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A NOTE ON FOREIGN ASSISTANCE AND THE CAPITAL REQUIREMENTS FOR DEVELOPMENT

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PREFACE

This RAND Memorandum was prepared for the Agency for International Development as a part of The RAND Corporation's continuing research on the economic, political, and military aspects of U.S. foreign assistance. The present study uses the concept of the discounted present-value "grant equivalent" to investigate one important aspect of efficiency in aid giving. This aspect of efficiency may be defined as the maximizing of the amount of grant equivalent received per dollar of grant equivalent given by the donor country.

The author is a RAND consultant and a member of the Yale University Economics Department. For helpful suggestions and criticisms of this study in draft, the author is grateful to RAND colleagues Benton F. Massell of the Economics Department and John Pincus of the Logistics Department.

SUMMARY

Much has been written in recent years about the "efficiency" of foreign assistance in achieving the broader objectives of U.S. policy regarding the less developed portions of the globe. These objectives are extremely diverse, are often intangible, and are occasionally in conflict. "Efficiency" under these circumstances is difficult to define, still more difficult to put into practice.

This RAND Memorandum addresses the question of efficiency in foreign assistance from a narrower point of view. It implicitly assumes that the sole purpose for extending foreign assistance is to further economic development in the recipient countries, and that economic development in the recipient countries can be measured solely in terms of increases in real national income properly valued. These are severely restrictive assumptions. Yet the furthering of economic development is one of the principal objectives of U.S. foreign assistance; and the increase of real national income is one important measure of economic development. At the same time, public resources are not free in the donor countries; they must be carefully allocated among competing needs. It is not wholly without purpose, therefore, to examine some dimensions of "efficiency" in aid-giving even in this narrow context.

This Memorandum, then, is essentially an exercise in optimization, given the need to conserve resources in the donor and given the objective of raising real national income in the recipient. Following the ideas developed by Pincus,[1] foreign assistance extended by the donor can be converted into a "grant equivalent," the amount that the donor in effect actually gives away as "pure" foreign aid. Using a similar technique, a "grant equivalent" can be defined for the recipient by taking the present discounted value of the foreign assistance and all

[1] RM-3317-ISA, The Cost of International Economic Aid in 1961, The RAND Corporation, October 1962 (For Official Use Only). Also published in part as "The Cost of Foreign Aid," Review of Economics and Statistics, XLV (November 1963), pp. 360-367.

future debt servicing associated with it. So long as the rate of discount for the recipient exceeds that for the donor, the grant equivalent for a given capital flow will typically be higher for the recipient than it is for the donor. On grounds of efficiency it is desirable to maximize the grant equivalent to the recipient per dollar grant equivalent from the donor. The analysis shows that in the case of straightforward lending this maximization is accomplished by lengthening the maturity of the loan indefinitely and raising the interest rate charged on the loan just enough to leave the grant equivalent from the donor unchanged.

Optimizing terms for other forms of assistance are more complicated. As illustrations, two recent proposals are examined using the tools of grant equivalents: the investment tax credit proposal and the proposal to subsidize interest rates on flotations by less developed countries in the bond markets of donor nations. In both cases, straightforward lending would very likely be a more efficient method, in the sense described above, for extending foreign aid.

A by-product of the analysis presented here is the discovery that several well-known projections of the capital needs of the less developed countries contain a downward bias because of a failure to distinguish carefully between increases in domestic output and increases in national income. The presence of debt-servicing requirements introduces a gap between these two global measures of economic activity and creates a close relationship between the <u>terms</u> of aid and total external capital requirements.

FOREWORD

After this RAND Memorandum was written the author's attention was drawn to Wilson Schmidt's "The Economics of Charity: Loans vs. Grants" in the August 1964 issue of The Journal of Political Economy. Schmidt covers much the same ground as Section IV of this Memorandum, although he approaches the subject somewhat differently. Schmidt does recognize the possibility, touched on only briefly here, that the rate of return on capital in its most efficient application may be higher in the donor countries than in the less developed countries. Where this is so, the conclusions drawn here must be modified substantially, though the method of analysis is still appropriate. If this is generally so, however, then much of the extant literature on economic development is misguided. The view adopted in the present study is that the proper application of external resources will raise output in most less developed countries by more than the same resources will raise output in the developed countries. But "proper application" may involve expenditures very different from mere installation of capital goods. It may also involve a time dimension that severely limits the quantity of external capital that may be usefully applied in any given year. A deluge of external resources, however much it may boost current consumption, may contribute little to future standards of living. This Memorandum is germane to development assistance with a relatively high payoff.

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I. INTRODUCTION

Raising incomes in the poorer parts of the world has increasingly commanded the attention of economists. Much effort has been devoted to discovering how the economically advanced countries might foster this economic development, and to mobilizing public sentiment in favor of extensive economic assistance for development. An essential part of this effort has been estimating the size of the task -- the amount of economic assistance that would be required to satisfy minimal development objectives. Since the public thinks in global terms, and parliaments appropriate global amounts, global estimates are required. Recent estimates of the global requirements for external assistance to the less developed countries hover in the range of $5.5 to $7.0 billion a year.[1] The United Nations reports a net flow of capital from the economically advanced countries to the rest of the world in 1961 of $7.2 billion and the Organization for Economic Cooperation and Development reports an even higher flow of $8.7 billion.[2] We thus seem to be meeting and even exceeding these targets for external capital. It would appear that we have reached the point where we can relax and let this massive flow of capital do its work.

Viewing things globally requires some commensurability among the parts. Yet the flow of capital to less developed countries, particularly government-to-government economic assistance, takes a wide variety of forms -- cash grants, commodity grants, grants in technical assistance, loans repayable in hard currency and soft currency, at

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[1] See for example the estimates by M. F. Millikan and W. W. Rostow, by Paul Hoffman, and by P. N. Rosenstein-Rodan, summarized in United Nations, The Capital Development Needs of the Less Developed Countries, New York, 1962.

[2] United Nations, International Flow of Long-Term Capital and Official Donations 1959-1961, New York, 1963; and Organization for Economic Cooperation and Development, The Flow of Financial Resources to the Countries in the Course of Economic Development in 1961, Paris, 1963.

low interest rates and high interest rates, with short maturities and long maturities, tied and untied. Dollar-for-dollar, these different forms of assistance contribute very unequally to economic development.

Recently, John Pincus has attempted to convert these different types of economic assistance to a common, comparable unit, a "grant equivalent."[1] Pincus is primarily concerned with the comparability of foreign assistance among the major donor nations in connection with an analysis of "fair shares" among donors in aid giving. Pincus' adjustments, while useful in a discussion of international burden sharing, are unfortunately not equally appropriate for comparing the external capital available to the less developed countries with their estimated capital requirements.

Section III of this Memorandum indicates some of the adjustments that enable one to assess various forms of capital inflow, especially foreign lending and equity investment with different yields and maturities, from the viewpoint of the recipient countries. It will be clear from the adjustments required that several projections of the capital requirements of less developed countries have been understated substantially because of a failure to distinguish adequately between output and income. This is discussed in Section IV. Using adjustments from the viewpoints of both donor and recipient, Section V finds aid terms that maximize the gain to the recipient for a given amount of aid from the donor. Finally, Section VI evaluates a recent U.S. proposal for extending assistance and suggests some alternatives. But first a brief review of Pincus' results will be useful.

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[1] John Pincus, RM-3317-ISA, The Cost of International Economic Aid in 1961, The RAND Corporation, October 1962 (For Official Use Only). Also published in part as "The Cost of Foreign Aid," Review of Economics and Statistics, XLV, November 1963, pp. 360-367.

II. FOREIGN ASSISTANCE AS GRANT EQUIVALENTS FROM DONORS

In contrast to grants, loans yield a flow of interest and amortization payments to the lender. Loans therefore contain less "aid" than a comparable amount in grants. Starting with new commitments of foreign assistance to the less developed countries as a group from each of nine major donors, Pincus attempts to compute "grant equivalents" of these commitments by deducting present discounted values of future interest and amortization payments from their nominal value. Choice of a discount rate influences these grant equivalents considerably, of course, but at all three rates chosen by Pincus -- 5 per cent, 10 per cent, and each donor's domestic long-term bond rate -- the grant equivalents were substantially less than the unadjusted flows. For instance, using each donor's long-term interest rate resulted in a grant equivalent for the nine donors together equal to only 68 per cent of the nominal flow. The higher discount rate of 10 per cent raised the grant equivalents, but still left them at only 77 per cent of the unadjusted flows.

This adjustment permits a comparison of the real grant component of foreign aid extended by different donors and hence permits some assessment of each donor's contribution toward what is professed to be a common objective -- raising output and incomes in the less developed countries. A complete picture of each donor's contribution would require still further adjustments. For example, many donors now tie foreign aid to procurement in the donor country or limit it to certain goods.[1] Unfortunately, the extra value to the donor country accruing from such limitations is not easily estimated; it depends among other things on the availability of unused productive resources able to satisfy the additional demand resulting from tied aid and on the additional demand actually created. A number of donors practice a certain degree of self-deception in tying increases in their aid to

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[1]See for instance the recently announced policy of the United Kingdom that it would extend extra aid to be used for purchases from British industries with excess capacity.

domestic procurement under conditions of full employment. Thus, although adjustments for aid tying and other practices would be desirable, the difficulty of making them precludes going much beyond adjustments for interest and repayment terms, and these are undoubtedly the most important.[1]

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[1]Pincus, op. cit., did attempt to reduce U.S. shipments of surplus agricultural products under P.L. 480 to a "grant equivalent" by valuing relief shipments at world prices. A brief attempt is made to estimate world prices in the absence of U.S. agricultural support programs, but this seems to me to be going excessively far afield, as it represents only a partial correction for the total impact of economic policy on relative prices and exchange rates. For example, if Europe abandoned its agricultural protection too, upward pressure would be put on world agricultural prices.

III. FOREIGN ASSISTANCE AS GRANT EQUIVALENTS TO RECIPIENTS

The adjustment to grant equivalents made by Pincus approaches foreign aid from the viewpoint of the donor. But the recipient is much more concerned with the real benefit of foreign aid to itself than with its real "cost" to the donor. It is concerned with its own economic development and wants to know how much new foreign assistance will contribute to that.

The objective of development assistance is to raise future incomes in the less developed countries.[1] Various target rates of growth in national income have been set, with the United Nations General Assembly calling for "a minimum annual rate of growth of aggregate national income of 5 per cent" by 1970.[2] Allowing for projected population increases, this amounts to a growth in per capita income of a bit more than 2 per cent a year. How much foreign capital is required to achieve these targeted growth rates? By assuming some fairly constant relationship between new investment and the increase in output, the total capital requirements for achieving any specified growth rates can be estimated. Estimates of the increases in domestic saving forthcoming at the targeted growth rates permit, by deduction, an estimate of external capital requirements -- the savings that must be transferred to the less developed countries from abroad if the targeted growth rates are to be achieved. As noted, the estimates made in the past are roughly the same order of magnitude as the net flow of capital actually moving into the less developed countries.

The technique for projecting capital needs outlined here, although frequently used, regrettably overlooks the critical distinction between total output (domestic product) and national income. The technological

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[1] Much foreign assistance is of course directed toward objectives other than economic development. This study focusses only on the objective of economic growth in the less developed countries.

[2] United Nations General Assembly Resolution 1710 (XVI), December 1961.

relationship used in estimating capital requirements specifies the relationship between new capital and additions to output, not to income. If the foreign owners of capital skim off some of the additional output in the form of interest and profits, the contribution of foreign capital to raising national income will be correspondingly less. Output may be increased in the geographical territory of the less developed countries without any addition to the income of the permanent residents of those countries.[1] Some idea of the importance of the distinction between net domestic product and national income is indicated by the national accounts for such countries as Venezuela, The Congo, Zambia (formerly Northern Rhodesia), and Iraq, where net domestic output exceeds national income by 8-20 per cent.

In comparing actual capital flows to the less developed countries with projections of their capital needs, it is useful to calculate a grant equivalent capital flow from the viewpoint of the recipient, analogous to Pincus' calculations for the donors. This grant equivalent for a given inflow of loan or equity capital can be defined as the grant that would raise national income in the recipient country by the same amount that the given inflow actually raises it. Thus if R represents the net marginal social rate of return on new investment in a particular country, I represents a net inflow of foreign equity capital or a perpetual loan, and P is the rate of profit or interest accruing to the foreign investor, then the grant equivalent H is defined by the equation

$$RH = (R - P)I$$

or

$$H = (1 - \frac{P}{R})I \qquad (1)$$

[1]According to balance of payments accounting practices in most countries, foreign-owned enterprises incorporated in the country in which they are located are considered "residents" of those countries, and increased net output by such firms will thus contribute to the recorded national income in those countries except for the earnings actually repatriated abroad. It seems more in keeping with the ultimate objective of development, however, to consider such firms as "non-residents" for the purpose of computing national income and to exclude total earnings accruing to foreigners, whether or not repatriated.

Here the annual increment to output in the debtor country is RI, but the addition to its national income is only (R - P)I. H is the grant that would increase national income by the same amount.

More generally, allowing for changes in R and P over time (t) and for the amortization of loans or the future repatriation of equity capital,

$$H = I \sum_{t=1}^{\infty} \frac{[R(t) - P(t)][1 - \sum_{i=1}^{t-1} D(i)]}{\prod_{i=1}^{t} [1 + R(i)]}, \qquad (2)$$

where D(i) is the amortization payment or capital repatriation in period i, and where I can now be a fixed-term loan. For a loan with amortization and interest payments made in equal periodic installments F per dollar over its life n, and with R and P constant over time, equation (2) becomes

$$H = I \left\{ 1 - \sum_{t=1}^{n} \frac{F}{(1+R)^t} \right\} = I \left\{ 1 - \frac{P(1+P)^n}{[(1+P)^n - 1]} \cdot \frac{[(1+R)^n - 1]}{R(1+R)^n} \right\}$$

$$= (1 - P^*/R^*)I \qquad (3)$$

where $P^* = \frac{P(1+P)^n}{(1+P)^n - 1}$, and so on.[1] H is thus the inflow of capital less

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$$\sum_{t=1}^{n} \frac{F}{(1+R)^t} = F \sum_{t=1}^{\infty} \frac{1}{(1+R)^t} - F \sum_{t=n+1}^{\infty} \frac{1}{(1+R)^t} = F \left[\frac{1}{R} - \frac{1}{R(1+R)^n} \right]$$

$$= F \frac{(1+R)^n - 1}{R(1+R)^n}.$$ Uniform interest and amortization installments F on a loan of maturity n and interest rate P equal $\frac{P(1+P)^n}{(1+P)^n - 1}$ per dollar loaned.

the present discounted value of future interest and amortization payments on it, where the marginal social rate of return R is used for discounting. A grant H, yielding R, will increase national income by the same amount as the loan I.

Before turning to a closer examination of equation (3) in the context of projections, a word needs to be said about the net marginal social rate of return on capital (R) and the rate of interest or profit on foreign investment (P).

The net marginal social rate of return is the amount by which an additional unit of capital employed in the most efficient way will increase output, properly valued, net of capital consumed in the process. The last qualification can be considered first. It implies that the value of capital is maintained indefinitely through capital consumption allowances which are deducted from gross output to get net output. This can be accomplished without affecting R if depreciation takes place on the "fixed annuity" principle.[1]

The most acute practical difficulties in measuring R arise in valuing output properly. In particular, if a country's exchange rate is overvalued and payments balance is maintained, for example, with direct controls over trade, then any output sold abroad (or that would replace imports from abroad) will have a greater social value than is indicated by money value added to net domestic product. Similarly, imported inputs will be socially more costly than the money cost attributed to them, so the true value added by projects using such inputs will be exaggerated. In computing R, adjustments also should be made for positive and negative externalities resulting from the additional output.[2]

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[1]See J. E. Meade, A Neo-Classical Theory of Economic Growth, London, George Allen & Unwin, 1961, Appendix III.

[2]Not all discrepancies between private and social cost will distort the recorded value of incremental output. For example, minimum legal or conventional wages in the presence of high underemployment of labor may reduce the private rate of return to capital but it affects only the distribution of real additions to output, not the recorded level.

It is assumed that additional external capital will be used in ways most efficient for raising output. In some cases this may not involve additions to the capital stock as conventionally defined, but rather may require hiring the services of foreign technical personnel or sending residents abroad for training, for instance. This assumption will be violated in the case of private investment if there are large differential discrepancies from project to project between private and social returns.

Finally, R will vary in practice not only from country to country but also according to any restrictions that are placed on the source or type of aid. One would expect R to be lower for tied aid than for untied aid, for in general aid tying will reduce the real value (measured at world prices) of a given amount of aid. When aid is limited to certain products, even when they are valued at world prices -- as is the case with most commodities shipped under P.L. 480, for instance -- the social return will be lower than for aid unrestricted as to product unless productive resources are highly mobile within the recipient country or unless such assistance is allocated very carefully. But these distinctions will be ignored in what follows.

Only a few comments are required on the earnings (P) on foreign capital. First, such earnings must include <u>all</u> earnings, not just earnings repatriated. Many private investors reinvest substantial parts of their earnings abroad, but in principle these reinvested earnings contribute to national income in the creditor country, not in the debtor country, and they represent a new allocation of foreign capital in the debtor country. Admittedly this distinction, sharp enough in theory, blurs somewhat in the presence of fiscal measures and direct controls designed to compel some reinvestment. If amortization and interest cannot be transferred or are undertransferred, real cost of P to the debtor country may be less than nominal cost.

Second, although the focus of attention is usually on economic assistance originating with governments, private capital can also contribute to the capital requirements of the less developed countries. Even when the bulk of additional output represents earnings of foreign

investors, some local factor payments and tax payments add to national income in the debtor country -- and scarce foreign exchange may be generated or conserved. The contribution of foreign private capital will be less than the contribution of economic assistance, ceteris paribus, to the extent that foreign earnings are greater on private capital. The value of P in equation (1) can be taken as a weighted average of the rate of return on grants, private equity capital, and perpetual loans. Loans with fixed maturities require separate treatment, as in equation (3).

IV. A DOWNWARD BIAS IN PROJECTIONS OF CAPITAL NEEDS

A number of attempts have been made to estimate the global capital requirements of the less developed countries over the next decade or so. Of these, perhaps the most thorough and detailed estimates have been offered by Rosenstein-Rodan.[1] His estimates can be taken as representative of the best efforts that have been devoted to such projections. Using a technique similar to that outlined in Section III, Rosenstein-Rodan estimates the annual requirements for foreign capital for over 80 individual less developed countries for the three periods 1961-1966, 1966-1971, and 1971-1976. When added up, the required flow of development capital from the economically advanced countries came to $5.7 billion annually during the first two periods and fell to $3.8 billion a year during the third period.[2]

Rosenstein-Rodan recognizes that not all capital inflows contribute equally to development and he therefore defines a more restrictive type of capital, "development capital," which excludes much of the capital inflow actually recorded. He excludes from development capital all loans under 10 years in maturity, one-third of the surplus agricultural products shipped under U.S. aid programs, one-half of all private direct investment in mineral extraction, and four-fifths of all "defense support" assistance from the United States. These adjustments are made on the grounds (a) that loans under 10 years are merely "selling devices" for exports, (b) that some part ("one-third") of agricultural shipments adds to consumption rather than investment in the recipient countries, (c) that investments in the extractive industries tend to create enclave economies that contribute little to

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[1] P. N. Rosenstein-Rodan, "International Aid for Underdeveloped Countries," The Review of Economics and Statistics, XLIII (May 1961), pp. 107-138. Recently Bela Balassa has also made very detailed projections of foreign capital requirements based on a very different methodology. See Trade Prospects for Developing Countries, Homewood, Illinois, Richard D. Irwin, 1964.

[2] Rosenstein-Rodan, ibid., p. 137; in contrast, Balassa, op. cit., p. 104, estimates capital requirements of $9-10 billion for 1970 and $11-14 billion for 1975.

real development, and (d) that "defense support" is not really economic assistance, although it can contribute some ("one-fifth") to capital formation. All technical assistance is also excluded, on the grounds that it does not contribute directly to capital formation.[1]

These are necessarily crude adjustments, but it is easy to appreciate the reason for some adjustment and to respect Rosenstein-Rodan's judgment in making the particular adjustments, although others might make somewhat different adjustments.[2] But once these adjustments are made, capital flow from the developed countries is not further differentiated; a 15-year loan is counted dollar-for-dollar the same as private direct investment or a development grant. Indeed, Rosenstein-Rodan explicitly suggests that the total capital flow to each country should be governed largely by its "absorptive capacity," whereas the terms of that flow should be governed by its "capacity to repay."[3] There is no recognition that the terms of a given capital inflow can substantially affect its impact on gross national product in the recipient country. Yet there is an enormous difference to the debtor between a 10-year loan, a 30-year loan, and a grant. For example (using equation (3) with R = .20), a 20-year, 3-per cent loan will raise national income by only two-thirds of the rise resulting from an equivalent grant.

To take into account differences in the terms of aid requires some adjustment such as that in equation (3), reducing all capital flows to a commensurable unit from the viewpoint of the recipient.

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[1]On this basis, Rosenstein-Rodan estimates an actual flow of development capital to the less developed countries in 1959 of $3.65 billion, or $4.15 billion if Soviet aid is included. According to the United Nations the flow of capital from the developed countries to the rest of the world rose $1.9 billion between 1959 and 1961, and virtually all of this increase was in official capital and donations, so Rosenstein-Rodan's global target of $5.7 billion has probably been met, though not necessarily his target for each country.

[2]In particular, "defense support" can contribute much more to development in a number of recipients than the one-fifth allowance implies.

[3]Rosenstein-Rodan, op. cit., p. 109.

This adjustment requires information on the social rate of return, R, about which we generally have only scanty knowledge. This deficiency applies equally to all projections of capital needs, however, where some assumption is usually made about the value of the (marginal) capital-output ratio. Rosenstein-Rodan, for example, assumes a gross capital-output ratio of 3.0 for nearly all of the countries for which he makes projections, and a slightly higher ratio for Argentina, Brazil, Chile, and Peru.[1] Millikan and Rostow use a net capital-output ratio of 3.0 in their study.[2]

Althoughly widely used in technical discussions on economic growth, the "marginal capital-output ratio" is unfortunately rarely defined precisely enough to leave it free of ambiguity. In particular, it is usually unclear whether the concept represents the amount of capital required per unit of additional output on the assumption that complementary factors are available at their opportunity costs or whether additional costs incurred in associating such factors with the new investment, such as workers' housing, are also taken into account. The capital-output ratio would be higher on the latter basis than on the former. In addition, it is often unclear whether the capital-output ratio refers to the economy as a whole or to particular projects. Labor to work with the new capital must be drawn from other uses, so while output will go up where the new capital is employed, it will go down elsewhere. Thus the marginal capital-output ratio will generally be higher for the entire economy than for individual investment projects.

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[1]The higher ratios for the last four countries are said to result from an assumed net capital-output ratio of 2.8 for all countries (ibid., p. 136). Rosenstein-Rodan has erred in this calculation, however, since the net capital-output ratio must exceed the gross capital-output ratio. A gross ratio of 3.0, used for Rosenstein-Rodan's calculations, implies a net capital-output ratio of 3.24 if depreciation equals 12 per cent of the change in net national product, for example.

[2]Max F. Millikan and W. W. Rostow, A Proposal, Key to an Effective Foreign Policy, New York, Harper and Brothers, 1957.

Of course if complementary factors such as labor and management are underutilized yet willing to work more, their social cost is nil and the ambiguity disappears. In this case the marginal net capital-output ratio implied by Rosenstein-Rodan's calculations would yield a net social rate of return, its reciprocal, of about .30, assuming that no adjustments for exchange rate overvaluation are necessary. Typically, however, the direct and indirect (opportunity) costs of employing complementary factors with new capital are understated, so the net social rate of return on new capital in the less developed countries may be well under .30. In their study of the Soviet economy, for example, Moorsteen and Powell find that imputing a marginal rate of return to capital of .20 would imply that virtually no technical improvements in Soviet production have taken place over the past 35 years. Since this is most unlikely in view of the vast educational improvements and substantial borrowing of technology from abroad, the return to capital must be well under .20.[1] The Soviet Union is by now highly capitalized compared with most of the less developed countries, but that was not so true 35 years ago. Although there is undoubtedly wide variation in the rate of return from country to country, an average for all less developed countries in the range .20 to .30 seems probable.[2]

Estimates of the earnings rate to foreign investors or lenders are less speculative. Total earnings (including reinvested earnings) on U.S. direct investments in less developed countries were about 16 per cent on book value in 1963. Earnings on other U.S. private claims (including short term) on the less developed countries came to 4 per

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[1]Richard Moorsteen and Raymond Powell, The Capital Stock of the Soviet Union, 1928-1962, Yale Economic Growth Center (forthcoming).

[2]Ando and Lefeber have estimated the net rate of return over cost in India at 20.5 per cent, for instance. See Albert Ando and Louis Lefeber, "Capital Formation: A Theoretical and Empirical Analysis" in P. N. Rosenstein-Rodan (ed.), Capital Formation and Economic Development, Cambridge, The M.I.T. Press, 1964, p. 109.

cent, while earnings on U.S. government claims amounted to 3 per cent.[1] The average return on all claims on the less developed countries exceeded 9 per cent.

Nonmilitary grants accounted for half of the flow of U.S. government funds to less developed countries in 1962 and 1963. These result in no financial claims on the recipient countries, but they should be included for purposes of computing the interest cost on total economic assistance. Assuming that new government loans also carried an average yield of 3 per cent, total U.S. economic assistance yielded an average return of 1.5 per cent. Because of the large grant element, economic assistance from France yielded less than this; assistance from the United Kingdom and Germany yielded a good deal more. These four countries together account for over 90 per cent of bilateral free world economic assistance.

Without knowing in some detail the maturity structure of new foreign lending, it is not possible to adjust Rosenstein-Rodan's projections of capital requirements with any accuracy. The next section will indicate by illustration just how much difference loan maturity can make to the recipient country. But even if we assume no obligation to repay -- or, what comes to the same thing, that gross capital flows grow enough to cover amortization payments -- the presence of interest charges can considerably raise the capital requirements of the less developed countries (or lower the growth in GNP resulting from a given capital inflow). If, for example, the future flow of capital from the United States to the less developed countries has the same composition between direct investment (10 per cent), other private investment (7 per cent), official loans (42 per cent), and grants (41 per cent) that obtained in 1962-1963, and if it goes

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[1]Computed from the U.S. Department of Commerce, Survey of Current Business, August 1963 and June 1964. Japan, Australia, New Zealand, and South Africa are included, but these accounted for less than 10 per cent of the earnings. "Book value" incorporates adjustments for exchange rate changes, confiscations, and changes in the value of marketable stocks, but not other changes in value.

at current average yields, the average return on the total capital flow, including grants, would be 3.25 per cent.[1] A social rate of return of R = .20 would raise capital requirements 20 per cent above those suggested by Rosenstein-Rodan, and even with R = .30, capital requirements would be 12 per cent higher. The presence of fixed-term loans, which account for about half of the capital flow from the United States to the less developed countries, would increase requirements still further. That this upward adjustment in capital requirements may fall within the 25 per cent error Rosenstein-Rodan allowed himself does not diminish the fact that it represents a known downward bias in his estimates (and in those of other projections); the 25 per cent range of error should be applied to the adjusted figures.

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[1]Rosenstein-Rodan in fact calls for a substantially higher share of private foreign investment. In the required increase in annual capital flow of $2 billion for 1961-1971 over 1959, $0.7 billion is to be private investment in the first half of the period and $1.2 billion in the second half. (Op. cit., p. 116.) This would raise capital requirements still further, for given growth rates; or it would reduce the growth in national income resulting from the specified inflows.

V. OPTIMUM TERMS FOR FOREIGN LENDING

The fact that "grant equivalents" will generally be different for donors than for recipients suggests the existence of optimum terms for capital flow -- terms that benefit the recipient most for a given cost to the donor, or cost the donor least for a given benefit to the recipient. This can be seen clearly by recalling the definition for "grant equivalent" from the donor as calculated by Pincus and comparing it with the grant equivalent to the recipient defined by equation (3) above. In computing grant equivalents for the donors (G), Pincus in effect used equation (3) with a rate of discount, r, taken from the donor -- each donor's long-term bond rate, for instance. Thus for a loan of maturity n,

$$G = I\left(1 - \sum_{t=1}^{n} \frac{F}{(1+r)^t}\right) = \left(1 - \frac{P^*}{r^*}\right)I \qquad (4)$$

where $r^* = [r(1+r)^n]/[(1+r)^n - 1]$.

The presence of a problem in optimization obviously depends on the relationship between R, r, and P. Both donor and recipient gain from as much lending as possible from the donor so long as P exceeds r but is smaller than R. If P exceeds R, the recipient will not be interested in the "aid" at all, because servicing the aid would involve a larger drain on its resources than the return that the capital inflow would generate. A problem in optimization arises when the social rate of return in the donor country exceeds that in the recipient, that is, when $r > R > P$. In this case, a transfer of capital from donor to recipient actually lowers world output compared with what it would be if the investment took place in the donor country. Foreign assistance might be deemed desirable even in this case, although economic efficiency would be served by investing in the donor country and making straight income grants to the recipient out of the return on investment. But the possibility of $r > R$ will be considered only briefly in what follows.

The typical problem in optimization arises when $R > r > P$; in this case it follows from equations (3) and (4) that $H > G$, that is, the grant equivalent to the recipient exceeds the grant equivalent from the donor. The recipient country desires of course to maximize H, and hence the contribution of external capital to growth in its national income. But there are limits on the resources that the donor country can or is willing to devote to development, and this gives rise to a problem in optimization. We can distinguish three possible constraints on the extension of assistance. First, donor governments may place an absolute ceiling on the grant equivalent -- the pure aid -- that they are willing to extend. In this case, with G fixed, H is maximized by setting the interest rate on loans to less developed countries as close as possible to the opportunity cost of capital in the donor countries, r. Indeed, if $P = r$, the flow of capital necessary to preserve a given grant level G becomes infinite. Because infinite flows of capital to the less developed countries have not been observed, other constraints, economic or political, must be operative. For example, the "absorptive capacity" of the less developed countries places limits on the ability of recipient countries to digest capital inflow in any given period of time without causing a drastic reduction in the rate of return, R.

Alternatively, donor governments may place a ceiling on the total gross flow of capital, public and private, to the less developed countries, regardless of the grant element. With I thus fixed, H is maximized by making the total capital flow true grants, so $P = 0$ and $I = G = H$.

Finally, donor governments may place limits both on the grant element in aid to less developed countries and on the total gross capital flow -- at least the total flow from public sources. In this case, the optimum form of aid is not a grant but a perpetual loan, that is, a loan without fixed maturity.[1] The interest rate on such

[1] It might be that the constraint on total capital flow would operate on net investment, not gross investment. This amounts to permitting amortization payments on all past loans to be reinvested without limit. If they are so reinvested, and continue to be reinvested

a loan can be set at the level required to provide the permitted grant element. This is clearly seen in Table 1, where two examples are shown. (See also Tables 2 and 3 in the Appendix which show the implications of various combinations of interest rates and maturities for total capital flow and for grant equivalents of donors and recipients.) If G and I are both specified, so is their ratio. Thus for a grant equivalent for the donor of about 21 cents for each dollar of capital flow, the grant equivalent to the recipient (where R = .20) per dollar of capital inflow rises from 50 cents for 10-year, 3-per cent loans to nearly 70 cents for perpetual loans at 6-1/3 per cent. Each dollar granted by the donor (where r = .08) implies a total capital outflow of about 4.7 dollars; but this flow in turn implies a grant equivalent to the recipient rising from 2.4 dollars for the low interest, short maturity loan to 3.3 dollars for the high interest perpetual loan.

It might seem strange that a recipient country should prefer a high interest perpetual loan to a low interest amortized one of equal value, since higher interest payments to foreigners reduce future national income, ceteris paribus. The explanation is to be found in the productiveness of the domestic savings that would be required for amortization of the short maturity loan. These savings can be invested locally to yield R, whereas their use to amortize the loan in effect yields only P, a difference of (R - P). This is just one illustration of the fact that the debtor would profit by borrowing as much as possible (and by avoiding repayment) so long as R > P.

If there are maximum permissible limits both on the grant equivalent from the donor and on the total flow of investment, the recipient countries should actually prefer loans to grants, because loans will

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indefinitely into the future, then a ceiling on new net lending amounts to lending without fixed maturity. In this case, for a given P < r, the grant equivalent from the donor would be higher than would seem to be the case from a calculation using the nominal maturities on the loans.

Table 1

GRANT EQUIVALENTS TO RECIPIENTS FOR A GIVEN GRANT EQUIVALENT FROM THE DONOR

n	P	G/I	H/I	H/G
		r = .08	R = .20	
10	.03	.22	.51	2.36
20	.05	.21	.61	2.87
40	.06	.21	.67	3.21
∞	.063	.21	.68	3.31
		r = .15	R = .30	
10	.00	.50	.64	1.29
20	.05	.50	.73	1.47
∞	.075	.50	.75	1.50

Notes:

n = maturity of the loan, in years

P = annual yield on the loan

G = grant equivalent to the donor

H = grant equivalent to the recipient

I = amount of the loan from donor to recipient.

r = rate of return on capital in the donor country

R = rate of return on capital in the recipient country

Sources:

Appendix, Tables 2 and 3.

use the total inflow of capital allowable, whereas outright grants would leave the ceiling on total outflow inoperative (unless, of course, this ceiling was identical with the ceiling on grants).[1] The presence of economies of scale would make the larger inflows under loans even more attractive, while sharply diminishing returns to additional capital would reduce the preference for loans over grants.

The conclusion that perpetual loans are preferable to amortized loans with lower yields assumes that the behavior of savings in the less developed country is not influenced by the form of capital inflow. One reason for preferring fixed-term loans to some countries is that the need to amortize such loans induces domestic saving that would not otherwise take place. But except for this possibility, the recipient can gain (with no loss to the donor) if loan maturities are lengthened and interest rates raised in such a way as to keep the donor's grant equivalent -- and the donor's total capital outflow -- constant. It follows, of course, that the donor could actually reduce its grant equivalent and total capital outflow without hurting the recipient by lengthening loan maturities while raising interest rates.

A number of economists have recently argued that the social rate of return to capital in the United States and other developed countries is much higher than market interest rates suggest. Tobin considers Phelps' estimate of 14 per cent too low, and Solow suggests that a rate of return between 15 and 20 per cent is likely for both the United States and West Germany.[2]

As can be seen in Table 1 (and by comparing Tables 2 and 3 in the Appendix), raising r from .08 to .15 increases the grant equivalent

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[1] A grant G will increase income by GR. The same grant equivalent in a perpetual loan of $I = rG/(r-P)$ will raise income by $r(R-P)G/(r-P)$, which is greater than GR if $R > r$.

[2] James Tobin, "Economic Growth as an Objective of Government Policy," American Economic Review, LIV (May 1964), p. 15; Edmund S. Phelps, "The New View of Investment: A Neoclassical Analysis," Quarterly Journal of Economics, LXXVI (November 1962), pp. 548-567; and Robert Solow, Capital Theory and the Rate of Interest, Amsterdam, North-Holland Publishing Company, 1963, Lecture III.

of the donor substantially. On a 20-year, 5-per cent loan, the grant equivalent rises from 21 per cent to 50 per cent of the value of the loan. Raising the rate of return in the recipient countries from 20 per cent to 30 per cent -- approximately the rate used in most projections of the capital needs of the less developed countries -- results in a much less pronounced rise in the grant equivalent to the recipient on loans of comparable terms (73 per cent versus 61 per cent on the 20-year, 5-per cent loan). A higher R, of course, lowers the total capital requirements for any specified growth in income. But it also reduces the relative gains to be had from lengthening loan maturities while holding the grant equivalent to the donor constant (in column 4 of Table 1, compare the rise for R = .20 with the rise for R = .30 as maturities are lengthened).[1]

Finally, we can consider briefly the possibility that the social rate of return in the donor country exceeds that in the recipient country. The case can be illustrated in Table 1 by reversing the roles of r and R, letting R be the rate of return in the donor country, r the rate of return in the recipient, and H and G the corresponding grant equivalents. We are then interested in maximizing G/H, that is, in minimizing the loss in world output arising from a transfer of capital from donor to recipient. For a given G, this can be achieved

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[1]These examples have all assumed that both the grant equivalent from the donor and the gross capital flow are limited. The importance of the form of constraint on aid in limiting its value to the recipient countries is indicated by considering a few of the illustrations in Table 2. It can be seen there that an interest free 10-year loan will result in a grant equivalent to the recipient of 1.8 dollars for every dollar grant equivalent from the donor. Curiously, an interest free 20-year loan results in only a 1.5 dollar gain to the recipient, while a 3-per cent 20-year loan yields a 2.0 dollar grant equivalent to the recipient, again holding the cost to the donor constant at one dollar. The 3-per cent 20-year loan yields more than the interest free 20-year loan because it involves a total capital flow nearly 50 per cent greater: 2.9 dollars as opposed to 2.0 dollars for every dollar grant equivalent. It yields more than the interest free 10-year loan, despite a slightly smaller gross capital flow, because the lower amortization requirements permit more domestic savings to be invested locally, with higher payoff.

by minimizing H, which will be done by lowering the interest rate to zero and setting the maturity of the loan as short as possible for the given G. As already mentioned, an even more efficient technique would involve investing in the donor country and making income grants to the recipient; in effect this would be a "loan" to the recipient with maturity of zero and a negative interest rate.

But with $R > r$, and with some constraint operating on the grant equivalent that donors are willing to give and (at least for official capital) on the total outflow of capital, the optimal form of aid is the perpetual loan with a rate of interest governed by the permissible grant equivalent per dollar outflow. It is noteworthy that since 1961 the U.S. aid program has made many new development loans at maturities of 40 years, with a credit fee of 3/4 per cent and no interest charges. Such loans represent the very high grant equivalent to the recipient of nearly 88 per cent of the total loan (from Table 2) if $R = .20$, and a substantial grant equivalent of 70 per cent to the donor if $r = .08$.[1] For $R = .30$ and $r = .15$, these grant equivalents rise to 92 per cent and 83 per cent, respectively. These are not much different from perpetual loans, yet interest-yielding perpetual loans would in fact be slightly superior to them, assuming the impact on output and savings is the same under the two types of loan, and ignoring the resentment and ill-will that payments to foreigners in perpetuity might generate in the recipient countries. There may be a political argument, in addition to the positive effect on domestic savings, that can be advanced in favor of amortized loans. However, the existence of loans without term need not involve actual payments in perpetuity if the borrower is given the option of repurchasing the claims at any time. Moreover, even without going to perpetual loans, mutual gain would result from lengthening loan maturities and raising the interest rates charged in the appropriate way.

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[1] Some of these loans also have a grace period of 10 years before amortization payments begin. Under the assumptions of Table 2, the grant equivalent to the recipient becomes nearly 98 per cent and that to the donor 85 per cent.

VI. DIFFERENT FORMS OF AID: AN ILLUSTRATIVE EVALUATION

The foregoing discussion has assumed that there are upper limits both on the grant equivalent the donor is willing to make and on the total capital outflow from the donor government. As indicated earlier, a given grant equivalent from the donor can result in a very large gain to the recipient (but subject to the possibility of diminishing R) if it is associated with a large total flow of capital. One way to stretch any existing ceiling on the total flow of official capital is to devote whatever grant equivalent the donor is willing to give to encouraging the flow of private capital, assuming such capital can be directed to investments with the highest social return. Such stimulus can be provided in a variety of ways that have substantial leverage in terms of the capital flow resulting from each dollar of government expenditure.

First, the donor government may guarantee the securities of certain foreign governments or enterprises sold in its own financial markets. This would give such securities virtually the same status as those of the donor government in its own markets. The donor government in effect accepts the financial risk of default by the borrower. One special and limited form of such a guarantee is provided by the International Bank for Reconstruction and Development which, against the collateral of large government subscriptions, borrows directly in various financial markets for relending to less developed countries. Here the limits of liability for the donor governments are set by their subscriptions -- which have been paid up only to the extent of 10 per cent, and will probably never have to be paid in full.

Second, governments can insure private loans or equity investments against certain kinds of risks such as physical destruction, confiscation, inability to remit earnings, and so on. The U.S. government has undertaken a political and commercial risk guaranty program, under which various risks can be insured for a small premium against loss up to 75 per cent. Such a program may in the end involve no grant equivalent at all if the premiums fully cover actual claims.

The donor government can bear a part of the cost of private investment in still other ways, for example by financing investment surveys and by providing various informational and technical assistance to prospective investors. This too is being done.

Fourth, donor governments could directly subsidize the yield on selected investments in certain countries. Especially where long-term interest rates are high, as in Germany, outflows of private capital to less developed countries at moderate rates could be accomplished by absorption of a part of the interest costs by the donor government. For example, a developing country could borrow capital at 3 per cent where market rates were 6 per cent if the donor government also provided 3 per cent. Such an arrangement might result in substantial capital flow at relatively modest cost to the donor government's budget. Interest subsidies need not be open to all comers, to insure that donor influence over project planning was maintained. An interest subsidy program could be established with its own annual budget, and applications for subsidy could be screened with the same care that loan applications are examined today.

Recently, the U.S. Agency for International Development has proposed an alternative way to subsidize the flow of private capital to the less developed countries: tax credits against the investor's U.S. tax liabilities, equivalent to 30 per cent of any new investment and a portion of reinvested earnings in a selected list of countries. This proposal applies only to equity investment, not to private lending. And although it excludes some broad categories of investment, such as investment in the extractive industries, it lacks any feature that permits discrimination among particular investments. The national income gains to the less developed countries per investment dollar under this proposal will vary widely, according to the employment of local factors and the ability of host countries to tax away some of the foreign profits. The loss to the U.S. government -- the grant equivalent to the donor government -- will be in the form of forgone revenues rather than budgetary expenditure, and thus as a practical matter will fall outside the normal process of annual budgetary scrutiny.

According to the previous analysis, it might seem as though this proposal is a move in the right direction as direct investments have no maturity and they return a higher yield to the donor. But, from the viewpoint of the recipients, the proposal is very likely inferior to the same donor grant equivalent used for interest subsidies or used in a program of straightforward lending. A more detailed examination of this proposal is considered in the Appendix and serves to illustrate the use of donor and recipient grant equivalents in a search for optimal terms for development assistance. The results can be briefly summarized here.

Suppose the offer of a tax credit of 30 per cent on total new direct investment in underdeveloped countries results in an increase in investment $\Delta I'$ to a country over the investment I' that would have taken place anyway. The tax revenues lost will be $.3(I' + \Delta I')$, and these represent, from the viewpoint of the donor government, an increased grant G' to the less developed country. In fact, of course, it is a domestic transfer from the government to the investors, but it is designed to stimulate foreign investment that would not otherwise have taken place and thus in part represents a transfer to the recipient.

The increased grant equivalent to the host country is $H' = (1 - P'/R)\ \Delta I'$, where P' is the profit rate accruing to the U.S. investors.

We want to compare the benefit to the recipient per dollar grant equivalent from the donor under this proposal with the benefit per dollar under alternative ways of extending assistance. Call the benefit ratio for the tax credit proposal $B = H'/G'$, and that for official lending to the less developed countries $A = H/G$. A is illustrated for various maturities and interest rates in Tables 2 and 3 in the Appendix. A will not be less than unity so long as $R > r$, because, as discussed earlier, full grants result in $A = 1$.

The benefit ratio for the tax credit proposed obviously will depend on the sensitivity of direct investment flows to changes in profit rates (after taxes) on new investment. If we define an elasticity of investment response E' to improved profits, then, as shown

in the Appendix, $B = \frac{E'(1 - P'/R)}{1 + .3E'}$, from which it follows that $B > A$ if $E' > \frac{A}{1 - P'/R - .3A} > 0$. For $A = 1$ (that is, the donor government cannot lend any more than it can grant) and $P'/R = 0.5$, $B > A$ requires that $E' > 5$; and for $A = 1.25$ (a very modest ratio, as indicated for example by the figures in the final column of Table 2), $E' > 10$ is necessary. Note that $E' = 10$ implies new direct investment must quadruple over present levels[1] if the tax credit is to be superior to straightforward lending -- always assuming that equally productive investments would be made under either arrangement.

It is clear that the ratio (P'/R) of foreign investment earnings to net social rate of return plays a critical role in determining the required investment response; the higher this ratio, the higher E' must be to make the tax credit superior to direct lending. Indeed, for a tax credit of 30 per cent, a P'/R equal to 70 per cent or more means that no elasticity of response can be high enough to ensure $B > A$ even if A takes on its lowest possible value, unity. Yet $P'/R \geq 0.7$ is certainly not out of the question, considering that past rates of return occasionally exceed 15 per cent on total U.S. direct investment even in those less developed countries where mineral extraction is not the predominant form of investment. For $A = 1.25$, $P'/R \geq 0.625$ will ensure that $B < A$ for all values of E'.

Furthermore, if $E' < 10/7$, the tax credit proposal would cost the donor government in forgone tax revenues more than the rise in investment, so that direct grants to the recipient would cost the donor government less and/or benefit the recipient more. This result arises, of course, from the impracticability of limiting the tax credit to <u>increases</u> in direct investment outflow; those who would have invested abroad anyway must be rewarded too. Restricting the tax credit to certain classes of investment represents an attempt to limit these large windfall gains.

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[1] In 1963 the net flow of direct investment capital from the United States to the less developed countries, excluding reinvested earnings, was $183 million in all industries excluding mining, smelting, and petroleum. Using this as a base line, quadrupling would require an increase to $732 million per annum.

If the response of investment flows is high enough to give the tax credit proposal an advantage over direct lending, then an interest subsidy program, even if it were not selective, would probably be still better. This would fail to be true only if equity capital were much more sensitive to improved yields than loan capital -- the opposite is more likely to be true -- or if the initial flow of direct investment capital greatly exceeds that of loan capital.[1] In 1963, new U.S. direct investment (excluding reinvested earnings) in less developed countries, excluding mining, smelting, and petroleum investments, amounted to $183 million, compared with a net flow of portfolio capital of $248 million. Eighty per cent of the portfolio capital was short term, however; if short-term capital were excluded from the proposal, or if short-term flows were considerably less sensitive to yields (as might be true of supplier credits, for example) than direct investment flows, then the tax credit proposal might dominate interest subsidies. On the other hand, any selectivity introduced in the granting of interest subsidies would improve the benefit ratio of an interest subsidy program. And such selectivity would certainly be possible for long-term lending.

Two qualifications are necessary before this implied inferiority of the tax credit proposal can be accepted.

First, this analysis has focussed exclusively on the flow of capital to the less developed countries, not on the entrepreneurship and technical skills that often accompany direct investment in less developed countries. Some of the return to direct investment really represents payment for these services, not payment for capital alone. The presence of these complementary factors with direct investment should be reflected in a higher return to investment in the host country than would be available on loan capital, since these factors presumably benefit that country. But such factors are available even in the absence of equity capital, as the many successful projects of

[1] See the Appendix for the expressions underlying these statements.

the World Bank testify. Technical assistance as a service separate from capital can be purchased with increasing ease, and often at a lower "price" than when the same individuals have controlling interest in local enterprise. An across-the-board tax credit for all investors may be an expensive way to obtain such necessary skills.

Second, loans result in a fixed charge on the future output of the debtor country. One advantage of direct investments is that debt servicing requirements (transferring output to foreigners) are often correlated with movements in the terms of trade, another major external influence on incomes in the less developed countries. As the terms of trade improve, some of the improvement is skimmed off by foreign investors as higher earnings; if the earnings deteriorate, so do the profits of foreign investors. This is obviously true where the investment is in the export sector, but it is also true when the investment caters to a domestic market in which income are dependent on other exported products. One way to introduce this desirable flexibility into loans would be to permit deferral of interest payment (perhaps with some small penalty) in years in which the balance of payments of the debtor country deteriorated by a specified amount, or even to provide an arrangement for waiving interest payments such as in the Anglo-American Loan of 1946.

In summary, the use of benefit ratios calculated in terms of grant equivalents to aid recipients and grant equivalents from aid donors offers a useful tool for evaluating various proposals for extending aid. Analysis using such ratios would suggest, for example, that the recently proposed tax credit on direct investment in the less developed countries is likely to be inferior economically to other forms of economic assistance. But the same technique might be usefully extended to other proposals. The terms of foreign assistance from the United States and (even more) from other donors could very likely be modified, by lengthening maturities and raising yields, to the mutual benefit of donors and recipients alike.

Appendix

COMPARISON OF SUBSIDIZING PRIVATE INVESTMENT FLOWS WITH GOVERNMENT LENDING TO LESS DEVELOPED COUNTRIES

This Appendix compares the merits of two methods of subsidizing private investment flows to the less developed countries with the alternative of government lending, using the analytical tool of grant equivalents for the donor government and for the recipient country. The two proposals for subsidizing private flows are (1) a tax credit equal to some proportion λ (30 per cent has been proposed) of new private direct investment in less developed countries, and (2) a subsidy equal to some proportion k of interest charges on new private lending to less developed countries. These are to be compared with direct lending from the donor government to the recipient, holding the grant equivalent to the donor government at the same level in all three types of contribution. We thus aim to find the grant equivalent to the recipient per dollar of grant equivalent to the donor government.

The case of government lending has already been discussed in the text. In formal terms, we want to maximize $H = (1 - P^*/R^*)I$ subject to a given $G = (1 - P^*/r^*)I = \bar{G}$. The following notation is used:

P = rate of interest paid by the recipient

R = net social rate of return on investment in the recipient

r opportunity cost of capital in the donor

I = gross flow of capital from donor to recipient

H = grant equivalent to the recipient

G = grant equivalent to the donor

$P^* = \dfrac{P(1 + P)^n}{(1 + P)^n - 1}$, etc., where n is the maturity of the loan

Assuming $P^* < R^*$, H can be maximized by making I as large as possible, that is, by choosing P^* infinitesmally close to r^*. But if total government lending is limited to $\bar{I}$, $\bar{G} = (1 - P^*/r^*)\bar{I}$ and therefore $P^* = r^* (1 - \bar{G}/\bar{I})$. For a given value of G, H is maximized if H/G is maximized. Substituting for P^*, setting $\bar{I}/\bar{G} = K$, and manipulating,

$H/G = K(1 - r^*/R^*) + r^*/R^*$. This is not dependent on P. For $r < R$, H/G is maximized at $n = \infty$, so

$A = \max (H/G) = K(1 - r/R) + r/R$.

$A > 1$ if $K > 1$, as would be reasonable to expect.

Consider now the case of a tax credit $\lambda = 30$ per cent of new private direct investment. Assume the tax credit succeeds in raising direct investment $\Delta I'$ over the direct invest I' which would have taken place anyway. Then $G' = \lambda(I' + \Delta I')$ and $H' = (1 - P'/R)\Delta I'$, where P' is the yield to the foreign investors and the primes associate each term with the tax credit proposal. Define an elasticity E' of investment response to increased after tax profits and set $B = H'/G'$. Then

$$E' = \frac{1}{\lambda}\frac{\Delta I'}{I'} \quad \text{and}$$

$$B = H'/G' = \frac{E'(1 - P'/R)}{1 + \lambda E'} .$$

Finally, consider an interest rate subsidy ammounting to k per cent of the yield P'' to the lender which raises the flow of lending by $\Delta I''$ over the lending I'' which would have taken place anyway. The flow of lending would increase because lenders are willing to lend more at a higher rate of interest and/or borrowers are willing to borrow more at a lower rate of interest. Then we have the following equivalents to the donor government and the recipient:

$$G'' = (I'' + \Delta I'') \sum_{t=1}^{n} \frac{kP''}{(1+r)^t} = \frac{kP''}{r^*}(1 + \Delta I''/I'')I''$$

and $H'' = (1 - P/R^{*\prime\prime})\Delta I''$, where $P = (1-k)P''$ and $R^{*\prime\prime} = \dfrac{R(1+R)^{n-1}}{(1+R)^{n-1}-1}$.

To keep the expression for the elasticity E'' simple, we assume here the loan is repaid in full at the end of period n instead of being amortized over the whole period. This accounts for the difference between H here and in equation (3) and for the slight difference between $R^{*\prime\prime}$ and R^* defined earlier. As before, define an elasticity E'' of investment response to increased yields to the lenders (or to

decreased costs to the borrowers) and set $C = H''/G''$. Then

$$E'' = \frac{1}{k} \cdot \frac{\Delta I''}{I''} \text{ and } C = H''/G'' = \frac{r^*}{P''} \frac{E''(1 - P/R^{*''})}{(1 + kE'')} .$$

In making a comparison among the proposals we cannot of course set λ and k independently of one another; we are interested in comparisons for the same grant equivalent from the donor government. Setting $G' = G''$ yields a quadratic in k and λ:

$E''k^2 + k - (r^*/P'')(\lambda + E'\lambda^2)(I'/I'') = 0$, which always has a positive solution $k = \frac{1}{2E''}\left(-1 + \sqrt{1 + 4E''(r^*/P'')\lambda(1 + \lambda E')I'/I''}\right)$ so long as direct investment and private lending are positive initially.

We now wish to compare A, B, and C where $\bar{G} = G' = G'' = \lambda(I' + \Delta I')$, with $\lambda = 0.3$ and k chosen accordingly. Consider first a comparison between B and C. Whether B exceeds or falls short of C depends on many parameters. But if we assume, as seems reasonable, that $(1 - P/R^{*''}) > (1 - P'/R)$ and $r^* > P''$, then it is easy to show that $C > B$ for $E' = E''$ and $I' = I''$. As E' is raised relative to E'', or I' is raised relative to I'', this inequality is gradually weakened and eventually reversed.

More interesting, however, are the conditions for $B > 1$ and $C > 1$. Because $B = \frac{E'(1 - P'/R)}{1 + \lambda E'}$, $B > 1$ requires $E' > \frac{1}{1 - P'/R - \lambda} > 0$.

Similarly, $C > 1$ requires $E'' > \frac{1}{(r^*/P)(1 - P/R^{*''}) - k} > 0$.

It is clear that these conditions may not be satisfied. If $B \leq 1$, straight grants dominate the tax credit, because for a straight grant $H = G$. Similarly for $C \leq 1$. Thus, unless the elasticities exceed these minimum values, A (which for $R > r$ always exceeds unity so long as $\bar{I}/\bar{G} = K > 1$) will exceed B and C, and direct government lending will be superior to tax credits and interest subsidies.

A more concrete notion of the required expansion in investment can be conveyed by assigning some specific, plausible values to the various parameters. Set the following values:

r^*/P''	=	1.2
P'/R	=	0.5
$P/R^{*''}$	=	0.2
I'/I''	=	2.0
$E' = E''$	=	3.0
r/R	=	0.5
K	=	1.5

Then for $\lambda = 0.3$, $G' = G''$ requires $k = 0.53$. With these values, $A = 1.25$, $B = 0.79$, $C = 1.11$. Given the other values above, it would be necessary for E' to exceed 10 to raise B above $A = 1.25$, and E' would have to be 5 just to raise B to unity. For plausible values of the parameters, A exceeds both B and C unless E' and E'' are quite large. Moreover, C will exceed B unless E' is substantially larger than E'' and I' is much larger than I''.

Table 2

GRANT EQUIVALENTS FOR DONORS AND RECIPIENTS FOR DIFFERENT LOANS

For R = .20, r = .08

n	P	G/I	H/I	I/G	H/G
10	.08	0	.37	∞	∞
10	.05	.13	.46	7.6	3.5
10	.03	.22	.51	4.6	2.4
10	.01	.29	.56	3.4	1.9
10	0	.32	.58	3.1	1.8
20	.06	.14	.58	6.9	4.0
20	.05	.21	.61	4.7	2.8
20	.03	.34	.67	2.9	2.0
20	.01	.46	.73	2.2	1.6
20	0	.51	.76	2.0	1.5
40	.06	.21	.67	4.8	3.2
40	.05	.30	.71	3.3	2.3
40	.03	.48	.78	2.1	1.6
40	.01	.64	.85	1.6	1.3
40	0	.70	.88	1.4	1.2
∞	.0635	.21	.68	4.8	3.3
∞	.05	.38	.75	2.7	2.0
∞	.03	.62	.85	1.6	1.4
∞	.01	.88	.95	1.1	1.1
∞	0	1.00	1.00	1.0	1.0

Notes:

n = maturity of the loan, in years

P = annual yield on the loan

G = grant equivalent to the donor

H = grant equivalent to the recipient

I = amount of the loan from donor to recipient

Table 3

GRANT EQUIVALENTS FOR DONORS AND RECIPIENTS FOR DIFFERENT LOANS

For R = .30, r = .15

n	P	G/I	H/I	I/G	H/G
10	.06	.32	.51	3.1	1.6
10	.05	.35	.53	2.9	1.5
10	.03	.41	.58	2.4	1.4
10	.01	.47	.62	2.1	1.3
10	0	.50	.64	2.0	1.3
20	.06	.45	.71	2.2	1.6
20	.05	.50	.73	2.0	1.5
20	.03	.58	.77	1.7	1.3
20	.01	.65	.81	1.5	1.2
20	0	.69	.83	1.5	1.2
40	.06	.56	.78	1.8	1.4
40	.05	.61	.81	1.6	1.3
40	.03	.71	.86	1.4	1.2
40	.01	.80	.90	1.3	1.1
40	0	.83	.92	1.2	1.1
∞	.075	.50	.75	2.0	1.5
∞	.05	.67	.83	1.5	1.2
∞	.03	.80	.90	1.3	1.1
∞	.01	.93	.97	1.1	1.0
∞	0	1.00	1.00	1.0	1.0

Notes:

n = maturity of the loan, in years

P = annual yield on the loan

G = grant equivalent to the donor

H = grant equivalent to the recipient

I = amount of the loan from donor to recipient