THE SOCIAL COST OF FOREIGN DEBT IN THE PRESENCE OF SOVEREIGN DEFAULT RISK

George Fane and Craig Applegate

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ABSTRACT

Borrowing by each individual imposes external costs (and similar benefits) on all others in a small country which is able, at a cost, to default on its foreign debts. The external costs are communally shared default penalties and higher contract interest rates on foreign debt; the benefit is the reduced probability of having to repay foreign debts. The determinants of the externality associated with foreign borrowing, and hence the optimal tax on foreign borrowing, are analyzed theoretically and empirical evidence is presented to show that in the case of Australia the externality is probably too small to warrant government action; however, taxation of capital inflows may be appropriate in some heavily indebted LDCs.
1. Introduction

In the presence of sovereign default risk, foreign borrowing by some agents can generate external costs for others. Even in a country which is too small to affect the world risk-free interest rate, increased borrowing by any of the country's residents will generally raise the probability of national default and hence raise the interest rates specified in contracts between foreign lenders and all residents of the borrowing country. If default occurs, penalties will be imposed on the country, such as seizure or freezing of assets, exclusion from international capital markets, or restrictions on trade, or trade finance. These penalties may hurt most residents, including those who may have borrowed little or nothing. If default does not occur, other borrowers from the same country face an increased burden of repayments as a result of increased borrowing by any one of the country's residents. Of course, the probability that these other borrowers will be able to default on their debts is correspondingly increased, but this gain is offset by the increased probability that they will suffer the communally shared penalties for default. Therefore the net marginal cost to all other borrowers of extra borrowing by any one resident is the increased burden of higher contract interest rates on them in the event that default does not occur.

The present paper has two purposes: to analyze the externalities associated with foreign borrowing in a model with sovereign default risk, and to determine what forms and levels of taxation can be justified as methods for internalizing those externalities. In contrast, most of the existing models in the sovereign debt literature treat the borrowing country as if it were a single optimizing individual. Determining the magnitude of the socially optimal taxes on foreign borrowing provides an answer to the question of

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1 The purpose of taxing borrowing from foreign, rather than from domestic, lenders is to raise the risk-free domestic interest rate relative to the world risk-free interest rate, and thereby stimulate domestic saving relative to domestic investment. The total (tax-inclusive) cost to a borrower will be the same, whether the lender is a foreigner or a domestic
whether the accumulation of private foreign debt is a "problem", which the
government should try to correct, or the outcome of optimal private
decisions, and not something which the government should try to influence.

Most foreign debt in LDCs is either directly owed, or at least guaranteed,
by the government of the borrowing country. However, private foreign debt
exists in LDCs, and makes up the bulk of foreign debt in some developed
countries, such as Australia, in which there are at least some doubts about
the long-term ability of the country to meet its foreign debt obligations.
Besides, even in a country in which all foreign debt is government debt,
the magnitudes of the externalities analyzed here are of relevance to
policy making, since they influence the gap between actual interest rates
and the social opportunity cost of capital in public projects. Estimates of
these externalities are therefore needed for efficient decision making
within the public sector. They are also needed if government agencies are
to set the appropriate charges on the private borrowers whose debts they
guarantee.

In practice, outright repudiation of debt has been very rare, and partial
default, involving rescheduling of debts, has been much more common.
However, as a preliminary to the analysis of partial default with bargained
partial default which is undertaken in section 3, we begin in section 2 by
assuming that the country either totally repudiates all its public and
private foreign debts, or that the entire principal and interest are repaid
in full. The assumptions on how private and public debt are treated in the

2 In 1970 the proportion of private non-guaranteed debt in total
long-term debt for all developing countries (i.e., all low-income and all
middle-income countries) was 25 percent, according to the data and
definitions of the World Bank's World Debt Tables 1991-92, External Debt of
Developing Countries, Volume I. This proportion had fallen to 16 percent in
1980 and to 6 percent in 1991 (projected). For all severely and moderately
indebted LDCs the proportions at these three dates were 25 percent, 15
percent and 5 percent, respectively. For all other LDCs the corresponding
proportions were 25 percent, 22 percent and 10 percent, respectively.
event of default are clarified at the start of section 2, where evidence is presented to defend the approximate realism of the assumptions made.

The model of all-or-nothing default analyzed in section 2 is similar to that of Sachs (1984, pp.23-25); however, the focus here is on analyzing the tax policies needed to ensure that decentralised private (and public) savings and investment decisions are socially efficient. The main result of the section 2 model is that, at least in the case of countries which are not severely indebted, the optimal tax on foreign borrowing is approximately equal to the excess of the ex ante contract interest rate charged to the borrowing country over the risk-free interest rate. It is shown that under certain additional assumptions, this result also carries over to the model of section 3. The implications of these results are summarized in section 4, where evidence is presented on the implied optimal tax rates for various countries. In the case of Australia the excess paid on foreign loans above the rates charged on loans to the most credit-worthy borrowers is very small. For countries in this situation, our analysis therefore supports the position of those economists - for example, Pitchford (1990) - who have argued that it would be inappropriate to restrict foreign borrowing: the potential benefits from doing so would probably be small in comparison to the other distortions and administrative costs not explicitly modelled here. However, our analysis also supports the view that government actions to discourage foreign borrowing may be justified in highly indebted countries.

2. A simple model of all-or-nothing default

In the models of both this section and section 3 we assume that in the event of either total or partial national default, the foreign holders of private non-guaranteed debts and of public debts or publicly guaranteed debts are treated in the same way: in particular, the government is assumed to impose exchange controls, which effectively control repayments of

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3 For example, the World Bank, or the governments of the major O.E.C.D. countries.
foreign debts by domestic private borrowers, and to stipulate that the proportion of their total contracted repayments of principal and interest which these private borrowers must actually repay is the same as the proportion of its contracted repayments to foreigners which the government proposes to repay. In these circumstances, foreign lenders are assumed to be unable to take effective legal action against private (or public) debtors in the courts of the home country to retrieve more than the reduced payments stipulated by the government.⁴

We also assume that if the government decides to repay its own debts in full, then private domestic borrowers must also repay their debts in full, because foreigners would otherwise be able to take legal action against them in the courts of the home country. Our analysis therefore deals only with country risk, and ignores the specific risks associated with the possibility of bankruptcy of individual borrowers. Some support for the approximate realism of the above assumptions is provided by Folkerts-Landau (1985):

"If the foreign borrower is a large and nationally recognized private entity in a developing country, then its domestic assets have ... proven, in practice, to be immune from seizure by a foreign creditor. In addition, domestic courts in developing countries rarely give foreign lenders equal standing with the borrowers..."

"In practice, most of the external private debt of developing countries has been transformed into publicly guaranteed debt in times of debt-service

⁴ Eichengreen and Portes (1986, p.619) describe how, in 1934, the US District Court in New York ruled that German exchange controls were "of no legal significance" in excusing a German shipping company for defaulting on a loan contract made in New York. Eichengreen and Portes then note that: "In practice, creditors could use a legal decision to obtain satisfaction only if the defendant had attachable assets abroad. Not surprisingly, the notable instances where arrears were paid in full or an acceptable readjustment plan was offered involved shipping companies, like those cited above, with attachable assets anchored in American ports."
problems, since debt-servicing difficulties experienced by private borrowers have usually taken the form of liquidity constraints on foreign exchange. This de facto aggregation of external debt that results from public guarantees and cross-default clauses means that bank lenders need not be concerned with the ability of individual borrowers in a country to pay their external debt, but only with the ability of the country itself to pay. And indeed, the differences in lending rates paid by different borrowers within the same country have typically been less than 50 basis points (World Bank, Debtor Reporter System, Washington DC 1984).” (Folkerts-Landau, 1985, p.326-327).

In the model of this section it is assumed that default is all-or-nothing: either the principal and interest on all public and private debt is repaid in full, or nothing is repaid at all. The analysis of bargained partial default is postponed to section 3. To explain why sovereign borrowers make any repayments at all, it is assumed that lenders can impose some form of penalty, \( R \), on defaulting sovereign countries. The default penalty is assumed to be non-negative and to depend positively on a non-negative random variable, \( \theta \), with a known probability density function, \( f(\theta) \). Since many of the penalties for defaulting relate to disruption of international trade, and since the costs to a country of having its trade disrupted depend positively on its terms of trade, the random variable \( \theta \) can be thought of as a measure of the terms of trade. In section 3 we allow for the possibility that the default penalty also depends on the amount, \( R \), contracted in period 0 to be repaid in period 1. In this section, however, we simply assume that:

\[
R = \theta(\theta).
\]  

(1)

The amount borrowed is denoted \( D \) and the amount contracted to be repaid is \( R \); therefore the "contract interest rate", denoted \( i \), is defined as

\( (R - D)/D \). It is assumed here that the government decides to default if, and only if, \( R < K \); i.e., if, and only if, \( \theta < \theta' \), where:
\[ \pi(\theta^*) = R. \] (2)

The probability of default, \( \pi \), is therefore given by:

\[ \pi = \int_{0}^{\theta^*} f(\theta) \, d\theta. \] (3)

It is necessary to distinguish between the contract interest rate, \( i \), and the expected real interest rate, \( r \). Foreign lenders are assumed to be risk-neutral and the home country is assumed to be small; therefore, whatever the amount borrowed, the expected real return to foreigners remains equal to the exogenous risk-free interest rate, \( r \), in the world capital market.

In common with most of the literature, we ignore the problems of asymmetric information\(^5\). Because the probability of default, \( \pi \), depends on the amount borrowed, and because lenders are assumed to be able to observe this amount, the contract interest rate, \( i \), also depends on \( D \). The expected interest parity condition can therefore be written as:

\[ 1 + r = (1 - \pi)(1 + i). \] (4)

Equations 1 and 2 ensure that the probability of default, \( \pi \), is a monotonically increasing function of the amount to be repaid, \( R \); therefore, with the world interest rate given exogenously, equation 4 ensures that the contract interest rate, \( i \), is also a monotonically increasing function of the amount to be repaid. This relationship is illustrated by the schedule abcd in the top panel in Figure 1, in which \( 1/(1 + i) \) is plotted.

\(^5\) In the case of bank loans, our simplifying assumption can be defended on the ground that the importance of asymmetric information is reduced by the formation of consortia, which can share the costs of collecting information among all the individual banks. In the case of bond issues, the rating agencies play a similar role in the provision of information to individual lenders. For a model which allows for the complications introduced by asymmetric information see Kletzer (1984).
\[
\frac{1}{(1+i)^2} = \frac{1 - \Pi(a)}{1 + r}
\]

\[
\frac{1}{(1+i)_e} = \frac{1}{1+i}_{c}
\]

\[
\frac{1}{(1+i)_d} = \frac{d}{1+i}_{D_1}
\]

\[
R = D(1+i)
\]

\[
\frac{i}{i_a} = \frac{i}{i_b} = \frac{d}{i_c}
\]

\[
D_1 \quad D_2
\]

Figure 1
on the vertical axis and \( R = D(1 + i) \) is plotted on the horizontal axis. The schedule gives the combinations of \( 1/(1 + i) \) and the amount to be repaid, \( D(1 + i) \), which yield an expected return to lenders of \( r \). The schedule must be negatively sloped, and at the point "a", where it meets the vertical axis, the contract interest rate must equal the world risk-free interest rate. By construction, the area of the rectangle under any point on the schedule abcd is \( R/(1 + i) = D \). Therefore the dotted rectangular hyperbolas \( D_1 \) and \( D_2 \) in the top panel of Figure 1 can be used to measure the amount borrowed corresponding to any particular point on the schedule. The lower panel in Figure 1 plots the contract interest rate, \( i \), against the amount borrowed, \( D \). For any given value of \( D \), it is clearly possible for there to be no corresponding value of \( i \), or for there to be many corresponding values of \( i \).

The government's objective is assumed to be the maximization of the discounted value, \( V \), of present and expected future utility of a representative individual:

\[
V = u(c^0) + \frac{\int_0^{\theta^*} f(\theta) u(c^d) \, d\theta - \int_0^{\theta^*} f(\theta) u(c^s) \, d\theta}{1 + \rho}, \tag{5}
\]

where \( \rho \) is the representative consumer's rate of time preference; \( c^0 \) is consumption in period 0; and \( c^d \) and \( c^s \) denote consumption in period 1 in the events of default and repayment, respectively. The exogenous production level in period 1 is \( y^1 \), for \( i = 1, 2 \). Only the presentation of the algebra would be complicated by allowing \( y^1 \) to depend on \( \theta \).

\[
c^0 = y^0 + D, \tag{6}
\]

\[
c^d = y^1 - \pi(\theta), \tag{7}
\]
\[ c' = y^1 - D (1 + i). \] (8)

The first-order condition for a social optimum is:

\[ u_d(c^0) = \frac{1 - \pi}{1 + \rho} u_d(c')(1 + i + D l_d). \] (9)

Here and in what follows subscripts denote partial derivatives.

We now assume that the government imposes a tax on interest payments abroad at rate, \( \tau \). In the event of default, no tax is collected, while if default does not occur, the revenue from this tax is returned in period 1 as a lump-sum subsidy, \( S \), to the representative individual:

\[ c' = y^1 - D (1 + i [1 + \tau]) + S, \] (10)

where:

\[ S = \tau i D. \] (11)

Together, equations 10 and 11 imply equation 8. However, the representative individual borrower is assumed to treat the lump-sum subsidy, \( S \), the contract interest rate, \( i \), the default penalty, \( \pi \), and the probability of national default, \( \pi \), as being exogenously given. Therefore the first-order condition for private utility maximization by an individual borrower is:

\[ u_d(c^0) = \frac{1 - \pi}{1 + \rho} u_d(c')(1 + i [1 + \tau]). \] (12)

By comparing equations 9 and 12 it is easy to see that the optimal tax rate, i.e., the tax rate which is needed to ensure that utility maximization by a self-interested individual leads to the social optimum, is the reciprocal of the elasticity of the schedule in the lower panel of Figure 1, relating the contract interest rate to the amount borrowed.
\[ \tau = \frac{1}{\varepsilon} \]  

(13)

where:

\[ \varepsilon = i \frac{\partial D}{\partial t} \]  

(14)

The form of this expression for the optimal tax on foreign borrowing is familiar from the literature on optimal tariffs (Kemp, 1964, pp.205-206; Hanson, 1974, p.628): in the absence of uncertainty and of default risks and penalties, the optimal tariff on foreign borrowing for a monopsonistic capital importing country would be given by equations 13 and 14 with i re-interpreted as the risk-free real interest rate. In contrast to these "traditional" assumptions, equations 13 and 14 above are based on the assumptions that the borrowing country is small and has no monopsony power; that default can occur; that both borrowers and lenders correctly estimate the true probability of default; and that the government of the borrowing country correctly takes account of all the costs and benefits of default. The exact equivalence of these results with those of the traditional analysis of a monopsonistic borrower therefore requires some explanation.

The key to the explanation is that we have assumed, in equation 2, that the sovereign borrower sets the default threshold, \( \theta' \), optimally. The envelope theorem therefore ensures that the effects of individual borrowing on \( \theta' \) cancel out in the social first-order condition, equation 9. Therefore the only Pareto-relevant externality associated with an extra unit of foreign borrowing by one individual is its effect, \( D_{i,p} \), on the contracted payments made by other borrowers if default does not occur. This is also of course the external cost of a unit of foreign borrowing in the case of a monopsonistic capital importing country, in a model with no default and no uncertainty.

Harberger (1985) obtained the same formula for the external cost of foreign
debt. In his model, the borrowing country "perceives [the risk-inclusive contract interest rate] i as the true cost of its debt, that is, that it gains no fillip of utility when the prospect of default increases."

Harberger's underlying model is based on the borrowing country's "quasi-monopoly power being generated by differing perceptions of risk by borrowers and lenders, the lenders' perception being always greater than that of the borrowers." Neglecting default penalties and setting a tax on capital inflows at a rate equal to the reciprocal of the foreign elasticity of supply would obviously be optimal if the borrowing country knew that default would definitely not occur and that the lenders' expectations of default were therefore totally unjustified. In this situation, the borrower would have actual monopoly power, rather than merely quasi-monopoly power, even though it might really be small and possess its monopoly power only because of the misconceptions of the lenders. One interpretation of Harberger (1985) is that he effectively makes these assumptions: his algebraic derivation of his formula and his neglect of default penalties are consistent with this interpretation. So too are his assumptions that borrowers perceive the contract interest rate as the true (average) cost of debt, and that lenders' perceptions of the probability of default systematically exceed those of borrowers. The assumption in Harberger (1985; n.1, p.256) that the borrowing country "gains no filip of utility when the prospect of default increases" suggests a second possible interpretation of his model, namely that it is essentially the same as the model of this paper: in period 0, in the neighbourhood of the optimal level of debt, a small increase in the probability of default caused by a small increase in debt has no net effect on utility, because it generates two external effects which cancel out: the probability of incurring the default penalty rises, and the probability of avoiding having to repay the principal and interest on the existing debt falls by the same amount.

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6 The summary in the main text is based on n.1, p.256 of Harberger (1985), which refers to an unpublished paper, Harberger (1983), which was presented at a World Bank conference. We have not been able to obtain a copy of this latter paper: in response to our request, the World Bank stated that it is "for internal use only."
If the optimal tax on foreign borrowing is in place, the shadow interest rate which should be used in appraising a risk-free public investment project is \( r(1 + t) \). If there is no tax on foreign borrowing, the shadow interest rate is a weighted average of \( r \) and \( r(1 + t) \), with weights measuring, respectively, the proportions in which marginal public sector net borrowing would be financed out of marginal domestic private net lending (i.e., private savings minus private investment) and marginal foreign net lending (i.e., capital inflow).

Although the formula for the optimal tax on foreign borrowing in the presence of sovereign default risk has the same form as the formula for the optimal tax on foreign borrowing for a country with monopsony power in the world capital market, it is nevertheless easier to estimate the optimal tax rate in the sovereign risk case than in the case of monopsony: in the model of section 2, the spread between the contract interest rate, \( i \), and the risk-free interest rate, \( r \), is approximately equal to the optimal tax per unit borrowed, \( i - r \), provided that the optimal tax has been imposed. We are grateful to Ted Sleeper for pointing out the significance of this latter qualification: if \( i \) varies linearly with \( D \), the observed value of \( i - r \) in a sub-optimal situation, in which no tax has been imposed on foreign borrowing, is an upper bound of the estimate of the optimal tax, since the imposition of the optimal tax would generally reduce \( i - r \). In the case of a linear relationship between \( i \) and \( D \), the optimal tax, \( i - r \), must be between 50 percent and 100 percent of \( i - r \) in the sub-optimal, no-tax situation.

The optimal tax formula obtained in this section takes no account of investment. If additional investment decreases the probability of default then the optimal tax formula obtained above would be inappropriate in the case of borrowing for consumption: if the same tax were applied to borrowing for investment, then it would also be necessary to provide a subsidy to investment, equal to the present value of the marginal reduction.

\footnote{This point was noted by Harberger (1985, n.1, p.256).}
in contracted interest payments on existing foreign debt, due to an additional unit of investment financed by increased domestic savings.

3. A model of bargained partial default

In the model of section 2 the lenders obviously lose from default, but, in the neighbourhood of the critical value of $0'$, the sovereign borrower is roughly indifferent between defaulting and repaying, since in the neighbourhood of $0'$ the default penalty is roughly equal to the cost of repaying the principal and interest on the debt. Obviously this asymmetry between the consequences of default for the borrower and the lender creates bargaining opportunities, since partial default can lead to a Pareto improvement relative to total default. Presumably for these reasons, partial default with rescheduling has been very much more common in practice than total default. In practice, private debt is often rescheduled along with public debt\(^8\). In this section we relax the assumption of section 2 that default is all-or-nothing, and analyze optimal tax policies in a bargaining model which allows for partial default.

The model set out below is a simplified two period version of the multi-period model of Bulow and Rogoff (1989), in which the terms of partial default between a lender and a sovereign borrower are analyzed using the bargaining models of Rubinstein (1982). Bulow and Rogoff assume that the explicit sanction available to lenders is to disrupt the trade of a defaulting borrower. In their model the borrower has four options: to repay in full; to bargain over partial repayment; to default entirely, and then trade subject to the disruptions imposed by the lender; and to default entirely, and then produce and consume in autarky. Our assumption that the monetary value of the default penalty is a stochastic variable allows us to merge the last two of these four possibilities, leaving the government with three options: full repayment; bargained partial default and the avoidance

of the default penalty; and total repudiation of debts and the suffering of the default penalty.

An additional difference between the model of this section and that of section 2 is that we now assume that the default penalty depends positively on the amount contracted to be repaid, $R$, as well as on $\theta$:

$$z = z(\theta, R).$$  \hfill (15)

The purpose of this assumption will become clearer later: the analysis of polar case 2 below shows that if it is not made the policy implications appear to be extreme and rather implausible.

If bargaining occurs, it is assumed to take place in period 1, after the realized value of $\theta$ has become public knowledge to both parties. The equilibrium level of repayment, given that bargaining occurs, is denoted by $x$. It is assumed that $x$ maximizes $W$, the weighted product of the gains to the two parties from reaching an agreed partial repayment, relative to a disagreement or threat point, at which the lender gets nothing and the defaulting borrower suffers the penalty, $z$. This threat point is therefore identical to the situation which corresponded in section 2 to the actual outcome under total default. The maximand, $W$, is therefore given by:

$$W = [u(y^1 - x) - u(y^1 - z)]^\alpha x^{1 - \alpha},$$  \hfill (16)

and the first-order condition for a maximum of $W$ with respect to $x$ is:

$$x = \frac{1 - \alpha}{\alpha} \frac{u(y^1 - x) - u(y^1 - z)}{u_c(y^1 - x)}.$$  \hfill (17)

If the weights $\alpha$ and $(1 - \alpha)$ are equal this solution concept can be viewed as Nash's (1953) solution to the one-shot bargaining game. Alternatively, as shown in the Appendix, it can be derived as the perfect equilibrium of a sequential bargaining game (Rubinstein (1982)). Given that the marginal
utility of consumption is positive, but diminishing with consumption, it is straightforward to confirm that equation 17 makes \( x \) a monotonically increasing function of \( \theta \), for a given value of \( R \). Therefore, there will generally be a unique\(^9\) critical value of \( \theta \), denoted \( \theta^* \), at which the bargained value of the repayment \( x(\theta^*) \), given by equation 17, is equal to the contracted repayment, \( R \). We assume that if \( \theta < \theta^* \) the sovereign borrower threatens not to repay in full and engages in a bargaining process which leads to repayment of \( x(\theta) < R \), as given by equation 17 above. However, if \( \theta > \theta^* \) the borrower can and does repay \( R \) without incurring any default penalty and without engaging in any bargaining with the lender, i.e. we assume that the lender cannot enforce a trade embargo, or any other penalty, on the borrower if the borrower repays in full. This assumed asymmetry clearly corresponds to the legal asymmetry underlying the sovereign debt problem: the lender can never recover more than the contracted repayment, but the sovereign borrower may succeed in repaying less than the contracted repayment. The first-order condition for a social optimum with respect to the amount borrowed is now:

\[
\begin{align*}
  u_r(c^0) &= \int_0^{\theta^*} \left( f(\theta) u_f(c^f) x_R(\theta, R) \right) d\theta + (1 - \pi) u_f(c^f) \\
  &\quad \frac{\partial R}{\partial D}
\end{align*}
\]

(18)

The corresponding first-order condition for private utility maximization by an individual borrower is:

\(^9\) Partial differentiation of equation 17 with respect to \( \theta \), for a given value of \( R \), confirms that \( x_R(\theta, R) > 0 \). Given the monotonicity of \( x(\theta, R) \) with respect to \( \theta \), there cannot be more than one value of \( \theta \) for which \( x(\theta, R) \) is equal to \( R \). If \( R < x(\theta, R) \) for all \( \theta \), debtors would always repay in full; if \( R > x(\theta, R) \) for all \( \theta \), partial default would always occur. Nothing in the subsequent analysis would be altered by explicitly allowing for these two possibilities.
\[ u(c) = \frac{\int_0^q \left( f(\theta) u_2(c^d) \beta \right) d\theta + (1 - \pi) u_2(c') [1 + i (1 + \tau)]}{1 + \rho}, \quad (19) \]

where \( \beta \) is the total private cost, per unit borrowed, by private domestic borrowers, following a rescheduling agreement. The total private cost is defined to include not only payments to foreign lenders, but also taxes on foreign borrowing paid to the domestic government.\(^{10}\) In principle, a social optimum could be achieved by setting \( \tau \) equal to the reciprocal of the elasticity of supply of debt with respect to the contract interest rate, as in equations 13 and 14 in section 2, and setting \( \beta \) equal to the partial derivative of the amount actually repaid to foreign lenders with respect to the amount borrowed, \( x_\delta(\theta, R) \partial R / \partial \delta. \)

Two polar cases help to clarify this latter condition. First, suppose that the tax rate \( \tau \) is set according to equations 13 and 14 and that for any given value of \( \theta \) the amount actually repaid, \( x \), happens to be directly proportional to the amount contracted to be repaid, \( R \):

\[ x(\theta, R) = p(\theta) R. \quad (20) \]

In this first polar case, the government's optimal policy is to announce in period 0 that, in the event of a bargained partial default in period 1, it will set \( \beta = \mu (1 + i (1 + \tau)) \), where \( \mu \) is the ratio of the aggregate values for the whole country of the actual repayments to the contracted

---

\(^{10}\) In comparing equations 18 and 19 with the corresponding equations in section 2, i.e., equations 9 and 12, it should be noted that not only have we moved from a model of all-or-nothing default to a model of bargained partial default, we have also made \( \tau \) a function of \( R \), as well as of \( \theta \). If the section 2 model were amended to make \( \tau \) a function of \( R \), equations 9 and 12 would differ from 18 and 19 only in that \( x_\delta(\theta, R) \) in equation 18 would be replaced by \( x_\delta(\theta, R) \), and \( \beta \) in equation 19 would measure the tax paid to the government in the event of total default by domestic borrowers, per unit of foreign debt incurred in period 0.
repayments. In aggregate, all individuals therefore pay \( \mu D(1 + i(1 + t)) \), of which the government receives \( \mu D(1 + i) \), and the foreign lenders receive \( \mu D(1 + i) - x \). Since \( \mu D(1 + i) - x \), this rule satisfies the requirement that foreign lenders receive \( x \), the bargained actual repayment; and it also satisfies the optimality condition, \( \beta = x_R(\theta, R) \cdot \partial R / \partial \theta \). To see the latter result, note that \( x_R(\theta, R) = \mu(\theta) - x/R \) and that \( 1 + i(1 + t) = \partial R / \partial \theta \). Therefore, in this first polar case, the optimal tax policy derived for the model of all-or-nothing default in section 2 carries over with only minor amendments to the model of bargained partial default.

The second polar case is that in which the default penalty is independent of the amount owed; in the case of bargained partial default, this assumption, which was made in section 2, and which is made in most of the literature on sovereign debt, leads to the conclusion that \( x_R(\theta, R) = 0 \). In this case a social optimum would be achieved if the government set \( t \) to satisfy equations 13 and 14, and set \( \beta \) at zero by promising that, in the event of a bargained partial default, it would take over all the rescheduled private sector obligations to foreign lenders at no charge to the private borrowers! This paradoxical result arises because the bargaining model predicts that, in the event of bargained partial default, the amount actually repaid depends only on the amount of the default penalty; therefore, if the default penalty is independent of the amount owed, the ex post marginal social cost of foreign debt is non-zero only in the event of full repayment without bargaining, i.e., only if \( \theta > \theta' \).

The conclusion of the above analysis is that the formula for the optimal tax rate derived in section 2 is also roughly appropriate for the model of this section if either of the following two assumptions is valid: (a) the first polar case is approximately realistic; or (b) the probability of full repayment, without bargained partial default, is high, so that setting \( t \) according to equations 13 and 14 will ensure approximate coincidence between the social and private conditions for utility maximization (equations 18 and 19), whatever the relationship between \( \beta \) and \( x_R(\theta, R) \cdot \partial R / \partial \theta \). Since international rescheduling agreements provide
pressures for similar treatment of countries in similar circumstances, it is clear that in practice the predictions of the first polar case are more realistic than those of the second.

The above analysis ensures that, from the perspective of the sovereign borrower, this bargaining model is formally equivalent to the model without bargaining of section 2: the function \( x(\theta) \) in the model of section 2 is now replaced by \( x(\theta) \); and the event "total default" is replaced by the event "bargained partial default". However, in the event of bargained partial default, \( x(\theta) \) is transferred to the lender in the model of this section, whereas \( x(\theta) \) was wasted in the model of section 2. Therefore the relationship between the contract interest rate and the amount borrowed, must be amended. In place of equation 4 we now have:

\[
1 + r = (1 - \pi)(1 + \hat{i}) + \int_{0}^{\theta^*} \frac{f(\theta) x(\theta)}{D} d\theta, \tag{21}
\]

where \( \pi \) now denotes the probability of bargained partial default; i.e., the probability that \( \theta < \theta^* \). This amendment affects the shape of the supply function of foreign capital, but not the structure of the equations which determine the optimal taxes.

4. Conclusions

In this paper we have analyzed the efficiency implications of the possibility of sovereign default by a small country, on the assumption that the penalty for default depends on a random variable, which can be thought of as its terms of trade. We argued that in such an economy, there are externalities associated with foreign borrowing. In the model of all-or-nothing default analyzed in section 2 the formula for the optimal tax needed to internalize these externalities turns out to have the same form as the optimal tax on foreign borrowing, in the absence of default risk, in a capital importing country which is large enough to have monopsony power.
in the world capital market. This similarity is somewhat surprising: firstly, the monopsony model is based on the assumption of certain repayments; secondly, in the present paper, we have analyzed a small country with no monopsony power. The explanation is that an increase in foreign borrowing by any one individual raises the contracted repayments which must be made by all others in the event that default does not occur, and also raises the probability that default will occur: however, provided that the decision on whether or not to default is taken optimally, a small increase in the probability of default does not have any net welfare effects in the borrowing country: the gain from being able to avoid repaying contracted debts is exactly offset by the loss from suffering the default penalty. Therefore, in the present model — as in the traditional certainty model of a monopsonistic borrowing country — the net external cost of additional foreign borrowing is the increase in the contracted interest payments which must be made by other borrowers in the event that default does not occur.\footnote{Although we have derived this result in a two-period model in which default occurs if and only if the stochastic default penalty is less than the principal and interest on the debt, it is clear from the underlying rationale, set out in the main text, that the result would also apply in a multi-period model in which the default penalty was exclusion from the international capital market, as in Eaton and Gersovitz (1981). What matters in ensuring that changes in the probability of default have no net external costs or benefits, and that the external cost of borrowing is therefore the increased interest burden on existing debt in the event that default does not occur, is only that the decision on whether or not to default is made optimally.}

In section 3, we analyzed a model in which bargained partial default is possible. This assumption changes the form of the optimal tax; however, if the probability of bargained partial default is small, and/or if, for any given value of the terms of trade, the actual repayments which result from bargaining turn out to be directly proportional to contracted repayments — and we argued that this latter assumption may not be a gross distortion of the stylized facts — then the section 2 formula for the optimal tax carries over to the model of section 3.
Graphs 1 to 6 below present data on spreads between borrowings in the same currency and with similar maturity by the Australian Commonwealth Government and three borrowers with, presumably, very low default risk: the World Bank, the European Investment Bank, and the Swedish Government. The excess interest paid by Australia was sometimes negative, and very seldom exceeded 50 basis points, i.e., .5 percent per year. There does not appear to be any very close correlation between the peaks and troughs in the six graphs, and it is remarkable that in comparing Australia with the World Bank, the sign of the spread often depended on the currency of the loan: from late 1987 to May 1989 Australia paid a lower interest rate on DM borrowings than the World Bank; but, over much of the same period, the interest rates paid by the World Bank on US dollar and Swiss franc borrowings were usually lower than those paid by Australia.

Our conclusion from Graphs 1 to 6 is that the risk premia on loans to Australia were very small, and were probably dominated by transactions costs. This suggests firstly, that the linear approximation to the optimal tax formula is valid, and secondly, that the optimal tax is so small that it would probably not be worth while to try to collect it. However, for many severely and moderately indebted LDCs, the spread between $i$ and $r$ is substantial. In these cases the linear approximation to the optimal tax formula implies a substantial optimal tax, and the linear approximation may itself be substantially inaccurate. Edwards (1984, p.733) presents data on estimated effective default probabilities for 19 LDCs over the period 1976-1980. These default probabilities range from 5.8 percent per year (Venezuela, 1977) to 11.9 percent per year (Panama, 1978). If the risk-free real interest rate is assumed to be 5 percent per year, the linear approximation to the optimal tax formula implies an upper bound to the

---

$^{12}$ An effective default probability of .5 percent could be generated by a 1 percent probability of a 50 percent default, together with a 99 percent probability of full repayment.

$^{13}$ The linear approximation overstates or understates the true upper bound to the optimal tax rate, according as to whether the relationship between $i$ and $D$ is concave, $i_{pp} < 0$, or convex, $i_{pp} > 0$. There appears to be
optimal tax rate, \( t \), of 54 percent (i.e., \( 5.8/(5 + 5.8) \)) in the case of Venezuela in 1977, and of 70 percent (i.e., \( 11.9/(5 + 11.9) \)) in the case of Panama in 1978.

In the case of Australia, our results support the argument of Pitchford (1990) that there is no case for other than negligible government interventions to reduce Australia's current account deficit: in this sense, the current account deficit is not a "problem". At the same time, our analysis and estimates are consistent with the view that, in a very heavily indebted economy, a continuing large current account deficit can be a "problem", in the sense that the optimal tax on foreign borrowing appears to be substantial. Correspondingly, in such economies, the interest rate at which a risk-free public sector investment project should be appraised exceeds the world risk-free interest rate.

little econometric evidence on this issue: for example, although Edwards (1984, 1986) has estimated regressions relating \( i - z \) to various measures of credit-worthiness, the functional form which he chose imposes the result that \( i_0 \) and \( z_0 \) have the same sign.
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APPENDIX: PERFECT EQUILIBRIUM AND THE BARGAINING MODEL OF SECTION

Suppose that the two "periods" assumed in the main text are really the present and the infinite future, and that the future is made up of a series of short periods each of length $h$, and denoted $F_1, F_2, F_3$, etc. The value of $\Theta$ is revealed at the beginning of period $F_1$, and the country can make rescheduling proposals in $F_1, F_3$, etc., while the lender - to be thought of a consortium of banks - can make proposals in $F_2, F_4$, etc. Bargaining ends as soon as agreement is reached, but in the meantime the country suffers the penalty at the rate $r$. The analysis is simplified by assuming away the possibility of subsequent default, thereby avoiding the need to analyze constant recontracting. We now reinterpret $y_1, x$ and $z$ as flow rates of output, repayment and penalty, respectively. Thus, for example, if agreement were reached at the start of $F_2$ the penalty suffered would be $h$ during period $F_1$ and the repayment in each subsequent period would be $hx$. At the start of $F_2$, the present value of these repayments is approximately $hx(1 + rh)/rh$, and their present value at the start of $F_1$ is $hx/rh$; the discounted value of present and future utility, evaluated at the start of $F_1$, would be $hu(y_1 - z) + hu(y_1 - x)/ph$.

We now use the method of Shaked and Sutton (1984)\textsuperscript{14} to confirm that equation 17 in the main text gives the unique perfect equilibrium of this bargaining model. Let $x$ be the largest repayment which the debtor offers in any odd numbered future period in any perfect equilibrium (PE), and let $x'$ be the largest repayment which the creditor demands in any even-numbered period in a PE. Suppose that agreement is not reached in period $F_1$; if the creditor demands $x'$ in $F_2$, and if the debtor agrees, the pay-off to the debtor, as of period $F_2$, is:

$$\frac{1 + \rho h}{\rho h} hu(y_1 - x').$$  \hspace{1cm} (A.1)

The maximum repayment by the debtor cannot be rejected by the creditor. Therefore, if the debtor rejects $x'$ in $F_2$ and offers its maximum repayment, $x$, in $F_3$ it must get at least expression A.2, as of period $F_2$:

$$hu(y_1 - z) + hu(y_1 - x)/\rho h.$$ \hspace{1cm} (A.2)

Therefore, if, in a PE, the creditor's demand, $x'$, is accepted in $F_2$ by the debtor, expression A.1 cannot be less than expression A.2. If the

difference between $x$ and $x'$ is small, this condition implies:

$$\frac{1 + \rho h}{\rho h} [u(y^1 - x) + (x - x')u_c] \geq u(y^1 - z) + \frac{u(y^1 - x)}{\rho h}. \quad (A.3)$$

This condition for $x'$ to be acceptable to the debtor can be re-written as:

$$x' \leq x + \rho h \frac{u(y^1 - x) - u(y^1 - z)}{(1 + \rho h)u_c} \quad (A.4)$$

Given that the creditor can never get more than $x'$ in $F_2$ in any PE, the largest rate of repayment which the debtor need offer in $F_1$ in any PE, which by definition is $x$, cannot exceed $x'/(1 + rh)$:

$$x(1 + rh) \leq x'. \quad (A.5)$$

Combining inequalities A.4 and A.5 gives:

$$x \leq \frac{\rho}{r} \frac{u(y^1 - x) - u(y^1 - z)}{(1 + \rho h)u_c} \quad (A.6)$$

To eliminate the first move advantage for the debtor, we take limits of inequality A.6 as $h$ tends to zero. This shows that in any PE, the actual repayment, $x$, must be less than, or equal to, the expression on the right side of equation 17 in the main text, with $(1 - \alpha)/\alpha = \rho/r$. Exactly analogous reasoning confirms that the minimum value of the bargained repayment in any PE is also given by equation 17. Therefore equation 17 gives the unique PE of this bargaining model.

The above analysis is very similar to that of Bulow and Rogoff, except that they assume a linear relationship between utility and consumption and allow for the physical depreciation, during the bargaining process, of the stock of the debtor's exports, which are assumed to be waiting to be shipped or consumed domestically. Under these assumptions, the ratio $(1 - \alpha)/\alpha$ equals $(\rho + \delta)/(\rho + \delta)$, where $\delta$ is the rate of physical depreciation.
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