International Bank Lending to LDCs -

An Information Based Approach

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Abstract

This paper develops an information based theory of international bank lending that is compatible with the LDC debt story of the 1970s and 1980s and emphasises the importance of market structure as a factor contributing to financial crises. A feature of the market for sovereign loans, hitherto neglected, has been the leadership role played by a small group of major international "money-centre" banks and their subsequent influence over a much larger grouping of smaller, "regional" banks. Lending behaviour amongst such creditor heterogeneity is captured using a signalling model that takes into account the incomplete information environment created by sovereign risk. Our main finding is that the "herd-like" behaviour of the late 70s and early 80s may have, in part, been generated by large money-centre banks seeking to capitalise on their ability to influence the inferences and actions of their smaller rivals'.

1. Introduction

Theoretical analysis of the "LDC debt crisis" has, in the main, been concerned with the post-crisis (post-1982) phase: a period characterised by credit scarcity and moves towards the partial relief and forgiveness of debt obligations.[1] Relatively little attention, however, has been devoted to an adequate explanation of the large build-up of commercial bank loans to the LDCs in the 1970s, a period in which according to Kindleberger (1989), "*multi-national banks...practically forced money on the less-developed countries*" (emphasis added). The popular defence of the lending spree was the appeal to Citicorp chairman Walter Wriston's declaration that "countries can never go bankrupt". Given this naive view of sovereign lending, the immediate consequences of the oil price rise of 1973-94 offered banks in the industrial countries new and apparently profitable investment opportunities overseas, at a time when domestic demand for credit was low because of recession.

Bank lending activities were more than just vehicles for smooth inter-temporal arbitrages and went beyond the recycling of OPEC surpluses. They were substantially influenced by institutional developments in the Euro-dollar market

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[1] See, for example, the papers by Sachs (1989), Krugman (1988) and Bulow & Rogoff (1989a,b)

which gave banks an advantage over international bond and direct investment markets in intermediating the flow of loans to LDCs.[2] The scale of loans to the LDCs led, moreover, to the development of syndicated lending. This lowered market perceptions of risk even further and dramatically increased the entry of new banks, particularly after 1977. Sovereign lending to LDCs between 1973-79 was therefore characterised by growing competition and rising confidence in the banking sector at large.

The lower perceived levels of risk of international bankers can be evidenced in the behaviour of interest rate spreads and country credit ratings (figures 1, 2). Interest rate spreads on publicly guaranteed loans to non-oil LDCs declined significantly from 1977 through to the early 1980s. Furthermore, figure 1(b) suggests that there was no indication of spreads rising before the Mexican moratorium of August 1982. These findings are supported by the Latin American credit ratings - during 1979-82, market confidence in the big four Latin American economies (Argentina, Brazil, Mexico, Venezuela), although showing some signs of decline, was well above the global average country credit

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[2] Some commentators, eg Folkerts-Landau (1985), have suggested that financial innovations in the domestic banking systems of industrial countries such as the US may have contributed to lower risk on the deposit liabilities of money-centre banks.

rating. As with interest spreads, these were not adversely affected until after 1982.

The remarkable aspect of international bank behaviour is not the rate of lending during 1973-79, but rather the outpouring of loans between 1979 and 1981, a period in which the world macroeconomic situation had soured markedly. Sachs (1989) stresses that bank lending did not slow down in anticipation of the impending crisis. As Table 1 indicates, in a mere three years (1979-81), total bank exposure *vis-à-vis* the major Latin American countries more than doubled over 1978 levels. As is well known, the anti-inflationary stance of the industrial countries after mid-1979 provoked a sharp rise in interest rates, an industrial country recession, and a steep fall in export prices and the terms of trade of the LDCs. Moreover, the prospects for future growth in LDCs such as Argentina and Brazil as reflected in the Private Investment/GDP ratios of this period appeared limited (figure 3). As Sachs(1989) notes, despite the debt-warning signs in the two years after the rise in real interest rates (see table 1, figure 4), the commercial banks made about as many net loans to the major debtors as during the entire period 1973-79. In short, at a time when increasing prospects of debt-servicing difficulties should have lead to higher spreads, lower credit ratings and reduced lending, the opposite occurred.

An important element in lending behaviour, hitherto neglected, has been the nature of the market for loans. The existing literature largely assumes perfect competition amongst lenders and sheds little light on the observed pattern of lending operations. Jones (1993) has argued, however, that syndicated lending to LDCs in the 1970s was characterised by strategic battles for market share between rival groups of syndicates.[3] In particular, syndicated lending was dominated by a small group of lenders, namely the US money centre banks, who assumed a leadership role in managing syndicates by virtue of their decision to pursue LDC clients at the beginning of the 1970s.[4] A second group of "follower" banks, which included regional US banks and non-US banks, were also active in organising syndicated credits but pursued more passive lending strategies. Moreover, as Eaton *et.al* (1986) observe, the oligopolistic nature of the international crdit market can give rise to free-rider problems in information. If one bank (or syndicate) is seen to be lending to a particular country, other banks may lend without adequate analysis of the country's position. There seems to be a case, therefore, for providing a model which addresses leader-follower behaviour in the market for international loans that takes into account the informational environment of that market.

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[3] Spiegel (1992) also presents a model of debt negotiations that emphasises creditor heterogeneity.

[4] The major money-centre banks are: CitiCorp, Bank America, JP Morgan, Chase and Manufacturers Hannover. Anecdotal evidence highlighting the client-chasing behaviour of banks in the lead-up to the debt crisis is provided in Basu (1991).

In what follows, we provide an information based theory of bank lending that is compatible with the broad evidence of the 1976-82 period. Our approach emphasises the strategic concept that leaders take actions at one stage in an attempt to influence their rivals' actions in subsequent stages. A credit market is introduced which comprises a representative money-centre bank and a representative regional bank, with the money-centre bank acting as market-leader in the Stackelberg sense. Expected payoffs for each bank in the model depend on the lending strategy of its rival. Both are uncertain about conditions in the debtor country, but have access to private forecasts about debtor performance. In this environment, the money-centre bank knows that its lending strategy reveals some of its information to its rival. As a result, it has an incentive to manipulate the regional banks' beliefs about the debtor. We demonstrate that, in the presence of incomplete information, a unique separating equilibrium exists where lending by both banks is greater than in the full information variant of the game. Conditions are derived under which the regional bank becomes more reliant on the actions of the money-centre bank for information - the more important the actions of the money centre bank, the greater is the distortion of lending above the full information level. The result thus captures the flavour of *herd behaviour*, in the sense that the regional bank attaches a greater weight to information other than its own.[5] Adjustment effort by the debtor is shown to be lower than under full information and declining in macroeconomic uncertainty.

The informational effects that arise in our model resemble those discussed by Gal-Or (1987), Judd & Riordan (1994) and Hviid (1992) in an industrial organisation context. As in the present works, they show how leading firms revise their strategies in an attempt to "fool" potential rivals in a setting where market demand is linear and stochastic.

The remainder of the paper is as follows. In the next section, we describe the model, giving a detailed presentation of the full information case in order to have a benchmark to evaluate the case of private information. Section 3 contrasts the results with the stylised evidence of the period and section 4 concludes.

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[5] Scharfstein & Stein (1990) present a model of herding that relies on managerial reputution and the incentives of bankers to "share the blame" for poor credit choices. Bannerjee (1992) and Bikchandani *et.al* (1992) present models of herding in more general settings that do not rely on prinicipal-agent relationships.

2. The Model

Consider the following stylised model of the international credit market. Creditors consist of two representative banks referred to as the "money centre" and "regional", or banks "1" and "2", respectively. Banks are identical in all respects except for the move order in which they make loans. Bank 1 is assumed to be the leader by virtue of its greater institutional (or political) presence in the debtor country. Let π be the net expected return, or payoff, that bank i can expect on its developing country loan. It is given by

(1) $$\pi_i = \alpha(1+r)L_i - \varphi(\Sigma L_i)L_i \qquad ; i = 1, 2$$

where L_i denotes the exposure of bank i to the debtor country as a percentage of total equity, r denotes the interest rate spread facing the debtor and α is the percentage of the debt obligation serviced by the debtor. In what follows, the units on L_i relate to percentages. Table 2 details the LDC exposure of some leading US banks as a percentage of total equity. As can be seen, the figures vary in size from 50% to 230%. It is assumed that banks face an opportunity cost of funds that is a linearly increasing function of total exposure to the debtor country.[6]

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[6] Sachs (1984) and Spiegel (1992) have suggested that upward sloping supply curves for funds might stem from premia charged by uninsured depositors.

The debtor country is assumed to care about two things: the level of resources available to it and the size of the adjustment effort it is required to make. We define the LDC's resource transfer potential as:

(2) $$\alpha = x + u$$

where x is a random variable reflecting the overall economic environment ("fundamentals") and u is a choice variable capturing "adjustment effort", i.e all those actions that debtors can undertake that affect their ability to make resource transfers: trade policies, investment, budget policies and so on. Output depends linearly on the amount borrowed and an initial endowment of capital per head, k:

(3) $$y = A(k + \sum L_i) \qquad ; A > 0,\ i = 1, 2$$

where A is a constant productivity parameter.

Assuming quadratic costs to adjustment effort, the debtor chooses the size of adjustment effort, u, to maximise

(4) $$W = A(k + \sum L_i) - \alpha(1 + r)\sum L_i - \frac{\gamma}{2}u^2$$

Complete Information Equilibrium:

Before turning to the separating (signalling) equilibrium of the game under incomplete information, it is useful to set out the simplest case of the model where there is no uncertainty about x. If banks possess full information about fundamentals, x, and adjustment effort, u, we can frame the above as a two-stage game in which the debtor moves first choosing a level of adjustment effort to maximise welfare. Creditors then choose loan exposures in the second stage of the game. By backwards induction, we first solve for the equilibrium levels of loan exposure (L_1^*, L_2^*) in the Stackelberg game between the banks conditional on adjustment effort before turning to the optimisation problem of the debtor.

Differentiating bank 2's payoff function (1) with respect to L_2 we obtain the first-order condition for profit maximisation, namely:

$$\text{(5)} \qquad \frac{\partial \pi_2}{\partial L_2} = \alpha(1 + r) - \varphi L_1 - 2\varphi L_2$$

yielding, for $d\pi_2/dL_2 = 0$,

$$\text{(6)} \qquad L_2 = \frac{\alpha(1 + r)}{2\varphi} - \frac{L_1}{2}$$

which is bank 2's reaction function. Substituting (6) into bank 1's payoff function and differentiating with respect to L_1 yields:

(7) $$\frac{\partial\pi_1}{\partial L_1} = \frac{\alpha(1+r)}{2} - \varphi L_1$$

implying that, in the full information Stackelberg equilibrium, loan exposures (equation 8) are increasing in spreads,r, in adjustment effort,u, and decreasing in φ, the marginal cost of borrowing. As might be expected from a Stackelberg game, the money-centre bank lends more than its rival.

(8) $$L_1{}^* = \frac{\alpha(1+r)}{2\varphi}$$
$$L_2{}^* = \frac{\alpha(1+r)}{4\varphi}$$

It remains for us to solve the optimisation problem of the LDC planner. The optimal creditor decisions are incorporated into the effort decision of the debtor. Substituting (8) into (4) yields the first order condition:

(9) $$\frac{\partial W}{\partial u} = -2(1+r)M[x+u] + AM - \gamma u$$

where $M = \frac{3}{4}\,[(1+r)/\varphi]$

Optimal adjustment effort on the part of the debtor balances the marginal benefits of receiving external finance against the marginal costs of exerting effort and is, therefore,

(10) $$u^* = \frac{M[A - 2x(1+r)]}{2M(1+r) + \gamma}$$

where we note that if the debtor's effort level is to have an interior maximum, it must be the case that $-2M(1+r) - \gamma < 0$. Furthermore, within the parameter space of positive adjustment effort (where $A > 2x(1+r)$), it can be seen that the lending strategy of the money-centre bank is more sensitive to debtor nation income shocks (i.e. changes in x, A) than that of the regional bank.

Notice that M corresponds to the marginal response of total lending by banks to the adjustment effort expended by the debtor and depends on the parameters of the model. It is straightforward to demonstrate that $du^*/dM > 0$. This has an intuitive explanation, namely that if marginal increases in adjustment effort by the debtor do not have a significant impact on lending (i.e M declines), then optimal effort by the debtor (u^*) will be lower as a result.

The Role of Private Information:

In the game developed so far the money-centre and regional banks have enjoyed complete information. At each decision stage, each bank has been assumed to possess full knowledge of debtor country resource transfer potential as reflected in the parameter α. It is clear, however, that banks are unlikely to possess complete information about α. Analysis of lending behaviour must, therefore, be fashioned as a game of incomplete information where strategy and/or payoff sets are not common knowledge, but are only known probabilistically.

We model incomplete information by assuming that expected bank returns, π_i, are stochastic. In particular, x is a normally distributed random variable with mean $\bar{x}$ and variance σ^2_x. In addition, we suppose that banks are unable to observe debtor country adjustment effort. However, each bank has access to private information about the debtor's repayment potential before making its lending decision. This private forecast is given by:

$$(11) \quad S_i = \alpha + \upsilon_i \qquad ; i=1, 2$$

where ν_i is a normally distributed random variable with mean zero and variance σ^2_ν that represents idiosyncratic forecasting shocks. As a further simplification, we assume that there is zero covariance between the two banks' forecasts of extraneous shocks ($cov(\nu_1, \nu_2)=0$) and that the shocks are independent of debtor-country resource transfer potential ($cov(\alpha, \nu_i)=0$ for all i). The form of (11) is common knowledge, and it is the realisation of S_i that is private information[7].

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[7] The assumption that bank forecasts are generated by a p.d.f. that is normally distributed allows us to deal with linear conditional expected values and, hence, linear updating rules for banks. This approach is standard in the industrial organisation literature (eg Gal-Or 1987, Judd & Riordan 1994).

We note at the outset that the conditional expectation of α, given S_1 is:

(12) $$E[\alpha|S_1] = \bar{x} + u^e + \tau(S_1 - \bar{x} - u^e)$$

where τ is defined as $\tau \equiv \sigma^2_x + (\sigma^2_x+\sigma^2_v)$ and where u^e reflects bank 1's expectations about debtor country adjustment effort.

Consider now a leader-follower game with loan exposure as strategies, where each bank chooses its level of sovereign exposure after observing its private forecast but before the realisation of the actual value of x. For instance, when bank 1 chooses a quantity L_1, it can condition it on its private forecast. Bank 2, on the other hand, can condition L_2 both on its private forecast and on the lending choice of bank 1. In other words, the follower can use the lead bank's choice of L_1 to draw some inferences about the leader's private information. We limit our attention to positive values of L_1 and L_2 and denote bank 1's and bank 2's strategy by $L_1(S_1)$ and $L_2(S_2, L_1)$ respectively, where L_1: $R \rightarrow R^+$ and $L_2 : R \times R^+ \rightarrow R^+$.

A key feature of the incomplete information situation outlined above is that the history of market moves can be used by the follower to update information about its rival. The regional bank can specifically review the money-centre bank's lending decision to extract information about the money-centre bank's ***type***. The ***type*** of bank refers, in this instance, to the nature of the money-centre bank's forecast, i.e the money-centre bank can come in two (or more) types: a "pessimistic" forecast type and an "optimistic" type. The money-centre bank knows this and attempts to use its lending strategy to decieve its rival. In particular, it would like to signal that conditions in the LDC are bad in order to capture greater market share. For its part, the regional bank knows that such deceptions are being played and uses that information to condition its lending decision. Further, the money-centre bank will know that the regional bank knows that it will attempt a deception, and will again attempt to take advantage of that - and so on in infinite regress. In such dynamic games the relevant solution concept is the perfect Bayesian equilibrium.

To begin with, let us suppose that bank 2 can infer S_1 from L_1 through the following conjectured relationship:

(13) $L_1 = f(S_1)$

where the function $f(.)$ is assumed to be continuous and strictly increasing. In other words, according to the quantity decision rule postulated in (13), the leader lends more if it observes favourable information. We define the set $f^1(L_1)$ as follows:

(14) $\phi(L_1) = f^{-1}(L_1) = [S_1 | f(S_1) = L_1]$

Thus, if the follower observes that the leader produces L_1, it can infer that the private forecast of the leader belongs to the set $\phi(L_1)$. Following Gal-Or (1987), we focus our attention on the unique, differentiable pure strategy separating equilibrium. This equilibrium is perfectly revealing since the follower can always invert the function *f(.)* and perfectly infer the private information of the leader. This focus does not exclude the possible existence of partially revealing, or non-revealing, equilibria. At those alternative equilibria, however, the leader may select a decision rule which is discontinuous or non-invertible.

For simplicity, we postulate that bank 1's strategy takes the linear form:

$$L_1 = a + bS_1 \tag{15}$$
$$\Rightarrow S_1 = \frac{L_1 - a}{b} = f^{-1}(L_1) = \phi(L_1)$$

The linear solution to the game is intuitive. If banks use ordinary least squares to compute mean expectations, they will be using linear rules necessarily. Linear inference rules by banks in turn make linear decision rules by the debtor optimal. The slope parameter *b* may be thought of as the weight attached by the money-centre banks to its private forecast.

Now bank 2's conditional expectation of α, given its private forecast S_2, and its inferences about bank 1's private information, $\phi(L_1)$, can be written as:

$$E[\alpha|S_2,\phi] = \bar{x} + u^e + \frac{1}{2}\tau(S_2 - \bar{x} - u^e) + \frac{1}{2}\tau(\phi - \bar{x} - u^e) \tag{16}$$

So, when the follower attempts to infer the leader's private information from its observation of L_1, its reaction function can be expressed as:

$$(17) \quad L_2 = \frac{E[\alpha | S_2, \phi](1+r)}{2\varphi} - \frac{L_1}{2}$$

implying,

$$(18) \quad L_2 = \frac{(1+r)(\bar{x}+u^e)}{2\varphi} - \frac{L_1}{2} + \frac{1}{\varphi}\left[\frac{1}{4}\tau(1+r)(S_2 - \bar{x} - u^e) + \frac{1}{4}\tau\left(\frac{L_1 - a}{b} - \bar{x} - u^e\right)\right]$$

Equation (18) may be compared with its full information counterpart (6). They are the same except for the final term which involves bank 2's signal S_2, it's perceptions of bank 1's signal, ϕ, and banks' expectations about debtor country effort. Notice that bank 1's choice, L_1, has two effects on the choice of bank 2:(i) the direct, and familiar, Stackelberg effect, and (ii) an indirect effect on the beliefs of 2 about the realisation of α. We can, therefore, make the following observation relating to the slope of the reaction function of the follower:

Observation 1: In an incomplete information environment, the follower's reaction function may slope upwards if the informational effects arising in the model are dominant. More explicitly, the slope of the follower's reaction curve is given by:

$$\frac{dL_2}{dL_1} = -\frac{1}{2} + \frac{(1+r)\tau}{4b\varphi}$$

The expression derived for the slope contains two terms contradicting in sign. The first term (-1/2) coincides with the regular negative slope in the perfect information Stackelberg game. The second (positive) term reflects the informational relationship between the loan exposure of the leader and that of the follower. Clearly, the reaction curve may be positively sloped if the latter effect were to dominate. As can be seen, this relationship implicitly depends on the variance of x, σ^2_x, through the definition of τ in equation (12). In addition, it also depends on b, the weight placed by the money-centre bank on its private signal. Thus, in circumstances where lending takes place under increasing macroeconomic uncertainty *($\sigma^2_x \rightarrow \infty$)*, an increase in exposure by bank 1 induces increased exposure on the part of bank 2.

Substituting bank 2's reaction function into the payoff function for bank 1 (equation 1), differentiating with respect to L_1 and taking expectations yields:

(19)

$$\frac{\partial \pi_1}{\partial L_1} = E[\alpha|S_1](1+r) - \varphi L_1 - \frac{(1+r)(1-\tau)(\bar{x}+u^e)}{2} - \frac{\tau(1+r)}{4}\left[E[S_2|S_1] + E[\phi|S_1] - E[\phi'(.)|S_1]L_1\right]$$

We are searching for an equilibrium in which bank 2's inference rule is correct , that is, if bank 1 lends L_1 then bank 2 is correct in believing that the forecast (S_1) observed by bank 1 actually equals *$[L_1-a]/b$*. Thus,

(20) $\quad E[\phi(.)|S_1] = S_1$

Moreover, following the methodology of Hviid (1992), we can show that

(21)
$$E[S_2|S_1] - \bar{\alpha} = E[\alpha|S_1] - \bar{\alpha}$$
$$E[\phi'(.)|S_1] = \frac{dS_1}{dL_1} = \frac{1}{b}$$

Equations (20), (21) allow us to express equation (19) as

$$\frac{\partial \pi_1}{\partial L_1} = (1+r)[\bar{x}+u^e+\tau(S_1-\bar{x}-u^e)] - \frac{(1+r)(\bar{x}+u^e)(1-\tau)}{2} - \frac{\tau(1+r)}{4}\left[S_1+\bar{x}+u^e+\tau(S_1-\bar{x}-u^e)+L_1\left(\frac{1}{b}-\varphi\right)\right]$$

where we note that for an interior maximum, it must be the case that

$$\frac{\partial^2 \pi_1}{\partial L_1^{2}} = \frac{-\tau(1+r)\left[\frac{1}{b}-\varphi\right]}{4} < 0$$

(22)

$$\Rightarrow 0 < b < \frac{1}{\varphi}$$

Observation 2: In the incomplete information stage game, both banks lend more than under full information. The unique, pure linear separating equilibrium lending strategy of the banks in the stage game is given by:[8]

$$L_1{*} = \frac{(1+r)}{\left[\varphi - \frac{\tau(1+r)}{4b}\right]}\left[\frac{\bar{x}+u^e}{2} + (S_1-\bar{x}-u^e)\left\{\frac{3}{4}\tau - \frac{1}{4}\tau^2\right\}\right]$$

(23)

$$L_2{*} = \frac{(1+r)(\bar{x}+u^e)}{2\varphi} - \frac{L_1{*}}{2} + \frac{\tau(1+r)}{4\varphi}\left[S_2 + \frac{L_1{*}-a}{b} - 2\bar{x} - 2u^e\right]$$

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[8] A proof of uniqueness is omitted for clarity of exposition. The uniqueness property follows from the nature of the "signalling" first-order ordinary differential equation implicit in the analysis above. An example of the method of proof can be found in Gal-Or (1987).

The preceding analysis enables us to identify two effects from which the follower benfits because of its second move in the game. First, since it is able to infer perfectly the private information of the leader, it is as well informed as the money centre bank about LDC conditions when it chooses its strategy. Second, in addition to this "better information effect", there is what Gal-Or (1987) terms a "conjectural variation effect". This effect is captured by the term $(1+r)\tau/4b\varphi$ in *Observation 1*. It measures the amount by which the incomplete information reaction curve exceeds the slope of its full information counterpart. As such, it measures the weight given by the follower to L_1 in updating its expectations about α. From *Observation 1*, we see that for τ small, $dL_2/dL_1 < 0$; that is, bank 2 will generally produce less for a given amount of L_1. As τ becomes larger, the "conjectural variation" effect takes hold and the reaction curve of bank 2 more steeply, and ultimately positively, sloped. The meaning is that bank 2 relies heavily on the observation of L_1 as a means of updating its beliefs about debtor country effort. Our model thus captures, albeit in a very simple way, the flavour of ***herd behaviour***, according to which agents pay more attention to the information of others than to their own private signals.

Figure 4 , together with a comparison of equations (8) and (23), provides an illustration of the effects on loan exposure in an incomplete information Stackelberg environment where the information effect is dominant. Bank 1's reaction curve becomes steeper and shifts outwards as a result of the strategic effects of information, whereas bank 2's reaction curve slopes upwards. Both banks will lend more than in full information.

Noting that, in equilibrium, banks' expectations about debtor country adjustment effort are correct and, hence, that $u^e = u$ we once again substitute the banks' equilibrium loan exposures (L_1^*, L_2^*) into the debtor's optimisation problem (4). The first-order condition for the debtor country takes the form

$$\textbf{(24)} \qquad \frac{\partial W}{\partial u} = AL'(u) - x(1+r)L'(u) - u(1+r)L'(u) - (1+r)L(u) - \gamma u = 0$$

$$\sum L_i^* = L(u)$$

where
$$L'(u) = \frac{(1-\tau)(1+r)}{2\varphi} + \left[\frac{(1+r)}{2\varphi - \frac{\tau(1+r)}{2b}} + \frac{\tau(1+r)^2}{4\varphi^2 b - \varphi\tau(1+r)} \right] \left\{ \frac{1}{2} - \left(\frac{3}{4}\tau - \frac{1}{4}\tau^2\right) \right\} \equiv M$$

M again captures the response, at the margin, of lending to the adjustment effort expended by the debtor. Notice that, as $\tau \rightarrow 1$ $M \rightarrow 0$ and as $\tau \rightarrow 0$ $M \rightarrow 3/4[R/\varphi]$. That is, as the signals received by the banks get more distorted, marginal changes in adjustment effort have less effect on lending decisions. Rearranging (24) yields an expression for optimal debtor country effort in terms of the parameters of the model that is analagous to (10):

(25)

$$u^* = \frac{AM - (1+r)[xM + Z]}{2(1+r)M + \gamma}$$

where

$$Z \equiv \frac{(1+r)\bar{x}}{\varphi}\left(\frac{1}{2} - \frac{\tau}{4}\right) + \frac{\tau(1+r)[S_2 - \bar{x}]}{4\varphi} - \frac{a\tau(1+r)}{4\varphi b} + \left[\left(\frac{1}{2} + \frac{\tau(1+r)}{4\varphi b}\right)\left(\frac{(1+r)}{\varphi - \frac{\tau(1+r)}{4b}}\right)\left\{\frac{\bar{x}}{2} + (S_1 - \bar{x})\left(\frac{3}{4}\tau - \frac{1}{4}\tau^2\right)\right\}\right]$$

A number of intuitive comparative static results can now be obtained from (24), (25). In particular, since $M'(\tau) < 0$ and $Z'(\tau) > 0$, it can be shown that for positive values of u^*

$$\frac{\partial u^*}{\partial \tau} = \frac{2(1+r)^2\left[Z(\tau)M'(\tau) - Z'(\tau)M(\tau)\right] + \gamma\left[AM'(\tau) - (1+r)M'(\tau) - (1+r)Z'(\tau)\right]}{\left[2(1+r)M(\tau) + \gamma\right]^2} < 0$$

(26) *and*

$$\frac{\partial u^*}{\partial M} = \frac{\gamma\left[A - (1+r)x\right] + 2(1+r)^2 Z}{\left[2(1+r)M + \gamma\right]^2} > 0$$

The first equation in (26) implies that as macroeconomic uncertainty increases, i.e as τ increases, the optimal adjustment effort of the LDC declines. Thus, the debtor exerts <u>less</u> effort in the incomplete information game than in the full information game. The second equation suggests that as M, the marginal responsiveness of banks to LDC effort, falls (i.e as $\tau \rightarrow \infty$) optimal debtor effort (u^*) falls also. This is because, as uncertainty rises, the debtor knows that the strategic behaviour of banks in an incomplete information environment will lead to increased lending - this induces the debtor to put in less effort <u>at the margin</u>.

The model is completed when the expression for optimal debtor effort (25) is substituted back into the reaction function of bank 1 in (23) and when the resulting expression for L_1* is substituted into the reaction function of bank 2. This final step offers little additional insight and is therefore omitted. The findings of the model may be summarised in the following proposition:

Proposition 1: There exists a unique, linear, separating equilibrium in the incomplete information game where lending by both banks is greater than, and adjustment effort by the debtor is less than, in the full information equilibrium. As the precision of banks' forecasts declines (in the sense that $\sigma_x^2 \rightarrow \infty$ and $\tau \rightarrow 1$, the regional bank relies more heavily on the actions of the money centre bank to update its beliefs about the debtor. Under such circumstances, the debtor - correctly anticipating a higher level of equilibrium lending - undertakes less adjustment effort at the margin.

3. Discussion

Although a thorough empirical analysis is precluded by the unavailability of disaggregated data on bank exposure levels in the pre-1982 period, the findings of the model appear to be consistent with actual experiences of creditors and debtors in the period before the Mexican moratorium.

Table 3 shows that the 1976-79 period was characterised by a fast growth in sovereign lending, in line with the optimism evidenced in interest rate spreads and country credit ratings (figures 1, 2). According to the data, the gross lending of UK banks to now heavily indebted countries grew at a annual average rate of nearly 57%. The gross lending of banks in the BIS area as a whole grew at an average annual rate of approximately 30%. It is reasonable to suppose that US banks played the dominant role in the BIS area and that the banks of other nations, for example the UK and Canada, were cast in the role of followers.[9] As Sachs (1989) points out, during this period LDC export proceeds boomed, interest rates were low and stable allowing debt-export ratios remained modest. This episode of commercial lending is consistent with the findings of our model. Bankers were able to make fairly accurate forecasts which, in view of the prevailing optimism, led to a large buildup of loans to the LDCs. Whilst we are unable to draw any inferences concerning the precise behaviour of leaders and followers, the evidence of Table 3 does suggest that the lending pattern of UK banks followed a different, and more optimistic, pattern compared with that of BIS banks. This would seem to indicate that "follower" banks did not place overwhleming weight on "leader" behaviour, choosing instead to follow their own strategies.

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[9] The BIS area includes Benelux, France, Germany, Italy, Austria, Denmark, Ireland, UK, US, Switzerland, Japan and Canada.

In contrast, the behaviour of UK banks converges with the behaviour of BIS banks in the 1979-82 period. The annual growth rate in the claims of UK banks to the LDCs was 12.1% as compared a BIS bank growth rate of 14.1%. An examination of growth rates *vis-à-vis* individual Latin American countries reveals a similar picture. We have already pointed out in the introduction that a spate of lending took place despite the very poor LDC debt-service indicators. Sachs (1989) observes that during this period, "... almost nobody properly understood that the era of high export growth and low interest rates would abruptly come to an end". The effects of industrial country recession contributed to a fall in the prices of many raw materials produced by LDCs leading to a marked decline in the terms of trade. As Artus (1983, Table 4) reports, from 1978 to 1981, the terms of trade of the major exporters of manufactures, the low income countries and "other" net oil importers declined at an average rate of 1.55, 8% and 6.5% respectively. Moreover, the period was also characterised by asset price volatility. As Table 4 makes clear, the standard deviation of monthly changes in long-term interest rates in the G-3 countries rose significantly over the 1974-79 period. To the extent that terms of trade shocks and interest rate fluctuations are indicative of increasing macroeconomic uncertainty (high τ), we can think of the 1979-82 period as being one in which the private forecasts of international banks were relatively uninformative. Under these circumstances, our model suggests that something akin to herd behaviour took place in international credit markets. "Follower" banks became much more reliant on the lending behaviour of "leaders" for extra information. This may have had some bearing on the convergence of UK and BIS bank growth rates during the period. The model, therefore, lends support to the view of Gibson & Oppenheimer (1992) that the lending boom of the 1970s and early 1980s was caused by a combination of the market structure of the international banking industry and an incomplete information environment.

Our model also suggests that the presence of incomplete information may act to induce lower adjustment effort on the part of the debtor country. Although the model does not purport to be a theory of debtor country adjustment effort it is, nevertheless, consistent with the evidence. Table 5 proxies adjustment effort by documenting the fiscal deficit as a percentage of GDP for Argentina, Mexico and the Philippines. As can be seen, there is a sharp increase in fiscal imbalances in the 1979-81 period. In the words of Sachs (1989), "foreign borrowing in the 1970s and early 1980s provided a short-term way out... by allowing government to finance large budget deficits without incurring high inflationary costs in the short-term".

4. Concluding Remarks

We have investigated how private information about a debtor may effect the lending behaviour of banks and the adjustment policies of debtors. Our main finding is that the lending spree of the 1970s and 1980s and the simultaneous failure by debtors to adopt sufficiently comprehensive adjustment programmes may have, in part, been generated by an informationa environment in which the large money-centre banks sought to capitalise on their ability to influence the inferences and behaviour of smaller regional banks. In so doing, the analysis accords an explicit role to the market structure of the international credit market.

Possible extensions could include the incorparation of syndicates and cartels in the analysis and capturing the rent-seeking motives (eg client-chasing behaviour) alluded to in the introduction. The model might also be extended to allow banks to endogenously determine how to conduct their market research - this would have implications for the distortions to capital flows induced by signalling. Also, on the empirical front, the findings of the paper could be considerably enriched by an investigation of the linkages between bank returns, the degree of lending exposure and news concerning the debtor. However, as mentioned earlier, the limited availability of data at a suitably dis-aggregated level is problematic.

TABLE 1

Selected Indicators of the Environment Facing The LDCS 1978-81 (% annual rates of change, except where otherwise stated)

Indicator	1978	1979	1980	1981
Trade Balance $bn	-18.3	-24.9	-38.2	-37.3
LDC Commodity Prices (real)	-18.3	2.9	-4.2	-9.6
Nominal Interest Rate (LIBOR %)	9.1	11.9	14.0	16.7
Net New Bank Loans to non-oil LDCs ($bn)	22.6	35.3	38.9	39.9
Net New Bank Loans (Latin America, $bn)	14.4	23.2	27.4	30.5

Source: Griffith-Jones et.al (1987).

TABLE 2

Claims of US Banks on non-oil LDCs 1977-82

	All Banks ($bn)	Top 9 ($bn)	Next 15 ($bn)	Top 9 (% equity)	Next 15 (% equity)	Others (% equity)
Dec 1977	46.9	30.0	8.8	163	106	57
June 1978	48.7	31.0	9.3	163	107	57
Dec 1978	52.2	33.4	9.9	167	110	54
June 1979	54.4	35.0	10.3	166	108	55
Dec 1979	61.8	39.9	11.3	182	112	60
June 1980	66.2	41.9	12.5	183	113	60
Dec 1980	75.4	47.9	14.2	200	125	62
June 1981	82.3	51.6	15.4	207	134	65
Dec 1981	92.8	57.6	17.4	230	151	76
June 1982	98.0	60.0	19.0	223	150	73

TABLE 3

Gross External Claims of Banks in the UK & BIS Area (% average annual rates of growth)

countries	1976-78 BIS Area	1976-78 UK Banks	1979-82 BIS Area	1979-82 UK Banks
Argentina	56.5	92.2	15.7	11.1
Brazil	20.2	48.3	11.8	11.1
Chile	60.2	122.8	25.0	25.6
Mexico	19.9	52.4	19.6	11.0
Venezuela	51.5	34.9	4.4	-1.9
TOTAL	29.7	56.6	14.1	12.1

Source: Griffith-Jones et.al (1987)

TABLE 4

Terms of Trade Shocks in LDCs & Volatility in G3 Long-Term Interest Rates

	1968-72	1973-78	1979-81
StdDevns of Monthly Changes in Long Term Rates			
USA	0.188	0.165	0.593
Germany	0.190	0.226	0.455
Japan	0.038	0.221	0.475
% Change in TOT			
Net Oil Exporters	-1.3	4.0	6.0
Low Income Nations	-1.4	-1.1	-8.2
Net Oil Importers	-0.9	-0.2	-6.4

Source: Artus (1983), Swoboda (1983)

TABLE 5

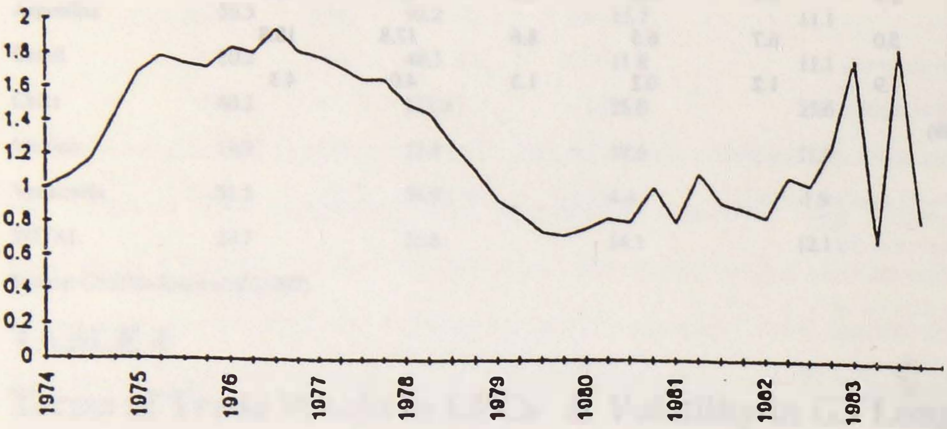
FISCAL DEFICITS IN SELECTED LDCs 1977-1982

% GDP	1977	1978	1979	1980	1981	1982
Mexico	5.4	5.5	6.0	6.8	13.6	16.3
Argentina	5.0	6.7	6.6	8.6	17.8	18.8
Philippines	1.9	1.2	0.2	1.3	4.0	4.3

Source: Sachs (1989)

Figure 1(a,b)

Average Interest Rate Spreads on Publicly Guaranteed Loans (non-oil LDCs, 1974-83) & Spread Between Yields on Mexican/European Investment Bank Bonds (1980-83)



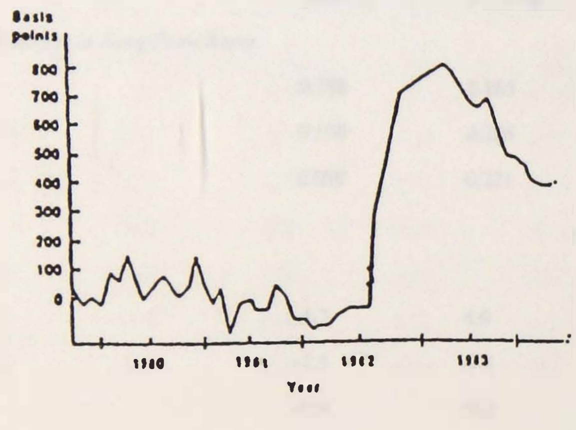
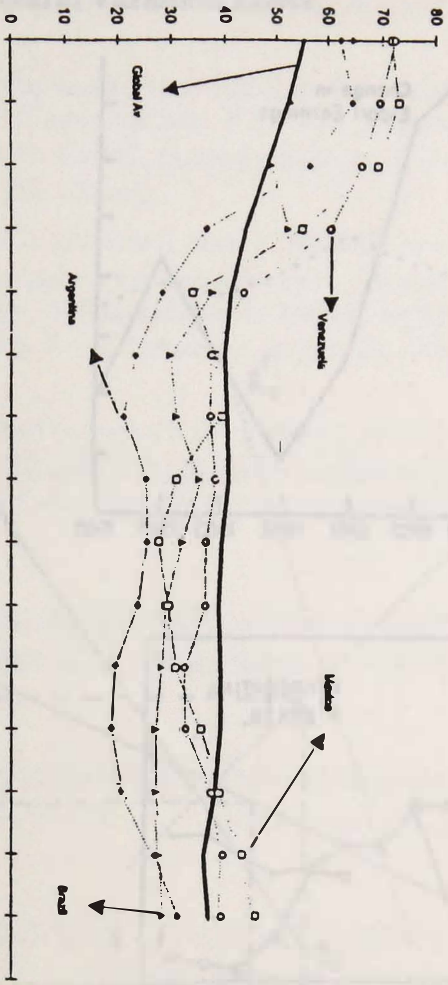


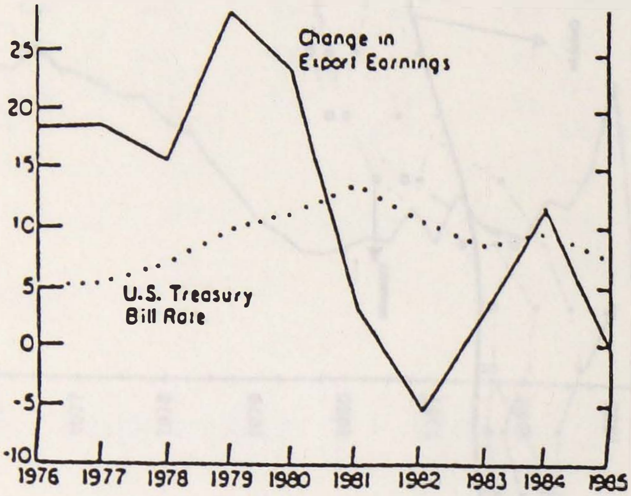
Figure 2

LDC Credit Ratings (Institutional Investor) 1979-93



Figures 3, 4

Interest Rates, Non-Oil Export Earnings & Private Investment/GDP Ratios
(Source: Sachs (1989))



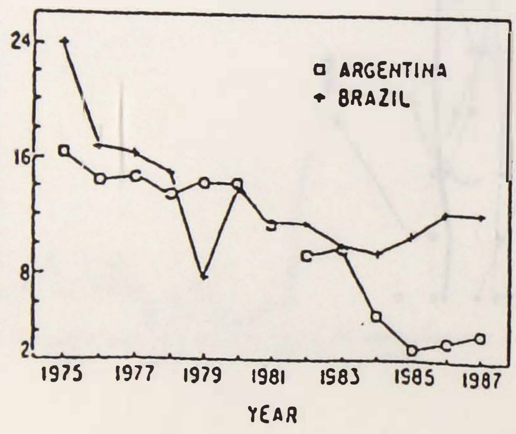
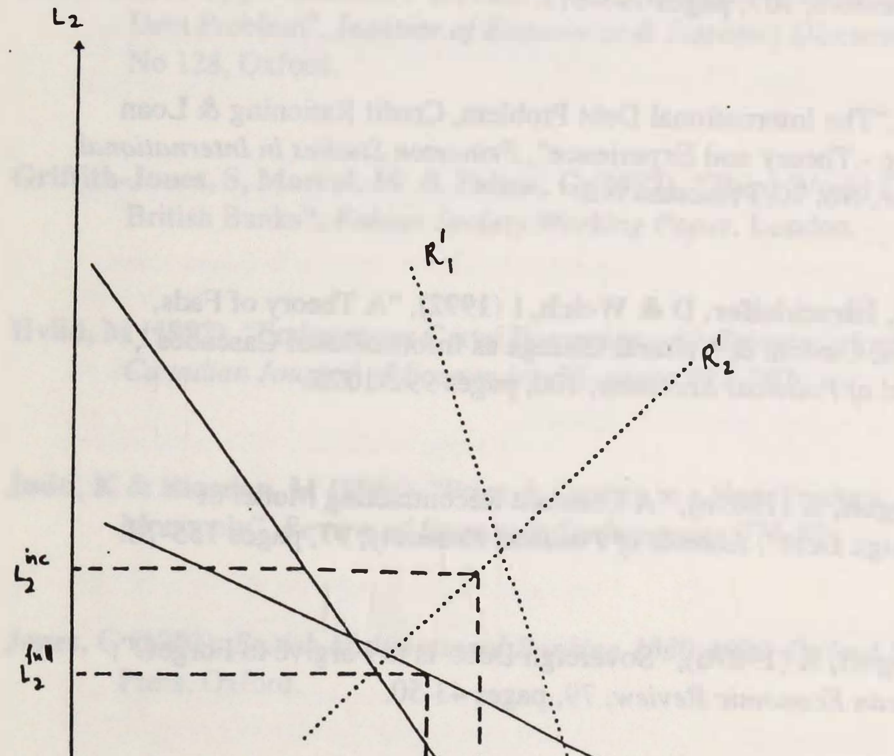


Figure 5

The Conjectural Variation Effect



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