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CENTER DISCUSSION PAPER NO. 523

EXTERNAL BORROWING BY LDC'S: A SURVEY OF THEORETICAL ISSUES

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Abstract

External Borrowing by LDCs: A Survey of Theoretical Issues

This paper surveys a broad range of theoretical issues of international borrowing and lending with a focus on the effects of sovereign immunity. The literature in credit market imperfections and existing theoretical models of sovereign borrowing provide a basis for much of the survey. Several institutional features of LDC borrowing are discussed heuristically which have not been formally modelled in the literature. These parts of the survey are intended as an agenda for further work. A brief critical review of the econometric implementation of the theoretical models of sovereign lending is included.

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External Borrowing by LDCs: A Survey of Theoretical Issues

1. Introduction

Inflows of foreign capital have played a role in the growth of developing regions for several centuries. Portfolio lending to developing countries experienced an extended period of expansion during the late nineteenth and early twentieth centuries. Although lending by the OECD countries to the LDCs grew steadily during the 1960's, the rapid growth of syndicated bank loans after 1973 and reschedulings of the 1980's have recently brought widespread attention to the role of risk in international lending.

International credit transactions are subject to the risks created by the sovereign immunity of debtors. In any setting, lenders encounter problems of the enforceability of contracts and of imperfect information about the characteristics and behavior of borrowers. One of the parties to a contract may later find reneging on some of their obligations in their best interests. Parties subject to the same legal jurisdictions can rely upon the authority of the state for a degree of enforcement of contracts. Loan contracts can incorporate performance requirements for debtors which rely on the legal institutions of the country for fulfillment in some contingencies. However, loans between governments or the nationals of different countries cannot rely on third party enforcement. Relationships between borrowers and lenders must be self-enforcing. Contractual terms are viable for which fulfillment is in the

enlightened self-interest of the debtor. With the absence of an external authority to enforce directly contractual obligations and the protection of debtor assets afforded by sovereignty, the enforcement of contracts necessarily occurs through the credibility of indirect sanctions for default. The interruption of other transactions, such as, future credit flows and trade agreements, between creditors and recalcitrant debtors provide the primary means of enforcement.

Many writers on LDC debt have concentrated on the question of whether repayment difficulties are the result of a lack of debtor solvency or liquidity. In only a few instances, can an argument even be made that a country's net worth is negative; even if the output counted includes only that readily transferable to foreigners, the present value of the stream of resources available for repayment exceeds the debt of almost all borrowers. If the current problems are ones of liquidity, then an explanation is needed of why lenders fail to provide additional loans to ultimately solvent debtors. The theoretical literature on lending with potential repudiation provides a starting point for modelling this issue. The ability of debtors to default on their external obligations implies that credit transactions are constrained by the proclivity of borrowers to repay, rather than by their ability. The amount of debt that is likely to be voluntarily repaid, under the threat of sanctions, is less than that which could eventually be serviced.

Lender's imperfect information about the actions and

characteristics of borrowers can lead to major imperfections in the international credit market. Asymmetries of information lead to a variety of moral hazard and adverse selection issues in all credit transactions (see Stiglitz and Weiss (1981 and 1983), for example). In domestic markets, covenants to loan contracts specifying borrower and lender behavior in various contingencies and legal institutions establishing bankruptcy procedures reduce many of these problems to a degree. In international lending, most loan covenants, for example, those establishing debt priorities, are not enforceable against a debtor. Because the penalties for default are indirect, moral hazard issues can arise through the ability of borrowers to take actions which reduce the costs of sanctions or the probability of penalization.

Short-term contracts may govern long-term debtor-creditor relationships because they allow frequent renegotiation of the terms of the relationship. When creditors have a limited ability to observe and restrain debtors' actions, many possible covenants to loan contracts specifying debtor behavior in various contingencies are unenforceable. The restricted ability of lenders to observe realizations of debtor income can lead to rescheduling of outstanding short-term debt. In one interpretation, rescheduling can be viewed as an outcome in some contingencies which is anticipated by both sides of the market; loan terms are rationally expected to be state-contingent. Another aspect of rescheduling is the strategic behavior of debtors and creditors, even when initial loans are made

under competitive conditions. The success of lenders to incorporate private sector loans extended without government guarantees into rescheduled public debt is evidence of their market power.

This paper is intended to survey those insights that can be obtained from the theoretical literature on credit market imperfections, in general, and on lending with sovereign risk, in particular, for understanding the determinants of portfolio capital flows to the LDCs. Several implications of these basic models and of results from the theory of games for the institutions observed in LDC borrowing are suggested which have not yet been formally modelled.

Four motives for external borrowing can be distinguished. If the value of output is subject to fluctuations, then borrowing to smooth consumption over time is advantageous when consumers are risk averse. Borrowing to finance capital accumulation can allow investment at a higher rate than otherwise optimal in a country with marginal productivity of capital exceeding the foreign rate of interest. The adjustment of consumption and investment following exogenous events, such as, terms of trade shifts, can be eased through foreign borrowing. Debt can also provide a media of exchange for international transactions, for example, the use of suppliers' credits for commodity trade.

The next section discusses optimizing models of the pattern of borrowing for the first two motives which exclude the possibility of repudiation. The implications of imposing a solvency-type budget constraint are presented. Problems encountered by studying

non-optimizing models are also discussed. The simple motives of lenders to extend credit beyond that which can be repaid in full with certainty are discussed.

The third section discusses the enforcement problem in international credit transactions and the possible sanctions for default. The credibility of threatened penalties is also examined. The points emphasized in this section are made in a variety of other sources; this exposition is quite similar to that given by Eaton, Gersovitz and Stiglitz (1986), where the reader will find elaboration of many of the issues raised.

The role of informational asymmetries for international credit transactions is surveyed in the subsequent section. A simple stochastic model of borrowing with potential default is presented to aid the exposition. The inability of creditors to monitor many of the actions of debtors and observe realizations of debtor-specific exogenous events can be related to a number of important market outcomes. The dominance of syndicated bank loans over bond debt, short original maturities of loans, debt-rescheduling, and reserve-holding behavior of debtors are discussed separately, although they are interrelated phenomena. One consequence of short-maturity structure, credit-rationing, and renegotiation is the possible procyclical pattern of lending in a consumption-smoothing framework. The role of borrowers' reputations in repeated lending games of incomplete information is also discussed; the co-existence of bond debt with syndicated bank loans and its apparent informal

priority is given as an example of the potential insights game theory may provide.

The sixth section discusses the flight of private capital from debtor nations. Capital flight can result from public guarantees of private sector foreign debt, because foreign asset income usually escapes the increased taxation of domestic capital earnings implied by bankruptcies. The next two sections briefly discuss the effects of select debtor country policies on indebtedness and the possible implications of deposit insurance and inadequate regulation of intermediaries in creditor countries, respectively. The last section contains a brief review of econometric studies of the determinants of external credit flows and repayment crises.

2. Solvency and International Lending

A natural starting point for a description of equilibrium lending to LDCs are models of external borrowing in the absence of potential default. Such models provide insights into the pattern of borrowing under alternative motives and serve as benchmark case for the analysis of the effects of external disturbances and domestic policy choices on the borrowing behavior of households and firms. A number of papers on foreign borrowing use two-period models¹. In these models, both the principal and interest on debts incurred in the first period must be repaid by the end of the second period; therefore, solvency requires that second period income equal or exceed indebtedness and the debt-service obligation. In any finite horizon model, the dynamics of borrowing are determined by the

exogenously set terminal level of debt. In an infinite horizon framework, debt principals need never be repaid; rather, the present value of debt-service payments must exceed the value of the principal. The steady-state net external asset position of the country is endogenously determined by optimization of some objective function. The solvency budget constraint requires that the present value of the stream of future income is not less than the current indebtedness.

The pattern of borrowing and lending under the consumption smoothing motive can be examined in the absence of default risk in either finite or infinite horizon models. Clarida (1986) studies optimal borrowing in an infinite horizon general equilibrium model with stochastic income under the imposition of the constraint that a debtor is solvent with unit probability. Borrowing is countercyclical, and any level of debt which can be serviced given the equilibrium interest rate is reached with positive probability.

Optimal borrowing by an initially capital-poor country for the purpose of accumulation has been modelled for one-sector economies by Bardhan (1967), for the small-country case, and Hamada (1966), in a two-country model. Since the domestic marginal productivity of capital initially exceeds that abroad, an exchange of bonds for capital leads to an increase in wealth and consumption. Current account deficits occur as the capital stock and consumption increase. In the steady state, the current account is balanced and trade surpluses cover interest payments on a permanent level of debt. In

two-sector economy models, early period current account deficits can be followed by surpluses for an initially capital-poor country. Engel and Kletzer (1985a) display such stages in the balance of payments in an optimal savings model with a tradeable investment good and a non-tradeable consumable under the usual Heckscher-Ohlin assumptions. Initially, bonds are traded for capital as resources move to the traded-goods producing sector. Thereafter, current account surpluses occur as resources shift toward the consumption goods producing industry; the capital stock rises or falls as wealth increases, depending upon the relative capital-intensity of the sectors. In the steady-state, the country can be either a net debtor or creditor².

Another literature which emphasizes the ability of debtors to repay exists. Domar (1950) presents a simple way in which debt and debt-service can permanently grow: the growth rate of new lending must exceed the interest rate (Avramovic (1964) presents a similar analysis). Under this scheme, the initial principal is provided in exchange for nothing. This line of modelling is adopted by Kharas (1984) and Sachs (1984) in the context of borrowing in the presence of constraints on government revenue. When governments incur external debts, repayment is constrained by the ability of the government to raise revenue and transfer it abroad. In the absence of lump-sum taxation, deadweight losses and national income are endogenous to the level of revenue-raising attempted. In the Kharas paper, the debtor's growth rate is exogenous and exceeds the interest rate, so that an equilibrium in international asset markets will fail

to exist. The growth rate should be treated as an endogenous variable. Sachs (1984) uses a two-period optimizing model with an exogenously imposed constraint on government revenue in the second period. This leads to a higher marginal cost of revenue in that period and to optimal borrowing up to a point below that which equates the domestic marginal productivity of capital to the interest rate. As Eaton, Gersovitz and Stiglitz (1986) emphasize, switching the period in which the constraint is binding reverses the result. While equilibrium intertemporal optimizing models only serve as a benchmark case, models which adopt arbitrary assumptions can lead to special or untenable conclusions.

Solvency models exogenously impose a constraint on borrowing, rather than deriving such constraints on the supply of loans from creditors' optimizing behavior. In a stochastic income framework, loans can serve risk-sharing purposes, in addition to providing intertemporal trades. If repayment capacity is uncertain, then a lender generally will lend more than can be repaid in all contingencies on schedule. A risk-neutral creditor seeking to maximize expected profit will extend credit beyond that amount which can be serviced with certainty. Jaffee and Modigliani (1969) demonstrate that such a lender would place an upper bound on the amount lent and incur a possibility of ex post losses.

The maximum debt for which a borrower remains solvent may itself be endogenous because the resources available for repayment can depend upon repayment obligations. Stiglitz and Weiss (1981) show

that the choice of investment can vary with the loan contract taken. If lenders cannot observe directly the project selection of a borrower, then adverse selection results in their model. Increasing the interest rate increases the riskiness of loans and can lead to a decrease in expected profits; therefore, credit rationing can result. An important implication is that solvency cannot be defined independently of the actions of agents on both sides of the market.

A surprisingly large percentage of the discussion about the indebtedness of the LDCs has focussed on the solvency or liquidity of debtor governments. The debts of countries are clearly less than the value of assets owned by governments and nationals in almost all cases. While the government may face limits in its ability to appropriate these assets, this action involves a set of trade-offs and is a choice taken by the government. As Gersovitz (1985) points out, Mexican oil reserves alone (the property of a parastatal) probably are adequate to cover Mexico's external debt. The other popular view is that borrowers have positive net worth but are illiquid. Clearly, the question of why are lenders unwilling to supply new credit arises.

Instead, sovereign governments can elect to default on terms of a contract or repudiate outright external obligations. This ability impedes the international movement of capital. The subsequent sections discuss the implications of sovereign risk for modelling external borrowing by the LDCs.

3. Sovereign Immunity and the Voluntariness of Repayment

Any credit transaction is subject to a potential problem of enforcement of the terms of the exchange. Nationals of the same country who enter into a contract can appeal to the external authority of the state in the event of one party's reneging upon an obligation. To varying degrees, the legal frameworks of nations provide protection for parties to a contract in the event of the inability or unwillingness of one of them to abide by the terms of the contract. Contracts written between nationals of one country and nationals or the government of another, however, are subject to a potential problem of sovereign immunity. Generally, creditors have little or no hope of obtaining compensation for nonperformance in the debtor's own political and legal jurisdiction. The sovereignty of nations rules out the existence of a credible third party to enforce terms of contracts involving governments. Therefore, many international credit transactions can involve only contract terms which would be in the best interests ex post of the borrower to honor. Many of the institutions surrounding international lending can be understood best in terms of this need for contracts to be self-enforcing. The primary impediment to international capital flows to the LDCs is not seen in the ability of countries to repay, but instead in the voluntariness of fulfilling contract obligations.

The major difference between international and domestic credit contracts is that the latter are legal obligations which are subject to enforcement under the power of the state. Debtors who are unable

to repay may file for bankruptcy, obtain protection from creditors and discharge of their obligations. Because repayment of external debt is largely voluntary, so that the penalties which can be imposed on a recalcitrant debtor country necessarily are indirect. A nation may suffer the consequences of incurring debt-service obligations it cannot service for an arbitrary period of time. Furthermore, while collateral plays a significant role in domestic lending, it plays virtually no role in international credit markets. Collateral remaining in the debtor country cannot be seized, and physical assets outside the country are often of little productive value (the exceptions tend to comprise value far less than outstanding debts of the LDCs).

In any context, a loan is a particular form of contract between parties governing an intertemporal exchange. The contract specifies repayment terms and actions which may be taken by debtors and creditors in a variety of contingencies. The possibility that repayment obligations may not be met as contracted is reflected in the covenants of the loan contract. These covenants are intended to ensure that the borrower engage in certain activities and not engage in others which affect the likelihood of full repayment. Contracts also specify conditions under which the lender can suspend terms of the contract prior to its expiration (in LDC lending, cross-default clauses serve this purpose).

Loan covenants are useful only if the contingencies to which they apply and debtor's actions they stipulate are observable by the

lenders. A crucial determinant of the nature of the relationship between lender and borrower is the set of actions and outcomes that are observable by both and upon which covenants can be written. Debt contracts specify an amount to be lent and a schedule of repayments of interest and principal to be made, but these are, to varying degrees, state-contingent terms. The degree to which observability is incomplete affects the extent that debtor-creditor relationships are governed by explicit and by implicit contracts. The lesser is the ability of creditors to restrain the actions of debtors during a contract's term, the greater is the incentive to offer short-term agreements in long-term credit relationships. Short-term loans allow for frequent recontracting of the terms of the agreements, therefore, a finer degree of conditioning on borrowers' actions.

The role of repetition of the relationship between borrower and lender should not be ignored. In a two-period framework, a borrower can either provide full repayment of a loan at the second date or default. A default is merely a payment of anything less than the principal plus agreed upon interest. In a multi-period setting, deviations from a repayment schedule do not necessarily imply that future payments will not maintain the present value of the loan. When credit relationships potentially last a number of periods, contracts may be renegotiated and entered into under full recognition of this possibility. A variety of responses by creditors to violations of the terms of the agreement are possible. As Eaton, Gersovitz and Stiglitz (1986) point out, declaration of a default is

only one of these. They define a default as occurring whenever a creditor formally declares that there has been a violation of a condition of the loan. The contract conveys upon the lender the right to declare a borrower in default; creditors may or may not choose to exercise this right. Therefore, default is the result of a sequence of decisions, not an automatic outcome. Insolvency of a debtor is not an adequate condition for the declaration of a default; the lender may lose the ability to obtain partial repayment by doing so. On the other hand, a default may be declared when a borrower has positive net worth. For example, declaration can follow the unwillingness of the debtor to repay other loans or the inability of the creditor to restrict actions of the borrower which increase the riskiness of outstanding debt. Formal declaration of a default in international lending can result in costly actions by regulators for both lenders and borrowers. The imposition of penalties by other governments on countries in default will tend to lower the expected flow of payments to existing creditors, even if anticipated payments fall below the amount lent in present value.

Penalization of Default

The willingness of sovereign debtors to abide by the terms of loan contracts depends upon the degree to which default can be penalized and the resolve of lenders to impose penalties. The penalties available to creditors include exclusion from future access to credit, interference with commodity trade, and disruption of access to trade finance. In the nineteenth century, military threats

against debtor nations and even the loss of sovereignty (Egypt) appear to have been credible threats. The suspension of favorable trade agreements, for example, revoking and granting to alternate suppliers voluntary quota arrangements, are probably credible contemporary threats along with embargoes on future lending. The nature of penalties is crucial to informative modelling of the international credit market, since the extent of capital flows to the LDCs depends upon the credibility of borrowers' willingness to repay. Kaletsky (1985) provides a comprehensive overview of the legal, political, and institutional issues involved in penalization of default. Eaton and Gersovitz (1981b) review U.S. legislation which provides for potential penalties to be imposed in the event of default on foreign obligations to the U.S. government or intermediaries.

Exclusion from future credit access is an often cited potential penalty (the Eaton and Gersovitz (1981a) and Kletzer (1984) models adopt this penalty structure). A denial of future credit access only makes sense in an infinite (or equivalently, uncertain) horizon model, since in a finite horizon setting, the penalty has no force in the last period. Therefore, no loans are made in the next to last, and the penalty has no force in that period as well. A loan market is unsustainable. Similarly, moratoria on future lending are inadequate penalties to maintain loan transactions if a date will be reached after which the debtor only makes positive net payments. In the standard infinite horizon optimal capital accumulation models,

such a point is attained when the marginal productivity of capital is drawn into equality with the interest rate. As the capital stock grows, the potential cost of the penalty declines toward zero. In this context, exclusion from the credit market is an insufficient penalty to support any credit transactions by backward recursion.

Furthermore, moratoria on credit access provide an adequate penalty to sustain lending only in infinite horizon models with stochastic debtor income. In this context, future flow of funds is in both directions so that the penalty can impose a cost on the debtor in any time period. If borrowers are risk averse, then the desire to borrow and the cost of moratoria derives from a motive to smooth consumption. Risk-neutrality on the part of lenders assures that some degree of lending will occur. In a capital accumulation model with stochastic output, the threatened denial of future credit can sustain lending for the purpose of investment if the borrower is risk-averse, since there is a cost to repudiation in the long run. However, the flow of capital to the country will be constrained by the extent of the penalty, so that, generally, the expected marginal productivity of capital will exceed the interest rate for extended periods.

In the Eaton and Gersovitz and Kletzer models, increases in the cost of losing access to credit shift outward the supply schedule of loans. The penalty for default is higher the lower the rate of discount, greater the borrower's degree of risk aversion, greater the variance in income, lower the interest rate, and more costly are

domestically available avenues for consumption smoothing. Increasing the penalty raises the amount lent in these models which benefits the borrower. However, since output is stochastic, risk-neutral lenders will extend credit to a point where default occurs with positive probability. In these states, debtors are worse off, and the states of default are less probable reducing the insurance benefits of potential default for the borrowers. Therefore, the expected utility of debtors can either increase or decrease.

An important role of international lending is in the financing of international trade. The cost of conducting barter trade is presumed widely to be quite high. Threatened trade embargoes or suspension of trade preferences can also provide incentives against debt repudiation.

A set of issues can arise in applying penalties if the actions of a borrower affect the burden of sanctions. Commitment to actions which lenders perceive as raising the burden will improve the supply of credit, and conversely. However, such actions must be observable by lenders and not easily reversed.

The potential disruption of trade finance can be partially offset. Debtors have an incentive to accumulate foreign reserves in anticipation of a default, instead of fully meeting their debt-service obligations. At the same time, forestalling a declaration of default by creditors allows the time required for this accumulation. Many people may see the 1986 Peruvian limitation of private market debt-service payments and maintenance of service on

official (non-IMF) credits, while foreign reserves rose, in these terms. The efficacy of the penalty may be diminished because a default declaration is not currently in the creditors' interests.

Penalization of a recalcitrant debtor through disruption of its international trade may be quite credible. If a debtor attempts to transact trade through banks on which it has defaulted, then any transactions balances can be attached to cover its debt obligations. Avoidance of the international banking system can significantly increase the cost of trading. Although punishment of a defaulter will often not increase the likelihood of ultimate repayment, a lender can credibly threaten to offset loan obligations against other balances of a non-performing borrower.

Gersovitz (1983) and Alexander (1985) study models in which the penalty for default depends positively upon the importance of trade to the debtor. A commitment to raise investment leads to an increase in the supply of credit if it increases the value of trading opportunities. If investment occurs in import-substituting industries, then it reduces the repayment incentive.

A number of papers (Sachs (1984), Cooper and Sachs (1985), and Sachs and Cohen (1985)) assume that the penalty for default is a loss of income proportional to GNP. Among the conclusions they derive is the implication that if a credit-constrained debtor can commit funds to investment, instead of to consumption, then the supply of credit will expand. As Gersovitz (1985) makes clear, this conclusion easily fails to hold in models adopting penalties of credit or trade

embargoes. Also, a reasonable argument can be given that the higher a debtor's income, the more able it will be to accomodate itself to sanctions.

The Credibility of Embargoes in Future Lending

While governments and banks may reasonably be expected to reduce a country's trading opportunities in the event of a default, threatened moratoria on future credit access may not always be credible. Current creditors or other potential lenders may find continued flows of credit to a recalcitrant borrower profitable. In particular, the full suspension of future borrowing possibilities will not increase the probability of even partial repayment of old debt.

In Eaton and Gersovitz (1981a), lenders are competitive so that any loan earns zero profit. They argue that, therefore, the costs of refraining from future lending are also zero. However, this equilibrium can be difficult to support under non-cooperative behavior amongst lenders. If all other creditors refrain from lending in the future to a defaulter, then any particular lender can provide a profitable loan. A cooperative outcome can arise in the infinite horizon case when borrowers' and lenders' identities are subject to recall by the other players in the repeated game. A player who fails to cooperate at one point (e.g. by defaulting) will face non-cooperative strategies chosen by the other players for some number of subsequent plays. The literature on repeated

non-cooperative games can be appealed to for a number of results, notably when discount rates are small, a degree of cooperation can emerge in equilibrium (see Fudenberg and Maskin (1986)).

The entry of new lenders during a moratorium on credit access enforced by old creditors can be restricted in repeated game models with imperfect information. The refusal of current creditors to lend may easily convey information to other potential creditors in this context. Also, the relatively small number of international banks may be capable of cooperating in the exclusion of defaulters. The banks themselves may be able to enforce an embargo through their other transactions with each other. The syndication of bank loans to the LDCs may be seen partly as a response to the need to credibly impose sanctions for default. Additionally, a current lender faces the possibility of recovering previous loans if it makes new loans to a debtor having repayment difficulties. Therefore, new lenders may have less to gain by negotiating loans to a problem debtor than do existing creditors.

Another possibility is that creditors can write covenants in loan contracts which pertain to other creditors' actions. These provisions, particularly seniority clauses, could be enforced in developed country courts to which both lenders are subject. Covenants of this type allow a creditor to obtain an enforceable judgment against another creditor in a common legal jurisdiction rather than attempt to enforce a contract with a sovereign borrower.³ Cross-default and seniority clauses in IMF and World Bank loan

agreements may also lend credibility to sanctions. Stiglitz and Weiss (1983) discuss the potential incentive effects of debt seniority clauses and show that a refusal of a current creditor to lend leads to refusals of new lenders as well.

Eaton (1985) emphasizes the importance of banks' reputations for punishing defaulters in maintaining the value of their equity. Owners of intermediaries are concerned with preserving their equity investments, and the failure to punish defaulting debtors causes this equity to lose its value. Eaton shows that the value of the equity must exceed the costs of penalizing borrowers. Therefore, if punishment is costly, banks' profits must be positive. This mechanism leads to a credible threat of punishment in an infinitely repeated game and to a lending rate of interest exceeding the deposit rate even if defaults never occur (e.g. in a non-stochastic model).

The difficulty for a lender to credibly commit to a cutoff of credit to debtors is demonstrated by Hellwig (1977). In his model, lenders extend a line of credit to a borrower with income following a simple hazard process. The borrower's income is zero until it jumps to a permanent positive level; the probability of the jump is the same each period. Default occurs if before the jump has occurred, the credit ceiling is reached and no new credit is forthcoming. The lender always has an incentive to increase the credit line if it is exhausted prior to the increase in income. Otherwise, no repayment takes place, while new loans embody the possibility of servicing of old debt as well. The new loans need not be profitable if viewed on

their own, and good money is thrown after bad. Debtors have the incentive to increase their consumption in zero income periods, running down their credit lines rapidly. Therefore, by making an initial loan, a creditor enters a relationship in which additional loans may be profitably written but the total debt provides negative expected profits. Consequently, the loan market breaks down.

4. Institutional Characteristics of LDC Borrowing

The necessity for lenders to rely upon the enlightened self-interest of sovereign borrowers for repayment can be related to the characteristics which distinguish international credit markets from domestic ones in the developed countries. Informational imperfections may be responsible for many of the market outcomes and institutions surrounding capital flows to the LDCs. The inability of creditors to observe certain actions taken by debtors and outcomes leads to restrictions on the types of contracts which can be enforced, hence entered into. The domination of syndicated bank lending over bond lending, short maturity lending in long term debtor-creditor relationships, and rescheduling of debts can be seen as outcomes of the enforceability problem in sovereign lending.

In this section, a basic model of borrowing with potential repudiation is presented in which debtor income is stochastic. The model makes a number of overly simplifying assumptions and is intended to serve only for drawing a few basic implications for modelling and serve as an aid to expositing the role of imperfect

information in the loan market.

4.1 Basic Stochastic Model

The simple model adopted is a variant of the Eaton and Gersovitz (1981a) one, following Kletzer (1984). Output is a random variable, which is identically independently distributed across periods.

Debtors obtain utility from a discounted stream of felicity (current period utility) of consumption each period and face a moratorium on future lending if they default. Utility is given by,

$$V = E \sum_{t=0}^{\infty} \beta^t U(c_t),$$

where $0 < \beta < 1$ and $E(.)$ is the expectation operator.

Output cannot be stored, and, for simplicity, the moratoria last forever.

In the event of debt repayment, a borrower's utility is,

$$V^r(y_t, R_t) = U(y_t - R_t) + \beta E[\max\{V^r(y_{t+1}, R_{t+1}), V^d(y_{t+1})\}]$$

and, if default is chosen,

$$V^d(y_t) = U(y_t) + (\beta/(1-\beta))E(U(y)),$$

where R is the debt-service obligation, and y is output, a random variable.

The borrower defaults whenever $V^d(y_t) > V^r(y_t, R_t)$. The model assumes that default or full-repayment are the only options available to a debtor.

If loans mature in one period, then the expected profits to lenders are given by

$$E\pi = \ell \cdot (P \cdot (1+r) - (1+\rho)),$$

where ρ is the opportunity cost of funds and r and ℓ are the interest

rate and size of the debt. P is the probability of repayment which depends upon the terms of the current and anticipated future loan contracts. Kletzer (1984) shows that if the range of possible values for output is bounded and felicity is concave, then the probability of default increases with the interest rate and, eventually, with the amount lent. Expected profits fall below zero for any interest rate as the principal passes beyond an upper bound and for any positive principal as the interest rises beyond a finite bound. Therefore, the set of positive loan contracts which provide non-negative expected profits is bounded in both the amount lent and the rate of interest charged. These results are depicted in Figure 1, where continuity of the cumulative distribution of output and some additional degree of concavity have been assumed. The set of loan contracts in Figure 1 are those available to a particular debtor.

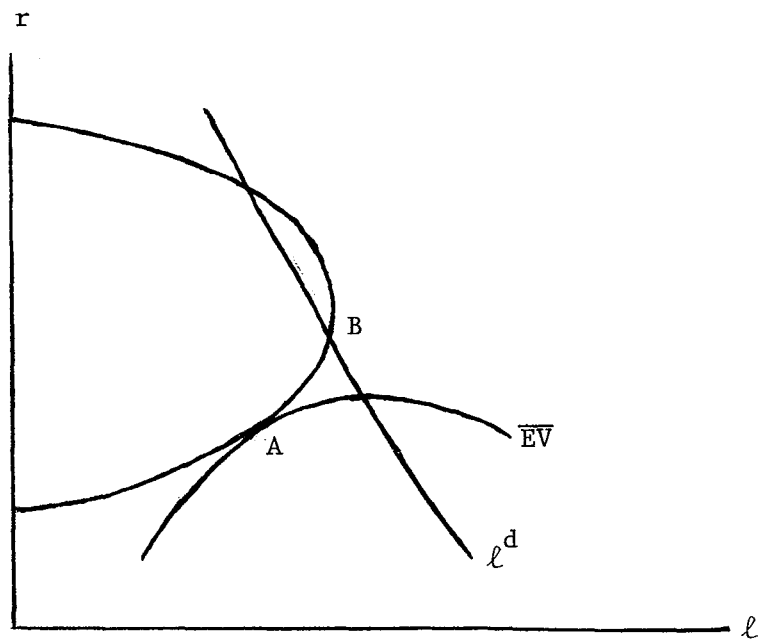
Lenders may be assumed to be risk neutral. However, a concept of equilibrium must be explicitly adopted. Competition amongst lenders is a useful starting point for examining market outcomes. In this model, free entry in loan contracts (interest rates and quantity lent) is a natural characterization of perfect competition. If there are no asymmetries of information between lenders, then it is appropriate to examine Nash equilibria in loan contracts. In this model, a Nash equilibrium in loan contracts is simply the best pair of interest rate and amount lent for the borrower from amongst those loan contracts which provide non-negative expected profits.

An important point is that the probability of repayment depends

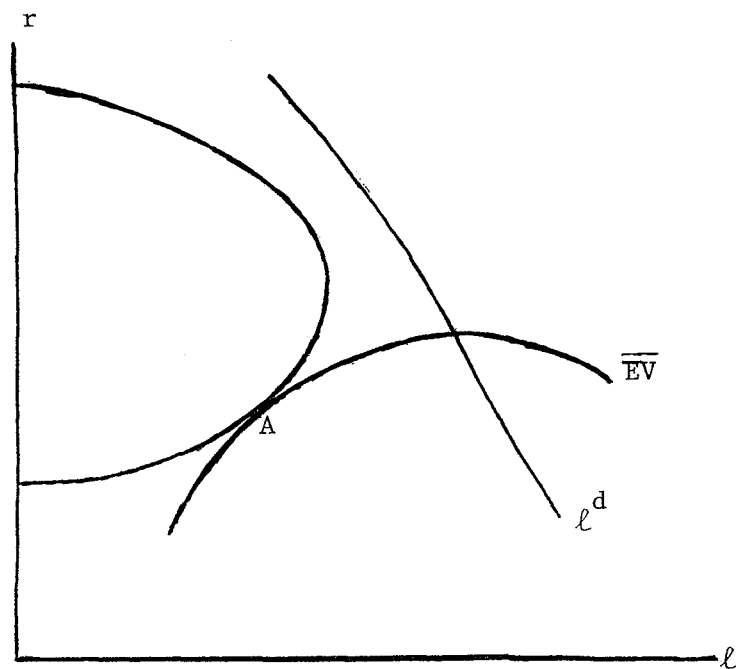
upon total debt-service obligations, so that the amount any particular lender will provide in equilibrium depends upon the amount lent by others. A Nash equilibrium is an equilibrium with free entry in loan contracts if each creditor can observe the amount lent by others. In equilibrium, a contract must specify the interest rate and total concurrent amount lent to the borrower from all sources. Such contracts are enforceable only if the total debt service obligations at each date are observable by each creditor.⁴ With general maturities of loans, contracts will need to specify the repayment schedule as a function of the stream of total debt-service obligations of the borrower at each date when a repayment is to occur.

A Nash equilibrium in loan contracts is depicted in Figure 1, taken from Kletzer (1984). The concave curve, \overline{EV} , passing through the equilibrium point, A, is an indifference curve for the debtor (constant expected utility given optimal default behavior). The loan demand curve, denoted ℓ^d , gives the amount of credit which would be desired at each given rate of interest. In the presence of possible default, borrowers demand more credit than they would in its absence. For this consumption smoothing model, the indifference curves and curve ℓ^d all vary with the realization of income, y . A smaller (that is, lower amount and interest rate) debt contract will be chosen with higher realized output.

The first implication that can be drawn from this model is that in an equilibrium with observability of total indebtedness, credit



(a)



(b)

Figure 1

must be rationed. The contract equilibrium can be supported using a non-linear interest schedule, that is, the interest rate as a given function of total concurrent indebtedness. However, the borrower cannot obtain all the credit demanded at the equilibrium rate of interest. This is the same type of credit-rationing demonstrated by Jaffee and Russell (1976)⁵.

The main point to be made here is that the terms of the loan contract are simultaneously determined. The interest rate and amount lent are both endogenous; the information of lenders which determines loan supply also determines the interest spread over the opportunity rate of interest. This point has been ignored in empirical studies of LDC credit flows⁶.

Furthermore, the interest spread cannot be interpreted in terms of a risk premium. For example, an increase in the borrower's discount rate reduces the penalty for default and leads to a contraction of the set of loan contracts which provide creditors with non-negative expected profits. The resulting equilibrium loan contract can be shown to entail a reduction in the amount lent (more severely rationed credit, since the demand curve shifts outward with the increase in default probability for constant contracts) and either an increase or decrease in the interest rate charged. The risk of default is reflected in both terms of loan contracts. In the presence of equilibrium rationing, reductions in the amount lent reflect increases in risk; because the probability of default declines with decreases in the interest spread, the change in the

spread is ambiguous.

An increase in the opportunity cost of capital to lenders or adverse shifts in the distribution of borrowers' incomes lead to a shrinkage of the set of loan contracts attaining non-negative expected profits. Because the set is bounded for principal amounts exceeding zero, combinations of given opportunity cost and low ranges of possible income can yield no positive profitable contracts. This may be seen as the source of exclusion of the low-income LDCs from the private external loan market.

4.2 Syndicated Bank Lending

One of the prominent institutional features of recent LDC borrowing has been the predominance of bank over bond lending, particularly through syndicated loans. Banks may be more able to enforce and monitor terms of loan contracts than bondholders. For example, the ability of banks to enforce seniority clauses and other covenants (such as cross-default clauses) between each other enhances their abilities to impose penalties upon reluctant debtors and renegotiate loan terms. Bondholders may be unable to agree upon terms of loan renegotiation because of their diverse interests or face significant transactions costs in doing so. While the value of bonds fluctuate on the secondary market varying the return to lenders, debtors may face only two options: continued full debt-service or default. Syndicated bank debt can be renegotiated changing both the value of the lenders' assets and the repayment obligations of borrowers. In the presence of sovereign immunity and

indirect enforceability, the ability of syndicates to reschedule loan payments through cooperation between creditors can give an advantage to bank over bond lending.

Another important point is that the credit-rationing equilibrium described above requires that lenders can observe, therefore condition loan terms upon, the total concurrent debt-service obligations of their borrowers. Restricting total lending, when the priority of debt is unclear, requires cooperation between lenders. This may be costly in the case of bondholders and fairly easy to do through syndication. An example of an equilibrium notion suitable to the case of non-observability of total indebtedness by creditors is a interest-rate taking free entry equilibrium in the model of Figure 1. Such an equilibrium, if one exists, will result in a contract on the borrower's loan demand curve at its lowest intersection with the set of zero expected profit loan contracts (point B in Figure 1a). Contracts along the demand curve above this point will be dominated, for the borrower, by this contract. In general, such equilibria may fail to exist (in Figure 1b, ℓ^d does not intersect the set of zero expected profit contracts). If this type of equilibrium exists, then the debtor is always at least as well off in the Nash equilibrium with observed total indebtedness⁷.

Syndicated bank loans may dominate LDC borrowing because of this potential asymmetry of information between lenders and each borrower. The ability of creditors to monitor total concurrent debt-service obligations has social value in this model. Because providing

additional loans raises the probability of default on all debt, lenders have an incentive to form a syndicate through which they can correctly observe the total lending by other members. A guarantee that an initial sale of bonds (at the Nash equilibrium level) will not be expanded subsequently is not credible in this model.

Investment banks may or may not be able to credibly restrict bond issues they register through the equity value of their reputations. There are incentives to increase indebtedness ex post selling new bonds with higher yields.

4.3 Debt Maturities

The basic model above (as in Eaton and Gersovitz (1981a)) assumes loan principals and interest payments are due after one period. Incentives to borrow using longer maturities are common, for example, gestation lags or investment costs with non-concavities in production may exist. In the simple repay-default framework, the accumulation of additional debt while paying debt-service without retiring principals on old debt generally will be an attractive option to debtors. In the consumption smoothing model without default, there would be no reason for particular debt-maturities to appear. However, the insurance aspects of the option of defaulting provide incentives for borrowers to prefer longer maturity debt contracts.

An important aspect of sovereign risk is the inability to enforce many bond covenants common to domestic capital markets. Covenants restricting debt-dilution and establishing debt priorities

are essential to the use of long term loan contracts. Because increased lending reduces the profitability of current debt in the moral hazard model, long-term loans must anticipate possible subsequent additions to debt. New loans will be made which require concurrent debt-service with long-term loans if they are profitable. Because new lenders may possess more information than was available when an old contract was made in a stochastic framework, additional debt will often be profitable. The increase in debt which occurs with positive events (e.g. information that reveals an increase in the ex ante probability of repayment) reduces the ex ante profitability of a given long-term loan contract. If additional shorter-term loans are expected profitable, then with free entry of lenders, both new creditors and the current providers of long term debt have the same incentive to make such loans. Therefore, covenants restraining additional future borrowing cannot be credibly enforced in this setting.

Sachs and Cohen (1985) argue that the interest spread on longer-term debt must rise as a consequence and that this can lead borrowers to choose shorter-term lower interest rate contracts. However, debtors may prefer longer-term contracts with higher interest rates and lower probabilities of full repayment, if they are offered, due to the insurance roles of long term debt. Kletzer (1984) points out that since the set of loan contracts which provide non-negative expected profits is bounded from above in the interest rate, the entire set of loan contracts which will be offered shrinks

with increasing maturities if information about ultimate outcomes is revealed over time. This implies that for maturities beyond some length, there may be no contract with a positive principal that creditors will offer. In a stochastic setting, only short and medium original term debt may be offered.

While many motives for long-term debtor-creditor relationships exist, transactions may take place only through a sequence of short-term contracts because lenders are unable to observe and, therefore, restrain subsequent actions by borrowers. The lack of enforceability of debt-dilution and seniority clauses are only a single cause; a variety of moral hazard and adverse selection problems may also give rise to short-term debt obligations. For example, Stiglitz and Weiss (1981) demonstrate that borrowers' choices amongst risky projects depends upon the terms of loan contracts and is subject to adverse selection from the creditors' viewpoint. In the presence of asymmetries of information between debtor and creditor, the ability to change the terms of a relationship with greater frequency will be valuable. Contracts cannot rely on covenants which are not credibly enforceable; periodic renegotiation of the terms of the relationship provides incentives for performance on the part of debtor which long-term contracts may be incapable of achieving due to imperfect information.

4.4 Debt Rescheduling

In the simple stochastic Eaton and Gersovitz (1981a) type model of lending with potential repudiation, creditors have an incentive to

renegotiate contract terms ex post when borrowers prefer default to full repayment. Since the original interest rate exceeds the opportunity cost of funds, creditors can still realize positive profits ex post for some reductions of repayment obligations, while incurring smaller losses in other instances than they would suffer by declaring a default. Likewise, debtors will prefer to pay something less than originally contracted and avoid the penalties consequent with default. When creditors possess complete information about debtors, debt-equity type contracts should emerge which allow, either explicitly or implicitly, for varying repayment obligations with the realized state of nature. Grossman and Van Huyck (1985) take this approach to interpreting debt-rescheduling. They suggest that since the conventional explicit legal contract only specifies a given rate of interest (which may float), lenders cannot increase the debt-service obligation prior to the contracted repayment date. Therefore, the set repayment schedule is the maximum of payments over states of nature. Lenders expect to receive less in many outcomes, and a default only occurs if the payment is less than the anticipated acceptable one for a given realized outcome. In the presence of sovereign immunity and credible penalties for outright repudiation, the basic model of this section can be used to show that risk-neutral lenders do not fully insure, that is, entirely smooth the consumption streams of, borrowers. Equity-debt contracts specifying state-contingent repayment obligations will be rationed in equilibrium.

If the income realizations of debtors can be observed by creditors, then loan contracts explicitly specifying state-contingent payments would arise. However, the standard debt-contract has been shown to be the optimal form of incentive-compatible contract for lending in two-period models when the state of nature can be observed only at a cost by the creditor (see Townsend (1978); also Gale and Hellwig (1985)). Costly observation of the realized income of debtors in a multi-period model with potential default could generate equilibrium standard debt contracts with renegotiation. The combination of the ability of borrowers to default and indirectness of penalties imply that equilibrium contracts will be of shorter original maturity than developed country corporate debt contracts and entail anticipated potential renegotiation of repayment terms when outcomes can be observed, but only at a cost, by creditors. This is one interpretation of debt-rescheduling.

The presence of creditors' incomplete information about debtors' characteristics can significantly affect the nature of debt-renegotiations. For example, lenders may be uncertain about the perceptions of borrowers of the costs of default penalization or the probability of particular sanctions being imposed. Even if lenders cannot observe the realized state of nature, debt-rescheduling could still take place. Debtors can be inhibited from persistently reporting poor outcomes because of the loss of reputation and deterioration of loan terms that result. Similarly, cooperation between lenders can arise, so that only certain types of arrangements

result, such as a lack of individual debt renegotiation in favor of simultaneous rescheduling of all outstanding debt.

Debt renegotiations in which debtors seek to obtain new net capital inflows and those in which they desire to lengthen the horizon over which principals are repaid or reduce interest obligations can lead to basically different outcomes. Most recent reschedulings have involved debt-service postponement by countries attempting to reduce their external indebtedness; net payments are made to creditors, which are smaller than required by the original contracts.

In the simple stochastic model of borrowing with potential repudiation, new lenders will only assume debt which assures non-negative expected profits. When a debtor realizes a poor output state, default with consequent penalization can be superior to full repayment and selection of a new zero expected profit debt contract. In this case, old creditors have an incentive to reduce debt-service obligations so that the borrower will choose not to default. If a debtor does not desire new inflows of capital, rescheduling results in a reduction in the present-value of the stream of repayments.

When a debtor seeks a new net inflow of funds, old creditors are more likely to supply them. Existing creditors have the possibility of recovering old debt-service in addition to new repayments when they provide new loans. In a low income state, a borrower will choose between full default with penalization and accepting a renegotiated debt contract offered by existing creditors. Because

new lenders will not assume the old debts on terms which the borrower would accept (full repayment in this event is inferior to default), old lenders can offer a rescheduling of existing debt-service combined with new loans with repayment terms exceeding those available in the competitive market. New lenders may be willing to extend more favorable terms on new inflows if the old debts are rescheduled, but existing creditors can offer the rescheduling and new loans as a single take-it or leave-it package. Even if the original loans were made in a competitive market (that is, with free entry in contracts), debt-renegotiation involves strategic behavior on the part of both lenders and borrowers.

Ozler (1984) presents a simple model of bilateral monopoly between lender and borrower. When the loan is made, second-period income and the penalty cost are both uncertain, but the borrower is known to be solvent. If income and penalty both exceed debt-service, then the debtor repays as contracted. If income falls below the repayment obligation, then the debtor seeks a rescheduling of debt-service. The new loan is made on more favorable terms for the lender than the initial loan because of the monopoly power the lender now has. On the other hand, if the penalty falls below the debt-service obligation, then the borrower threatens default and extracts concessionary terms from the lender. Ozler examines the effects of rescheduling announcements on the equity value of banks and finds that reschedulings during the late 1970's increased bank market values while those during the early 1980's reduced them.

Of course, other explanations of rescheduling exist. Banks may agree to postpone debt-service for insolvent or recalcitrant borrowers because managers are wrong about a debtor's proclivity or ability to repay, acting in the best interests of their own careers and moving on, acting in shareholders' best interests by postponing costs regulators will impose, or hoping that official and multilateral agency creditors will take over portions of the debt.

Potential problems for lending can be created by the short-term nature of original loans in the presence of potential default and consequent credit-rationing. If the simple model of borrowing is extended to allow more general stochastic income processes (other than identically independently distributed ones), then low income states can lead to reductions in the amount of debt lenders wish to hold. For example, when output realizations are positively serially correlated and debt matures in one period, the set of loan contracts providing non-negative expected profits shrinks inward in low-income states. Because original maturities are shortened for reasons of imperfect information, lending becomes procyclic in the consumption-smoothing framework. Net principal retirements are desired by creditors when income is low and additions to debt forthcoming when income is high. Besides providing a reason in addition to borrowing for investment for the observed strongly procyclical pattern of lending to LDCs, this model could provide a basis for depicting panics amongst lenders.

Diamond and Dybvig (1983) present a game model of bank runs.

Each depositor is better off withdrawing funds if others do so, but everybody benefits if nobody withdraws their deposits. Essential to the result is the assumption that deposits are refunded in full on a first-come, first-served basis. When lenders wish to hold fewer assets in a country, the net payments required rise (at the same time the value of output falls) which raises the probability of default. As one creditor withdraws, the profitability of others' loans are adversely affected. Without well-defined debt seniorities, this could potentially lead to a crisis.

Sachs (1984) and Krugman (1985) suggest models similar to Diamond and Dybvig (1983), substituting syndicated bank loans for bank deposits and allowing current income to fall short of debt-service obligations. Sachs assumes that each bank faces an upward-sloping marginal cost curve of loans; banking regulations or risk-aversion are cited as possible sources. This implies that a single creditor may find extending the entire loan to avoid default unprofitable. Because the refusal of one creditor to relend raises the probability of default on other loans of other creditors, an externality exists so that cooperation between lenders can lead to a superior outcome. However, as already noted, a new loan need not be expected profitable on its own to be offered by an existing creditor. The bank already holding the largest amount of debt will be most willing to extend further credit.

Gersovitz (1985) points out that both the Sachs and Krugman models really explain the prorating of payments moratoria and

reschedulings across lenders and not rescheduling itself. In the Diamond and Dybvig model, intermediaries are unable to recoup the full value of their investments after one period, but depositors are able to claim the full value of their deposits on a first-come, first-served basis so that a depositor panic can result. A sovereign debtor for which resources available for repayment fall below debt-service obligations has an incentive to unilaterally reschedule payments, proportionally revaluing the assets of creditors. If creditors all face the same increasing marginal cost of funds, then debtors will each minimize their losses by accepting partial proportional payments if a debtor is incapable of servicing the complete debt. A lender panic does not occur for the same type of reason runs on mutual funds do not occur.

4.5 Debt and Reserve-Holding

Eaton and Gersovitz (1980) present an interesting empirical finding: foreign reserves rise as debtor countries are rationed more severely on international credit markets. Reserve-holding by debtors can be justified by the same transactions cost arguments that serve for creditors. However, credit market imperfections and default sanctions can be identified as additional sources of motives for reserve-holding and help explain the pattern of reserve accumulation by borrowers.

The difficulty encountered in explaining reserve holding by debtors in the absence of transactions costs is that the interest paid on debt should equal or exceed that earned on reserves. We have

already argued that short original debt maturities in a model of credit-rationing under potential repudiation with a general stochastic income process can lead to a procyclical pattern of lending (which happens to be socially inefficient). The supply curve of credit shifts inward with low income realizations, so that the cost of credit increases and eventually becomes infinite. The gap between the marginal borrowing rate of interest and the discount rate during low income events can compensate for the gap between the interest rate on debt (or, more generally, the marginal productivity of domestic capital) and the interest earned on reserves. This motive for further consumption-smoothing through saving in the form of reserves derives from the presence of a credit constraint. In general terms, uncertainty about the future marginal rate of substitution of consumption between periods and the future marginal cost of borrowing leads to the holding of precautionary reserves. The imperfection in credit markets creates the insurance role for reserves. The addition of capital accumulation to the model will introduce possible precautionary motives in investment.

The costs of default penalization also provide a precautionary motive for reserve-holding for the same reason in the same framework. The cost of accumulating some reserves ex ante may be offset by the reduction in the likelihood of default they facilitate. Available reserves allow continued debt-service with a smaller reduction in current consumption, so that the benefits in low income events are simultaneously increased consumption and reduction in the probability

of facing default and consequent sanctions. In the context of borrowing and lending with imperfect information, reserves provide insurance to allow continued debt-service payments during low income events, so that the possible reputation costs of debt rescheduling can be avoided. Losses of reputation can lead to adverse shifts in the supply of loans in any given future event. These costs will also offset the current opportunity cost of holding foreign reserves.

The discussion so far implies that an autonomous increase in the reserves held by debtors during poor events will have a positive impact on the probability of repayment and functioning of the international credit market. However, reserves may rise in anticipation of repudiation, as was noted in section 3. If default sanctions include interference with access to trade finance, then increasing foreign reserves reduces the cost of penalization, as long as reserves cannot be confiscated by creditors. The probability of default may rise instead of fall because reserves are precautionary savings against default sanctions.⁸

4.6 Debtors' Reputations and Repeated Games of Incomplete Information

A number of references have been made to the possible role of borrowers' reputations in models that emphasize asymmetries of information in the credit market. Recent results in the theory of games with incomplete information are likely to find widespread use in theoretical models of international financial markets. Aizenman (1986) presents a variant of the Eaton and Gersovitz (1981a)

certainty model of lending with potential repudiation in which creditors possess incomplete information about the perceptions of debtors of the costs of penalties for default. Lenders form beliefs about borrowers' penalty cost perceptions which are summarized by a probability distribution. Debtors know the exact cost of sanctions. Aizenman uses the model to generate an upward-sloping, then backward-bending, supply curve of loans analogous to that derived from a stochastic model (e.g. Figure 1).

Some insights might be gained by stating an explicit equilibrium notion for this model. The setup can be represented by an extensive form game with incomplete information. An appropriate equilibrium concept is the sequential equilibrium one proposed by Kreps and Wilson (1982b). Multiple sequential equilibria exist for the model. Restricting attention to those equilibria in which default never occurs yields a potentially useful insight. In such equilibria, loan contracts are offered which provide non-negative expected profits given lenders' prior beliefs about a debtor's perceived default penalty, and equilibrium repayment obligations are less than the actual penalty perceptions of debtors. Even though repudiations never occur in such sequential equilibria, creditors' beliefs are not controverted. However, updating priors may be inappropriate, because extending more favorable loan terms may lead to a default. Therefore, learning by creditors is costly. Information which adversely alters a debtor's reputation can have persistent effects.

An example of the applicability of games of incomplete

information to the interpretation of international credit market institutions is the existence of bond lending to LDCs along with syndicated bank loans. The dominance of bank over bond lending has already been discussed. However, a large number of medium and high income LDCs have floated bonds on international markets since 1973, and approximately \$27 billion of bond debt is currently outstanding (the bulk is Mexican and Brazilian). Furthermore, during recent debt rescheduling, interest payments on and amortization of bond debt continued. Bondholders have little option to declaring default if payments are suspended; the prospect of repayment is already reflected in the value of bonds on the secondary market. Therefore, lenders will hold bonds only if the borrower is inhibited from defaulting on individual bonds. An equilibrium with positive bond debt under potential default is possible in a reputational game because the ability to issue future bond debt depends upon maintaining the servicing of existing bonds; the cost of a failure to completely fulfill obligations to current bondholders is the loss of any access to the bond market. Moreover, the cost of defaulting on bond obligations, however small, can lead to a loss of reputation in all asset markets in a game of incomplete information, so that the supply of bank loans is contracted or a default is declared by other creditors.

Many of the characteristics of external lending to the LDCs might find explanations in repeated games of incomplete information. However, these games typically possess multiple equilibria, and the

qualitative nature of equilibria often is very sensitive to the particular assumptions made about the information possessed by different players. While some insights might be gained into the role of debtors' and creditors' reputations in the market, the approach is unlikely to yield empirically testable models. Models based on the characteristics of perfect equilibria in repeated stochastic games of complete information which incorporate the enforceability problem are difficult to handle but may be much more promising.

5. Private Capital Flight and Public Debt

A widely publicized feature of large debtor countries is the significant extent of the acquisition of foreign assets by their citizens. Using different methodologies, Dooley, et. al., (1983) and Cuddington (1985) estimate that up to one half, and possibly more, of the increase in the gross indebtedness of Argentina, Mexico, and Venezuela during the period 1974-1982 was offset by private outflows of capital. Standard portfolio diversification can explain large two-way flows. If capital flight is a result of such motives, then it is not the outcome of a market failure requiring intervention. However, the imperfect enforceability of international debt contracts provides a basis for concern.

In the presence of sovereign immunity, lenders may have little ability to impose penalties on individual private debtors or assess the value of their assets in the event of bankruptcy. Creditors are likely to have a greater ability to penalize the country as a whole for default, so that capital inflows are in the form of loans to the

government or to private borrowers with government guarantees.

The majority of lending to the LDCs has taken the form of public or publicly-guaranteed debt. In the absence of ex ante explicit guarantees, governments have been held accountable by lenders for the debts of private borrowers. Diaz Alejandro (1985) gives an example of the extent of implicit public guarantees of private debt. The Chilean government explicitly did not guarantee foreign loans to several private banks. However, when these banks failed, creditors demanded and received repayment from the government.

Diaz Alejandro (1984) links capital flight from large Latin American debtors to the subsidization and public guaranteeing of private debt and the ability of nationals to avoid domestic taxation of the income from foreign assets. Eaton (1986) presents a model in which capital flight can be generated by the tax obligations implied by the potential nationalization of private debt. Explicit and implicit government guarantees create an interdependence between private investment decisions through the public sector budget constraint. Actions which raise the probability of one borrower's default increase the anticipated tax obligations of other borrowers. The other borrowers have an incentive to place their assets abroad, thereby increasing the probability of default on their own loans.

Multiple equilibria exist in each version of Eaton's model. In one of these, all creditors restrict loan amounts given debtors' tax obligations, so that investing domestically and fully repaying debts are in each borrower's self-interest. Potential nationalization of

private debts provides an incentive to borrowers to invest abroad, raising the expected tax obligations of all borrowers. Therefore, another equilibrium exists in which all debtors invest abroad and the government defaults on foreign debt.

A similar approach is taken in Eaton and Gersovitz (1986), in which public borrowing is shown to lead to possible capital flight because of the implied increases in the taxation of domestic investment income with increased debt. Khan and Haque (1985) model capital flight as a response to an asymmetry in the risk of expropriation facing domestic and foreign investors. Nationals face a higher risk of expropriation by their government, so they invest abroad. Consequently, domestic investment is financed with foreign loans. Using the Eaton and Gersovitz (1986) argument, the governments expropriation decision can be related to public indebtedness. Expropriation and other forms of taxation are a means for raising government revenue to meet external debt-service obligations. Increases in public debt contribute to the private sector's anticipated taxation. If assets located abroad escape taxation and the risk of expropriation, then capital flight can be a consequence of extensive foreign borrowing.

Much discussion of capital flight from Latin American debtors has emphasized the role of overvalued currencies and domestic financial instability. Dornbusch (1985) points out that the threat of devaluation in the presence of currency overvaluation is a primary source of capital flight. Inflationary finance, a form of taxation

of domestic capital, can lead to capital flight as an application of the analysis of Eaton (1986).

6. Debtor Country Policies

The consequences of domestic policies for external borrowing are a significant concern for countries facing imperfect international credit access. Debtor countries having repayment difficulties will undertake policies intended to improve their current account balances. Furthermore, the option of defaulting introduces moral hazard issues in the selection of domestic policy; part of the risk of policy choices is borne by creditors. Poor policy-making is cited as a source of repayment difficulties, often because capital flight is a perceived outcome.

The presence of a rising cost of external credit with country-wide indebtedness implies that an optimal policy response is to assure that the domestic rate of interest equals the marginal cost of foreign credit rather than the average cost. Aizenman (1986) shows that this can be achieved through borrowing taxes if domestic credit markets are not subject to imperfections. If moral hazard, adverse selection, or enforceability problems arise in domestic credit transactions, then additional time-varying taxes and subsidies are necessary. Adoption of optimal taxes on foreign borrowing and second-best commodity taxes and subsidies in the presence of domestic market imperfections requires policymakers to possess complete information on the external indebtedness of the country. Recent experience has shown that most large debtor nations have had a very

limited accounting of public and publicly-guaranteed foreign borrowing.

The adoption of policies to improve the current account is widespread, as is concern that liberalization of trade can lead to debt problems. Tariffs are widely thought to bring about current account improvements because they raise the relative price of importables. In a general equilibrium context, this is not necessarily the case. The effect of tariffs on the excess of saving over investment depends on their effects on the desired long-run levels of physical capital and wealth in the economy. Engel and Kletzer (1985b) show that permanent tariff increases have an ambiguous effect on the rate at which a country borrows from abroad; the result depends crucially upon the particular formulation of household objectives in an optimizing framework. Calvo (1986) demonstrates that temporary liberalization often leads to increasing indebtedness because consumers' intertemporal consumption plans anticipate the future change in relative prices. The implication is that an intended permanent liberalization can lead to current account deficits if households perceive the possibility of future reversal. As a consequence, a reversal of the plan can become optimal. Calvo proposes that borrowing restraints accompany trade liberalization programs.

A much less rigorously studied issue is debtor-optimal policy choice under potential default. If debtors are able to commit themselves to follow some policies over others, then improved loan

terms will be forthcoming. Commitment is essential, since increased lending is accompanied by moral hazard problems when default is possible. The presence of moral hazard and adverse selection in policy choices suggests an important role for multilateral agencies in the coordination of lending to the LDCs. IMF conditionality can be seen as potentially imposing commitment to policies from which a debtor would optimally deviate ex post. In the presence of creditor imperfect information, IMF involvement may be essential to the terms of loan contracts. When lenders infer information about debtor characteristics from other lenders' actions, IMF and World Bank lending may play important roles in the formation of borrower reputations.

7. Creditor Country Regulation

Since the debt crises of 1982 began, a popular view in the creditor nations has been that the banks lent too much. Although bankers may have made ex ante profitable loans which ex post they would prefer not to have written, there is the possibility that market imperfections lead to inefficient lending practices. The implications of basic models of lending with enforceability problems is that credit is rationed and capital flows less than would occur if potential sovereign default were not possible.

Kletzer (1984) discusses the potentially important inefficiency in international lending which results when lenders are unable to observe the magnitude of concurrent lending. Since the lending of each additional amount raises debt-service obligations, the

probability of default on all outstanding debt increases. Therefore, in a rationing equilibrium the interest rate depends on the total amount borrowed from all sources and not on the size of the particular loan. In the absence of observability of total concurrent indebtedness, if an equilibrium exists, then more is lent at a higher rate of interest than in an equilibrium with observability. The debtor is worse off as a result (see section 4). Because seniority clauses are less extensive and foreign loans are often made to a variety of government agencies, public enterprises, and private sector firms under government guarantee, the problem of observability of total debt may be significant for international lending. The dissemination of information on the external private and official debt of LDCs could be coordinated by the IMF and World Bank in an effort to alleviate this type of international credit market imperfection.

Because lenders have less information about their borrowers than the debtors themselves or different information than do other lenders, another informational externality arises. Information about the credit-worthiness of borrowers can be inferred by the willingness or lack thereof of other creditors to lend. This externality could contribute to panics by lenders, in which each lender's attempt to protect themselves by withdrawing increases the likelihood others will also, so that no one is able to recover their assets. The revision of a debtor's reputation induced by other lenders' cutbacks can lead to a further reduction in the willingness to lend,

increasing the probability of default.

Public insurance of bank deposits is widespread in the developed countries. This insurance promotes capital market efficiency by reducing the need for depositors to monitor bank activities or demand large risk premia. As a result of deposit insurance, banks have incentives to increase the riskiness of their portfolios. Bank regulation accompanies insurance to restrain moral hazard on the part of management.

The amount of bank capital lent to a single borrower is restricted in the U.S.; however, countries or individual agencies in countries were not classified as a single borrower. Therefore, banks could increase insurers' exposure to risk while raising expected profits.

Regulators could take two steps to deter moral hazard problems. The first is adopt full disclosure of lending to individual countries. Increased reporting (which has occurred in the U.S.) can allow more extensive monitoring of banks portfolios by depositors and shareholders and reduce the problems created by incomplete observation of indebtedness by all lenders. The other step is to require bank capital increases. The rescheduling of loans otherwise in default allows banks to pay dividends on interest income created by new loans. This act can raise the upper bound on an insurance claim arbitrarily high.

Compensation of bank managers can also create moral hazard difficulties. The performance of one banks' management is likely to

be judged by that of other banks. A manager who fails to undertake a high-yield, high-risk loan which is repaid will suffer, while if all banks make loans which fall into default, then any particular manager is unlikely to be blamed. This can lead to significant correlation of risk between banks' portfolios. Regulations restricting management actions and increasing disclosure can partially offset the adverse effects of these incentives.

8. Empirical Implementation of Theories of Sovereign Borrowing

A number of econometric studies of LDC borrowing are available. This section critically reviews the general approach of many of these studies in terms of the theoretical analysis of sovereign lending. A comprehensive review of the empirical literature is not intended.

Existing econometric work investigates sovereign borrowing and lending in two circumstances. Several studies examine voluntary lending and attempt to identify determinants of the level of debt and the terms on which it was contracted. A second group concentrates on when debt problems occur. The factors influencing a resumption of voluntary lending to problem debtors have not been modelled.

Empirical implementation of theories of lending under sovereign risk faces two basic problems. Information on the terms of loans is incomplete; studies must use some level of aggregation over loan contracts. Cumulative debt figures include public foreign debt and private debt covered by varying degrees of government guarantee, explicit or implicit. Another problem is the absence of suitable exogenous variables which vary across debtors. The terms of trade

are an important source of external disturbances which may be treated as roughly exogenous for many LDCs; however, few other variables exist. A primary problem with much of the extant empirical literature is the inclusion of variables endogenous to external capital flows as explanatory variables.

Estimation of the determinants of outstanding debt and voluntary credit flows requires allowing for the possibility that desired debt levels exceed a creditor imposed debt ceiling. In the absence of repayment problems, two regime models must be used. With problem debtors in the sample, three (or more) regimes are necessary to allow for both voluntary and involuntary lending.

Eaton and Gersovitz (1980 and 1981a) estimated a two-regime version of their model using data from forty-five countries for the two years 1970 and 1974. They find that the credit-constrained regime is more prevalent than the unconstrained one. Hajivassiliou (1985) estimates a three-regime model using a panel set of data for seventy-nine countries over the period 1970-1982. By accounting for unobserved heterogeneity across debtors, persistent country effects are found over time.

Bank loans to the LDCs typically specify the interest rate as the sum of a reference rate, usually the London Inter-Bank Offer Rate, and a spread. The spread is fixed for the term of the loan, while the reference rate floats. As noted in section 4, the quantity lent and repayment terms are jointly determined. In a stochastic setting, the interest spread is endogenous to the same set of

variables that determine quantity (in the certainty version of the Eaton-Gersovitz model, the spread is zero). However, several studies treat the rate as exogenous. An alternative econometric approach to that taken by all authors would be simultaneous estimation of the spread and amount lent; however, such an exercise may require extensive individual loan data rather than the aggregated loan data available to these authors. Hajivassiliou (1985) cites evidence that interest spreads are not responsive to the same variables which determine credit inflows. More complete information on loan terms is necessary to adequately test for exogeneity. In particular, interest payments do not comprise the full return to lenders, for example, front-end fees are widespread in sovereign lending.

Interest spreads reflect the riskiness of loans but are not strictly risk premia, because the amount lent is rationed and also reflects lenders' perceptions of risk. McDonald (1982) surveys a number of studies which attempt to interpret the spread as a risk premium. In addition to poorly revealing creditors' risk assessments, spreads should reflect other factors, such as differing tax treatment of interest income across borrowers. These studies use a number of explanatory variables the inclusion of which is not derived from a well-stated model of sovereign lending. For example, while the maturity of debt is not exogenous to the other terms of loan contracts, the term structure of debt is often included as an independent variable.

A large number of econometric studies of LDC borrowing

concentrate on debtor nations which experienced debt-servicing difficulties. McDonald (1982) provides a review of a number of these papers. McFadden, et. al., (1985) adopts a multi-regime model which emphasizes borrowers falling first into arrears and then possibly rescheduling. Events are analyzed rather than credit flows. The use of the occurrence of a debt problem as a dependent variable creates a number of difficulties: debt problems are hard to define. Because the formal declaration of a default can be costly to lenders, some debtors experiencing debt-servicing problems may not be identified. Borrowers may not choose to explicitly repudiate so that penalties are delayed and reduced. Rescheduling of some loans may not reduce the present-value of the debt, while in other cases, it will. The adoption of the event of rescheduling as a dependent variable does not allow for a distinction between these instances. Of primary interest in debt-servicing problem cases are the determinants of the future flows of capital. The study by Hajivassiliou (1985) which includes incidences of repayment problems in an analysis of the determinants of the flows of funds is a step in this direction.

Edwards (1984) also analyzes problem debtors. The interest spread is selected for the dependent variable, while the amount lent is used as an independent variable. As in many other papers, Edwards uses explanatory variables which are likely to be jointly determined with the dependent variable, for example, international reserves to GNP ratio, capital inflow to debt-service ratio, and investment to GNP ratio.

9. Conclusion

This paper has attempted to survey ideas developed in the literature on the role of sovereign immunity in international capital markets. A number of implications of the enforcement problems and informational imperfections in international credit markets for the nature of capital flows to the LDCs have been discussed; many of these have not yet been modelled rigorously. The relationship between sovereign immunity and debtor country macroeconomic policy choices and the role of multilateral agency and official lending for coordinating capital flows have received sparse attention in the theoretical literature. Many of the econometric studies of sovereign borrowing have not taken account of the theoretical analysis and fail to recognize the simultaneity of the determination of dependent and explanatory variables. The inadequacy of data on private sector loans and difficulties for defining problem cases hamper the best efforts.

Footnotes

1. For example, see Sachs (1984).
2. Fischer and Frenkel (1975) display stages in the balance of payments in a non-optimizing model with a fixed saving rate. The results of Engel and Kletzer (1985a) are derived in a small country model with endogenous time preference, but they clearly generalize to other saving formulations and to a two-country framework.
3. See Eaton, Gersovitz and Stiglitz (1986).
4. Arnott and Stiglitz (1982) discuss the importance of observability of total insurance purchases in moral hazard models at length. The comparison between credit market equilibria with and without observability in Kletzer (1984) draws on this paper extensively.
5. This type of equilibrium credit-rationing contrasts with that derived by Stiglitz and Weiss (1981). Here (and in Jaffee and Russell (1976)) each borrower receives a loan smaller than what they demand at the equilibrium rate of interest. In the Stiglitz-Weiss adverse selection model, some borrowers' projects are fully-funded and other potential borrowers receive no funds even though they demand them at the equilibrium rate of interest.
6. For example, see McFadden, et. al., (1985) and Edwards (1984).
7. See Kletzer (1984) and, also, Gale and Hellwig (1985).
8. O'Connell (1986) discusses these issues in a bargaining game with incomplete information.

References

- Aizenman, J. (1986), "Country Risk, Asymmetric Information and Domestic Policies," NBER Working Paper Series, No. 1880, April.
- Alexander, L.S. (1985), "Trade and Sovereign Lending," Federal Reserve Board of Governors, manuscript.
- Arnott, R. and J.E. Stiglitz (1982) "Equilibrium in Competitive Insurance Markets: The Welfare Economics of Moral Hazard," Queen's University Institute of Economic Research, Discussion Paper No. 465.
- Avramovic D., et. al., (1964) Economic Growth and External Debt. Baltimore: Johns Hopkins Press.
- Bardhan, P.K. (1967) "Optimum Foreign Borrowing," in K. Shell, ed., Essays on the Theory of Optimal Economic Growth. Cambridge, MA.: MIT Press, 117-128.
- Calvo, G. (1985) "On the Costs of Temporary Liberalization/Stabilization Experiments," Columbia University Department of Economics, mimeo, September
- Clarida, R. (1986) "International Lending and Borrowing in a Stochastic Sequence Equilibrium," NBER Working Paper Series, No. 1944, June.
- Cooper, R. and J.D. Sachs (1985) "Borrowing Abroad: The Debtor's Perspective," in Gordon W. Smith and John T. Cuddington, ed., International Debt and the Developing Countries. Washington, D.C.: IBRD, 21-60.
- Cuddington, J. (1985), "Capital Flight: Issues, Estimates and Explorations," World Bank, unpublished.
- Diamond, D. and P. Dybvig (1983) "Bank Runs, Deposit Insurance, and Liquidity," Journal of Political Economy, 91, 401-409.
- Diaz-Alejandro, C. (1984), "Latin American Debt: I Don't Think We are in Kansas Anymore," Brookings Papers on Economic Activity, 2, 335-403.
- Diaz-Alejandro, C. (1984), "Good-bye Financial Repression, Hello Financial Crash," Journal of Development Economics, 19, 1-24.
- Domar, E. (1950), "The Effects of Investment on the Balance of Payments," American Economic Review, 40, 805-826.

- Dooley, M. et. al., (1983), "An Analysis of the External Debt Positions of Eight Developing Countries through 1990," Federal Reserve Board of Governors, International Finance Discussion Paper, No. 227.
- Dornbusch, R. (1985), "External Debt, Budget Deficits, and Disequilibrium Exchange Rates," in G. Smith and J. Cuddington, eds., International Debt and the Developing Countries. Washington, D.C.: IBRD.
- Eaton, J. (1985) "Lending with Costly Enforcement of Repayment and Potential Fraud, " Department of Economics, University of Virginia, mimeo.
- Eaton, J. (1986), "Public Debt Guarantees and Private Capital Flight," World Bank, Development Research Department, mimeo, August.
- Eaton, J. and M. Gersovitz (1980) "LDC Participation in International Financial Markets: Debt and Reserves," Journal of Development Economics, 7, 3-21.
- Eaton, J. and M. Gersovitz (1981a) "Debt with Potential Repudiation: Theoretical and Empirical Analysis," Review of Economic Studies, 48, 289-309.
- Eaton, J. and M. Gersovitz (1981b) Poor Country Borrowing and the Repudiation Issue, Princeton N.J.: Princeton Studies in International Finance, No. 4.
- Eaton, J. and M. Gersovitz, (1986), "Country Risk and the Organization of International Capital Transfer," World Bank, Development Research Department, mimeo, August.
- Eaton, J., M. Gersovitz, and J.E. Stiglitz (1986) "The Pure Theory of Country Risk," European Economic Review, 30, 481-513.
- Edwards, S. (1984) "LDC Foreign Borrowing and Default Risk: An Empirical Investigation, 1976-80," American Economic Review, 74, 726-734.
- Engel, C. and K. Kletzer (1985a) "International Borrowing to Finance Investment," Yale University, Economic Growth Center Discussion Paper Series, No. 469, February.
- Engel, C. and K. Kletzer (1985b) "Tariffs, Savings and the Current Account," Yale University, Economic Growth Center Discussion Paper Series, No. 477, December.
- Fischer, S. and J. Frenkel (1974) "Economic Growth and the Stages in the Balance of Payments," in G. Horwich and P. Samuelson, eds.,

- Trade, Stability, and Macroeconomics. New York: Academic Press.
- Fudenberg, D. and E. Maskin (1986) "The Folk Theorem in Repeated Games with Discounting and with Incomplete Information," Econometrica, 50, 863-894.
- Gale, D. and M. Hellwig (1985) "Incentive-Compatible Debt Contracts: The One-Period Problem," Review of Economic Studies, 52, 647-663.
- Gersovitz, M. (1983) "Trade, Capital Mobility and Sovereign Immunity," Research Program in Development Studies Discussion Paper No. 108, Princeton University, September.
- Gersovitz, M. (1985) "Banks' International Lending Decisions: What we know and implications for future research," in G. Smith and J. Cuddington, eds., International Debt and the Developing Countries. Washington, D.C.: IBRD, 61-78.
- Grossman, H. and J.B. Van Huyck (1985) "Sovereign Debt as a Contingent Claim: Excusable Default, Repudiation, and Reputation," Brown University, mimeo.
- Hajivassiliou, V. (1985) "Analyzing the Determinants of the External Debt Repayments Problems of LDCs: Econometric Modelling using a Panel Set of Data," Yale University, Economic Growth Center Discussion Paper Series, No. 495, December.
- Hamada, K (1966) "Economic Growth and Long-Term International Capital Movements," Yale Economic Essays, 6, 41-96.
- Hellwig, M. (1977) "A Model of Borrowing and Lending with Bankruptcy," Econometrica, 45, 1879-1906.
- Jaffee, D. and F. Modigliani (1969) "A Theory and Test of Credit Rationing," American Economic Review, 59, 850-872.
- Jaffee, D. and T. Russell (1976) "Imperfect Information, Uncertainty and Credit Rationing," Quarterly Journal of Economics, 90, 651-666.
- Kaletsky, A. (1985) The Costs of Default. New York: Priority Press.
- Khan, M.S. and N. Hague, (1985) "Foreign Borrowing and Capital Flight: A Formal Analysis," IMF Staff Papers, 32, 606-628.
- Kharas, H. (1984) "The Long-Run Creditworthiness of Developing Countries: Theory and Practice," Quarterly Journal of Economics, 99, 415-439.
- Kletzer, K. (1984) "Asymmetries of Information and LDC Borrowing

- with Sovereign Risk," Economic Journal, 94, 287-307.
- Kreps, D.M. and R. Wilson (1982) "Sequential Equilibria," Econometrica, 50, 863-894.
- Krugman, P. (1985) "International Debt Problems in an Uncertain World," in G. Smith and J. Cuddington, eds., International Debt and the Developing Countries. Washington, D.C.: IBRD, 79-100.
- McDonald, C.D. (1982), "Debt Capacity and Developing Country Borrowing: A Survey of the Literature," IMF Staff Papers, 29, 603-646.
- McFadden, D. et. al., (1985) "Is There Life After Debt? An Econometric Analysis of the Creditworthiness of Developing Countries," in G. Smith and J. Cuddington, eds., International Debt and the Developing Countries. Washington, D.C.: IBRD, 179-209.
- O'Connell, S.A. (1986) "Reserves and Debt in LDCs," University of Pennsylvania Department of Economics, mimeo, March.
- Ozler, S. (1984) "Rescheduling of Sovereign Government Bank Debt," Stanford University, mimeo.
- Sachs, J. (1984) Theoretical Issues in International Borrowing, Princeton, N.J.: Princeton Studies in International Finance, No. 54.
- Sachs, J. and D. Cohen (1985) "LDC Borrowing with Default Risk," Kredit und Kapital, special issue.
- Stiglitz, J.E. and A. Weiss (1981) "Credit Rationing in Markets with Imperfect Information," American Economic Review, 71, 393-411.
- Stiglitz, J.E. and A. Weiss (1983) "Incentive Effects of Terminations," American Economic Review, 73, 912-927.
- Townsend, R. (1978) "Optimal Contracts and Competitive Markets with Costly State Verifications," Journal of Economic Theory, 21, 417-425.