A Conceptual Approach to the Analysis of External Debt of the Developing Countries

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A CONCEPTUAL APPROACH TO THE ANALYSIS OF EXTERNAL DEBT OF THE DEVELOPING COUNTRIES

This paper postulates that debt crises might result either from solvency problems or liquidity problems. A solvency problem would mean that the real interest rate on the marginal external loan exceeded the increase in national income made possible by this loan. A liquidity problem would mean that the borrower would be unable to obtain the foreign exchange to make the debt service payments on schedule. The thesis of the paper is that the external debt of most developing countries will increase for the foreseeable future, and that crises occur when the "refunding mechanism" breaks down, either because the lenders are reluctant to extend new credits as they mature, or because the borrowers are reluctant to refinance due to the very high short-term effective interest cost. If borrowers expect that their domestic currencies may be devalued, they will delay refinancing to avoid the exchange loss.

Examination of debt crises over the last several decades reveals that the most debt crises occur when currencies are overvalued. The evidence was strong that most of the countries involved had overvalued currencies. The plausible inference is that most if not all of these currencies should have been devalued. Hence the strong association between debt crises and devaluations is consistent with the view that the external debt problem is primarily a liquidity issue.

The various statistical models used to predict or forecast when individual countries are likely to have a debt crisis are found to ignore the distinction between solvency-type crises and liquidity crises. An appendix summarizes some of these models and their empirical results.

Prepared by: Robert Z. Aliber (Consultant)
Economic Analysis & Projections Department
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A CONCEPTUAL APPROACH TO THE ANALYSIS OF EXTERNAL DEBT OF THE DEVELOPING COUNTRIES

INTRODUCTION

The sharp increase in the external debt of the developing countries in the last five years has led to great concern about their ability to meet their debt service payments on schedule. The situation is straightforward. Because of the petroleum price increases, the cost of petroleum imports increased. However, the increase in current account deficits of non-oil developing countries greatly exceeded the increase in their oil import bills, as many of these countries were able to borrow large amounts abroad, largely because of the liquidity of the international banking system. The debt service problem will be intensified by the increase in their current account deficits as a result of increases in the price of petroleum in 1979 and 1980.

In the early 1970's, the rapid growth in the external debt of the developing countries reflected the increase in the supply of credit from the major international banks and the reduction in the demand for credit in the industrial countries. Given the relationship between the interest rates at which major international banks would lend to borrowers in the developing countries and to borrowers in the industrial countries, the developing country borrowers sold an unusually large amount of debt to the international banks.

For the last several years there has been concern that their external debts are too large. The question is whether the developing countries made a mistake and borrowed too much, and, at the same time, whether the international banks made a mistake and lent too much. However, it seems that despite the growth in the volume of the debt, there has been no apparent increase in debt servicing problems. Therefore there is also a question of whether the concern with such problems may be excessive, or it may only be premature.

Attempts to develop models to predict whether individual countries have borrowed too much abroad or were likely to require a rescheduling of their external debts began in the late 1950's. Some of these studies were comparable to the efforts in the 1960's to determine whether a country's holdings of international reserves were too large or too small. Traditionally, the analysis of a country's debt servicing capacity was related to various factors, including the ratio of its imports to its holdings of international reserves, the growth of its commodity exports, or its exports of goods or services. If the numerator in the fraction increased relative to the denominator, a debt crisis seemed inevitable. However, predicting the timing or likelihood of a crisis remained highly uncertain.
Today, lenders and borrowers still feel a need for effective indicators of when a country's external debts are too large or are increasing at too rapid a rate. Many of the indicators used to date, singly or in combination, do not appear to meet the need as their predictive power is slight.

The search for indicators has led to a re-examination of the external debt servicing problem. The next section of this paper discusses a conceptual view of the external debt situation of the developing countries; it emphasizes the distinction between solvency-type considerations and liquidity-type considerations. The second section presents a conceptual approach to forecasting debt crises and considers the usefulness of alternative approaches. Some operational aspects of analyzing when a debt crisis may occur are discussed in the conclusion. An appendix summarizes some of the past empirical analyses of debt crises.

I. A Conceptual View of the Debt Problem in Developing Countries

The concern about the growth of the external debt of the developing countries takes numerous forms. One is that individual countries will not be able to repay even if they are willing; a second is that individual countries might not be willing to repay even if able. There is concern with the interdependence among the policies of the borrowers, and a further and residual concern that numerous borrowers will be unable or unwilling to repay on schedule. The distinction between capability and willingness is important, for a lack of willingness to repay when able to imply a decision to cut or diminish international relationships. The distinction between delay and default is important; delay suggests a shortage of foreign exchange, while default suggests a political decision to rupture external financial relationships.

Debt crises may take numerous forms. At one extreme, some lenders may receive scheduled payments of principal with modest delay, but receive interest payments on schedule. At the other, some lenders may receive no scheduled repayments, either because the borrowers decide to sever ties or because the borrowers disappear--the governments may be absorbed by some other governments as a result of non-peaceful changes in national borders. Between these two extremes, there are numerous intermediate forms of crises.

There is also a range of responses by lenders. In some cases, some debts may be consolidated or refinanced; the lenders may extend maturities and usually raise interest rates. In other cases, interest rates might be reduced as a way of further easing the debt burden.1/

1/ In this paper, a debt crisis occurs when the borrower cannot or will not repay on schedule. The crisis may be resolved in several ways, almost always through a debt renegotiation; the renegotiation may involve a rescheduling, where the current lenders extend the maturities on existing loans, or a refinancing, where current lenders are repaid with the funds obtained from a new set of lenders.
The distinction between capability and willingness is also important in terms of the form and amount of the loss that the lenders may incur if loans are not repaid on schedule. Delays in payment need not mean a financial loss, for there may be more than compensatory increases in interest rates. Ultimately, the private lenders may be bailed out from large loans by loans to the borrowers from national or international lenders or aid agencies; the large risks are—or will be—socialized by the governments in the lending countries.

Analytical statements about the external debt of the developing countries can be categorized according to the aspect of debt addressed. One set of statements deals with the growth of debt in nominal terms. A second set deals with growth of debt in real or constant dollar (or mark) terms, where the adjustment from nominal data involves the use of a deflator or deflators which reflect changes in prices of developing countries' exports or imports, or both together, or some other price variables. A third set of statements involves the relation between the real or effective cost of incremental external debt and the returns earned by the investments financed by (or made possible by) additional foreign borrowings. A fourth set involves the risks that some or all of the developing countries will not be able to repay their foreign creditors on schedule because of a "shortage of foreign exchange," even though the debtors may be easily able to make repayment in their domestic currencies.

The current value of the external debt of the developing countries is also an area of uncertainty, reflecting two factors. One is the problem of measurement: the data in many countries are incomplete because the debt has been contracted by numerous government agencies and private firms. The second involves conceptual problems: should the external debt be measured gross or net, with the latter involving an adjustment for the external reserves of the borrowers? Since international reserves of the non-petroleum exporting developing countries increased from $16 billion in 1972 to $51 billion in 1978, this concern is not trivial.1 Another conceptual problem is whether direct foreign investment should be included with external debt. The argument for inclusion is that the payments of dividends from subsidiaries in the developing countries to their parent companies in the industrialized countries are a "charge" on foreign exchange earnings similar to payments of interest. Restrictions on such payments would adversely affect the inflow of new direct investments and perhaps even some portfolio investments.

Measurement is also complicated by inflation. At times, the current account deficits in large developing countries are viewed as an

1/ Although the developing countries are not large holders of gold, the market value of their gold holdings increased from $5 billion to $50 billion in this period as a result of the increase in the market price of gold from $35 to $350.
indicator of their vulnerability to a debt crisis. But the surge in
these current account deficits in part represents a response to the
increase in interest rates on their external debts during an inflationary
period. One component of the interest payment is an inflation premium
intended to maintain the real value of the lender's wealth, or at least
to minimize the decline in its real value. From the point of view of
the borrowers, an imputation might be made to their current account
receipts to indicate the decline in the real value of their external
debt. This imputed receipt would then partly offset some of their
interest payments.

The adjustment of the current account balance to reflect changes
in the inflation rate should be distinguished from the adjustments
needed to illustrate changes in the value of debt in terms of a constant
unit of account. Because of the extensive inflation in all commodity
prices in the last decade, comparisons of changes in the external debt
position of individual countries over an extended period require a
deflator so that nominal values can be converted into constant values. 1/

The number of possible deflators is large. An export price
index is frequently used as a deflator; it results in a sharp decrease
in the real burden of the external debt contracted before 1972. The
case on is straightforward: when the nominal interest rate on these
debts were used in calculations, the resulting inflation rate was
underestimated to such an extent that the real interest rates on many
pre-1972 loans emerged as negative. Developing country export earnings
have increased in nominal if not real terms, while the pre-1973 debt has
decreased in real terms although it remained constant in nominal terms.
Using an export price index as a deflator neglects the possibility that
import prices may have increased as much as export prices. Yet,
regardless of any change in import prices, the increase in export
prices—and presumably in the nominal value of exports—eases the debt
servicing problem of the borrower. The borrower might have become
worse off if import prices had risen while export prices had remained
constant.

Ability to Service External Debt

In analyzing a country's position with respect to external
debt, it is important to distinguish the changes in the real value of
the external debt from changes in the capacity to service external debt.

1/ Changes in the nominal interest rates can be used to deflate the
current account balance to compensate for higher interest payments.
Changes in the nominal interest rates could also be used to convert
the nominal value of external debt into a constant value, e.g., by
the amount that the debt would have increased if the interest rate
had been constant.
The usual approach toward measuring capacity involves ratio analysis. Ratios are developed for the volume of imports to foreign exchange reserves, or of debt service payments over some future period to exports of goods, or of goods and services over the same period. When one or several of these ratios become too high, the borrower is deemed unusually susceptible to a debt crisis.

The ability to service external debt depends on an income or quantity variable as well as on the price (e.g., terms-of-trade) variable; thus the ability to service external debt may increase even if export prices remain unchanged, if the volume of exports is growing rapidly. Hence, a debt servicing ratio based on projected values for future years may be more important than the ratio based on current values in determining the ability of a country to make its external debt payments on schedule.

Changes in the debt service ratio do not indicate whether a country has borrowed too much or too little, but only that a crisis may occur at an unspecified future date if debt service payments continue to grow relative to exports.

At a conceptual level, a country might have borrowed too much abroad, even if its debt service ratio is falling, if the return on the domestic investment were lower than the incremental interest rate on external debt. The debt servicing ratio could be declining because the maturity of debts is lengthening—and by proportionally more than the increase in the interest rate on this debt. Consequently, the distinction between solvency and liquidity used in the analysis of domestic financial firms can be usefully applied to the analysis of the external debt of individual developing countries.

**Solvency vs. Liquidity**

Within the domestic economy, some firms go bankrupt because they are insolvent, whereas other firms go bankrupt because they are illiquid. Insolvency involves the relation between the value of the firm's assets and the value of its liabilities.

The international counterpart to insolvency is not bankruptcy, but rather the relationship between the interest rate on a particular loan and the productivity of the investment financed by—or made possible by—this loan. The question is whether the loan will lead to a higher or lower level of national income in a borrowing country.

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Within the domestic economy, illiquidity means payment obligations cannot be made on schedule, even though the value of a firm's assets may exceed the value of liabilities. The borrower is in a cash bind.

Most firms are able to refinance debts as they mature; indeed, the funds to repay the maturing debt are in effect obtained by selling new debt. Refinancing is virtually automatic. In the event of a liquidity crisis in a domestic context, a key question then becomes why the debts are not "rolled-over" as they mature—why the automatic refinancing mechanism does not work?

In some cases, a liquidity crisis occurs because the cash flow of the borrower is inadequate to meet his current scheduled payment obligations; for example, Real Estate Investment Trusts (REITs) in the United States might have had net rental income smaller than the scheduled interest payments. In most domestic cases, however, a liquidity crisis occurs because the debtor is unable to refinance maturing debts (or debts which are payable on demand) as the lenders project that the borrower is likely to become bankrupt because of the magnitude of current losses.1 In 1979, Chrysler might fit this situation.

The international counterpart of the liquidity problem is an inability to make interest and amortization payments to foreigners on schedule. Within the domestic economy, firms borrow as long as new loans add to the market value of the firm; thus they borrow as long as the returns on new projects exceed the cost of capital. At the same time, firms also maintain liquid assets and unutilized credit lines even at the cost of foregoing immediate income because of the advantage of having ready cash. The firm which has failed to prepare itself to cope with a liquidity problem may be higher risk and have a lower market value than one with lower income. Hence, there is a "trade-off"—the allocation of wealth to enhance liquidity has a cost in terms of foregone productive assets that might otherwise have been acquired, but a benefit in terms of a higher market value.

The implications of the growth of the external debt can be viewed separately for both solvency and liquidity. Consider first the solvency issue. Assume that initially a country has no external debt. Then it begins to sell debt abroad. The growth in debt might occur in three stages. During the first stage, the external debt of the country grows more rapidly than the increase in its national income, yet the magnitude of the increase in its national income is greater than the interest payments on the external debt. In the second stage, the interest rate on the marginal external debt is equal to the marginal product of the investment made possible by the increase in debt; the external debt grows

1/ While the borrower might be able to repay one or several lenders on schedule or demand, repaying many lenders on demand at the same time may be impossible.
as rapidly as the country's debt-servicing capacity. This stage represents a long-run equilibrium; existing debts are repaid on schedule, and, at the same time, new debts are sold, so that in effect the foreign exchange realized from the latest sales of debt is used to finance the repayment of maturing debt. The country gains because the external borrowing used to acquire a larger capital stock leads to a higher level of domestic income. In stage three (as in stage one), external debt increases more rapidly than debt servicing capability. The national income of the country is adversely affected by the marginal debt because interest costs are too high relative to the productivity of the investments made possible by the external loan.\(^1\)

The several stages of the country in relation to the solvency boundary of a country are shown in Figure 1. The volume of external loans is measured on the vertical axis, time is shown on the horizontal axis. The line SS represents the locus of points at which the external debt is optimal at different times. The slope of this line is equal to the country's growth rate.

Two conditions are satisfied at the long-run equilibrium solvency boundary identified with stage two: one is that the real interest rate on marginal external debt equals the marginal product of capital domestically; the second is that the rate of growth of external debt in real terms is equal to the real interest rate. If the country's debt is below the locus, its real income would be enhanced by selling more debt abroad and running a larger current account deficit, provided that the additional funds were appropriately invested. As the interest rate on external debt declines, the SS locus shifts to the left; this shift is represented by a vertical displacement of the solvency boundary, as with the shift to S's'.

As the country's external debt increases, its liquidity position may move through three stages. In the first stage, the debt grows more rapidly than its debt servicing capability. In effect, the country takes advantage of its previously underexploited debt servicing capability. In the second stage, the country's debt and its debt servicing capacity increase at the same rate and the country is in equilibrium in terms of liquidity. In the third stage, as in the first, the external debt grows more rapidly than the debt servicing capacity, and any of several different types of disturbances might trigger a crisis.

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\(^1\) The country might gain even more if it "rations" access to external debt, for otherwise the marginal borrower might increase the interest rate paid by infra-marginal borrowers. Arnold C. Harberger, "On Country Risk and the Social Cost of Foreign Borrowing by Developing Countries," 1976).
Determining the optimal level of debt for a country in terms of liquidity is more straightforward than determining the optimal level in terms of solvency. The country must optimize between having too little debt and having too much debt; if the debt is too large, a disturbance or change, external or domestic in origin, might trigger a crisis; the resolution of the crisis might involve a cost, usually in the form of a higher interest rate on the refinanced debt. If there were no uncertainty about the number, nature, and severity of future disturbances, there would be no need to be concerned with liquidity. And if there were no costs to a debt crisis, even though the likelihood of such crises were uncertain, there also would be no need to be concerned.

Figure 1

The band labeled LL in Figure 1 represents the locus of points at which the country's external liquidity position is optimal at different points in time. The optimal position is represented by a band rather than by a line, reflecting that there is no single optimal level of debt in terms of liquidity. The lower bound of this band is drawn to show a 50 percent chance of a liquidity crisis in the next x years, while the upper bound is drawn to represent a 75 percent chance of a crisis. Changing the estimates of a liquidity crisis leads to a change in both the location of the bounds to the band and probably the position of the bank (in relation to the solvency boundary). The more rapid the growth of the
country's exports, the closer the band will be to the solvency boundary for any given set of estimates of a liquidity crisis. Similarly, the longer the average maturity of the external debt, the closer the band will be to the solvency boundary for any given set of estimates of a debt crisis.

In Figure 2, the solvency bound is represented by the vertical axis, the liquidity band by the horizontal axis. The position of individual countries in each year with respect to both the bound and the band can be represented by a point, which is almost always in the northeast quadrant. As the country increases its external debt, it is likely to move in a southwest direction—toward both the solvency bound and the liquidity band.

A country's position with respect to the solvency bound over time does not change much, since change occurs only as two factors vary—the real interest rate on external debt and the country's trend rate of growth. In contrast, the country's position with respect to the liquidity band is more volatile, with the changes dependent on such factors as changes in the terms of trade, the real exchange rate and the volume of external reserves.

Figure 2

Constraints on External Debt
Debt management policy involves manipulating a number of variables so that the country approaches the solvency bound without coming too close to the liquidity band. The variables a country can include the real exchange rate, the level of foreign exchange holdings, and, to a lesser extent, the maturity of external debt.

The band shows only the probability of a debt crisis. The country's preferred position depends on its estimates of the trade-off between the costs of a crisis and the costs of maintaining excessive liquidity. If the level of a country's debt is less than optimal, the implication is that it can enhance its income by selling more debt abroad; in this case, the level of external debt moves toward the solvency bound. As the country's debt increases relative to its income, the likelihood of a debt crisis increases.

The major cost of a debt crisis is the change in the net interest rate on external loans; a debt crisis causes the solvency bound (and hence the liquidity band) to pivot in a clockwise direction. The process is straightforward: rescheduling raises the interest rate paid by borrowers on all new loans or the interest rate spread or markup over the London Interbank Offer Rate (LIBOR). Thus, the interest rate paid in the remaining years of existing loans is increased. Moreover, management fees are amortized over a shorter period, so that the interest rate equivalent of these fees is increased ex post.

Changes in the exchange rate—in the domestic price of foreign exchange—affect the position of both the solvency bound and the liquidity band. Explicit recognition of the exchange rate term is necessary because domestic borrowers may be able to repay on schedule in domestic currency and yet be unable to make the repayment in the currencies in which the debts are denominated. As domestic currency becomes overvalued, perhaps because the domestic price level is rising relative to the world price level at the prevailing exchange rate, both the solvency bound and the liquidity band shift to the right. The shift in the solvency bound reflects that the increase in overvaluation reduces the marginal product of capital domestically, while the interest rate on external loans remains unchanged. The shift in the liquidity band reflects that the foreign exchange may not be available to finance repayment, because export earnings decline with overvaluation. As the real exchange rate changes over time, the liquidity band is likely to shift relative to the solvency bound, in part because the liquidity problem usually occurs within a shorter time frame than the solvency problem.

1/ "...What is commonly known as a 'rescheduling' of obligations, whereby the grace period of maturity structure of the contract are amended to favor the borrower, while some other terms (usually the interest rate) are changed to compensate the lender,..." Arturo C. Porzecanski, "The Assessment of Country Risk: Lessons from the Latin American Experience," Morgan Guaranty Trust Co., 1978, mimeo p. 3.
International debt crises can take two forms. In one, the debt problem is indicative of the country's having borrowed so much abroad that domestic income is adversely affected. The level of debt places the country above the solvency boundary. In such a case, the present value of external debt needs to be reduced. One approach is for creditors to discount the value of the debt or reduce the interest rate on the debt. Public loans on concessional terms might be used to refinance loans from private lenders on non-concessional terms.

The second type of debt crisis occurs because the scheduled repayments of principal are too large relative to new loans which can be sold abroad. A country can have a liquidity crisis without having any solvency problem, just as a domestic borrower can. (A country could also have a solvency problem without having a liquidity problem; it could meet its next several debt service payments even though it could not meet all future debt service payments.) The reason that most debt crises involve the liquidity problem rather than a solvency problem is evident in Figure 1—the liquidity band is below the solvency boundary.

The economic explanation for why there are so many more liquidity crises than solvency crises is straightforward. The solvency issue implicitly assumes that all external debts are perpetuities and thus that the only significant relationship is that between the real interest rate on the marginal loan and the marginal product of capital. The liquidity issue involves the continuous repayment and refunding of external debt in a non-automatic or discretionary process. The debt servicing payments include payments for amortization as well as the payments of interest. If all external debt were perpetuities, then the liquidity band would disappear, and only the solvency bound would remain.

A liquidity-type crisis occurs because a country's ability to sell new debt to get the funds to repay existing debt diminishes. The problem may originate with a reduction in the supply of funds—lenders may not be willing to buy new loans, that is, some of them may wish to reduce their outstanding loans in a particular country because more attractive loan opportunities may exist in other countries. The problem may also originate in the demand for funds—some domestic borrowers may be reluctant to "roll-over" their external debts. There may also be a simultaneous reduction in the supply of funds and in the demand for funds. If the lenders reduce the supply, then it is because other borrowers are willing to pay higher interest rates or because the lenders fear exchange controls may delay receipt of payments from the borrowers. If the reluctance is on the side of the borrowers, it may reflect a concern that the total cost of the new external loans, including both the exchange rate term and the interest rate term, is too high.

1/ The solvency crisis might have occurred because of a sudden, permanent drop in the marginal product of capital within a country; at the new and lower level, the interest rates on external debt are now too high. Whether solvency crises reflect such disturbances is an empirical issue.
A country's inability to pay on schedule might reflect world or global events or country-specific events. One world event which might lead to a debt crisis is a recession in the industrialized countries, which would lead to a decline in developing country exports. Another world event might be a contraction of credit in the industrialized countries and a decline in their demand for securities sold by borrowers in the developing countries. Country events are likely to take the form of structural disturbances such as a crop failure or an appreciation of domestic currency because the domestic price level is rising relative to the world price level at the prevailing exchange rate.

As liquidity problem arises when the inflow of funds from new loans is inadequate to finance the amortization of existing loans, the debt servicing problem becomes acute in a foreign exchange crisis. The crisis reflects either a surge in the current account deficit above its trend value, or a reduction in the net capital inflow below its trend level, or both together.

Three different factors might explain a surge in the current account deficit: exports might decline because of: a commodity event such as crop failure; an external event such as a recession in the industrialized countries; or a domestic event, usually domestic inflation with an effective appreciation of the currency.

One reason the capital inflow might decline below its trend value is that the supply of external funds may decline because the lenders are more cautious about stability within the borrowing country, perhaps as a result of less confidence in the qualities of financial management and political leadership. A second reason is a reduction in the demand of borrowers because of a greater likelihood of a devaluation. Borrowers within the developing country may be reluctant to incur new external debts (or to roll over maturing debt) because of the surge in the effective borrowing costs associated with an anticipated depreciation of domestic currency. The factor common to adverse movements both in the current account and in the capital account is an effective appreciation of the currency of the developing country.

The liquidity issue involves a monetary phenomenon. It is usually short-run or transient and occurs because repayments cannot be made on schedule, either because the refunding mechanism works much less well or because additional debt cannot be sold in the amounts necessary to cover the increase in the current account deficit. Export earnings and new debt sales become inadequate for the annual debt service payments, which may be large because maturities are short. Yet the lenders ignore the "fallacy of composition," since the external debt of the developing countries is "permanent." Few of these borrowers are likely to be able to generate the current account surpluses so they can reduce their external debt.
The solvency issue is a real or structural phenomenon and has more of a long-run character. The country has borrowed too much abroad relative to its productive capacity. The solvency issue reflects an exaggerated belief in a country's productive potential.

Most efforts to anticipate debt service crises involve economic variables that appear more closely related to a solvency problem. If a developing country's debt grows more rapidly than its exports, then an extrapolation suggests a debt-servicing problem will occur at some future time. Such ratios have modest predictive accuracy. There is no convincing or inherent reason why debt cannot rise more rapidly than exports for any extended period. Although the risk of a debt crisis may increase as the ratio increases, more is needed to explain why the risk increases.

II. Approaches to Forecasting

An effective method of predicting the countries that are likely to encounter debt crises would have economic value. Lenders might take in measures to limit increases in their exposure with these borrowers. Borrowers might adopt measures to forestall or delay the crisis.

A debt crisis may lead to a refinancing if a developing country has borrowed too much abroad, resulting in an incremental interest rate on external loans that is too high relative to the productivity of the incremental investments. In such cases, the refinancing might lead to a reduction of interest rates as well as a lengthening of maturities. A domestic analogy is the refinancing of the REITs. The lenders have an interest in avoiding a write-down in the face value of their claims, but they accept a lower interest rate. As a result, the present value of their loan falls.

In general, however, reschedulings appear to be associated with an increase in the present value of developing country loans, although the higher interest rates on the rescheduled loans and on subsequent loans to the same borrower may reflect greater risk.

Few of the developing country debt crises have involved solvency crises, primarily because the real interest rate on most dollar-denominated loans to the developing countries have been negative in the last five years because the commodity price level of dollar goods—and developing country exports—has increased rapidly and has approached or exceeded the interest rates on dollar loans. While the real interest rates on loans denominated in most European currencies and the Japanese yen increased because of the appreciation of those currencies, such increases have probably been dominated by the decline in the real interest rates on dollar-denominated assets. At the same time, productivity of the investments financed by the external loans has been substantial. Roughly, it
has been equal to the country's growth rate. A solvency crisis is likely only in those countries with extremely low growth rates.

If debt crises are monetary phenomena, then the most significant independent variables to explain the timing of the crises are likely to be changes in monetary variables—changes in real exchange rates and in real interest rates. Changes in these variables in turn lead to changes in the current account balance. If it seems paradoxical to focus on these real variables in explaining a monetary phenomenon, it is because the reschedulings are part of an adjustment process that seeks to return these variables to equilibrium values. Much of the adjustment involves an effective depreciation of the country's currency.

The dates of reschedulings for 25 countries, together with the dates of changes in the foreign exchange value of their currencies, for the period 1960-78 are shown in Figure 3. About 16 of the 26 reschedulings occurred in a year in which a change in the exchange rate occurred or in the year before or after such a change.

The association of a rescheduling and a currency devaluation is consistent with the monetary interpretation. Five countries—Argentina, Chile, India, Indonesia, and Turkey—accounted for more than half of the reschedulings. In at least two, and possibly three cases, the reschedulings appeared to have been associated with drastic changes in political leadership.

One explanation for the simultaneous rescheduling and devaluation is that a country incurred a balance-of-payments problem because its currency had appreciated in real terms and undertook a devaluation to obtain approval of lenders for the reschedulings. (A competing explanation is that authorities in the developing countries recognized their currencies were overvalued and that they had to devalue, and they used the occasion of change in parity to obtain a net credit inflow in the form of a rescheduling.)

In a few countries (Egypt, India, Turkey, and Zaire) reschedulings were not associated with changes in exchange rates. One interpretation is that changes in the foreign exchange value of the currencies of these countries were not necessary because the currencies were not overvalued. A competing interpretation is that such changes in exchange rates were necessary but that creditors were unwilling or unable to attach conditions

1/ The countries included in Figure 3 are from a table provided by Saini and Bates (1978). The information on the changes in exchange rates was obtained from International Financial Statistics, International Monetary Fund, various issues.

2/ A casual effort was made to determine which reschedulings might be associated with solvency crises; Turkey and Zaire might be solvency-type crises.
Figure 3 (Part A)

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D = Depreciation in the Foreign Exchange Value of Domestic Currency
R = Debt Rescheduling
*V* = "Voluntary" Rescheduling
B = Balance of Payments Support Loan
Figure 3 (Part B)

Debt Reschedulings and the Exchange Rate

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about the need for devaluations to the debt rescheduling. A possible test for these competing views would consist of an examination of the development of the black market premium for each country's currency. If the premium were large, the presumption would be strong that a devaluation of the country's currency should have been part of the rescheduling package.

The strong association between reschedulings and devaluations and the lack of association between reschedulings and the currencies which were not devalued is too important an empirical phenomenon to be overlooked. The implication is that the first step in predicting a debt crisis is to identify countries whose currencies tend to appreciate in real terms. The second step is to determine whether the country will react quickly or slowly to the decline in its international competitive position.

**Traditional Approaches to Forecasting Debt Crises**

The traditional approach to forecasting debt crises, like much credit analysis, has been judgmental. A group of wise men scan the economic data and the political stability of the borrowing countries and the control and management capabilities of their leaders. There is a checklist of variables, and countries are given scores. The technique is rather like evaluating application for Visa cards. No explicit weights are attached to determine the relative importance of the various types of information, but at the same time the weights of each variable are not necessarily identical. For example, "political stability" (however measured) might be weighted more heavily than the ratio of debt to exports.

Recently, more formal statistical models have been used to predict or forecast debt crises. The objective is to determine those countries whose debts will not be rescheduled in that year. The data set is the 450 cells in Figure 3—the product of the 25 countries and the 19 years for which data are available. The forecaster seeks to avoid two things: failing to predict reschedulings which occur (a Type I error) and predicting reschedulings which do not occur (a Type II error).

One problem inherent in using the statistical approach to forecasting debt crises is that the number of observed reschedulings is small. There have been less than 30 in nearly 20 years. In the early 1960s, the experiential base that could be used in forecasting debt crises was very small. Moreover, this approach does not recognize that not all crises are independent events. However, because the number of participants is small, it seems plausible that there is some interdependence in the number and timing of reschedulings on the side of both lenders and borrowers. Once the lenders have become accustomed to participating in reschedulings, they may be less reluctant to do so in the future.
A further problem with the statistical approach is that the outcomes are binary—either there is a rescheduling in a particular year, or there is not. The use of multiple regression models to indicate which countries will reschedule in a particular year means that the dependent variable must be forced to take the value of either one or zero in each year. Consequently, the error term in the equation takes on a large value. Indeed, the size of the error is so large that the use of this technique to forecast debt crises seems intuitively implausible.

The success of both the statistical and the judgmental approaches to forecasting debt crises is an empirical matter. Each technique might be used to predict reschedulings in year $t_2$, using the available data from years $t_0$ to year $t_1$; then each technique might be used to predict reschedulings in year $t_3$, using the data from years $t_0$ to year $t_2$, etc. ($t_0$ might be 1960, $t_1$ 1961, and so forth). Ideally, the results of judgmental approaches might be included in such a calculation; however, it seems unlikely that a particular group of wise men would make a consistent set of forecasts for more than a few years. As the data set is extended to include more years, it might be expected that the statistical techniques would become more successful than the judgmental approach in predicting debt crises and that both Type I, and especially Type II, errors would decline. Since, in using each of these techniques, the choice of the independent variable is continually altered to improve success, continuity in the choice of independent variables as the data set is extended from one year to the next would provide useful information about the predictive power of each technique.

Several different factors suggest a need for skepticism about the value of the data-based approaches. One is that with the sharp change in the attitudes toward maintenance of rigid exchange rate parities in the mid-1970's, the strong association between reschedulings and an appreciation of the real exchange rate may be less evident. If so, the data for the 1960's and the early 1970's will have only modest usefulness in predicting when debt crises are likely to occur. The second is that these techniques fail to distinguish those debt crises associated with the solvency problems from those which are associated with the liquidity problems, even though it might be easier to predict these different debt crises separately rather than jointly. The third reason for skepticism is that the techniques make little if any effort to determine whether a debt crisis is a function of changes in structural variables or a function of changes in behavioral variables.

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1/ A relatively large number of these statistical approaches are summarized in the appendix.
III. Conclusion

Most of the debt crises observed over the last 20 years appear to have been monetary in origin, the consequence of an appreciation of the real exchange rate. A country's current account deficit increases. At the same time, there may be an outflow of private capital. At the very least, private firms and investors may become increasingly reluctant to acquire debts denominated in foreign currencies because of the high anticipated real interest rate associated with such debts; they anticipate that the exchange loss on these debts denominated in foreign currencies will be large relative to the interest rate, especially on relatively short-term loans. Importers will then advance the date of payment on trade debts, while exporters will delay the date of conversion of foreign exchange receipts into domestic currency. The result is that the capital account balance does not change to accommodate the increase in the current account deficit above its trend value.

The relationship between reschedulings and currency devaluations was strong in three-fourths of the observed cases in which reschedulings had occurred. Moreover, it seems plausible that devaluations should have occurred in most of the other cases in which reschedulings took place. The countries in this group which did not devalue shared a number of characteristics: they had an oversupply of university graduates and economic regulation was extensive relative to production. Finally, the extensive array of exchange controls and high black market premiums in their currencies suggests that their currencies were overvalued.

In the last few years, a variety of statistical approaches has been used to forecast debt crises of individual countries in an effort to improve on the traditional judgmental approach. Several factors suggest a need for skepticism toward exclusive reliance on these approaches. One is that none of the statistical approaches has taken an historical view of debt crises; implicitly, each uses data from the observed reschedulings in the 1970's to "forecast" reschedulings that occurred in the 1960's. It seems more appropriate to use data from year $t_0$ to year $t_1$ to forecast reschedulings in a later year, $t_2$, and to forecast reschedulings in year $t_3$ using data from year $t_0$ to year $t_2$.

Further, the distinctions between reschedulings by countries with loose exchange controls and those with tight systems is ignored, as is the distinction between reschedulings which might be considered to have arisen from liquidity crises and those resulting from a solvency crisis. The sharp changes in many countries' attitudes toward maintenance of parities, evidenced by crawling parities and floating rates, suggest that countries may be less likely to encounter debt crises because their currencies are less likely to become overvalued.
A New Conceptual Approach

In developing an approach toward detecting future debt crises, it might prove useful to distinguish those variables likely to be associated with liquidity problems from those identified with solvency problems. The variables that would seem most relevant to a liquidity crisis include an appreciation of a country's currency in real terms, usually as a result of an increase in domestic prices relative to world prices. Hence, a monitoring approach might focus on unusual increases in the growth rates of money supply and changes in black market premiums. A monitoring system might be devised for changes in the pattern of trade financing. In the effort to forecast crises resulting from solvency problems, it might be useful to determine if there has been a decline in the growth rate of economic growth and in the growth of exports.

This conceptual approach suggests a number of research topics. One is to plot each country's position relative to its solvency bound and the liquidity band; a sketch of the points relating positions in successive years could be readily developed. A second is to separate reschedulings attributable to liquidity problems from the total set of debt crises. A third is to distinguish the significance of behavioral factors from structural factors. A fourth is to examine the costs of reschedulings in terms of higher interest rates. A fifth is to trace the changes in each country's capital account as it approaches a rescheduling.
SUMMARY OF STATISTICAL STUDIES

Discriminant analysis has been used to distinguish two groups of countries—those that reschedule in a particular year, and those that do not reschedule—by means of a set of explanatory variables: \( X_1, X_2, \ldots, X_m \). The discriminant function

\[
Z = \sum_{i=1}^{m} W_i X_i
\]

represents a linearly weighted combination of the variables that will maximize the discrimination between the two groups by maximizing the ratio of variance between the groups to variance within the groups. Then the Z-values for each country are computed by substituting the values for the explanatory variables in the equation. A critical value—that which distinguished reschedulings from non-reschedulings—is selected, depending on the weights the analyst chooses to assign to Type I and Type II errors (i.e., how many reschedulings will not be predicted compared to how many non-reschedulings will be predicted by the model).

In one application, three of the eight variables considered (the ratios of debt service payments to exports, of debt amortization to external debt, and of imports to reserves) were found significant at the 5 percent level. This model generated a Type I error rate of 23 percent and a Type II rate of 11 percent (Frank and Cline).

Several problems occur when this type of analysis is applied to forecasts of debt crises. One is the assumption that the variables used to characterize the countries into two groups are multivariate and normally distributed. Violation of this assumption implies that estimated error rates are biased and that the t-statistics so generated cannot be confidently used to reduce the original number of variables to a smaller set. A second problem concerns the selection of the critical discrimination function. This value is chosen to minimize the number of errors within the sample period, a technique which may reduce its effectiveness in identifying potential debt service problems outside the sample period. A third problem, one shared by other techniques, is that some of the independent variables may be highly correlated, so that a spurious form of t-statistic will result.

The principal components technique involves replacing the original independent variables with a set of components which are each a linear combination of all the initial indicators. Each also expresses a relation among the indicators. The components with the highest informational content are then selected, but on a trial and error basis.
Appendix A

Using this approach, the Type I error was 33 percent and the Type II error was 13 percent (Dhonte).

This approach has several drawbacks. It explains how the independent variables interact rather than indicating whether a country is likely to reschedule. Its trial and error nature is unsatisfactory. Moreover, the economic interpretation of the components is complex.

Logit analysis has been used to indicate which countries are likely to reschedule in a given year; the problem posed by the need for the dependent variable to take the value of either zero or one was met by attaching a probability to the likelihood of a rescheduling. Logit analysis involves the estimation of coefficients to fit the form

\[
\log \frac{p}{1-p} = \beta_0 + \sum \beta_j \log X_{ij},
\]

assuming that the probability of rescheduling is related to the vector by the functional form

\[
P(y_i = 1) = P_i = \frac{1}{1 + \exp - (b_0 + \sum b_j X_{ij})}.
\]

Three significant variables that emerged were per capita income, capital inflows/debt service payments, and the real export growth rate. The Type I error was 5 percent and the Type II error 2.5 percent (Feder and Just).

As in discriminant analysis, a problem with this technique is that there is no explicit procedure for determining the critical value that distinguishes rescheduling from non-rescheduling cases. This value is chosen to minimize Type I and Type II errors and may not be useful for prediction.

Saini and Bates extended the dependent variable to include balance-of-payments support loans and compared logit and discriminant analysis. They found no difference between the success of these two types of analysis and found that the results were improved when the modified dependent variable was used.

Sargen segmented the analysis of the debt service problem into two parts: the debt-service approach, which is similar to the other studies, and the monetary approach, which relies on the overvalued currency of a country to predict rescheduling. He tested six variables with a discriminant approach and found that the inflation rate (a behavioral variable) and debt service payments/exports (a structural variable) were the two most important explanatory variables. His error rates were 33 percent for Type I (relatively high) and 8 percent (relatively low) for Type II.
Grinols used discriminant and discrete analyses on a set of 20 variables over the 1961-74 period to predict which countries would devalue. He found that discriminant analysis was more effective at explaining reschedulings within the sample period and identified five significant explanatory variables: debt service payments/reserves, disbursed external debt/debt service payments, external debt/exports, and external debt/GDP. He also obtained much lower error rates than Frank and Cline—Type I rate of 12.5 percent and a Type II of 6 percent.

Mayo and Barrett designed an early warning model for the U.S. Export-Import Bank by extending the work of both Frank and Cline and Feder and Just. Using logit analysis, a larger sample size (48 countries for the period 1960-75), and 50 economic variables, they predicted reschedulings by defining as the independent variable the occurrence of an incident up to five years later (other measures of debt servicing difficulty were included, such as Eximbank reschedulings and claims). Six ratios were selected because of their predictive ability: disbursed external debt/exports, reserves/imports, gross fixed capital formation/GDP, imports/GDP, rate of increase in consumer prices, and reserve position in the IMF/imports. Their error rates were 25 percent for Type I errors and 13 percent for Type II.

Gordon W. Smith extended the logit and discriminant analysis models to predict reschedulings in the middle and later 1970's. These models produced a very high Type II error rate, which he attributed to recent structural changes, especially the decline in the real value of debt service payments. He also explained the failure of the models to predict reschedulings accurately on the greater reluctance of higher income borrowers to risk their creditworthiness since they had become more reliant upon private sources of funds and the increased availability of private funds.

Porzecanski proposed a relatively simple model with two independent variables: one was the ratio of the current account deficit plus amortization payments to Gross Domestic Product less net direct investment inflows, noncompensatory official, and multilateral loans; the second was the ratio of "excess" foreign exchange reserves to Gross Domestic Product. He applied this model to Latin American countries, but did not attempt to pinpoint reschedulings because "such an exercise is an approximation and can be misleading." He noted that between 6 and 18 months elapsed from the start to the successful conclusion of a debt relief arrangement, and yet, because of insufficient information, only the latter date was usually recorded. His Type I error rate was 5.4 percent, while that for Type II could not be estimated.

The major debt rescheduling empirical studies are summarized below:
<table>
<thead>
<tr>
<th>Name/Method</th>
<th>Significant Variables</th>
<th>N</th>
<th>Type I Error</th>
<th>Type II Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhonte/Principal Components (1975)</td>
<td>Net transfers/imports, debt disbursements/imports, external debt/exports, external debt/GNP, debt service payments/external debt.</td>
<td>81</td>
<td>33 percent</td>
<td>13 percent</td>
</tr>
<tr>
<td>Feder/Logit (1977)</td>
<td>Per capita income, capital inflows/debt service payments ratio, real export growth rate.</td>
<td>238</td>
<td>5 percent</td>
<td>2.5 percent</td>
</tr>
<tr>
<td>Frank/Discriminant (1971)</td>
<td>Debt service payments/exports, debt amortization/external debt, imports/reserves.</td>
<td>145</td>
<td>23 percent</td>
<td>10.5 percent</td>
</tr>
<tr>
<td>Grinols/Discriminant (1976)</td>
<td>Debt service payments/reserves, disbursed external debt/debt service payments, debt service payments/imports, external debt/exports, external debt/GDP.</td>
<td>343</td>
<td>12.5 percent</td>
<td>6 percent</td>
</tr>
<tr>
<td>Mayo/Logit (1977)</td>
<td>Disbursed external debt/exports, reserves/imports, gross fixed capital formation/GDP, imports/GDP, rate of increase in consumer prices, reserve position in the IMF/imports.</td>
<td>571</td>
<td>25 percent</td>
<td>13 percent</td>
</tr>
<tr>
<td>Saini/Discriminant (1978)</td>
<td>Consumer price index, money supply growth rate, five year cumulative current account balance minus (plus) increase (decrease) in reserves/exports in the latest year, growth rate of international reserves.</td>
<td>159</td>
<td>9 percent</td>
<td>10 percent</td>
</tr>
<tr>
<td>Saini/Logit (1978)</td>
<td></td>
<td>159</td>
<td>9 percent</td>
<td>10 percent</td>
</tr>
<tr>
<td>Sargen/Discriminant (1977)</td>
<td>Inflation rate, ratio of scheduled debt service payments/exports.</td>
<td>466</td>
<td>33 percent</td>
<td>8 percent</td>
</tr>
</tbody>
</table>

N = total number of years for all countries included in the study. Adapted from Saini & Bates. Type I and Type II are error rates.
REFERENCES


Aliber, Robert Z.
A conceptual approach to the analysis of external debt of the developing countries