NBER WORKING PAPERS SERIES

DEBT CONCENTRATION AND SECONDARY MARKET PRICES: A THEORETICAL AND EMPIRICAL ANALYSIS

Raquel Fernandez

Sule Ozler

Working Paper No. 3654

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 1991

Raquel Fernandez wishes to acknowledge NSF support under grant SES-89-08390 and many helpful discussions during the period when the author was a Visiting Scholar at the World Bank. Sule Ozler wishes to acknowledge NSF support SES89-10253 and an NBER Ford Foundation Fellowship. We wish to thank Michael Dooley and Paul Milgrom for helpful comments. This paper is part of NBER's research program in International Studies. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #3654
March 1991

DEBT CONCENTRATION AND SECONDARY MARKET PRICES: A THEORETICAL AND EMPIRICAL ANALYSIS

ABSTRACT

In the context of a model that distinguishes between large money center banks and smaller regional banks, we show that the percentage of a country's debt held by the large banks affects the secondary market price of that country's debt: the higher the concentration of the debt, the higher the secondary market price. We also show that the free trade of debt in the secondary market does not necessarily imply that the entire stock of debt will eventually be owned by the large banks. Our empirical analysis incorporates a number of potential determinants of secondary market prices. Among these are variables that are associated with a country's economic performance, variables that can be associated with the regulatory structure in the creditor's country, and the concentration of debt in the hands of the largest US banks. Our empirical findings indicate that concentration indeed has a positive effect on secondary market prices.

Raquel Fernandez
Hoover Institution
Stanford University
Stanford, CA 94305-6010

Sule Ozler
John F. Kennedy School
of Government
Harvard University
79 John F. Kennedy Street
Cambridge, MA 02138

1. Introduction

In the ongoing debate as to what should and/or can be done about the scale of developing country debt, secondary market prices for government and government guaranteed debt are often referred to as indicators of the value of the outstanding debt of these countries. What are the factors, however, that may be thought of as affecting secondary market prices? Theoretical models suggest elements such as the rate of impatience of various parties, the seizure technology of the creditors, and the importance of future credit markets to the debtors, to name but a few.[1] Empirical studies have primarily focused on factors associated with a country's economic performance such as GNP per capita, export revenue, reserves, and the regulatory environment in the creditor country.[2] Identifying the set of factors that influence secondary market prices is of importance to all attempts to judge the merits of any proposal to deal with the debt crisis.

In this paper we attempt a theoretical and empirical analysis of the effect that the degree of debt concentration in the hands of the largest banks may have on the value of developing country debt. This is a factor that until now has been ignored both by the theoretical and empirical literature.

We develop a theoretical model that distinguishes between two types of banks: large money center banks and smaller regional banks. We show that the percentage of a country's debt held by the large banks affects the value of that country's debt: the greater the degree of concentration, the higher the

---

[1]See, for example, Bulow and Rogoff (1989b), Eaton and Gersovitz (1981), and Fernandez and Rosenthal (1990).

[2]See Berg and Sachs (1989), Cohen (1988), Hajivassiliou (1989), and Ozler and Huizinga (1990).

value. Our empirical investigation demonstrates that concentration indeed has a positive effect on secondary market prices.

The theoretical model assumes that the debt renegotiation process possesses three fundamental characteristics: (i) the country's motivation to repay its debt is its fear of being penalized by its creditors, (ii) penalizing the country is costly for the banks, and (iii) although the amount repaid by the country is shared pro rata by all banks, the large banks face a greater than pro rata cost in penalizing the country due to the damage that the penalties inflict on their extensive business interests with these countries. We show that the most favorable subgame-perfect equilibrium for the banks has the country repaying an amount that is an increasing function of the proportion of the debt owned by the large banks. As modeled, the value of the debt increases as the percentage of the debt owned by the large banks increases. We construct a model of the secondary market to show, however, that this does not necessarily imply that the large banks will end up owning the entire stock of debt. The free-rider problem, evident when it comes to discussions of debt forgiveness and new money contributions, also plays a critical role here.

We conduct an empirical analysis of secondary market prices to determine how these are affected by debt concentration. Our measure of the degree of concentration is calculated as the ratio of exposure of the nine largest US banks to the exposure of all US banks that are not in the largest 24 (largeness is defined by asset size). Quarterly data over the 1986-1988 period for 43 countries is employed. In addition to a measure of concentration, two other types of variables are considered as possible determinants of secondary market prices: A first set of variables include

borrower country characteristics that may function as indicators of a country's repayment prospects, such as debt ratios and GNP per capita. Second, bank exposure to countries and bank capital aggregates--variables that may reflect regulatory features of the creditor's country--are also considered.

Employing a Tobit model we find that the degree to which a country's debt is concentrated is an important and statistically significant determinant of the secondary market price of that debt. Specifically, a higher debt concentration is found to imply a higher secondary market price. Our estimations suggest that as concentration is doubled from its sample mean of 5 to 10, secondary market prices show an increase of 7 cents to 30 cents on the dollar from their sample mean of 48.

Our paper is organized as follows. Section 2 develops the main bargaining model between the creditor banks and the debtor country. Section 3 presents a simplified model of the secondary debt market. Section 4 consists of an empirical investigation of secondary market pricing behavior, and Section 5 concludes.

2. A Model of Sovereign-Debt Renegotiation

Over the past decade the question as to why debtor countries repay any of their debts has received much attention. As is well recognized, there must exist either some benefit from repayment or some cost from repudiation in order to support positive lending to sovereign countries. To name but a few examples, Eaton and Gersovitz (1981), Eaton (1989), Bulow and Rogoff (1989b), and Rosenthal (1990) have examined the role of reputation in sustaining loans (where default is taken to imply the exclusion from credit markets in the

future), Fernandez and Rosenthal (1990) the role of benefits from repayment, and Bulow and Rogoff (1989a), and Fernandez and Glazer (1990) the effects of penalties.

Our principal interest here is to develop a penalty based model of sovereign-debt renegotiations that is able to provide an explanation for why the secondary market price of a country's debt and the concentration of this debt in the hands of the top US banks is positively correlated.

We construct a sequential bargaining model (a la Rubinstein (1982)) between the debtor country and the "large" banks component of its creditors. The banks are assumed to possess the ability to punish a country that does not repay its renegotiated debt.[3] Our model differs, however, in a critical aspect from the other sequential bargaining models that rely on penalties. In, for example, Bulow and Rogoff (1989a) banks always have an incentive to penalize a defaulting country (by seizing some portion of its traded output), since they obtain an immediate net benefit from doing so, namely a certain percentage of the country's traded output.[4] In our model, by contrast, there are equilibria in which the banks never penalize the country since to do so is costly and does *not* guarantee eventual repayment. The economics that underlies these two different modelling strategies concerns the nature of the punishments which banks can apply. If these penalties consist primarily of the seizure of traded goods which can be immediately translated into a net benefit for the banks (independently of whether or not the country repays), then the Bulow and Rogoff type model of debt renegotiation is best able to

[3]They cannot, however, commit to punishment.

[4]Bulow and Rogoff suggest that their results can also be extended to costly punishments though implicit in their argument is that banks can commit to bearing small costs.

capture this. If, however, penalties cannot be committed to and do not, in and of themselves, provide a net benefit to creditors, such as with the negation of trade credits and/or sanctions applied by the creditor countries' government (or even exclusion from all future credit markets), then a model of costly penalties is more appropriate. We choose to work with the latter conceptualization of the penalty structure.

Our second critical distinction is between large international banks and smaller, primarily domestic, banks. The analyses of sovereign-debt renegotiations mentioned previously have, by and large, abstracted from any differentiation among the creditor banks (an exception is Fernandez and Kaaret (1988)) although, of course, free rider problems have received some attention (e.g. Krugman (1988) and Sachs (1983)). Rescheduling, however, is an extremely complicated process involving hundreds of banks and loans of various terms and maturities. Negotiation typically takes place between the debtor country and a creditor committee consisting of a small group of very large international banks (e.g. Citibank, Chemical Bank, Manufacturers Hanover, etc.). What distinguishes these banks, aside from sheer size, is the nature of their relationship with the debtor countries. These banks provide services to their domestic customers to enable trade between them and the country. They often have branches in these countries and a considerable portion of their profits is derived from other business with these countries and their customers. The small banks, on the other hand, only entered the international arena temporarily in the credit boom of the seventies and do not otherwise have extensive links with the debtor countries. Consequently, any action taken to punish the country is bound to be more costly for the large

international banks than for the small banks. We now turn to a more formal description of the model.

We consider the following situation. Two parties, one consisting of the large creditor banks (which we will henceforth call the large bank, B, and assume that it acts as one agent, ignoring any problems which may exist within this coalition), and the other consisting of the debtor country, are engaged in negotiating over how much of its debt the country must repay. In order to simplify an already quite complex problem, we will consider repayment of the debt to be once and for all and not over a number of periods.[5] $D>0$ is the amount of the country's outstanding debt. Bargaining takes place over discrete time $t \in \{1,2,\ldots\}$. In every odd period the large bank offers a debt settlement x_t, $0 \leq x_t \leq D$ which specifies the amount that the banks are asking to be repaid and simultaneously engages in a lobbying effort $L(\tilde{p}_t)$. The country (C) then responds by either accepting the offer (Y) or rejecting it (N). If the country accepts the offer, negotiations are over. The country then pays the banks x_t and the remainder of the debt, $D-x_t$, is forgiven. If the country rejects the offer, the large bank must then make a decision as to the level of punishment p_t, $0 \leq p_t < \tilde{p}_t$ to inflict on the country that period. After the country is punished (the punishment can be zero), time advances one period.

In every even period it is the country's turn to make a debt settlement offer y_t specifying the amount that the country is willing to repay. The bank then responds by either accepting (Y) or rejecting (N) the offer and engaging in a lobbying effort $L(\tilde{p}_t)$. Once again, an acceptance indicates the end of

---

[5]Bulow and Rogoff (1989a) deal with this problem by imposing conditions on the discount factors of the two parties and specifying a time horizon after which all production in the country ceases.

negotiations and the country pays the banks y_t, the latter forgive the remainder $D-y_t$. A rejection leaves the bank with a punishment decision to be made in that period, p_t. After the country is punished, time advances one period. This game can continue for a potentially infinite number of periods. See Figure 1 for the extensive form of this game.[6]

It is costly for the large bank to punish the country. These costs are modeled as having two components: $L(\bar{p}_t)$ and $c(p_t)$. The first is meant to capture elements such as lobbying costs which the large bank must engage in in order to be able to punish the country subsequently. The greater the maximum punishment which the large bank wishes to contemplate using that period, the greater the lobbying cost L.[7] $L(\cdot)$ is a continuous, increasing, convex function of the maximum punishment $\bar{p}$, with $L'(0)=0$ and $L'(\infty)=\infty$. $c(p_t)$ is the actual cost to the operations of the large bank within that country and to its profits derived from servicing domestic clients who do business with that country from punishing the latter by the amount p_t. The p_t chosen by B cannot exceed $\bar{p}_t$. $c(p_t)$ is assumed to be an increasing, continuous, convex function of the punishment level with $c'(0)=0$ and $c'(\infty)=\infty$.

It is in the bearing of costs that there is an asymmetry between the large creditor banks and the many small banks. Although both large and small banks share <u>pro rata</u> in any repayment by the country, the costs incurred in lobbying and in punishing the country are not shared <u>pro rata</u>. And, despite

---

[6]We have not modeled the small banks' decision as to whether they wish to participate in the debt forgiveness agreement. Note, however, that they will indeed wish to participate since they are assumed not to possess the ability to punish the debtor singlehandedly.

[7]These lobbying costs can be thought of as being incurred in an effort to persuade Congress and other interested parties to accept the harm that will results to certain domestic constituencies if the country is punished.

the fact that debt contracts require some costs to be shared pro rata (court expenses, for example), the large banks will find it much more costly to disturb their normal operations with the debtor countries than the small banks. These costs are not written into the debt contract. For simplicity, we assume that this asymmetry between large and small creditor banks is such that the large banks bear all the costs of punishing the defaulting country.[6] Hence, if the large banks are able to obtain a payment of Z from the country and α is the fraction of that country's debt owned by the large banks, then αZ is the payment received by the large banks. Any cost incurred in obtaining this payment, however, is borne in its entirety by the large banks.

We now turn to a discussion of each party's payoff. The large bank is assumed to maximize the discounted value of its share of the country's payment net of the cost it incurs in punishing the latter. The large bank's payoff from a settlement z reached in period T is

$$-\sum_{t=1}^{T-1} \delta_b^{t-1} [L(\tilde{p}_t) + c(p_t)] + \delta_b^{T-1}[\alpha z - L(\tilde{p}_t)] \qquad (1)$$

where $0<\delta_b<1$ is the banks' common discount factor.

The country attempts to minimize the discounted value of its punishments and payment. Consequently, its payoff from a settlement z in period T is

[6]What is essential is that the large banks' share of the costs be greater than their share of the country's repayment.

$$-\sum_{t=1}^{T-1} \delta_c^{t-1} p_t - \delta_c^{T-1} z \qquad (2)$$

where $0<\delta_c<1$ is the country's discount factor. Thus, if the bank punishes the country for two periods before obtaining a settlement of x_3, the large bank's payoff from the entire play is $-[L(\tilde{p}_1)+c(p_1)+\delta_b L(\tilde{p}_2)+\delta_b c(p_2)] + \delta_b^2(x_3-L(\tilde{p}_3))$, and the country's is $-[p_1+\delta_c p_2+\delta_c^2 x_3]$.

We are interested in examining the subgame-perfect equilibria of this game. By imposing this refinement of Nash equilibria, we are ruling out those equilibria based on non-credible threats. That is, we are eliminating equilibria that possess the characteristics that in some subgame a player would not actually find the sequence of actions dictated by its strategy to be a best response to the other player's strategy in that same subgame. More technically, the strategies of all the players form a subgame-perfect equilibrium of the game if they form a Nash equilibrium of the game and if, in addition, they induce equilibria on all subgames of the game.

The game described above has many subgame-perfect equilibria, including some inefficient ones.[9] One efficient equilibria, for example, has the country never repaying any part of its debt and the banks never punishing the country for this behavior. To see why this is an equilibrium, note that if the bank never threatens to punish, the country never has an incentive to repay. Any deviation by the bank, that is, any positive level of lobbying and/or punishment, will simply be ignored by the country since in the

[9]For a particular illustration of this point, see Fernandez and Glazer (1991).

following period the country's best response will still be to not repay given its expectation of no future punishments in response to this behavior.

We will concentrate here solely on the subgame-perfect equilibrium most favorable to the banks. Let p_m be the level of p such that

$$L'(p) = \alpha \tag{3}$$

and p_s be the level of p such that

$$\frac{c(p)}{p}\,\frac{(1-\delta_b\delta_c)}{\delta_b^2} + \frac{L(p)}{p} = \alpha \tag{4}$$

Furthermore, let

$$\bar{p} = \min\{p_m,\ p_s\} \tag{5}$$

Consider the following pair of strategies. In the first period the large bank makes an offer $\bar{x}$ where[10]

$$\bar{x} = \frac{\bar{p} - \frac{\delta_b\delta_c}{\alpha} L(\bar{p})}{1-\delta_b\delta_c} \tag{6}$$

---

[10]We are assuming that we are in a debt crisis situation, i.e. $D>\bar{x}$, so that even in the most favorable equilibrium for the banks the country does not repay its entire debt. It is not difficult to construct a larger game, modeling the initial loan decision, such that there is uncertainty prior to the making of the loan (say, as to the c(p) function) so that $D>\bar{x}$ is the result of an unfavorable shock to the bank's cost function.

and lobbies by the amount $L(\bar{p})$. If this offer is rejected, the bank punishes the country by the amount $\bar{p}$. In every even period, if in all preceding odd periods the bank has punished the country's rejection of its offer by the amount $\bar{p}$, then the bank accepts any offer greater or equal to $\bar{y}$ and rejects any offer strictly smaller than $\bar{y}$, where

$$\bar{y} = \frac{\delta_b(\bar{p} - \frac{L(\bar{p})}{\alpha})}{1-\delta_b\delta_c} \tag{7}$$

If, however, in some preceding odd period, p_t differed from $\bar{p}$, then the bank accepts any offer $y \geq 0$. In both cases, in every even period $\bar{p}=p_t=0$.

In every odd period, subject to prior compliance with the odd-period punishment behavior described above, the bank offers $\bar{x}$ and lobbies by an amount $L(\bar{p})$. Once again, any prior deviation from the odd-period punishment behavior implies that in all subsequent even periods the bank offers $x=0$, i.e. complete forgiveness of the debt. Note that the bank never lobbies nor punishes the country on even periods. $\bar{p}$ is a function of α and so, therefore, are $\bar{x}=\bar{x}(\alpha)$, $\bar{y}=\bar{y}(\alpha)$, and L.

The country's strategy in the first period is to accept any offer $x \leq \bar{x}$. In every even period, if in all preceding odd periods the bank has punished the country by an amount $\bar{p}$, the country offers $y=\bar{y}$. If in some preceding odd period punishment has been of a different magnitude, the country offers $y=0$. In every odd period, subject to the bank's prior compliance with the odd-period punishment rule, the country accepts any offer of $x \leq \bar{x}$ and rejects any offer strictly greater than $\bar{x}$. Once again, any deviation by the bank from

this behavior implies that in all subsequent even periods the country rejects any offer strictly greater than zero and accepts x=0.

It is not difficult to check that this is a pair of subgame-perfect-equilibrium strategies. The play of these strategies has the bank lobbying by an amount $L(\bar{p})$ and making an offer of $\bar{x}$ in the first period, which the country accepts.[11]

Ignoring, for the moment, any restriction on the level of punishment given by lobbying considerations, note that what the bank might wish to do is to threaten to severely punish the country by an amount, say, of $\tilde{p}$, unless the latter repays its entire debt. If the country were to "believe" this threat, it would repay the debt in its entirety as long as the discounted (absolute) value of being punished forever (every odd period from now till infinity) were greater than the value of the debt, i.e. $\tilde{p}(1-\delta_c^2)^{-1} \geq D$. Let us examine, however, the subgame in which the country rejects this offer. The bank's payoff from carrying out its threat would at most be $-c(\tilde{p})+\alpha\delta_b D$. If this payoff were negative, however, the bank's strategy would not be subgame perfect since it could always choose not to impose the punishment and obtain a payoff no smaller than zero. Thus, subgame perfection requires that in the odd-period punishment strategy the punishment level be no greater than the p that satisfies

$$-c(p) + \alpha\delta_b y = 0 \qquad (8)$$

[11]A proof similar to the one required to show that this strategy yields the large bank its greatest payoff is in Fernandez and Glazer (1991).

where $y = \frac{\delta_b[p-L(p)\alpha^{-1}]}{1-\delta_b\delta_c}$. Using this restriction to solve for p_s results in (4).

Turning to the lobbying cost, note that in equilibrium B's payoff for a given p is $-L(p)+\alpha x$ where $x = \frac{p-\delta_b\delta_c L(p)\alpha^{-1}}{1-\delta_b\delta_c}$. Thus, the greatest payoff for B is obtained by choosing p so as to solve

$$\begin{aligned} &\underset{p}{\text{Max}} \quad -L(p) + \alpha x \qquad (9)\\ &\text{s.t.} \quad -c(p) + \frac{\alpha\delta_b^2}{1-\delta_b\delta_c}\left(p - \frac{L(p)}{\alpha}\right) \geq 0 \end{aligned}$$

When the subgame perfection constraint is not binding this yields $L'(p)=\alpha$ as the first order condition (see equation (3)) and, hence, p_m as the optimal p. When the constraint is binding, the optimal p is given by p_s. Thus, the optimal p, $\bar{p}$, is given by $\min(p_m, p_s)$ as expressed in (5).

Lemma 1: The amount of its debt that a country will repay and, therefore, the value of a share of a country's debt in the equilibrium outcome generated by the strategies that yield the large bank its greatest payoff (i.e. the strategies described above) is an increasing function of the share of the debt held by the large banks.

Proof: Use of the implicit function rule on (3) and (4) yields $\frac{dp_s}{d\alpha} > 0$ and $\frac{dp_m}{d\alpha} > 0$. Hence $\frac{d\bar{p}}{d\alpha} > 0$. By (6), $\bar{x}$ is an increasing function of $\bar{p}$. Thus, as α increases, the level of punishment that is credible and optimal increases and with it the country's payment, the large bank's payoff, and the value of a share of debt.||

Lemma 1 establishes that as the degree of concentration of a country's debt in the hands of the large bank increases, so does the amount of debt that will be repaid. The intuition behind this result is straightforward: as the degree of concentration increases, the payment received by the large bank for a given punishment level increases accordingly. This means that the large bank can credibly and profitably increase its punishment threat (and thus total repayment) and its lobbying effort since its ability to obtain a greater share of any payment allows it to credibly withstand a greater cost of punishment and incur a greater lobbying cost.

3. A Model of the Secondary Debt Market

If the value of a share of a country's debt is an increasing function of the proportion of its debt that is owned by the large bank, won't the latter attempt to buy up the debt of the small banks on the secondary debt market? The answer to this question is far from trivial and will depend on how the secondary market is modeled. A natural extension of the model discussed above to include a secondary market would be to allow bidding between large and small banks in the secondary market to alternate periodically (or be simultaneous) with bargaining between the large banks and the country. Unfortunately, this is a very complex game to solve since we have now introduced a state variable, namely the fraction of the country's debt owned by the large banks, into the bargaining game between debtor and creditor.

As an alternative, we allow the secondary market to function solely prior to any bargaining between the country and the large bank. While the latter is, admittedly, not a realistic depiction of the functioning of the secondary debt market, it allows us to bring out clearly the intuition as to why one

would not necessarily expect the large banks to end up owning the entire stock of debt.

The structure of the game is as follows. In each period in which the secondary market functions, the large bank makes a series of offers $(z_i, \bar{d}_i)$ establishing the price per share, z_i, that it is willing to pay for up to $\bar{d}_i$ shares of debt owned by small bank i. Small bank i can choose to tender less than $\bar{d}_i$.[12] Let $d_i \leq \bar{d}_i$ be the quantity of debt actually tendered by small bank i at the price z_i. Then $z_i d_i$ is the revenue received by small bank i when it sells d_i shares at price z_i per share. Each small bank is able to accept (or partially accept) or reject the offer it receives. At the end of each period t (except the last) the large bank, now owning a proportion of the country's debt α_t, can choose whether to end its attempts to purchase debt on the secondary market and enter into negotiations with the country, or to continue its presence in the secondary market for an additional period. The secondary market game must end, however, by period T.

Whenever B enters into negotiations with the country then, by Lemma 1, an agreement between the two will be reached in that same period. Thus, if at the end of period t the bank decides to enter into negotiations with the country, its payoff from this play is

$$-\sum_{t=1}^{\hat{t}} \sum_{i} \delta_b^{t-1} d_{it} z_{it} + \delta_b^{\hat{t}-1} [\alpha_{\hat{t}} \bar{x}(\alpha_{\hat{t}}) - L(\alpha_{\hat{t}})] \tag{10}$$

[12]Note that in this fashion we preclude the possibility of the large bank making a small bank a strict take-it-or-leave-it offer.

and the i^{th} small bank's payoff is

$$\sum_{t=1}^{\hat{t}} \delta_b^{t-1} d_{it} z_{it} + \delta_b^{\hat{t}-1}(D_i - \sum_{t=1}^{\hat{t}} d_{it}) D^{-1} \bar{x}(\alpha_{\hat{t}}) \qquad (11)$$

where D_i is the quantity of the country's debt initially owned by small bank i and $\alpha_t = \alpha_0 + (\Sigma_t \Sigma_i d_{it}) D^{-1}$. (Note that both the small and large banks have the same discount factor δ_b.) α_0 is the proportion of the country's debt owned by B at the beginning of period 1. In general, α_{t-1} is the proportion of D owned by B at the beginning of period t. Note that we are expressing $\bar{x}$ and L (derived from the equilibrium strategies in the previous section as functions of α.

Since the purpose of this section is to show that there exist plausible circumstances under which B will not end up owning the entire stock of debt, we shall concentrate on one of two possible cases by making the following assumption.

Assumption: There exists $0 \leq \alpha^* < 1$ such that for all $1 \geq \alpha \geq \alpha^*$, $\bar{p} = p_m$. This situation is depicted in Figure 2.

This assumption ensures that for any $\alpha \geq \alpha^*$, the solution to the large bank's maximization problem given in (9) is the unconstrained solution. Note that either this or its opposite (i.e. $\bar{p} = p_s$) must be the case.

Theorem 1: In no subgame-perfect equilibrium will B purchase all the debt in the secondary market.[13]

---

[13]We are assuming throughout that once bargaining between B and C commences, the equilibrium chosen is the most favorable for B, i.e. that described in the previous section.

We shall prove this theorem by first establishing the following lemma.

Lemma 2: Consider a subgame of any subgame-perfect equilibrium in which B has purchased the remaining debt in its entirety. The price per unit of debt received by any small bank in this subgame can be no lower than $\bar{x}(1)/D$.

Proof: Suppose that for some small bank j, $z_j<\bar{x}(1)/D$. Consider the following deviation for j: Let j decrease d_j by $\epsilon>0$ such that $\bar{x}(1-\epsilon/D)>z_jD$, $(1-\epsilon/D)\bar{x}(1-\epsilon/D)-L(1-\epsilon/D) > \delta_b[\bar{x}(1)-L(1)]$, and $(1-\epsilon/D)>\alpha^*$. Such an ϵ exists by continuity of $\bar{x}$ and L and our assumption on α^*. This is a profitable deviation for j since the game will still end this period and it now obtains an ϵ/D share of $\bar{x}(1-\epsilon/D)$ instead of ϵz_j.||

We now return to the proof of Theorem 1.

Proof: We divide the proof into two cases. Let t^* be a subgame generated by a pair of subgame-perfect-equilibrium strategies in which $\alpha_{t^*-1}<\alpha_{t^*}=1$ (i.e. t^* is the subgame in which the remaining debt is bought up in its entirety).

Case 1: $\alpha_{t^*-1}\geq\alpha^*$. Recall, from lemma 2, that the remainder of the debt in period t^* is bought up at a price no smaller than $\bar{x}(1)/D$. But then B is better off not buying all the additional debt that period since, in the best case, if it buys up all the debt at a price of $\bar{x}(1)/D$ it obtains a payoff of $\alpha_{t^*-1}\bar{x}(1)-L(1)$ as of that subgame, whereas not buying any additional debt it obtains a payoff of $\alpha_{t^*-1}\bar{x}(\alpha_{t^*-1})-L(\alpha_{t^*-1})$ which is greater. Thus, the option of not buying any debt that period and ending the secondary market game is preferable to buying all the additional debt. Consequently, if $\alpha_{t^*-1}\geq\alpha^*$, not all the debt will be purchased by B.

Case 2: $\alpha_{t^*-1}<\alpha^*$. We shall show that a profitable deviation exists for B. Let B reduce the amount of debt purchased from some small bank j by $\varepsilon>0$ by changing its bid from $\hat{d}_j$ to $\hat{d}_j'=d_j-\varepsilon<d_j\leq\hat{d}_j$ such that $\alpha_{t^*}'=1-\varepsilon/D>\alpha^*$.

Note that if everything goes through as before, i.e. no small bank other than j changes the quantity of debt it tendered, this is a profitable deviation for B since

$$\pi(\alpha_t') - \pi(1) = \alpha_t'\bar{x}(\alpha_t') - R(\alpha_t') - L(\alpha_t') - \bar{x}(1) + R(1) + L(1) \qquad (12)$$

$$= \alpha_t'\bar{x}(\alpha_t') - \bar{x}(1) + \varepsilon z_j - (L(\alpha_t') - L(1))$$

where $\pi(\cdot)$ is the payoff to B as of period t^*, z_j is the price per share associated with $\hat{d}_j'$, and $R(\cdot)$ is the amount spent by B that period purchasing debt.[14] Recalling, from Lemma 2, that $\varepsilon z_j\geq(\varepsilon/D)\bar{x}(1)$, yields

$$\pi(\alpha_t') - \pi(\alpha_t) \geq \alpha_t'\bar{x}(\alpha_t') + \frac{\varepsilon}{D}\bar{x}(1) - \bar{x}(1) - (L(\alpha_t') - L(1))$$

and the right hand side equals

$$\alpha_t'\bar{x}(\alpha_t') - L(\alpha_t') - [\alpha_t'\bar{x}(1) - L(1)]$$

which is strictly positive. Hence, this is a profitable deviation.

---

[14]For notational simplicity we have eliminated * from the t subscripts.

We now need to show, however, that indeed everything will go through as before. Suppose this play occurred in period T. Then no small bank has any incentive to change the amount it tendered since it is already receiving a price per share at least as great as $\bar{x}(1)/D$ and tendering less debt will only yield it a return per share strictly smaller than this value.

If this play had occurred instead in period T-1, there also would be no incentive for any small bank to change its quantity tendered. The following period B will not buy more debt than that required to maximize equation (9) inclusive of its expenses in purchasing debt. Since it can then make a credible take-it-or-leave-it offer of $\bar{x}(\alpha_T)/D$ per share, the price obtained by a small bank will be strictly smaller than $\bar{x}(1)/D$. Hence, once again any small bank that decreased the quantity that it tendered is made strictly worse off. By backwards induction one can show that the small banks will not decrease the quantity tendered in period t^* independently of the period in which this occurs. Thus B's deviation is indeed profitable. This ends the proof.||

This section has established that there is no reason to believe that, simply because the value of the debt increases the more concentrated its ownership becomes, all the debt must necessarily end up in the hands of the large bank. The free-rider problem is also endemic to this scenario. While each small bank would be better off if another small bank sold all of its debt to the large bank or if all small banks coordinated and sold all of their debt to the large bank, the fact that each small bank has the incentive to hold out implies that in equilibrium the large bank will never acquire all the debt.

4. Empirical Issues

An implication of the theoretical model developed in this paper is that the increased concentration of a country's debt in the hands of large banks has a positive effect on the secondary market price of that country's debt. Our purpose in this section is to provide an empirical analysis of secondary market prices so as to investigate the presence of the relation posited by the model. Nevertheless, although our empirical finding is in accordance with our theoretical result, our empirical analysis is not a test of the model developed previously. To put it another way, our theoretical model, which is in accordance with the stylized facts, is one plausible explanation of our empirical finding.

In most empirical studies of secondary market prices, the occurrence of trade in the secondary market, as well as the magnitude of secondary market prices (or discounts) is investigated only as a function of various borrower country characteristics. These country characteristics are economic variables, such as debt-to-exports ratio and real per capita GNP, that presumably indicate a country's repayment prospects, and events of non-payments, rescheduling agreements (Berg and Sachs (1989), Cohen (1988), Hajivassiliou (1988), Huizinga (1989), Sachs and Huizinga (1987), and Purcell and Orlanski (1988)). Although there is not a unique set of variables derived from a specific theoretical specification, there is, by now, a large body of empirical studies of developing country debt that has employed economic characteristics of borrowers.[15] Such variables have been included, for

[15]Incorporation of political factors to such studies has been limited. An exception is Ozler and Tabellini (1990), where the authors employ measures of political instability among the determinants of the level of debt

example, in studies that attempt to predict the occurrence of repayments difficulties, and in studies that investigate credit terms (for a review see Eaton and Taylor (1986); recent studies include Ozler (1990a,b)).[16]

In contrast to most empirical studies, here we introduce certain characteristics of a country's creditors among the determinants of a borrower's repayment prospects, and hence secondary market prices. Specifically, we examine the impact of concentration of debt in the hands of large banks relative to small banks on the secondary market prices. Our basic measure of concentration is the ratio of the exposure of the nine largest U.S. banks to the exposure of U.S. banks that are not on the largest 24 (largeness is defined by asset size).

Our approach here is in accordance with that of Ozler and Huizinga (1990) since in that study the authors also introduce an element of the creditors' side--the regulatory environment in the creditor country. In that study, limited liability and deposit insurance is demonstrated to encourage banks to choose a more heavily concentrated loan portfolio so as to increase the value of banks implicit claim on the deposit insurance. Furthermore, in this setting poorly capitalized banks benefit more from a risky developing country loan portfolio than well capitalized banks. The empirical investigation yields results consistent with that prediction: the higher the exposure of large U.S. banks to a borrower, the higher is the secondary market price of debt, and the higher the capital of large U.S. banks the lower is the

---

accumulation.

[16]The relation between non-payment events and lender banks' stock market values have been investigated in Ozler (1989).

secondary market prices.[17] The presence of this evidence concerning the impact of banks characteristics, in particular bank's exposure distribution, suggests that in our investigation of the impact of concentration here, care must be shown to control for these effects. Note that exposure and concentration are two distinct variables. For example, a large bank may be equally exposed to two different countries but possess very different concentrations of their debt depending on the magnitude of each country's total outstanding debt.

In what follows, we first describe an empirical model that will be used for the analysis of secondary market prices. The model described is a Tobit model. Second, we present a cursory investigation of the data and discuss how debt concentration is measured. Finally, results of our estimation are presented, and the primary finding that increased debt concentration has a negative (positive) impact on secondary market discounts (prices) is shown to be robust to alternative empirical specifications.

4.1 Empirical Specification

The trading of loans at a discount in the secondary market has taken place only for some of the indebted countries. Define T* as follows (for convenience, time and country indicators are omitted):

$$T^* = \beta\phi + u_1 \tag{13}$$

[17]Bank characteristics are also found to be significant determinants of commercial bank behavior when these are confronted with a menu of options (see Demirguc-Kunt and Diwan (1990)).

where T^* - a latent variable such that, if $T^* > 0$ we observe trading at a discount in the secondary market, but if $T^* \leq 0$ we do not observe trading at a discount in the secondary market,

ϕ - variables that determine the occurrence of trading in the secondary market,

u_1 - normally distributed error term with standard error σ_1.

As will be discussed in more detail in the data section, variables in ϕ measure the creditworthiness indicators of countries as well as the extent of their private debt.

The magnitude of discounts is determined as described below:

$$D^* = \gamma\phi' + u_2 \tag{14}$$

where D^* - discount in the secondary market. Discount is defined as (1-price), where price is the secondary market price of $1 of debt.

ϕ' - in addition to the variables in ϕ, a measure of the concentration of a country's debt in the hands of large U.S. banks.

u_2 - normally distributed random error term with a standard error σ_2.

However, we observe positive discounts only when $T^* > 0$. Since no discounts are recorded for those countries whose debt is not traded in the secondary market, their debt appears to be at par. Accordingly, the observed discounts would be described as follows:

$$D = D^* \text{ if } T^* > 0, \tag{15}$$

$$D = 0 \quad \text{otherwise.}$$

The econometric model described with equations (13-15) is a Tobit model (Tobin 1958) (type two Tobit model according to the classification of Amemiya (1984)). The standard Tobit model is a special case of the model where T*=D*.

It is well known that ordinary least squares estimation method is not the appropriate one for the type of econometric model considered. The parameter estimates are known to be biased and inconsistent if equation (14) is estimated using ordinary least squares over the observations with positive discounts. Alternatively, one may conduct the estimation by employing ordinary least squares over all the observations by assigning zeros to those countries for which positive discounts are not recorded. This approach implies that if the debt of those countries were traded, the secondary market price would be zero, which obviously is incorrect. Accordingly, we employ a censored regression estimation technique as discussed next.

It has been shown that Heckman's two-step estimator (Heckman (1976)) can be used in this type of model (Amemiya (1984)) and that it yields consistent parameter estimates. According to this method, one first estimates the probit model described in equation (13) using maximum-likelihood procedure and obtains the inverse Mills' ratio (or the hazard rate).[18] The discounts then are estimated according to the following second stage equation by employing only the observations in the sample with positive recorded discounts:

$$D = \gamma\phi' + \gamma_1\lambda + \varepsilon_2 \quad \text{for } T^* > 0 \tag{16}$$

[18]From the estimation of (13) on obtains ω and Ω, where they are the density and distribution functions of the standard normal evaluated at $(\beta\phi/\sigma_1)$ respectively. The ratio ω/Ω is the hazard rate.

where λ = inverse of the Mills' ratio (hazard rate),

ϵ_2 = error term with mean zero.[19]

Equation (16) is estimated after replacing λ with its estimated value from equation (13), and using ordinary least squares method. The problem with this approach is that the asymptotic variance-covariance matrix of the parameters obtained in the second stage is not consistent.[20] It has been pointed out by Lee (1982), however, that consistent estimates of the variance-covariance matrix can be obtained by applying an estimator similar to the heteroskedasticity consistent estimator developed by White (1980). Accordingly, in this paper we use Heckman's two-step estimation method and follow Lee (1982).[21]

4.2 A Cursory Inspection of the Data

Equations (13) and (16) above will be used to investigate the relation between secondary market discounts and debt concentration. In this section we discuss the variables that enter ϕ of equation (13) and ϕ' of (16), as well as characteristics of our sample. In ϕ we include country characteristics that are relevant for repayment prospects and the extent of private indebtedness of

---

[19]Variance of ϵ_2 is given by eq. (89), Amemiya (1984), p. 32.

[20]Heckman's method does not require the joint normality of D* and T*. The detailed discussion of the method summarized here and the underlying assumptions are in Amemiya p. 13 and pp. 32-33.

[21]It should be noted that the identifying variable in the estimation of equations (13) and (16) is a measure of debt concentration. Our theoretical model takes as given the existence of a secondary market and therefore does not address the question as to whether debt concentration should be included in (13). As long as all the debt is not owned solely by one large bank, however, it is difficult to see why a greater concentration would lead to that debt not being traded.

a country. ϕ', in addition to the variables in ϕ, primarily includes a measure of concentration of a country's debt. Some specifications include in ϕ' additional creditor country factors, such as the exposure distribution of banks, so as to ensure the robustness of our results.

To control for characteristics of borrower countries we employ variables similar to those employed in previous studies. These variables are: debt-to-exports ratio, reserves-to-imports ratio, real GNP per capita, lagged-value-of-investment-to-GNP ratio, rate of inflation, debt-to-GNP ratio, imports-to-GNP ratio, and reserves-to-GNP ratio. In addition to these standard indicators, some structural variables have also been considered. These include the share of agriculture in GDP and a measure of income distribution. A lower agricultural base and unequal income distribution have both been argued to contribute to political instability and therefore to a less favorable environment for timely repayment (Berg and Sach (1989)).

A cursory look at the data suggests that the debt of countries with bad repayment prospects is more likely to be traded at a discount in the secondary market. In Table 1 the means and standard errors of the repayment indicators for the countries in our sample are presented. Our data contains information on 43 developing countries, based on data availability, for the period of 1986-88. In this sample the debt of 23 countries was traded at a discount. Overall, the repayment indicators appear worse for these 23 countries. Furthermore, almost all of the countries in this group have had rescheduling agreements with their creditor banks, in contrast to the remaining group with almost no reschedulings.

Table 1 also indicates that those countries with debts that are traded at a discount have larger debt outstanding to private creditors. A closer

inspection of this variable for countries that are not in the traded group is instructive. In this group countries that might be judged to have good repayment prospects have larger outstanding debt to private creditors: near 16 billion 1986 U.S. dollars for Korea and near 6 billion 1986 U.S. dollars for Greece. In contrast, countries with relatively bad repayment prospects, such as Ethiopia, and Trinidad and Tobago, also appear in this group. Debt to private creditors are .08 billion 1986 U.S. dollars, and .19 billion 1986 U.S. dollars for Ethiopia and Trinidad and Tobago respectively. One plausible explanation for these observations is that the transaction costs incurred in trading private debt on the secondary market prevents trading for countries with a small amount of private debt.

Table 2 presents some summary information concerning the secondary market discounts for the 23 countries whose debt was traded at a discount in the market over the 1986-88 period. The discounts presented in this table are calculated using bid prices. The mean discount for all countries over the period 1986-88 is 52.27 (with a standard deviation of 25.56).

The variable of interest is the degree of concentration of debt in the hands of the large international banks relative to small banks. The model suggests that we incorporate information on all banks that have outstanding loans to a country. In our empirical analysis, however, we will be restricted to data for U.S. banks only, since bank exposure data for individual countries are available only for U.S. banks in a systematic way. Since U.S banks have historically been the major players in the market, however, one may argue that not having other countries' banks may not be a major defect.

Another issue raised in creating a measure of concentration across countries is how the large banks should be selected. Should the set of large

banks be the same for each country or should, for each country, a number of banks with the highest exposure to that country be selected? Since our theoretical model does not incorporate differences among large banks, there is not a clear theoretical argument for choosing one strategy over the other. The nature of the available data, however, only permits us to look at a constant set of large banks. One may argue, in any case, that choosing the same set of the largest money center banks, independently of particular country exposure, is the more sensible strategy. The large money center banks have been unfailingly the most important players in making these loans and most likely are the banks with the greatest volume of business, in addition to debt, with the debtor countries. In comparison with the smaller banks, the large banks have greater exposure overall to all foreign borrowers. This also leads us to believe that they are the ones that would be more likely to lobby for the imposition of penalties on defaulting countries.

The exposure data that we use to compute debt concentration is compiled by the Federal Reserve Board. In this data banks are categorized as the largest nine, the next largest 15, and remaining U.S. banks. Largeness, in this data, is measured by the asset size of the banks. Accordingly, one measure that can be created using this data is the exposure of the largest nine U.S. banks to a country scaled by the exposure of the U.S. banks that are not in the largest 24 banks to that country (from here on, variable name is con1). For the countries in our sample we present the mean and the standard deviation for this variable on a country basis in Table 2.[22] The total sample

[22]Con1 was computed as 174 and 30 for Zambia and Malawi respectively. These countries were excluded from the analysis not only because these numbers are extraordinarily high relative to the sample mean, but also they show very high volatility between quarters suggesting deficiency in the data.

mean is 5.08 with a standard deviation of 2.30. It also appears that borrowers with high discounts also have low levels of concentration. The partial correlation coefficient between discounts and concentration is significantly different from zero and its magnitude is -.22, supporting the view that discounts (prices) and the concentration of debt in the hands of largest U.S. banks are negatively (positively) correlated.

An alternative measure of concentration is calculated by scaling the exposure of largest nine U.S. banks to the total outstanding private debt of a country (con2). The reason for creating this variable is to attempt to control for the presence of smaller banks from countries other than the U.S. in negotiations. The means and standard deviations on a country basis are presented in Table 2.

Two other issues require care in this investigation. First, since it has been demonstrated that exposure of large banks to countries is negatively correlated with secondary market prices (see Ozler and Huizinga (1990)), it is important for us to show that concentration is not a mere proxy for exposure. As can be seen in Table 2, countries to which the large U.S. banks have high exposure trade at rather large discounts, in contrast to the larger borrowers. Cursory evidence suggests that this should not be a source of concern: The partial correlation between concentration (con1) and exposure, however, is small (.004) and not statistically significant. Second, it should be noted that the secondary market spreads (calculated as the percentage differences between the offer and bid prices quoted in the secondary market) are large for some low concentration countries. This observation suggests that an investigation of secondary market prices based on solely the bid prices may be misleading.

4.3 Estimation Results

In this section we present results from the estimations of the equations described in the previous section: the probit specification for the occurrence of trading in the secondary market as in equation (13), and the secondary market discounts specified in (16). The primary result of our empirical investigation is that the discount in the secondary market decreases with increased debt concentration.

In order to investigate the robustness of these results we attempted a number of alternative specifications in the estimation of the two equations. Three issues require attention: First, it is important to establish that the results are not a consequence of a particular choice of economic indicators as measures of country risk among the potential ones. In order to address the first potential problem we employed alternative specifications of country characteristics. Second, the results should not be contaminated by specific market characteristics such as the size of the spread between the bid and ask prices. To address the second source of concern, we calculated the discounts as averages of bid and ask prices in the secondary markets. Third, the reuslts concerning concentration should not be contaminated when creditor factors such as the exposure distribution of banks and bank capital aggregate are incorporated.

In Tables 3-6 we present estimation results for two basic empirical models with alternative specifications. We next describe the differences between these models and various specifications: (In addition to the variables that are described below, each specification employs region specific and quarterly dummy variables.) Model 1 (presented in Tables 3-4)

incorporates the following basic variables: stock of debt to private creditors, debt-to-exports, reserves-to-imports ratios, real GNP per capita, and the inflation rate. Alternative specifications of this model include investment-to-GNP ratio, a measure of income distribution, and share of agriculture in GDP, and a measure of bank exposure and bank capital. Model 2 (presented in Tables 5-6) replaces debt-to-exports and reserves-to-imports by debt-to-GNP, imports-to-GNP, and reserves-to-GNP. Alternative specifications of Model 2 are structured analogous to the alternatives of Model 1.

Table 3 primarily indicates that bank concentration is negatively related to the discounts. The variable is found to be a significant determinant of secondary market discounts as indicated by large "t" values. The result is robust to using the alternative measures of the concentration variable and to the inclusion of exposure and capital variables. The estimations suggest that higher debt-to-exports ratio, higher inflation, lower GNP per capita, and lower reserves-to-imports ratio increase the likelihood that the debt of a country is traded at a discount in the secondary market. (The estimated probabilities of trading are large for all countries for which there is trading and drop dramatically for the remaining countries.) In the same table we also observe that variables that contribute towards the occurrence of trade increase the magnitude of discounts; the variables that decrease the likelihood of trading decrease the magnitude of discounts. An exception is the amount of debt outstanding to private creditors. An increase in this variable increases the likelihood of trading, but decreases the discounts. The income distribution variable is incorporated only in the discount equation since it was not possible to estimate the probit equation when this variable is incorporated. The sign of the income distribution variable indicates that

the debt of countries with historically worse income distribution is traded at lower discounts in the secondary market (this is in contrast to the finding of Berg and Sachs (1988)).

Table 4 is a further variation of Model 1. The basic finding that the concentration of debt is negatively related to the magnitude of the discounts continues to hold. Investment-to-GNP ratio and the share of the agriculture sector in GDP are incorporated in Model 1, both in the estimation of the probit equation and in second stage equation. An increase in the magnitude of either of the variables is found to decrease the probability of trading in the secondary market. Share of agriculture is also found to decrease the magnitude of discounts.

Tables 5 and 6 are exposited the same way as Tables 3 and 4, except that the basic underlying structure is that of Model 2. The main finding continued to hold: debt concentration is found to have a negative impact on the magnitude of discounts in the secondary market and this finding is robust to alternative definitions of the concentration variable as well as to the incorporation of bank exposure and capital variables. In addition, these tables indicate that GNP per capita and inflation rates continue to hold the same signs as in Tables 3-4 and they remain important determinants of trading. Higher reserves-to-GNP, higher imports-to-GNP, higher debt-service-payments-to-exports ratio all reduce the likelihood of trading. Estimated probabilities from all these specifications also seem reasonable in that actual no-trading countries are assigned quite low probabilities of being traded, in contrast to the remaining countries. As in Model 1, worse income distribution is found to contribute to increased probability of trading but it appears to reduce the discounts.

Overall, the signs of repayment indicators are consistent with their expected signs: high debt-to-exports ratio or a high ratio of debt-to-GNP makes non-payment more likely. The negative sign of reserves-to-GNP ratio suggest that it is an indicator of the level of international liquidity of the borrower. A high ratio of imports to GNP may make the borrower more creditworthy since the borrower may become more vulnerable to trade embargoes. High inflation appears to be an indicator of a larger probability of balance of payments crisis. Finally, countries with high GNP per capita are found to be more creditworthy.

It is important to note that our finding are not a consequence of a few extraordinarily influential observations. Specifically, the magnitude of spreads between the bid and ask prices of the secondary market for some countries may raise this concern. As indicated in Table 2, the spreads for Bolivia, Liberia, Peru and Sudan are quite large (18, 37, 18, 61 percent respectively). Our findings, however, are robust to the exclusion of these countries from the sample.

To summarize, the finding that emerges from these tables is that the degree to which a country's debt is concentrated is an important determinant of the magnitude of its secondary market discount. In particular, a higher debt concentration leads to a lower (higher) secondary market discount (price). How important is the magnitude of this effect? Evaluated at the mean of our sample (near 52 and 5 for discount and concentration (conl) respectively), doubling the concentration would yield a change in the discounts in range of 7 cents to 30 cents on the dollar. The range is a function of the alternative magnitudes (in the range -.12 to -.59) for the estimated parameter value for conl in various specifications. Most

specifications yield parameter values for the variable conl near (-.25), a magnitude that would indicate that a doubling of concentration from the sample mean of 5 to 10 would cause a 13 cent decrease in secondary market discounts.

Concluding Remarks

Evaluations, both normative and positive, of different schemes to deal with the debt crisis rely on secondary market prices as indicators of the expected value of a country's repayments. In this paper we argue that certain characteristics of a country's creditors, in particular the degree of concentration of a country's debt in the hands of the largest U.S. banks, will affect a country's repayment prospects and, hence, secondary market prices. We conduct a theoretical and empirical investigation of this issue.

In the context of a model that distinguishes between large money center banks and smaller regional banks, we show that the percentage of a country's debt held by the large banks affects the value of that country's debt: the higher the concentration of the debt, the higher the valuation. We also show that if debt is freely traded in the secondary market, the entire stock of debt will not eventually end up owned by the large banks. Our empirical analysis incorporates a number of potential determinants of secondary market prices. Among these are variables that are associated with a country's economic performance, variables that can be associated with the regulatory structure in the creditor's country, and the concentration of debt in the hands of the largest US banks. Our empirical findings indicate that concentration indeed has a positive effect on secondary market prices.

Our finding of a positive effect of debt concentration on secondary market prices has a number of important implications for policy making and

theoretical debates. A first point is that secondary market prices are not influenced solely by the "good" or "bad" behavior of the debtor countries. The degree of debt concentration is a feature that characterizes creditors: the structure of the banking system, the regulatory systems in the lender countries, and optimal portfolio considerations are among the factors that might lead to a particular distribution of the debt among banks in the initial syndication of a loan. The contribution of each of these factors to debt concentration, and hence to secondary market prices, should be taken into account when assessing the value of debt forgiveness programs, debt-equity swaps, and virtually any other scheme that relies on secondary market prices. Secondly, the role that differing characteristics among creditor banks may play in any negotiation--in our case, the asymmetry in the extent of banks involvement, exclusive of debt, with these countries--is an important feature that has been neglected, in most part, by the theoretical and empirical literature. Lastly, the (theoretical) presence of free-rider problems in our model of the secondary debt market indicates, once again, that there may be important room for coordinated responses to the debt crisis.

References

Amemiya, T., "Tobit Models: A Survey," Journal of Econometrics, 24, 1984.

Berg, A. and Sachs, J., "The Debt Crisis: Structural Explanations of Country Performance," Journal of Development Economics, 1989.

Bulow, J. and Rogoff, K., "Sovereign Debt: Is to Forgive to Forget," American Economic Review, 79, 1989a.

_____ and _____, "A Constant Recontracting Model of Sovereign Debt," Journal of Political Economy, 1989b.

Cohen, D., "Is the Discount on the Secondary Market a Case for LDC Debt Relief?," PPR Working Paper 132, World Bank, 1988.

Demirguc-Kunt, A. and Diwan, I., "The Menu Approach to Developing Country External Debt: An Analysis of Commercial Banks' Choice Behavior," mimeo, 1990.

Eaton, J., "Sovereign Debt, Reputation, and Credit Terms," mimeo, 1989.

_____ and Gersovitz, M., "Debt with Potential Repudiation: Theory and Estimation," Review of Economic Studies, 48, 1981.

_____ and Taylor, L., "Developing Country Finance and Debt," Journal of Development Economics, 22, 209-265, June 1986.

Fernandez, R. and Glazer, J. "Striking for a Bargain Between Two Completely Informed Agents," American Economic Review, March 1991.

_____ and Kaaret, D., "Bank Size, Reputation and Debt Renegotiation," NBER Working Paper no. 2704, September 1988.

_____ and Glazer, J., "The Scope for Collusive Behavior Among Debtor Countries," Journal of Development Economics, 32, 1990.

_____ and Rosenthal, R., "Strategic Models of Sovereign Debt Renegotiations," Review of Economic Studies, July 1990.

Hajivassiliou, V., "Do Secondary Markets Believe in Life After Debt?," in H. Ishrat and I. Diwan (eds.) Dealing with the Debt Crisis, World Bank, Washington, D.C., 276-292, 1989.

Heckman, J., "The Common Structure of Statistical Models of Truncation, Sample Selection, and Limited Dependent Variables and a Simple Estimator for Such Models," Annals of Economic and Social Measurement, 5, 475-492.

Huizinga, H., "The Commercial Bank Claims on Developing Countries: How Have Banks Been Affected?," In H. Ishrat and I. Diwan, (eds.) Dealing with the Debt Crisis, World Bank, Washington, D.C., 129-143, 1989.

Krugman, P., "International Debt Strategies in an Uncertain World," in International Debt and the Developing Countries, G. Smith and J. Cuddington, eds., A World Bank Symposium, 1985.

Lee, L. F., "Some Approaches to the Correction of Selectivity Bias," Review of Economic Studies, 49, 355-372, 1982.

Ozler, S., "On the Relation Between Reschedulings and Bank Value," The American Economic Review, December 1989.

_____, "Evolution of Credit Terms: An Empirical Study of Commercial Bank Lending to Developing Countries," Journal of Development Economics, forthcoming 1990a.

_____, "Have Commercial Banks Ignored History?," mimeo, May 1990b.

_____ and Huizinga, H., "Secondary Market Prices for Developing Country Debt: The Role of Creditor Country Factors," mimeo, April 1990.

_____ and Tabellini, G., "External Debt and Political Instability," mimeo, November 1990.

Purcell, J., and Orlanski, D., "Developing Country Loans: A New Valuation Model for Secondary Market Trading," Corporate Bond Research, Salomon Brothers, Inc., June 1988.

Rosenthal, R., "On the Incentives Associated with Sovereign Debt," mimeo, 1990.

Rubinstein, A., "Perfect Equilibrium in a Bargaining Model," Econometrica, 50, 1982.

Sachs, J., "Theoretical Issues in International Borrowing," Working Paper no. 1189, National Bureau of Economic Research, Inc., 1983.

_____ and Huizinga, H., "U.S. Commercial Banks and the Developing-Country Debt Crisis," Brookings Papers on Economic Activity, 1987.

Tobin, J., "Estimation of Relationships for Limited Dependent Variables," Econometrica, 26:24-36, 1958.

White, H., "A Heteroscedasticity-consistent Covariance Matrix Estimator as a Direct Test for Heteroscedasticity," Econometrica, 48, 817-838, 1980.

Table 1

Sample Characteristics

	For Countries Whose Assets Are:[a]			
	Traded		Not Traded	
	Mean	Standard Deviation	Mean	Standard Deviation
Debtexp	4.02	2.47	2.62	2.22
Resimp	1.20	1.00	1.03	0.74
Rgnp	1.30	0.76	2.03	2.05
Inf	0.10	0.13	0.02	0.03
Invgnp[b]	0.18	0.05	0.22	0.06
Debtgnp	0.71	0.34	0.40	0.16
Resgnp	0.22	0.18	0.39	0.64
Impgnp	0.22	0.11	0.37	0.37
Increat[c]	0.19	0.09	0.08	0.02
Agrat	0.15	0.07	0.19	0.11
Pridebt	5.07	6.62	3.76	4.21

(Variable definitions and sources are provided below.)

Notes:

[a]The countries whose debt is traded in the secondary market are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa-Rica, Dominican Republic, Ecuador, Honduras, Ivory Coast, Jamaica, Liberia, Mexico, Morocco, Panama, Peru, Philippines, Sudan, Turkey, Uruguay, Venezuela, Yugoslavia, Zaire.

The remaining countries in our sample are: Cameroon, Egypt, El Salvador, Ethiopia, Greece, Hungary, India, Indonesia, Israel, Jordan, Kenya, Korea, Pakistan, Paraguay, Portugal, Singapore, Sri Lanka, Thailand, Trinidad and Tobago, Tunisia.

[b]This variable is not available for Argentina, Mexico, Sudan, Turkey, and Zaire.

[c]These series are obtained from Sachs and Berg (1988) and are not available for Bolivia, Cameroon, Dominican-Republic, El Salvador, Ethiopia, Greece, Honduras, Jamaica, Jordan, Liberia, Pakistan, Sri Lanka, Sudan, Venezuela, Zaire.

Table 1 (Continued)

Variable Definitions and Sources:

(Variables that are not noted as quarterly are measured as annually.)

Detexp : Ratio of total public outstanding debt to exports (exports are quarterly)
Resimp : Ratio of total reserves to imports (both quarterly)
Rgnp : GNP per capita in thousands of 1986 U.S. dollars
Inf : Rate of inflation (quarterly)

Invgnp : Ratio of domestic investment to GNP
Detgnp : Total public debt to GNP ratio
Impgnp : Imports to GNP ratio (imports are quarterly)
Resgnp : Reserves to GNP ratio (reserves are quarterly)
Incrat : A measure of income distribution, defined as the ratio of the highest income quartile to the lowest income quartile for the early 1970s. The variable is available for the cross-section of some countries.
Agrat : Agriculture to GDP ratio averaged over the period of 1970-1981.
Pridebt : Debt outstanding to private creditors in billions to U.S. dollars (quarterly)

Sources: International Financial Statistics (IMF), World Debt Tables (The World Bank), Sachs and Berg (1988).

Table 2

Country	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Argentina	53.33	18.76	7.38	1.00	0.87	2.82	6.48
Bolivia	91.32	2.01	3.04	1.01	0.05	18.32	0.04
Brazil	41.03	13.66	5.45	1.44	0.60	2.43	15.86
Chile	36.92	4.77	3.98	0.88	0.81	2.44	3.92
Columbia	23.90	10.15	5.10	0.75	0.38	2.00	1.52
Costa Rica	70.80	14.96	2.91	0.51	0.36	9.49	0.20
Dominican Republic	65.42	11.91	5.50	0.57	0.60	7.05	0.28
Ecuador	54.33	19.40	2.87	0.60	1.34	4.31	1.17
Honduras	67.29	8.42	1.74	0.75	0.11	8.46	0.05
Ivory Coast	43.95	21.64	5.84	1.30	0.09	5.57	0.28
Jamaica	59.72	4.99	6.95	1.20	0.48	9.43	0.12
Liberia	91.54	5.02	2.96	0.88	0.47	37.72	0.03
Mexico	46.73	5.11	2.68	0.42	0.63	2.38	13.29
Morocco	38.77	9.45	7.99	1.62	0.43	3.16	0.59
Panama	49.14	21.37	3.55	0.90	0.49	5.97	0.54
Peru	87.75	6.47	2.92	0.35	0.18	18.64	0.57
Philippines	40.38	8.30	8.97	1.45	0.44	3.04	3.37
Sudan	95.38	3.67	6.08	3.29	0.02	61.91	0.02
Turkey	2.53	0.65	5.52	1.05	0.15	1.47	1.15
Uruguay	36.12	4.73	8.53	0.72	0.90	2.91	0.68
Venezuela	35.96	12.33	5.96	0.24	0.52	2.15	6.14
Yugoslavia	34.97	15.91	4.14	0.45	0.17	2.46	1.24
Zaire	77.91	2.81	6.78	0.97	0.02	13.89	0.007

Notes:

Col(1) : Average discount in the secondary market (100-bid price) over the 1986-1988 period.

Col(2) : Standard deviation of the discounts.

Col(3) : Exposure of top nine US banks scaled by the exposure of US banks that are not in the top 24 (Con1). The variable is computed as an average over the 1986-1988 period.

Col(4) : Standard deviation of Con1.

Col(5) : Exposure of top nine US banks scaled by total outstanding private debt of the country (Con3). The variable is computed as an average over the 1986-1988 period.

Col(6) : Percentage difference between the bid and ask prices in the secondary market.

Col(7) : The exposure of the top nine US banks in US$ billion.

Sources: *Indicative Prices for Less Developed Country Bank Loans*, Salomon Brothers.

Country Exposure Lending Survey, Federal Reserve Board.

World Debt Tables, The World Bank.

Notes to Tables 3-6

The numbers in parentheses are "t" values.

The dependent variable in the second stage equation (eq. 16) is the logarithm of discounts. The discounts are calculated as (100 - avprice) where avprice is the average of bid and ask prices.

Lcon1 and Lcon2 are the logs of concentration measures con1 and con2.

Lex9 and Lk9 are the logs of top nine US bank exposure and capital respectively. Both variables are in thousands of 1986 US $.

Not reported here are coefficients of quarterly dummies.

In Table 3 and Table 5 columns (2-4) are 2nd stage equations. They all use the specification in column (1) for the 1st stage in the respective tables.

In Table 4 and Table 6, column (2) employs column (1) and column (4) employs column (3) as first stage equations.

Table 3

Secondary Market Prices and Concentration -- Model 1

	(1)	(2)	(3)	(4)	(5)
Lconl		-0.26 (-4.26)		-0.21 (-3.63)	-0.59 (-4.81)
Lcon2			-0.80E-01 (-2.66)		
Lex9				-0.13 (-7.07)	
Lk9				4.06 (1.03)	
Incrat					-0.26E-01 (-4.61)
Pridebt	0.27E-06 (6.62)	-0.16E-07 (-3.34)	-0.13E-07 (-2.62)	0.56E-08 (1.04)	-0.10E-07 (-1.57)
Debtexp	0.84E-03 (2.16)	0.37E-03 (3.25)	0.26E-03 (2.10)	0.36E-03 (3.39)	0.60E-04 (0.30)
Resimp	-0.80E-02 (-6.07)	-0.85E-03 (-2.45)	-0.11E-02 (-3.16)	-0.42E-03 (-1.24)	-0.21E-02 (-3.20)
Rgnp	-0.88 (-5.19)	-0.13 (-2.26)	-0.13 (-2.35)	-0.67E-01 (-1.14)	-0.48E-01 (-0.67)
Inf	0.16 (6.42)	0.11E-01 (3.91)	0.11E-01 (3.96)	0.11E-01 (4.25)	0.13E-01 (3.79)
Latin	4.15 (9.40)	1.02 (3.71)	1.28 (4.73)	1.04 (0.27)	1.74 (4.76)
Africa	2.20 (6.31)	0.97 (3.68)	1.00 (3.83)	0.85 (3.30)	1.26 (3.84)
Constant	-1.75 (-3.32)	4.56 (9.31)	3.07 (9.86)	-5.90 (-3.62)	6.52 (10.67)
Millsinv		0.22E-02 (0.01)	0.11 (0.48)	0.16 (0.64)	0.86 (2.34)
McFadden R-Square	0.58				
% of Right Predictions	0.88				
Nobs at 1:	237				
Nobs at 0:	208				
Adjusted R-Square		0.38	0.37	0.43	0.38

Table 4

Secondary Market Prices and Concentration — Model 1

	(1)	(2)	(3)	(4)
Lconl		−0.28 (−4.59)		−0.26 (−2.72)
Invgnp	−0.79E−01 (−4.12)	−0.45E−02 (−0.61)		
Agrat			−0.34 (−2.64)	−0.35E−01 (−5.44)
Pridebt	0.26E−06 (5.63)	−0.10E−07 (−2.03)	0.59E−06 (4.24)	−0.14E−07 (−2.62)
Debtexp	0.51E−03 (1.11)	0.21E−03 (1.17)	0.38E−03 (3.87)	0.20E−04 (0.12)
Resimp	−0.75E−02 (−5.39)	−0.11E−02 (−2.44)	−0.15E−01 (−3.87)	−0.99E−03 (−2.61)
Rgnp	−0.52 (−2.66)	−0.21 (−3.86)	−6.03 (−4.44)	−0.18 (−2.69)
Inf	0.84E−01 (2.92)	0.61E−02 (2.76)	0.51 (4.84)	0.88E−02 (3.02)
Latin	4.13 (9.25)	0.43 (2.07)	11.56 (5.06)	0.96 (3.74)
Africa	1.96 (5.04)	0.13 (0.93)	3.88 (3.80)	0.78 (2.83)
Constant	−0.11 (−0.16)	5.51 (11.35)	7.69 (2.16)	5.27 (9.90)
Millsinv		0.13 (0.80)		0.39 (1.10)
McFadden R-Square	0.57		0.83	
% of Right Predictions	0.89		0.93	
Nobs at 1:	171		174	
Nobs at 0:	196		140	
Adjusted R-Square		0.41		0.34

Table 5
Secondary Market Prices and Concentration — Model 2

	(1)	(2)	(3)	(4)	(5)
Lconl		-0.21 (-2.91)		-0.13 (-2.01)	-0.33 (-2.64)
Lcon2			-0.67E-01 (-2.06)		
Lex9				-0.12 (-5.84)	
Lk9				3.33 (4.08)	
Incrat					-0.22E-01 (-3.27)
Pridebt	0.52E-06 (5.24)	-0.18E-07 (-4.62)	-0.17E-07 (-4.10)	0.25E-08 (0.51)	-0.43E-08 (-0.60)
Debtgnp	0.17 (5.57)	0.50E-02 (2.93)	0.42E-02 (2.44)	0.31E-02 (1.79)	0.88E-02 (2.86)
Resgnp	-0.81E-01 (-3.88)	-0.39E-02 (-2.44)	-0.39E-02 (-2.44)	-0.16E-02 (-1.10)	-0.13E-01 (-3.52)
Impgnp	-0.67E-01 (-2.62)	-0.51E-02 (-1.40)	-0.45E-02 (-1.19)	-0.61E-02 (-1.75)	0.16E-01 (1.19)
Rgnp	-0.59 (-1.68)	-0.10 (-1.53)	-0.11 (-1.72)	-0.68E-01 (-1.06)	0.14E-01 (0.18)
Inf	0.45 (4.94)	0.79E-02 (3.07)	0.67E-02 (2.80)	0.64E-02 (2.84)	0.12E-01 (3.03)
Latin	5.51 (5.31)	0.68 (2.91)	0.79 (3.39)	0.68 (2.90)	1.45 (3.39)
Africa	1.26 (1.22)	0.49 (1.82)	0.46 (0.26)	0.42 (1.58)	0.54 (1.36)
Constant	-1.63 (-4.87)	4.50 (10.24)	3.45 (9.98)	-5.99 (-3.68)	4.30 (5.08)
Millsinv		-0.62 (-2.07)	-0.69 (-2.37)	-0.61 (-2.10)	0.47 (0.78)
McFadden R-Square	0.84				
% of Right Predictions	0.95				
Nobs at 1:	239				
Nobs at 0:	208				
Adjusted R-Square		0.42	0.42	0.46	0.37

Table 6

Secondary Market Prices and Concentration -- Model 2

	(1)	(2)	(3)	(4)
Lconl		-0.37 (-6.48)		-0.12 (-2.21)
Invgnp	-0.37 (-3.69)	-0.15E-01 (-2.09)		
Agrat			-1.21 (-2.52)	-0.18E-01 (-2.15)
Pridebt	0.13E-05 (4.22)	-0.87E-08 (-1.87)	0.17E-05 (2.96)	-0.68E-08 (-1.11)
Debtgnp	0.30 (4.29)	0.95E-02 (4.70)	0.42 (2.67)	0.94E-02 (3.06)
Resgnp	-0.89E-01 (-2.41)	-0.47E-02 (-2.65)	-0.24 (-2.89)	-0.53E-02 (-2.14)
Impgnp	-0.95E-01 (-1.91)	-0.54E-02 (-1.43)	0.13 (1.45)	0.82E-03 (0.07)
Rgnp	-0.88 (-1.33)	-0.60E-01 (-1.14)	-16.49 (-2.67)	-0.23E-01 (-0.24)
Inf	0.79 (3.76)	0.72E-02 (3.56)	1.99 (2.91)	0.76E-02 (2.56)
Latin	10.83 (2.60)	-0.30E-01 (-0.27)	30.34 (2.97)	0.55 (2.21)
Africa	-0.81 (-0.52)	-0.37 (-3.26)	1.47 (0.67)	0.78E-01 (0.27)
Constant	-1.41 (-0.14)	6.02 (15.15)	-0.43 (-0.05)	3.78 (4.51)
Millsinv		-0.24 (-1.62)		
McFadden R-Square	0.92		0.92	
% of Right Predictions	0.98		0.98	
Nobs at 1:	173		176	
Nobs at 0:	196		140	
Adjusted R-Square		0.54		0.38

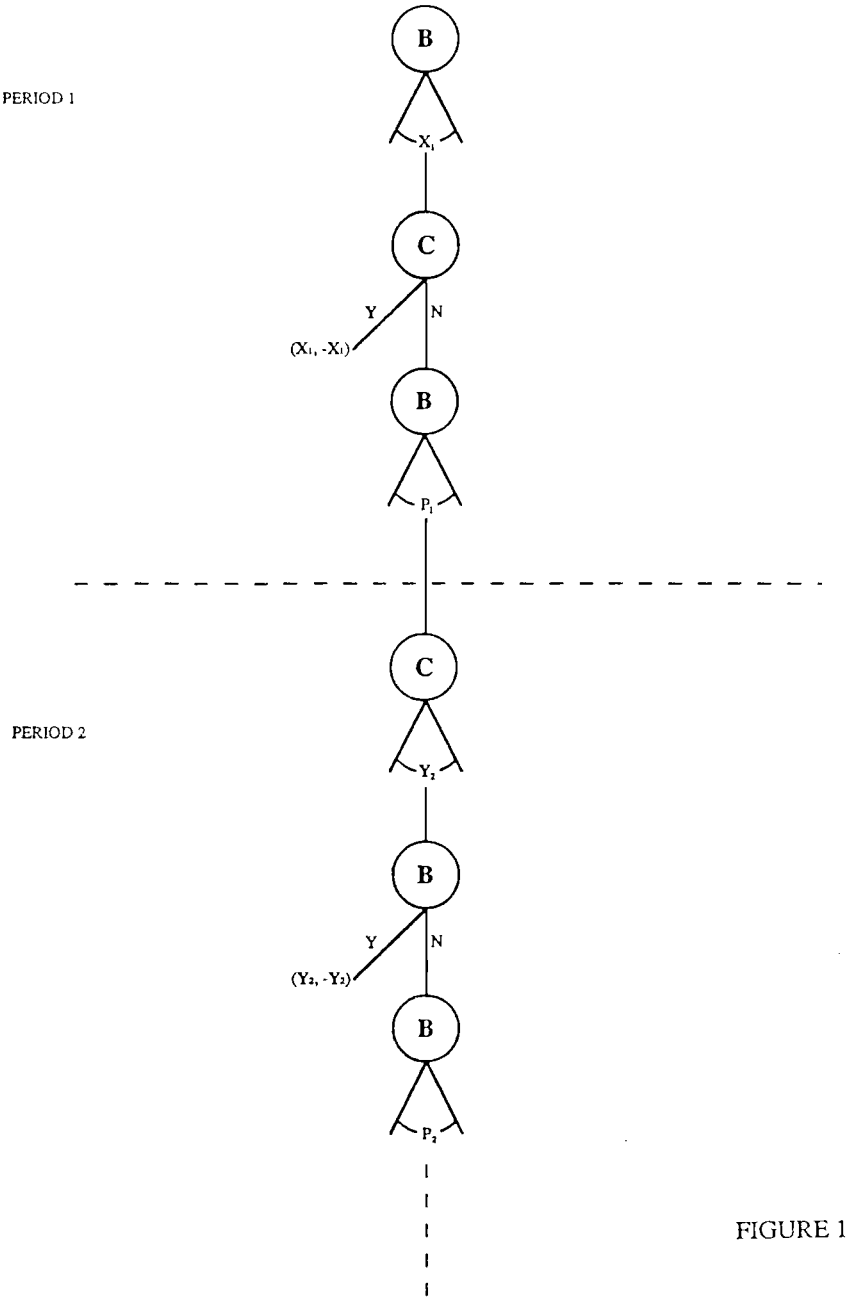

FIGURE 1

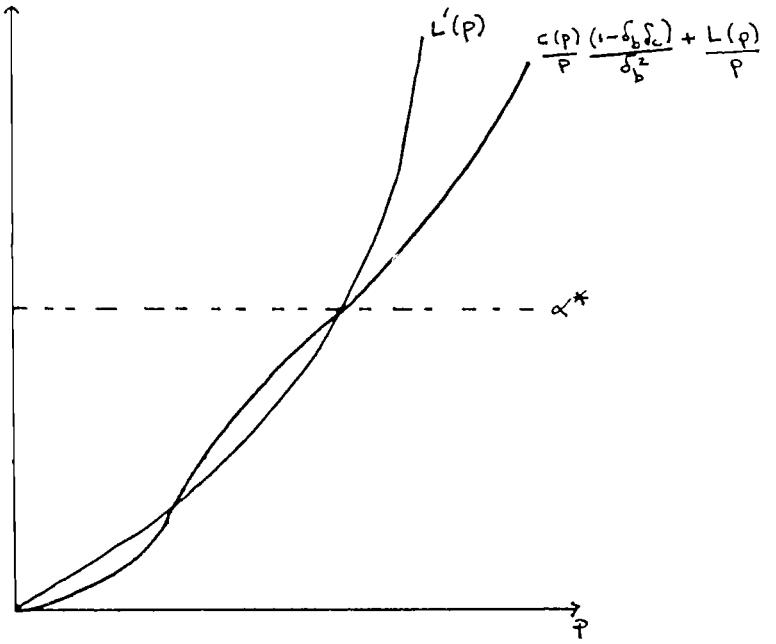

FIGURE 2