additionality was not being achieved, it tried to enforce it by greatly reducing the size of the positive list. The list eventually became so tight that the PL could not be utilized at the projected rate.

5. Only when faced with inability to move the aid did Incomex begin to take stronger measures to divert purchases toward products of the United States. But since these increased incentives were now working on a much-reduced list of goods, Incomex's efforts had to be greater than if the incentives had been working with a larger list.⁸

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).

⁸ Instead of having to divert a few thousand dollars to United States varieties of each of thousands of goods, they now had to divert tens of thousands of dollars to United States varieties of each of hundreds of goods.

IV. THEORY AND METHOD

We will now develop a model that incorporates imperfect substitutability between varieties from the United States and from the rest of the world (labeled u and r , respectively). The optimal allocation of import purchases when the LDC's own foreign exchange is supplemented by a program loan (PL) is the result of a simple maximization problem, the success of which depends upon the constraints imposed on the use of the PL. We recognize constraints of three kinds: (1) the usual budget constraint on the foreign-exchange budget; (2) "tying" constraints imposed by the donor; and (3) self-imposed LDC constraints because of internal political pressures or organizational failings. In this section we will develop hypotheses about the behavior, for particular products, of certain ratios between varieties from the United States and from third countries under the operation of various constraints. As a benchmark we begin with the allocation of imports in the absence of a PL and then proceed to the allocation when the use of a PL is constrained in the 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. The licensing of rest-of-world imports (of all products) remains unchanged from the pre-PL situation, a self-imposed LDC constraint.

Case V. The licensing of all imports, other than varieties from the United States of PL-eligible products, remains unchanged from the pre-PL situation, another self-imposed LDC constraint.

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

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

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

¹ And where brackets represent functions and parentheses multiplication.

are

$$(5) \quad \frac{W_{1u}}{W_{1r}} = \frac{P_{1u}}{P_{1r}} \quad \text{and} \quad \frac{W_{2u}}{W_{2r}} = \frac{P_{2u}}{P_{2r}},$$

where the subscripts to W indicate the relevant partial derivatives of the welfare function. If we further assume a homothetic welfare function among varieties,² then the optimal variety ratio of each good (i.e., Q_{1u}^O/Q_{1r}^O and Q_{2u}^O/Q_{2r}^O) is a function only of the price ratio of the varieties,

$$(6) \quad \frac{Q_{1u}^O}{Q_{1r}^O} = f_1 \left[\frac{P_{1u}}{P_{1r}} \right] \quad \text{and} \quad \left[\frac{Q_{2u}^O}{Q_{2r}^O} \right] = f_2 \left[\frac{P_{2u}}{P_{2r}} \right],$$

where the f 's represent (for now unspecified) functions (with f' negative and f'' positive) and the superscript O 's 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 and cross-partial price elasticities of nitric acid imported from France and the United States are much more likely to be equal than are those of perfume.

We now consider the maximization problem after the LDC receives a PL (of amount L) to supplement its foreign-exchange budget (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:³

$$(7) \quad \frac{Q_{1u}^I}{Q_{1r}^I} = \frac{Q_{1u}^O}{Q_{1r}^O} \quad \text{and} \quad \frac{Q_{2u}^I}{Q_{2r}^I} = \frac{Q_{2u}^O}{Q_{2r}^O}.$$

² Homotheticity in this context implies, essentially, equal "income" elasticities among the different imported varieties of each good. We also assume equal cross-elasticities between the price of any other product and the purchases of the two varieties of a particular product.

³ The Roman superscripts refer to the case under consideration.

Case II. The PL is subject to source tying; it may be spent only on goods from the United States. 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 States must rise L above what they would have been in the absence of the PL (i.e., above $P_{1u}Q_{1u}^0 + P_{2u}Q_{2u}^0$). Optimal exchange allocation becomes a problem of the form

$$(8) \quad \text{Max } W = W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] \\ - \lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - F - L) \\ - \lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q_{1u}^0 + P_{2u}Q_{2u}^0) + L),$$

where λ_1 represents the value of the foreign-exchange constraint (including the PL) and λ_2 the source-tying constraint. For nominal source tying, $z = 0$; for full additionality, $z = 1$.⁴ The necessary conditions for maximization are⁵

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

or

$$(10) \quad \frac{Q_{1u}^{\text{II}}}{Q_{1r}^{\text{II}}} = f_1 \left[\frac{P_{1u}}{P_{1r}} \left(1 - \frac{\lambda_2}{\lambda_1}\right) \right] \quad \text{and} \quad \frac{Q_{2u}^{\text{II}}}{Q_{2r}^{\text{II}}} = f_2 \left[\frac{P_{2u}}{P_{2r}} \left(1 - \frac{\lambda_2}{\lambda_1}\right) \right].$$

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 available. In contrast, a country with a relatively large PL and different historical trading preferences (e.g., Pakistan or Morocco) might find nominal source tying 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 rest-of-world varieties of goods and thereby leads to substitution, within *each* product, of the varieties of

⁴ 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 partially able to evade additionality. On the other hand, AID's definition of additionality may not include allowance for price or trend changes, so more than 100 per cent additionality could be imposed.

⁵ 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.

the United States,

$$(11) \quad \frac{Q_{1u}^{II}}{Q_{1r}^{II}} > \frac{Q_{1u}^I}{Q_{1r}^I} = \frac{Q_{1u}^O}{Q_{1r}^O} \quad \text{and} \quad \frac{Q_{2u}^{II}}{Q_{2r}^{II}} > \frac{Q_{2u}^I}{Q_{2r}^I} = \frac{Q_{2u}^O}{Q_{2r}^O}.$$

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 the varieties of the United States is greater for good 1 or good 2.

Case III. The PL not only is subject to source tying, as in Case II, but is also restricted to use on a limited number of eligible goods. Here, we treat good 1 as eligible. The allocation problem is⁶

$$(12) \quad \begin{aligned} \text{Max } W = & W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] \\ & - \lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - F - L) \\ & - \lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q_{1u}^O + P_{2u}Q_{2u}^O) + L) \\ & - \lambda_3(-P_{1u}Q_{1u} + L), \end{aligned}$$

and the solution⁷

$$(13) \quad \frac{Q_{1u}^{III}}{Q_{1r}^{III}} = f_1 \left[\frac{P_{1u}}{P_{1r}} \left(1 - \frac{\lambda_2 + \lambda_3}{\lambda_1} \right) \right] \quad \text{and} \quad \frac{Q_{2u}^{III}}{Q_{2r}^{III}} = f_2 \left[\frac{P_{2u}}{P_{2r}} \left(1 - \frac{\lambda_2}{\lambda_1} \right) \right].$$

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 variety from the United States is raised for good 1 and not lowered for good 2,

$$(14) \quad \frac{Q_{1u}^{III}}{Q_{1r}^{III}} > \frac{Q_{1u}^O}{Q_{1r}^O} \quad \text{and} \quad \frac{Q_{2u}^{III}}{Q_{2r}^{III}} \geq \frac{Q_{2u}^O}{Q_{2r}^O}.$$

⁶ 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 does $\lambda_2 = 0$; 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 United States share otherwise.

⁷ As long as the marginal worth of the PL is positive, $\lambda_1 > \lambda_2 > \lambda_3$.

It should be noted that constraint 3 is not likely to be binding if the United States share in good 1 is large, if good 1 comprises a large and income-elastic portion of the 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 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 exporting industries of the United States, it is clearly inefficient unless the 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., $L \leq P_{1u}Q_{1u} - P_{1u}Q_{1u}^0$). 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. AID was under pressure from Commerce and the Treasury to move toward this "strong version" of Case III. It should be noted that this "strong version" of Case III is even more inefficient, in that the United States is no better off (unless exports of good 1 are somehow preferred to exports of good 2) and the recipient is worse off.

A valid objection to the analysis thus far would be that coordinating 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 varieties from the United States suggests this.⁸ Therefore, we now analyze two cases of suboptimal response by the recipient.

Case IV. Suppose that, owing 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.⁹ The only changes are that increased licenses are issued to those who want to import varieties of both eligible and noneligible goods from the United States. If there is sufficient excess demand for imports at the current exchange rate, tariffs, and advance deposits, then the PL can be utilized and additionality fulfilled. For comparability with previous cases, we note that this case is

⁸ In Colombia, for example, there are 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, the director of the central bank, and the Finance Minister.

⁹ With "normal" assumed to be the pre-PL levels (i.e., Q_{1r}^0 and Q_{2r}^0).

equivalent to the following allocation problem:

$$\begin{aligned}
 (15) \quad \text{Max } W &= W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] \\
 &- \lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - F - L) \\
 &- \lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q_{1u}^0 + P_{2u}Q_{2u}^0) + L) \\
 &- \lambda_3(-P_{1u}Q_{1u} + L) \\
 &- \lambda_4(P_{1r}Q_{1r} - P_{1r}Q_{1r}^0) \\
 &- \lambda_5(P_{2r}Q_{2r} - P_{2r}Q_{2r}^0).
 \end{aligned}$$

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_{1u}^{IV}/Q_{1r}^{IV} to Q_{1u}^0/Q_{1r}^0 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 suboptimal 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 United States varieties of PL-eligible goods are licensed exactly as before,¹⁰ and the entire loan is used to purchase additional quantities of PL-eligible goods.¹¹ This means that not only Q_{1r} and Q_{2r} but also Q_{2u} remain at "normal" levels. This implies another constraint,

$$\begin{aligned}
 (16) \quad \text{Max } W &= W[Q_{1u}, Q_{2u}, Q_{1r}, Q_{2r}] \\
 &- \lambda_1(P_{1u}Q_{1u} + P_{2u}Q_{2u} + P_{1r}Q_{1r} + P_{2r}Q_{2r} - F - L) \\
 &- \lambda_2(-P_{1u}Q_{1u} - P_{2u}Q_{2u} + z(P_{1u}Q_{1u}^0 + P_{2u}Q_{2u}^0) + L) \\
 &- \lambda_3(-P_{1u}Q_{1u} + L) \\
 &- \lambda_4(P_{1r}Q_{1r} - P_{1r}Q_{1r}^0) \\
 &- \lambda_5(P_{2r}Q_{2r} - P_{2r}Q_{2r}^0) \\
 &- \lambda_6(P_{2u}Q_{2u} - P_{2u}Q_{2u}^0).
 \end{aligned}$$

Again the solution is trivial; constraints 4, 5, and 6, together with 1, determine the solution. Clearly, Q_{1u}^V/Q_{1r}^V is greater than Q_{1u}^0/Q_{1r}^0 , and Q_{2u}^V/Q_{2r}^V equals Q_{2u}^0/Q_{2r}^0 . 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 $\lambda_2 = 0$).

¹⁰ Again, we arbitrarily assume that "as before" means the pre-PL levels (i.e., Q_{1r}^0 , Q_{2u}^0 , and Q_{2r}^0).

¹¹ Provided there is sufficient excess demand for these. If there is not, the PL will not be fully used.

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 aiding 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 is a constant elasticity of substitution (CES) between the variety from the United States and the variety from the rest of the world for any particular (i^{th}) good, although this constant elasticity (σ_i) may differ among 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 varieties of the i^{th} good as

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

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 nonoptimizing decision rules, always result in a variety ratio, Q_{iu}/Q_{ir} , such that

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

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 among the different cases outlined above. For Case I, a completely untied PL, we have

$$(19) \quad \ln \left[\frac{Q_{iu}^I/Q_{ir}^I}{Q_{iu}^O/Q_{ir}^O} \right] / \sigma_i = 0$$

for all goods, where the O^{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

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

for all goods. Hence

$$(21) \quad \ln \left[\frac{Q_{iu}^{II}/Q_{ir}^{II}}{Q_{iu}^O/Q_{ir}^O} \right] / \sigma_i = - \ln \left[1 - \frac{\lambda_2}{\lambda_1} \right] > 0$$

for all goods. By similar substitution in each of the five cases, we arrive at Table 3 (where the subscript 1 refers to goods for which the United States varieties are eligible for PL use, and the subscript 2 to goods for which the United States 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: (1) it is not known *a priori* whether Colombia's allocative response was optimal, or, if not, in

TABLE 3
VARIETY-RATIO DIFFERENCES IN THE FIVE CASES

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

^a 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).

what way it was suboptimal; and (2) it is not clear *a priori* whether the nominal imposition of source tying and restricted product eligibility was effective in distorting Colombian import allocations or was mere window dressing for the U.S. Congress and/or administration.¹²

¹² It could have turned out to be window dressing either because AID intended to undermine the policies of other agencies of the U.S. Government or because Colombia managed to do so.

V. EMPIRICAL EVIDENCE

By 1967, the PL from the United States to Colombia represented a sizable fraction of Colombia's foreign exchange and "additionality" was (supposedly) being 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^{th} good, Q_{iu}^A/Q_{ir}^A); the difficulty arises in estimating the optimal variety ratio (written Q_{iu}^O/Q_{ir}^O) in 1967 or 1968. We shall do it in the following manner: (1) for the years 1955-64, we assume the aid program was sufficiently small and/or its tying to purchase in the United States was sufficiently mild (or avoidable) that Colombia was not prevented from choosing optimal variety ratios for all goods in those years; (2) 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 (3) we assume that the Colombian social-welfare function (W) was of the CES form for *varieties* of goods; that is,

$$(22) \quad W = W[W_1, W_2, \dots], \quad \text{and}$$

$$W_i = (\alpha_i(Q_{iu})^{-\beta_i} + (1 - \alpha_i)(Q_{ir})^{-\beta_i})^{-\frac{1}{\beta_i}}, \text{ for } i = 1, 2, \dots$$

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

$$(23) \quad \frac{Q_{iu}^O}{Q_{ir}^O} = \left(\frac{\alpha_i}{1 - \alpha_i} \right)^{\sigma_i} \left(\frac{P_{iu}}{P_{ir}} \right)^{-\sigma_i}$$

One further complication requires discussion before equation (23) can be used to estimate the optimal variety-ratio function.² Even the most casual inspection of Colombian import data indicates that there was a

¹ For the 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.

² Often called a "substitution function" in the trade literature (see Edward E. Leamer and Robert M. Stern, *Quantitative International Economics* [Boston: Allyn and Bacon, 1970], Chaps. 3 and 7).

TABLE 4
PERCENTAGE SHARE OF COLOMBIAN IMPORTS FROM THE UNITED STATES

<i>Imports from the United States</i>	1957	1958-60	1961-63	1964
Total Colombian imports	60	59	52	48
Colombian commercial imports	59	55	46	41

SOURCE: *Colombia—A Case History of U.S. Aid* (Washington: U.S. Senate, Committee on Foreign Relations, 1969), p. 168.

trend away from the United States varieties during the late 1950's and early 1960's (see Table 4). This trend can be attributed only partially to relative-price phenomena as we measure them—more important are the (exogenous for our purposes) increases in ALALC (Asociación Latinoamericana de Libre Comercio) trade, bilateral imports resulting from coffee agreements, and Japanese and West European marketing efforts. Thus, the final statistical estimating equation is based upon equation (23) with the addition of a trend term,

$$(24) \quad \ln \left[\frac{Q_{iu}}{Q_{ir}} \right] = a_{i0} + a_{i1}T + a_{i2} \ln \left[\frac{P_{iu}}{P_{ir}} \right] + v_i,$$

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 (unconstrained) regression in which all three parameters (i.e., a_{i0} , a_{i1} , and a_{i2}) were estimated. Whenever, for this regression, the sign of a_{i2} was correct (negative) and the R^2 was significant at the 10 per cent 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 elasticity of substitution ($-a_{i2}$) was held, in turn, at $\frac{1}{2}$, 1, and 2. These are the "constrained" estimates, and the one with the lowest standard error is the "best constrained" estimate.³

These regressions were then used to estimate the optimal variety ratio of each product (Q_{iu}^0/Q_{ir}^0) for 1967 and 1968, inserting the 1967 or 1968 values of T and the relative-price ratio (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

³ For fuller discussion of the regressions, see Appendix A.

importing system over the period 1955-64 and an unchanging (correctly specified) structure of the welfare function of imports over the period 1955-68.⁴ These assumptions 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,

$$(25) \quad \ln \left[\frac{Q_{iu}^A/Q_{ir}^A}{Q_{iu}^o/Q_{ir}^o} \right] / \sigma_i.$$

For none of the products—whether PL-eligible or not—do we expect the critical variable (25) to be negative, since the PL constraints should never induce Colombia to distort purchases *away* from varieties from the United States. Nevertheless, the estimates of the critical variable are negative almost as often as they are positive, over the entire sample of 121 products.⁵ This result is hardly surprising, considering the naïveté 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 is not without value.

We shall deal with three groupings of products:⁶ (1) a sample of 63 PL-eligible products; (2) a sample of 41 non-PL-eligible products; and (3) a sample of 24 major PL-eligible products.⁷ 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 group⁸ but *not* eligible for PL use; and the third a complete collection of the traceable and usable major imports eligible for PL use.

The means and standard deviations of the estimates of the critical variable 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 is truly random and hence significance tests are not warranted, the variance of the critical variable 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

⁴ More accurately, since the regressions include time (T), we are assuming an unchanging rate of change in the structure.

⁵ The actual variety ratio in 1967 is less than the optimal for 44 per cent of the 121 products when the "best constrained" estimate of the variety ratio is considered.

⁶ For details, see Appendix A.

⁷ By "major" is meant that the total Colombian imports, of all countries' varieties, exceeded U.S.\$500,000 in 1967.

⁸ I.e., nearby in the tariff classification.

TABLE 5
ESTIMATES OF THE CRITICAL VARIABLE

Sample	Free Estimates ^a			Best Constrained Estimates		
	Mean	S. Dev. of Mean	No. of Observ.	Mean	S. Dev. of Mean	No. of Observ.
1. <i>PL-eligible products:</i>						
1967	+1.595	0.628	29	+0.663	0.472	63
1968	+1.583	0.741	27	+0.704	0.618	59
2. <i>Adjacent non-PL-eligible products:</i>						
1967	-0.598	0.976	19	+0.089	0.642	41
1968	+0.214	0.660	16	+0.521	0.554	37
3. <i>Major PL-eligible products:^b</i>						
1967	+0.505	0.744	9	-0.125	0.597	24
1968	+0.714	0.706	9	+0.894	0.962	24

^a Only those free estimates are considered for which the estimated σ_i is positive and R^2 is significant at 10 per cent confidence.

^b Includes seven products also in "PL-eligible products" sample.

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 sample of PL-eligible products) and is less than 1 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 or the statistically indistinguishable "strong version" of Case III.⁹

At first glance, the evidence of the third sample, especially in 1967, would appear to counter the above. The twenty-four major PL-eligible products look more like the sample of adjacent non-PL-eligible products than like the sample of PL-eligible products. But this result is less dis-

⁹ The indistinguishability is unfortunate in that it precludes assignment of "blame." Under the strong version of Case III, the entire loss is the responsibility of the United States; under Case V, Colombian authorities share the responsibility.

turbing 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—about one-half of these major imports are capital goods, which have always been licensed liberally. If, indeed, there is little *excess* demand (i.e., beyond traditional licenses), any increased generosity in approving applications for varieties from the United States will result in few increased imports from the United States, and the critical variable for these products will not rise much above zero. A second possible explanation of the findings from the third sample lies with the power of importers. Since these are major imports (and appear to be largely purchased by a few firms), the private costs imposed by variety distortion are large. To the extent that these importers have greater ability to bring pressure on the licensing authorities and the benefits to them of successfully preventing variety distortion are greater, the actual results become probable. For major imports, despite Incomex's desire to augment the licenses only of varieties from the United States, the excess demand for such varieties may have been small and/or the pressures put on them may have forced a liberalization of other 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 United States varieties along the lines of Case V or the "strong version" of Case III.

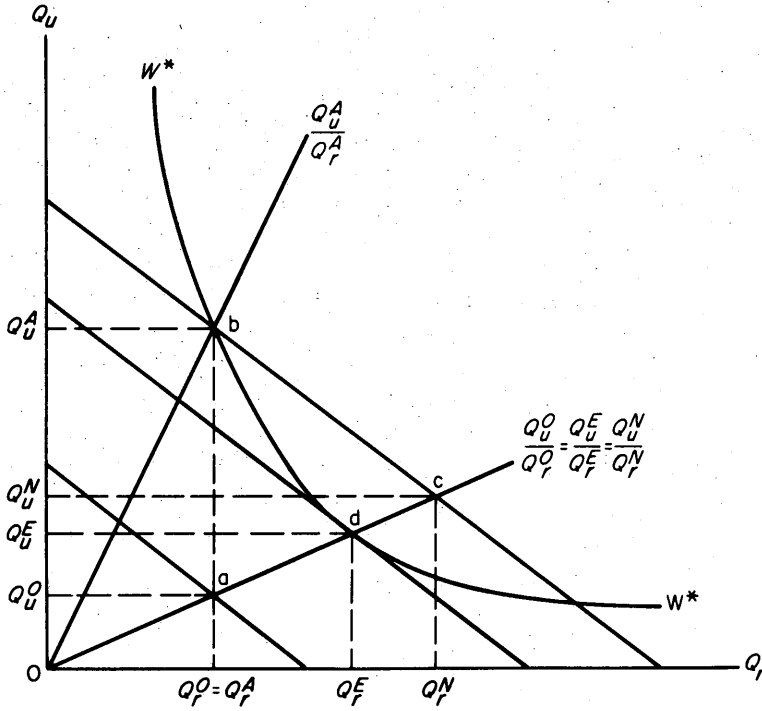
VI. THE COST OF TYING

As was seen earlier, the cost to Colombia of a PL restricted by source tying and limited product eligibility can be divided into two components, the costs due to the allocative distortions between eligible and noneligible products (i.e., the product-distortion cost) and the costs due to the allocative distortions between the varieties of the United States and the rest of the world within 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 substitutability among products (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^0/Q_r^0 , to the actual, sub-optimal ratio, Q_u^A/Q_r^A . We further assume that the 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 $Q_r^A = Q_r^0$ 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 $Q_r^A \geq Q_r^0$ 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 $\sum_i P_{ir} Q_{ir}^0$ 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 the 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 variety from the United States. This cost, and the means of measuring it, can be more clearly seen with the aid of Figure 3. The quantities (for the i^{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, respectively. The superscripts carry the following

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

FIGURE 3
VARIETY-DISTORTION COST



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 .

meanings:

Q_u^O, Q_r^O the quantities purchased before, or in the absence of, the PL (i.e., O for optimal).

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).

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 *e*qually well-off).

From our assumption of a homothetic welfare function (for varieties of a particular good), it follows² 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 point *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 ratio³ 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 point *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 choice concerning varieties had not been restricted. Finally, with knowledge of the shape of the iso-welfare curve⁴ (W^*) passing through point *b*, we can find its intersection at point *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 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 only ad/ac as large as the actual PL used on this product. For any given product, this cost (i.e., cd/ac) can now be estimated.⁵

² For the given 1967 or 1968 price ratio (P_u/P_r).

³ Based on data of earlier years (i.e., 1955-64) and 1967 or 1968 prices.

⁴ The *level* of welfare is irrelevant.

⁵ See Appendix B for the precise formula and its derivation.

Before 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. 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 calculated for the various samples. For variety-distortion costs, therefore, medians are reported.

The distributions of the variety-distortion costs are given 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 $\ln [\dots] / \sigma_i$ calculations, the results are qualitatively similar. For 1967 the medians of the distributions of variety-distortion costs 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 to 15 per cent is indicated. For 1968, the median variety-distortion cost of the sample of PL-eligible products rose to 30 to 35 per cent; even for the sample of major PL-eligible products, a cost of around 10 per cent 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 force of additionality 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 began to cause variety distortion even for the major "positive list" goods.

It cannot be too strongly emphasized that these results should not 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 per cent), for approximately one-third of the products no variety-distortion cost is found and for another third, costs above 60 per cent are estimated. Such high sample variances mean that, even if significance tests were warranted and possible, one might not be able to reject confidently the null hypothesis of zero medians for all samples.

Nevertheless, there remain the "point estimates" of variety-distortion costs above 10 per cent in 1967 (for at least the minor "positive list" products) and ranging into the 30 per cent region in 1968. Let us look again at what such 10 to 30 per cent estimates of costs imply: if Colombia

TABLE 6
DISTRIBUTION OF VARIETY-DISTORTION COSTS

Sample	Year	No. of Observations	Variety-Distortion Costs				Median Percentage
			Negative	0 to 30%	30 to 60%	Above 60%	
1. <i>PL-eligible products:</i>							
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. <i>Adjacent non-PL-eligible products:</i>							
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. <i>Major PL-eligible products:</i>							
Free estimate	1967	9	4	4	0	1	0.0 ^a
	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

^a Median is positive but less than 0.05 per cent.

had been able to spend the 1967 or 1968 PL on an optimal variety ratio within each category of goods, even without any ability to reallocate the PL differently among goods, it would have been just as well-off with 10 to 30 per cent fewer 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 to 30 per cent 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 Program Loan (PL) from the United States. 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 1 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) Standard International Trade Classification (SITC or, in Colombia, CUCI). Since, in order to estimate the optimal 1967 or 1968 ratio of varieties of the i^{th} good (i.e., Q_{iu}^0/Q_{ir}^0), import data before 1965 are used, products had to 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 that whenever a single SITC classification could be traced *closely* to an eight-digit BTN classification, the product was retained in the sample. "Closely" was defined 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 per cent of the 1964 imports (of all the 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 per cent 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 were zero imports from the United States or

¹ For a general discussion of the comparability of SITC and BTN, see *The Development of a Uniform Tariff Nomenclature* (Washington: U.S. Tariff Commission, 1968).

from the rest of the world in a particular year, it was of course impossible to calculate 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.² Finally, since historical import data were needed for statistical estimates of the degree of substitutability between 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.³

Once the inability to trace products through the change-over in tariff classification and the problems of 100 or 0 per cent imports of United States varieties (in 1967 or in too many years over 1955-64) were considered, there remained a sample of 63 PL-eligible products.⁴ Thus the sample of "PL-eligible products" discussed in the present study consists of 63 of the roughly 1,000 PL-eligible commodities. These 63 are clearly a nonrandom sample of the original random sample of 180 PL-eligible commodities.⁵

For purposes of comparison, a sample of commodities that were not eligible for use under the PL was also needed. Since PL-eligible (i.e., "positive list") products are certainly not a random sample of all intermediate and capital goods, we decided not to attempt a random sample of non-PL-eligible products; such a random sample would have included many goods whose historical price and national share patterns, as well as Colombian licensing priorities, had changed quite differently over the period from PL-eligible products. We preferred to examine comparable non-PL-eligible commodities—that is, goods not eligible but as similar as possible to goods that 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 subsample of the sample of 63 PL-eligible commodities was chosen; for each of the 41 PL-eligible commodities in the subsample, we located the nearest non-PL-eligible commodity in the tariff classifications (which

² For the 1968 samples, eight more products had to be discarded for this reason.

³ 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 United States (or rest-of-world) imports.

⁴ For 1967. The sample consists of 59 products in 1968.

⁵ Moreover, it is not easy to guess the net direction of any bias the various ejections may have caused.

could be closely traced through the SITC-BTN tariff change and which fulfilled the requirements of nonzero 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.⁶

Finally, since there were indications that the PL affected major imports differently from minor imports, it was decided to draw another *nonrandom* sample of the important imports into Colombia that 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."⁷

For each of the products in the three samples, the quantity and value (and hence unit value) of imports from the United States and from the rest of the world were traced for each of the years 1955 through 1964 and for 1967 and 1968. These data were found, for 1955-64, in the annual volumes of *Anuario de Comercio Exterior*⁸ and, for 1967 and 1968, in unpublished printouts.

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 σ_i ($= -a_{i2}$) have the expected sign, and only 3 per cent of the estimates have a significant (at 10 per cent 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 United States share is shown, at the micro level, by the fact that two-thirds of the trend coefficients are negative).

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. Government view would

⁶ For 1967. The sample consists of 37 products in 1968.

⁷ 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.

⁸ (Bogotá: Departamento Administrativo Nacional de Estadística.)

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 ^a	9(6)	10(8)	4(2)	1(1)
Total	41	50	26	4

Quartile Statistics: $Q_1 = -2.0176$
 $Q_2 = -1.0934$
 $Q_3 = +0.0008$

^a Figures in parentheses exclude the seven products that are also included in the sample of PL-eligible products.

TABLE A-2
DISTRIBUTION OF THE 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 ^a	7(4)	10(9)	6(3)	1(1)
Total	33	48	32	8

Quartile Statistics: $Q_1 = -.2604$
 $Q_2 = -.0795$
 $Q_3 = +.0780$

^a Figures in parentheses exclude the seven products that are also included in the sample of PL-eligible products.

TABLE A-3
COMPARISONS OF PL-ELIGIBLE AND NON-PL-ELIGIBLE PRODUCTS
(in per cent)

	<i>PL-Eligible Products</i>	<i>Non-PL-Eligible Products</i>
Elasticity of substitution greater than 1 ($a_{i2} < -1$)	50	54
Trend negative ($a_{i1} < 0$)	69	63
(P_{iu}/P_{ir}) higher in 1964 than in 1955 ^a	61	44

^a Or for the nearest year to 1964 or 1955 for which data were available.

be those goods (1) with secular trends away from the United States varieties, (2) with high substitutability among varieties, and (3) with rising (over 1955-64) United States 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 estimates of the elasticity with respect to relative prices that are of incorrect sign for 30 products and are not significantly different from zero at a 10 per cent confidence level (although of correct sign) for another 50. Accordingly, it was decided to fit further regressions in which the relative-price 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 $\frac{1}{2}$, 1, and 2, the data being left the job only of determining the constant term (a_{i0}) 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.

APPENDIX B: THE FORMULA FOR VARIETY-DISTORTION COST

Colombia's actual expenditure on a particular product that is eligible for PL use is¹

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

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

$$(B-2) \quad P_u Q_u^O + P_r Q_r^O.$$

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

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

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 given by

$$(B-4) \quad VDC = \frac{P_u(Q_u^A - Q_u^E) + P_r(Q_r^A - Q_r^E)}{P_u(Q_u^A - Q_u^O) + P_r(Q_r^A - Q_r^O)}.$$

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

$$(B-5) \quad VDC = \frac{Q_r^N - Q_r^E}{Q_r^N - Q_r^O}.$$

In equation (B-5), neither Q_r^N nor Q_r^E is observable,² but each can be expressed in terms of observable and estimated quantities. First, the regression estimates of the relation of variety ratio to time and prices³ 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 (Q_u^O/Q_r^O) as q_0 , the actual variety ratio (Q_u^A/Q_r^A) as q_A , and the 1967 (or

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.

³ See equation (24) and Appendix A.

1968) price ratio (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) ,⁴ we can derive

$$(B-6) \quad \frac{Q_r^N}{Q_r^O} = \frac{pq_A + 1}{pq_O + 1}$$

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),

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

or, simplifying,

$$(B-8) \quad \frac{Q_r^E}{Q_r^O} = \left(\frac{\alpha(q_A)^{-\beta} + (1 - \alpha)}{\alpha(q_O)^{-\beta} + (1 - \alpha)} \right)^{-\frac{1}{\beta}}$$

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

$$(B-9) \quad VDC = \frac{(1 + pq_A) - (1 + pq_O) \left(\frac{\alpha(q_A)^{-\beta} + (1 - \alpha)}{\alpha(q_O)^{-\beta} + (1 - \alpha)} \right)^{-\frac{1}{\beta}}}{p(q_A - q_O)}$$

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 .

⁴ I.e., at points b and c in Figure 3.

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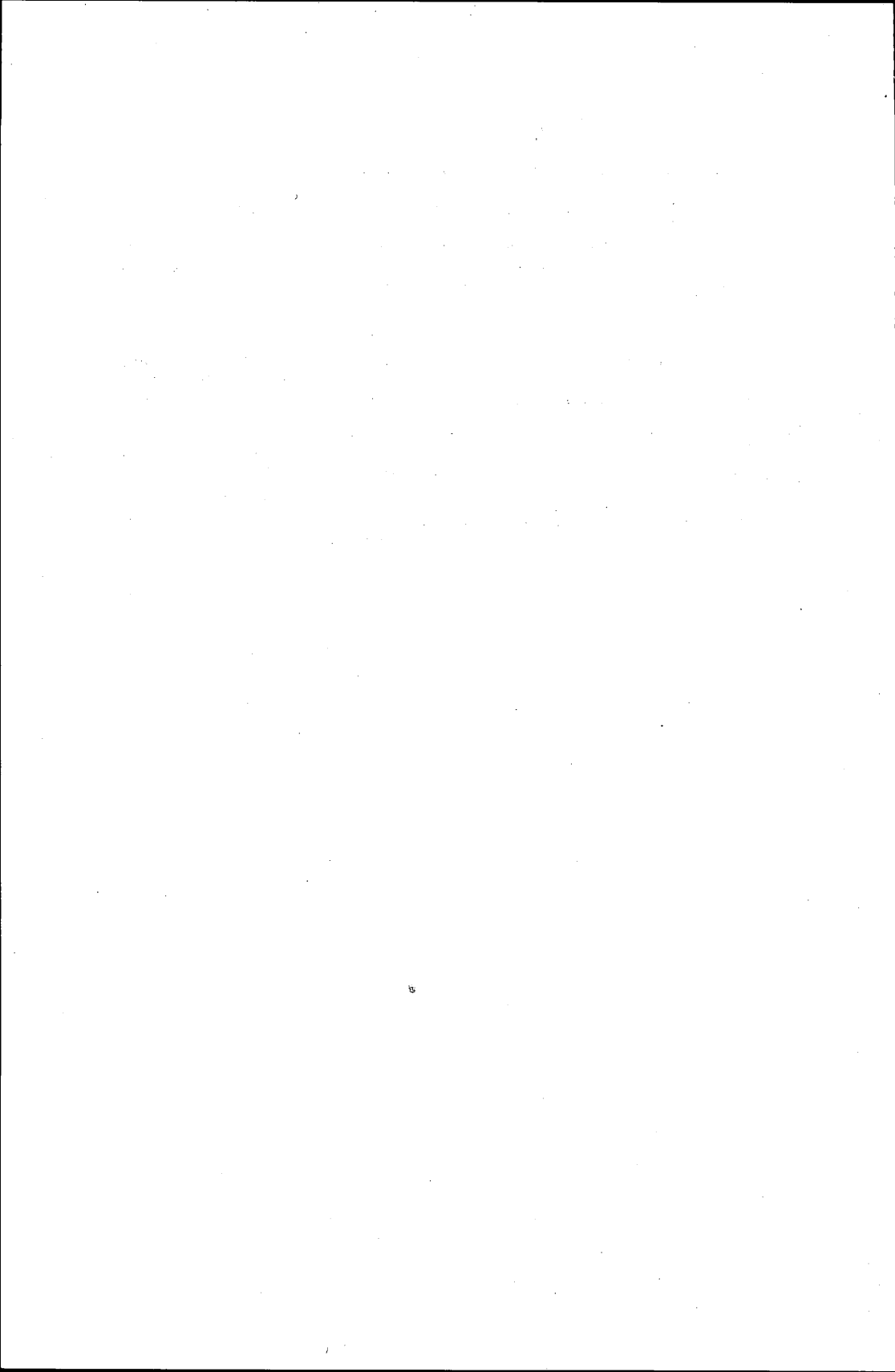
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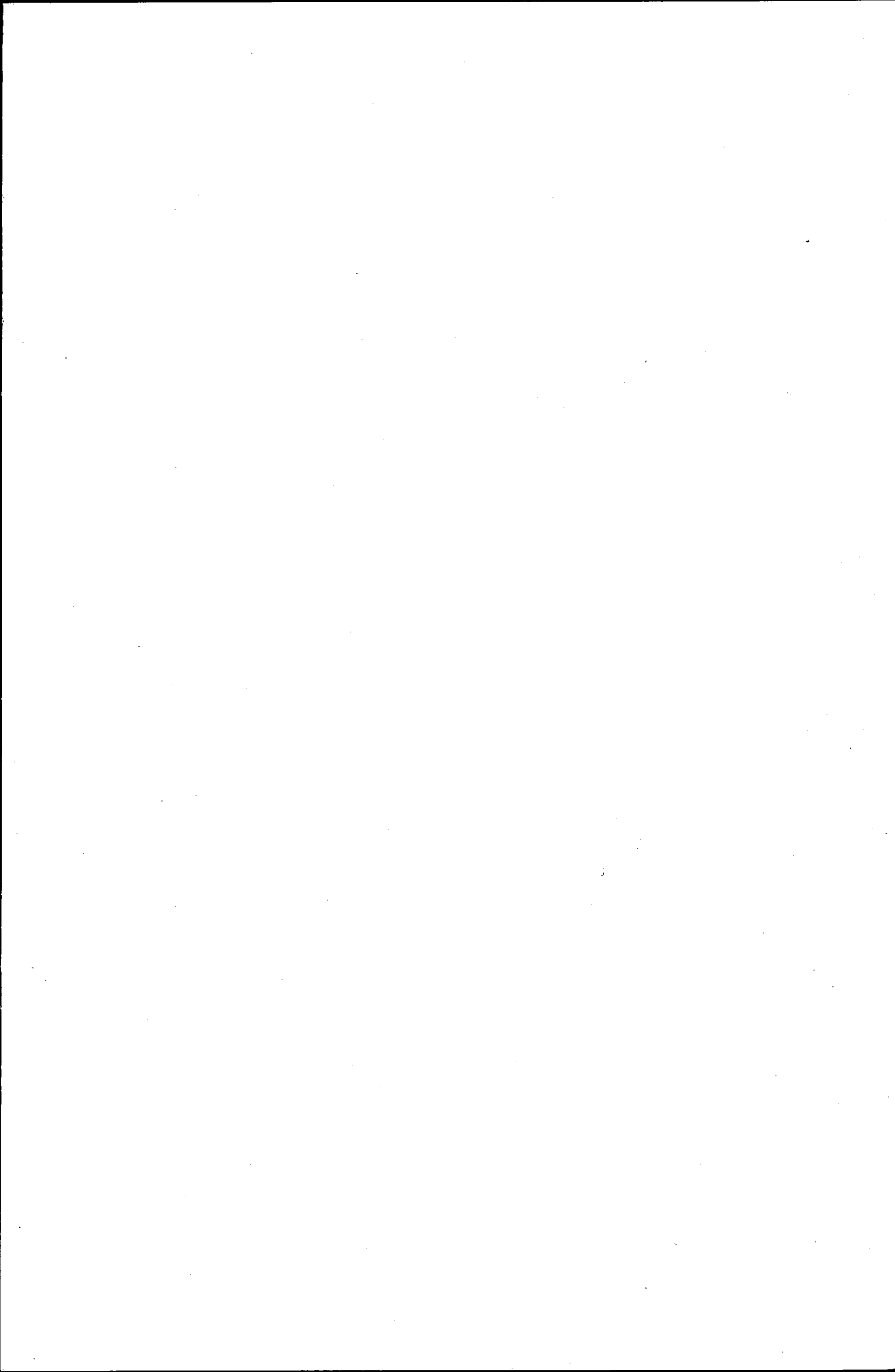
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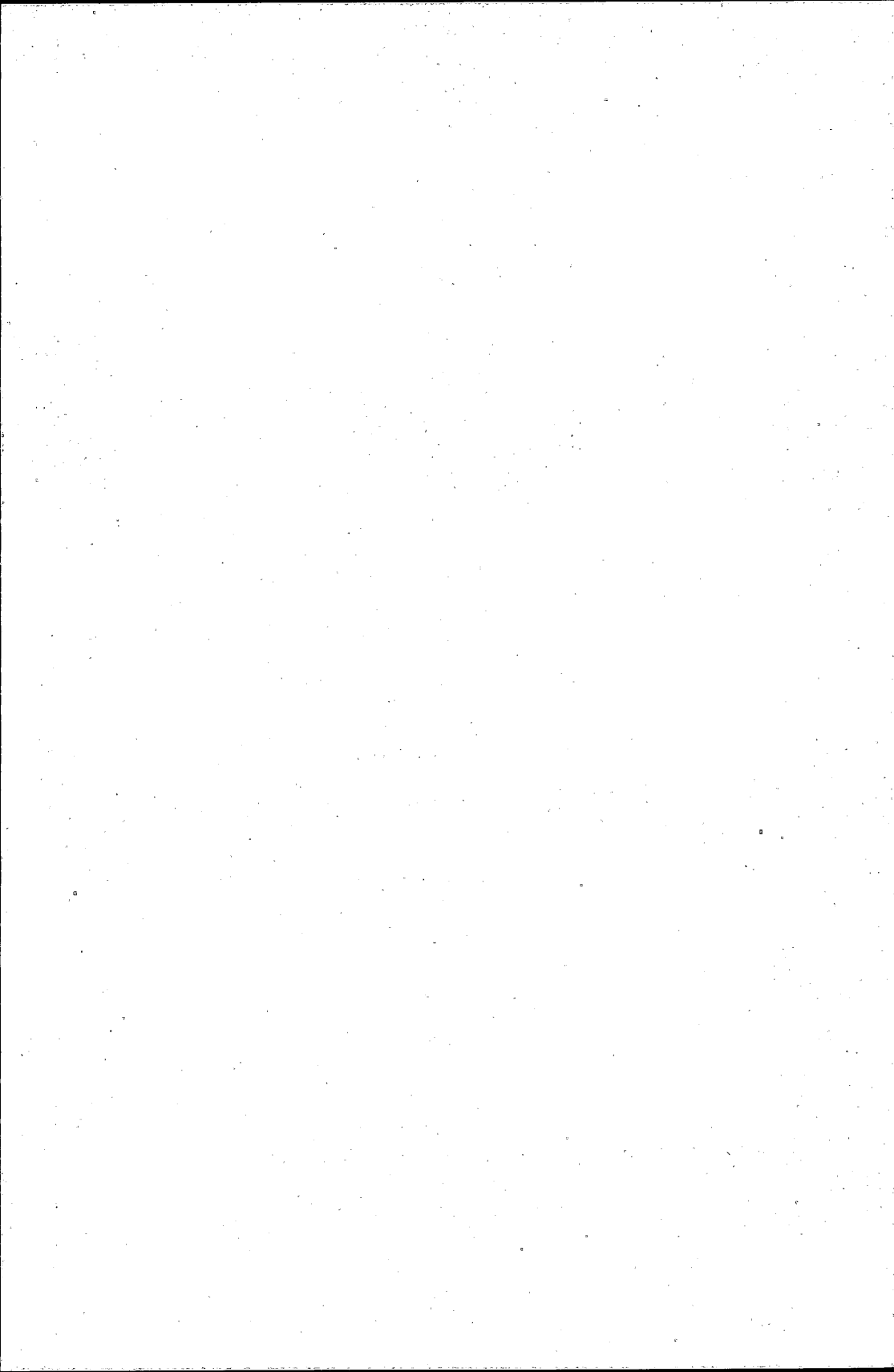
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