BIBLIOGRAPHIC DATA SHEET	1. CONTROL NUMBER	2. SUBJECT CLASSIFICATION (695)
	PN-AAK-056	DA00-0000-0000

3. TITLE AND SUBTITLE (240)

Debt servicing and foreign assistance: an analysis of problems and prospects in less developed countries

4. PERSONAL AUTHORS (100)

Frank, C.R.; Cline, W.R.

5. CORPORATE AUTHORS (101)

AID/PPC

6. DOCUMENT DATE (110)	7. NUMBER OF PAGES (120)	8. ARC NUMBER (170)
1969	35 p.	

9. REFERENCE ORGANIZATION (130)

PPC

10. SUPPLEMENTARY NOTES (500)

(In A.I.D. Discussion Paper no. 19)

11. ABSTRACT (950)

12. DESCRIPTORS (920)

Financial management
Balance of payments
Statistical analysis
Loans

13. PROJECT NUMBER (150)

14. CONTRACT NO.(140)	15. CONTRACT TYPE (140)
PPC	Res

16. TYPE OF DOCUMENT (160)

70

A.I.D. DISCUSSION PAPER NO. 19

DEBT SERVICING AND FOREIGN ASSISTANCE: AN ANALYSIS OF PROBLEMS AND PROSPECTS IN LESS DEVELOPED COUNTRIES

OFFICE OF PROGRAM AND POLICY COORDINATION, A.I.D.

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D. C.

Office of Program and Policy Coordination

A.I.D. Discussion Paper No. 19

DEBT SERVICING AND FOREIGN ASSISTANCE: AN ANALYSIS OF PROBLEMS AND PROSPECTS IN LESS DEVELOPED COUNTRIES

Charles R. Frank, Jr.
William R. Cline

Princeton University

June, 1969

Note

Mr. Frank is an Associate Professor of Economics and International Affairs at Princeton University. He is the author of several books and numerous articles and papers including:

> The Sugar Industry in East Africa, Nairobi, East African Publishing House and Kampsala, East African Institute of Social Research, East African Studies Series, Number 21, 1965, pp. 115.
>
> Economic Accounting and Development Planning, Nairobi, Oxford University Press, 1966 (with B. Van Arkadie), pp. 387.
>
> "Urban Unemployment and Economic Growth in Africa," Oxford Economic Papers, Vol. 20 (New Series), No. 2, July 1968.
>
> "Employment Generation and Industrialization in Nigeria," Nigerian Journal of Social and Economic Studies, November 1967.

In 1966 he participated in A.I.D.'s Summer Research Program as a consultant on Nigerian economic development.

Mr. Cline is a lecturer in Economics at Princeton University. He has written on land reform in Brazil, Cuba and Japan, among other things. Under the auspices of A.I.D.'s 1967 Summer Research Program he prepared an analysis of the proposed "Geran" project for agricultural modernization in N.E. Brazil.

In the preparation of the 1967 Summer Research Project that formed the basis for this Discussion Paper, Drs. Frank and Cline were assisted by Mr. T. Gewecke who is now Assistant Program Economist with USAID/Nigeria.

TABLE OF CONTENTS

The large increase in foreign assistance to the less developed world in the late 1950's and early 1960's has created a set of problems concerning the repayment of foreign debts which promise to become increasingly severe throughout the the next decade. The purpose of this paper[1/] is to draw on recent experience in handling problems of debt service in order to make some projections and assess future prospects.

The next section of this paper points out some trends in debt rescheduling exercises which have important implications for future policy. Section III discusses the causes of debt servicing difficulties. Data on debt service and other related economic variables are used to perform a statistical discriminant analysis to distinguish variables most associated with experiencing severe debt problems. Traditional discriminant analysis techniques are not quite adequate to this task, and a modified approach is also applied. Section IV uses past data on the level and structure of foreign debt for 17 less developed countries to project debt service payments over the next decade. Projections of the discriminant function are also made to assess the likely seriousness of future debt servicing problems. Finally, a concluding section assesses the policy implications of the preceding analysis, especially with regard to the terms of foreign assistance.

1/ Which is a shorter version of a classified report on Debt Servicing Problems of Less Developed Countries and Terms of AID: with Special Reference to United States Policy, by Charles R. Frank, William R. Cline, and Thomas Gewecke. This report was sponsored by the Agency for International Development, Office of Program and Policy Coordination, under its Summer Research Program for 1968.

II. Trends in Debt Rescheduling

2.1 Institutional Arrangements

In the last ten years, a number of countries experienced such severe difficulties in servicing their debt that they negotiated with creditors to postpone payments of interest or principal.[1/] In some cases these negotiations were preceded by a period in which arrears of payments occurred. There have been at least 20 cases of debt reschedulings over the last ten years for ten different countries. These are listed in Table I.

The great majority or reschedulings have occurred in multilateral settings. Only Yugoslavia, Liberia and the U.A.R. negotiated bilaterally with each major creditor. The Latin American reschedulings took place under the auspices of The Hague and Paris Clubs, groups of creditors formed originally for the purpose of pooling non-convertible currencies. France was most often the major creditor. The Ghanaian negotiations were held in London with IMF sponsorship. The United Kingdom and the Federal Republic of Germany were the major Ghanaian creditors and virtually dictated the terms of debt rollover. The Turkey, Indonesia, and India negotiations were conducted within the framework of consortia of the major aid-giving countries. In the India case, the leadership in the negotiations stemmed from the IBRD.

The IMF played a significant role in nearly all of the reschedulings listed in Table I. Typically, the debtor received some IMF standby credits in conjunction with debt rollover. The acceptance of standby credits implied

---

1/ An extensive discussion of these debt renegotiations is presented in an unpublished report, Multilateral Debt Renegotiations: 1956-1968, #EC 170, I.B.R.D., prepared by Patrick B. deFontenay, April 11, 1969.

an obligation on the part of the debtor to fulfill certain pledges with regard to monetary and fiscal policy. Frequently, the creditors have also required the debtor to limit its future borrowing of short-term commercial credit.

The Latin American and Ghanaian negotiations are most often described as "ad hoc informal meetings of the major creditors." The creditor countries in these negotiations have done their best to maintain the idea that debt relief is not an institution but a very serious and unique event whenever it occurs. The recent trend toward the use of consortia, which are also responsible for the pledging and coordination of the regular flows of financial aid, has resulted in the erosion of the ad hoc concept. India, Indonesia, and Turkey are now in a situation which promises periodic rescheduling meetings.

Table I

DEBT RESCHEDULINGS SINCE 1957[1]

Country	Years in which Payments Deferred	Institutional Arrangement
Argentina	1957[2]	Paris Club
	1961-62	Paris Club
	1963-64	Paris Club
	1965	Paris Club
Brazil	1961-65	The Hague Club
	1964-65	The Hague Club
Chile	1965-66	Paris Club
Turkey	1958-1963	OEEC Auspices
	1965-1967	OECD Donor Consortium
	1968	OECD Donor Consortium
Indonesia	1966-67	Donor Consortium
	1968	Donor Consortium
	1969	Donor Consortium
India	1968	Donor Consortium under IBRD leadership
Ghana	1966-68	IMF Auspices
	1969-70	IMF Auspices
	1969-72	IMF Auspices
Peru	1968-69	United Kingdom Sponsorship
Liberia	1963	Bilateral
U.A.R.	1967-68[2]	Bilateral*
Yugoslavia	1965-66	Bilateral

*Rescheduled arrears with major creditors except the United States.

[1] A number of countries not included in this table rescheduled some very short-term debt (less than one year maturity).

[2] Dates of agreements to reschedule arrears.

The difference in conception stems in part from differences in the structure of the debt. Many of the Latin American negotiations arose from difficulties encountered in servicing short- and medium-term commercial debt. The more recent phenomenon faced by consortia creditors is one in which long-term official lending forms a much more significant role in the debt-service burden. A rescheduling of payments over a one to five year period combined with some restrictions on the volume of commercial borrowing can significantly reduce the amount of debt service in the former case. In the long-term lending case, the debt must be rescheduled over a considerable period of time to have any significant impact on the debt service burden. In the Indian case there was no balance of payments crisis but it was seen easily that the level of debt service was likely to cause problems in the future. The goal of the consortium-approved development program was the reduction of debt service to about 15 per cent of exports. This necessitated a rescheduling of about 25 per cent of the debt due in 1968 but will require regular and increasing amounts of rescheduling for quite some time to come.

2.2 Amounts and Terms of Rescheduling

The amount of debt service rescheduled in the last decade has been considerable, probably in the order of $2 billion. A partial list is contained in Table II. The moratoriums on payment of debt service are typically very short. In the earlier reschedulings, this reflected the ad hoc nature of the negotiations and the hope that the difficulties would be of short duration.[1/] In the cases of India,

---

[1/] On the other hand, the list of debt reschedulings in Table I indicate that recurrence of debt problems after a debt rollover are quite frequent. The short moratoriums frequently do nothing more than shift the burden of debt service one or two years into the future.

Indonesia, and Turkey, the shortness of the moratoriums may be a simple case of the reluctance to change traditional formulae but also may indicate a preference for repeated reschedulings to maintain control over the debtor countries' economic policies.

Table II

AMOUNTS OF DEBT RESCHEDULINGS

Country	Year	Moratorium Length (years)	Amount ($ million)	Portion of Service Due (per cent)
India	1968	1	100	25[a]
Ghana	1966-1968	2½	170	80[a], e
Turkey	1965-1967	3	217	80/60[b], c, e
Chile	1965-1966	2	90	70[b], e
Brazil	1964-1965	2	190	70[a], e
Argentina	1965	1	90	60[b], e
Indonesia	1966-1967	1½	350	100[a], d

a. Interest plus principal.
b. Principal only.
c. 60 per cent commercial and 80 per cent official debt.
d. Excluding Eastern Bloc debt.
e. Excluding certain official credits.

The terms have varied considerably. Table III summarizes some recent experience. It is hard to find meaningful invocation of general principles although the relatively soft terms for India and Turkey presumably reflect the long-run nature of their debt servicing problems. The traditional formula for negotiations is to decide at meetings attended by all creditors on the amounts to be rescheduled, the length of the moratorium, and the period of repayment. The consolidation interest rates typically differ from creditor to creditor, being determined on the basis of bilateral negotiations. Frequently, the result of these negotiations has been the use of a so-called commercial rate, often 5 or 6 per cent, and at times higher than 8 per cent.

Table III

TERMS OF RESCHEDULINGS

Country	Year	Grace Period (years)	Repayment Period (years)	Interest Rate (per cent)
India	1968	10	1	0
Ghana	1966-1968	2½	8	Bilateral determination
Turkey[a]	1965-1967	5	5	0
Chile	1965	3	5	Bilateral determination
Brazil	1964-1965	3	5	Bilateral determination
Argentina	1965	3	5	Bilateral determination
Indonesia	1968	3	8	3

a. Most common terms

2.3 Burden Sharing

The Anglo-Saxon legal tradition of bankruptcy and debt settlement does not generally pretend to find, in different types of borrowing, the "cause" of the whole problem. Each creditor is expected to absorb an equal burden in terms of the portions of total debt owed him which is not paid. On the international plane, there is often considerable disparity between the terms of different donors' lending, with the result that there has been a fair amount of concern over the appropriate shares of credits when an LDC needs help. The U.S. in particular, as a soft lender, has been in conflict with the hard-lending Europeans. In spite of the fact that its share of the total rescheduling is usually small by any measure, the U.S. has been moderately successful in having long-term debt and interest excluded from reschedulings. Outside of this, however, justice has most often been equated with relief by each creditor of an equal percentage of the total amount due it. The Indian case marks an important breakthrough. The IBRD devised a formula for determining the relief to be given by each creditor in such a way that the hard lenders would have to sacrifice more.

It was decided how much India could afford to pay per year (around 20 per cent of exports), and this was divided by total debt outstanding. This came to 6 per cent. Every creditor was then to reschedule whatever service payments were over this limit. Countries under the limit (like the U.S.) got no rebate and, in fact, had to make a certain minimum contribution to the rescheduling. It seems likely that this idea will be used more often in the future, although if rescheduling comes to be considered more equivalent to aid, the criteria now being considered for distributing the aid burden, such as per capita income, may enter the picture.

III. Causes of Debt-Servicing Problems

3.1 Debt Service and Balance of Payments

It is difficult to speak of the causes of reschedulings without reference to the level of generality involved. The cause at one level is usually a balance of payments crisis. Aside from cases in which individual private debtors default on their obligations, the inability to pay interest and principal on debt outstanding is just one among a number of other indications of a lack of foreign exchange. In one sense, the ability to pay debt is limited only by the extent to which foreign exchange can be saved from a very strict curtailment of imports, and foreign exchange can be earned by exporting as much of the domestic product as can be sold abroad. When debt service is very large, however, the monetary, fiscal, tariff, and exchange rate policies required to restore international balance might result in extreme sacrifices and political difficulties which both the debtor and creditor countries might wish to avoid. The rescheduling of debt service is an alternative means of helping to alleviate a country's foreign exchange difficulties, which avoids some of the difficulties associated with

more stringent economic policies in the debtor country. This is, of course, not the only means available, and debt rescheduling ought to be viewed in the context of other policy alternatives designed to meet foreign exchange shortages.

3.2 Special Difficulties with Debt Service Obligations

In one sense, at least, a high level of debt service presents its own special problems. Unlike payments for imports of goods and services, debt service payments are fixed obligations which cannot be avoided without severe repercussions on the foreign balance for years to come. Imports can be reduced temporarily merely by applying appropriate restrictions on demand. When foreign exchange is more freely available, restrictions on import demand can be lifted. The supply of goods and services for import is likely to be affected very little. When a country defaults on its debt, however, the supply of capital in the future will be severely reduced. Without any assurances of repayment, both official and private creditors will not be very willing to lend. Only in the most extreme circumstances will a country be willing to default. The unattractiveness of default is considerably strengthened by the existing web of international political relationships. A country with close economic and political ties to the United States or Britain might find default accompanied by a series of diplomatic and economic reprisals, e.g., cutting the sugar quota, limiting oil imports, elimination of Commonwealth preferences, etc. Thus, the U.A.R. and Indonesia under Sukarno found default with respect to the Western powers attractive/partly in view of their attenuated relationships with these countries.

Leaving aside the difficult question of when it pays a country to default,[1/] the fixed nature of debt service obligations has focused the attention of many analysts and experts on the debt service ratio. This ratio is defined as the ratio of service on debt to export earnings.[2/] The rationale for the use of the debt service ratio as an indicator of a country's debt-servicing capacity is that an increase in the debt service ratio indicates increased vulnerability to foreign exchange crises. Any shortfall in foreign exchange earnings or capital imports which is not covered by exchange reserves must be met by reducing imports; since debt service is a fixed obligation, the higher the debt service ratio, the greater is the relative burden on import reduction for a given shortfall in foreign exchange.

Unfortunately, the debt service ratio in and of itself is not a very good indicator of a country's ability or lack of ability to pay its debts. The debt service ratio is merely an indicator of the proportion of foreign exchange earnings which are free to purchase imports. If exchange earnings are high relative to import demand, a high debt service ratio can be maintained. Furthermore, a country with good credit standing in international money markets may be able to finance a high debt service ratio, for a time at least, through a high level of borrowing.

The historical behavior of debt service ratios and instances of default also indicate an ability of some countries to tolerate high debt service ratios. Mexico and Israel have not defaulted nor requested

---

[1/] See W.E. Schmidt, "Default on International Public Debts," The National Banking Review, March 1965.

[2/] Modified versions of the debt service ratio include the ratio of debt service to earnings from exports of goods and services and the ratio of debt service to current account foreign exchange receipts. The ratio of debt service plus payments of income from equity investments to various definitions of exchange earnings is also used.

debt rescheduling despite debt service ratios of 39 and 26 per cent respectively in recent years.[1]

> Australia managed to avoid defaults on public and private debts with an investment service-exchange earnings ratio ranging from 43 to 44 per cent during the period 1930-1934. Canada avoided defaults and the imposition of exchange restrictions on current transactions with an investment service-exchange earnings ratio of 32 to 37 per cent over the 1931-1933 period.[2]

On the other hand, Bolivia, Brazil, Colombia, Cuba, Peru, and Uruguay defaulted in the period 1931-1933 with debt service ratios that were generally lower, in the order of 16 to 28 per cent.[3]

It is clear that there are a host of other factors which influence a country's ability to service debt. In previous studies a number of indicators other than the debt service ratio (denote by X_1) have been used as possible warning signals for debt servicing difficulties. Among these are:

(i) the rate of growth of exports (X_2),

(ii) the variability of export earnings (X_3),

(iii) "compressible" imports relative to non-compressible imports (X_4),

(iv) per capita income (X_5),

(v) the rate of amortization of outstanding debt (X_6),

1/ Using export figures from IMF, International Financial Statistics, and IBRD data on debt service for Mexico in 1967 and Israel in 1966.

2/ Raymond F. Mikesell, The Economics of Foreign Aid, Chicago, Aldine, 1968, p. 118. Investment service includes dividends on equity investments as well as debt service but the former is typically very small relative to debt service for most less developed countries today.

3/ D. Avramovic, Debt Servicing Capacity and Post-War Growth in International Indebtedness, Baltimore, Johns Hopkins Press, 1958, p. 194.

(vi) the ratio of imports to GNP (X_7), and

(vii) the level of exchange reserves relative to imports (X_8).[1/]

One can make a number of heuristic and theoretical arguments for the use of each and every one of these indicators, some convincing and others not so convincing. In order, however, to use these indicators for predictive purposes or for discriminating between countries which are likely to have debt-servicing problems and those which are not, one must specify some function of the various indicators which provides a composite index of debt servicing capacity.

3.3a Linear Discriminant Analysis

The composite index which we wish to estimate may be expressed as a linear function of the eight indicators above:

(1) $Z = \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_8 X_8$.

The methods for estimating the β weights are discussed elsewhere.[2/]

3.3a The Sample

The sample used to estimate the β's is combined cross-country time series data. We chose the nine-year period 1960 to 1968. In order to reduce the number of observations, we eliminated from consideration all

1/ See, for example, D. Avramovic, et al., Economic Growth and External Debt, Baltimore, Johns Hopkins Press, 1964. The Secretariat of the Development Assistance Committee has worked with an "organic indicator of vulnerability" equal to the possible imports during a crisis, divided by current imports. Possible imports is defined as minimum expected exports, plus foreign exchange reserves, plus capital inflows, less debt service payments.

2/ See unclassified, mathematical Appendix A, Discriminant Analysis When Variances are Unequal, to report cited in Footnote 1, page 1.

countries smaller than Ghana, the smallest rescheduling country in terms of population and gross national product. Other countries were eliminated because of lack of data. The result was to include 26 countries over 9 years or theoretically 234 country-year observations. Absence of data for specific years reduced the number of observations to 145. The data included 13 reschedulings in 8 countries; Argentina, Brazil, Chile, Ghana, India, Indonesia, Turkey, and the U.A.R.

3.3b The Indicators

The first indicator of debt servicing difficulty is the ratio of debt service to exports, X_1. A one-year lag is specified in this and all subsequent X-variables, on the assumption that the debt service payment interruption in year t occurs after decisions made near the end of year t-1 and that these decisions are based on the appearance of indicators during year t-1. Thus,

$$(2) \quad X_{1t} = \frac{S_{t-1}}{\hat{E}_{t-1}}$$

where S_{t-1} is debt service payments and $\hat{E}_{t-1}$ is "normal" exports in year t-1. "Normal" exports are used rather than actual exports in year t-1, under the assumption that authorities pay little attention to temporary highs or lows in exports but base decisions on what normal exports can be expected to be. $\hat{E}_{t-1}$ was calculated as the "predicted" exports in year t-1, based on a regression of the logarithm of exports on time for the five-year period ending in year t-1. One should note that the debt service ratio was calculated on the basis of data on public debt and publicly guaranteed private debt. Good data on private debt are not available.

The second indicator is $\underline{X}_2$, the growth rate of exports. We assume that a country with a high export growth rate is less likely, ceteris paribus, to reschedule since the prospects are brighter for increasing foreign exchange earnings in the near future. The growth rate of exports is calculated on the basis of four year averages, over an eight year period preceding the year of observation.

The variable $\underline{X}_3$ is an export fluctuation index measured as the average absolute percentage deviation from an eight year trend preceding the year of observation. We reasoned that a country with stable export earnings was less vunerable to foreign exchange crises and could tolerate a higher debt service ratio.

The fourth variable $\underline{X}_4$ is "non-compressible imports" as a fraction of total imports. It represents the degree to which imports may be reduced in time of balance-of-payments crisis. The higher this value, the more difficult it will be for a country to meet a debt servicing burden, and, therefore, the more likely debt rescheduling. Non-compressible imports were essentially intermediate goods, capital goods, anb basic foodstuffs. They were found by subtracting from total imports the values of the following "compressible" items: finished manufactured goods, meats, poultry, fruits, and nuts.

The fifth indicator $\underline{X}_5$ is per capita income. It would seem likely that the lower per capita income, the less flexibility there would be for reducing consumption and thus, the more likely debt rescheduling.

The sixth indicator $\underline{X}_6$ is the ratio of debt amortization to total outstanding debt (the inverse of the "average" maturity of loans). A low value for this indicator should be associated with a tendency to reschedule debt given the value of the debt service ratio and the other indicators.

First, a low amortization rate indicates that the current debt service ratio is unlikely to be reduced much in the near future even if no new borrowing takes place. A country in such a situation may be tempted to try to reschedule in anticipation of future difficulties and in an attempt to increase the near term ability to incur additional debt. Secondly, a high amortization rate usually indicates a heavy reliance on commercial credit facilities, access to which is usually granted to the more "credit-worthy" countries in the eyes of commercial lenders. A good credit reputation enhances a country's ability to obtain additional credits when shortfalls in exchange earnings occur. The ability to gain additional credits helps to avert foreign exchange crises and the necessity for debt rescheduling.

The seventh variable X_7 is the ratio of imports to Gross National Product. A country with low imports relative to GNP is more likely to be able to withstand temporary import cuts than a country with high imports relative to GNP. Since X_4 already accounts for consumption import "compressibility", X_7 may be thought of in the following terms. A country with high imports of intermediate inputs relative to GNP will find its production much more seriously threatened by inability to import than will a country which draws little of its intermediate inputs from imports. In sum, the higher X_7, the more likely a country is to require debt rescheduling.

Finally, the country's reserves must be considered. Variable X_8 is the ratio of imports to reserves, where reserves include gold reserves, holdings of dollars or sterling, and net position at the IMF[1/]. Other influences equal, the country with high reserves relative to imports is in less need of debt rescheduling.

1/ That is, the ceiling of permissible borrowings less the amount of borrowings already incurred.

3.3c Data Sources

The data sources were as follows. Debt service amortization, and outstanding debt were taken from studies by the IBRD, Avramovic[1], the Development Assistance Committee of the OECD, and AID country files. An attempt was made to find "ex ante" debt service for the year in which rescheduling occurred. In cases where these data were available, they were used in place of debt service in the prior year: in variable X_1, "expected" service in year t replaced observed service in year t-1.[2]

Population, dollar values of exports, imports, and reserves (gold and foreign exchange plus net IMF position) were taken from standard international statistical sources. Gross national product in current U.S. dollars was found from AID country files. The "non-compressible" imports were calculated from the SITC breakdowns of imports[3] and include cereals (SITC group 4) and raw materials and manufactured goods in SITC groups 2 through 7, excluding passenger cars, textile yarn, and finished paper goods. Thus, the consumer goods considered "compressible" were foods other than cereals, beverages and tobacco (SITC group 1), the exceptions to groups 2 through 7 mentioned above, and other manufactured goods (SITC group 8), such as clothing.

1/ Avramovic, Economic Growth and External Debt, 1964.

2/ That is, the use of debt service in year t-1 to calculate X_{1t} was made on the assumption that this value approximated the expected level of debt service in year t which would occur in the absence of rescheduling. Thus, in rescheduling cases in which the actual anticipated debt service for year t (if there were to be no rescheduling) was known, it was used in the calculation X_{1t}.

3/ U.N., Yearbook of International Trade Statistics, various years. For several countries, complete time series from 1957 to 1967 were not available. In these cases, data for the missing years were estimated by assuming that of total imports, the non-compressible fraction was identical to that for the closest three-year average for which data were available.

3.3d Empirical Results

The results of the discriminant analysis are shown in Table IV. Although the assumptions of regression analysis are not appropriate in discriminant analysis, we found it useful to apply the usual linear regression tests to obtain some notion of the relative importance of the various variables.

The most striking result was the dominance of only three variables: the debt service ratio (X_1), the amortization/debt ratio (X_6) and the imports/reserves ratio (X_8). Only these three variables were statistically significant at the 5% level. Note that all three have coefficients with the "correct" sign. In model B, only these three variables were included, yet the multiple correlation coefficient declined very little.[1/] Model C was estimated with only the debt service ratio and the amortization/debt ratio as explanatory indicators, on the grounds that a low reserve ratio and a rescheduling negotiation are symptoms of the same thing, a balance of payments problem. Furthermore, the debt service ratio and amortization/debt ratio are more susceptible to prediction than the imports/reserve ratio, and thus model C lends itself more easily to a projection of debt servicing difficulties.

Table V shows the correspondence between the linear discriminant functions and the actual debt reschedulings in the country-year data examined. The discriminant functions in Table IV were applied to find the Z value of each observation, and the critical value Z^* was determined by assuming that the probability of choosing from either the rescheduling or non-rescheduling population was equal and that the costs of misclassification were equal.[2/]

1/ Note that the R^2 cannot be interpreted as the "percent of variation explained," since even if the model perfectly fitted all observations as rescheduling or not rescheduling, the R^2 would not be unity because the estimated dependent variable is continuous but the observed "dependent' variable is zero or one, depending on whether the country-year was non-rescheduling or rescheduling, respectively.

2/ See unclassified, mathematical Appendix A, Discriminant Analysis when Variances are Unequal, to report cited in Footnote 1, page 1.

TABLE IV

LINEAR DISCRIMINANT FUNCTIONS

Coefficient of:	Model		
	A	B	C
1 (constant)	-0.0891	-0.1068	-0.0045
X_1	1.4955 (5.16)	1.4204 (6.46)	1.6261 (7.07)
X_2	-0.0545 (-0.13)	-	-
X_3	-0.0724 (-0.11)	-	-
X_4	-0.1121 (-0.59)	-	-
X_5	0.0152 (1.01)	-	-
X_6	-1.3739 (-3.27)	-1.3168 (-3.29)	-1.2147 (-5.28)
X_7	0.2655 (0.70)	-	-
X_8	0.0360 (3.60)	0.0373 (3.73)	-
R^2	0.3615	0.3501	0.2698

Note: Figures in parentheses are t values.

Table V

CORRESPONDENCE BETWEEN
LINEAR DISCRIMINANT FUNCTIONS
AND ACTUAL DEBT RESCHEDULINGS

Model:	A	B	C
Type I errors	3	3	1
Type II errors	15	14	17
Total errors	18	17	18
Total observations	145	145	145
Critical value	.219	.239	.126

Note: Type I error = Predict non-rescheduling for rescheduling country-year

Type II error = Predict rescheduling for non-rescheduling country-year.

The linear discriminant functions correctly distinguished rescheduling and non-rescheduling in all but 18 of the 145 country-years. The fact that models B and C perform as well as model A is consistent with the low significance for variables included in A but excluded in B and C. Concerning the prediction errors, it is important to note that false predictions of rescheduling ("type II" errors) were heavily concentrated in countries which had debt reschedulings in other years. Using model A, for example, 11 of the 15 type-II errors were for observations from countries which in other years did have reschedulings (Argentina, Brazil, Chile, India, Turkey). This pattern represents continuation of worrisome debt-service situations in non-rescheduling years for countries that have recently rescheduled.

3.4 Discriminant Analysis with Unequal Variance

To improve the accuracy of classification of observations as "rescheduling" or "non-rescheduling," we may take into account differences in the degree of variability of the X-indicators between the two groups. The simple linear discriminant function discussed in Section 3.3d requires the assumption that the covariance matrix of the X-variables is identical for the rescheduling and non-rescheduling groups. Two other methods were developed for estimation of discriminant functions when the covariance matrices differ for the two classes of observations. The first method estimates a quadratic function,

(3) $\underline{Z} = \underline{X}'\underline{A}\underline{X} + \underline{B}\underline{X} + \underline{C}$

where $\underline{Z}$ is the discriminant value for an observation, $\underline{X}$ is the observations vector of $\underline{X}$ variables, and $\underline{A}$ is an estimated matrix of coefficients, $\underline{B}$ an estimated vector of coefficients, and $\underline{C}$ an estimated constant.

The second method is an iterative estimate of a linear discriminant function, in which the initial estimate assumes equal covariance of the $\underline{X}$ variables for both classes of observations, but subsequent iterations consider the two separate estimated covariance matrices for the two groups.[1/]

We have estimated a variety of quadratic and iterative linear discriminant functions.

1/ See unclassified, mathematical Appendix A, Discriminant Analysis when Variances are Unequal, to report cited in Footnote 1, page 1.

In terms of minimum errors the best model is an iterative linear model with the following function:[1]

$$Z = 45.850\ X_1 + 2.500\ X_6$$

Therefore this model is used for the projections of section 4.4. The model gave only 13 incorrect predictions for past data. Its errors were relatively balanced between the truly rescheduling observations (5 errors in 13 observations) and the truly non-rescheduling observations (8 errors in 132 observations).[2]

IV Future Prospects

4.1 Existing Debt Service Projections

The total international debt of the less developed countries of the world was about $45 million in 1966. The service on that debt amounted to about $5 billion.[3] A number of projections of debt service have been made by various organizations.[4] All seem to indicate an alarming growth in interest and amortization payments. For example, the Secretariat of the

---

1/ This function is the result of the tenth iteration. The variable X_6 was restated as the natural logarithm of the ratio of debt to amortization. The critical value was defined as the average of the means of the discriminant function in the scheduling and non-rescheduling groups of observations, each weighted inversely by the estimated standard deviation in each group, plus the term $\log_e (k_1/k_2)$. With this definition the critical value is based on equal costs of misclassification, bug allows for unequal covariance matrices, and unequal estimated *a priori* probabilities. The variables k_1 and k_2 are the number of observations in the scheduling and non-rescheduling groups, respectively.

2/ A final note concerning the prediction results is that the number and allocation of prediction errors is highly sensitive to the critical value chosen. In the linear models, for example, the errors are more sensitive to the critical value than to differences between the 10th iteration and the first iteration of the model.

3/ United Nations Conferenee on Trade and Development (UNCTAD) Secretariat, The Outlook for Debt Service, TD/7/ Supp.5, mimeo, October 31, 1967,p.2.

4/ Projections of debt service have been made by a number of national and international organizations including the United States State Department, and Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD), the World Bank (IBRD), and the UNCTAD Secretariat.

United Nations Conference on Trade and Development recently made two sets of projections for all less developed countries. One assumes that net capital flows (gross capital flows less repayments) will remain at the 1966 level. The second set of projections, assuming a constant level of gross lending, reveals that the reduction in net flows, due to an increasing repayment stream, will be about 40 per cent by 1975.1/

4.2 Projections for 17 Countries

While the existing debt projections seem to indicate increasing debt servicing difficulties for less developed countries, they are not very useful for the purpose of applying the composite indices computed above. First, many of the projections are on a global basis and do not reveal individual country differences. Second, the few individual country projections available are not made on a consistent basis, differing greatly in methodology and assumptions concerning growth in lending, trends in lending terms, and kinds of foreign debt included.

In order to provide a set of consistent estimates for a reasonably large number of countries, we made a set of projections based on 1967 data to the year 1977 for 17 countries. The 17 countries are:

Argentina	Peru	Bolivia	Mexico
Turkey	Korea	Dominican Republic	Indonesia
Chile	Iran	India	
Colombia	Nigeria	Pakistan	
Israel	Tunisia	Brazil	

Fifteen of these countries rank in the top 20 in terms of total foreign

---

1/ UNCTAD, The Outlook for Debt Service, p. 8.

debt outstanding. Together they have accounted for well over one-half of total foreign assistance received in the last decade. Many of them have already experienced debt servicing difficulties. Note that Ghana and the United Arab Republic, although heavily involved in the payment of debt service, are not included because of lack of data.

The foundation of the projections was, in most cases, IBRD estimates of service payments due during the period 1967-1992 on the basis of debt already outstanding at the beginning of 1967.[1/] Upon this foundation, we assumed new loan disbursements to these countries to occur at the same gross rate (or as an alternative, at the same net rate) as it had in the recent past (in most cases the last two or three years). The new lending was broken down into several terms categories (usually from 4 to 7 categories) based on recent experience in borrowing by source. The most recent set of loan terms of each lending sources, e.g., A.I.D. development loans or IBRD loans, were then applied to the appropriate categories.

The resulting debt service projections are shown in Table VI and show marked differences among countries. The countries are grouped to preserve the confidentiality of the IBRD data, so the table shows only the overall picture. Note that the bulk of the repayments over the ten-year period are based on service due on debt already outstanding in 1967. Thus,

---

1/ The IBRD data includes all debt which is payable to creditors outside the debtor country with an original maturity of one year or more which are obligations of governments or public agencies. However, it includes publicly guaranteed private debt. It does not include: (1) transactions with the International Monetary Fund; (2) non-guaranteed private debt; (3) local currency obligations; and (4) other minor categories of debt.

while the assumptions concerning the bulk and terms of new lending affect the projections, the projections are not highly sensitive to these factors. Under the constant gross aid assumption, countries in Group A (taken all together) experience a doubling of their debt service obligations in five years and a tripling in ten years, a rate of growth of 11.1 per cent per annum over the ten-year period. On the other hand, countries in Group C (in combination) would have a decline in absolute value of debt service. Under the constant net aid assumption, all three groups would experience substantial growth in debt service.

Table VI

PROJECTIONS OF DEBT SERVICE

Country Groups	Year	Total Debt Service ($million) Gross Aid Constant	Total Debt Service ($million) Net Aid Constant	Index of Debt Service Gross Aid Constant	Index of Debt Service Net Aid Constant
Group A 1/	1967	762.4	764.6	100	100
	1972	1563.5	1658.5	205	217
	1977	2313.3	2750.1	303	360
Group B 2/	1967	420.8	420.8	100	100
	1972	612.6	662.3	146	157
	1977	678.6	998.0	161	237
Group C 3/	1967	1556.8	1556.8	100	100
	1972	1228.0	1550.1	79	100
	1977	1344.3	2000.1	86	128

1/ India, Indonesia, Israel, Korea, Nigeria, Pakistan.

2/ Chile, Colombia, Dominican Republic, Iran, Peru, Tunisia.

3/ Argentina, Bolivia, Brazil, Mexico, Turkey.

Group A countries combined would have a rate of growth of debt service payments of 13.7 per cent per annum.

One very interesting implication of the constant gross aid projections is that by 1977 ten of the seventeen countries reach a situation in which net capital flows reverse direction; that is payments of interest and amortization exceed the value of new lending. If the projections are extended to 1984, all 17 countries reach the turning point in net flows of foreign assistance.

4.3 Debt Service Ratios

In order to translate the debt service projections into indicators of debt servicing difficulty, we first computed the implied debt service ratios. These ratios were based on three alternative assumptions about export growth:

(i) a continuation of the 1960-1967 export growth trend for each individual country,

(ii) a four per cent rate of export growth, and

(iii) an eight per cent rate of export growth.

The countries are grouped into three categories, I, II, and III, and Table VII shows the combined results for all countries in each group. Thus the table gives only an overall picture.

There are large differences among countries, and the results are quite sensitive to the assumed export growth rate. Group I (taken all together) would be faced by debt-service ratios rising to higher levels than those experienced by any but a few countries in the past, if the export growth rate were only 4% or--even worse--at the 1960-67 trend. If their

exports expand at 8%, their debt-service ratios would still rise from about 21% to 28-33% over the next decade. Group II (taken all together) starts with a debt-service ratio of about 28%, but if exports expand at 8%, their combined debt-service ratio would decline to 16-21%. On the other hand, if exports expand at only 4%, their combined debt-service ratio would remain high. Group III starts at a debt-service ratio about 5%, and though it rises, it reaches at most 10%, in the case of low export growth and constant net aid.

Table VII

PROJECTED DEBT SERVICE RATIOS

Country Group	Constant Gross Aid			Constant Net Aid			Year
	Export Growth Rate			Export Growth Rate			
	1960-1967 Trend	4 per cent	8 per cent	1960-1967 Trend	4 per cent	8 per cent	
I India							
Indonesia	.209	.209	.209	.209	.209	.209	1967
Pakistan	.387	.355	.295	.407	.374	.310	1972
Tunisia	.476	.413	.283	.551	.477	.327	1977
II Argentina							
Brazil							
Chile							
Colombia	.283	.283	.283	.283	.283	.283	1967
Dom. Rep.	.182	.212	.176	.220	.244	.207	1972
Israel	.167	.240	.164	.217	.301	.206	1977
Korea							
Mexico							
Peru							
Turkey							
III Bolivia	.052	.052	.052	.052	.052	.052	1967
Iran	.053	.066	.054	.062	.069	.058	1972
Nigeria	.062	.083	.057	.087	.103	.071	1977

4.4 Projecting the Discriminant Functions

To further examine the likelihood of future debt servicing difficulties, we applied the discriminant functions estimated in section 3.4, after first projecting debt service/export and amortization/debt ratios. The projections of the debt service ratio are those described in the previous section and the projections of the amortization rate were based on the projections of debt service discussed in section 4.2. Table VIII gives the percentage of total country-years in which the iterated linear discriminant function indicated a serious debt servicing problem. It groups the countries in the same three groups as in Table VII.

Table VIII

PROJECTIONS OF DISCRIMINANT FUNCTION: PERCENTAGE OF COUNTRY-YEARS FOR WHICH SERIOUS DEBT SERVICING PROBLEM IS INDICATED

Country Group	Constant Gross Aid			Constant Net Aid		
	Export Growth Rate			Export Growth Rate		
	1960-1967 Trend	4 per cent	8 per cent	1960-1967 Trend	4 per cent	8 per cent
I India Indonesia Pakistan Tunisia	100	100	67	100	100	90
II Argentina Brazil Chile Colombia Dom. Rep. Isreal Korea Mexico Peru Turkey	22	30	13	45	73	32
III Bolivia Iran Nigeria	0	0	0	10	0	0

The projections of the discriminant functions show results broadly similar to the projections of the debt-service ratios. Group I (taken all together) would be faced by serious debt-servicing problems virtually continuously, if the export growth rate were only 4% or continued as in 1960-67. If their exports expand at 8%, and gross aid is constant, they would face such problems about two-thirds of the time. Group II (taken all together) would face serious debt-servicing problems only occasionally if their exports expand at 8% and gross aid is constant. On the other hand, if their exports expand at only 4% and net aid is constant, they would face such problems about three-fourths of the time . GroupIII should be essentially free of serious debt-servicing problems for the next decade or so under the various assumptions we have made.

4.5 An Overall Assessment of Prospects

This analysis indicates that over the next decade a number of developing countries are likely to face a burden of debt service such that they will request some form of debt relief from their creditors. This assumes that roughly the same factors which operated in the past are likely to operate in the future.

There may, however, be mitigating circumstances in the future that will make the debt service burden less onerous. First, an increasing number of foreign aid recipients are serviced by consortia of aid donors who are likely to take into account the debt service burden when setting aid levels and policies. Secondly, the buildup of debt service is relatively

easy to foresee given the availability of data on government and government guaranteed loans outstanding. Appropriate policies for adjusting to the increased level of debt service can be initiated well ahead of time. In many past rescheduling exercises, debt servicing difficulties arose suddenly and without warning as the result of excessive reliance on short-term, non-guaranteed export credits for which little data were available.

On the other side, however, there are many reasons to believe that debt servicing difficulties will be even more severe than indicated by our projections. First, both the constant gross aid and constant net aid assumptions used in the debt service projections may be conservative in light of past experience and in view of reasonable estimates of LDC need for foreign capital. For example, between 1960-62 and 1965-67 gross aid from members of the Development Assistance Committee to the LDC's and multilateral agencies grew at 4.2 per cent annually and aid net of amortization and interest grew at 2.5 per cent.

Secondly, the debt service projections assume that terms of foreign lending will be roughly the same in the future as in the 1964-66 period. Several recent developments will very likely invalidate that assumption and cause a greater burden of debt service. United States terms on development loans have hardened substantially since 1964.[1/] PL 480 assistance is gradually being shifted to a hard currency repayable basis by 1971 with terms similar to development loans. Another development is a

---

1/ In 1964, these terms were 1.0 per cent interest during a ten year grace period for repayment of principal and 2.5 per cent over the remaining life of the loan. In 1968 these two rates were 2.0 and 3.0 per cent, respectively.

prospective rapid increase in lending by countries (e.g. Germany and Japan), multilateral agencies (e.g. the World Bank, and the Inter-American Development Bank) and other institutions (e.g. the U.S. Export-Import Bank) which lend on near-commercial terms. Revised and more recent data which were just becoming available at the time this paper was written indicate that for a number of countries in Groups I and II, the debt service projections for 1967 and 1968 are under estimates because of the hardening of average terms.

Thirdly, the data and projections for debt service exclude non-guaranteed export credits which can add significantly to the debt service burden and cause "lumpiness" in debt service payments.

On balance, then the prospects for serious debt servicing difficulties implicit in the analysis probably err on the optimistic rather than the alarmist side. Furthermore, it is significant to note that many of the countries in Groups I and II have a debt structure including many long term, low interest loans, notwithstanding their high level of debt service. It will be difficult for these countries to work themselves out of a high debt service situation by a temporary restriction on commercial borrowing.

V. Conclusions

The above analysis and projections suggest a very strong case for a substantial softening of the terms of foreign assistance. It also indicates that caution should be exercised with regard to expanded use of institutions which because of their use of borrowed capital must lend on

near-commercial terms. Furthermore, special assistance efforts are necessary for those countries which are highly likely to have serious debt servicing problems. These countries should either be assured of aid levels which will compensate for their high level of debt service, or of access to some established procedures for rescheduling their debt payments. Without such assurances, default on international debt will become increasingly attractive.

The analysis also suggests that export growth rates have a heavy influence on debt servicing capability. Repayment of foreign debt is possible only to the extent that eventually exports of goods and services exceed imports. While it is beyond the scope of this paper to consider trade policies in general, it is well to note that increased access to markets in developed countries and less tieing of aid to purchases in developed countries are policies which can add to the ability of the LDC's eventually to transfer the real resources implicit in the commitment to repay foreign loans.