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THE UNIVERSITY OF WOLLONGONG
DEPARTMENT OF ECONOMICS

**A SEQUENTIAL BARGAINING MODEL OF INTERNATIONAL
DEBT RENEGOTIATION**

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ABSTRACT

This paper models the renegotiation of an international debt contract. The model is distinguished from and extends the Bulow-Rogoff (1989a) complete-information model in that it uses an incomplete-information sequential setting which more closely approximates the actual bargaining situation facing countries and their creditors. The model allows a focus on the reasons for delays in reaching agreement, highlighting the important role played by information in reducing the time taken to reach agreement. It also allows a focus on the actual *process* of renegotiation, highlighting the choices faced by and the factors influencing the parties at each step of the bargaining. This contrasts with the instantaneous arrival at agreement by complete-information models which lack this particular dimension.

This paper is based on Chapter 4 of my PhD thesis, "The Economics of International Debt Renegotiation", submitted to the Australian Graduate School of Management, University of New South Wales, December 1989. For valuable comments and discussions I am grateful to Chris Adam and Bob Marks, my supervisors and also to Malcolm Fisher, Gerald Garvey, and John Powell. I wish also to thank my examiners Jonathon Eaton, Shelagh Heffernan and Douglas McTaggart. Finally, I thank John Roberts for first suggesting the game-theoretic approach to me. All remaining errors are my responsibility.

1. INTRODUCTION AND BACKGROUND

In recent years, the economics literature has drawn increasingly on advances made in bargaining/game theory to obtain insights into various aspects of the debt crisis. A problem with many of the models in the international debt literature, which typically assume that an indebted country chooses between the two extreme options of full debt service and total default, is that they do not allow for the possibility of intermediate outcomes, because the traditional tools of analysis which they employ would not permit a solution. The analysis has nothing to say about what sorts of outcome might emerge from the bargaining. It is only recently that the literature has begun addressing strategic issues (Eaton and Gersovitz, 1981, represents a well-known early example), and possibly the first study to adopt an explicitly bargaining-theoretic framework to analyse the debt situation did not surface till less than five years ago (Bulow and Rogoff, 1989a¹).

More recent studies have addressed a variety of other topics, including issues around reputation (Bulow and Rogoff, 1989b), the effect of bank size on the debt renegotiation process (Fernandez and Kaaret, 1988), as well as long-standing puzzles such as why we do not observe a debtors' cartel (Holler, 1989; Fernandez and Glazer, 1989). It has become increasingly obvious that many aspects of the debt crisis are amenable to a bargaining-theoretic treatment, and that the approach is capable of furnishing unique insights.

In this paper we use an extensive-form game to examine the set of actions available to the parties as they bargain over time. Unlike Bulow and Rogoff (1989a), who use the Rubinstein (1982) complete-information model, we adopt an incomplete-information setting. As is well known, in a setting of complete information, it is common to find (as Bulow and Rogoff, 1989a, do) that agreement between the parties is reached instantaneously, something that does not accord with what we observe in practice. A feature of the debt renegotiation situation (and, indeed, of most bargaining situations) is the incompleteness of the information available to the parties. For example, a central issue in debt renegotiations is the extent of the Borrower's inability to service the loan on the original terms. But it is precisely information on this which is difficult to obtain. Theoretically, information incompleteness is a cause of bargaining inefficiency (Sobel and Takahashi, 1983; Cramton, 1984; Fudenberg, Levine and

Tirole, 1985). This manifests itself as a delay in reaching agreement, or a complete failure to reach agreement despite potential gains to the parties. In sequential games, in which the parties are modelled as bargaining over time, delay in reaching agreement is a common result. The sequential game structure therefore allows us to focus on the role that information plays in reaching an agreement.

In typical debt renegotiation situations, the main motivating factor inducing the parties to reach agreement is their impatience to do so. The Borrower will have had his access to short-term funds severely restricted or cut off, and will be depleting finite stocks of foreign exchange reserves in order to continue his conduct of essential international trade. At the same time, the Borrower would also typically be in arrears on a significant portion of his international debt. Because Creditor banks are often under pressure to keep their loans "current" - U.S. banks, for example, are legally required to downgrade the status of loans that have not paid interest within ninety days of their falling due (see Lipson, 1985) - an early resolution is also in the interest of the banks. The equilibrium time path to agreement is therefore also of interest to us in this paper.

The model adopted in this paper is one of one-sided incomplete information in which only the Creditor's valuation of the loan to be bargained over is common knowledge. This structure allows us to focus on the information-transmission aspects of the bargaining situation. We can learn something about the way in which the equilibrium time path alters with changes in the informational structure because the way the Borrower responds to an offer from the Creditor conveys information to the latter about the former's willingness to pay. Similarly, the Borrower uses the initial offer of the Creditor to infer something about subsequent offers, and on the basis of that inference decides whether to accept the initial offer or to wait. As we shall see, even within this simplified structure we can derive important insights.

2. MODELLING DEBT RENEGOTIATION AS A SEQUENTIAL BARGAINING PROCESS

At the outset, it is important for us to identify the item being bargained over by the parties. This is the loan which the Creditor has already extended to the Borrower; and the

parties are bargaining over the (new set of) terms at which the loan is to be repaid. We assume that both sides expect positive gains from reaching agreement.

If no agreement is reached, we have a situation in which the Creditor can declare a default. The outcome of this declaration is that default penalties are invoked against the Borrower. These include the exclusion of the Borrower from credit facilities; his exclusion from the international payments system, with consequent difficulties in conducting international trade; and varying forms of trade embargo.² The Creditor may be able to seize some of the Borrower's assets which are held overseas, but these are typically of relatively insignificant amounts compared to the total debt outstanding. Moreover, there are no direct gains to the Creditor apart from these. The penalties imposed on the Borrower do not on the whole translate into direct benefits for the Creditor. Declaring a default will therefore not normally be in the Creditor's interest, although in the event of outright (explicit) debt repudiation by a Borrower, Creditors would find it in their interest to invoke default penalties, if only for the deterrent effects such an action would have on other would-be defaulters.

The cost of default to the Borrower will depend very much on how dependent on trade his economy is. The more open the Borrower's economy, and the more dependent on international trade it is, the more costly a default is likely to be. In the context of the current international economy, where a significant proportion of countries' national incomes derives from international trade, the cost of forced economic autarky is likely to be extremely high for the vast majority of countries. The inescapable conclusion is that not reaching agreement, or refusing to do so, is an irrational course of action for the Borrower as well.

In the situation we are modelling, the Borrower's knowledge (or lack of it) about the Creditor is not particularly relevant. The Creditors will typically refuse to consider rescheduling a loan unless the Borrower is in a state of "imminent default" - that is, unless they are convinced that the reason for the difficulty is an inability to pay on the Borrower's part.³ There is no other reason for the Creditor to modify the terms of the original loan.

The fact that the Creditors are able to specify the preconditions under which they are prepared to contemplate renegotiating the loan indicates that they hold some advantage over the Borrower in this situation. The Creditors are able to initiate a renegotiation simply by cutting off

ongoing sources of funds to the Borrower. Under these circumstances, the Borrower has little choice but to request a renegotiation subject to the Creditors' preconditions, the main one being that the Borrower satisfy the Creditors of his inability to pay. The fact that the Creditors are able, via the International Monetary Fund (IMF), to impose conditions on the Borrower as part of the terms of the renegotiated loan lends further support to our interpretation that the Creditors exercise some power over the Borrower.

Once a loan is in arrears, the value of it to the Creditors is zero. This is because the loan has already been extended and, for that reason, there is no other party which the Creditors can offer it to.⁴ This fact is common knowledge. Nonetheless, the Creditors hold contractual rights to the face value of the loan, and those rights count for something in a world of infinitely-lived (or close to it) institutional and country agents, however one may argue that those rights are directly unenforceable. The Creditors can make things very uncomfortable for the Borrower if he does not observe the original contract terms (Bulow and Rogoff, 1989a, Appendix). If, after the Borrower has demonstrated his inability to meet the original contract terms, the Creditors insist on receiving the contractual payments, this amounts to their making a take-it-or-leave-it offer. But since few direct benefits accrue to them from imposing default penalties (as we pointed out earlier), this course of action is not rational or, for that reason, credible. Because of their contractual rights, however, the Creditors will be able to press for a renegotiated payment amount as close to the face value as they can possibly obtain from the Borrower. This amount depends on the Borrowers' ability to pay, while the face value of the loan represents the maximum claim the Creditors are likely to make. In view of the above, we model the debt renegotiation situation as a game of one-sided incomplete information, where the Creditor has imperfect knowledge about the Borrower's ability or willingness to service his loan, while the Borrower is fully informed about the Creditor's valuation of the loan. In this game, only the Creditor makes the offers, while the Borrower responds to the offers by either accepting or rejecting the terms proposed. This assumption captures to some extent the Creditor's advantage over the Borrower. This is because, just as there is a first-mover advantage to the party making the initial offer in a game where both parties make offers (Rubinstein, 1982), bestowing on one party a greater frequency of opportunities to make offers

allows him to appropriate a larger share of the benefits from bargaining (see, for example, Bulow and Rogoff, 1989a).

We then solve for the unique stationary perfect Bayesian equilibrium.

3. THE MODEL

The model is an infinite-horizon one, and is a special case, after Fudenberg, Levine and Ruud (1983), of the Sobel and Takahashi (1983) model. There are two parties, a Borrower and a Creditor. For various reasons, the Borrower has suspended debt service payments on his loans, and has requested a renegotiation of his contract on more favourable terms. The Creditor therefore makes offers based on the information available to him about the Borrower's ability to service his loan. The Borrower's role in this model is passive in the sense that he responds only by accepting or rejecting the offers made by the Creditor.

The purpose of the model is to examine the equilibrium time path of offers by the Creditor, and to see what that time path depends on. We also examine the role of information in reaching agreement. The driving force which encourages an agreement to be reached here is the parties' impatience to do so. The parties to the renegotiation will be concerned about reaching agreement on a number of key variables, namely, the new maturity profile of the loan, the interest payments on it, and the timing of those payments. Each stream of cash flows will be discounted at the relevant discount rate by each party to obtain a certain value, which is that party's valuation of that particular stream of cash flows. Each stream of cash flows will obviously be valued differently by the parties because in general they will have different discount rates. For convenience, we refer to the discounted value from only the Creditor's point of view in our discussion of the model; but the reader should bear in mind that they refer to different streams of cash flows over various time horizons, and that they will be valued differently by the Borrower.

Let $t = 0$ represent the start of bargaining, and let the Creditor's offer to the Borrower at time t be denoted X_t . This represents the Creditor's valuation of the stream of cash flows he is suggesting the Borrower should adopt as his new payments schedule.⁵ The Borrower is able to pay an amount B which is known to him, but unknown to the Creditor. The Creditor's

reservation value of the loan is zero, and we assume that this is common knowledge. The zero valuation assumption simply reflects the fact that the loan has already been made and the Creditor cannot bargain with any other Borrower. Without loss of generality, we can take it that $B \geq 0$, since otherwise the Borrower would choose not to participate in the renegotiation.⁶ In other words, the parties start off with the common knowledge that there are mutual positive gains from reaching agreement.

Delay in reaching agreement is costly to the parties, since they both have positive rates of time preference. The Borrower's rate of time preference, ρ_B , is assumed to be common knowledge. In practice, ρ_B will be related to factors such as the openness of his economy (see Gasiorowski, 1985) and the size of his stock of foreign exchange reserves - in other words, it will be related to the vulnerability of the Borrower's economy to external pressure. The Creditor's rate of time preference, ρ_C , is also assumed to be common knowledge. It will be directly related to the interest rates determined by market forces, which reflect their opportunity cost of funds. A direct implication of this is that higher world interest rates, via their effect on his rate of time preference, puts the Creditor in a weaker bargaining position compared to before the increase in interest rates, since it makes him more impatient to reach a settlement. The Borrower and the Creditor both seek to maximise their respective payoffs from arriving at an agreement.

At each stage (t) of the game the Creditor makes an offer X_t which the Borrower may accept or reject. If the Borrower accepts the Creditor's offer, then his payoff is

$$\exp(-\rho_B t) [B - X_t],$$

while the Creditor's payoff is

$$\exp(-\rho_C t) X_t.$$

If the Borrower rejects X_t at time t then, after a time lag of δ , the Creditor makes another offer $X_{t+\delta}$. As we shall see, the Creditor's offers will decline with time, and so the Borrower is

presented with a well-behaved choice criterion in which the potentially increasing term $(B - X_t)$ is being discounted by the term $\exp(-\rho_B t)$.

The time lag δ is an important part of the analytic apparatus of this model. It is determined by institutional and other factors. For example, a large number of London Club creditors from different geographical regions may mean that each time an offer is rejected by the Borrower a significant time lag may be necessary before the next offer is made in order, first, for this fact to be communicated to all the creditors and, second, for a new set of offer terms to be formulated and agreed on. The time lag δ may also be interpreted as the Creditor's ability to commit himself since, once he makes an offer, he has to stand by it for the length of time represented by δ . If $\delta = \infty$ then the Creditor makes a take-it-or-leave-it offer. As we have argued earlier, such an offer is not credible, and we assume here that δ is strictly finite. Moreover, for simplicity, we assume that δ is a constant.

The Creditor does not know the value B that the Borrower is able to pay, but has the following cumulative density function defined over it:⁷

$$F(B) = \begin{cases} 0 & B < 0 \\ (B/\bar{B})^\lambda & 0 \leq B \leq \bar{B} \\ 1 & B > \bar{B} \end{cases} \quad (1)$$

for $\lambda > 0$. Equation (1) says that, in the Creditor's view, the lower bound of the range of possible values of B is zero, and the upper bound of this range is \bar{B} . The probability to the Creditor that the Borrower's valuation of the loan takes a value B within this range is some power λ of the ratio (B/\bar{B}) . Since the parties are here bargaining over the amount of debt relief the Borrower is to receive, we can reasonably assume that the largest conceivable value \bar{B} can take is represented by the original face value of the loan. Depending on the information available to the Creditor, however, it may well be less.

What factors determine B ? We argue that it reflects the Borrower's willingness to pay, which in turn depends on his ability to pay. It also will reflect the cost to the Borrower of agreeing to IMF conditionality, the terms of which he will already be aware of by the start of

bargaining.⁸ This will reflect in turn the size of any outstanding debt the Borrower has, since this will affect his incentives.

On the Creditor's side, notice that when λ is "large" the density clusters around the upper end of the range, and that when it is "small" the density clusters around the lower end of the range. The variable λ may therefore be interpreted as reflecting the Creditor's degree of optimism regarding how much of the value of the loan he can recover from the Borrower. Among other things, λ will depend on the bargaining strength of the parties with respect to each other. If the Borrower is "small" and the loan represents an insignificant proportion of the Creditor's portfolio, the latter can afford to adopt a tougher bargaining position. In this case, λ would be correspondingly larger. The variable λ would also reflect the information available to the Creditor regarding the Borrower's ability to pay.

A perfect Bayesian equilibrium can then be defined as a set of beliefs for the Creditor and a pair of strategies which satisfy the following conditions. First, the Creditor's beliefs about B should be updated (according to Bayes' rule) to take account of new information at each stage of the bargaining. Second, for each value of B , the Borrower's chosen strategy should be the best response to the strategy of the Creditor, and the Creditor's strategy should be optimal given both the Borrower's strategy and the Creditor's beliefs about B .

The Creditor's strategy will be to make offers, X_t , each period as a function of his previous offers. The Borrower's strategy determines for him, given B , which offers should be accepted, also as a function of previous offers. We assume that each player believes that his opponent will optimise in the future regardless of what has happened in the past (the equilibrium is then "subgame perfect"). This assumption is not innocuous: it rules out empty threats. In particular, it prohibits one potentially useful strategy: that is, the Creditor cannot make a take-it-or-leave-it offer in the first period. Because it is common knowledge that gains from agreement are available to both parties, it is in the Creditor's interest to continue bargaining towards an agreement, and therefore he cannot credibly commit to walking away from the bargaining table if his offer is rejected. This assumption seems to be consistent with what actually happens in practice.

We can now solve for the (unique) stationary reserve price equilibrium under the Bayesian updating procedure. The Borrower chooses a function $\tilde{X}(\bullet)$ and accepts the first offer which meets the criterion $X_t \leq \tilde{X}(B)$. That is, the function $\tilde{X}(B)$ generates a value (which we would, in equilibrium, expect *a priori* to be some fraction η of B); this is the maximum amount the Borrower is willing to pay to the Creditor (it is his reservation value) given their rates of time preference. A result quoted in Fudenberg, Levine and Ruud (1983) cites that (in a different context) the function $\tilde{X}(B)$ is strictly increasing in B . This result is intuitively reasonable: we can interpret it as saying that the greater the extent to which the Borrower is *able* to pay, the greater the amount he will be *willing* to pay the Creditor, given their respective rates of time preference. Then, given B , the first offer which equals or falls below this maximum amount is accepted.

The bargaining has started. The Creditor's prior beliefs about B are that it lies in the range $[0, \bar{B}]$. If a settlement has not been reached and the lowest offer made so far is \tilde{X}_t , then the Creditor will be able to use this information to upgrade his knowledge in the following way. Given the criterion for agreement, and given that the last rejected offer was \tilde{X}_t , the Creditor is able to infer that $\tilde{X}_t \geq \tilde{X}(B)$, and hence that $\tilde{X}^{-1}(\tilde{X}_t) \geq B$. In other words, if he knew the function $\tilde{X}(\bullet)$, he would use the value \tilde{X}_t in the inverse of it, and solve backwards to obtain the implied maximum value of B . The assumption here is that the Creditor knows what the function $\tilde{X}(\bullet)$ is.⁹ Given that, his posterior density can be derived as

$$F(B/\tilde{X}_t) = \begin{cases} 0 & B < 0 \\ (B/\tilde{X}^{-1}(\tilde{X}_t))^\lambda & 0 \leq B \leq \tilde{X}^{-1}(\tilde{X}_t) \\ 1 & B > \tilde{X}^{-1}(\tilde{X}_t) \end{cases} \quad (2)$$

So, while his lower limit (zero) remains unchanged, his upper limit is now $\tilde{X}^{-1}(\tilde{X}_t)$, where $\bar{B} > \tilde{X}^{-1}(\tilde{X}_t)$, and so the range of his beliefs about B has narrowed. His knowledge about the value of B has been improved as a direct result of the bidding process.

Notice that the range $[0, \bar{B}]$ can be interpreted as reflecting the Creditor's state of knowledge, or his degree of uncertainty, about the Borrower's ability to pay. The more

informed (less uncertain) the Creditor is about the Borrower's ability to pay, the narrower will be the range and the more quickly, other things equal, will agreement be reached.

We can now define more closely the concept of a stationary equilibrium. If the Creditor found it optimal to offer X_0 when he had the prior density $F(B)$, he now finds it optimal to offer

$$[\tilde{X}^{-1}(\tilde{X}_t)/\bar{B}] X_0 \quad (3)$$

when his previous lowest offer is \tilde{X}_t . Since $\tilde{X}^{-1}(\tilde{X}_t) \leq \bar{B}$ (it makes no sense for him to offer more than $\tilde{X}(\bar{B})$) this just means that his offer will now be a fraction of the initial offer X_0 . In other words, the move from the prior density to the posterior is simply a rescaling of his beliefs about the Borrower's reservation value of the loan B to a new scale $\tilde{B} \equiv [\tilde{X}^{-1}(\tilde{X}_t)/\bar{B}]B$. This is the merit of the functional form chosen here: updating simply changes the scale. As the size of the offers declines, so the density accumulates about a smaller range of possible values of B . Since each offer made by the Creditor on the equilibrium "concession schedule" is obviously going to be less than the previous one, the bidding function can be expressed as:

$$X_{t+\delta} = \gamma X_t \quad (4)$$

for some $0 < \gamma < 1$, which is constant over time under the assumption of stationarity, and where δ is the length of the bargaining period (the length of time between offers).

We now consider the Borrower's optimal strategy. If the Borrower accepts X_t , his gain from negotiation is $[B - X_t]$. If the Borrower waits one period, he receives $\exp(-\rho_B \delta) [B - \gamma X_t]$, given the discounting function of his payoff. Indifference between these two terms provides the intertemporal reservation value function $\tilde{X}(B)$, which occurs at the value of X_t that makes the Borrower indifferent between the two. This yields

$$\tilde{X}(B) = \eta B, \quad (5)$$

where

$$\eta \equiv \frac{1 - \exp(-\rho_B \delta)}{1 - \gamma \exp(-\rho_B \delta)}.$$

This tells us that the amount which the Borrower will be willing to pay the Creditor depends on his (the Borrower's) impatience to reach an agreement as well as on how quickly the Creditor reduces the size of his offers. Notice that the Borrower yields less (η is smaller) as the Creditor concedes more (γ is smaller). And if the cost of waiting increases (ρ_B or δ rise) then the value of η rises and the Borrower becomes more conciliatory.

Now we can find the optimal strategy for the Creditor (the value of γ). Let us take η as given and suppose that the Borrower rejected an offer of $X_{t-\delta}$ the previous period. If the Creditor next offers $\gamma X_{t-\delta}$, this offer is rejected with the probability $F(X_{t-\delta})/F(\gamma X_{t-\delta}) = \gamma^\lambda$, using the density assumed earlier. Define U_C as the expected value to the Creditor from offering X_t . The offer $X_t = \gamma X_{t-\delta}$ is accepted with probability $1 - \gamma^\lambda$. Imposing stationarity then means the Creditor obtains γU_C in the next period with probability γ^λ if the Borrower rejects X_t .

So the expected value for the Creditor under stationary conditions is

$$U_C = (1 - \gamma^\lambda) \gamma X_{t-\delta} + \gamma^\lambda \exp(-\rho_C \delta) \gamma U_C$$

or, after collecting terms,

$$U_C = (1 - \gamma^\lambda) \gamma X_{t-\delta} [1 - \gamma^{1+\lambda} \exp(-\rho_C \delta)]^{-1} \quad (6)$$

where ρ_C is the Creditor's rate of time preference. Differentiating this last expression with respect to γ , we find the first-order condition for a maximum of U_C to be

$$\exp(-\rho_C \delta) \lambda \gamma + \gamma^\lambda = 1 + \lambda \quad (7)$$

This has a unique solution for γ in the interval (0, 1). This may be seen by letting γ go first to zero and then to one. As γ approaches zero, the left-hand-side of (7) goes to infinity; with $\gamma = 1$ the left-hand-side is less than the right-hand-side of the expression. This tells us that the solution for γ lies strictly between zero and one. Differentiating (7) with respect to γ , we obtain $\lambda (e^{-\rho_C \delta} - \gamma^{1-\lambda})$ which is negative (making use of our earlier finding regarding the bounds for γ), thus confirming that the solution is also unique. Further, since the second-order condition for a maximum is satisfied, the solution for γ (call it Γ) is an optimum.

Despite the nonlinearity of the expression for Γ we can consider its marginal responses to changes in the parameters of the expression. Inspection of the first derivative of (7) shows that a rise in ρ_C or δ , which represents increases in the cost of delay to the Creditor, reduces Γ and so implies that the Creditor concedes more rapidly. An increase in λ increases Γ and lowers the concession speed. This result is reasonable: a rise in λ means the density $F(\bullet)$ accumulates at its upper value of \bar{B} . Since even a minor concession on the part of the Creditor will cause the Borrower to accept the offer, there is no reason for the Creditor to concede swiftly. Intuitively, since the Creditor's degree of optimism (reflected by λ) regarding the amount he can recover from the Borrower is "higher", he will tend to make smaller concessions each time.

Now it remains for us to determine the appropriate level of the initial offer. Any rejected offer $X_{t-\delta}$ implies that $\eta B \leq X_{t-\delta}$, and the next chosen offer for debt relief will be $X_t = \Gamma X_{t-\delta}$. The initial guess about B cannot place it above \bar{B} , and stationarity implies that the first offer should be $X_0 = \Gamma \eta \bar{B}$. The concession schedule from there becomes

$$X_t = \Gamma \eta \bar{B} \Gamma^{t/\delta} \quad (8)$$

when offers are made after each interval δ . This function represents the unique stationary perfect Bayesian reservation price equilibrium.

We have ignored the nonstationary equilibria, which may yield higher returns to one side or the other; such equilibria make the time path dependent on the starting date and the entire

sequence of associated information rather than just the data relevant to a move from any one time period to an adjacent one. Further, nonstationarity implies that the probability of the bargaining persisting another "round" depends on the length of the period between offers being made. This prevents a closed-form solution for the model, although simulation may be used to study special cases.

4. EVALUATING THE OUTCOMES

The model presented in this paper offers a number of insights and suggestions on addressing some relevant issues in international debt. First, the model establishes the existence of an equilibrium, which is unique, under the assumption of stationarity. This equilibrium depends on a number of key parameters associated with the bargainers' time preferences and views of the world (the Creditor's optimism regarding the Borrower's ability to service his debt), as well as established data (e.g., publicly-available information on the Borrower's financial position).

Second, the equilibrium supports the model structure where only one side of the bargaining process has full information. Under this model structure, the Borrower has little incentive to reveal the level of B to the Creditor. The information incompleteness is the source of delay in reaching agreement in this model, and this, together with the lack of incentives for the Borrower to reveal his valuation, implies a need for an external party which is able to provide the required information, in order to reduce the level of uncertainty around the Borrower's economic state of affairs. This is in part the function fulfilled by the IMF when a standby agreement is reached with the Borrower.

Some of the observations we made earlier also have interesting implications. Equation (5), for example, suggests that, if it is in the Creditor's power to increase the Borrower's cost of waiting (ρ_B), it would be in his interest to do so. We know in fact that it is within the power of bank creditors to do just that. Simply by cutting off access to further credit and forcing the Borrower to draw down on his stock of reserves means that the more reliant on international trade the Borrower's economy is, the more subject to such pressure he will be.

Further, denying access to the international payments system means that the Borrower has to resort to alternative means of payment (such as counter-trade, or barter, for example), and imposes additional costs on the Borrower.

Looking beyond the model, it suggests possible reasons why London Club negotiations are so much more protracted than Paris Club ones.¹⁰ The parameter δ , representing the time lag between successive rounds of bargaining, can be interpreted as, *inter alia*, reflecting delays by the Creditors in framing a new set of offer terms when the previous set of terms is rejected by the Borrower. Because London Club creditors tend to vastly outnumber Paris Club ones, the coordination problems in the former group are correspondingly greater. Although these problems are mitigated to some extent by the (comparatively recent) commercial-bank practice of coordinating operations through steering committees, there is still the problem of communicating decisions to all the individual creditor banks involved. While the model does not explicitly address the issue of coordination, the obvious conclusion is that better coordination among creditors who comprise the lending syndicate as a whole would reduce the time taken to reach agreement. In the context of the model, this occurs via a reduction in δ .

5. CONCLUSION

The contribution of this paper is the application of a model which allows a dual focus on aspects of the debt renegotiation situation. First, the model allows a focus on the reasons for delays in reaching agreement, highlighting the important role played by information in reducing the time taken by the parties to reach agreement. The degree of uncertainty as reflected in the range $(0, \bar{B})$ is reduced as more preliminary information is made available to the Creditor. As a direct result, given the parameters of the model, the time taken to reach agreement will be reduced. Since the Borrower has no incentive to reveal his private information, an external party which is able to provide the information would speed up the bargaining process. Recent developments, in particular the formation of the Institute of International Finance in 1983, support the relevance of this result. That organisation was formed to provide its commercial-

bank members with information corresponding to that provided to the multilateral institutions on a confident basis (Surrey and Nash, 19840).

Second, the model allows a focus on the actual *process* of renegotiation, highlighting the choices faced by the factors influencing the parties at each step of the bargaining. This contrasts with the instantaneous arrival at agreement by complete information models (eg. Bulow and Rogoff, 1989a) which, while valuable, lack this particular dimension.

Therefore, while the findings of the model may not be novel in a purely theoretical sense, the application of it to the debt renegotiation situation lends a further dimension to our understanding of the problem.

ENDNOTES

- 1 An early version of this paper appeared as a National Bureau of Economic Research working paper in December 1986.
- 2 See the Appendix to Bulow and Rogoff (1989a) for estimates of the costs of trade disruptions for some Latin American Countries.
- 3 See Rieffel (1985). Another reason why the Creditors do not approach the Borrower for a renegotiation may be because doing so would place them at a disadvantage right from the start: they would implicitly be accepting the premise that the Borrower actually does need a softening of terms, rather than requiring the Borrower to prove his need.
- 4 This ignores the secondary market in bank loans, which is generally very thin in any case, so that prices quoted on it cannot be taken as good indicators of what the Creditor banks would be able to obtain for their loans (Fischer 1989). The fact that a loan syndicate in the process of renegotiating the loan contract was seeking to sell off portions of that loan would very likely be taken as a bad sign, forcing the price of the loan towards zero.
- 5 In actual bargaining, what the Creditor puts forward as his offer will be a suggested stream of cash flows which the Borrower then puts a value on.
- 6 Fudenberg, Levine and Tirole (1985) discuss the case of a buyer and a seller, with a model structure similar to ours: the seller makes all the offers and has incomplete information about the buyer's valuation; and the parties' discount factors and the seller's production cost are common knowledge. They show that if it is common knowledge that the buyer's valuation strictly exceeds the seller's, then not only does an equilibrium exist, but it is also unique.
- 7 While this is an arbitrary functional form, it is flexible enough to accommodate a considerable range of alternative densities if necessary to model the outcomes of empirical work (Fudenberg, Levine and Ruud, 1983).
- 8 This is because the most fundamental precondition for a rescheduling, in either the Paris Club or the London Club, is that the Borrower must have concluded a "standby agreement" with the IMF covering the period for which debt relief is requested. This is an agreement which assures the Borrower (who must be a member of the IMF) that he may draw on IMF resources up to a specified amount during a given period without further review of its economic policies, provided he has observed the conditions and other terms of the agreement. If the conditions are not observed, the Borrower's access to further credit is interrupted.
- 9 This in turn rests on our assumption that the Borrower's rate of time preference is known to the Creditor (see Equation (5)). Since η is a function of both the Borrower's rate of time preference as well as γ , the rate at which the Creditor makes concessions, and the latter is known to the Creditor, the common knowledge assumption of the parties' rates of time preference turns out to be crucial.
- 10 While Paris Club negotiations are usually concluded within thirty-six hours (Rieffel, 1985), London Club ones may take more than a year to reach agreement (Park and Zwick, 1985).

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