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SOVEREIGN DEBT BUYBACKS CAN LOWER BARGAINING COSTS

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ABSTRACT

I develop two models in which debt repurchases by highly indebted sovereign nations are advantageous for all parties. The models are based on the idea that when sovereign debts are large, bargaining costs are large. Creditors spend more resources convincing the debtor that they are tough when they have more at stake. Also, the sanctions which are sometimes triggered when bargaining fails to produce an agreement are larger when debts are larger. For both these reasons buybacks, which reduce the face value of the outstanding debt, can be beneficial. The resulting equilibria are constrained Pareto Optima. But, donors who subsidize buybacks increase overall welfare more than donors who make direct gifts. I also argue that Bulow and Rogoff (1988)'s empirical evidence on buybacks is consistent with my models.

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Sovereign Debt Buybacks Can Lower Bargaining Costs

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Highly indebted countries and their creditor banks have experimented with numerous approaches to ameliorate the "LDC Debt Crisis". One rather popular approach is to have the country repurchase its debt at its current market price. Since the debt currently trades below par, countries pay less than they would if they actually honored their debts. The repurchase, or "buyback", recognizes that the debts are very unlikely to be paid in full.

Several authors (Huizinga and Sachs (1987), Bulow and Rogoff (1988), Froot (1988), Krugman (1988)) have noted that other schemes are closely related to buybacks. For example, "debt/equity swaps" allow investors to purchase local currency with foreign debt that they obtain in the secondary market. This is equivalent to letting investors pay for their local currency in hard currency and use the hard currency to buy back the debt.

We would obviously like to know why these schemes arise and who benefits from them. An additional reason for studying these schemes is that we now have some data on their effect. These data can help disentangle the empirical validity of various theoretical models of the debt crisis. In a thought provoking paper, Bulow and Rogoff (1988) show that the March 1988 debt repurchase of Bolivia raised the secondary market's price of Bolivia's debt substantially. It rose so much that the secondary market's valuation of outstanding debt was almost unchanged by the buyback. Why then did Bolivian officials do this?

Bulow and Rogoff (1988)'s explanation is that Bolivian officials were misguided or unpatriotic. Stated differently, there exist models of rational optimizing governments which are inconsistent with the facts. To make this point with some generality, consider situations

where buybacks affect only the flows of payments between countries.[1] They do not affect real activity in either. If borrowers and lenders apply the same discount factor to future cash flows, these purely redistributive (or financial) buybacks cannot benefit all concerned. The sum of the welfare effects on all parties sums to zero. So, these models imply that the lenders welfare improvement is matched by a reduction in borrower welfare.

Borrower countries are probably constrained in the amount they can borrow. Thus, their discount rates presumably exceed those of their lenders. Such a difference in discount rates would imply that the lenders' benefit from purely financial buybacks is more than offset by borrower losses. This occurs because buybacks increase current payments from the borrower while, at best, reducing future payments.

Bulow and Rogoff (1988) argue that, in the case of sovereign debts, we should expect only the lenders to benefit from purely financial buybacks. Sovereign debts are those whose repayment depends only on the ability to threaten the debtor with reprisals and not on borrower net worth.[2] Therefore, buyback induced reductions in the face value of the outstanding debt have a very small effect on future repayments. This makes them a bad deal for borrowers. By contrast, in the case of corporate debts the creditor can dissolve the debtor and keep the net worth. Thus, buybacks are financed with cash which really belongs to creditors. In this case, creditors lose from repurchases.

Both of these stories assume that buybacks take place in the open market. If buybacks are negotiated and if, as in Bulow and Rogoff (1986), negotiation is costless, purely financial buybacks change nobody's welfare. The evidence that buybacks make lenders better off is thus inconsistent with Bulow and Rogoff (1986). It is now unrealistic to maintain, as they do, that countries are rational pursuers of their self interest and that debts have only redistributive effects.

For buybacks to improve everybody's welfare, they must have real consequences. Acharya and Diwan (1988), Froot (1988), Helpman (1987), Krugman (1988) and Sachs (1988) have formally studied one particular real effect of buybacks. Their effect relies on

[1] Dooley (1988) provides an example of such a model.
[2] See Eaton, Gersovits and Stiglitz (1986) and the literature cited therein.

moral hazard.[3] They argue that the fall in nominal debt outstanding induced by buybacks raises the country's incentive to invest. This occurs because the country gets to keep a larger fraction of the investment's return. The investments available to the debtor have very large rates of return but there is no mechanism, other than debt reduction, to induce the country to undertake them. Once they are undertaken however, their high returns make it possible for the country to pay more per unit of outstanding debt. Therefore, reductions in the face value of debt tend to increase payments on the debt that remains outstanding. Lenders get more money, borrowers get some of the surplus from the valuable investments and everybody benefits.

In this paper I model a second real effect of buybacks. As Sachs and Huizinga (1986) argue informally, debt repurchases can lower bargaining costs. They do so in my models because smaller debts lead to less wasteful bargaining between country and banks. There are many ways in which bargaining is wasteful. They stem from the imperfection of information. With perfect information (as in Rubinstein (1982)) bargaining simply leads to some division of the total pie. There are no resources spent on the dividing itself. If such bargaining were in fact typical, one would not expect protracted debt crisis. There would only be capital gains and losses as, over time, bargaining positions change.

By contrast, we see very valuable resources spent as the countries and the banks seek agreements. First, individuals with important responsibilities such as running countries or banks devote much time to LDC debt negotiations. Second, individuals engage in actions which are costly to the coalition of country and banks as a whole to demonstrate their bargaining power. Third, the failure to reach agreement as the participants act tough sometimes leads to costly sanctions.

These bargaining costs are closely related to those explored in Fudenberg and Tirole (1983), Sobel and Takahashi (1983) and Admati and Perry (1987). This theoretical literature has principally focused on model with alternating offers where temporary failure to reach agreement is costly because the future is discounted. Delay to reach agreement

[3] See Atkeson (1988) for an infinite horison rather tan a finite horison model of sovereign debt with moral hasard. Atkeson's analysis is conducted at such a level of generality that ideas such as "buybacks" have no simple analytical counterpart. Nonetheless, buybacks could well be going on behind the payment flows predicted by his model.

emerges in equilibrium and constitutes the only cost of bargaining.[4] In practice, bargaining parties also employ tools other than delay to demonstrate their resolve. Moreover, the cost of failing to reach agreement at any given time is often more severe than the simple postponement of agreement. Failure to reach agreement often triggers aggressive retaliation. For added realism I thus focus on these other costs of bargaining.[5]

The empirical relevance of these bargaining costs is readily apparent.[6] For example, the trade of Brazil was severely disrupted during its 1987 debt moratorium. Banks tried hard to demonstrate how expensive it would be for Brazil not to repay.[7] This disruption certainly cost Brazil and its bankers some resources.

In the models presented below I argue that the costs of bargaining increase as the level of debt increases. This is true for two reasons. The first is that ministers and bank presidents are less likely to spend as many resources demonstrating how tough they are when they are splitting a smaller pie. Chest-beating loses some of its appeal. I have in mind situations where bargaining is accompanied by costly negotiations. In these negotiations the actors spend resources to demonstrate how committed they are to a good outcome. Such negotiation and posturing (which is socially unproductive) then becomes privately less attractive as the level of debt falls.

The second reason is that the sanctions which are often triggered by imperfect information may depend on the level of the debt. For instance, many debt contracts with highly indebted nations are subject to US laws. This means that US courts will enforce seizures on foreign assets. The level of these seizures could depend on the level of debt. Another form of sanction is the disruption of a country's access to trade credit. This disruption is actually not easy for banks to enforce. Individual banks would like to deviate from this sanction and offer trade credit unilaterally for a fee. Banks will presumably try harder to keep each other in check when they have more at stake, i.e when the debt is bigger.

When the bargaining costs increase as the level of debt increases, there is an obvious

[4] Not all models of this type exhibit costly delay. Compare Gul and Sonnenschein (1985) to Admati and Perry (1987).

[5] One paper which shows how bargaining costs can take unexpected guises is Saloner (1987). He shows that predatory actions by firms can be used to demonstrate that one is willing to pay little for the purchase of one's competitor. This rationalises predation in situations where the two parties are negotiating the terms of a horisontal merger.

[6] See Sachs and Huisinga (1987).

[7] New York Times, February 22, 1988.

benefit to reducing the extant debt. Buybacks are a mechanism which allows these reductions. Under plausible conditions the social benefits from the debt reduction are shared by both banks and debtor countries. Therefore both find some buybacks in their interest. The debtor gains because there is less costly posturing and because the disagreements, when they arise, are less costly. The creditor gains because posturing is costly for him as well and because he receives some money up front. The key result of the paper is that it is perfectly consistent for both to benefit even though buybacks increase the secondary market price of debt substantially.

I also show that, unless they are able to modify the institutions of bargaining, governments cannot generally produce Pareto improvements. Nonetheless, governments who wish to help the parties involved have a role in debt repurchases. Buying up the debt and tearing it up produces a higher amount of recipient welfare per unit spent than do lump sum transfers. This intervention is desirable because it reduces bargaining costs.

Of course, buybacks are far from the only mechanism of debt reduction. One alternative is to forgive some of the debt. In this regard it is worth pointing out that, in moral hazard models, buybacks are often worthwhile for lenders only if outright debt forgiveness is worthwhile as well.[8] By contrast, in my models, lenders always lose from outright forgiveness.

On the other hand, perhaps only certain special features of the model make buybacks the mechanism of choice. The key feature of buybacks that I want to emphasize is that they require little coordination and bargaining. The countries can enter a market where debt is traded anonymously. Therefore, the costs of bargaining and negotiation are avoided. In other words, buybacks are attractive exactly where other methods for reaching agreement are costly. If it were possible to bargain costlessly, buybacks would be dominated.

The paper proceeds as follows. In Section 1, I present a model of negotiation and posturing. In Section 2, I extend this model while in Section 3 I study costly sanctions. Section 4 concludes with a comparison of these models to the moral hazard models of equilibrium buybacks.

[8] See Krugman (1988) for the circumstances under which this equivalence holds. When the buyback is financed, as in Froot (1988) with funds not previously recoverable by creditors, the equivalence breaks down. Creditors can then benefit from buybacks even where forgiveness would be detrimental to their interests.

1. Costly Negotiation

I consider a collection of lenders and a sovereign borrower. The sovereignty of the borrower implies that, as in much of the literature surveyed in Eaton, Gersovitz and Stiglitz (1986), repayments depend only on the creditors ability to punish the debtor. Repayments do not depend at all on the borrowers' resources. Problem debtors rarely have debts exceeding even one year's GNP. It is thus reasonable to suppose as I do that, if they wished, they could easily repay their entire obligation.

The borrower has previously incurred a debt whose face value has a present discounted value of D. This means that there is an outside agent which prevents the lenders from collecting more than D. More precisely, the lenders have some ability to inflict pain on the borrower and this is the reason the borrower pays back. However, the US courts condone this giving of pain only if the borrower has not paid D in full. Otherwise they do not permit the lender to inflict pain.[9]

The relationship between lender and borrower has three stages. At the beginning of period 1 the borrower decides whether to engage in buybacks at all. I thus give the borrower the option of not engaging in any buyback if he so desires. If he does decide to buyback some debt, this becomes public knowledge at the beginning of period 1. After this, a secondary market for the debtor's claims opens. The price q for the debt generally depends on whether buybacks will take place. By using this timing convention, I explicitly consider the losses to debtors from buybacks considered by Dooley (1988) and Bulow and Rogoff (1988).[10]

Bargaining starts in the second period. Bargaining involves negotiations between the lenders as well as negotiations between the lenders and the borrower. As these negotiations get under way the lenders discover how tough they are. There are several reasons for this relatively late resolution of uncertainty. One reason is that there are many lenders. Therefore, individual creditors cannot know how tough lenders are collectively until they start trying to coordinate their actions. The second reason the toughness of each individual

[9] We would otherwise have a model of extortion. Pure extortionists are limited only by the available resources of the victim or by the desire to induce the victim to keep producing resources.

[10] If, by contrast, the debtor were allowed to make secret, unforeseen, buybacks he would obtain the debt at a lower price. Such secret buybacks would lead to a redistribution of income from lenders to borrowers. Of course, for secret buybacks to have this feature they must not always occur in equilibrium.

lender evolves randomly over time. If the date of bargaining is set in advance, the actual bargaining strength of the lenders cannot be known with certainty before this date.

In the second period the lenders have the opportunity to convince the borrower that they are tough. To act tough one must spend resources harassing the borrower. In practice, some trade and credit flows must be disrupted. This aggressive behavior is tolerated by the US courts because, at this stage the borrower is not in full compliance with the terms of the loan.

In period 2 lenders can be of one of two types. Tough lenders need to spend less resources than soft lenders to instill a given degree of pain. Therefore the level of harassment is a useful signal of the lender's true ability. As a result, in equilibrium, the tough lenders harass more than the soft lenders.

Bargaining continues in the third period. To keep the analysis simple I assume that, at this point, lenders collectively issue a take-it-or-leave- it offer to the borrower. If the borrower does not pay the amount demanded the lenders unleash their collective punishment power. For this theory to make sense, the lenders must be willing to mete out these punishments *ex post*. Subgame perfection of this type is guaranteed if, as in Bulow and Rogoff (1986), these punishments are simple trade seizures. Such trade seizures are worthwhile for the lenders even if the seized goods are worth much more to the debtor than to the creditor.

While the punishments I consider here can be interpreted as seizures, it is likely that in practice other forms of punishment are employed as well. I expect lenders who are punishing a debtor to disrupt its trade and financial relations as much as possible. There are two reasons for this. The first is that the commitment to sanctions helps the lenders.[11] This commitment tends to soften the position of this particular borrower. Such a commitment can probably be ensured by hiring individuals who become very angry when the debtor pays little.

The second reason is that lenders often have other debtors. There is some benefit in having a reputation for toughness with these other borrowers. Penalizing a particular

[11] Just like commitment to jail criminals helps the innocent.

borrower may help establish this reputation with others. Of course, lenders differ in their exposures to different debtors. Also the conditions of debtors vary. As a result, reputation is not perfectly transferable. This is the reason why period two harassment is helpful to the lenders.

Whether the punishments are seizures of tradeable goods or whether they are more extensive, borrowers are unlikely to know initially how much damage lenders can inflict. To inflict much damage, lenders must know a great deal about the country's vulnerabilities. To cripple a country, it is helpful to impede its access to trade credit. This requires that lenders be able to prevent other financial institutions from transacting with the debtor. Tough lenders have both the requisite knowledge and resolve. It is for this reason that the disruption of trade and financial flows required by period two harassment is relatively costless for these lenders.

The utility of the borrower has four components. The first is the buyback payment B which they make in the first period. The second is the present discounted value of third period payments P. The third is the disutility from the pain N suffered in period 2. The fourth is the loss from the punishment after period 3 if the borrower does not accept the lenders offer. This loss equals L_τ where τ equals s or t depending on whether the lenders are soft or tough. Tough lenders find it easier to retaliate so L_t exceeds L_s. Total borrower utility can be written as:

$$U = -E\Big(B + P + N + L\Big) \tag{1}$$

where the expectation E is taken over the subjective distribution of types. In equation (1), I assume that the borrower is indifferent between paying one dollar in period one and one dollar of present discounted value in period 3. This is standard if payments are discounted at the borrower's opportunity cost of funds.

The pain N is a function of the effort A and the type of the lenders. It is convenient to define the functions which give the level of effort needed by type τ to obtain the level of pain N. This is given by:

$$A = f_\tau(N) \qquad \tau = s, t. \tag{2}$$

The function f is strictly increasing in the harassment N. For any given N, f_τ is larger

when τ is equal to s than when it is equal to t. More importantly, the derivative $\frac{df_\tau}{dN}$ (which I write as f'_τ) is strictly higher when τ equals s. This captures the idea that those lenders who are tough from period 3 on are likely to find harassment in period 2 relatively inexpensive. These are the lenders who find it easy to coordinate and police each other.

In the period 1 secondary market, q is the price of any debt instrument whose discounted face value equals one. The buyback, if it occurs, takes place at this price. This means that the outstanding nominal debt after the buyback, $\tilde{D}$, is given by:

$$\tilde{D} = D - \frac{B}{q}. \tag{3}$$

Lenders act competitively in this market. They perceive that it is impossible to change this price through their individual actions. As a result they must be indifferent between selling at q and keeping the debt.

By selling his claim on a single unit of present value, a lender gets a utility equals to q. If he keeps the debt, he shares in the payments from the debtor as well as in the harassment costs. I assume that his share of both is equal to his share of the claims outstanding. Thus, the claim on a unit of present value gives a lender who chooses not to sell his claim a period 2 utility equal to:

$$W = E\left(\frac{(P-A)}{\tilde{D}}\right) \tag{4}$$

where E takes expectations over types. In equilibrium, W must equal q.

One important feature of (4) is that lenders and borrowers use the same discount rate. The future payments which equal one dollar of present discounted value when discounted at the borrower's opportunity cost of funds also equal one dollar when discounted at the lender's discount rate.[12] My notation, where everything is denominated in discounted units, is actually easiest to understand if one pretends that the future isn't discounted at all.

[12] This simplifies the analysis without affecting the qualitative conclusions. Since borrowers have limited access to capital markets we expect them to discount the future more heavily. This would imply that future payments which give a disutility of P to the borrower give a smaller utility to the lenders. This large discounting of future payments by the borrower reduces the attractiveness of buybacks from his point of view. Nonetheless, there are still parameter configurations for which buybacks benefit all parties.

Equal discounting by both parties rationalises my assumption that the debts are fully settled after one round of bargaining. With equal discounting there is no reason to defer payments further. If borrowers discount the future more heavily, equilibrium payments to lenders might well accrue more slowly over time. This would rationalise the protracted nature of debt crises.

To analyze this game, I start with the last period. Suppose that, in period 3, the borrower believes that the lender is soft with probability σ. This means that the borrower expects to lose $\sigma L_s + (1-\sigma)L_t$ if he turns down the lenders' offer. As a result he accepts any offer which involves a payment such that

$$P \leq \sigma L_s + (1-\sigma)L_t. \tag{5}$$

The lenders, knowing this, will ask for the amount which makes (5) hold with equality.

In period 2, there is now a classic signaling game.[13] In this game the level of harassment acts as a signal of the lenders type. If neither type harasses the borrower, the borrower will pay at most $\mu L_s + (1-\mu)L_t$ where μ is the prior probability that the lender is soft. There are now two cases to consider depending on whether $\tilde{D}$ is smaller than or equal to $\mu L_s + (1-\mu)L_t$. In the former case, neither type gains by signaling since they recoup the entire face value of the debt in any event. Thus, in this case, the equilibrium has no harassment and the period 3 payments equal $\tilde{D}$.

Suppose instead that $\tilde{D}$ exceeds $\mu L_s + (1-\mu)L_t$. Then, once dominated strategies have been deleted,[14] lack of harassment cannot be an equilibrium. Tough lenders would deviate by inflicting an N such that:

$$\min(\tilde{D}, L_t) - f_s(N) = \mu L_s + (1-\mu)L_t - \epsilon$$

where ϵ is a small positive number. After deviating in this manner they would demand a payment equal to $\min(\tilde{D}, L_t)$. If the borrower recognizes these deviators as tough, he will accede to their request. As a result, tough lenders gain from the deviation since $f_t(N)$ is smaller than $f_s(N)$. Moreover, borrowers would rationally recognize these deviators as tough. After all, soft lenders would lose from this deviation even if it led the borrower to subsequently view them as tough and pay them $\min(\tilde{D}, L_t)$.

As shown by Cho and Kreps (1987) arguments of this type establish that there is a unique equilibrium and that it separates the types. At this equilibrium the tough lenders inflict N^* such that:

$$\min(\tilde{D}, L_t) - f_s(N^*) = L_s. \tag{6}$$

[13] See Spence (1974).
[14] See Cho and Kreps (1987).

Equation (6) implies that soft lenders are indifferent between harassing and not harassing the borrower. I assume they leave him alone. Tough lenders strictly gain by harassing and receiving $\min(\tilde{D}, L_t)$ instead of L_s.

At this equilibrium, changes in the extant face value of the debt matter as long as $\tilde{D}$ is smaller than or equal than L_t. In this case:

$$\frac{dN^*}{d\tilde{D}} = \frac{1}{f_s'}. \tag{7}$$

Equation (7) captures the basic reason for buybacks in this model. A reduction in the outstanding debt lowers the amount the tough can collect without affecting the amount the soft can collect. This makes imitation of the tough's behavior by the soft less attractive. The equilibrium level of harassment is such that it just deters the soft from imitating the tough. Therefore, reductions in the attractiveness of imitation reduce the equilibrium level of harassment. Equation (7) is derived under the strong assumption that tough lenders collect the face value of the debt in full. In the next section, I show how this can be relaxed. All that is necessary is that there exist some states of nature in which tough lenders collect the entire face value of the debt.

The advantage of debt reductions given in (7) is reflected in the secondary market price of debt. Using (4), the secondary value of the debt is:

$$q\tilde{D} = \mu[\tilde{D} - f_t(N^*)] + (1-\mu)L_s \tag{8}$$

where I have substituted $\tilde{D}$ for payments to tough lenders and L_s for those to the soft. The simplest way of understanding how the secondary market responds to changes in $\tilde{D}$ is to compute the change in $q\tilde{D}$, the total market value of secondary debt:

$$\frac{d(q\tilde{D})}{d\tilde{D}} = q + \tilde{D}\frac{dq}{d\tilde{D}} = \mu\frac{f_s' - f_t'}{f_s'}. \tag{9}$$

Since both μ and $\frac{f_s'-f_t'}{f_s'}$ are positive and less than one, the total secondary market value of debt increases although it increases by less than the face value. The increase in value implies that lenders would lose from unilaterally destroying some of their claims on the borrower. Such forgiveness amounts to a reduction in $\tilde{D}$.[15]

[15] This result distinguishes this model from Krugman (1988) where lenders benefit from buybacks only when they also benefit from forgiveness. Forgiveness is potentially valuable in his model because it alleviates moral hazard. On the other hand, buybacks are more valuable in my model because I assume that the debtor's ability to pay is not impaired by the buyback.

That the increase in market value is smaller than the increase in face value is not very surprising since the face value is only paid off with probability μ. What is perhaps more surprising is that the total market value may well respond very little to changes in $\tilde{D}$. This possibility arises because f_s' can be arbitrarily close to f_t'. Then, marginal increases in harassment are almost equally costly to both types. As a result, even tough lenders must waste most of the increased collections in the form of increased harassment. Through this mechanism, the model can easily account for the rather small reduction in the market's valuation of Bolivian debt in the wake of the buyback.

Having determined how the total market value of debt responds, I now compute the change in q. Using (8) and (9):

$$\frac{dq}{d\tilde{D}} = \frac{1}{\tilde{D}}\left(-\frac{(1-\mu)L_s}{\tilde{D}} - \frac{\mu f_t'}{f_s'} + \frac{\mu f_t}{\tilde{D}}\right) \tag{10}$$

$$< \frac{1}{\tilde{D}}\left(-\frac{L_s}{\tilde{D}} + \mu\frac{f_s' - f_t'}{f_s'}\right) \tag{11}$$

where the inequality is obtained from (6) and the properties of the function f. There are two reasons for q to fall when $\tilde{D}$ rises. These two reasons are represented by the first two terms of (10). The first reason is that soft lenders always collect the same, so payments to the soft per unit of outstanding debt fall. The second is that the increase in debt increases equilibrium harassment and this is costly. On the other hand, the third term in (10) gives a reason for q to rise. The increased debt spreads the costs of harassment over more units thereby making them less important.

While the overall effect on q is ambiguous, it follows from (11) that a sufficient condition for q to fall is that:

$$\mu\frac{f_s' - f_t'}{f_s'} < \frac{L_s}{\tilde{D}}. \tag{12}$$

It is worth reiterating that this analysis only applies when $\tilde{D}$ is smaller than L_t. Otherwise, small increases in $\tilde{D}$ do not raise the amount collected by the tough. This means that the equilibrium harassment does not change. In turn, this implies that the secondary market price of the existing debt remains the same.

We now come to the first stage of the game. I assume for the moment that D is smaller than or equal to L_t. If the country decides to abstain from buybacks, (8) with $\tilde{D}$ equal to

D gives the secondary market value of the debt. I denote this value by $\bar{q}$. Equation (6) gives the equilibrium level of harassment.

Suppose the country does decide to repurchase some debt. Then, the outstanding value of debt falls. If (12) is met, the secondary price of debt rises so the lenders are better off. I now focus on the borrower. One issue which arises is whether the borrower can act monopsonistically in the market for his own debt. If he acts competitively, he perceives the secondary price of debt as independent of the buyback's size.

Whether competitive or monopsonistic behavior is more realistic depends on the institutional arrangements of the secondary market. Suppose the borrower cannot commit himself to the amount of resources B he spends on repurchasing debt. Suppose further that lenders simultaneously announce a price at which they are willing to sell their claims on the secondary market. In equilibrium, all lenders announce a q which is equal to W in (4). Since they all announce this price, the borrower can indeed purchase as much debt as he wants at this price. He thus acts as if:

$$\frac{d\tilde{D}}{dB} = -\frac{1}{q}. \tag{13}$$

Suppose instead that, before the lenders announce the price for their claims, the borrower can commit himself to an expenditure B. This commitment induces monopsonistic behavior. Now the borrower realizes that the change in the outstanding face value of the debt when B changes is given by differentiating (3):

$$\frac{d\tilde{D}}{dB} = \frac{-1}{q - (D - \tilde{D})\frac{dq}{d\tilde{D}}}. \tag{14}$$

For very small buybacks, D is essentially equal to $\tilde{D}$ so there is no difference between (13) and (14). Whether small buybacks are worthwhile reduces to the question of whether the borrower gains by buying a small amount of his debt at the price $\bar{q}$. To compute the answer to this question I first rewrite (1) as:

$$U = -B - \mu\left(\tilde{D} + N^{*}\right) - (1 - \mu)L_{s}. \tag{15}$$

Differentiating this expression with respect to B at $D = \tilde{D}$:

$$\frac{\mu}{\bar{q}}\left(1 + \frac{1}{f_{s}'}\right) - 1. \tag{16}$$

The expression $\frac{1}{f_s'}$ gives the amount of pain the borrower suffers when soft lenders increase their effort by one unit. This amount can be arbitrarily large. It can easily be large enough that the expression (16) is positive.

One can interpret bargaining under full information as occurring when f_s' is infinite. Here the costs of harassment are so large for the soft that essentially no harassment is needed by the tough to separate themselves. In this full information case N^* is essentially zero so, from (8), $\bar{q}$ exceeds μ. As a result the expression in (16) is always negative when bargaining occurs under full information. This simply reproduces the result of Bulow and Rogoff (1988) and helps highlight the importance of imperfect information for my results.

When small buybacks are worthwhile, borrowers often choose interior solutions where the debt outstanding continues to trade at a discount. The interior optima tend to exist because higher levels of B correspond to higher secondary market prices. Whether (13) or (14) applies, higher values of q make additional debt repurchases less attractive. Assuming an interior solution, the best buyback for the borrower is such that

$$-\mu\frac{d\tilde{D}}{dB}\left(1+\frac{dN^*}{d\tilde{D}}\right)=1. \tag{17}$$

The LHS of (17) gives the borrower's benefit from an additional unit spent on the outstanding debt. That benefit must, at an optimum equal the cost. The benefit consists of two parts. First, the borrower pays $\frac{d\tilde{D}}{dB}$ less with probability μ, . Second, the reduction in $\tilde{D}$ reduces harassment. The second order conditions for this optimum require that the LHS of (17) fall when B increases. This condition is met because the resulting increase in q lowers the absolute value of both the expressions (13) and (14).

For any positive level of B, $-\frac{d\tilde{D}}{dB}$ is smaller when the borrower acts monopsonistically as in (14) than when he acts competitively. This implies that the equilibrium level of B is bigger in the latter case. When the borrower acts monopsonistically, he reduces his secondary market purchases so that he benefits from a lower price.

Equation (17) applies when the borrower chooses an interior solution. Extremal solutions are also possible. These arise when the borrower chooses to buyback so much debt that the outstanding debt is paid with probability one. If buybacks are so large that $\tilde{D} \leq L_s$ the borrower pays $\tilde{D}$ to both types in period 3. So, no signaling is necessary and

there is no equilibrium harassment. As a result, q is one. Reduction in buybacks from this point increase equilibrium harassment and so might be strictly undesirable. On the other hand, further increases in buybacks have no effect on harassment.

To gain further insight into these extremal points, I study the conditions under which a borrower who acts competitively would choose to lower $\tilde{D}$ until q is one. Using (7) and (13) in (17) extremal values of B are worthwhile if:

$$\mu\left(1+\frac{1}{f_s'(0)}\right) \geq 1$$

or

$$f_s'(0) \leq \frac{\mu}{1-\mu}. \tag{18}$$

If (18) is not satisfied, borrowers shy away from these extrema.

Until now, I have studied buybacks assuming that D is smaller than or equal to L_t. For larger values of the debt, small buybacks do not change the amount paid in the third period and so leave harassment unaffected. Thus, small buybacks do not benefit the borrower. Nonetheless, even for such large debts, it may be worth having a large buyback and jumping to a point which is either extremal or satisfies (17).

The level of B which satisfies (17) or, in the extremal case, that which equates $\tilde{D}$ and L_s, is an equilibrium when borrowers buy debt freely. The remaining question is whether this equilibrium is desirable. At the monopsonistic equilibrium the borrower is indifferent to purchasing an additional unit of debt while the lenders are strictly better off. So, at the monopsonistic equilibrium a very small increase in repurchases is Pareto improving. Yet, for even slightly larger buybacks, simply mandating a change in repurchases does not lead to Pareto improvements. Further buybacks raise q thereby benefitting lenders and hurting the borrower. Thus the equilibrium is constrained Pareto optimal in a certain sense. This optimality obtains as long as we do not consider changes in institutions and ask simply whether all could be made better off by using the existing institutions differently.

By contrast, unconstrained Pareto optimality allows lump sum redistributions across agents. If such redistributions are possible, optimality reigns when harassment disappears. The reasons is that both lenders and borrowers care equally about money and they both

lose from harassment. Unconstrained Pareto optimality thus requires that the debt be written down until harassment ceases being worthwhile. Yet, unless (18) holds, the equilibrium level of harassment is positive. Hence, buybacks are usually smaller than those dictated by unconstrained Pareto optimality.

While this argument suggests that buybacks beyond the equilibrium level are worthwhile, its practical implications are unclear. This argument relies on costless lump-sum transfers. However, the actors will presumably bargain over these redistributions. The essence of my analysis is that, as they bargain, they find socially costly actions in their private self interest. It may simply be impossible to orchestrate a solution to the bargaining problem at negligible cost.

Of course, if outsiders wish to transfer resources to the lenders and the borrower, they can improve the welfare of both. Moreover, by subsidizing buybacks outsiders can improve borrower and lender welfare by more than by simply giving them resources. To take an extreme example, suppose a donor pays the face value of the debt in full to the lenders. The donor then annuls the claims on the borrower. The cost of this intervention is D. Lenders gain $D(1-\bar{q})$. Borrowers gain their expected payments as well as the punishment costs. Using (8) this sum equals:

$$D\bar{q} + \mu(N^* + f_t(N^*)).$$

Therefore, this intervention nets borrowers and lenders put together:

$$D + \mu(N^* + f_t(N^*)).$$

By contrast, if the donor had simply distributed D, and this didn't affect bargaining ability neither side would deviate from the original equilibrium. So borrower and lenders put together would only gain D. Giving the donation through intervention in the secondary loan market thus produces an extra gain of $\mu[N^* + f_t(N^*)]$.

One difficulty with this analysis is that it treats borrower and lender welfare symmetrically. Many donors would like to help borrowing nations for political reasons. If these donors do not care about lender welfare, it is hard to see why they should intervene in

the secondary debt market. Perhaps, such interventions are warranted if there are other mechanisms for taxing the lenders. Such an analysis is beyond the scope of this paper.

While the model of this section is a model of buybacks, it can also be interpreted as a model of the size of sovereign debts. The equilibrium $\tilde{D}$ is then the amount that banks loan to sovereign borrowers. This interpretation raises a puzzle. Why would the equilibrium $\tilde{D}$ exceeds L_S given that both sides have the same discount rates and that such debts create bargaining costs?

The answer is, once again, that the equilibrium is not unconstrained Pareto optimal. Even when the borrowers take q as given, they may have a socially inefficient incentive to pile up debts. They realize that increased indebtedness does not raise payments to the soft. On average, the payments on an additional unit of debt tend to be smaller than q. From a purely financial viewpoint, additional debt is thus attractive. This must of course be weighted against the additional bargaining costs. However, since the lenders bear some of the bargaining costs, the borrower may accumulate socially excessive debts.

In any event, my assumption on borrowers' opportunities for changing $\tilde{D}$ are more appropriate for buybacks than for debt accumulation. I assume that there is an anonymous market for this debt and that borrowers are allowed to participate. This seems realistic for buybacks. In the case of loan origination, on the other hand, the institutions are rather different. Loans to nations tends to originate through large consortia. These consortia have numerous mechanisms for preventing borrowers from excessive increases in debt. They can pressure potential new lenders, they can pressure the borrowers themselves. Loan origination is best understood as a different bargaining game which occurs before the one studied here.

One peculiar feature of the loans to nations who are highly indebted today is the optimism surrounding their origination. Lenders seemed unaware that the possibility of default loomed in the horizon.[16] Perhaps the lenders were irrational. A different possibility is that the debts would have been manageable without the world recession, low commodity prices and high interest rates of the early 1980's. In other words, the level of debt was

[16] See Guttentag and Herring (1985).

such that no bargaining was anticipated. When resistance to payments by the countries rose, it became obvious that lenders known to be soft would collect little. The bargaining considered here ensued.

2. An Extension: Random Repayments

The model of section 1 has the advantage of simplicity. It has two weaknesses which I correct in this section. The first weakness is that third period payments depend only on the coordinating capabilities of the lender. They do not depend on the random characteristics of the borrower. The second weakness is that the range of initial debts D for which buybacks are desirable appears somewhat restricted. For debts below L_s buybacks are unnecessary. For debts above L_t they are not locally useful.

In this section I assume that the ability of the borrower to tolerate third period reprisals is unknown in period 2. For instance, the borrower's ability to do well under autarky is initially random. This bargaining position of the borrower is revealed at the beginning of period 3. It becomes known just before the lenders make their take-it-or-leave-it offer. Therefore, if the borrower would suffer a loss of L from the reprisals, the offer entails a payment P such that:

$$P = \min(L, \tilde{D})$$

As of period 2, this level L is unknown. What is known is that the density function $H_\tau(\hat{L})$ gives the probability that L is below $\hat{L}$ if the lender's type is τ. This density function has support $[\underline{L}_\tau, \overline{L}_\tau]$. To capture the idea that soft lenders are less capable of punishment, I assume that:

$$\underline{L}_s < \underline{L}_t,$$

$$\overline{L}_s < \overline{L}_t$$

and that, wherever the supports overlap:

$$H_s(\hat{L}) > H_t(\hat{L}).$$

As a result of these assumptions the lenders in period 2, who know their own type, do not know the payment they will receive. Their welfare continues to be given by the

expected value of payments. Similarly the borrowers, who never incur the penalties given by L in equilibrium, care about the expected value of their payments.

With these provisos, equations (1)-(4) remain valid in this modified model. The principal difference is that pooling of types without harassment is now ruled out whenever:

$$D > \underline{L}_s. \tag{19}$$

If the debt exceeds the smallest amount that a soft lender can ever expect to get then tough lenders find signaling worthwhile.

If the debt supports an equilibrium with signaling, small buybacks are worthwhile as long as two additional conditions are met. The first is that borrowers find increased harassment very costly. The second is that reductions in the face value of the debt reduce the payments to the tough. Only in the presence of such payment reductions will the soft find imitation of the tough less worthwhile. Whereas before such payment reductions applied only if L_t exceeded D, they now apply whenever:

$$D \leq \overline{L}_t. \tag{20}$$

In other words, payments fall if there is any state of nature in which the tough collect less than the value of their reprisal. Conditions (19) and (20) appear substantially weaker and more plausible than the corresponding conditions of the original model.

3. Costly Reprisals

In sections 1 and 2 I have assumed that the lenders can discover the borrower's relevant characteristics costlessly. As a result, their take-it- or-leave-it offers extracted all the surplus at no further social cost. In practical situations, it is unlikely that the borrowers can learn so much so easily. Ascertaining the borrower's ability to sustain punishment is probably no easier than ascertaining the lenders ability to mete it out.

One way of capturing these difficulties is to consider borrower posturing as well. Borrower governments would then show how tough they are by ruining their countries with resolve. Their electorate would show how tough they are by choosing obstinate and

otherwise undesirable rulers. I do not pursue such models here because they would add little to those of sections 1 and 2.

Instead, I look at a different consequence of uncertainty about the borrower's character. This uncertainty leads to costly reprisals when the borrower turns out to be tougher than expected. Formally, I allow the lenders to issue a take-it-or-leave-it offer. Tough borrowers decline this offer. Such declines trigger sanctions. Unlike harassment, sanctions are not meant to extract concessions from this particular borrower.

As discussed in Section 1, these sanctions have three roles. When they consist of seizures of tradeables, the sanctions help the lenders recoup some of their losses. Commitment to further disruption of trade and financial flows also serves to soften the borrower. Finally, these additional disruptions enhance the lenders reputation with other borrowers.

Whether punishments follow from commitment ability, from the desire to collect something or from reputational concerns they are likely to increase when the outstanding debt is higher. Tough punishments probably convey a stronger reputation when people regard them as fair. Also, gaining a reputation for punishing large debtors probably promotes a cutback in large borrowing. This is precisely what the banks desire. Finally, the US Courts may well allow lenders who hold larger unpaid debts to seize more assets and punish the borrower more severely.

My model of costly punishments is very similar to that of sections 1 and 2. As in both sections the utility of the borrower is given by (1). Unlike earlier sections I simply rule out the harassment costs N. This harassment is unnecessary because there is now no uncertainty about lender's ability to punish. In period 1, as before, borrowers can buyback debt at the market price q. In period 2, lenders make a take-it-or-leave it offer. This offer specifies a payment P. In period 3, the offer is either accepted or it is rejected and the borrower is punished.

I assume that, from the perspective of all agents in periods 1 and 2, the punishment L is a random variable related to the level of debt. In period three, however, the borrower knows L. The assumption of symmetric information about L in the early stages of the game considerably simplifies the analysis. Without such late revelation of the true L one

would have to worry about borrowers signaling their L via the buybacks they engage in.[17]

As of periods 1 and 2, let $H(L, \tilde{D})$ be the density function of L with associated p.d.f. $h(L, \tilde{D})$. The support of this distribution is $[\underline{L}, \overline{L}]$. Because increases in $\tilde{D}$ raise punishments, $\frac{dH}{d\tilde{D}}$ is negative.

When crafting their period 2 offers, lenders know that borrowers will turn down offers whose payment P exceeds L. Any offer P is thus turned down with probability $1 - H$. Their optimal offer thus maximizes expected period 3 revenue R:

$$R = P[1 - H(P, \tilde{D})]. \tag{21}$$

Assuming an interior solution, the equilibrium offer satisfies:

$$1 - H(P, \tilde{D}) - Ph(P, \tilde{D}) = 0. \tag{22}$$

Expected borrower welfare from period 2 on is:

$$-R - \int_{\underline{L}}^{P} Lh(L, \tilde{D})dL. \tag{23}$$

I now consider changes in $\tilde{D}$. From application of the envelope theorem to (21) the change in R from an increase in $\tilde{D}$ is:

$$\frac{dR}{d\tilde{D}} = -P\frac{dH}{d\tilde{D}}.$$

Since this expression is positive, revenues increase when creditors acquire a tool which raises penalties.

Differentiation of (22) gives the change in P:

$$\left(2h + P\frac{dh}{dL}\right)dP + \left(\frac{dH}{d\tilde{D}} + P\frac{dh}{d\tilde{D}}\right)d\tilde{D} = 0. \tag{24}$$

The term multiplying dP must be positive for the second order conditions to hold. This condition is met as long as the density does not increase dramatically with L. If one ignores

[17] Such signaling could never be sufficient to induce full separation of types. If lenders could perfectly infer L from the repurchase of debt, they would extract payments equal to L. There would be no punishments in equilibrium. The trouble is that all borrowers would then pretend to be that type whose total payments are lowest. For a rather different model where the extent of buybacks does produce complete separation of types see Acharya and Diwan (1988). They focus on a moral hazard model where the extent of buybacks can distinguish borrowers with different discount rates.

the derivative of the density h with respect to $\tilde{D}$, the term multiplying $d\tilde{D}$ is negative. In this case, as seems plausible, the offered payment P rises as the threat increases.

Ignoring $\frac{dh}{d\tilde{D}}$ the only consequence of an increase in $\tilde{D}$ is that it the probability of agreement goes up for any given P. This raises the benefit from a small increase in P. By contrast, increases in h induced by increases in $\tilde{D}$ have the opposite effect. They make the lenders more concerned about the decline in agreements induced by rises in P. Reasonable large increases in h as $\tilde{D}$ rises are needed for this second effect to dominate. Is a positive $\frac{dh}{d\tilde{D}}$ even reasonable?

Increases in $\tilde{D}$ lower H. This means that they tend to lower h for small L's and raise h for big L's. The question of whether h tends to rise or fall with $\tilde{D}$ thus depends whether equilibrium P is high or small. It is difficult to make an a *priori* judgment on this question.

Given Bulow and Rogoff (1988)'s evidence, a relevant question is how q responds. Since lenders must be indifferent between keeping and selling their claims at the price q, the market value of the debt $q\tilde{D}$ must equal expected revenues R. Therefore the change in q is given by:

$$\frac{dq}{d\tilde{D}} = -\frac{q}{\tilde{D}} - \frac{P}{\tilde{D}}\frac{dH}{d\tilde{D}}. \tag{25}$$

The first expression in (25) is negative while the second is positive. On the one hand the price of the claims tends to fall because a given revenue must be distributed over more claims. On the other hand the increased threat from the larger $\tilde{D}$ increases revenues. For small $\frac{dH}{d\tilde{D}}$, the first effect dominates because the increase in revenues is minor.

I now come to first period buybacks. In the presence of buybacks period 1 lender welfare is simply:

$$B + R. \tag{26}$$

Period 1 borrower welfare is instead:

$$-B - R - \int_{\underline{L}}^{P} Lh(L, \tilde{D})dL. \tag{27}$$

The expression under the integral sign captures the cost of equilibrium punishments. In other words it captures the social cost of disagreement. Ignoring this expression, (26) and

(27) are symmetric and buybacks have only redistributive consequences. Buybacks can make all agents better off only by reducing the social cost of disagreement.

A small buyback raises B from zero to dB. Equations (13) and (14) demonstrate that small buybacks reduce the outstanding debt by $\frac{dB}{q}$. The change in $B + R$ is therefore:

$$\frac{d(B+R)}{dB} = 1 + \frac{P}{q}\frac{dH}{d\tilde{D}}. \tag{28}$$

Expression (28) is proportional to expression (25). More generally, the only effect of buybacks from the perspective of the lenders is that $\tilde{D}$ falls. Lenders therefore gain, and $B + R$ rises, if q rises. As I discussed above, these increases in q occur as long as the effect of $\tilde{D}$ on the distribution of L is not too pronounced.

The derivative of (27) with respect to B gives the benefits to borrowers. These benefits include two terms. The first is the fall in $B + R$ given by (28). The second is:

$$\frac{Ph(P,\tilde{D})}{q}\frac{dP}{d\tilde{D}} + \int_{\underline{L}}^{P}\frac{L}{q}\frac{dh(L,\tilde{D})}{d\tilde{D}}dL. \tag{29}$$

The first term is positive in the normal case. An increase in B tends to lower the offer made by lenders and thereby reduce the costs of disagreements. The second term has an ambiguous sign because it depends on $\frac{dh(L,\tilde{D})}{d\tilde{D}}$. However, since increases in $\tilde{D}$ lower H, it seems reasonable to suppose that they lower h for small values of L. Since the integral is only over these small values of L, it is likely to fall as well. The economic interpretation of this is the following. Reductions in outstanding debt reduce the typical punishment. This means that the probability associated with punishments below the cutoff P tends to rise. This raises the costs of potential disagreement.

Only if the expression (29) is positive, which remains a distinct possibility, and is also larger than (28), are small buybacks worthwhile. Even when (29) is positive so that small buybacks are socially worthwhile, they may not occur in equilibrium.

It is tempting to interpret this result as well as the related one in Section 1 as suggesting that outside agents should promote buybacks. This does not follow if these outside agents are purely self interested. As before, it is probably impossible to implement the transfers which are necessary to make everybody better off without also incurring bargaining costs. On the other hand buyback subsidies remain a tool of choice for donors. A

donor who destroys the whole debt after purchasing it at face value produces a gain equal to the integral in (27) over and above the cost of the program.

4. Conclusions

Economists find it tempting to attribute human and institutional behavior to self-interest. It is therefore important to understand whether the currently popular debt repurchases can be attributed to rational motives. This paper has emphasized that repurchases can help lower bargaining cost. This benefit is complementary to the saving in agency costs emphasized by Acharya and Diwan (1988), Froot (1988), Helpman (1987), Krugman (1988) and Sachs (1988). Both these savings accrue because there is imperfect information. Perhaps it would be more accurate to say that they accrue because contracts are imperfect.

In the moral hazard context, for instance, it doesn't really matter whether lenders observe the investments of the borrowers. What is essential is that borrower and lender be unable to write enforceable contracts which stipulate payments as a function of investment. Similarly, in my model of section 1, it is essential that borrower and lenders are unable to write contracts with payments as a function of the level of harassment.

One difficulty with the agency-theoretic approach is that contracts contingent on macroeconomic variables such as investment do seem feasible. The IMF makes very specific demands on the macroeconomic policies of borrowers. Overall, the IMF requirements probably curtail investment since tight monetary policies and cutbacks in public investment are standard. This presents a challenge to agency based models if one believes the IMF is trying to improve the debt crisis.

Perhaps the bargaining models presented here suffer from the same problem. Perhaps contracts contingent on harassment are feasible. However, it appears difficult to specify contractually what sorts of behavior constitute costly harassment.

The main difference between the moral hazard models and the bargaining models is in the role they leave for outside donors. In my bargaining models, it makes sense for the donors to spend their resources pushing buybacks. This rationalizes the actual behavior of governments. By contrast, with costless bargaining it seems difficult to understand why

governments should interfere in what are basically agency relationships.[18]

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