



Factors Affecting the External Debt-Servicing Capacity of African Nations: An Empirical Investigation

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Abstract

While there has been a vast number of studies and international discussions on the debt-servicing capacity of developing nations, not much attention has focused on the African dimension. This article examines the determinants of debt rescheduling for 45 African nations over the twelve-year period 1976 to 1987. A logit model of the macroeconomic variables affecting the probability of rescheduling is developed. The findings indicate that the debt-service ratio, reserves to imports ratio, the debt-service payments to capital inflow ratio, the GDP growth rate, the rate of domestic inflation, and the ratio of net government deficits to the GDP are important indicators of debt-servicing capacity. The overall results, while providing strong support for some of the often mentioned causes of Africa's debt crisis, are seen to hold useful possibilities for both the debtor countries and for international creditors.

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Introduction

As the debt burden balloons in many African countries towards the end of 1980 decade, the debt-servicing capacity of these nations (excluding South Africa) has become a subject of interest and concern for both international lending organizations and the debtor nations. Between 1980 and 1987, 24 African nations experienced severe difficulties in servicing their international debt in at least 75 instances. Payments of interest on principal on most of the debt to creditors were rescheduled through the so-called Paris Club arrangements.¹

Debt rescheduling amounts to a rearrangement which usually involves an extension or stretching out of the original repayment schedule with respect to a particular debt or a set of debts. It usually comes with some restrictions on the volume of future borrowings over a specified number of years.

The problems posed by the increasing number of African debt reschedulings and the poor results obtained from current methods governing the management of Third World sovereign debt have heightened the need for a well-developed conceptual framework for analyzing the factors that affect the likelihood of repayment crises in developing countries.² Such a framework may be useful to both the debtor countries and international creditors in formulating policies aimed at achieving payments stabilization and improved debt-service capacity.

The objective of this study is to empirically identify the macroeconomic correlates of debt reschedulings for African nations. Very little work has been done in this area of quickly developing importance.

Origins of the African Debt Crisis

The recent increase in the frequency and severity of external debt-servicing difficulties experienced by many developing countries has prompted numerous assessments of the nature and causes of the problems. The origins of the debt predicament in which many African nations (and their creditors) now find themselves can

¹ I thank James B. Stewart, editor of the journal and two anonymous referees for their valuable comments on an earlier draft. All errors, of course, are the responsibility of the author. Recent official multilateral debt renegotiations of African debtor nations can be found in Peter M. Heller and Nissanke E. Weerasinghe, "Multilateral Official Debt Rescheduling: Recent Experience," *World Economic and Financial Surveys*, I.M.F. Washington, D.C. (May 1988).

² Congress of the United States. *Report of the Joint Economic Committee*. (April 20, 1988), p. 20. According to this report, no African country involved in external debt rescheduling since 1982 has significantly reduced its debt ratio or improved its economic condition.

be attributed to several factors. The most frequently cited are the second OPEC oil price hike of 1979-80, the simultaneous emergence of inordinately high "real" interest rates, and declining volumes/terms of trade for exports from African countries. Of the more than \$40 billion increase in the external debt of African countries between 1973 and 1982, \$33 billion can be attributed to factors beyond the control of African countries, i.e., factors which were exogenous to their activities, policies, and growth.³

In addition, the strong measures taken by industrial countries to fight inflation in the early 1980s contributed to a worldwide recession. This led to diminished demand and falling primary commodity prices--that exacerbated the deterioration in the terms of trade for many African countries. As demand for exports fell, and prices tumbled, the domestic growth of these countries became stagnant. Naturally, the current account deficits of African nations quadrupled. The

Empirical Evidence on Debt Servicing Capacity

While there has been a vast number of studies and international discussions on the global debt crisis, not much attention has been focused on the African dimension of the problem.

Previous work by Frank and Cline⁴, Dhonte⁵, Grinols⁶, Feder and Just⁷, Mayo and Barrett⁸, Sargen⁹, and Saini and Bates¹⁰, have attempted to quantify the economic

³ For a complete description of these factors, see example, Eugene Rotberg, "The World Bank Approach to Debt," *Euromoney*, (December 1983), pp. 22.

⁴ Charles R. Frank and William W. Cline, "Measurement of Debt Servicing Capacity: An Application of Discriminant Analysis," *Journal of International Economics*, Volume 1, (1971), pp. 327-344.

⁵ Pierre Dhonte, "Describing External Debt Situations: A Roll-over Approach," *IMF Staff Papers*, Volume 22, (1975), pp. 159-186.

⁶ Emmanuel Grinols, "International Debt Rescheduling and Discrimination Using Financial Variables," U.S. Treasury Department, Washington, D.C., (1976), Unpublished Manuscript.

⁷ Gershon Feder and Richard E. Just, "A Study of Debt Servicing Capacity Applying Logit Analysis," *Journal of Development Economics*, Volume 16, (1977), pp. 25-38.

⁸ A. Mayo and A. Barrett, "An Early Warning Model for Assessing Developing Country Risk," in *Proceedings of a Symposium on Developing Countries' Debt*, edited by S. Goodman, (1977), Washington, D.C.: Export-Import Bank.

⁹ Nicholas Sargen, "Economic Indicators and Country Risk Appraisal," *Economic Review of the Federal Reserve Bank of San Francisco*, (Fall 1977), pp. 19-35.

¹⁰ Krishnan Saini and Philip Bates, *Statistical Techniques for Determining Debt-Servicing Capacity for Developing Countries: An analytical Review of Literature and Further Empirical Results*. Federal Reserve Board of New York Research Paper no. 7818, (September 1978).

variables which should be considered in assessing the likelihood that a developing country will experience debt servicing difficulties.

Frank and Cline used discriminant analysis to classify 26 debtor nations from 1960 to 1968 as belonging to one of two possible populations: default or nondefault. Their experiments with discriminant analysis show that debt service ratio and average maturity of debt are best predictors of debt service capacity. Grinols used discriminant and discrete analyses on a set of 20 variables to classify 64 countries into rescheduling and non-rescheduling groups for the period 1961 to 1974. His results identified debt/service payments ratio, disbursed external debt/debt service payments ratio, debt service payments/ exports ratio, external debt/GDP ratio, and external debt/exports ratio as the most significant variables explaining rescheduling. Sargen applied discriminant analysis on six economic indicators to rank 44 countries according to their probability of default for the 1960 to 1975 period. First, using a debt service approach, he found that the ratio of scheduled debt service payments to exports was significant in explaining rescheduling. Next, using a monetary approach, he concluded that the rate of inflation was the most important indicator of a country's debt servicing problems.

Feder and Just used logit analysis on a sample of 30 countries for the period 1965 to 1972. They found six variables, per capita income, capital inflows/debt service payments ratio, real export growth rate, imports/reserves ratio, debt service ratio, and amortization/debt service ratio to be statistically significant in explaining the probability of default. Mayo and Barrett used logit analysis on a set of 48 countries to develop an early warning model of debt service problems for the period 1960 to 1975. The model attempted to predict a country's debt servicing problems five years into the future. Their results showed that disbursed external debt/exports ratio, reserves/imports ratio, gross fixed capital formation/GDP ratio, imports/GDP ratio, and the rate of increase in consumer prices are most significant in forecasting debt servicing difficulties. Saini and Bates applied both discriminant and logit analyses on a sample of 25 countries of which 13 had either rescheduled or secured balance of payments support loans in the period 1960 to 1977. They found the growth rate of consumer prices, growth rate of reserves, money supply growth rate, and adjusted cumulative current account balance/exports to be significant.

Monte, on the other hand, used principal components to identify a group of economic variables affecting debt service capacity. He selected 13 cases of debt rescheduling between 1959 and 1971, and compared them with a sample of 69 nonrescheduling countries in 1969. Monte found six economic indicators to be the most significant for the

first and second principal components which explained 53 percent of the variation in the sample data.

A critical examination of earlier models of debt servicing capacity reveals various limitations which make their reported findings unsuitable for use in predicting the debt servicing capacity of African countries.¹¹ First, the models were based on the periods of the sixties and seventies which contained only a few cases of African debt rescheduling (see Table 1) and were estimated before the period of vast debt accumulation. Second, the usage of variable-rate loans had increased which made the debtor countries more vulnerable to changes in international interest rates. In addition, two oil price shocks had altered trade relationships and had distorted the balance of payments of some non-oil.

African developing countries. Hence, events which caused debt reschedulings in the late sixties and early seventies may be entirely different from those which caused reschedulings in the early eighties. With the recent wave of African debt reschedulings, a model utilizing the larger number of African country debt rescheduling observations could be more meaningful in forecasting the factors affecting the debt repayment problems of these nations.

Table 1
Number of African Countries
Included in Previous Debt Rescheduling Studies

Author(s)	Total number of countries examined	African countries	Percent of total
Frank & Kline (1971)	26	1	3.8%
Dhonte (1975)	82	2	2.4%
Grinols (1976)	64	4	6.2%
Feder & Just (1977)	30	2	10.0%
Mayo & Barrett (1977)	48	4	8.3%
Sargen (1977)	44	3	6.8%
Saini & Bates (1978)	25	3	12.0%

Indicators of Debt Servicing Capacity

Seven indicators of debt servicing capacity are used in this study. In selecting the variables to be used in the analysis, consideration was given to (1) variables used in

¹¹ For an analytical review of the literature, see John B. Morgan, "A New Look at Debt Rescheduling Indicators and Models," *Journal of International Business Studies*, (Summer 1986), pp. 37-54.

previous studies, (2) variables justifiable by existing theories on the causes of African debt crisis, (3) data availability to permit the calculation of variables across countries.

Initially, 16 variables (see Appendix) representing various financial and economic characteristics of African countries were obtained for the analysis. Since these variables tend to be highly correlated, their use in multivariate analysis can cause multicollinearity. To alleviate this problem, the principal components analysis(PCA) method was used to reduce the original set of correlated macroeconomic variables to a smaller set of uncorrelated principal components. Principal components analysis is concerned with summarizing the interrelationships among explanatory variables by grouping them into a few principal components that retain a maximum of information contained in the original variable set¹².

The original 16 variables were used as input to SAS-PRINCOMP program. As shown in Table 2, seven principal components with eigenvalues of one or greater were retained. The seven principal components account for nearly 88 percent of the total variation in the original data set. The varimax orthogonal rotation was used to obtain the final factor-pattern/structure matrix. The factor loadings of the seven principal components show the correlation between the principal components and the 16 variables and are presented in the Appendix.

Table 2
Summary of Principal Components Analysis
For 16 Macroeconomic Variables

Principal Component		Percentage of Variance	Cumulative
<u>Number</u>	<u>Eigenvalue</u>	<u>Explained</u>	<u>Percentage of Variance</u>
<u>Explained</u>			
1	10.43	22.52	22.52
2	9.05	19.67	42.19
3	6.84	12.69	54.88
4	5.20	10.39	65.27
5	4.03	8.76	74.03
6	3.28	7.13	81.16
7	2.56	6.56	87.72

¹² For a comprehensive explanation of the principal components analysis methodology, see Richard A. Johnson and Dean W. Wichern, *Applied Multivariate Statistical Analysis*, 2nd edition (Englewood Cliffs: Prentice Hall, 1988).

Since all original variables make some contribution to each principal component, one of the main difficulties in principal components analysis is the naming and interpretation of principal components obtained. Because of this difficulty, in some studies, one variable with the highest factor loading is picked from each principal component and later used as input in multivariate analysis.¹³ Seven variables with the highest factor loading (highly correlated with a given principal component) were selected from the principal components for use in this study. The variables selected with their respective factor loadings are shown in Table 3. In order to conserve space, the following explanation of debt servicing capacity indicators for African countries will be limited to the selected variables.

A traditional indicator for creditworthiness, debt-service ratio relates debt service requirements to export income. The higher the ratio of debt service to exports of goods and services, the greater will be the likelihood that in the event of a severe decline in export earnings the country will no longer be able to meet debt-service obligations. The probability that a country will seek a rescheduling rises as its debt-service ratio rises. Reserves to imports ratio relates a country's foreign reserve levels to its potential need for reserves. When reserves are high, perhaps, 50 percent of imports or above, it is likely that export shortfalls can be met through drawdowns of reserves. The higher the ratio of foreign reserves to imports, the lower will be the probability of rescheduling.

Table 3
Variables with the Highest Factor Loadings Selected
as Indicator of Debt-Servicing Capacity

Principal Component		Factor
<u>Variable Name</u>	<u>Number</u>	<u>Loading</u>
Debt-Service Ratio	4	0.972
Reserves to Imports Ratio	5	-0.814
Debt-Service Payment to		
Capital Inflow Ratio	3	0.873
GDP Growth Rate	1	0.950
Rate of Domestic Inflation	2	0.885
Net Government Deficit to		
GDP Ratio	6	0.786
Global Supply of Lending	7	0.894

¹³ See for example, George E. Pinches and K. Mingo, "A Multivariate Analysis of Industrial Bond Ratings," *Journal of Finance*, (March, 1973), pp. 1-18.

Capital inflows in form of loans, grants, direct foreign investments, and transfer payments are important sources of foreign exchange receipts which can be used for debt service. As the ratio of debt-service payments to capital inflow increases, a country's ability to meet debt-service obligations declines.

GDP growth rate measures a country's potential wealth, productivity and return on investment. When a decline in economic growth occurs, especially negative growth per capita, increased demand for borrowing can be expected. Furthermore, the more severe the decline in national income, the closer the country's consumption level will be to levels considered minimally acceptable, and the greater will be the resistance to austerity cutbacks in an adjustment program. In this case, the probability of rescheduling is negatively related to the debtor country's rate of economic growth.

Inflation may act as a proxy variable for the quality of economic management. A high rate of inflation is a sign of internal economic tension and of the inability or unwillingness of the government and the central bank to balance the budget and to restrict money supply. The higher the inflation rate, the more risky the government is perceived to be. Furthermore, inflation can influence the demand for foreign funds through its adverse impact on the trade accounts. That is, inflation would tend to cause export demand to fall and import demand to rise, and the growing trade deficit, in turn, would increase trade-financing requirements.

Net government deficit to GDP ratio is a measure of the ability of a government to fund its activities from its own resources. Many African countries opted for major development programs during the commodity boom years of the late 1970s, acquiring external debt as spending increases outpaced the rise in tax receipts. After the post-1980 collapse in commodity prices, these countries found themselves hard-pressed to meet their debt-service obligations. Thus, a country is more likely to experience debt repayment problems as its ratio of net government deficit to GDP rises.

Global supply of lending concerns the global supply of lending rather than country-specific conditions. In 1981 and 1982 shocks to the confidence of capital markets tended to reduce lending to developing countries. Many African countries faced a declining credit supply because of global conditions rather than because of their economic performance. Similarly, the large surge in international lending in the mid-1970s, associated with the recycling of petrodollars, meant that many developing countries faced abundant supply of credit. The global supply of credit is negatively related to the demand for rescheduling. This indicator provides a way of overcoming a

major limitation of previous debt rescheduling models: their inability to capture the changing conditions in the 1970s when sharp increases in international lending prevented reschedulings that would have been expected on the basis of earlier model estimates.

The Model

We use a logit model to analyze the factors affecting the debt servicing capacity of African nations. The logit model is a multivariate regression analysis technique which is used primarily to make predictions in dichotomous situations. Once a logistic function has been estimated from historical data, new data can be substituted into the function to estimate the current probability that a country will experience payments difficulty.

The underlying logit model of the present study assumes that the probability of rescheduling (P_i) can be estimated as

$$P_i = \frac{1}{1 + e^{-(\alpha + \beta_{xi})}} \quad (1)$$

where the individual P_i are not observed but we have information for each observation on whether a given country rescheduled its foreign debt payments or not. X is a vector of economic indicators and e is the base of natural logarithm of both sides of the equation. The measured dependent variable is $Y_i = 1$ if a country rescheduled and 0 if not. Our objective is to find parameter estimators for alpha and beta which make it most likely that the pattern of choices in the sample would have occurred.

When using the logit model with individual observations the most suitable estimation method is that of maximum likelihood. The maximum likelihood estimation procedure has a number of desirable properties. All parameter estimators are consistent, asymptotically efficient and normal.¹⁴ Our sample consists of n_1 countries that rescheduled their foreign debt and n_2 countries that did not ($n_1 + n_2 = N$). The data were ordered so that the n_1 observations are associated with rescheduling. Thus, the maximum likelihood function that we wish to maximize has the form

$$L = \text{Prob}(Y_1, \dots, Y_N) = \text{Prob}(Y_1) \dots \text{Prob}(Y_N) \quad (2)$$

¹⁴ For a comprehensive discussion of maximum-likelihood logistic regression, see G. S. Maddala, *Limited-Dependent and Qualitative Variables in Econometrics*, (Cambridge: Cambridge University Press, 1983).

By taking into account the fact that the probability of a country falling in the non-rescheduling group is equal to 1 minus the probability of it being in the rescheduling group, and using n to represent the product of a number of independent variables, the likelihood function reduces to

$$L = P_1 \dots P_{n1} (1 - P_{n1+1}) \dots (1 - P_N) = \prod_{i=1}^{n1} P_i \prod_{i=n1+1}^N (1 - P_i) = \prod_{i=1}^N P_i^{Y_i} (1 - P_i)^{(1 - Y_i)} \quad (3)$$

The last expression follows because $Y_i = 1$ for the $n1$ observations, and 0 for the $n2$ observations.

We maximize the logarithm of L by substituting for the logistic probability function from equation (1). Note first that

$$1 - P_i = 1 - \frac{1}{1 + e^{-(a + bx_i)}} = \frac{1 + e^{-(a + bx_i)} - 1}{1 + e^{-(a + bx_i)}} = \frac{e^{-(a + bx_i)}}{1 + e^{-(a + bx_i)}} = \frac{1}{1 + (1/e^{-(a + bx_i)})} = \frac{1}{1 + e^{a + bx_i}}$$

In other words

$$\ln L = \sum_{i=1}^n \ln P_i + \sum_{i=n1+1}^N \ln (1 - P_i)$$

To obtain the slope estimators of a and b we partially differentiate $\ln L$ with respect to a and b , set the result equal to zero, and solve:

$$\frac{\partial(\ln L)}{\partial a} = \sum_{i=1}^n \frac{\partial P_i / \partial a}{P_i} - \sum_{i=n1+1}^N \frac{\partial P_i / \partial a}{1 - P_i} = 0$$

$$\frac{\partial(\ln L)}{\partial b} = \sum_{i=1}^n \frac{\partial P_i / \partial b}{P_i} - \sum_{i=n1+1}^N \frac{\partial P_i / \partial b}{1 - P_i} = 0$$

Since the above equations are nonlinear, they can be solved using the Newton-Raphson or the Taylor Series expansion method.¹⁵ To test the significance of all or a subset of the coefficients in the maximum likelihood logit model, we use a chi-square distribution and likelihood ratio tests.

Data

¹⁵ See Gregory C. Chow, *Econometrics*, (McGraw-Hill Book Company, 1983).

To apply the logit model to the estimation of rescheduling probabilities, we compiled data for 45 African countries (IMF/World Bank members) over the twelve-year period 1976 to 1987. As shown in Table 4, there were 74 observations on rescheduling involving 24 countries. Table 5 lists the additional 246 nonrescheduling cases included in the sample $(12 \times 20) + 6$.¹⁶ The sample thus consists of 320 observations.

The World Bank, *African Economic and Financial Data*, was the data source for all the debt data and most of the original 16 explanatory variables used in this study¹⁷. All variables were calculated one year prior to the year of rescheduling (see Appendix).

¹⁶ Data for Zimbabwe were not available for the years 1976 to 1981.

¹⁷ World Bank, *African Economic and Financial Data* (Washington, D.C., 1989).

Table 4
Debt Rescheduling Cases Included in the Logit Analysis

Debtor Country	Date of Agreement	Amount Rescheduled (mill.of\$U.S.)
Zaire	1976	\$270.00
	1977	\$210.00
	1979	\$1,040.00
	1981	\$500.00
	1983	\$1,497.00
	1985	\$408.00
	1986	\$429.00
	1987	\$671.00
Sierra Leone	1977	\$39.00
	1980	\$37.00
	1984	\$25.00
	1986	\$86.00
Gabon	1978	\$63.00
	1987	\$387.00
Togo	1979	\$260.00
	1981	\$232.00
	1983	\$300.00
	1984	\$75.00
	1985	\$27.00
Sudan	1979	\$487.00
	1982	\$203.00
	1983	\$518.00
	1984	\$249.00
Liberia	1980	\$35.00
	1981	\$25.00
	1983	\$17.00
	1984	\$17.00
Madagascar	1981	\$140.00
	1982	\$107.00
	1984	\$89.00
	1985	\$128.00
	1986	\$212.00
Central African Republic	1981	\$72.00
	1983	\$13.00
	1985	\$14.00
Senegal	1981	\$75.00
	1982	\$74.00
	1983	\$72.00
	1985	\$122.00
	1986	\$65.00
	1987	\$79.00
Uganda	1981	\$30.00
	1982	\$19.00
	1987	\$170.00
Malawi	1982	\$25.00
	1983	\$26.00
Zambia	1983	\$375.00
	1984	\$253.00
	1986	\$371.00
Morocco	1983	\$1,152.00
	1985	1,124.00
	1987	1,008.00
Niger	1983	\$36.00
	1984	\$26.00
	1985	\$38.00
	1986	\$34.00
Cote d'Ivoire	1984	\$230.00
	1985	\$213.00
	1986	\$370.00
	1987	\$567.00
Mozambique	1984	\$283.00
	1987	\$361.00
Mauritania	1985	\$74.00
	1986	\$27.00
	1987	\$90.00
Guinea	1986	\$196.00
Congo	1986	\$756.00
Tanzania	1986	\$1,046.00
Gambia	1986	\$17.00
Nigeria	1986	\$6,251.00
Egypt	1987	\$5,586.00
Somalia	1985	\$127.00
	1987	\$153.00

Results

Results of the estimation of the logit model of rescheduling appear in Table 6. The variables in the table refer, respectively, to the debt-service ratio, the ratio of reserves to imports, the debt-service payments to capital inflow ratio, the GDP growth rate, the rate of domestic inflation, the net government deficit to GDP ratio, and the global supply of lending.

The estimated results broadly confirm the hypothesized influences on debt rescheduling and succeed in a relatively high degree of explanation of rescheduling and nonrescheduling. The likelihood ratio index (analogous to R^2 in linear regression) is 91 percent and the Chi-squared statistic implies strong significance of the model with only two cases of actual rescheduling unpredicted (type I error) and only one nonrescheduling case falsely predicted as rescheduling (type II error). This incidence of error compares favorably with that obtained in previous studies of this nature.¹⁸

The debt-service ratio is significant and has the correct sign: The probability that a country will reschedule its debt increases as its debt service ratio increases. The same is true of the reserves to imports ratio, which has the expected negative sign (higher reserves mean lower likelihood of rescheduling). The debt-service payments to capital inflow ratio has the expected positive sign (rising debt-service payments to capital inflow means more likelihood of rescheduling) and is highly significant. The debt-service payments to capital inflow ratio and the debt-service ratio of most of the countries in our sample exhibit a rising trend. The rise in these variables can be partly attributed to the decline in real net capital inflows, including external assistance to African countries during the 1980s. As real net capital inflows declined, the ability of African countries to meet their debt-service obligations significantly diminished.

¹⁸ For a comparison of the degree of explanation achieved in earlier studies, see Robert Z. Aliber, "A Conceptual Approach to the Analysis of External Debt of the Developing Countries," *World Bank Staff Working Paper*, no. 421 (October 1980), pp. 24-50.

Table 5
Non-Rescheduling Countries
Included in Logit Analysis

	Country	Period Included
1.	Benin	1976-87
2.	Burkina Faso	1976-87
3.	Burundi	1976-87
4.	Cameroon	1976-87
5.	Chad	1976-87
6.	Comoros	1976-87
7.	Djibouti	1976-87
8.	Equatorial Guinea	1976-87
9.	Ethiopia	1976-87
10.	Ghana	1976-87
11.	Guinea-Bissau	1976-87
12.	Kenya	1976-87
13.	Lesotho	1976-87
14.	Mali	1976-87
15.	Mauritius	1976-87
16.	Rwanda	1976-87
17.	Sao Tome	1976-86
18.	Seychelles	1976-87
19.	Swaziland	1976-87
20.	Tunisia	1976-87
21.	Zimbabwe	1982-87

The GDP growth rate also has the correct sign and is significant (the higher a country's GDP growth rate, the lower its probability of rescheduling). Many African countries, especially those now experiencing severe debt-servicing problems, assumed in the 1960s after independence that their national economies would grow over time, and that commensurate increases in export production would allow the debt-service obligations arising from foreign borrowings undertaken to finance public projects to be met. These assumptions became increasingly unrealistic in the light of the two oil price shocks during 1973-74 and 1979-80 and the subsequent depression in non-oil commodities markets during the 1980s.

The decline in non-oil commodity prices affected a number of African countries, including the Central African republic, Madagascar, Sierra Leone, and Tanzania (all coffee growers); Côte d'Ivoire (cocoa and coffee grower); Gambia and Senegal (producers of ground nuts and phosphate); Malawi (sugar and tobacco producer); Niger (uranium producer); and Togo (phosphast producer). In addition, several oil producing countries such as Gabon, Egypt, Nigeria, and Congo used their access to foreign capital markets to support major public investment schemes during the 1980s. When oil prices plummeted early in 1986, these countries found themselves hard-pressed to meet their debt-service obligations. Indeed, according to IMF data compiled for the October 1988 World Economic Outlook Exercise, the total debt levels for African countries have risen steadily since 1978, while export earnings in 1987 were barely above their dollar level nine years earlier.¹⁹

The rate of domestic inflation is highly significant and has the hypothesized positive sign. The same is true for the ratio of net government deficit to GDP. The significance of these two variables is not surprising. Domestic policies have often been mentioned as a major cause of African debt crisis. Besides expansionary fiscal policies and outright borrowing for consumption, many African countries pursued policies that weakened their external positions. Growing fiscal deficits and surging private credit demand led to rapid monetary expansion in many countries. This, in turn, contributed to higher inflation, with consumer prices rising on average by 20 percent a year during the 1980s.²⁰ Because most of these countries did not depreciate their currencies to offset this inflationary impact, many currencies became overvalued, thus inhibiting exports.

The variable for the global supply of lending has the appropriate negative sign: higher level of lending globally means there is less likelihood of rescheduling for individual countries. However, it is not significant. The low significance of this variable is surprising since it was intended to explain the wave of rescheduling among African debtor nations that began in 1982 when capital availability reversed sharply.

¹⁹ International Monetary Fund, *World Economic Outlook Exercise*, (Washington, D.C., October, 1988).

²⁰ *Ibid*, p. 78.

Table 6
Estimates of Logit Model of Debt Rescheduling

Variable	Coefficient	T-ratio	Lower	Probability	Upper
Debt-Service Ratio	10.986	4.194*	0.4221	0.9875	0.993
Reserves to Imports Ratio	-3.219	-3.850*	0.2873	0.5632	0.743
Debt-Service Payments to Capital Inflow Ratio	4.013	8.366*	0.0061	0.3539	0.501
GDP Growth Rate	-12.61	-4.219*	0.2440	0.9866	0.993
Rate of Domestic Inflation	2.181	7.328*	0.0078	0.4720	0.611
Net Government Deficit to GDP Ratio	5.216	8.062'	0.3133	0.8023	0.921
Global Supply of Lending	-6.015	-1.009	0.0904	0.1159	0.785

Observations: 320

Reschedulings: 74

Likelihood Ratio Index: 0.9124

Model chi-squared: 315.19

Error^c:

Type I = 2

Type II = 1

*Significant at 0.05 level

#Significant at 0.01 level

^aLower confidence limit of predicted probability.

^bUpper confidence limit of predicted probability.

^cType I error = failure to predict actual rescheduling.

Type II error = prediction of rescheduling when non occurs.

Summary and Conclusions

In summary, on the basis of statistical tests, the logit model estimates indicate that debt-service ratio, reserves to imports ratio, debt-service payments to capital inflow ratio, GDP growth rate, rate of domestic inflation, and net government deficit to GDP ratio are important indicators of debt servicing capacity for African nations.

The results of this study may be useful for debt servicing capacity analysis by potential lenders. But the results also hold some useful possibilities for African countries. For example, armed with information on the type of economic indicators that affect their

debt-servicing capacity, these countries could begin implementing programs aimed at improving their position.

Debt obligations can be eased temporarily by rescheduling. However, the time bought through this rescheduling must be used to make adjustments which are both necessary and inevitable. New net bank lending to African countries with heavy principal payments on rescheduled debt is likely to be particularly constrained. These countries could find it advantageous to encourage a greater inflow of direct investment and equity capital to maintain sufficient resource inflows to support an adequate growth rate, as well as to reduce vulnerability to any future deterioration in economic conditions.

African countries that are undergoing external debt crisis may also improve their situation by: liberalizing their economies in order to bring competitive pressures on domestic private business activities, adjusting the exchange rate so that exports are encouraged and imports are restrained, and reducing inflation through strong policies of fiscal and monetary adjustment. In sum, because of the structural difficulties facing most African countries, a comprehensive policy package for managing external debt has to aim at addressing not only demand management issues, but also the structural problems.

Appendix
List of Potential Indicators of Repayment Problems
Used in the Principal Components Analysis

1. Debt Service ratio =

(Total debt service paid, including total interest payments on all debt and amortization of medium and long-term debt)/Total exports of merchandise and services.

2. GNP per capita =

$$(Y_t) = Y_t^{\$} / N_t - e_t - 2, t) \quad (\text{based on World Bank's Atlas method})$$

where $Y_t^{\$}$ = GNP per Capita in U.S. dollars.

Y_t = current GNP (national currency) for year t

e_t = annual average official exchange rate for year t

N_t = midyear population for year t

3. Net Government deficit to GDP ratio =

(Receipts from revenue-prants)/Total domestic output of goods and services (GDP)).

4. Imports to GDP ratio = Total imports of merchandise and services/GDP.

5. Exports to GDP ratio = Total exports of merchandise and services/GDP.

6. Reserves to Imports Ratio =

(Foreign currency holdings + (ceiling on permissible International Monetary Fund borrowing-amount of borrowing already incurred) /imports of merchandise and services)).

7. Growth rate of money supply =

Annual percentage change in money (M_t), defined as the sum of currency outside of banks and demand deposits other than those of the central government.

8. Total debt to total imports ratio =

Total debt, including official concessional and nonconcessional, and private debt/Total merchandise and services imports.

9. Total consumption per capita =

The sum of general government consumption/population.

10. Reserves to exports ratio =

(Foreign currency holdings + Ceiling on permissible IMF borrowing-amount of borrowing already incurred) /Exports of merchandise and services.

11. Debt service payments to capital inflow =

Total interest payments on all debt/(Net official and unofficial transfer payments that carry no provisions for repayment + net official development assistance).

12. Short-term debt to total external debt ratio =

(Total short-term loans + interest arrears on long-term debt)/Total debt.

13. GDP growth rate =

Annual growth rates calculated from GDP data at constant 1980 values.

14. Global supply of lending

Total net external borrowing by all non-oil developing countries/Total imports of these countries. Data to permit the calculation of this variable was obtained from the World Tables published by the World Bank.

15. Amortization to total debt ratio =

Total external debt/Total external debt service payments.

16. Rate of domestic inflation =

Calculated as percentage change in Consumer Price Index as published in the International Financial Statistics.

*Except otherwise noted, data for the above variables were obtained from African Economic and Financial Data published by the World Bank. To facilitate cross-country comparisons, ratios were derived from values expressed in U.S. dollars.

Rotated Factor Matrix for Rescheduling

Variable Number	First Prin. Comp.	Second Prin. Comp.	Third Prin. Comp.	Fourth Prin. Comp.	Fifth Prin. Comp.	Sixth Prin. Comp.	Seventh Prin. Comp.
V 1	0.025	0.189	-0.279	0.972	0.125	0.489	0.398
V2	0.162	0.485	0.089	-0.206	-0.011	-0.053	0.128
V3	-0.213	0.119	-0.315	0.082	-0.227	0.786	-0.124
V4	0.085	-0.436	0.181	0.687	0.115	-0.116	-0.073
V5	-0.006	-0.109	0.025	-0.059	0.069	0.669	0.282
V6	-0.214	-0.035	-0.192	0.025	-0.814	-0.014	0.035
V7	-0.252	-0.170	-0.103	0.649	-0.559	0.234	0.044
V8	-0.181	-0.081	-0.091	-0.143	0.697	0.060	-0.133
V9	0.159	-0.068	-0.279	0.098	0.623	-0.565	0.202
V10	-0.125	0.655	0.025	0.082	0.000	0.071	0.077
V II	-0.147	0.191	0.873	0.163	0.091	-0.224	0.075
V12	0.468	0.094	0.766	0.234	0.061	-0.225	0.293
V13	0.950	-0.059	0.092	-0.126	0.078	-0.056	0.107
V14	0.536	-0.045	0.278	-0.044	0.046	-0.073	0.894
V15	0.349	-0.106	-0.021	0.154	0.018	-0.076	-0.009
V16	-0.222	0.885	0.070	-0.229	-0.024	-0.029	0.538