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FINANCING VS. FORGIVING  
A DEBT OVERHANG

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ABSTRACT

This paper examines the tradeoffs facing creditors of a country whose debt is large enough that the country cannot attract voluntary new lending. If the country is unable to meet its debt service requirements out of current income, the creditors have two choices. They can finance the country, lending at an expected loss in the hope that the country will eventually be able to repay its debt after all; or they can forgive, reducing the debt level to one that the country can repay. The post-1983 debt strategy of the IMF and the US has relied on financing, but many current calls for debt reform call for forgiveness instead.

The paper shows that the choice between financing and forgiveness represents a tradeoff. Financing gives the creditors an option value: if the country turns out to do relatively well, creditors will not have written down their claims unnecessarily. However, the burden of debt distorts the country's incentives, since the benefits of good performance go largely to creditors rather than itself.

The paper also shows that the tradeoff itself can be improved if both financing and forgiveness are made contingent on states of nature that the country cannot affect, such as oil prices, world interest rates, etc.

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Discussion of new approaches to the developing country debt problem is more intense now than at any time since 1983. Some proposals, such as the Baker initiative, involve revitalization and continuation of the 1983 strategy of financing without either debt forgiveness or change in the nature of claims. Other proposals, such as the Bradley Plan, call for major debt forgiveness in an effort to clear the books and restore normal conditions. In between are a variety of proposals for changing the character of the relations between debtors and creditors, including interest capitalization, lending or debt relief contingent on world prices, conversion of debt into equity or equity-like claims, and so on.

Somewhat surprisingly, this practical discussion is taking place with little parallel analytical discussion among economists. While there is a fairly substantial theoretical literature on the problem of sovereign risk (surveyed by Eaton, Gersovitz, and Stiglitz(1986)), the bulk of this literature has focussed either on the case of creditor rationing of a country that is borrowing with no existing debt, or the choice by a country whether to repay or default. The position in the real world, however, is one of both repayment and new borrowing; countries have arrived in the

current situation with a stock of "inherited" debt, which they cannot fully service without new borrowing. If the countries' future repayment were not in doubt, they would have no difficulty in borrowing to service existing debt, but for a group of large debtors doubt about future repayment is sufficient that only through extraordinary measures have creditors been induced to provide new money.

Now there does exist a small theoretical literature that bears on the actual debt problem fairly closely. This is the literature on the problems posed by a debt overhang. By a debt overhang I mean the presence of an existing, "inherited" debt sufficiently large that creditors do not expect with confidence to be fully repaid. The effects of such a debt overhang have been analyzed in only a few papers, including Sachs (1984,1986) and Krugman (1985a,1985b). These papers have shown that the presence of a debt overhang may give creditors an incentive to lend at an expected loss to protect their existing claims (Sachs 1984; Krugman 1985a, 1985b). It also shows that there may be a conflict between creditors' individual and collective interest, and that free rider problems may compromise the ability to achieve desirable new lending. On the other hand, the incentives of a debtor may be distorted by the presence of a debt overhang, and the distortion will be reduced if creditors provide immediate debt

forgiveness rather than providing new money and hoping for more favorable future conditions (Sachs 1986). The debt overhang approach is highly suggestive of the desirability of innovative approaches to the provision of funds, and perhaps of changes in the nature of bank claims on developing countries.

The purpose of this paper is to provide a synthetic presentation of the debt overhang analysis that, although abstract, may help clarify ideas for practical discussion. The first part of the paper sketches out three examples that are intended to convey some of the key issues. The second part of the paper presents a more formal model that focusses on the tradeoff between new lending and debt forgiveness as ways of coping with a debt overhang. The third part then examines how changing the nature of claims might help resolution of a debt overhang.

The debt overhang problem: some illustrative examples.

A debtor country is something like a debtor firm, although the parallel is not exact. At any given time, the creditors of a firm view that firm as having a probability distribution over streams of future earnings, out of which debt service can be paid. If the present value of the stream of earnings is expected to be less than the firm's debt, then creditors will not expect to be

fully repaid -- although they may prefer to wait and see rather than force the firm immediately into bankruptcy proceedings.

A country, like a firm, has an expected stream of earnings, but not all of this stream is potentially available to service debt. Instead, some fraction of national income represents the maximum resource transfer that the country can be induced to make. Loosely, we can think of the expected stream of potential resource transfers from a country to its creditors as analogous to the expected stream of earnings of a firm.

Now the analogy is less than exact, because the potential resource transfer from a country to its creditors is not really a fixed number. Instead, the maximum level of resource transfer is determined ultimately by the country's willingness to pay, which in turn reflects both rational calculations of the cost of default and internal political considerations. There is a bargaining problem between creditors, who would like to get the most possible out of a country, and the country, which would like to minimize resource transfer. Some progress has been made on the bargaining issue, for example by Bulow and Rogoff (1986). However, it is useful for analytical purposes to put this bargaining issue aside, and imagine that the rate of resource transfer that is possible at any point in time is a well-defined number (although perhaps uncertain ex ante).

If we grant ourselves the enormous simplification of taking maximum resource transfer as given, we are left with a straightforward definition of the problem of debt overhang. A country has a debt overhang problem when the expected present value of potential future resource transfers is less than its debt.

To illustrate the implications of debt overhang, I will consider three highly stylized examples of the problems that such overhang can cause. The three examples share a common structure, in which the action takes two periods. In the first period a country starts with an inherited debt, all of which (for simplicity) is due during that period. The country attempts to pay that debt with resource transfer plus new borrowing. The new borrowing, in turn, must be repaid with resource transfer in the second period.

What happens if a country is unable to repay fully at the end? For the moment, I will ignore the problem of costs of default and assume that creditors simply share the maximum resource transfer the country can make. Thus if the country is unable to repay fully in the second period, the result is effectively that part of the debt is forgiven. This shifts the emphasis to the first period. The key question is whether the country will experience a liquidity crisis. Will the country be able to attract new borrowing in order to service its inherited debt? This depends

on the behavior of lenders. I will assume that lenders are risk neutral, and face a given opportunity cost of funds on world markets. An important question is whether creditors are purely competitive or can operate collusively in their joint interest. We will consider both cases.

#### Debt overhang without uncertainty

Consider first the situation where there is no uncertainty, i.e., the potential resource transfers in period 1 and 2 are known from the beginning. We assume that all of the debt comes due in period 1, with required debt repayment  $D$ ; the resource transfer possible in each period is  $x_1$ ,  $x_2$ . We let  $i$  be the opportunity cost of funds to lenders.

Does this country have a liquidity problem? The country can make repayment of debt equal to  $x_1$  out of current resources; if current debt service exceeds this amount, it must engage in new borrowing equal to  $D - x_1$ . Lenders will supply this voluntarily at their opportunity cost  $i$  if they believe that they will be fully repaid, as they indeed will provided that  $(1+i)(D - x_1) < x_2$ , or, equivalently, if  $x_1 + x_2/(1+i) > D$ . Not surprisingly, there will be no problem of liquidity if the present value of potential resource transfer exceeds the inherited debt.

Suppose on the other hand that  $x_1 + x_2/(1+i) < D$ . Then the country will not be able to meet its debt service. It certainly cannot borrow the needed resources  $D - x_1$  at the safe rate, since it will be seen to be unable to repay its loans in full. Nor can it attract additional lending by offering an interest rate above the safe rate. The total resources available for debt repayment in period 2 are  $x_2$ , with a present value of  $x_2/(1+i)$ . Regardless of the interest rate on period 1 loans, that is what creditors will get, and it is less than the value of the necessary loans.

Thus the best that the initial creditors can do is reach a settlement with the country that immediately reduces the country's obligations. The mechanics of the settlement are, at this level of abstraction, arbitrary. Any combination of rescheduling, forgiveness of principal, forgiveness of interest, and new lending at concessional rates will do as long as it brings the actual resource transfer in line with what is possible.

In the absence of uncertainty, then, the problem of what to do about debt overhang would be straightforward. If the country can pay, there will be no liquidity problem. If it cannot, the debt must be written down at the outset.

Debt overhang with uncertainty

Now consider a country that similarly has inherited a debt  $D$ ,

but faces an uncertain future. Either because the world economic environment is uncertain, or because the country's own economic performance cannot be predicted, the potential resource transfer in period 2 is a random variable. To keep things simple, we suppose that first period resource transfer is a known value  $x_1$ , while in the second period the maximum transfer will take on only one of two values,  $x_G$  (good case) or  $x_B$  (bad case). In the bad case, the present value of potential resource transfer will be less than the initial debt, while in the good case it may be possible that the debt can be repaid.

Is this country solvent? This is not a well-defined question. Unless the present value of resource transfer is less than the debt in both states, it is simply unknown whether the country can earn enough to repay its debt. However, we can ask whether the country will have a liquidity problem, and here there is a straightforward answer: it will be able to borrow to service its debt if and only if the expected present value of the resource transfer is at least as great as the debt.

To see this, let  $p$  be the probability of a good outcome,  $1-p$  be the probability of a bad outcome. What we want to ask is whether there is an interest rate that the country can offer that will induce lenders to supply the resources  $L - D - x_1$  that are necessary to allow debt service. Suppose that the country offers

an interest rate  $r$  on its new borrowing such that  $L(1+r) = x_G$ . This is the highest interest rate that makes sense, since the country cannot even in the best case pay more than this. Then lenders will receive all of the potential resource transfer in either state. The expected present value of their receipts will be  $[px_G + (1-p)x_B]/(1+i)$ . They will be induced to lend if this exceeds the necessary lending  $D - x_1$ . But the condition  $[px_G + (1-p)x_B]/(1+i) > D - x_1$  is simply the condition that the expected present value of resource transfer exceed the value of the inherited debt.

As long as this criterion is satisfied, the country will be able to borrow enough to service its debt simply by paying a sufficiently high interest premium. If it is not satisfied, the country will not be able to attract voluntary borrowing, and will thus be unable to service its debt.

Now if that were that, we would simply see a default whenever financial markets view a country as having less future ability to pay than its existing debt. However, it is in the interest of existing creditors to prevent this. Even without any explicit modelling of how a liquidity crisis is played out, it seems obvious that the creditors are not likely to collect the full potential resource transfer from the country if there is a disorderly default. Let  $Z$  be the present value of what creditors

expect to be able to collect from a country if there is a liquidity crisis in period 1; it seems safe to assume that  $Z < x_1 + [px_G + (1-p)x_B]/(1+i) < D$ . Yet it is not necessary that creditors accept the certainty of loss. Suppose that they are able to relend enough to the debtor to avert default in period 1, and postpone the reckoning until period 2. Then if they are lucky, they may receive full repayment after all; while if they are unlucky, they will still be better off than if they had allowed a default to take place immediately.

We can easily construct a strategy that will achieve this aim. Let the existing creditors relend the country  $L = D - x_1$  at an interest rate such that  $L(1+r) = x_G$ . Then the creditors will receive all of the potential second period resource transfer in either state. Viewed in isolation, this will still be a losing proposition: the expected present value of their receipts will be  $[px_G + (1-p)x_B]/(1+i) < L$ . Thus no lender would voluntarily enter the package if she had no stake in the repayment of the original debt. From the point of view of the initial creditors, however, a lending package insures that they receive the full present value of the country's potential resource transfer, which is more than they would get without the lending. Thus lending that would be unprofitable viewed in isolation is worth doing as a way of defending the value of existing debt.

There are several points worth noting about this kind of defensive lending scenario, since even this simple an example is enough to show that several commonly held beliefs about debt problems are incorrect.

First, much discussion about the debt problem tries to make a clear distinction between liquidity and solvency, with the argument being that new lending to cover debt service is appropriate for liquidity but not for solvency problems. Even this simple schematic approach makes clear, however, that the distinction is not useful. If we knew that the country could repay the full present value of its debt -- or even if the expected value of potential payments were large enough -- the country could attract voluntary lending by offering a sufficiently high interest premium. The inability to attract funds comes because the expected ability to pay is too low; a liquidity crisis must occur because of doubts about solvency. As we have just seen, however, the expectation of insolvency does not prevent new lending from being in the interest of existing creditors.

Second, some commentators have pointed to the large discounts at which developing country debt sells on secondary markets as evidence that further lending is inappropriate. Clearly in this model new lending to the debtor would immediately sell at a discount, since it has an expected present value less than the

value of the lending. The discount is just another aspect of the fact that the new lending is unprofitable viewed in isolation. The point is, however, that it is still worth doing because it does not take place in isolation; it is essential to the repayment of existing debt.

Third, we have seen that it is in the interests of existing creditors to relend enough to avoid an immediate default on the part of the country. However, it is only in their collective interest. Any individual creditor would be better off if it could opt out of the new lending and let other creditors carry the burden. Thus we have the free rider problem emphasized by Cline (1983) and many others. This free rider problem could lead to a liquidity crisis even though this is not in anyone's interest.

Fourth, we often ask whether or not the new lending that takes place to debtors is at concessionary terms or not. The standard usually used is a comparison with market interest rates. However, the example makes it clear that the market rate comparison is essentially irrelevant. From the point of view of the lenders, the loans yield an expected return less than the market rate, whatever the face interest rate; thus they will view this as lending at concessional terms. Whether the interest rate on the loan is more or less than their opportunity cost of funds depends on how favorable the good state is. The interest they

charge is defined by the relationship  $L(1+r) = x_G$ . The rate  $r$  will exceed  $i$  if  $x_G/(1+i) > D-x_1$ , be less than  $i$  if  $x_G/(1+i) < D-x_1$ ; that is, on whether even in the good state the present value of resource transfer exceeds the opportunity cost of funds.

This last observation raises a puzzle. The example suggests that if there is any state in which the present value of resource transfer exceeds the value of existing debt, the interest rate charged by creditors on new lending should exceed their opportunity cost of funds. Presumably for most debtors there is at least the possibility of such a favorable state; even Bolivia might discover a valuable, unsuspected natural resource. Yet this description of creditor behavior seems both wrong in practice and disturbing; isn't there any circumstance under which new lending (or rescheduling of existing debt) will take place at concessional rates? To develop any motivation for debt forgiveness, we need to have an example in which creditors have to be concerned about the incentives they give the debtor.

#### Incentive effects

In the last example, creditors have an incentive to lend to the debtor, even at an expected loss, as a way to defend the value of their existing claims. However, their incentive is to lend at the highest interest rate that could be paid, even in the most

favorable state of nature; only in this way can they insure that they collect the maximum resource transfer from the country. In effect, while the creditors are taking an expected loss, they will have an incentive to provide financial relief to the country entirely through new money rather than through interest rate reduction. Indeed, as long as there is any state of nature in which the present value of resource transfer exceeds the value of inherited debt, the creditors will charge an interest rate that is higher than their opportunity cost of funds.

In order to soften this result, we need to take into consideration the effect of the debt burden on the incentives facing the debtor. In the real world there are a variety of actions that debtors can take which affect their future ability to make resource transfers: exchange rate adjustment, investment, budget policies, and so on. Let us summarize these policies under the vague heading of "adjustment effort". Then creditors will want a country to make as much adjustment effort as possible, certainly more than the country would like to undertake. Now suppose that the debt burden on a country is as large as the maximum that the country could possibly pay, even with maximum adjustment effort. Then there is in fact no reason for the country to make the adjustment effort, since the reward goes only to its creditors. It makes sense, therefore, for the creditors to demand less than this

maximum, in order to provide the creditor with some incentive to adjust.

For our third example, we consider the extreme case where the potential resource transfer depends only on the action of the debtor, and not at all on the state of nature (this is the case considered by Sachs (1986)). In period 1, as always, there is a debt service requirement  $D$  and a known maximum resource transfer  $x_1$ . Creditors thus must lend  $D - x_1$  to prevent a liquidity crisis. In the second period, however, the potential resource transfer depends on the adjustment effort. If the adjustment effort is high, maximum resource transfer is  $x_H$ ; if it is low,  $x_L$ . Other things equal, the debtor would prefer to make the lower adjustment effort.

The maximum interest rate that could conceivably be paid is defined by  $L(1+r) = x_H$ . If the creditors charge this interest rate, however, the debtor will have no incentive to make the high adjustment effort. It may thus be in the interest of creditors to charge an interest rate sufficiently low that the debtor makes the higher adjustment effort. If there is a liquidity problem, and no uncertainty, the optimal interest rate in the absence of uncertainty must be one that is below the market rate  $i$ .

Several observations follow from this example. First, we note that charging an interest rate that is below the maximum resource

transfer and below the market rate is actually in the interest of the creditors. If we compare the value of their claims with the optimal interest rate with the value with a higher interest rate, we will find that reducing the face value of loans actually raises their market value.

Second, this example suggests both the motivation for conditionality and the problems of enforcing it. The creditors would like to impose a requirement for high adjustment as a condition for the loan -- in which case the interest rate could be higher. On the other hand, the threat not to lend if the country fails to act correctly may be hard to establish credibly, since it remains in the interest of the creditors to avoid provoking a liquidity crisis.

Third, while debt forgiveness may be desirable from the point of view of creditors as a way of creating incentives, it is clearly a blunt instrument for this purpose. The example immediately suggests that loans are the wrong form of claim; some form of contingent claim would be preferable. (The specification of the optimal claim is left to the more elaborate discussion below).

We have now gone about as far as we can with simple examples. In order to integrate the insights from these examples, we now turn to a formal model.

## 2. A formal model of debt overhang

As in the simplified examples, we consider a country that has inherited a stock of debt  $D$ , all of it due in the first of two periods. In period 1 the country can make a known maximum resource transfer  $x_1$ . In period 2 the country's resource transfer potential is unknown, so that

$$(1) \quad x_2 = s + z$$

where  $s$  is a random variable that ranges from  $\underline{s}$  to  $\bar{s}$  and  $z$  is a choice variable capturing the concept of "adjustment effort" by the debtor country.

The country is assumed to care about two things: the level of resources left to it in the second period, and the size of the adjustment effort it is required to make. Let  $C_2$  be the difference between the country's potential resource transfer  $x_2$  and the actual payment it must make to creditors:

$$(2) \quad C_2 = x_2 - P$$

For simplicity, and to avoid mixing insurance issues into our

analysis, the country's objective function will be assumed linear in  $C$ :

$$(3) U = C_2 - v(z) \quad v' > 0, v'' > 0$$

where the function  $v(z)$  captures the dislike of the country for making adjustments that enlarge its future ability to pay creditors.

Suppose that the creditors are able to overcome the free rider problems we mentioned in the previous section and lend enough to avert default in the first period. Then it follows that first period lending will be equal to the difference between maximum potential debt service and the value of the debt,

$$(4) L = D - x_1$$

Suppose that the creditors have charged an interest rate  $r$  on their new lending. If potential resource transfer exceeds  $L(1+r)$ , the loan will be repaid in full. If it does not, we assume that the creditors will receive the maximum possible, so that

$$(5) P = x_2 \text{ if } x_2 < L(1+r) \\ = L(1+r) \text{ if } x_2 > L(1+r)$$

We can now think of this as a game in which the creditors first choose the interest rate, then the debtor chooses the level of adjustment effort. To solve this game, we first solve the debtor's problem conditional on the interest rate. From (3) and (5) we derive the expected utility of the country:

$$(6) \text{ EU} = \int_{L(1+r)-z}^{\bar{s}} [(s+z) - L(1+r)]f(s)ds - v(z)$$

An increase in the adjustment effort  $z$  raises the resources of the country in favorable states when it does not have to pay all of its potential resource transfer to the creditors, but is costly in and of itself:

$$(7) \partial \text{EU} / \partial z = \int_{L(1+r)-z}^{\bar{s}} f(s)ds - v'(z)$$

If the effort level has an interior maximum, we must have  $\partial \text{EU} / \partial z = 0$  and  $\partial^2 \text{EU} / \partial z^2 < 0$ , where

$$(8) \partial^2 \text{EU} / \partial z^2 = f[L(1+r) - z] - v''(z)$$

We now want to calculate the response of adjustment effort to the interest rate charged by creditors. To do this we first

calculate the cross-derivative

$$(9) \quad \partial^2 EU / \partial z \partial r = -L[L(1+r) - z] < 0$$

Then we use the implicit function theorem to derive the response

$$(10) \quad dz/dr = Lf[L(1+r) - z] / (\partial^2 EU / \partial z^2) < 0$$

Thus the higher the interest rate, the lower the country's adjustment effort.

The objective of the creditors is to maximize the expected value of their new lending. From (5)

$$(11) \quad ER = \int_{\underline{s}}^{L(1+r)-z} (s+z)f(s)ds + \frac{L(1+r)}{L(1+r)-z} \int_{L(1+r)-z}^{\bar{s}} f(s)ds$$

The creditors' first-order condition is therefore

$$(12) \quad \partial ER / \partial r = \int_{\underline{s}}^{\bar{s}} f(s)ds + (dz/dr) \int_{\underline{s}}^{L(1+r)-z} f(s)ds = 0$$

This condition clearly indicates the two motives facing the creditors. The first term, which is always positive, is the

"new-money" bias imparted by the presence of uncertainty. Since something may always turn up that allows the debtor to pay more than you expected, creditors have an incentive to roll over debt at as high an interest rate as possible in order to be able to benefit from good news. The second term, which is always negative, represents the "debt forgiveness" bias imparted by the problem of incentives for the debtor. Creditors do not want to make the country's situation too hopeless, or it will have no incentive to improve its ability to repay.

If the situation were dominated only by one or the other consideration, the choice between new money and debt forgiveness would be clear. If uncertainty were the only issue, it would always be best for creditors to finance but not forgive, so as to preserve the option of cashing in on unexpected good fortune. If incentives were the only issue, it would on the contrary be best for creditors to take their loss up front so that it does not act as a prohibitive tax on debtors' effort. Unfortunately, in reality both issues are present, so that the choice of the right strategy is not an easy one.

The dilemma presented by this tradeoff, however, is not inescapable. It is due to the fact that both new money and debt forgiveness are rather blunt instruments for dealing with the problem of debt overhang. Can an innovative repayment scheme, one

that effectively changes the nature of claims, do better? In principle, at least, it can.

### 3. Changing the nature of claims

A number of proposals have been advanced for converting debt into some other kind of claim. The proposals range from piecemeal debt-equity conversions, to Bailey's (1982) proposal to convert debt to proportional claims on exports, to proposals that either interest rates or new lending be indexed automatically to prices of exports. The approach taken in this paper cannot do justice to the details of such schemes, since it treats the real economy as a "black box" out of which resources are somehow extracted. Nonetheless, it is possible to capture some of the spirit of innovative proposals by considering schemes in which the required repayment depends on the size of the potential resource transfer.

We may divide proposals to change the nature of claims into two broad classes. First are schemes that link repayment to some general measure of ability to repay. The best-known examples are proposals that debt repayment be proportional to export revenues. The key point about these schemes is that they make no distinction between favorable results due to national effort and those due to factors outside the nation's control. On the other side are

proposals to link repayment to some measure of the shocks experienced by a country, such as the level of world interest rates or the price of the country's principal export good. These two kinds of proposal are quite different at least in principle.

There is a further distinction within these proposals between debt postponement and debt forgiveness. Most proposals that link repayment either to ability to pay or to the state of nature do not, at least on paper, reduce the eventual obligation of a country to pay: the obligation is simply rescheduled, at market interest rates, into the future. However, it will be easier analytically to imagine that what is at stake is immediate debt forgiveness. We can then ask whether debt postponement is similar in its implications.

#### Repayment linked to ability to repay

Suppose that we have a country exactly like that described in the previous section, but the its creditors take an innovative approach to its problem. Instead of lending it the money needed to service its debt, they establish a claim that varies with the ability to repay. We can approximate such a scheme by supposing that repayment is a function of second-period potential resource transfer:

$$(13) P = A + Bx_2 \quad 0 < B < 1$$

Does such a scheme resolve creditors' conflict between taking advantage of good news and providing debtors with an incentive to adjust? Unfortunately, it does not. Consider the first-order condition of the debtor. Given the repayment schedule, the difference between potential and actual resource transfer will be

$$(14) C_2 = -A + (1-B)x_2$$

Thus the debtor will maximize

$$(15) EU = \int_{\underline{s}}^{\bar{s}} [-A + (1-B)(s+z)]f(s)ds - v(z)$$

with the first-order condition

$$(16) \partial EU / \partial z = (1-B) - v'(z) = 0$$

This condition may be interpreted as follows: the country receives only a fraction  $(1-B)$  of the benefit from any improvement in its resource transfer capacity. There is a tradeoff in substituting a

claim contingent on ability to repay for a simple loan: it is no longer the case that in bad states of nature extra adjustment effort provides no benefit to the debtor, but the benefit it receives in good states is diluted. It is unclear without a detailed model of the economy which will distort incentives more.

This analysis shows that proposals to link repayment to exports or other measures of capacity to repay do not eliminate the problem of incentives, and therefore do not eliminate the tradeoff between new money and debt forgiveness. Notice, however, that while this is the only issue that can be addressed in the stylized framework presented here, in practice exchange participation notes or other schemes might still be valuable for other reasons, for example as a way to allow debt service to rise over time in line with economic growth and inflation.

Payment linked to the state of nature

The alternative class of proposal would link repayment to some measure of the state of nature. An ideal measure would separate perfectly between the consequences of the country's effort and events outside its control; it is easiest to concentrate our formal analysis on this case, then discuss how the imperfection of real measures affects the argument.

In the context of our formal model, the form of an optimal scheme is obvious: it would appropriate all of the gains that result from the state of nature  $s$ , but none of the consequences of the effort level  $z$ :

$$(17) P = A + s$$

The resulting first-order condition will be

$$(18) \partial EU / \partial z = 1 - v'(z) = 0$$

Thus the distortion in the country's incentive to adjust is completely eliminated.

For the creditors, the degree of freedom in the scheme would be in setting the constant term  $A$ . At first glance, it might seem that the creditors could set  $A$  equal to the optimal  $z$ , so that they would provide the debtor with a marginal incentive to adjust yet in the end capture all of the debtor's potential resource transfer by the debtor. This may look too clever to be real, and it is. In addition to satisfying the marginal condition (18), the debtor's choice of adjustment effort must be globally optimal. If there is no gain from adjusting, the debtor will be better off choosing its own preferred level of effort and simply defaulting

on the payment scheme (17). Thus the expected resource transfer that can be extracted from the country will be limited by the need to provide enough incentive for the country to participate in the debt initiative. This constraint is not, however, unique to state-contingent schemes. The only unique feature is that a perfect state-contingent scheme would extract from the country less than its maximum resource transfer in all states of nature, even the least favorable.

It is clear from the analysis that an ideal state-contingent scheme should be able to do better than either a simple loan that will probably not be repaid in full or a claim linked to broad ability to repay. In reality, of course, a scheme will be less than ideal, if only because the state of nature cannot be fully specified. For example, repayment might be linked to the price of the country's principal export, but shocks arising from weather fluctuations might not be included. What this imperfection will do is to blur the effectiveness of the state-contingency in eliminating incentive problems. There will be some states of nature in which the country will be unable to meet its obligations, even though these will in principle be indexed to the state of nature. At the margin, an improvement in the country's ability to pay will in these states of nature benefit only the creditors, not the country; thus the country's incentive to adjust

will be diluted. Clearly, however, the dilution will be less if the obligations at least somewhat reflect the state of nature than if they do not. So an imperfect state-contingent claim is still better than a claim that is not state-contingent at all.

#### Debt postponement

So far we have discussed only schemes that link debt forgiveness to either ability to pay or the state of nature. However, the more immediate issue is one of proposals to link new money to export revenues or export prices. Is this something completely different, or is the analysis similar?

The essential point here is that once we are in a situation of defensive lending by existing creditors, the creditors do not expect to be fully repaid -- nor do the debtors expect to pay fully. Thus new money contains a concessional element, even if it does not do so on paper. As a result, the same considerations that apply to eventual forgiveness also apply to new money.

Consider an extension of our basic model to three periods. In period 1 the country makes a decision about adjustment effort, which affects maximum resource transfer in period 2; ability to repay in period 3 is also uncertain. Then any relief from the burden of resource transfer in period 2 will not be fully offset

by an increase in the expected burden in period 3. It follows that the incentive to adjust initially will depend on the conditions attached to new money in period 2. If creditors will demand the maximum possible resource transfer regardless of the state of nature, there will be no incentive to adjust. If, on the contrary, new lending is linked to the state of nature, so that adjustment effort at the margin benefits the country rather than the creditors, the incentive to adjust will be greater.

Although the analysis is highly abstract, then, we seem to be left with a clear conclusion: linking either eventual repayment or new money to measures of the state of nature is a good idea.

#### 4. Concluding remarks

This paper has presented a highly abstract analysis of the issues involved in dealing with the developing country debt problem. I have argued that the best way to think about that problem is as one of debt overhang: the "inherited debt" of some countries is larger than the present value of the resource transfer that their creditors expect them to make in the future.

Much popular discussion seems to presume that the appropriate handling of a debt problem is simply contingent on the distinction between liquidity and solvency. If it is a liquidity

problem, financing should be provided until the country has worked its way out; if it is a solvency problem, some kind of bankruptcy procedure is called for. What even a highly abstract analysis of the debt overhang problem shows is that this is a misleading way to view the issue. There is no such thing as a pure liquidity problem; it must arise because of doubts about solvency. Even if there is a significant possibility that debt will not be repaid in full, however, it may still be in creditors' interest to provide enough financing to avert an immediate default. As is fairly widely appreciated, however, there is a conflict between the collective interest of creditors in providing financing and the individual interest of each creditor in getting out.

The choice between financing and debt forgiveness should not, according to the analysis presented here, hinge on some attempt to settle the liquidity vs. solvency question. Instead, it represents a tradeoff between the option value of a large nominal debt and the incentive effects of a debt that is unlikely to be repaid. Since good news is always possible, creditors would like to keep their claims high, so that if by some chance a country should turn out to be able to repay, they will not turn out to have forgiven debt unnecessarily. On the other hand, if a country is not going to be able to repay except in exceptional circumstances, it will have little incentive to try to adjust. Thus creditors may wish to

forgive part of a country's debt to increase the likelihood that it will repay what remains. It is because of the tension between these two objectives that the issue of how much to rely on debt forgiveness and how much to rely on financing is a difficult one.

There seems to be a compelling case that the tradeoff between forgiveness and financing can be improved by indexing repayment to the state of nature. If payment is linked to some measure of conditions outside the country's control, the probability for any given expected payment that adjustment effort will at the margin benefit the country, not its creditors, will be increased. Thus the analysis in this paper, abstract though it is, does suggest that linking new money and possibly debt relief to measures of economic conditions could be to the mutual benefit of debtors and their creditors.

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