

# LDC BORROWING

## GROWTH OPPORTUNITIES, THE OPTION TO REPUDIATE AND DEBT RESCHEDULINGS

by

Sayeed Sadeq

Submitted in partial fulfillment of the  
requirements for the  
degrees of

Bachelor of Science  
and  
Master of Science

at the

Massachusetts Institute of Technology

May 1985

© Sayeed Sadeq 1985

The author hereby grants to MIT permission to reproduce and to  
distribute copies of this thesis document in whole or in part.

Signature of Author .....  
Alfred P. Sloan School of Management  
May 1985

Certified by .....  
Donald R. Lessard  
Thesis Supervisor

Accepted by .....  
Dr. Jeffrey A. Barks  
Director of the Masters Program

ARCHIVES  
MASSACHUSETTS INSTITUTE  
OF TECHNOLOGY

JUN 06 1985

LIBRARIES

# **LDC BORROWING**

## **GROWTH OPPORTUNITIES, THE OPTION TO REPUDIATE AND DEBT RESCHEDULINGS**

by

Sayeed Sadeq

Submitted to the  
Alfred P. Sloan School of Management  
on May 17, 1985, in partial fulfillment of the requirements  
for the degrees of Master of Science and Bachelor of Science in Management.

### **Abstract**

This paper provides a conceptual basis for an analysis of the external borrowing of Less Developed Countries. Modern financial economic theory, and in particular the theory of options valuation, is used extensively to develop the framework.

The paper first studies the circumstances under which borrowing countries, faced with a stock of external debt, would choose policy and investment alternatives substantially different from those they would choose in the absence of external debt. These distorted choices affect the real side of the economy and reduce the future growth potential of the country. The riskiness of the country's return stream from investments is also shown to increase. Clear explanations are provided for the observed existence of credit rationing and the preponderance of short maturity debt in the market for sovereign loans.

In the second part, the paper applies options valuation methods to the external debt of a country to define the claims held by various lenders on its earnings stream. Furthermore, the analysis traces out the incentive structure faced by each party to the debt contracts and derives both explanations and predictions of the likely behavior of these parties under different states of the world. Reschedulings are given an options trading interpretation and a clearer understanding is thus provided for the prevalence and optimality of what actually occurs when LDC debt is restructured. The knowledge that reschedulings can occur in the future is shown to allow lenders and borrowers to take actions which simultaneously make the market for sovereign loans more efficient.

Thesis Advisor: Dr. Donald R. Lessard  
Title: Professor of International Management

## Acknowledgments

Somehow, I always managed to walk away, after a long conversation with Don Lessard, my thesis advisor, with some issue in international finance remarkably clarified and others amazingly muddled. Most of all, I would like to thank him for the latter because I later always came to realize that what I thought I saw most clearly was what I knew very little about. Don's guidance throughout has been invaluable and I sincerely thank him for guiding me through the maze of current thinking on LDC debt.

It is difficult for me to express how indebted I am to Surjit Bhalla, Armeane Choksi and Charlie Blitzer. Without their understanding, encouragement and support, this thesis would never even have begun. Homi Kharas and I spent many an hour going over the intricacies of country borrowing and his help is evident throughout the thesis.

Finally, I must express my gratitude to E-Entry. Without their constant attention, pedagogical brow-beating on the uses and misuses of computers, and unflinching, thoughtful consideration in times of stress, this thesis would have been finished six months earlier.

To my parents and to my wife, Fari.

# Table of Contents

<b>Chapter One: The Sovereign Debt Problem</b>	<b>6</b>
1.1 Introduction	6
1.2 A Brief Review	7
1.3 Structure of the Analysis	9
<b>Chapter Two: Growth Prospects and Determinants of LDC Debt</b>	<b>16</b>
2.1 Introduction	16
2.2 Risks and Type of Assets	17
2.3 The Presense of Risky Debt	19
2.4 Short Term Debt	23
2.5 Long-Term Debt, Risk Shifting and Spillovers	24
2.6 Game Theoretic Issues	31
<b>Chapter Three: The Option to Repudiate and Debt Rescheduling</b>	<b>33</b>
3.1 Introduction	33
3.2 The Claim Structure of a Country's Debt	38
3.3 Some Implications of the Claims Structure	41
3.4 Asset Claims and Options	44
3.5 The Option to Repudiate	50
3.6 Repudiation, Claim Structure and Rescheduling	54
<b>Chapter Four: Concluding Remarks</b>	<b>64</b>
<b>Appendix A: Diagrams</b>	<b>68</b>

# **Chapter One**

## **The Sovereign Debt Problem**

### **1.1 Introduction**

In recent years, the external borrowing of Less Developed Countries (LDCs) has been the focus of several articles in the economics and political science literature. These papers attempt to analyze what has become known as the LDC debt problem in a variety of ways, often using formal economic and game theoretic equilibrium models to predict and explain the behavior of countries faced with a need for (and stock of) external debt. Since 1978, attention has mainly been devoted to the possibility that some large developing country borrowers may choose to repudiate all or part of their external debt and thus cause substantial disruption in the international financial system.

The fundamental issue is that there exists no formal and credible legal mechanism for assigning the rights to the financial and real assets of a country among its creditors, if the country chooses to default on, or repudiate, its debt. The debt contract is not effectively enforceable within the current international legal system in the sense that there exists no authority that can force a country to make debt service payments if it does not wish to do so. In a very basic way, the contract is essentially a contingent claim on the future income stream of the country and, in large part, not on its physical assets. This similarity with lending to individuals based on their human capital and future expected earnings stream is drawn later.

## 1.2 A Brief Review

Of the several recent articles on the subject, some are particularly significant. Eaton and Gersovitz [11], in a now well-known and important article, formalize the notion of debt repudiation but in a model with no uncertainty and no investment. In their model, countries borrow only to smooth consumption over time and upon default, are permanently excluded from any future loans. This leads to credit ceilings being imposed on different countries which depend on the costs faced by each country if it is excluded permanently from the market for debt. Sachs and Cohen [36], extend this analysis to include investment as an important reason for external borrowing by countries and further recognize that the real cost of repudiation is the immediate inability of the country to trade. However, uncertainty is not explicitly recognized in their model either. Their results, which are a subset of the results of this paper, include quantity rationing by creditors and shortening of maturity of loans which result because the market for loans (if it exists) to developing countries is not complete in an informational sense.

In addition to these two formal papers, a number of less rigorous analysis have been undertaken. By and large, these have been attempts to find solutions to the debt problem and in large part, have played a minor role in increasing understanding of the major underlying issues<sup>1</sup>. Other related papers have shed considerable light on a likely set of alternative means of financing LDC debt. For example, Lessard's seminal work [24], [25] and [26], recognizes that standard variable rate loans to LDCs cannot be optimal instruments to finance country's foreign exchange needs. He proposes commodity and index linked bonds which have two very attractive features: (1) Their repayments are linked to the well-being of a country's asset returns and are thus contingent claims which do not

distort repayment incentives and (2) The country cannot influence the index to which the repayment is linked and therefore cannot play the games described in detail below. Although these features have not yet received widespread exposure in the international loan market, they clearly represent a future trend which will perhaps be reflected in any new loans to LDCs.

Kharas [19], Kharas and Glick [21] and Kharas and Shishido [22] have modelled the demand for external borrowing by LDCs in the context of dynamic optimization optimal growth models. This work is at the forefront of the literature on optimal borrowing by LDCs and incorporates uncertainty and investment simultaneously in a setting with growth maximization as the objective function. The general equilibrium nature of their models, while realistic and rich in implications, leaves the decision to repudiate and its associated incentive problems out of the picture. An important insight developed in this work is that the risk of repudiation leads to credit rationing and evidence for this is found in Kharas and Shishido [22]. The option features inherent in country debt, explained below, do not play a role in these models. Game theoretic implications are drawn in Crawford's [9] survey paper.

Bollier [6], in ongoing research, explicitly brings in the stochastic nature of the GNP of countries and determines the optimal borrowing structure for sovereign debtors with endogenous investment. In a departure from other work, this general equilibrium, single-good model allows the country to make its borrowing choice dependent upon what path it wishes its consumption- investment mix to follow over time. The possibility of default is also recognized, and the country simply repudiates when it perceives the cost of constraining its future investment-consumption mix to be greater than the value of its



Portions of the text  
on the following page(s)  
are not legible in the  
original.

outstanding debt. This model has not, as of yet, yielded substantially new results, but is expected to do so when complete.

### 1.3 Structure of the Analysis

In contrast with other work on the subject, this paper explicitly takes into account the options elements embedded in sovereign debt to obtain further insight into the nature of country borrowing. It draws upon a large literature which uses contingent claim valuation methods to study risky debt issued by corporations and further extends the analysis to the case of sovereign debtors. The work presented here provides a better understanding of the determinants of country borrowing. Its main purpose is to distill out key aspects of the observed and expected behavior of both borrowers (countries) and lenders (commercial banks and official creditors) under conditions where debt becomes risky. In particular, the paper looks at:

- The determinants of the level and term of debt
- The option to default
- The option to reschedule existing debt

To draw its major conclusions, the paper treats growth opportunities as real options to undertake investments with positive net present value at some time in the future, as explained below, and also treats repudiation and rescheduling as the optimal exercise of options. To date, no other study has incorporated all these factors into an analysis of sovereign borrowing. Thus, the paper builds on the literature in financial economics which has applied similar frameworks to analyze risky corporate debt.

Were LDC debt traded on international capital markets, investors would demand a

substantial discount from par value to account for default risk. Required rates of return (yields) on this floating rate debt would then be represented fully in its market price which would reflect the repudiation or default risk discount. The discount would incorporate also *exogenous* risks -- that is, the impact of changes in country specific and worldwide economic conditions which lower the value of the return stream on a country's assets. This paper is partly about how knowledge of the existence of these risks influences borrowers and lenders to act in ways which directly influence these very risks; and partly about how the availability of these actions can be interpreted as options held by the involved parties.

Black and Scholes [5] in their pathbreaking paper, pointed out that the various claims on a corporation's assets (stocks, bonds, preferred shares, etc.) could be given an options interpretation. This insight, which has led to a large literature extending and applying their framework, can be particularly well utilized in the context of developing country debt. In the case of a corporation, legally enforceable contractual stipulations determine, for example, that common shares with limited liability are essentially call options on the underlying assets of the firm with exercise price equal to the promised payment on its debt and with time to expiration equal to the maturity of the debt. In a similar fashion, Chapter 3 of this paper uses the utility maximizing behavior of lenders and borrowers to replace enforceable contractual provisions and thereby provides an options interpretation for the external debt of countries. In contrast, Chapter 2 examines the real options to invest in growth prospects held by a country. Whether or not a country chooses to exercise these options is shown to be a major determinant of the value of its debt.

Options are simply special forms of contingent claims and in this paper the terms are

used interchangeably. In essence, the value of an option can be determined largely by the value of observables and it changes in known ways with respect to changes in these determining variables. The price of the option is a relative price and thus, if the price of an asset on which it is written can be determined, so can the value of the option. The only unobservable determining variable in options or contingent claims valuation is the volatility of the price of the underlying asset. This has to be estimated using historical data.

The price of any option depends critically on the degree of uncertainty associated with the price taken on by the underlying asset during the time to expiration of the option.

In a similar way, the value of LDC debt depends fundamentally on risks associated with the income stream of the borrowing country. The debt claim held by the creditors of the country can be interpreted as a contingent claim which derives its value from the variability and amount of the appropriable income of the country. Risk and uncertainty can thus be explicitly recognized and incorporated into the framework for analyzing sovereign borrowing. Furthermore, the country can influence, by taking actions ex post, the very variables which determine the value of options embedded in the debt claim. As a result, the options (or contingent claims) interpretation of LDC debt developed in this paper leads not only to the development of a clear conceptual basis for analysis but also to new results unavailable elsewhere.

The analysis of this paper, thus, depends fundamentally on incorporating risk and uncertainty into the framework. Furthermore, a multi-period setting is necessary so that the benefits and costs to renegotiation of contracts can be kept in view. Nevertheless, at this stage, little will be gained by writing down formal option pricing models that can *solve* the

problems addressed here; the focus is accordingly on developing a conceptual basis for thinking about country borrowing.

In order to put structure on the analysis, think of a country as a firm, with some unique identifying characteristics. The citizens (taxpayers) of the country are its stockholders. Unlike the firm in standard corporate finance, which borrows to finance investments, countries borrow both to invest and to smooth intertemporal consumption. While stock and bondholders of a corporation can individually decide on how best to optimize their consumption-savings decisions over time, a country that borrows externally must perform this function for its residents. Citizens therefore can be viewed as stockholders of a firm which makes part of their savings investment decisions for them. Thus, a country takes on the characteristics both of a firm and of an individual. The separation traditionally posited in finance theory between investors and firms breaks down in the case of sovereign debt. Diversification across a worldwide portfolio is not possible for individuals in LDCs, they cannot borrow and lend at the same international interest rate and their returns from different states of the world are implicitly tied to the returns the country itself achieves. The country participates in international sovereign loan markets to smooth out, in the aggregate, the intertemporal consumption of its stockholders who cannot do so of their own accord and also to increase the rate of investment. Current consumption can then be viewed as a dividend payment achieved optimally partly through borrowing by the country in external markets.

Having recognized these points, the view taken in this paper is that it does not much matter whether the country is viewed as firm or as a combination of a firm and an individual

except in the following sense: upon default (takeover by the bondholders) the firm essentially disappears and no reputation problems remain; however, a country faces reputation risk in that upon repudiation of its external debt, it remains an entity (as does an individual upon filing for bankruptcy) and reenters the market for debt in the future, with its latest credit rating intact. That is, there is no way to wipe the slate clean (except perhaps through a takeover by another nation). This plays a fundamental role in determining the costs of repudiation over and above the costs of trade sanctions and loss of external assets. Viewing a country essentially as a corporation seems to overlook some key issues relating to sovereign borrowing. Just as a creditor has little credible power to take over the human capital of an individual who chooses to default, international lenders face few choices if a country chooses to repudiate its external debt. The claim a lender has on individuals is a claim on the future returns from their human capital (that is, their income stream), and this claim cannot be enforced credibly. At any point in the future, the individual can choose to affect adversely the income received from use of acquired human capital and thus damage significantly the value to creditors of their debt claim. In a similar way, a country can influence its export earnings and/or GNP when it benefits from doing so, at the expense of its creditors. Reputation and credible commitments, it will be shown below, are important ways in which both individuals and countries seek to establish credit ratings. These factors do not detract in any way from the analysis presented even though the borrowing country is considered as a corporation for ease of exposition.

Thus, think of commercial bank loans to countries as essentially privately-placed (i.e. non-traded) bonds purchased by these banks; the *stock* or equity of a country is held by its residents while governments are the former's (possibly duly elected) representatives and

managers. The objective of these managers is to maximize the value of the country's wealth, which, in this framework can be thought of as maximizing the value of the residents equity claim. Given any total valuation of a country's assets, the equity claim is a residual value left over after more senior claims, such as debt, have been paid off. However, unlike corporations, the managers of a country can, under certain circumstances, repudiate the external debt claim on the assets of the country and capture a minimum share for equity, i.e. for the residents. In either case -- that is, in the case of a corporation or of a country -- equity is a residual claim and this implies that it is a contingent claim on the country's assets; in the event that the value of these assets is greater than the value of the debt (or other senior) claims, the equity holders capture the entire remainder.

Whether actual repudiation will in fact maximize the value of equity is, however, a very different issue. Since debt is essentially a contractual contingent claim where the originally specified contract terms are based upon limited knowledge of future states of the world, it is easy to see that renegotiations of debt contracts in extreme circumstances may lead to changes that benefit both the debtor and the lender. The possibility of renegotiations and the accompanying reschedulings (or restructurings) of debt will in fact mitigate against the incentive to repudiate - i.e. the option to repudiate will not be exercised in a larger set of circumstances.

With these rather straightforward notions in place, the paper now proceeds to show what factors determine the value of the various contingent claims embedded in LDC debt and how the special properties of contingent claim (or option) valuation can help in detangling the explanations for some observed phenomena. In Chapter 2, growth

opportunities held by countries are examined as *real* options to undertake positive net present value investments. The presence of risky debt is shown to distort incentives to undertake future investments. In the sense of option pricing theory, risky debt changes the value of these real options in such a way as not only to reduce the chance that they will be exercised but also to select for exercise a different portfolio of options. Chapter 3 considers the option to repudiate debt and shows how such an option can be valued (without getting into the mathematics). This value can give insights into whether the option will be exercised or not, prior to maturity of the debt. Interpretation of the characteristics external debt will take on, when this option is included as a part of sovereign lending, is provided. Debt reschedulings finally are thought of as an exchange of assets and alternatively as a trade of options between the country and its bankers. Throughout, this paper places emphasis on implications of option pricing theories for country debt, leaving aside actual valuations for an accompanying study. Also questions of why countries borrow externally are not answered; borrowing, whether for intertemporal consumption smoothing or for direct capital investment is assumed to be undertaken with an *ex ante* view to sticking by the contractual terms. Chapter 4 offers some brief concluding remarks and summarizes the major results of the paper.



## Chapter Two

### Growth Prospects and Determinants of LDC Debt

#### 2.1 Introduction

Current thinking about country debt policy has focused primarily on how much a country should borrow, given what it wants to do with the cash inflow. Here, concepts are advanced that try to explain what forces in the market for country borrowing will determine how much a country will be able to borrow, why some countries borrow more than others (adjusting for size, of course) and why some borrow short, others long, and what these factors imply for investment incentives within the country.

This section relies heavily upon the seminal work of Myers [33]. In analyzing corporate debt policy, Myers looked at factors which determine why different companies leverage their assets in different proportion. Behavior in the corporate world, even when tax effects are taken into account, differs widely from that predicted by the classic Modigliani-Miller framework and Myers provides an appealing framework for looking at these issues. Here the analysis is extended to the case of sovereign borrowing and the main focus is on how the real options held by the managers of a country's assets can result in the observed borrowing patterns across countries, how the selective exercise of these options can increase or decrease the risk of external debt, and how these actions can influence the perceived debt capacity of countries.

## 2.2 Risks and Type of Assets

Countries cannot issue totally risk-free debt to outsiders. No matter how one looks at it, external debt of countries is risky because of the repudiation option. In this part, risky debt is thought of in the more usual sense -- debt that has some probability of not being fully paid back because of the occurrence of events that make the return stream on the borrower's assets less valuable. This implies that debt can become risky even without any reliance on the lack of full contract enforceability. That is, even with completely enforced debt contracts, there remains the risk that states of the world will reveal themselves in the future which make the assets, or the return stream, of a debtor country, less valuable than the outstanding promised payment. As described below, such exogenous events are compounded by endogenous incentive distortions which can further increase the risk of loans to countries. The key to the sovereign borrowing situation is that the non-existence of enforceable international debt contracts further exacerbates the problem by bringing in willful default, i.e. repudiation. If a country knows it can choose, with no additional penalty, to repudiate its external debt, the conclusions drawn in this section would be considerably magnified.

Without the repudiation option, the borrowing country could default on its debt by handing over to its creditors the management of its assets. This need not be taken literally; a bankruptcy negotiation could provide, for example, for a mutually agreed upon value to be transferred to creditors as adequate compensation. Unlike a corporation, a country cannot, after a bankruptcy, disappear and reincarnate itself as a totally new corporation without a credit history. Reputation matters and the country's need to borrow in the future will (as discussed in more detail later) ensure that some mutually agreed transfer could take

place which will leave the country with its reputation intact. (Note that this will not be a possibility under repudiation.) The transfer will leave a residual which is the equity stake held by the country itself.

Now consider what makes up the value of a country's assets. In a very basic sense, a country holds fixed capital assets (think of these as its in-place manufacturing, agricultural and services production units) and a portfolio of growth opportunities. The latter can be thought of as a set of prospects in which there will occur at some time in the future, a chance to invest, which will lead to growth. Examples of these are unexploited mineral deposits, unutilized land, research and development, an unemployed labor force, educational systems, etc. Many other assets also held by a country can be viewed as having value only if the country's managers choose to exploit the opportunity when it shows up. If, at the appropriate time, the prospect is not exploited, it may well expire worthless, or if postponement is possible, then the opportunity may be exploited at a lower net return (possibly due to higher costs, or saturation of markets, etc.). It is simpler and no less general to think of such assets as expiring worthless after a certain period of time. The value of the claim on such assets is contingent upon a discretionary expenditure, which is the cost of investment with a positive net present value. Assume that the managers and all others recognize that the country owns such contingent claims and that the opportunity, when it arises, will be recognized. Such a contingent claim is essentially a call option and its value, at any point in time, is determined by a fixed set of variables.<sup>2</sup> Thus, if it were possible to write down exhaustively all such options owned by a country, one could, in some sense, value its worth.

In the case of widely-held corporations, various claims on their assets (such as debt, stock, etc.) are traded on efficient markets. Embodied within the prices of such assets is the value of the corporation's assets in place and its growth options value. The former is the current market value of the firm's fixed assets (in-place capital, etc.) while its options value is the remainder and reflects the market's assessment of the availability of growth opportunities.

No such valuation mechanism exists for a country's assets, especially for the value of its implicit growth opportunities. What can be said, however, is that the asset-in-place or current capital stock has a return stream that is rather predictable. Note that this does not mean that it is not volatile, but that in the short run, the volatility and expected growth rates of (say) GNP or export earnings are known with a degree of certainty or at least can be modeled as functions of exogenous variables. There is little that the manager of the country can do to affect this return stream substantially. Contrast this with the growth opportunity -- the expected return stream depends critically on the discretionary expenditure made by the country in the future. The option to invest is not an obligation and can be allowed to expire at no further loss to the country. The managers can influence which growth option they choose to exercise and which they allow to expire worthless. This will influence the value of the debt in important ways.

### **2.3 The Presence of Risky Debt**

Were a country fully equity financed, or its debt holders the same as its equity holders (that is, it borrowed only domestically), the distinctions made above would be less important, so long as capital was relatively immobile. This is because debt is a prior claim

on assets which forces equity holders and debt holders to play games. That is, the country's managers can, after contracting their debts, take actions which materially increase the value of equity at the cost of reducing the value of debt. Ex ante, creditors may have anticipated that the country would undertake to perform, in some sense, according to a well-formulated growth maximizing plan. Ex post, having entered into the loan agreement, the country may decide to change its plans in such a way that its gain is the creditors' loss. Anticipating this game, creditors would seek to play the game, ex ante, of credibly committing the country to take actions which benefit lenders more and equity holders less. The resulting solution of these games is to determine who gets how much of the pie and, this paper will assert, how large the pie is.

In a world of certainty, lacking taxes and with frictionless capital markets, it is well known that the investment decision that a country or a firm makes can be completely separated from the financing decision. The Modigliani-Miller framework, for example, shows that if borrowing and lending rates are the same, and assets are priced according to their risk- return characteristics, a positive NPV project should be undertaken no matter how it is financed. It should not matter whether a country borrows (externally) to undertake any project or uses retained earnings, equity, etc. -- the actual decision is what to invest in. But the approach taken in this paper, which follows the work of Myers, suggests that how much a country borrows and for what term is determined by the proportion of its assets made up of the call options mentioned earlier. In fact, the presence of debt, with the possibility that it can become risky, leads to limits placed not only by banks (rationing) but also by countries themselves on how much borrowing is to be undertaken.

Consider at first the very simple case in which the country owns some set of assets-in-place and a portfolio of growth options. Its total value is the sum of these two:  $V_A = V_K + V_G$ , where  $V_K$  is the value of the earnings stream from the *capital* stock, and  $V_G$  is the value of the portfolio of growth options;  $V_A$  is the *value* of the country's assets. A fundamental question to ask is what is the debt capacity of this country, i.e. to what extent can  $V_K$  and  $V_G$  carry debt? An extensive literature has been devoted to the debt capacity question (see the review by McDonald [29]), but it fails to make this distinction between asset types. It is assumed, by and large, that a country with very high levels of  $V_A$ , regardless of how these are distributed, ought to be able to borrow more. The supply curve for loans to LDCs with high expected growth prospects is thought to be further to the right than for countries with relatively stagnant economies.

Quite the converse may in fact be true. Take the extreme cases for a moment: Country X has all fixed assets and no growth options, while Country Y is endowed with only growth options (a true LDC). Assume that each makes a decision to borrow today; tomorrow the prevailing state of the world is revealed and the investment option must be exercised or let expire worthless (i.e. it matures); on the third day, the debt must be repaid. Order the states of the world,  $S$ , in terms of how they affect the value of the options. If  $S_1 < S_2$  then  $V_G(S_1) < V_G(S_2)$ . Country Y must make an investment of  $I$  in order to undertake the growth opportunity. Say both borrow  $B$ . Country X experiences, in effect, no change across the three periods, no matter what state of the world occurs because whether the changing states reduce the value of its existing assets or not, it can do nothing -- debt becomes risky or not depending on whether Country X's  $V_K$  is equal to  $V_A$  and  $V_A$  is less than or greater than  $B$ . But the situation is markedly different for Country Y. Say a state of

the world,  $S$ , occurs which makes the value of the option portfolio  $V_G(S)$ . If  $V_G(S) > I$ , the option has positive net present value and then it ought to be undertaken. But say  $V_G(S) > I$ , but  $V_G(S) < I + B$ . Now the debt is risky. And the option is not worth exercising, for it does not provide any residual value for the country itself. All options which follow this characteristic will be left to expire worthless when state  $S$  occurs. Others, nevertheless, may be exercised, but the portfolio has diminished in value. Figure 1 illustrates.

The problem clearly arises because of the conflicts between the equity holders and debt holders. As mentioned before, by combining ownership, for example through domestically issued country debt, this *deadweight* loss is avoided so long as domestic capital is not allowed to move abroad. The reason is that the incentives of the managers of the country are then to maximize the total claims on assets, that is the asset value itself, rather than the equity claim. The game played above, where options are left to expire will then occur only in the case of external debt.

Since both borrowers and lenders are presumed to know that such incentives will be generated whenever growth options and risky debt are simultaneously present, the market for country borrowing will exhibit the following characteristics. Countries with a substantial portion of asset value in fixed capital and few growth opportunities will tend to exhibit a lower risk of suffering from the *deadweight* loss problem, and thus will be able to borrow more. Countries whose value is made up mostly of unexploited opportunities for growth, such as Zambia, Pakistan, Sri Lanka and many African states, will be offered less debt but will also wish to borrow less for precisely the reasons related to this underinvestment problem. This will be the case regardless of any changes in interest rates across the different

types of countries because in this situation, the market for sovereign loans displays rationing and there exists no market clearing rate of interest for any segment.

Even fixed assets-in-place require continual reinvestment, such as replacement of depreciated capital stock, the incorporation of new technology into current production, etc. Country-wide policies of governments affect asset values, and policies towards interest rates, exchange rates, education (and other) subsidies, distortionary taxes and tariffs can all have significant impacts. The point is that each of these has the element of option value, and thus is a contingent claim. The problem can be more widespread than the above simple example illustrates.

This problem could be lessened somewhat through the use of internalized debt because then the debtholders and equity holders are the same and, in the aggregate, do not benefit from hurting each other. However, internal debt could suffer from the very problems described above if capital is mobile. Then, required rates of return on internal debt must reflect the risk that these moral hazard and repudiation problems will occur for otherwise capital will flow out of the country. Rationing also would be observed if the market for domestic borrowing suffers from the information problems described for external debt.

## **2.4 Short Term Debt**

Why do some countries wish to borrow and succeed in borrowing for long or medium terms while others are restricted to fairly short maturity (e.g. less than one year) debt? The framework presented here provides some clues. Think of the three-period structure of the above analysis. The investment opportunity arose in the second period while the debt



matured in the third. Now, assume that debt matures before (or in the same period as the investment option matures, in the discontinuous time framework) the option must be exercised. In this case, there are clearly no distortionary incentives, for no matter what path the government of a country chooses to take, the debt value remains unaffected. Countries whose asset value is made up largely of investment options, therefore, would prefer, as would their creditors, to have short-term debt. This debt could continuously be rolled over but not automatically, for if so, then the original problem reappears. However, if the rollover is a contingent rollover, that is if the creditors have the option to rollover the debt after observing whether the investment option is exercised or not, a more stable, distortion-free contract can result. This is akin to a strand of thought that will be developed in greater detail later which provides further analysis of debt renegotiations and restructurings. Countries with proportionately many growth opportunities (i.e. many choices) would be expected to have external loans of, on the average, short maturity, while those with a large proportion of fixed assets (i.e. few choices) in place would have longer term debt.

## **2.5 Long-Term Debt, Risk Shifting and Spillovers**

In this section, the three-period framework set up earlier will be used to draw some additional inferences regarding investment incentives. The results are qualitative and reflect observed behavior even though no complicated dynamic model is constructed.

Once again, consider the case of a country holding a portfolio of call options on real assets, that is a set of growth opportunities. Whether it, in addition, has some fixed assets in place at the same time is unimportant, but think of the option portfolio as constituting a substantial portion of total asset value. At any time,  $t$ , the country's asset value is  $Y_t$  and is

made up on the debit side of the balance sheet by resident's claims,  $V_{R,t}$  and external debt holders claims,  $V_{D,t}$ . Thus  $V_t = V_{R,t} - V_{D,t}$ . In order to undertake an investment, the country uses retained earnings from public sector projects, tax revenues, etc. The incremental investment is  $I$  and this changes the total value of the country's assets as well as the value of each of its liabilities, i.e.  $V_{R,t}$  and  $V_{D,t}$ . Thus,  $\frac{dV_t}{dI} = \frac{dV_{R,t}}{dI} + \frac{dV_{D,t}}{dI}$ . Note that an investment opportunity would only be undertaken if it produces positive net present value, i.e.  $\frac{dV_t}{dI} > 0$ , only if the country's managers were interested in jointly maximizing the values of the external and internal claims on their assets. But the investment option would only be exercised if  $\frac{dV_{R,t}}{dI}$  were positive, and this would clearly depend upon what the return to debt,  $\frac{dV_{D,t}}{dI}$ , was.

Fundamentally, this is where the classic conflict between debt holders and equity holders arises. Residents of the country hold a claim on the residual value of assets; in an option framework, they hold a call option on the value of these assets with exercise price equal to the total promised payment on their external debt, while debt holders, in a theoretical sense, *own* the assets but have sold the call option to the residents of the firm. Thus, they are short the call, and anything that increases the value of the call without simultaneously increasing the value of the assets by at least that much hurts debt holders. The value of the debt then can be evaluated in terms of the current value of the assets and other factors which influence<sup>3</sup> option valuation. For the present, ignore prevailing interest rates; then the factors which determine debt value are time to maturity of debt and risk. Represent risk by volatility of the return stream of the assets; as mentioned before, ignore the risk of repudiation, so that

$$V_{D,t} = g_t [V_{A,t} \sigma^2(\bar{V}_{A,t+1} / V_{A,t})]$$

where  $\sigma^2$  is the instantaneous variance of the total return stream of the assets.

In a similar way, the value of the call option, or equivalently, the residents claim will depend on the volatility of aggregate income. Note that this call option is not be confused with the option to invest in growth opportunities. While both are calls, the latter is an option which the country holds to invest in real assets, while this claim is the option to pay off all remaining external debt and capture the residual. The selective exercise of investment options influences the value of the option being discussed here. It must be emphasized at this point that risk aversion, and correlations with returns from the country's assets and worldwide economic conditions are not only excluded from the analysis but are relatively unimportant.<sup>4</sup> However, it must be kept in mind that correlations of returns from a worldwide portfolio with consumption will tend to be important. The fact is that total variance of returns determines the value of this option. This gives:

$$\frac{dV_{R,t}}{dI_t} = \frac{dV_{A,t}}{dI_t} \left(1 - \frac{\delta g_t}{\delta V_{A,t}}\right) - \frac{\delta g_t}{\delta \sigma_t^2} \left(\frac{\delta \sigma_t^2}{\delta I_t}\right)$$

Whenever there exists risky debt, this equation implies that some transfer of the returns must be made to debtholders if the investment option is exercised. This transfer is given by:

$$T_t = \frac{dV_{A,t}}{dI_t} \frac{\delta g_t}{\delta V_{A,t}} + \frac{\delta g_t}{\delta \sigma_t^2} \frac{\delta \sigma_t^2}{\delta I_t}$$

The above equations give a number of revealing insights. Assume first that exercising the investment or growth opportunity does not change the volatility of the country's asset

returns; this implies that  $\frac{\delta\sigma^2}{\delta I_t} = 0$ . Then so long as the debt is risky, that is, not default-risk free,  $T_t$  is positive. Some of the excess return from the investment must flow to debt holders and this weakens the incentive to exercise the investment option. Countries will then pass up positive net present value investments in the presence of risky debt, for they only capture a residual -- part of the return enhances the *market* value of the debt, i.e. makes it less risky. (Notice that in these situations, the assumption of perfect real asset markets has been relaxed: positive NPV projects can in fact be found and undertaken.) This results in underinvestment, and presumably lowered growth rates. Figure 2 illustrates the deadweight loss triangle, using again the earlier setup with information about states of nature arriving over time.

Another interesting implication can be derived without changing the current assumptions. Think now of the investment being partially or wholly financed by debt. By this *tying* of new debt to the exercise of investment options, the government can no longer gain at the expense of the new external creditors, but still could erode, as before, the capital gain (or lessened riskiness) of the old debt. In the absence of restrictions, old debt holders would ensure that any new lending to countries was made by them and no others; they would also try to ensure that lending was made for specific projects; and finally, they would try to restrict the country to target debt ratios. This last point is rather interesting: in the absence of repudiation risk, and with perfect capital markets of the sort assumed so far in the literature, there is no rational reason to restrict countries to particular debt ratios. But here, it is clear that the more new debt raises the debt-equity ratio of a country, the more residents can benefit at the expense of old debt holders. In order to signal that they will not take advantage of this benefit, countries would voluntarily set certain debt-equity ratio

targets, and bankers would look for these as signals that the *game* would not be played in the future.

But what if the country's option portfolio is such that by exercising any particular growth opportunity, it increases the volatility of asset returns, i.e.  $\frac{\delta\sigma^2}{\delta I_t} > 0$ . Note that  $\frac{\delta B_t}{\delta\sigma^2} < 0$  -- that is, the more volatile the return stream, the more risky the debt. This is because increasing volatility increases option value; debt holders are short the call option and so the value of their claim has decreased. Therefore, the larger is  $\frac{\delta\sigma^2}{\delta I_t}$ , the more  $T_t$  decreases and the lower is the transfer to debt holders (creditor banks). It is in the country's interest to exercise those options from its portfolio which result in more risky or volatile return streams. This benefits the residents for they hold, as a claim on the country's assets, a call option. Countries will invest in riskier assets whenever they have risky debt outstanding. But note an additional, perhaps more serious, implication -- countries may choose to invest in projects which may even be negative NPV projects, so long as their return volatility is high enough. The loss suffered from the negative value of these investments may well be made up by the reduction in transfer to their creditors. Growth rates could be severely hampered, even without restrictive practices imposed by outsiders and beyond the direct impact of worldwide recessions.

Consider what is meant by an increase in volatility of the earnings stream. Any volatility measure can split up into a covariance with other returns and country-specific variance. An increasingly variable sequence of returns to a country's assets can partly be attributed to worldwide conditions (e.g. worldwide recessions and booms, rising and falling returns on a world portfolio) and partly to domestic conditions. Thus, if the return stream is

more variable, it is possible (though not necessary) that if the sign of its correlation with worldwide returns is the same, the magnitude may be higher. Thus, when a world recession or external shock hits, the returns on the country's assets are strongly depressed thus making the debt even riskier. The point is that the current debt crisis is not because banks were imprudent (though they may have failed to see this implication) or countries *over-borrowed* in some irrational sense nor is it solely because of the exchange rate, interest rate and recessionary shocks. Endogenous (and rational) behavior on the part of debtor countries would be expected to lead to a result such as this. Thus, if worldwide recessions (and other shocks) hit, the resulting domestic shock due to the type of investment options exercised earlier would ensure that the country's returns were even more severely affected: the major losers, in this case, would be creditors, not the countries alone.

Clearly, both debtors and creditors realize that some of these implications may well be important. They take steps to correct for the resulting distorted incentives. The next chapter elaborates further on this point.

But consider some implications of the fact that both recognize these distortions. Say, for example, that a country requests a long-term (maturing after the maturity of the growth option) loan from a private, commercial international bank. A mutually agreed upon sum and rate of interest evolves where the bank and the country's negotiators both know of the existence of these options. But now, say the country requests a larger loan at a higher rate. On the face of it, it seems a reasonable deal; but the banker may not agree. This is because bankers recognize that having acquired a larger loan at a higher interest rate, more options to invest in growth opportunities will be abandoned or let expire worthless. The higher rate

of interest means nothing -- the country will simply default (note: this is not repudiation) rather than invest in projects the returns from which will accrue largely to debtholders if certain adverse states of nature occur. Furthermore, the country, having acquired the debt, will choose to exercise options with riskier underlying prospects, as explained earlier. This kind of analysis can be extended cross-sectionally. Countries with large parts of their asset base made up of growth opportunities will be rationed out of the market for external loans while even those with more fixed assets may find themselves unable to borrow as much as they may wish. In reality, this kind of behavior will occur both because banks will ration out countries with a high proportion of growth prospects and because these countries will ration themselves out, for it will be in their best interests to do so.

In sharp contrast with results derived earlier, a new counterintuitive result is that countries with more risky growth opportunities in their portfolios, relative to their total asset's base risk, will want to, and be able to, borrow more. The higher the level of borrowing, the more likely it is that some of the options to invest in growth producing projects will be abandoned. The result is that the riskiness (or volatility) of the country's assets returns thereby drops as the level of borrowing increases. It may be observed, therefore, that as a country's asset values reflect more risky options (because of abandonment of some of the options in the portfolio due to external shocks, say) they may be able to borrow where they could not earlier. Also, countries that are currently considered to have high but risky growth prospects (oil, gold fields) may in fact be able to borrow more as well, as compared with countries that have relatively safer options.

## 2.6 Game Theoretic Issues

Extending the analysis of Myers [33], Aivazian and Callen [2] suggest that for corporations with outstanding debt and equity claims, the externalities which result in underinvestment in potentially expropriable assets (by the debtholders) can be internalized by the complete purchase of one claim type by the holders of the other. The potential for such an action will lead to incentive compatibility and thus to a resolution of the conflict between the bondholders and stockholders. With the existence of multiple claimants, such as subordinated and senior debtholders, preferred stockholders, etc, there is no core to the game and the resolution is not possible. Here this analysis is modified somewhat and extended to the case of sovereign borrowing.

Consider that the external debt of countries is held at least by two types of claimants - senior creditors such as the World Bank and IMF and subordinated debtholders such as commercial bank syndicates. None of the claims can easily be bought up by another asset holder, and in fact there is not even the potential to do so. Thus, there is no recourse to the above argument which mitigates against external effects. Transactions costs are high enough so that the standard Coase theorem does not apply and the games played by debt and equity holders will persist.

One interesting adjunct to this analysis is that an alternative form of financing can be used to internalize some of the external effects of straight variable rate loan financing in LDCs. Consider the use of a convertibility option given to creditors as part of their claim. The bond (or loan) would be convertible into an index (commodity price, say) linked bond as suggested by Lessard [25] at the option of the creditor. With such an instrument,



whenever traditional debt became *excessively* risky, the commercial banks would convert it into an alternative bond, with a payment stream unfettered by the endogenous moral hazard effects which are inherent in a straight bond. This form of financing allows banks to maintain the value of their bond portfolio under adverse circumstances. It would allow them to participate as the country does (because of its equity-like claim) in the gains which accrue through actions which benefit equity holders at the cost of straight bond holders. Conversely, knowing this, the country would have little incentive to take precisely such steps. The market for loans would be forced to operate as a market which prices assets, at the margin, efficiently.

## Chapter Three

### The Option to Repudiate and Debt Rescheduling

#### 3.1 Introduction

The analysis presented in this section takes as its starting point recent work in the finance literature on the theory and practical implications of the value of different claims on the assets of corporations, especially under conditions of financial distress. Black and Cox [4] provide a rigorous framework for studying the impact of different indenture provisions contained in the securities issued by corporations on the value of the securities and on the incentives of their holders. Here, the basis offered by this framework is further extended to the case of a country which has issued debt of varying maturities, held by both senior and junior creditors. Options pricing theory is extensively used to put structure on the presentation and to derive intuitively appealing results.

While standard theoretical models of this type provide predictions of how claims will be resolved when a firm faces financial distress they are valid only for cases in which the entire loss of bankruptcy is borne by the direct claimants on the assets of the firm. The disruption caused by actual liquidation, however, can have substantial economy-wide external effects. This deadweight cost is not well analyzed as yet and its impact is most likely to be felt when the corporation involved is large. Recent history has provided examples of corporate financial distress, including Massey-Ferguson, Chrysler, Penn Central, International Harvester, and Dome Petroleum, where these theoretical predictions

are substantially invalidated. In fact, the behavior of legal authorities and of the claimants to securities in such corporations bear a marked resemblance to behavior observed in the sovereign loan market. The fundamental point is that just as an absolute default by a large sovereign debtor such as Brazil would cause substantial disruption in the world financial system, the closing down of a large corporation causes externalities which are economy-wide in nature. While this is a sufficient reason for regulators and legal authorities to treat large, naturally monopolistic corporations in special ways, it does not fully explain why any such firms endure extended periods of distress by liquidating assets, and recontracting debt without formally declaring bankruptcy. Baldwin and Mason [3], in an empirical study, address this problem and find that the priority rules embedded in debt contracts are often not enforced. The market behaves as if the debt and equity claims will be recontracted before the current creditors take over the firm and prices the individual claims accordingly.

Substantial similarities exist in the sovereign loan market. The impact on the behavior of creditors and debtors, however, is not simply the result of accounting for the external effect on the financial system of a large, sovereign repudiation, but has more to do with optimizing incentives of the claim holders themselves. As mentioned before, reputation is a critical element in reducing the probability of repudiation by countries. Lack of any legal recourse to the in-place assets of a country by its external creditors also mitigates against their calling it in forced bankruptcy. The impact of this incentive structure results in actions similar to those observed among large corporations in financial distress. The analysis presented here theoretically derives precisely such results for sovereign claims and gives an overall view of country debt options which forms the basis for prediction of future behavior.

Games played by equity holders and the creditors of a country were analyzed in the earlier sections within the context of discount bonds. At maturity date, the debt was fully paid off, if all was well, or if risky, partly paid or not at all. The three-period framework was only relevant in the sense that states of nature revealed themselves, and options to invest in growth opportunities either were exercised or allowed to expire worthless. In this part of the paper, the analysis is further expanded to include periodic debt payments (of interest and/or principal) in addition to zero-coupon bonds. Although the main focus here will be on the repudiation option, the problem needs to be set up first with a discussion of how debtor-creditor game playing is restricted. This will help to isolate the repudiation option as, to put it awkwardly, a super threat, the exercise of which damages asset values both for the country and its creditors. The order of this section, therefore, is first to resolve some issues which split the asset value in a way such that one's loss is the other's gain; and then go on to consider repudiation and reschedulings as joint losses and gains albeit with differential impacts.

Assume once again that a country owns real assets and a portfolio of options. But now the valuation of the various claims on the country's assets depends more on the seniority structure of the claims, rather than largely on the exercise of options. This means that there exists a mutually agreed upon (or understood) order, according to which claimants will be paid off when and if necessary. Behind this seniority structure, however, is a set of restrictive conditions which the governments of countries are expected to follow with respect to their investment and consumption policies. Now, if government debt were sold on public markets, rather than being largely privately placed, the demands placed by investors on the issuer's available set of policy options would be considerably more

restrictive. This analogy with corporate placements of public versus private debt is made because it explains to an extent why most country borrowing has been in the form of commercial bank loans rather than public bond issues. In the corporate world, public offerings of debt securities are commonplace, though the largest borrowings are made through private placements. The latter fulfill special purpose borrowing requirements and satisfy a clientele which require that their instruments be free of the various provisions that accompany public offerings. Clearly, a publicly offered issue must be embedded within a restrictive contract which frees the purchaser of the debt from incurring costs of monitoring the issuing corporation to ensure that it does not play some of the games described in the earlier chapter, which would increase equity value at the expense of debt. This is because of the free rider and public good problems which are obvious in a public bond issue which can have hundreds, if not thousands, of subscribers. No individual owner of the bonds has the incentive to incur the entire cost of monitoring, for the benefits redound to the rest of the bondholders as well. In the case of a country, syndicated loans, for example, suffer from similar problems, although in the majority of cases the number of banks involved in the syndication is not very large. In all cases, the syndication is controlled by a lead manager who has the responsibility of monitoring the country's policy and overseeing the proper payment of the debt. When it comes to restructuring debt which involves new loans, the junior members of the syndicate are clearly reluctant to advance additional funds - the benefits from each additional dollar accrue partly (if not largely) to the lead manager.

Collective action is needed on the part of the lenders to ensure that the public goods problem is internalized. Recent experience has shown that independent moves by small members of a syndication team are strongly discouraged by lead managers and the threat

used is exclusion from future syndicate membership in the corporate or sovereign lending market.

Privately placed issues, however, internalize this problem, for now the monitoring costs and benefits accrue to the same party. Furthermore, debt contracts can be more *personalized* -- that is, the payment structure and terms can be geared to the needs of both the borrower and the lender. Freed from the restrictive covenants of public debt, corporations refrain from policies which hurt bondholders, for now the incentives to monitor their actions are not distorted. Therefore, debt can be issued at rates more closely linked to the exogenous risk faced by the corporation and remain free of the endogenous *behavioral* risk induced by public issue.

Much of this discussion is directly applicable to the case of country borrowing. It is clearly enormously difficult to place credibly restrictive covenants around debt issued by countries. Not only are the monitoring costs high, the nature of public policy is such that only imperfect signals can be gathered as to what the actions (adverse or otherwise) taken by governments really were. This information signalling problem adds to the public goods problem mentioned above and the result is that debt cannot be publicly issued, at virtually any price. This does not suggest that credit markets are inefficient; rather it suggests that market uncertainty can manifest itself in a way that causes the market itself to disappear, and to ration out a certain class of customer. The effects are much like those caused by lack of complete information in the *market for lemons* paper of Akerlof [1]. Any suggestions that country debt be sold to public holders, thus, is not really reasonable. For were it the best way to do things, it would have been done when a degree of optimism surrounded the entire

issue; when things are as adverse as they now seem to be, it is unimaginable that the debt could be sold at any price much different from zero.

### 3.2 The Claim Structure of a Country's Debt

Having to put into place some ideas on the nature of problems associated with what determines the yield (and thereby the value and riskiness) of debt, the problem of the various claims on a country's assets is now structured in the fashion of modern corporate finance. Here, the contingent claims analysis suggested previously plays a critical role in defining how the value of the commercial bank debt claim on a country's assets may be determined.<sup>5</sup>

In the simplest case, when a corporation defaults on its debt, contractual provisions upheld by national law ensure that its assets are transferred over to bondholders, among whom are senior and junior (and perhaps several more) classes of creditors. These are strict rules that then allow bondholders to recover what they can from sale or use of the remaining assets. Implicitly, ownership of the corporation passes on to the creditors. In the case of a country, this is clearly difficult to envision (except perhaps in a colonial world, or with the existence of gunboat diplomacy), especially when a country can choose to repudiate the debt holder's (commercial bank's) claim. This suggests that upon default or repudiation, commercial banks are left with little -- they may seize airplanes, country assets placed abroad, etc., but the value of these is likely to be small.

The real factor which keeps countries from defaulting on or repudiating their debt is the expected immediate loss of trade credits, and loss of future access to external borrowing. While stockholders of a corporation are protected by limited liability, the country's residents

are protected only to the extent that sovereignty ensures that repudiation is a possibility, which also can be construed as limited external liability. Stockholders, the equity claimants of a corporation, do not face the additional cost of lack of access in the future to capital markets -- a country does. Although there are deadweight costs associated with corporate bankruptcies as well (for example, loss of customers and suppliers while a reorganization is taking place), the point here is that countries exist even after a complete repudiation while the average corporation can well be liquidated. Thus, the important question is -- What is the value of a country's assets if it defaults or repudiates, given the costs of doing so?

Consider Figure 3. So long as the country's assets, in present value terms as always, are worth more than  $V_f$  the debt is risk-free and is worth  $D$  as given by the vertical axis. If asset value lies between  $V_d$  and  $V_f$  the entire asset value passes to the creditors. At  $V_d$  and to its left, even they get nothing. This payoff diagram is relevant only at the maturity of the debt, which is necessarily the starting point for any contingent claims analysis. Clearly if the value of the assets is greater than  $V_f$  the residents of the country obtain the residual, after paying off their creditors. Their payoff diagram then is as given in Figure 4.

Terminal payoffs of this kind are only valid under enforceable contracts which determine, ex ante, the values of  $V_f$  and  $V_d$ .<sup>6</sup> Within the framework of this analysis, however, such contracts do not exist; rather, there exist contracts between debtor countries and their creditors, but certain terms are clearly not enforceable. Repudiation is a possibility. What, then, is the payoff diagram under repudiation? In this case, the entire value of the assets does not pass over to the creditors. In fact, they get nothing. The country is left with the residual. Therefore, Figure 4 is transformed into Figure 5 while Figure 3



must be given a new interpretation.

Think of the value of the assets of a country as the present value of both its in-place asset returns and the real options on new investments it possesses. The diagram does not change, but  $V_d$  and  $V_f$  are now partially appropriable<sup>7</sup> asset values. Payoffs which accrue to the creditors are given by the vertical axis. But it is still not so simple: since the  $45^\circ$  line between  $V_d$  and  $V_f$  in Figure 4 defines the value of creditor payoffs when debt is *risky*, it depends on discretionary repudiation by the country. In other words, the country sets a threshold proportion ( $\theta$ ) of asset values which are to be transferred to creditors in certain adverse states of the world. With the assumption that the proportion does not change with asset value, this line is no longer  $45^\circ$ , but of slope less than unity. Figure 4, therefore, is changed to Figure 6.

This leads to Figure 5 which is now easy to interpret. The sloping line between  $V_d$  and  $V_f$  is of slope  $(1 - \theta)$ , while beyond  $V_f$  the line slopes up to  $45^\circ$ . Again the vertical axis defines payoffs, this time to the country's residents. Recall that these are terminal payoffs -- i.e. valid only at maturity of the debt. This claim structure of a country's assets defines exactly not only the terminal payoffs, but under some very unrestrictive assumptions, the valuation of each claim at any point in time before maturity, in terms of the country's asset value. The theory of options pricing, or in more general terms, contingent claim pricing allows these valuations to be carried out with only limited recourse to assumptions about the attitudes of the various claimholders towards risk. Genotte and Sadeq [14] demonstrates the mathematical validity of carrying out such a valuation.

Finally, consider the claim of the other external claimants on a country's assets -- these

are official lenders to LDCs and have the most senior claim. Even if a country repudiates its external commercial bank debt, it, by and large, chooses to continue to pay its official obligations. This is not because, as in the case of a corporation, it is contractually bound to do so; rather, the future costs of repudiating its official debt can be thought of as being ordinarily greater than those of repudiating private loans. Figure 7 gives the payoff structures again at terminal dates of official, senior debt; all claims on a country's assets are residuals after this claim has been satisfied. In principle, it matters that the terminal dates, or maturities, be the same for the diagrams thus far presented to *aggregate* into a 45° line through the origin -- i.e. the sum of all claims on an asset should be the asset's value itself. Although the discussion so far has implicitly assumed this, it is by no means necessary when the generalization is made to valuing these claims at any point in time. This, as demonstrated elsewhere, is possible simply by including contingent claims of various different maturities exhaustively into the valuation and *adding up* the results.

Commercial bank credits and loans can be considered, therefore, as subordinate debt -- i.e. junior debt which has rights on assets only after the official debt has been paid off. This is implied not by contractual provisions, but simply by the order in which, given some assumptions about the various costs of default and/or repudiation, a country will choose to renege on its debt obligations.

### 3.3 Some Implications of the Claims Structure

Leave aside for the moment the entire issue of renegotiations under certain states which change the division points (i.e.  $V_d$  and  $V_p$ ) and possibly, the value of the assets of a country (though the structure of the claim does not change). Then, the fortunes of a

country, determined by the states of nature revealed at future dates, can cause the value of the assets to rise to arbitrarily high levels or fall to almost nothing. Assume that the value cannot fall absolutely to zero. Although this is unnecessary for the analysis to go through it is realistic in the case of the country and not in the case of a corporation.

Then, the possibility of repudiation and/or default causes the claim structure to take on the shapes in Figures 5, 6, and 7, and it is clear that if the country can appropriately influence  $V_f$  or  $V_d$ , its residents can gain. That is,  $V_f$  and  $V_d$  will be determined endogenously as part of a solution to a decision problem faced by a country's managers, rather than contracted stipulations. As a consequence, debtholders are left at the mercy of a country's fortunes (which they are possibly willing to bear, given the right price, for this is an exogenous risk) and the value of their claim is determined by the actions of its manager. This endogenous risk, which is akin to the moral hazard problem (addressed earlier in the section on growth opportunities) plays a greater role as the riskiness of the debt increases. In the corporate world, various safety covenants are specified in bond contracts, to guard against adverse actions by stockholders, or managers who are maximizing equity values. These include restrictions on dividend payments, investment policy guidelines and provisions such as negative pledge clauses on the issuance of new debt or stock. Most importantly, safety covenants ensure that bondholders can call bankruptcy on the corporation if it fails either to meet debt payments or is observed to be undertaking actions that signal that the firm is passing value to equity holders at the expense of bondholders (such as selling off assets and using the cash to pay dividends).<sup>8</sup> Such restrictions, in line with the earlier discussion, must be enforceable and the adverse actions taken by the firm must be observable.

The structure of claims on a country's assets suggests that a lack of safety covenants and future costs of repudiation would ensure that managers would have incentives to repudiate debt immediately. No debt would be issued in this case, for debtholders know this will happen. Costs to the country of repudiation are relatively uncertain, and there is little historically to judge these by. Therefore, in order that the seniority structure of claims on the country's assets is maintained, additional covenants are required. The more risky debt is thought to be, the more necessary are these covenants. Such covenants typically take the form of negative pledge clauses for countries.

In this analysis, safety covenants on country debt are interpreted as any restriction debtholders place on what shape a country's economic policy must take. IMF conditionality World Bank policy loans and others substitute for the contractual restrictions corporations face when they issue debt. The discussion above places this analogy into perspective for although it is not perfect, the impact is, by and large, the same. These covenants exist exactly because of the adverse incentives discussed earlier which influences the behavior of those who have an influence on the underlying assets.

The conflicts of interest arise not only among equity claimants and debt claimants but also among the various classes of debt claims. The result is that the repudiation option further serves to define the claim structure of debt classes (i.e. seniority). Its value under different states of the world and over time can influence which debt claimant gets paid how much. It defines also when and how conflicts (or convergence) of interest can arise among these claimants. When commercial banks or the IMF or all creditors as a group impose restrictions, they and the country explicitly recognize how the benefits and costs from these

restrictions will be shared. A stable set of agreements can only be reached if the distribution of net returns is set in a mutually acceptable way.<sup>9</sup> Countries, therefore, would be willing to agree to restrictions on policy alternatives if it means that in this way their residual asset value increases to a level greater than that they would have remaining if they repudiated.

### 3.4 Asset Claims and Options

Repudiation not only leaves the value of loans to banks at zero, it also reduces the present value of the country's assets. The latter, in the sense of availability of access to trade and foreign capital markets is best viewed, again, as a set of options. By repudiating its external debt, a country essentially gives up options on future assets which, while held, are valuable. It also gives up the option to repudiate at a future date and this implies that countries will, like American option holders, wait until the last moment before exercising their option.

Before repudiation, the country holds many such options that make up a part of its asset value and the ability to give up, or trade, these options gives the country and its creditors a degree of flexibility. Covenants, in a similar sense, can be viewed as the giving up by a country of its right to undertake types of policies which benefit it and redound negatively on its creditors. Think, therefore, of a country option portfolio as consisting of certain rights (but not obligations), to undertake a variety of actions. Banks realize that a country holds these options and that there is value attached to them which benefits the country. In order to lend for a given term, a given amount at a stated cost, countries are asked to give up, in credible fashion, a set of these options.<sup>10</sup> This immediately lowers the total value of assets, but increases the value of debt claims. The net loss must come from the

shareholders or residents of the country.

Among the options that a country may be asked to give up, for example, is that of deciding how much current consumption it can undertake, at the expense of investment. The analogy with dividend payments from the return stream of a corporation's assets is obvious: returns from a country's assets can be reinvested or used for current consumption, like dividends paid out to the country's residents. Doing so, however, reduces the value of assets in comparison to reinvestment. Debtholders, in all states, prefer that the value of a debtor's assets remain as high as possible, for if and when it falls below par value of the loans, the debt becomes risky in the sense that default becomes more likely. Fiscal restraint is a common prescription in most IMF structural adjustment schemes and can be interpreted as the installation of bond covenants. Clearly, reduction in consumption expenditure makes debt safer, but the analysis suggests that there are good reasons for transferring this value over to debtholders (banks) even at the expense of shareholders (residents) -- this removes some of the information asymmetries that result in credit rationing in sovereign loan markets.

Another restrictive covenant may be that banks, the IMF, or both may require that net foreign exchange earnings reach certain levels, i.e., the country must maintain specified debt service ratios. If exports are largely determined by exogenous factors, this requires that imports be reduced; consumption may have to be steered towards domestic goods and capital goods imports may fall as well. Although the country effectively gives up its option to set its trade deficit where it pleases, the more important impact is likely to be that the import reduction will come largely from restricting capital goods imports. This is clear from

the earlier discussion where it was shown that, given the ability to do so, countries would underinvest in the face of risky debt.

This interpretation suggests that the effect of conditionality is to change the value of the contingent claims which make up the liability side of a country's balance sheet. The analysis suggests that the more important reasons for the existence of covenants are that a *market* for debt is possible (as discussed earlier, when monitoring and uncertainty were discussed) and that the games creditors and debtors play which reduce total asset value, are to an extent, lessened. Lacking covenants, one would expect that countries would borrow and consume out of debt (i.e. pay out dividends) rather than invest in growth opportunities. This is not to imply a qualitative judgement about what is preferable, but only that the incentives clearly would bias country behavior towards immediate consumption. Whether the real rate of interest charged on external debt is negative or not and whether the country has investment opportunities which yield, in an expected value sense, returns higher than the interest rate, the effect is either to reduce or increase this more fundamental effect. As a result, countries with risky external debt reduce their savings rates and increase consumption, implying that the consumption function would shift out in the presence of debt. More importantly, countries would be induced to invest in assets which have non-appropriable returns and also in assets with more volatile returns.

Now reconsider the claim structure on a country's assets. Contingent claim valuation methods allow a useful interpretation of these claims as various positions taken in options. Simply by matching asset claim structure to a replicating portfolio of options positions allows each claim to be precisely valued in terms of the asset value, at any point in time.

Once again, consider the terminal payoff functions described in Figures 3 and 4. (Although the more relevant figures are 5 and 6, they comprise a more complex set of options positions, which are similar to warrants (or partial positions in options) and require technical discussion beyond the scope of this paper.) The equity interest of the residents of the country can be viewed as a call option on the value of the underlying asset base. If this value is greater than  $V_f$  at maturity, they pay off their debt in its entirety and retain the residual. When it is lower than  $V_f$ , but greater than  $V_d$ , they pay off (in this simple sense, where reserved equity value as in Figures 5 and 6 is not considered) their debt by transferring any appropriable assets to creditors. The creditors then receive in return for their loan, whatever the value of assets is at that time. Clearly this would only happen if this value were less than or equal to the value of the debt. The commercial banks then own a call option with exercise price  $V_d$  and have sold a call option to the country with exercise price  $V_f$ . Their portfolio is like a spread position in options. It is clearly a hedged portfolio whereby they can lose no more than the value of the debt, but can gain no more than the promised payment. Asset value can clearly go negative, especially when borrowing is involved. But commercial banks, with their spread portfolio establish a bottom limit and in this sense, their loans are similar in effect to equity, when the underlying asset value is between  $V_f$  and  $V_d$ . Suggestions of converting debt to equity are thereby rendered meaningless for creditors already own partly risk free debt, and partly equity; the debt is risk free (and like risk free bonds) when asset values are greater than  $V_f$  and is close to being pure equity when asset values lie between  $V_d$  and  $V_f$ . The point is that any options portfolio consisting of the simple options (i.e. calls and puts) can be thought of in this way, that is, a portfolio consisting of (constantly rebalanced) proportions of equity and risk free debt.



Say asset value is less than  $V_d$ ; then default by the country ensures that commercial bank creditors get nothing. Asset value passes on to the senior claimant, in this case the official lenders. This contingent claim can be represented as a portfolio which consists of *owning* the assets of the country but with a short position in a call option, with exercise price  $V_d$  sold to the commercial banks (who in turn have bought this call and sold another to the country's residents).

Note that so far the repudiation option has not been considered in this framework. The impact of repudiation is to change the slope of the line between  $V_d$  and  $V_f$  as described earlier. How much a country is willing to pay on its debt upon repudiation is represented by the slope  $\theta$  which lies between zero and unity. The impact of this is to transform the call into a warrant. The valuation of such a contingent claim is quite straightforward, but the methodology is relatively intricate for it changes the distribution of the asset claims. This is left for an accompanying paper.

Having placed the various claims on the assets of a country in the framework of options, it is now possible to value each as a relative value, in terms of a country's assets. The important thing to note is that options valuation does not need a general equilibrium framework, and requires only that the total volatility of the returns from the underlying assets be known. There is no need to calculate expected rates of return, nor is there a need to know the covariance of this return with other worldwide assets. In order to value these claims it is not necessary to know the  $\beta$  of a country's earnings with respect to the rest of the world.<sup>11</sup>

The interest of this paper is not in pricing these securities, but in drawing implications

for the behavior of the various holders of these options under different circumstances. Although a number of such inferences were drawn earlier, the paper now looks at how the options elements embedded in LDC debt influence the behavior of countries and lenders when debt becomes (or is viewed as having become) risky. In fact, since this method of looking at country debt allows *valuation* of safety covenants themselves, it is possible to gauge how lenders and borrowers would behave when debt is risky under the implied policy restrictions. Policy restrictions themselves contribute to how much value is transferred by one party to another and especially when debt is risky, this transfer would influence the behavior of governments. Specifically, they may be induced to repudiate if, under certain states of the world, the transfer is *too great*; they also would follow investment policy which ensures that any such transfer will be reduced in the future. On the other hand, if debtholders call the country in default as soon as an interest payment is missed, they may in fact end up reducing the value of their claim in certain states. There are therefore mutual gains to recontracting which change the total value of the asset, and leave all claim holders better off in an expected value sense.

This is discussed in greater detail below, but first the basis of what constitutes the repudiation option is presented. How this option can be valued and its similarity with other contingent claims is examined and these concepts are later used to see more precisely how the mutual gains from recontracting etc. accrue. Option valuation can also help to decide the split of this gain. This is discussed below as well, but more detail is presented in Genotte and Sadeq [14].

### 3.5 The Option to Repudiate

When a corporation defaults on its debt obligations, its bondholders (and Bank creditors) take over ownership of its assets, in lieu of further contractual payments. Countries, however, hold the right to refuse further payments on their external debts (or at least to reduce to arbitrarily low levels, or postpone them) albeit at a future cost. There exists presently, no accepted way of transferring the rights to the entire value of a country's assets over to lenders in the event of an exogenously imposed or willful default. Lenders stand to lose the entire outstanding value of their holdings in a country upon repudiation. The option to repudiate is valuable to the country, in that it allows it the right, but not the obligation, to give its lenders nothing in return for cancelling its external debt obligations, in certain states of the world. Unilaterally imposed revocation of debt will obviously occur when it benefits a country to do so, and since there clearly are circumstances in which this would be the case, the option is valuable.

When banks make loans to countries, they must recognize that part of what constitutes the value of the loan to a country is this option (among the other discussed earlier). In rational markets, banks will demand a payment as compensation for having *sold* this option while countries must be willing to pay for it. The risk of a loan to a country, depends not only on exogenous states of nature which can make the assets of a country less valuable but also upon the value of this option. That is, the riskiness of a loan, over and above the other factors, is embodied fully in the value of the option to repudiate.

In order to think about what would constitute this value, think of country borrowing essentially as bonds bought by banks. Then repudiation is the ability to exchange these

bonds (sold by the country), at any time for another asset worth zero. That is, repudiation is effectively the same as buying back the bonds at an exercise price equal to the costs of repudiation without paying the bankholders anything. This cost of repudiation is borne entirely by the country and does not accrue to the bank. Clearly, the bank may be loathe to write off its debt, even if this happens, since there is always the possibility that at some time in the future a new management will elect to pay its past obligations (so that it may borrow again on international capital markets). But from the current government's point of view, a repudiation has the same effect as a buy back of its bonds - its bondholders are left with nothing while it gains the nominal remaining principal and bears the costs of loss of ability to trade on credit, lost access to capital markets, etc. Whether the country chooses to buy back these bonds at a zero price, or at some other price equal to an arbitrary proportion ( $\theta$ ) of the promised payment, is immaterial. The essential feature is that one can think of repudiation as the option to *call* a bond at an exercise price equal to the cost of repudiation.

Corporate bonds often have such a built-in feature; those that have call provisions, sell for lower prices (all other things the same) than those lacking this option. These provisions, however, are tied to exogenous factors while in the case of repudiation the entire problem is one of endogenously determined option value. The bond-issuing firm holds a call option to buy back the bond at a given price, usually for a stated number of years, after which the option expires. In the case of a country, the option expires only on the maturity of the debt. Longer lasting options are obviously more valuable for they give the holder more flexibility over a longer period. Thus, the repudiation option on longer term debt is more valuable than that on shorter term debt. The more the promised payment of debt, the more valuable the option is; again this is intuitively obvious for then the country buys back

a more valuable asset at the cost of repudiation. And the more volatile is the price of the bond (think of interest rate volatility which directly links with bond price volatility) the more valuable is this option; it gives the holder flexibility precisely when flexibility is important. The volatile is the return stream of the underlying assets, the more valuable is the option to repudiate. These fundamental effects (among others) are used later to derive behavioral implications but do explain already why it is that bonds with explicitly stated call provisions, having reserved some rights for the issuing firm are less valuable to investors - just when they become more valuable (as interest rates changes, or states of the world change) the issuing corporation reserves the right to call them back at some lower price.

Similarly, think of the banks as private holders of developing country debt. Just as individual investors who hold bonds with call provisions demand that they be compensated ex ante for the loss of flexibility, (or transfer of certain contingent claims to the corporation) so do banks. The value of the option to repudiate is possibly well recognized, although not explicitly priced, and banks would be expected to demand a payment up front for this option which they effectively have sold to the country.

At a zero exercise price, though, it would always be more valuable to exercise the option immediately; i.e., the country, it would seem, ought to buy its debt back as soon as it is issued, thereby repudiating the entire sum. The longer it waits, the more debt it has paid off. But this is clearly not reasonable. The repudiation option would presumably have a cost associated with exercise. Exercising the option changes the value of the assets owned but the country, since the original asset value includes the expectation that future borrowing will be possible. This is unlike regular traded options and so it must be thought of in a

slightly different way. As the debt is payed off, the underlying asset which the country buys back at a given exercise price drops in nominal terms, for unlike bonds, countries also pay part of the principal on their borrowings. The debt, therefore, is like a sinking fund. However, as time passes, and payments are made, the costs to the country of repudiation do not diminish - whether the country repudiates all or part of its debt, access to trade credits and capital markets diminishes in identical ways. Thus, the option to repudiate, given a constant nominal amount of debt, drops in value over time. Note, however, that if the underlying volatility of interest rates, or its external (foreign exchange) earnings stream rises, the option becomes more valuable, but this is not time-dependent.<sup>12</sup>

Debt capacity in this sense can be interpreted, when the repudiation option exists, as that amount of debt in excess of which it is more beneficial for a country to exercise than to hold on in the hope that it will become more valuable later - i.e., the point at which the option is worth more dead (i.e. exercised) than alive is a function of how much debt the country has outstanding. In order to increase debt-capacity, the country must demonstrate in a credible fashion that the value of the repudiation option is such that it pays the country to refrain from exercising it. One way to do this would be to invest in a way such that its future earnings stream is more heavily tied to export markets and export credits investment must be made in appropriable resources. This increases the cost of repudiation and represents therefore a lowered option value - a credible commitment is always such that the option to repudiate (or expropriate, etc.) moves further away from the exercise value. This means that the commitment must ensure that the value of exercising now rather than later is negative.

In the following sections, this way of thinking about riskiness in country debt is expanded to provide a framework for analyzing debt reschedulings. Recontracting, which is what reschedulings amount to, is a way of changing the distribution (and amount) of return streams and asset value such that the option value embedded in each claim is either lowered or increased, depending upon which makes the new contract more sustainable.

### **3.6 Repudiation, Claim Structure and Rescheduling**

How the value of the underlying assets of a country are to be split up at maturity date of the debt, as described earlier, determine (endogenously in the case of a country, exogenously in the case of a corporation) the lower boundaries at which the country would default on its commercial bank debt and its official borrowings. The repudiation option just discussed defines in effect the upper boundary of asset value at which it will pay the country to call back its bonds without compensating its bondholders (i.e., banks). These boundaries are given by some optimal decision rule followed by the country. The exact point of the boundaries are beyond the scope of this analysis. In order to value the options discussed thus far, explicit consideration of these boundary conditions will be necessary but qualitative implications can be derived without reference to what exactly the terminal payoffs are.

This section is divided into two parts. First since the asset claim structure itself induces the various holders of LDC debt to behave in predictable ways, under the assumption that each is trying to maximize the value of the respective claim, the incentive to gain at another claimants expense is studied. Then, the idea that jointly determined future actions can increase the size of the pie (i.e. asset value) is considered. The critical role that

the repudiation options plays is explicitly recognized and treated in an options trading framework where front-end fees and the like are thought of as option prices.

Recall that commercial bank debt was interpreted as a subordinated (to official loans) claim. That is, any payment of debt must first be made to official lenders; if anything is left over the junior debtholders have first claim on this; and finally the residual accrues to the country's residents. Note that this occurred not because of any contractual stipulations but because of the way in which LDCs would choose optimally pay off their debt. This structure insures that like safety covenants, senior or official debt is more valuable than an equal proportion of an undifferentiated debt issue. Intuitively, the debt is safer because it must be paid off first - as part of an undifferentiated debt issue it would have to be split with the rest of the bondholders.

If official creditors gain because of the claim structure, someone must lose. Since commercial banks recognize that such a seniority structure exists, they demand to be compensated for the subordination of their claim with perhaps a higher margin over the interest rate reset. If the debt is properly priced, the cost of this feature must be borne by the country itself. Given any asset value, the claim structure ensures that the country will bear the cost of transferring some risk away from the senior bondholders to commercial banks, so long as it holds the option to repudiate its junior debt. If it is willing to commit that repudiation will not involve a complete loss, part of the gains from the subordination that an official debtholder enjoys will be paid off by commercial banks. This is because now the commercial banks hold partly equity (as discussed earlier) and must share in the costs of the covenant.



This essential characteristic of subordinated debt, or the type of debt held by commercial banks, gives it properties quite unlike the standard garden variety senior bonds. Because commercial bank loans can be considered as a portfolio of two call options, one long and the other one short, it is possible that the value of the loans at any point can be an increasing function of the volatility of the underlying asset returns. Recall that option values unambiguously increase with this volatility since they offer protection on the down side; any increase in the variance of the price of the underlying asset will increase the likelihood that the option will be more valuable, and so if the call option held long is more elastic with respect to variance than is the one held short, this result will obtain. However, senior debtholders only hold a short position in call options; this means that under certain circumstances, the debtholders as a group will exhibit conflicting interests with respect to change in the country's investment policy. While commercial banks may occasionally want the country to invest in risky projects, official lenders never will. Note also that if the elasticity of the short call option implicit in the commercial bank debtholding is greater with respect to volatility than is the elasticity of the long position, the interests of both commercial banks and official creditors will coincide; i.e., both will want the country's managers to invest in less risky investments than the managers themselves wish. These implications which are relatively clear in an options framework are not obvious lacking contingent claim analysis.

Note that in the context of the framework as it has been set up, official debt is never worthless. Countries always have an incentive to pay as much of it as possible. Commercial bank debt, though, under repudiation (or under exogenous default) can become valueless. At maturity, so long as the asset value is non-zero, official creditors get something while

commercial banks get nothing - the country simply sells off its assets, pays the resulting cash to official creditors and commercial banks are left with nothing. Consider what commercial banks in this framework (and not official creditors) would want to do. The best lenders with senior status can do is to call default and take over all the assets of the country. the best junior debtholders can do is to extend the maturity of their debt. This increases the value of their long position in the call option. Since they are more senior in claim than the country itself, barring repudiation, they gain because there is a non-zero chance that states of nature will occur which makes their claim regain some value. As it stands they get nothing; if they extend the maturity of the debt, they stand to gain. The latter strategy dominates. Commercial bank debt in this situation has a value which behaves much like the value of equity claims. There is no need to *convert* debt to equity; when subordinated debt get risky, it is equity.

Consider now debt which has periodic interest (and possibly principal) payments. When any one of these payments is missed, the debt theoretically is default. In this situation, banks can either call the country in default or try and force the country to sell off assets to repay the debt in full. If the latter were an enforceable penalty, or if the costs of repudiation were high enough, the country would always prefer to make the payment rather than suffer the costs of failure to do so. On the other hand, the maximum value a lender's debt can take, at any point in time, is the current value of the appropriable assets. If default implies that full restitution be made to the lender, then that is the best possible position, under the circumstances. Under corporate law, this is precisely the structure of incentives. For a country, however, the lender also loses upon default or repudiation. Therefore, there are mutual gains or losses to making or missing a payment, which is quite unlike the

corporate case. Corporations often end up in bankruptcy even when there is substantial value left in the underlying assets, for the interests of bondholders are to call default as soon as it seems a possibility. Quite the contrary should be expected to occur in the case of a country - when it seems as if a payment may be missed, there should be a wild scramble to renegotiate the contract in a mutually beneficial way.

But how is the next payment to be made? Clearly, some assets must be sold in international markets, or reserves must be drawn down (which is exactly akin to the sale of equity, for reserves are like retained earnings and retained earnings can be distributed to a country's residents or used for investment purposes, just as proceeds from a sale of equity can) or further new borrowing must be undertaken. By and large, the sale of assets to make the next interest (plus principal) payment is not in the interest of creditors or debtors - it unambiguously reduces the value of assets in place, thereby increasing the probability that debt will again become risky in the future. The status of the new borrowing, in terms of its claim structure then becomes important. So long as commercial bank lenders do not have the right to manage a country's assets they would insist that any new debt be subordinated to their own, just as would likely be stipulated in the negative pledge clauses in a corporate senior debtholders claim. But consider the case where the new debt is issued to the same commercial banks. Here, they are indifferent about the subordination issue, for they hold both claims, old and new. But who gains from the new debt issue? Clearly the official lenders gain, for their debt is now safer. The country loses, for the value of its residual claims is now subordinated to an even greater amount of debt; it loses less than under default or repudiation, however. And the commercial banks it would seem, are left indifferent.<sup>13</sup> But in the case of a country, that is not entirely right. There are mutual gains

from increasing the value of a country's debt in such situations for if the resulting new borrowing is from senior creditors, it can be used to make the upcoming payment to junior creditors. Since commercial bank debt has embedded within it, a call option as does the resident's claim, the increase in time to expiration (till the next payment date) adds value (the worst that can happen is that the next payment will not be made, but then debt is no worse off, while if the state of the world improves, it could be better off). This gain does not come free, however. Something must be given up, and this leads naturally to the next part of the analysis where the repudiation option is once again considered and an explicit description is given of reschedulings.

In order to lead into the analysis of debt restructurings, note that in all the case analyzed above, the senior claim holders, such as the IMF and the World Bank always gained by new debt issues that were subordinated to theirs, so long as the country did not increase the riskiness of investments. But this is the critical issue. By taking adverse action on its investment decisions, a country can most heavily influence the value of the highest priority claim - it is the only claim that holds a short position in options. No doubt, the impact of commercial bank debt can also be negative, but as described above, the interpretation of this lending as a spread position in options implies that the banks are partly hedged against such adverse actions by the country.

In essence, the country can choose to take the most volatile of its investment options, and exercise these. This means, that given a choice among investments of say, similar net present value, it would be induced to choose the most risky ones. This point has been discussed earlier, and it is a direct consequence of the fact that the resident's claim is

fundamentally a call option on the value of assets. If the volatility of the return stream of the investment option is high enough, it may in fact pay the country to invest even in negative NPV projects. Clearly, since the senior claim holders, (i.e., official banks) tend to lose the most in this case, they would be most vigilant in keeping track of a country's policies. Not only that, if and when the commercial bank debt becomes risky (or the country came close to missing a payment), it would be in the interest of official creditors to step in and impose conditionality. That is, it is not just that official creditors have, in some sense, more *clout* with countries (because countries have more to lose when official debt is called in default) but that it is in the best interests of the official holders of the country debt to take credible restrictive action.

A priori, one would then expect that restructuring, and restrictions placed on how a country goes about financing its debts payments would come from official lenders, purely because of self-interest. The amount of official lending as a proportion of a country's total external borrowing may be small, but as a proportion of the subordinated creditors lending may be quite large - they stand to lose, especially in the case of some Latin American countries, a substantial proportion of their total assets. These senior creditors would also be expected to resort more to covenants and policy restrictions on their loans than would commercial bank lenders. In other words, the push for policy loans and structure adjustment loans would come from official creditors not simply because these are in the best interest of the country, but because such loans place implicit and explicit restrictions on how a country may invest and how it may finance its external obligations - and this benefits largely these creditors themselves.

Any such restrictions on policy that a senior debtholder can convince a subordinated debt claimant to impose on the borrower country redounds mostly to the benefit of the former. Of course, in certain circumstances, as discussed above, it increases the value of the commercial bank claim as well; when these interests coincide as they could when the debt is not very risky, one would expect a formation of a coalition among senior and junior debtholders to protect their claim. The coalition would explicitly recognize that there are mutual gains to recontracting when debt becomes risky. It would also recognize that the implied claim structure limits the ways in which recontracting can be effected in a time-consistent way.

Banks then face two choices - either let the country repudiate and lose the remaining face value of their loans, or recontract in such a way that the probability of repudiation diminishes. Repudiation is an option, and it will be exercised if the value of doing so is positive for the country - i.e., when the benefits of exercising the option exceed the value of keeping it alive. As such, it has, at each point in time, a threshold value, called the exercise boundary beyond which the option is better left alive for it still retains the possibility of increasing in value. Intuitively, this exercise boundary is simply a relationship between the value of debt outstanding, its time to maturity, the expected costs of defaulting and the underlying volatility of the country's earnings stream which defines the benefit-cost difference in present value terms. If the value of the option falls below exercise value, it pays to exercise it; otherwise, it pays to keep it alive.

Lenders realize that this option value changes with the amount of debt outstanding and with time left to maturity. At any time when the value of the option falls below its

exercise value, it is in the interests of both parties to push it back up - the country again holds a more valuable option, the bank's debt is no longer valueless.

How might this be done? Note that the fundamental issue here is to exchange one option for another. That is, the current repudiation option, if below exercise value, has a high probability of being exercised, while a new option with a different time to maturity and different underlying asset value (that is, the promised payment) can be constructed such that it is worth more alive than dead. Since thus far, the option to repudiate has been thought of as a call option, it is immediate that increasing the amount of debt (i.e., changing the exercise value of option, and the current value of the option) has an ambiguous effect. (Although this can be settled unambiguously by looking at some more detailed analysis of options valuation, it is beyond the scope of the present paper). Nevertheless, changing the nominal value of debt, changes the two values by different amounts - in fact, the option value is more elastic than is the exercise value of the option under conditions where the option value is close to exercise value. Thus, increasing the debt amount, which is exactly equivalent to delaying one (or more) payment reduces the chances that the option will be exercised. Note, furthermore, that the option to repudiate will only be considered for exercise at or just before each payment due date. There is no sense in exercising it just after (for then it should have been done before, and the payment need not have been made) nor is there reason to repudiate in between payments- there is always the (non-zero) probability that the state of the world will change in favor of the holder of the option during this time.

Lengthening the maturity of debt unambiguously increases the value of the option and thus one would expect that part of the recontracting negotiation would increase the

average term of country debt. Taken together, these two choices could benefit both parties - but again the split in the benefit need not be symmetric. The country now has a more valuable option, in that if it chooses to repudiate immediately after the recontracting, it would retire a higher debt value at zero additional cost. If the renegotiation were to result in the country receiving this new option free of charge, it would be getting something for nothing. This would not be a stable situation in which to bargain. It therefore must be willing to pay something for the exchange of these options - this can be interpreted as the net difference in price between the options.

A rescheduling fee can be interpreted as just a mechanism. The repudiation option can be exercised at any time, and simply increasing the margin over Libor (or the U.S. prime rate) does not constitute a credible scheme by which banks can collect the option premium - it must be paid up front. A front-end fee, before any new loan is made, can be thought of in a similar fashion. The value of repudiation is embodied in the value of an option and the value of this option at time of negotiation must, in equilibrium, be paid up front. If the debt could only be repudiated at maturity (for example, a discount bond with no regular interest and/or principal payments) the implicit interest rate charged could reflect the repudiation risk. Clearly, this cannot hold true with interest paying (or sinking fund) instruments which carry with them not just the potential risk of default, but also that of repudiation before maturity.



# Chapter Four

## Concluding Remarks

This paper developed a framework using option pricing theory to analyze some important issues underlying the valuation of LDC debt. It also provided insight into the expected incentives and behavior of various parties to the sovereign debt contract. Its major contribution was to look at both sides of the debt contract. The behavior and the incentive structure of borrowers was the focus of Chapter 2, while Chapter 3 concentrated on the implications of the derived claim structure for the behavior and incentives of lenders. In Chapter 2, the *value* of a country's assets was separated into two types:

- Option value derived from holding the right to undertake growth producing investments in the future.
- Asset-in-place value obtained as the present value of the already undertaken capital investments.

Using the theory of option valuation, this paper showed that countries with most of their value invested in assets-in-place would find they had easier access to international loans. In contrast, countries with mostly growth opportunities would find themselves rationed and would not be able to borrow as much as they wished even if they were willing to pay higher interest rates. In addition, it was shown that the more a country's asset value is made up of long dated growth options the shorter would be the maturity of their external borrowings while countries with established capital assets would be able to borrow at longer maturities. This result, among others, is implicit in other papers on the subject.

When a country has a substantial stock of external debt, it is more likely to experience

substantially reduced growth rates. This deadweight loss problem was again shown to apply most forcefully to countries with a higher proportion of growth options. Knowing this, lenders would be forced to limit the ability of such country to borrow in an international setting. If such countries faced foreign exchange bottlenecks, they would be forced to rely on internally generated funds (e.g. excessive concentration in exportables).

The paper recognizes that a borrowing country is in part similar to an individual who attempts to smooth his consumption over time, and in part similar to firms which borrow solely to invest. In fact, this interpretation served to give greater force to the arguments presented in Chapter 2.

An important result of the analysis is that countries with a stock of external debt would choose to invest in projects with highly risky earning streams. By increasing the spread of the distribution of asset returns, the country would increase the value of its own claim on its assets. This distortion in incentives which results in more volatile GNPs and especially export earnings is a fundamentally new result in the analysis of LDC debt. If the increase in variances were brought about through increasing investment in volatile assets with high  $\beta$ 's relative to a worldwide portfolio, the country would experience financial distress precisely when the world economy is in recession. This seems to have been a cause (over and above the strength of the dollar, high U.S. interest rates, etc.) of the recent LDC debt crisis, particularly among the Latin American countries.

Another important and related conclusion was that those countries whose growth opportunities were largely made up of very risky potential investments would tend to borrow more than those whose opportunities were made up largely of investments with

stable returns. This counterintuitive result is derived from the earlier results on the incentives and behavior of a country which has a large stock of external debt. Since such countries give up growth options, their resulting income stream is likely to be determined more by existing assets than by the new investments. Thus, by giving up options to invest in risky projects, the country makes a credible commitment to reduce the risk of its income stream.

Chapter 3 extended this analysis to derive the seniority structure of the various claims on a country's assets. These indenture provisions were derived by recourse to the order in which borrowing countries, if they chose to, would repudiate their external debt. Official creditors such as the World Bank and IMF were regarded as the borrower's most senior claimholders, commercial banks as holders of subordinated debt and the managers and residents of the country as the equity holders. This structure was shown to prevail even when no recourse is available to legal authorities which enforce the terms of international contracts.

In such a setting, incentives of each claimholder tend to converge and diverge under different states of the world. As the riskiness (or worth) of a country's earning stream changes, subordinated creditors hold claims, which bear, in some instances, a marked resemblance to equity, and in other cases are congruent with straight senior debt. Behavior therefore, is contingent upon the value of options embedded in each claim. It was shown that when debt becomes very risky, that is, in situations where the country would be most likely to default, commercial banks and managers of the country would have similar attitudes towards real investment and consumption. Under conditions when debt was *safe*,

their incentives will diverge while senior creditors and commercial banks would display congruent incentives. The implications of this analysis, for the role of the IMF and the World Bank and for the types of loans they would extend, were derived. The paper also showed why it would be that the official creditors of a country, notwithstanding the small proportionate amount of their loans, would be the most credible and likely claimholders to impose covenants and conditionality. Several new results pertaining to the relationships between the claimants to LDC debt were derived.

Finally the relationships were incorporated in the analysis and were discussed as a means of making the inherently unstable international debt contract credible and time-consistent. Rescheduling itself was interpreted as a method by means of which options on different assets could be traded between borrowers and lenders of different contingent claims. Since rescheduling results in mutual gains in this context, the fee charged by banks is essentially a way of sharing the gains from a restructuring. The fee is also interpreted as the price of the option to repudiate on a new stock and structure of debt, sold by creditors to the borrowing country.

# **Appendix A**

## **Diagrams**

**Figures 1 through 7 appear on the following pages.**

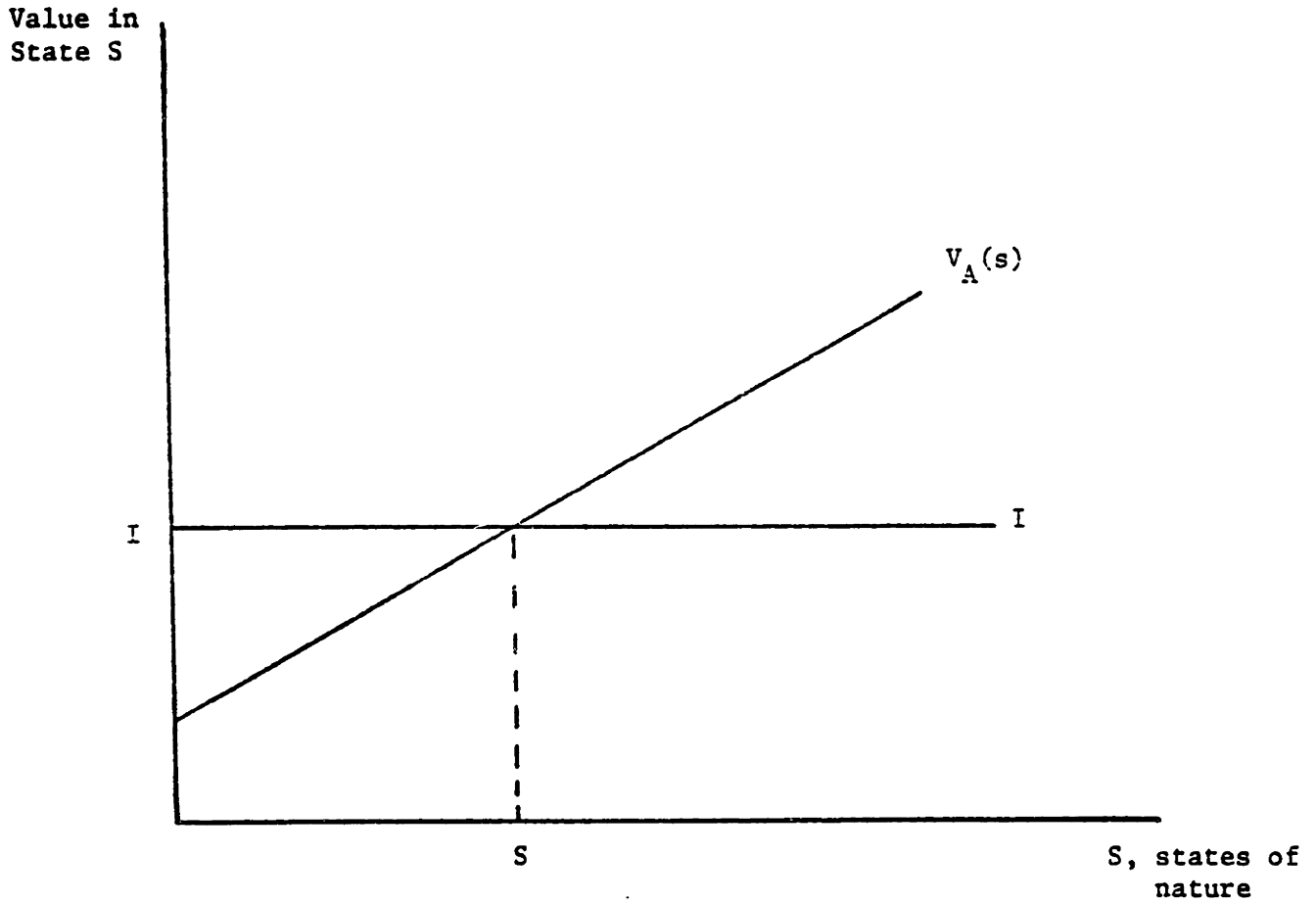


Fig. 1

Note: States of nature are 'ordered' from left to right, in terms of their impact on the total value of a country's assets. The ordering is not time dependent.

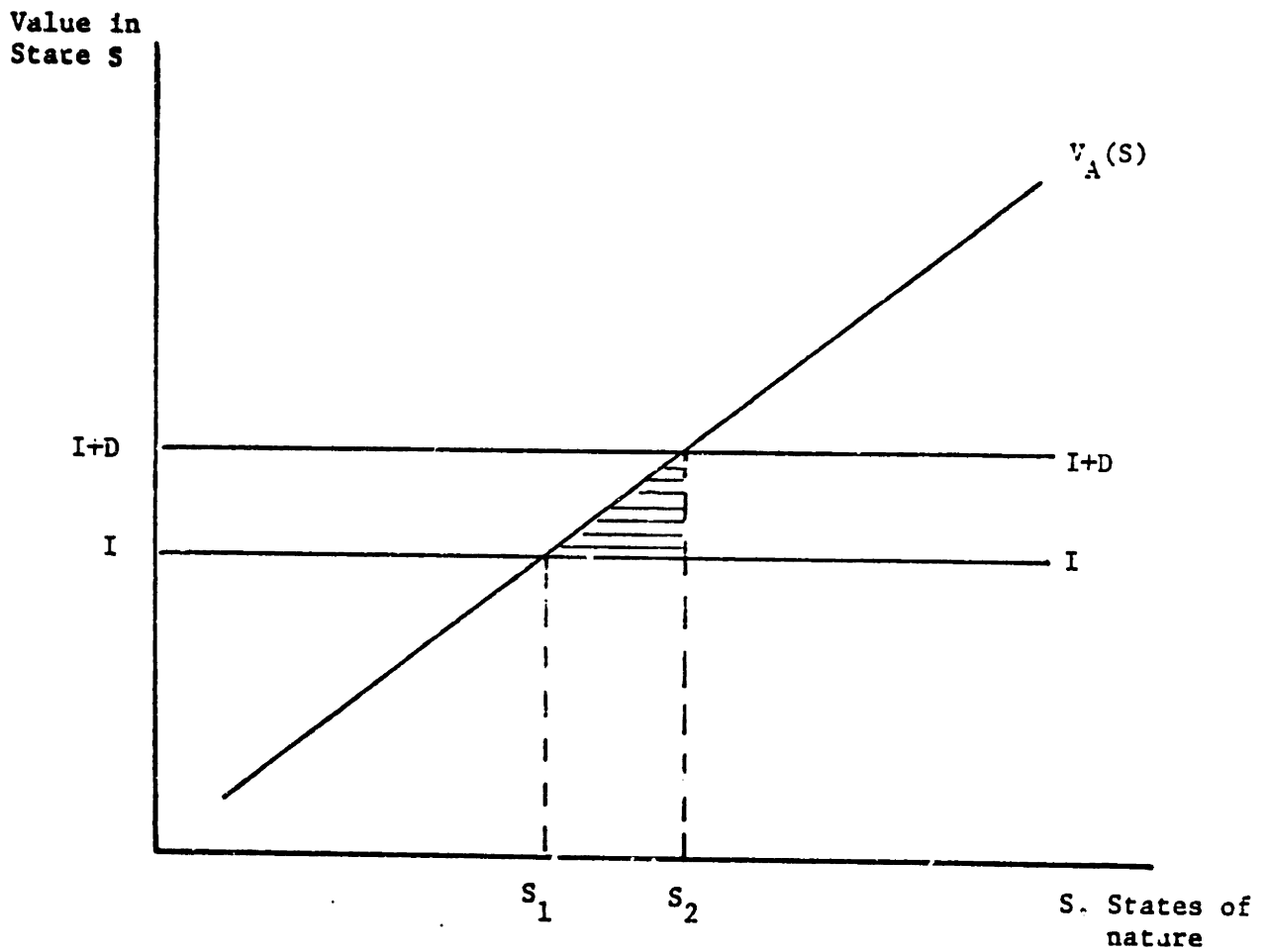


Fig. 2

Note: Country's investment decision in period 2, with existing debt,  $D$ .  $S_1$  and  $S_2$  are possible outcomes of the state of nature, where  $S_2$  potentially provides greater asset value than  $S_1$ .

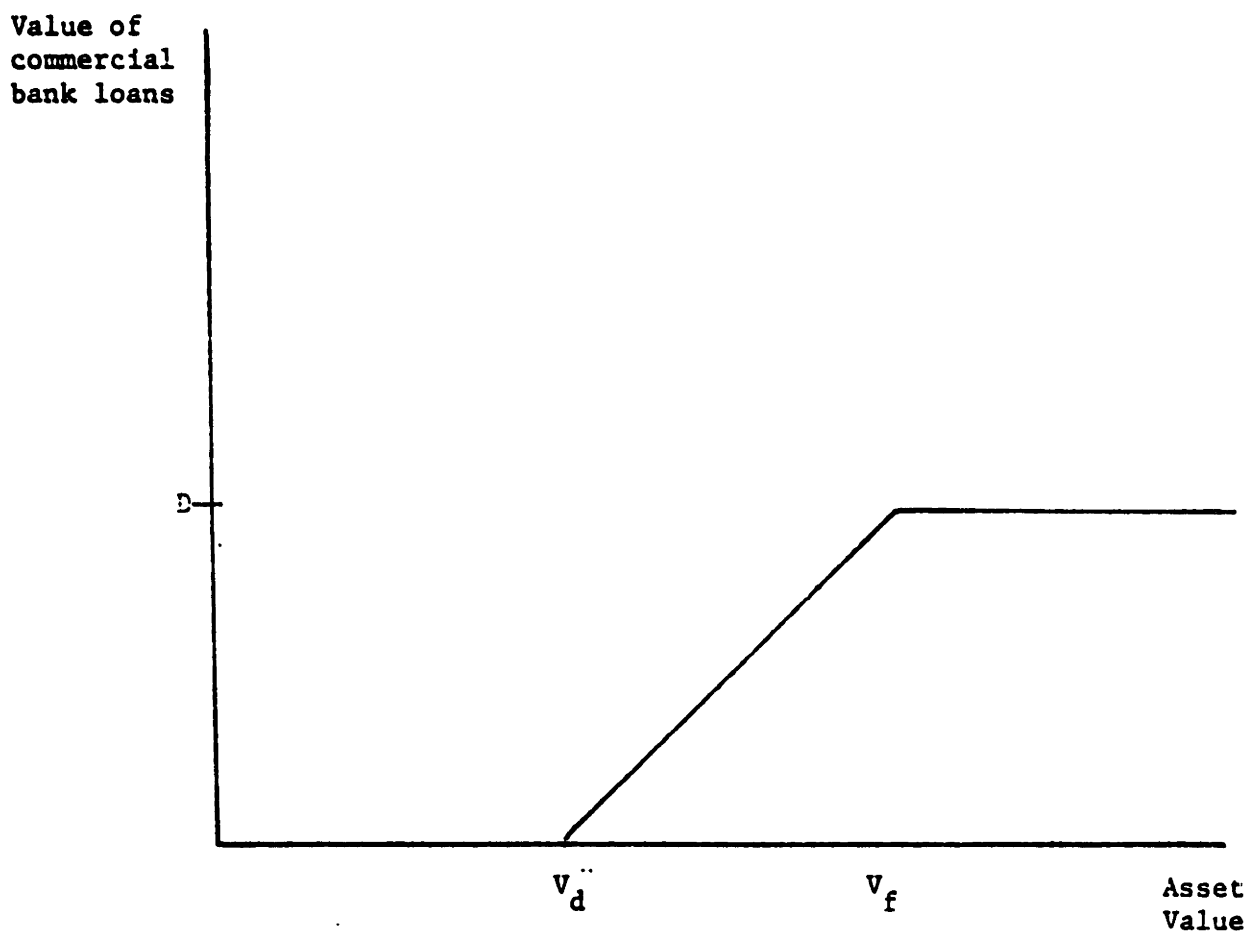


Fig. 3

Note: The sloping line is at  $45^\circ$ . Also, the payoffs (vertical axis) as represented here occur at maturity of the debt.



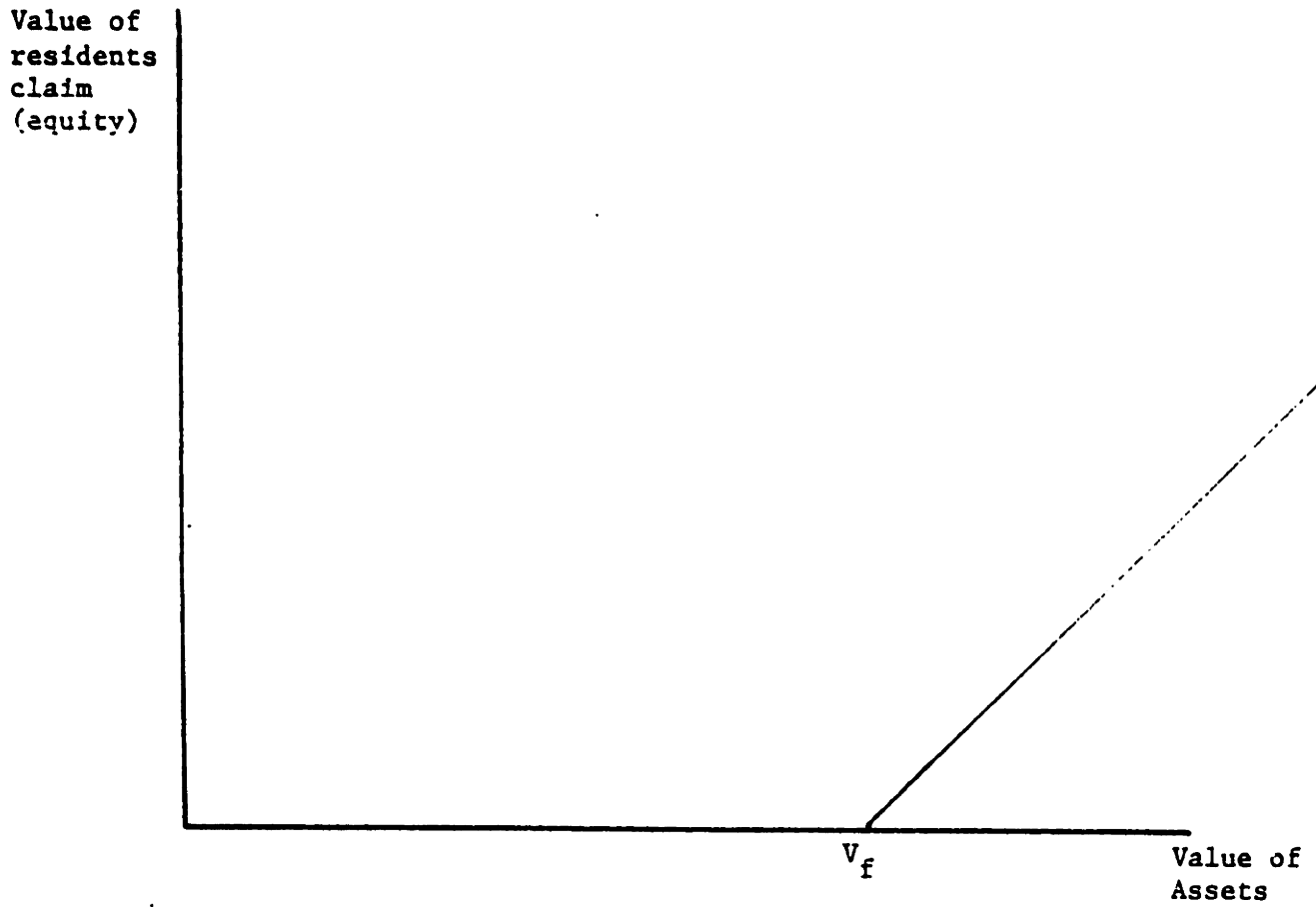


Fig. 4

Note: This diagram represents payoffs at maturity of debt.

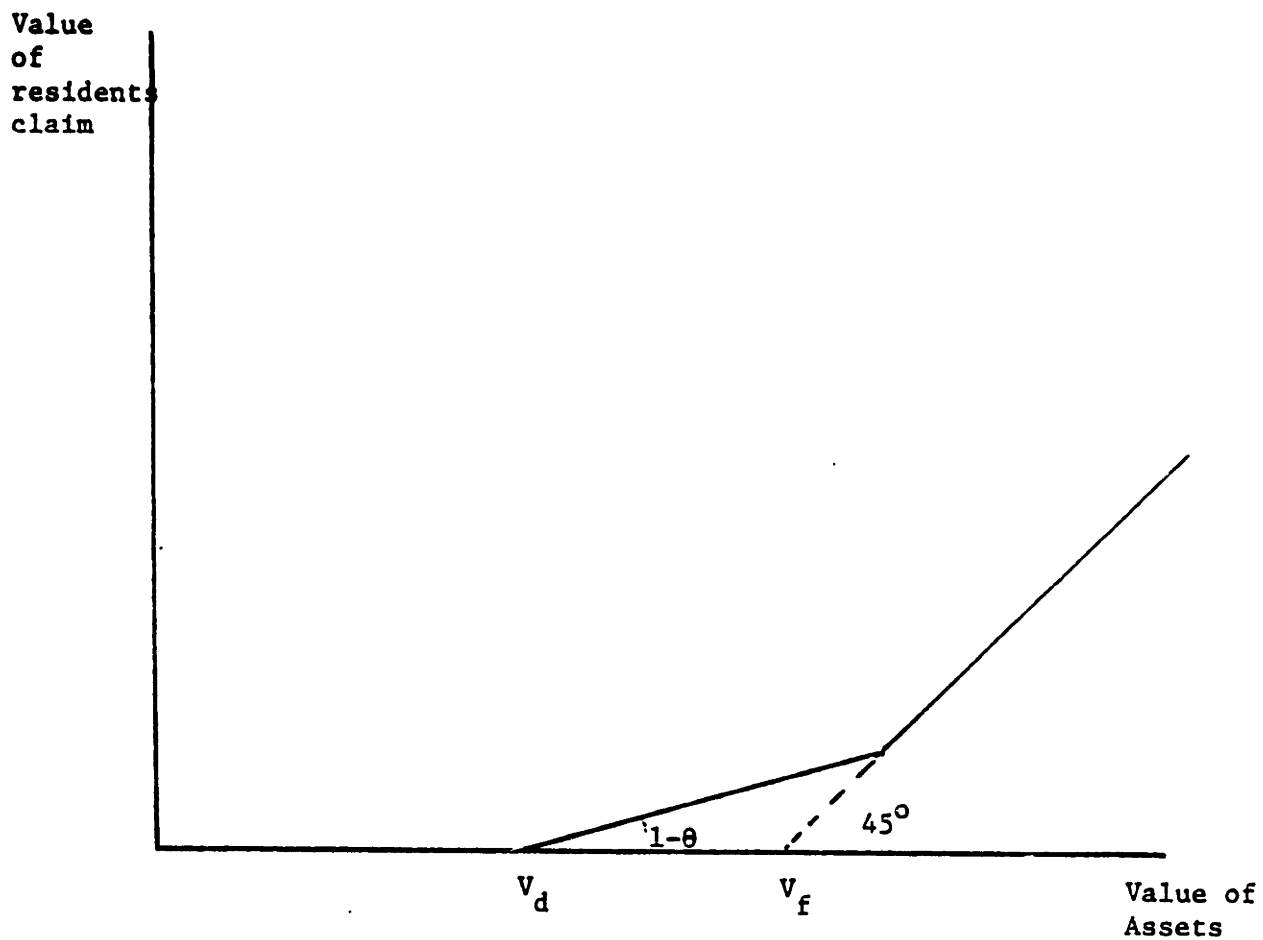


Fig. 5

Note: Residual value accruing to country, at maturity of debt, under potential repudiation.

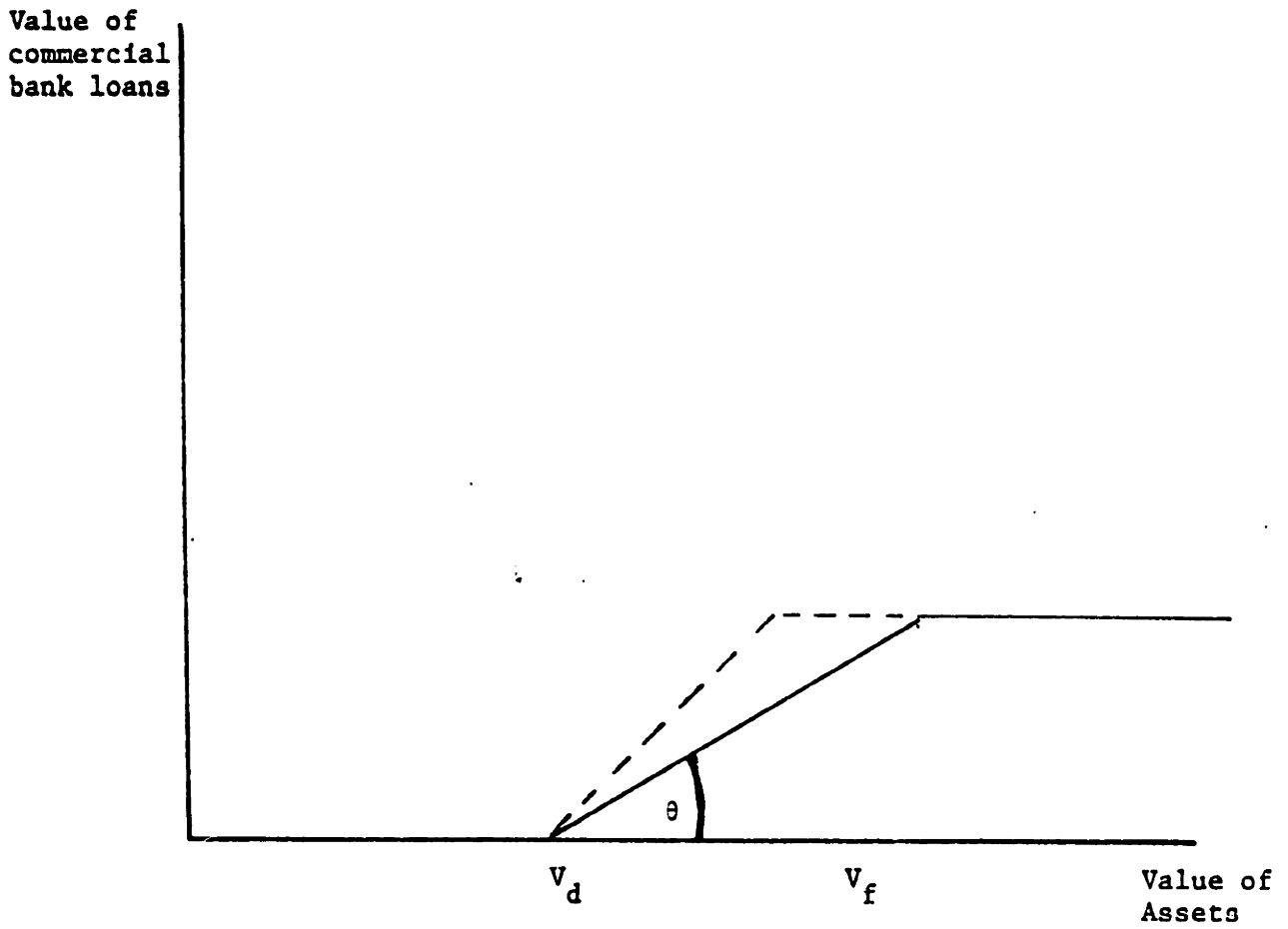


Fig. 6

Note: Value of commercial bank debt at maturity, under potential repudiation.

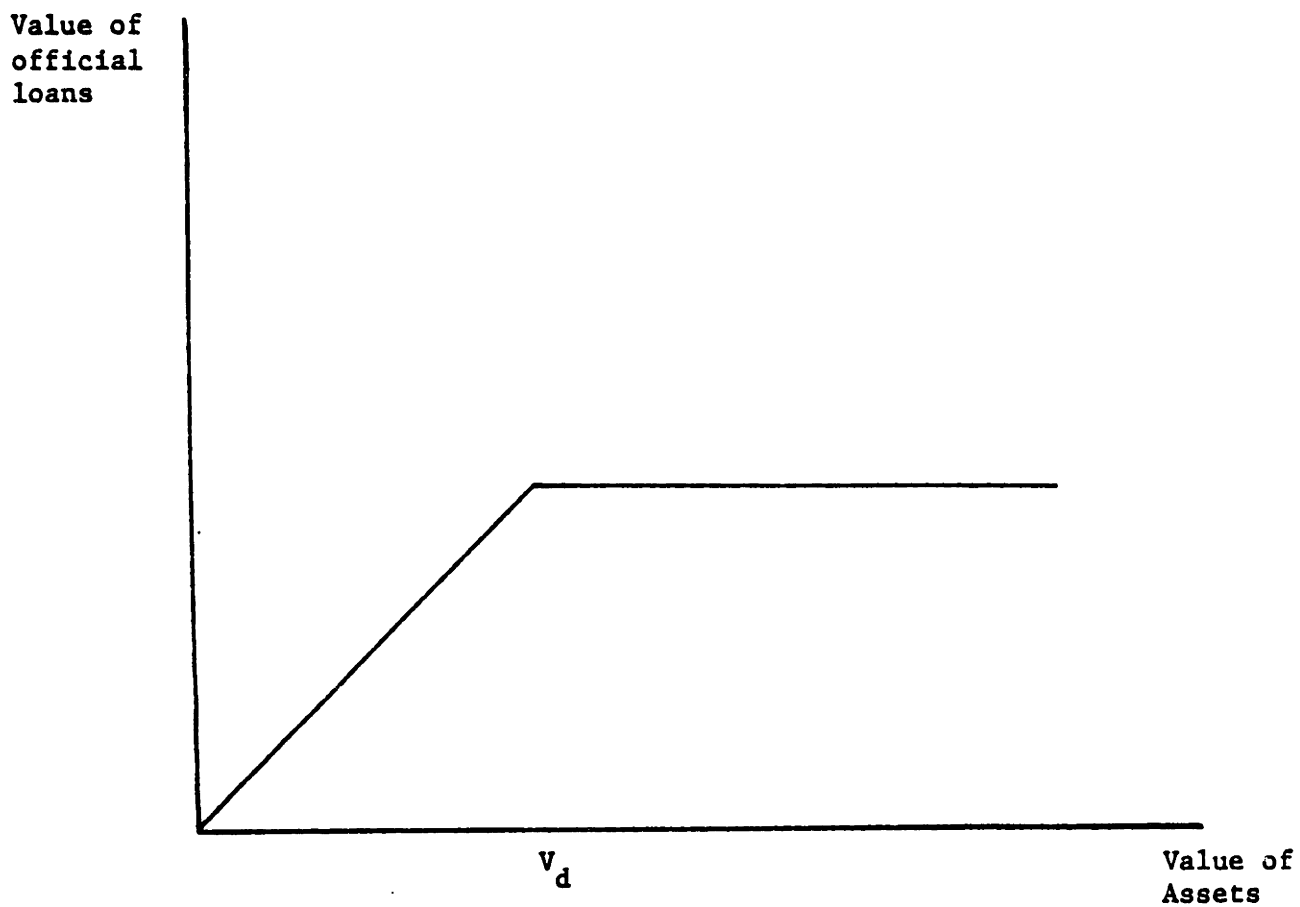


Fig. 7

Note: Again, these are terminal payoffs.

## References

1. Akerlof, George, 1970, The Market for "Lemons": Quality Uncertainty and the Market Mechanism, *Quarterly Journal of Economics* 84, 488-500.
2. Aivazian, Varouj, A. and Jeffrey L. Callen, 1980, Corporate Leverage and Growth: The Game-Theoretic Issues, *Journal of Financial Economics* 8, 379-399.
3. Baldwin, Carliss, Y. and Scott P. Mason, 1983, The Resolution of Claims in Financial Distress: The Case of Massey Ferguson, *Journal of Finance* 38, 505-516.
4. Black, Fischer and John C. Cox, 1976, Valuing Corporate Securities: Some Effects of Bond Indenture Provisions, *Journal of Finance*, 21, 351-367.
5. Black, Fischer and Myron Scholes, 1973, The Pricing of Options and Corporate Liabilities, *Journal of Political Economy* 81, 637-654.
6. Bollier, Thierry, 1985, Ongoing Ph.D Dissertation, Sloan School of Management, M.I.T.
7. Cooper, Richard N. and Jeffrey D. Sachs, 1984, Borrowing Abroad: The Debtors Perspective, Draft, Harvard University.
8. Cox, J., S. Ross and M. Rubinstein, 1979, Option Pricing: A Simplified Approach, *Journal of Financial Economics*, 7, 229-263.
9. Crawford, Vincent P., 1984, International Lending, Long-Term Credit Relationships and Dynamic Contract Theory, CPD Discussion Paper 1984-23, The World Bank.

10. Dornbusch, R., 1983, Real Interest Rates, Home Goods and Optimal External Borrowings, *Journal of Political Economy*, 141-153.
11. Eaton, J. and M. Gersovitz, 1981, Debt with Potential Repudiation, *Review of Economic Studies*, 289-309.
12. Fischer, Stanley, 1978, Call Option Pricing when the Exercise Price is Uncertain, and the Valuation of Index Bonds, *Journal of Financial Economics* 3, 145-166.
13. Gavish, B. and Avner Kalay, 1983, On the Asset Substitution Problem, *Journal of Financial and Quantitative Analysis* 18, 21-30.
14. Genotte, Gerard and Sayeed Sadeq, 1983, A Valuation Model for International Debt with Endogenous Rescheduling, Sloan School of Management, M.I.T.
15. Geske, R., 1979, The Valuation of Compound Options, *Journal of Financial Economics* 7, 63-81.
16. Green, Richard C., 1984, Investment Incentives, Debt, and Warrants, *Journal of Financial Economics* 13, 115-136.
17. Ho, Thomas S. Y. and Ronald F. Singer, 1982, Bond Indenture Provisions and the Risk of Corporate Debt, *Journal of Financial Economics* 10, 375-406.
18. Jones, E. Phillip and Scott P. Mason, 1980, Valuation of Loan Guarantees, *Journal of Banking and Finance* 4, 89-107.
19. Kharas, Homi J., 1984, The Analysis of Long-Run Creditworthiness: Theory and

Practice, *Quarterly Journal of Economics*.

20. Kharas, Homi J. and Reuven Glick, 1984, The Costs and Benefits of Foreign Borrowing: A Survey of Multi- Period Models, CPD Discussion Paper 1984-5, The World Bank.
21. Kharas, Homi J. and Reuven Glick, 1984, Optimal Foreign Borrowing and Investment with an Endogenous Lending Constraint, CPD Discussion Paper 1984-3, The World Bank.
22. Kharas, Homi J. and H. Shishido, 1984, Credit Rationing in International Capital Markets: An Empirical Analysis, CPD Draft, The World Bank.
23. Kydland, Finn E. and Edward C. Prescott, 1977, Rules rather than Discretion: The Inconsistency of Optimal Plans, *Journal of Political Economy* 85, 473-491.
24. Lessard, Donald R., 1982, Appropriate Non-Concessional Industrial Financing for Developing Countries, Sloan School of Management, M.I.T.
25. Lessard, Donald R., 1982, Commodity-Linked Bonds for LDCs: An Investment Opportunity, Sloan School of Management, M.I.T.
26. Lessard, Donald R., 1984, International Finance for LDCs: The Unfulfilled Promise, Sloan School of Management, M.I.T.
27. Margrabe, William, 1978, The Value of an Option to Exchange One Asset for Another, *Journal of Finance* 33, 177-186.

28. Mason, Scott P. and Sudipto Bhattacharya, 1981, Risk Debt, Jump Processes and Safety Covenants, *Journal of Financial Economics* 9, 281-307.
29. McDonald D., 1982, Debt Capacity and Developing Country Borrowing: A Survey of the Literature, *IMF Staff Papers*.
30. Merton, Robert C., 1973, Theory of Rational Option Pricing, *Bell Journal of Economics* 4, 141-183.
31. Merton, Robert C., 1974, On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, *Journal of Finance* 29, 449-470.
32. Modigliani, Franco and Merton Miller, 1958, The Cost of Capital, Corporation Finance and the Theory of Investments, *American Economic Review* 48, 261-297.
33. Myers, Stewart C., 1977, Determinants of Corporate Borrowing, *Journal of Financial Economics* 5, 147-175.
34. Ramakrishnan, Ram T.S. and Anjan V. Thakor, 1984, The Valuation of Assets Under Moral Hazard, *Journal of Financial Economics* 39, 229-239.
35. Rubinstein, Mark., 1976, The Valuation of Uncertain Income Streams and the Pricing of Options, *Bell Journal of Economics*, Autumn, 407-425.
36. Sachs, Jeffrey D. and Daniel Cohen, 1982, LDC Borrowing with Default Risk, National Bureau of Economic Research, Working Paper No. 925.
37. Smith, C. and J. Warner, 1979, On Financial Contracting: An Analysis of Bond



Covenants, *Journal of Financial Economics* 7, 117-161.

38. Stapleton, Richard C. and Marti G. Subrahmanyam, 1980, Default Risk, Debt Capacity, and the Valuation of Corporate Loans, New York University Working Paper No. 215.
39. Stapleton, Richard C. and Marti G. Subrahmanyam, 1984, The Valuation of Multivariate Contingent Claims in Discrete Time Models, *Journal of Finance* 39, 207-228.
40. Warner, Jerold B., 1977, Bankruptcy, Absolute Priority, and the Pricing of Risky Debt Claims, *Journal of Financial Economics* 4, 239-276.
41. Williamson, John, 1982, The Why and How of Funding LDC Debt, S. Al-Shaikhy (Ed.), *Development Financing*, Westview Press, 1982.
42. *Default and Resheduling*, Euromoney Publications, 1983.

<sup>1</sup>See the list of references at the end of this paper

<sup>2</sup>When the asset on which the option is written is priced in efficient capital markets, arbitrage arguments put forth by Black and Scholes [5], Merton [30] and Cox, Ross, and Rubinstein [8] can be used to construct a risk-free portfolio of bonds, the asset and the option. This allows the price of the option to be determined by the solution to a stochastic partial differential equation where the only state variable is the price of the underlying asset. The fundamental determining variables there are the volatility of the option, its exercise price and the current price of the asset itself. Pricing real options of course is a considerably more formidable task, especially under conditions where the real asset's price is not determined in an efficient capital market. The *risk neutral valuation relationship* derived for stock options need not now be valid, although such a relationship can still be derived if some knowledge of the shadow price of the asset were available. Nevertheless, the behavioral implications of viewing this claim as an option all go through and the argument remains valid. For an actual valuation process for options on assets traded in incomplete or inefficient markets see Stapleton and Subramanyam [39] and Gennotte and Sadeq [14].

<sup>3</sup>See footnote 2. Especially when the debt is paid off as a mortgage, i.e. with interest and principal payments made periodically, the value of the debt must be computed as a series of options on options. Each payment allows the debtor to gain the option of making the next payment etc. See Geske [15] for further elaboration on this point

<sup>4</sup>These correlations and risk aversion turn out to be important when an actual evaluation of the options to repudiate and to reschedule are analyzed. See Gennotte and Sadeq [14] where an actual valuation methodology is developed for the pricing of LDC debt

with potential repudiation and endogenous rescheduling.

<sup>5</sup>Although it is best to think of claims on the cash-flows of a country rather than on its assets, here, think of the assets as being largely appropriable. This is of course a simplification, but it brings out all the important issues clearly. In a later paper, the analysis is explicitly formulated in cash flow terms. This will allow a more realistic way of thinking about what factors determine the riskiness of debt, but it brings with it a fair amount of complication which arises from defining how these cash flows are correlated over time.

<sup>6</sup>Provisions in corporate law relating to conditions under which Chapter 11 and Chapter 10 bankruptcy can be filed enforce adherence to these values. In fact, sanctity of contract law allows the characterization of limited liability as imposing a discontinuous payoff structure akin to that of the terminal payoffs of options. International law relating to sovereign contracts is far less enforceable. Nevertheless, it is suggested in *Default and Reschedulings* [42], that the claim structure proposed here is in fact tenable. Furthermore, the analysis presented here derives this claim structure by relying on maximizing behavior by the country itself; incentives to optimize its intertemporal investment and consumption paths will impose precisely this claim structure on a country's assets.

<sup>7</sup>Appropriable assets are defined as those which have returns dominated largely in international currencies. Clear examples are traded goods and mobile, currency convertible assets.

<sup>8</sup>In the case of country borrowing, dividend payouts (over and above those stipulated in debt contracts) can be thought of as excess consumption. Resources devoted to

increasing current consumption are just like a cash dividend paid out to stockholders by either selling off assets, or by using the proceeds of a new debt issue for an increase in dividends.

<sup>9</sup>This clearly implies that all external debt contracts with countries must be self-enforcing and time-consistent. In later sections, it is shown that the rescheduling of debt is essentially a flexibility necessary to increasing the probability that the loan contract is time-consistent. For a definition of time-consistent contracts, see Kydland and Prescott [23].

<sup>10</sup>Credibility is increased, for example, when the country invests in appropriable assets or in assets which have high foreign earnings components in their return stream. The country then reduces the probability that it will repudiate both by increasing the cost of repudiation (its exercise price) and by giving up options to invest in other non-appropriable, risk-increasing assets.

<sup>11</sup>Unfortunately, things are really not so simple. If the country's return stream could be traded on efficient capital markets, this indeed would be true. But LDCs do not enjoy this benefit and so must behave in a perhaps excessively risk averse manner. The value they place on their asset returns would then depend heavily on their parameter of risk aversion. However, if the asset values can be determined by using a derived parameter of risk aversion and the country can be assumed to exhibit constant relative risk aversion, the options can again be priced using risk-neutral valuation relationships. See Rubinstein [35] and Stapelton and Subramanyam [39].

<sup>12</sup>A better formulation of the problem is to recognize that the cost of repudiation (i.e.

the exercise price of the option) falls as the amount of debt repudiation falls. This is a complicated formulation and cannot conveniently be described as a continuous function of the total principal amount of debt repudiated. It is most likely to be a step function.

<sup>13</sup>The new debt must be thought of as a zero NPV project, at the very least. No new lending would be forthcoming, in fact, unless the marginal value of each extra new dollar is greater than one. That is, new lending with new covenants would occur only to the extent that it increases the safety of the entire subordinated debt issue.