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International Lending, Long-Term Credit Relationships, and Dynamic Contract Theory

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CONTENTS

1 INTRODUCTION

Recent theoretical work has attempted to explain the long-term credit relationships that often arise in modern international capital markets between large banks or groups of banks and developing countries. Realistic models of these relationships must allow for several special features: mutually beneficial relations between lenders and borrowers may require complex long-term credit agreements; legal enforcement of loan contracts is difficult or impossible; asymmetries of information restrict the effectiveness of other enforcement techniques; and competitive forces are too weak to prevent strategic behavior from influencing the organization of relationships. In surveying and criticizing this literature, I shall use the term "dynamic contract theory" to refer to models based on rationality in which credit relationships have some or all of these features. Dynamic contract theory furnishes significantly better explanations of behavior than perfectly competitive models in which parties can make complete, perfectly enforceable long-term contracts.

This study considers to what extent dynamic contract theory has been, or could be, used to explain several phenomena often observed in modern international capital markets—notably credit rationing, rescheduling of loan payments, the predominance of short- and medium-term credit over long-term credit, and restricted access of poor countries to commercial loan markets. Dynamic contract theory allows unified, relatively simple explanations of these phenomena and helps to identify several likely sources of inefficient capital allocation, either within a given relationship or across countries in market equilibrium. These, in turn, may suggest roles for intervention by institutions like the International Monetary Fund and the World Bank in order to improve market performance.

The study is organized as follows. Chapter 2 describes the features of international loan markets that make dynamic contract theory appropriate to model them. It then briefly discusses dynamic contract models in general terms and presents a scheme for classifying them that is helpful later on. Chapters 3 and 4 provide a critical survey of recent theoretical work on loan markets that is relevant to international lending. Chapter 3 discusses one-period models of loan agreements, and Chapter 4 discusses models of long-term credit relationships. Chapter 5 is the conclusion.

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2 DYNAMIC CONTRACT THEORY

Features of International Loan Markets

Several features of modern international capital markets are important in determining how best to model long-term credit relationships.

1. An efficient allocation of capital requires complex intertemporal decision making. Developing countries must base current investment plans on predictions of how much they can borrow in the future and on what terms.

2. The lender cannot directly control the borrower's fulfillment of loan contracts. Yet the borrower's failure to fulfill loan obligations imposes costs on the lender that cannot be fully shifted to the borrower. As we shall see, this implies that lenders can typically benefit by using instruments other than interest rates—usually credit limits—to control borrowers' use of funds. Thus, market equilibrium will be contractual, with the market cleared by complex loan agreements rather than prices alone.

3. Despite the need for loan agreements, legal enforcement of contracts is almost impossible in international capital markets, because there is no authority with sufficient power to override the sovereignty of nations and settle international contract disputes.

4. There is typically considerable uncertainty about a borrower's ability to meet future loan obligations. Nevertheless, it is generally not optimal to structure a loan agreement so that default or rescheduling will not occur under any foreseeable circumstance, because risk sharing is an important source of potential gain for both borrowers and lenders. In many cases, the probability of default or rescheduling could be reduced to zero only by not lending at all.

5. Finally, competitive forces are very weak in modern international capital markets. Borrowers are highly heterogeneous, and lenders, although less heterogeneous, are small in number.[1] Even in cases where the conditions for perfect competition prevail *ex ante*, loan agreements may create monopoly power over time. A lender with loans outstanding to a given borrower has a cost advantage over other lenders, because extending further loans raises the probability that the earlier ones will be repaid (see Hellwig, 1977). For this and other reasons, it is typical for a credit relationship to generate a significant surplus, at some or all times during its life, relative to the parties' next-best alternatives. Therefore, competition from outside the relationship cannot

[1] The small number of lenders is a crucial difference between modern capital markets and earlier international bond markets, because it makes renegotiation of loan agreements easier (see, e.g., Sachs, 1984).

compensate for the impossibility of enforcing contracts, and strategic behavior can exert considerable influence on the way relationships are organized.

Structure of Dynamic Contract Models

The institutional features of modern international capital markets suggest the structure of the dynamic contract models needed to describe them. These models are inherently dynamic and game-theoretic; they apply the standard notion of rational behavior in dynamic games to long-term relationships in which parties have opportunities to make beneficial agreements. (In the discussion that follows, however, game-theoretic technicalities are kept to a minimum. Readers who desire a fuller explanation of the underlying theoretical structure are referred to Crawford, 1985a, where the notion of rationality employed—perfect Bayesian Nash equilibrium—is defined and discussed at length.) Requiring this much rationality is clearly very strong, but it appears to be the only working hypothesis that has been used with success in this kind of analysis. Simple, realistic models based on rationality are flexible enough (some would argue, *too* flexible) to explain most observed behavior. And the range of behavior that is possible without rationality, even in models with simple, realistic structures, is so enormous that it is difficult to have confidence in any specific prediction not based on rationality. By assuming rationality, the theorist submits to a useful discipline: credit-market inefficiencies must be explained solely by realistic limitations on the ability of borrowers and lenders to make and enforce agreements or contracts.

Dynamic contract models can differ along several dimensions. Many of the possibilities are illustrated in Chapters 3 and 4, but I provide a classification scheme here, both as a guide to the discussion of specific models that follows and to illustrate possibilities that have not yet been explored in the literature. These are some dimensions that must be considered:

1. Competition from outside may be weak or strong on either side of a credit relationship and may vary in strength over its life.

2. Borrowers and lenders may share in many ways the surplus their relationship generates, and surplus sharing may interact with borrowing and lending decisions.

3. Borrowers and lenders may have perfect information, imperfect but symmetric information, or asymmetric information.

4. Relationships may differ with respect to what decisions can feasibly be covered by contract.

5. Finally, the parties may enforce a loan agreement in different ways. In general, parties' enforcement strategies relate their actions at each decision point to observable history, and those actions will have effects both within and outside the relationship. The three kinds of enforcement that are theoretically possible are discussed below. All three play important roles in the literature on credit markets, sometimes coexisting within the same model.

Enforcement Techniques

It is often possible for parties to forge a cooperative agreement in an enduring relationship by relating their current behavior to past history, not only because of the direct influence past actions may have on the costs and benefits of current actions, but also because past actions create expectations about future behavior. In applications, cooperation usually ceases forever if these expectations are violated. Because the agreement is implicit in the kinds of behavior that will terminate cooperation or elicit other sanctions, and need not be stated to be effective, it is called an *implicit contract* in the literature.

A useful distinction can be made between an implicit contract in which the behavior of the parties is influenced only by the anticipated responses of the parties themselves and one in which it is influenced in part by the anticipated responses of outsiders. I call the former an *internal* implicit contract and the latter an *external* implicit contract. A party (hereafter referred to as "he") who violates an internal implicit contract typically loses the opportunity to cooperate with his current partner; a party who violates an external implicit contract loses the opportunity to cooperate with some or all potential partners as well.

The theory of implicit contracts has been worked out primarily for a simple model known as the "repeated Prisoner's Dilemma," made up of a series of one-stage Prisoner's Dilemmas played between the same two parties. The parties can identify each other and observe and recall exactly what happened each time the game was played in the past. They may therefore use strategies that make their current actions depend in any desired way on past history.

To see how such strategies allow the parties to maintain cooperation, it is first necessary to understand the one-stage Prisoner's Dilemma. In the one-stage Prisoner's Dilemma, each party chooses between two actions, which I shall call responsible behavior (R) and cheating (C). An example is shown in the figure, in which the "payoffs" of the party who chooses between rows are listed first in each cell of the payoff matrix, and the payoffs of the party who chooses between columns are listed second. The game is designed so that the outcome is better for both parties if both behave responsibly (5,5) than if both cheat (2,2). It is nevertheless in a party's individual interest to cheat no matter what he expects his partner to do (because $6 > 5$ and $2 > 1$).

	R	C
R	5,5	1,6
C	6,1	2,2

The one-stage Prisoner's Dilemma is a simple example of the tension between individual incentives to cheat and the collective benefits of responsible behavior. As such, it can be viewed as a highly stylized model of a loan agree-

ment. Responsible behavior by the borrower, for example, might be taken to mean eschewing repudiation and avoiding actions that could impair his ability to repay. Responsible behavior by the lender might be taken to involve not cutting off credit or attempting to extort more than the agreed-upon loan payment in times when the borrower's need for continued credit makes him vulnerable to "holdups."

When the one-stage Prisoner's Dilemma completely describes the situation under study—when, in particular, parties cannot make binding contracts before they play the game—there is no incentive for responsible behavior: cheating is unassailably rational on the individual level, even though it leads to an outcome that is collectively irrational, i.e., inefficient. Fortunately, even though legal enforcement of loan contracts is typically impossible in international capital markets, a long-term credit relationship more closely resembles a repeated Prisoner's Dilemma than the one-stage version of the game, and repetition opens up a wide range of possibilities for implicit-contract enforcement of cooperative agreements.

1. *Internal Implicit Contracts.* Internal implicit contracts support cooperation with credible implicit threats to end or interrupt cooperation if cheating is detected (see Crawford, 1985a; Fudenberg and Maskin, 1986; and Kreps, 1984, for overviews of the theory). For such threats to be effective, continuation of the relationship must have value for both parties relative to their next-best alternatives.

To see how such threats can support cooperation, consider the repeated Prisoner's Dilemma when the time horizon is infinite and parties discount the future at constant, equal rates. (If the time horizon were finite, a standard argument shows that rationality would require cheating in every period. If both parties know that they are in the last period, and know that they both know, and so on, they must know that rationality requires cheating in that period. This implies, in turn, that there are no gains to behaving responsibly in the penultimate period, and so on by backward induction to the start of the relationship.) [2] Let each party adopt the strategy of behaving responsibly if and

[2] This result is contradicted by the observations of Axelrod (1984) and others that experiments run with a large but finite known horizon usually yield cooperation in the repeated Prisoner's Dilemma until very near the end of the horizon. The infinite-horizon model can be viewed as a convenient way to model this phenomenon. If an infinite horizon seems objectionable on first principles, it may help to interpret the parties' behavior as reflecting (entirely or in part) an exogenous probability that the repeated game will be terminated in any given period. On this interpretation, the horizon is only potentially infinite, and the infinite-horizon assumption may be taken to mean that, no matter how long the relationship lasts, parties assign a nonnegligible probability to its continuation for at least one more period. Kreps, Milgrom, Roberts, and Wilson (1982) give an alternative explanation for the occurrence of cooperation in the finitely repeated Prisoner's Dilemma. In their explanation, a party behaves responsibly to keep alive his partner's hope that he will continue to do so and thus discourage the partner from cheating.

only if both parties behaved responsibly in the previous period. Once a party cheats, no matter what his subsequent behavior, his partner will cheat in the next period. Given the parties' strategies, this implies that both parties will cheat in all future periods.

In the example above, a party will therefore behave responsibly if an infinite stream of payoffs of 5 is preferable to an initial payoff of 6 followed by payoffs of 2 forever. If a is the discount factor ($a < 1$), responsible behavior yields a discounted lifetime payoff of $5/(1 - a)$; and cheating yields $6 + 2a/(1 - a)$. Responsible behavior is thus weakly preferred if and only if $a \geq \frac{1}{4}$. As long as the discount factor is high enough for the value of continued cooperation to exceed the one-time gain from cheating, these strategies support cooperation in the repeated Prisoner's Dilemma. (There is, in fact, a range of supportable implicit agreements that favor one party or the other by permitting a party to reap the short-run benefits of cheating some of the time without ending the relationship.)

The strategies just described meet the normal standard of rationality in dynamic games (i.e., perfect Nash equilibrium): if a party ever cheated, he would cheat in all future periods no matter what his partner did, so it would be rational for his partner to punish him in keeping with his strategy. In theory, then, these strategies give credibility to threats to terminate the relationship in response to cheating, even though *both* parties would forgo the future potential benefits of cooperation if the threat were carried out.

Yet the realism of this way of supporting cooperation can be criticized on various grounds. Perhaps most important, it is not robust to "mistakes," which the theory assumes away but which are certainly important in practice. Axelrod (1984) presents experimental evidence that the tit-for-tat strategy (begin by behaving responsibly, and then behave responsibly if and only if your partner did so in the previous period) is a superior way to play the repeated Prisoner's Dilemma. Its punishments are severe enough to prevent cheating, but, unlike the strategies described above, "forgiving" enough to allow the relationship to recover after a mistake. Green and Porter (1984), Porter (1983), and Radner (1980, 1981) discuss strategies that perform well when there is some noise in the environment, so that cheating cannot be detected with certainty. These analyses confirm the intuition that when punishments are costly for the punisher as well as for the transgressor, it is advantageous to moderate their severity when they must actually be carried out.

2. *External Implicit Contracts.* External implicit contracts enforce cooperation by using the responses of parties outside the relationship to supplement the penalties for cheating in internal implicit contracts (see Bull, 1983; Crawford, 1985a; Cremer, 1986; Holmstrom, 1981; Kreps, 1984; and Wilson, 1985, for an overview; and Eaton, 1985, for an application to loan markets,

where intermediation is viewed as a device to ensure the costly enforcement of default penalties). For this kind of sanction to work, behavior within the relationship must be observable by parties outside it, and relationships with outside parties must be potentially valuable to the parties within the relationship.

Again, the repeated Prisoner's Dilemma provides a good illustration. Suppose that the economy consists of a large number of identical individuals, each of whom has many opportunities during his life to form relationships with other members of the population. Let each party adopt the strategy of behaving responsibly vis-à-vis another party if and only if that other party has never cheated in the past. When one party violates an agreement, he knows that he will never again find a partner who will behave responsibly with him. Because cheating is the only rational action in the one-stage Prisoner's Dilemma, and behaving responsibly can no longer yield any future benefits to someone who has already cheated, it would be rational for him to cheat again if he were lucky enough to form a relationship. This makes it rational for all other parties to cheat in relationships with him and ensures that such relationships will never form if they have any opportunity cost and if it is possible to find potential partners who have not yet cheated.

When parties have many potential opportunities to form beneficial relationships, these strategies support cooperation even when the immediate gain from cheating is high and parties discount the future significantly. When cheating is perfectly observable by all, external implicit contracts therefore support a wider range of agreements than internal implicit contracts.

3. *Explicit Contracts.* There is a third technique for enforcing cooperation, which I shall call "explicit contracting," for want of a better name. In explicit contracts, parties can base their current actions on past experience only to the extent that it *directly* influences the current costs and benefits of possible actions. Dependence on history that is informative but does not otherwise have a direct influence on the costs and benefits of parties' actions is not excluded, because new information directly influences expected costs and benefits. (By contrast, the implicit contracts discussed above support cooperation in the repeated Prisoner's Dilemma only by allowing parties to base their current decisions on history that does not influence the current payoffs, which are fixed throughout.)

A legally binding contract, which is the leading example of explicit-contract enforcement, provides a useful illustration, even though the sovereignty of nations makes it impossible to enforce such a contract in international capital markets. In the repeated Prisoner's Dilemma, such a contract between rational parties might simply stipulate responsible behavior for all time, specifying penalties for cheating that are high enough by themselves to make it unprofitable. In the numerical example discussed above, for instance, any

penalty greater than 1 for each instance of cheating would make it unprofitable.

More generally, explicit contracts work by changing the payoffs in the game in a way that creates incentives for parties to behave as desired. In the extreme case of perfectly, costlessly enforceable legal contracts, explicit contracting can duplicate the effects of a complete commitment about all future actions, except that it may be impossible to preclude renegotiations that both parties consent to.[3] Under more realistic assumptions, explicit contracts allow parties to make partial, but still useful, commitments by various devices, such as leaving reserves in foreign banks as "hostages" or choosing an investment policy that lowers the risk of default.

Explicit-contract analyses play an important role in the literature, partly because they allow the modeler to control the assumptions about the kinds of agreements parties can make and thus facilitate the analysis of the effects of realistic limitations on contracting. When no agreements are possible, the model is completely "noncooperative" in the conventional use of the term. As the set of allowable agreements is expanded to permit more complete stipulations about parties' choices, the model becomes more "cooperative." Note that the same standard of noncooperative rationality is maintained in each case: cooperative and noncooperative models are distinguished by their assumptions about parties' opportunities to make and enforce agreements, not by the principles that govern behavior in the agreements.

To the extent that implicit contracts succeed in supporting the desired agreements, the observable differences between implicit and explicit contracts are subtle. The problem lies in the importance of those portions of parties' strategies that specify what *would* happen if the agreement were violated. If violations do not occur, much of the structure of a working implicit agreement can remain invisible to outside observers. The kind of enforcement being used can only be inferred, within a fully specified model, from the kinds of commitment it allows parties to make.

When the short-run gains from cheating are large and parties discount the future, implicit-contract enforcement may be significantly less effective than a complete, legally binding explicit contract, if one can be made. Implicit contracts can penalize cheating only to the extent that future cooperation remains valuable, and this limits the range of supportable agreements. In environments like the one studied by Green and Porter (1984) and Porter (1983),

[3] Commitment not to renegotiate might actually be beneficial in some realistic circumstances (see, e.g., Hellwig, 1977, or Stiglitz and Weiss, 1983, which are discussed in Chapter 4). Whether such commitments can be enforced legally seems to be a delicate question: the modal response among lawyers I have asked is surprise at being asked the question, followed by the statement that it might be possible, in some cases, "with a good lawyer." In contrast, there seems to be no reason, at least in theory, why *implicit* contracts cannot preclude renegotiation.

where imperfect observability prevents parties from attaining the first-best outcome, the limitations may reduce efficiency as well as restrict the possible divisions of surplus. External implicit contracts tend to have a larger set of enforceable agreements than internal implicit contracts, because they punish cheating by ending cooperation not just with the cheater's current partner, but also with other potential partners.

3 ONE-PERIOD LOAN AGREEMENTS

The primary purpose of the models of one-period loan agreements discussed here is to explain the occurrence of credit rationing, defined broadly to include any method of allocating credit other than posting an interest rate for each identifiable class of borrowers and allowing each borrower to determine the size of his loan. Credit rationing may thus include nonlinear pricing of loans, the imposition of credit ceilings, and, in extreme cases, the complete cutoff of credit to some borrowers in some circumstances.

Credit rationing derives, ultimately, from the inability of lenders to exercise direct control over the fulfillment by borrowers of loan-contract obligations. In domestic capital markets, this inability follows from bankruptcy law. In international lending, the sovereignty of nations has the same effect. Because failures to fulfill loan obligations impose costs on the lender, this incompleteness of loan contracts creates externalities analogous to moral-hazard problems in insurance. When loan contracts are incomplete in other ways, the resulting externalities can lead in turn to more complex moral-hazard and adverse-selection problems, which are illustrated below. When, as is typical, the interest rate affects the borrower's incentive to fulfill his loan obligations, the lender can use additional instruments, such as credit limits, to deal more effectively with these problems.

It is useful to distinguish three kinds of failure to fulfill loan obligations: default, rescheduling, and repudiation. "Default," which technically means any failure to meet the terms of a formal loan agreement, will be used here to refer to an interruption of loan payments that is beyond the borrower's control. "Rescheduling" means a negotiated change in the timing, and perhaps the magnitude, of loan payments. "Repudiation" means a "voluntary" failure to meet loan obligations when it would be feasible (albeit costly) to meet them. Repudiation usually involves a complete, permanent failure to comply with the loan agreement, whereas default is normally temporary. (In models with only one repayment period, of course, repudiation and default are not very different, because it is impossible to distinguish between permanent and temporary interruptions.) In what follows, I shall use these definitions even when it requires a departure from the terminology used in the work being surveyed.

Bester (1985), Jaffee and Russell (1976), Keeton (1979), Stiglitz and Weiss (1981, n.d.), and Gale and Hellwig (1985) all study the use of credit rationing to control bankruptcy externalities in domestic loan markets. Because bankruptcy plays a role in domestic markets analogous to the role of default (or, in