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COUNTRY RISK AND CONTINGENCIES

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ABSTRACT

The purpose of this paper is to study the role of credit market policies in the presence of country risk from the nationalistic and the global point of view, to address the role of endogenous default penalties that are contingent upon the intensity of default on the part of the borrowing nation, and to evaluate the effects of contingency plans that make the interest rate dependent upon variables that are correlated with the default penalty. This is done by considering an economy where a default will trigger a penalty, in the form of either a trade embargo or effective exclusion of the defaulting nation from future borrowing. Assuming costly enforcement of the penalty we show that the optimal borrowing tax from the global point of view exceed the optimal borrowing tax from the nationalistic point of view. The economic principle guiding the borrowing tax is that in the presence of country risk an activity that changes the probability of default generates thereby an externality. This principle applies also for investment: if a given investment reduces (increases) the probability of default it generates positive (negative) externality. Consequently, the social interest rate associated with this activity is lower (higher) than the private one, calling for a subsidy (tax) on borrowing used to finance that investment. Next, we evaluate the role of endogenous penalties. We design alternative incentive schemes by varying the responsiveness of the penalty to the intensity of default, without changing the total cost applied in case of a complete default. We turn then to an assessment of the welfare effect of plans that make the interest rate contingent upon realization of shocks. We conclude by deriving the optimal borrowing plan for an example where the source of uncertainty is a stochastic terms of trade. It is shown that allowing for contingent payment has the effect of raising the credit ceiling, raising the expected income, and stabilizing income across states.

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1. INTRODUCTION AND SUMMARY*

In the 1980's various countries have engaged in debt rescheduling, whereas others have found that new borrowings involve a significant risk premium[1]. Consequently, attention has been focussed on the design of credit policies and the role of institutions in the presence of country risk. Recently we have observed initial attempts to design payment plans that will make the effective interest rate paid by the borrowing nation contingent upon its terms of trade[2]. These circumstances have raised important questions regarding the design of incentive schemes for the borrowing nations. Such schemes should enhance the borrowing nations' incentives to service their debt, thereby reducing the risk premium charged for a given credit volume and allowing smoother operation of the international credit market. The purpose of this paper is to address three policy issues related to the design of incentives. We start by evaluating the optimal borrowing tax from the global and the nationalistic point of view for a non-contingent loan. We continue by analyzing the role of endogenous default penalties that are contingent upon the intensity of default undertaken by the borrower nation, and then we evaluate the effects of contingency plans that make the interest rate dependent upon variables that are correlated with the default penalty.

Section 2 starts by formulating the bench mark case, where there is only an exogenous default penalty. We consider a two-periods example. Borrowing takes place in period zero; debt repayment is scheduled for period one. In case of default, a fixed default penalty is inflicted upon the borrower. This penalty has the form of either a trade embargo or effective exclusion of the defaulting nation from future borrowing. There is uncertainty in period zero regarding the magnitude of the effective default penalty, and debt issuance occurs before the resolution of uncertainty. We consider risk-neutral lenders, who charge an interest rate that results in an expected yield equal to an exogenously given risk-free interest rate. We review the derivation of the supply of credit, which may include a backward-bending portion. As was shown in Aizenman (1986), the presence of country risk introduces a distortion, calling for an optimal borrowing tax. Among other effects, the optimal tax eliminates the possibility of an equilibrium on the backward-bending portion of the supply of credit. We assume that such a tax is applied, allowing us to focus our analysis on equilibria on the upward-sloping portion of the supply of credit.

This tax is derived first for the nationalistic case, where it is designed to maximize the expected welfare of the borrowing nation. We turn then to the other relevant case, designing the tax that will maximize global expected welfare. We consider the case where enforcing the default penalty on the borrowing nation require direct enforcement costs that are external to the lenders (like enforcing the trade embargo). It is shown that the presence of these costs imply that the optimal borrowing tax from the global point of view exceed the optimal borrowing tax from the nationalistic point of view. This result imply that there is potentially a conflict between the global and the nationalistic point of view. While both call for a borrowing tax, global considerations may call for a higher tax than the nationalistic optimum. This in turn imply that there is a potential need for institutions like the IMF and the World Bank to coordinate the borrowing tax policies between the lenders and the borrowers. It is noteworthy that one can view this result as a modified extension of the optimal tariff to country risk case. A classic result in trade theory is that a country with market power can enhance its welfare by an optimal tariff, but this will reduce the global welfare. The extension of 'optimal tariff' to country risk is that in the presence of default risk the borrowing nation will enhance its welfare by an optimal borrowing tax. The modification is that optimal borrowing tax is applicable even if the country is small in the international capital market, and that unlike the optimal tariff case, both the domestic and the global welfare are enhanced by the borrowing tax.

The economic principle guiding the borrowing tax is that in the presence of country risk and price taker agents an activity that changes the probability of default generates thereby an externality. If the activity raises the probability of default (as is the case with marginal borrowing to finance higher consumption in period zero) the externality is negative, implying that the social interest rate associated with this activity is higher than the private one, calling for a tax on borrowing used to finance consumption. The last part of Section 2 extends this principle for investment: if a given investment reduces (increases) the probability of default it generates positive (negative) externality. Consequently, the social interest rate associated with this activity is lower (higher) than the private one, calling for a subsidy (tax) on borrowing used to finance investment. The magnitude of the appropriate subsidy is determined by the intensity of the induced drop in the probability of default. If, for example, an investment in tradables reduces this probability by more than investment in non-tradables, the optimal subsidy for investment in the traded sector exceeds the investment subsidy in the non-traded sector. If the investment in the non-traded sector increases the probability of default (by making the country more self-sufficient, thereby reducing the default penalty) then such an investment will be taxed.

In section 3 we modify the assumptions of section 2 by allowing for a default penalty that is contingent upon the default intensity. In general, the supply of credit is determined by the nature of the expected default penalty. A default may trigger two types of penalties. The first is exogenously fixed, and its magnitude is independent of the intensity of default. The second is variable, and its magnitude is determined by the intensity of default. We start section 3 by addressing a positive issue--assessing the dependency of the supply of credit on the elasticity of the penalty with respect to the default intensity. This sets the stage for the normative discussion. The first policy issue addressed is the welfare implications of contingent default penalties. We turn then to an assessment of the welfare effect of contingent interest rates in the presence of country risk. To permit a comparison across regimes we design alternative incentive schemes by varying the responsiveness of the penalty to the intensity of default, without changing the total cost applied in case of a complete default. At the limit our incentive scheme converges to an exogenous default cost regime. The characteristics and the random nature of the full default penalty (i.e. the penalty associated with complete default) are the same as in section 2. These assumptions allow us to derive the dependency of the supply of credit on the elasticity of the penalty with respect to the default intensity. In general we will observe incidences of partial default whose magnitude rises with the level of borrowing relative to the cost of a complete default. A rise in the elasticity of the penalty with respect to the default intensity is shown to induce a higher default rate and and to raise the country risk as reflected in the interest rate associated with a given borrowing, causing a leftward shift in the supply of credit. Using the expected welfare of a representative consumer it is shown that the introduction of partial defaults due to a variable penalty has adverse effects.

We turn then to an assessment of the welfare effect of plans that make the interest rate contingent upon realization of shocks. Section 4 shows that a plan that will index the interest rate such as to correlate it perfectly with the default penalty will eliminate the adverse effects of country risk on the expected income. An optimal contingency plan that will index the effective interest rate to the realization of the terms of trade will raise the credit ceiling and the expected income, and will stabilize income across states. Section 5 closes the discussion with interpretative remarks that tie the discussion in section 4 to recent attempts to make the effective interest rate paid by the borrowing nation contingent upon its terms of trade.

It is noteworthy that the gain resulting from making the interest rate contingent on the terms of trade can be viewed as the result of moving closer to a complete markets environment, where prices are state contingent. Making the default penalty contingent upon the intensity of default fails to improve welfare because it depends on the endogenous behavior of the borrower instead on the exogenous state of nature.

2. COUNTRY RISK WITH EXOGENOUS DEFAULT PENALTIES

The purpose of this section is to characterize country risk for the case of a fixed default penalty. This case will define the bench mark for the subsequent discussion. We start by modeling the supply of credit in the presence of country risk. Next, we discuss the demand for credit and optimal policies for the borrowing nation. The discussion in this section sketches the analysis in Aizenman (1986), whereas section 3 extends the framework for the case of endogenous default penalties[3].

2.1 The Default Decision

Consider a two-periods small economy. Borrowing $\bar{B}$ takes place in period zero at an interest rate r^*. Debt repayment $\bar{B}(1+r^*)$ is scheduled for period one. In case of default, a stochastic penalty N is inflicted upon the borrower, given by

$$N = N_0 / \Psi \tag{1}$$

The term Ψ represents a stochastic disturbance, whose density function is g. Debt issuance occurs in period zero, before the resolution of uncertainty regarding Ψ. The information regarding Ψ is summarized by a distribution of Ψ, which is known to both the lenders and the borrowing nation. This information is applied to determine the supply of credit. We consider the case where the default decision is arrived at by a centralized decision maker, like the central bank. While consumers are assumed to be price takers in the credit market, they are fully aware of the default rule guiding the central bank. The penalty considered here represents economic loss that is not captured by lenders. Equation (1) can reflect various economic environments. For example, let the default penalty be the result of adverse commercial policies (like banning trade in goods and services). In such a case the term Ψ may reflect a stochastic term measuring the effectiveness of the trade embargo. Alternatively, the default penalty can be the result of exclusion from future borrowing. Let N be the future cost of being excluded from the credit market (in terms of period two) due to a default in period one; and Ψ be the effective discount factor that translates the future penalty (N) into N/Ψ in terms of period one. Thus, Ψ can be viewed as a myopia measure, where a higher Ψ corresponds to a smaller weight attached to the future by the decision maker in period one. In such a case the uncertainty regarding Ψ may reflect political uncertainty regarding the horizon of the future decision maker.

Default will take place if the debt exceeds the penalty, or if

(2) $$\bar{B}(1+r^*) > N_0 /\Psi$$

Alternatively, the default rule can be summarized by:

(3) $$\begin{cases} \text{default if} & \Psi > Z \\ \text{no default if} & \Psi < Z \end{cases} \quad ;$$

where $Z = N_0/\bar{B}(1+r^*)$ denotes the marginal value of Ψ associated with default.

2.2 <u>The Supply of Credit</u>

We assume a credit market that is dominated by risk-neutral lenders, fully informed regarding the nature of the decision rule guiding the borrower, as well as regarding the borrower's indebtedness position[4] ($\bar{B}$). A risk-neutral lender will extend credit $\bar{B}$ at a rate r^* such that the expected yield on the risky loan equals the risk-free return:

(4) $$(1+r^*) P = 1+r_f$$

where r_f is the exogenously given risk-free interest rate, and P is the probability of no default. From (4) we infer that

(5) $$P = \int_{\varepsilon}^{Z} g(\Psi)\, d\Psi$$

where g is the density function corresponding to Ψ, defined for $\Psi > \varepsilon \geq 0$. Thus, P is a function of $(1+r^*)\bar{B}$, $P = P\{(1+r^*)\bar{B}\}$, with $P' < 0$. Equations (4) and (5) define the credit supply curve, which is determined by the distribution g. We summarize the reduced form of the supply of credit by:

(4') $$r^* = r^*(\bar{B})$$

Notice that a rise in the interest r^* rate has two opposing effects on the expected income yield. The direct effect is reflected in the rise of the yield for a given probability of no default (P). But it also implies a drop in P. This second effect works to depress the expected yield, implying that under certain conditions (derived in Aizenman (1986)) the supply is backward-bending[5].

2.3 <u>The Demand for Credit</u>

The demand for credit is derived from the underlying consumer preferences. We assume that consumers' utility is given by

(6) $$U = u(X_0) + \rho u(X_1)$$

where X_i is the consumption in period i, and ρ stands for the subjective rate of time preference. A representative consumer maximizes his expected utility subject to his budget constraints. He is facing an interest rate r, that may differ from the external interest rate r^* due to the presence of borrowing taxes. The social role of these taxes will be examined in the sequel. The representative consumer's budget constraints are given by

$$(7) \qquad X_0 = \bar{X}_0 + B$$

$$(8a) \qquad X_{1,n} = \bar{X}_1 + R_1 - B(1 + r)$$

$$(8b) \qquad X_{1,d} = \bar{X}_1 - N_0/\Psi$$

where $\bar{X}_i$ stands for the endowment in period i, R_1 for lump-sum transfers in period one, $X_{1,n}$ is the consumption in case of no default, $X_{1,d}$ is the consumption in states of default and B is the borrowing by the consumer. Equation (7) defines the budget constraint for period zero, whereas for period one we observe two possible budget constraints, corresponding to the possibility of no default (8a) and default (8b). To simplify exposition, we start by assuming an endowment model (adding production and investment would not change the main results, as will be shown in section 2.5). Applying the budget constraints to (6) we can characterize the consumer problem as choosing B so as to maximize expected utility V:

$$(9) \quad V = u(\bar{X}_0 + B) + \rho\int_{\varepsilon}^{Z} u(\bar{X}_1 + R_1 - B(1 + r))g(\Psi)\, d\Psi + \rho\int_{Z}^{\infty} u(\bar{X}_1 - N_0/\Psi)g(\Psi)\, d\Psi$$

Optimizing (9) yields the following first-order condition:

$$(10) \qquad V'(X_0)/V'(X_{1,n}) = 1 + r$$

where $V'(X_i)$ stands for the expected marginal utility of consuming X_i:

$$V'(X_0) = u'(X_0) \quad ; \quad V'(X_{1,n}) = \rho\int_{\varepsilon}^{Z} u'(\bar{X}_1 + R_1 - B(1 + r))g(\Psi)\, d\Psi.$$

Optimal borrowing B is chosen by the consumer so as to support a consumption path that yields equality between the ratio of the corresponding expected marginal utilities of consumption and the interest rate. The assumption that the consumer is a price taker is reflected in the fact that each consumer treats aggregate borrowing $\overline{B}$ (and the corresponding Z and r) as exogenously given.

2.4 Optimal Policy for a Borrowing Nation

To gain insight into the potential role of optimal policies let us evaluate the solution of the optimal consumption path by a centralized decision maker. Potential deviations between the planner's and the consumer's solutions will justify policies needed to support optimality. These policies will be shown to be in the form of optimal borrowing taxes. We assume that the transfer R_1 is used to rebate consumers such that the net present value of the planner's revenue is zero (when the relevant interest rate from the planner's perspective is the external interest rate, r*). Subject to this requirement the budget constraints facing the planner can be shown to be

$$X_0 = \overline{X}_0 + \overline{B} \tag{7'}$$

$$X_{1,n} = \overline{X}_1 - \overline{B}(1 + r^*) \tag{8a'}$$

$$X_{1,d} = \overline{X}_1 - N_0/\Psi \tag{8b'}$$

with the help of these budget constraints the planner's problem is reduced to a choice of $\overline{B}$ that will maximize

$$V = u(\overline{X}_0 + \overline{B}) + \rho\int_{\varepsilon}^{Z} u(\overline{X}_1 - \overline{B}(1 + r^*))g(\Psi)\, d\Psi + \rho\int_{Z}^{\infty} u(\overline{X}_1 - N_0/\Psi)g(\Psi)\, d\Psi \tag{9'}$$

A key difference between the consumer's and the planner's problems is that the centralized planner is not a price taker in the credit market, and he is aware that the choice of borrowing $\bar{B}$ will impact on the interest rate via the supply of credit (4'). Consequently, (9') implies that the condition for optimal borrowing is

$$(10') \qquad V'(X_0)/V'(X_{1,n}) = (1 + r^*)\left(1 + \frac{d \log(1 + r^*)}{d \log\bar{B}}\right)$$

where[6] $V'(X_0) = u'(X_0)$; $V'(X_{1,n}) = \rho \int_{\varepsilon}^{Z} u'(\bar{X}_1 - \bar{B}(1 + r^*))g(\Psi)\, d\Psi.$

Optimal borrowing $\bar{B}$ is chosen by the planner so as to support a consumption path that yields equality between the ratio of the corresponding expected marginal utilities of consumption and the 'social' interest rate (defined by $d \log(1 + r^*)/ d \log \bar{B}$). A comparison between the planner's and the consumer's solutions reveals that the two differ in that the planner applies the 'social' interest rate, whereas the consumer applies the 'private' one. In the absence of borrowing taxes the presence of country risk implies that there is a distortion, and that from the social point of view the equilibrium is associated with "excessive" borrowing because the private falls short of the social interest rate. This situation provides the rationale for government intervention. The distortion arises from the fact that individual borrowers treat the rate of interest as given even though from the perspective of the country as a whole the rate of interest rises with the volume of borrowing because of the rise in the probability of default. Note that each small consumer overlooks the marginal rise in the probability of default induced by his marginal borrowing. This rise implies that the welfare of all consumers will drop because of the rise in the frequency of defaults and the consequent rise in the expected default penalty inflicted on all domestic consumers. Thus, we observe an externality, and the role of policies is to internalize it. An optimal borrowing tax is needed to yield equality between the social and the private interest rates[7]. As is shown in Aizenman (1986), the optimal borrowing tax has an important consequence -- ruling out inefficient equilibria on the backward-bending portion of the supply of credit. Henceforth, we will assume that the optimal borrowing tax is applied and therefore we will neglect the backward-bending portion of the supply of credit. This argument is summarized in Figure One. Curve DD is the demand for credit, KLMN plots the supply curve, and KLM' corresponds to the 'social supply' curve (the marginal to KLM). Optimality calls for a borrowing tax, defined by the vertical distance between $\tilde{r}^*$ and $\tilde{r}$ (Figure One)[8].

Our discussion in this section has focussed on welfare from the perspective of the small economy. A relevant question is the degree to which the optimal borrowing tax is also optimal from global perspectives. As Appendix A demonstrates, the answer depends on the nature of the cost of defaults. If the cost of default N is borne only by the borrowing country, then the policy derived in this section also represents the global optimum. If, however, there is a spillover effect on other nations, then the global optimum differs. For example, if the penalty N represents the cost of a trade embargo which is costly to implement, it will require further 'waste' of real resources on the part of lenders to enforce it. Suppose that enforcing a penalty N requires lenders to spend resources kN, where k is a proportionality factor. In formulating the problem we assume that the default enforcement costs are borne collectively by the lending nations (as is the case of enforcing the trade embargo), and not by the direct lenders. Appendix A demonstrates that the optimal tax from global perspective satisfies the following first order condition

$$(10')\qquad V'(X_0)/V'(X_{1,n}) = (1 + r^*)\left(1 + \frac{d\,\log(1 + r^*)}{d\,\log\bar{B}}\right) / (1 - k\lambda)$$

$$\text{where } \lambda = N_0\, g(Z)\left(1 + \frac{d\,\log(1 + r^*)}{d\,\log\bar{B}}\right) / [\bar{B}(1 + r_f)]$$

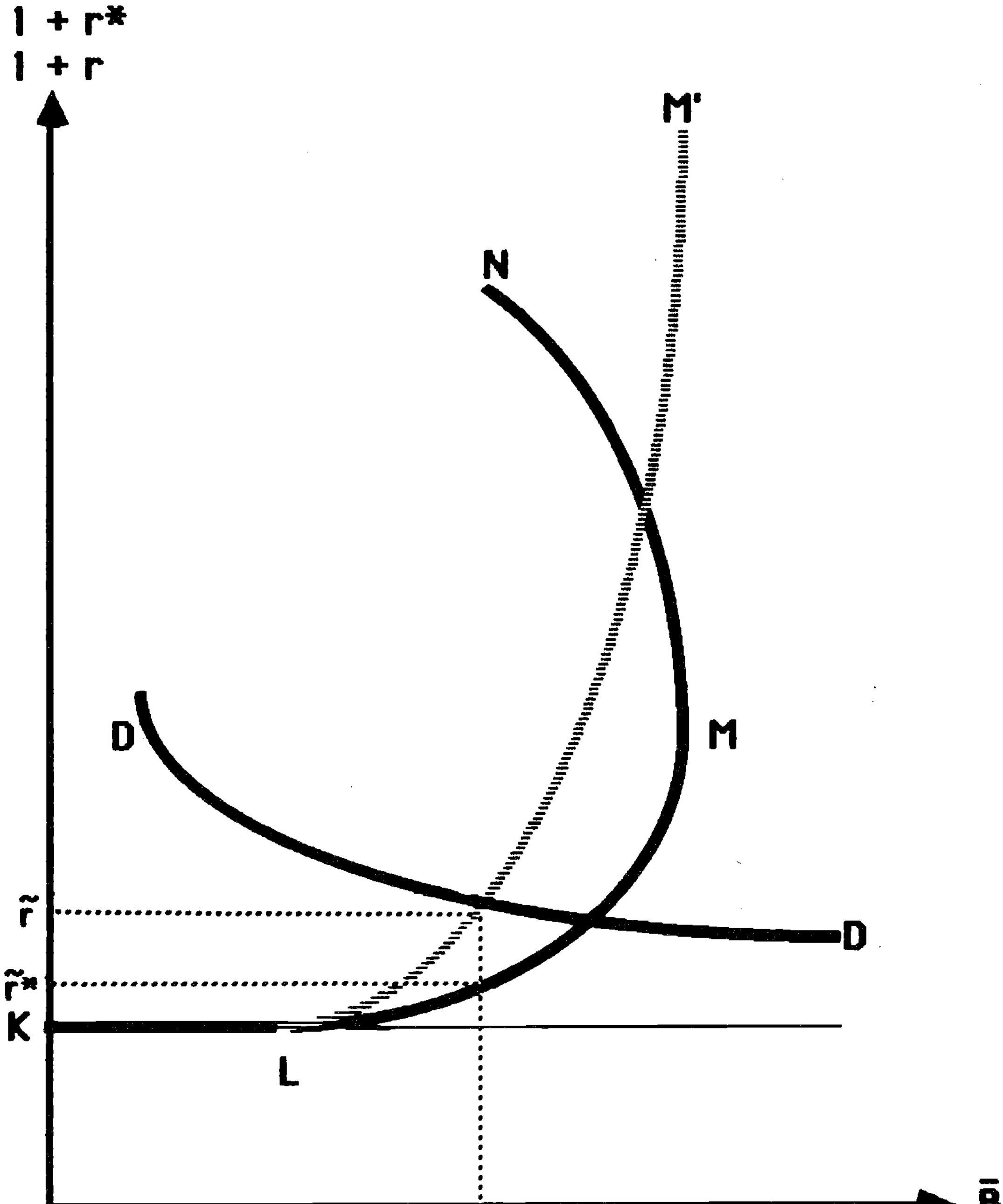

FIGURE ONE

Notice that the small consumer in the borrowing nation associates borrowing with a cost of only $(1 + r^*)$. Thus, the last two terms multiplying $(1 + r^*)$ in (10") measure the externality and also define the optimal tax. Equations (10') and (10") define the optimal borrowing tax from the nationalistic and global perspective, denoted by t_n and t_g, respectively:

$$t_n = \frac{(1 + r^*)}{r^*} \frac{d \log(1 + r^*)}{d \log\bar{B}}$$

$$t_g = \frac{(1 + r^*)}{r^*} \left[\frac{d \log(1 + r^*)}{d \log\bar{B}} + k\lambda \right] / \left[1 - k\lambda \right]$$

If the penalty enforcement costs are zero $k = 0$ and $t_g = t_n$. In this case the optimal borrowing tax from the point of view of the borrowing nation is also the tax that maximizes global welfare, because of the lack of spillover effects. If $k > 0$ then the externality from the global point of view exceeds the domestic externality. In terms of equation (10"), a higher k is associated with a rise of the left hand side of (10") for a given r^*. Consequently, global welfare considerations call for a higher optimal borrowing tax than the optimal nationalistic tax. This result reflects the fact that costly enforcement of the trade embargo raises the global externality generated by marginal borrowing, calling for a higher borrowing tax. Thus, we conclude with the observation that costly enforcement of the default penalty works to increase the optimal borrowing tax from the global perspective. This result imply that there is potentially a conflict between the global and the nationalistic point of view. While both call for a borrowing tax, global considerations call for a higher tax than the nationalistic optimum. This in turn imply that there is a potential need for institutions like the IMF and the World Bank to coordinate the borrowing tax policies between the lenders and the borrowers.

It is noteworthy that one can view our analysis as a modified extension of the optimal tariff to the country risk case. A classic result in trade theory is that a country with market power can enhance its welfare by an optimal tariff, but this will reduce the global welfare. The extension of 'optimal tariff' to country risk is that in the presence of default risk the borrowing nation will enhance its welfare by an optimal borrowing tax. The modification is that optimal borrowing tax is applicable even if the country is small in the international capital market, and that unlike the optimal tariff case, both the domestic and the global welfare are enhanced by the borrowing tax.

2.5 Optimal Policies and Investment

Our previous analysis considered an endowment model, neglecting the possibility of investment. The analysis can be easily extended for the case where borrowing is used to support both consumption and investment in period zero. The economic principle guiding the previous discussion is that in the presence of country risk an activity that changes the probability of default generates thereby an externality. If the activity raises the probability of default (as is the case with marginal borrowing to finance higher consumption in period zero) the externality is negative, implying that the social interest rate associated with this activity is higher than the private one, calling for a tax on borrowing used to finance consumption. This principle can be extended for investment: if a given investment reduces the probability of default it generates positive externality. Consequently, the social interest rate associated with this activity is lower than the private one, calling for a subsidy on borrowing used to finance investment. The magnitude of the appropriate subsidy is determined by the intensity of the induced drop in the probability of default. If, for example, an investment in tradables will reduce this probability by more than investment in non-tradables, the optimal subsidy for investment in the traded sector should exceed the investment subsidy in the non-traded sector. Using this logic, if the investment in the non-traded sector increases the probability of default (by making the country more self-sufficient, thereby reducing the default penalty) then such an investment should be taxed.

To exemplify this result consider a simple example of an economy producing a commodity. Let future output be a function of present investment. The default penalty is proportional to GNP, and the source of uncertainty is that the term of trade converting the commodity to consumption goods is stochastic. Specifically, suppose that the commodity output at time one depends positively on investment I undertaken in period zero: $\overline{X}_1 = \overline{X}_1(I)$. Let the term of trade be $1/\Psi$, implying that the GNP at period one in terms of consumption goods is $\overline{X}_1/\Psi$. The default penalty is assumed to be a fraction 'a' of the GNP : $N = a\,\overline{X}_1/\Psi$. We preserve all the other assumptions of our previous discussion (including that Ψ is the only source of uncertainty). Applying the methodology of section 2.4 we can infer that the social interest rate applicable for borrowing for consumption and investment (denoted by $r_{s,C}$ and $r_{s,I}$) are:

$$\text{(10')} \quad \begin{aligned} &\text{a.} \quad 1 + r_{s,C} = (1 + r^*)\left(1 + \frac{d\log(1 + r^*)}{d\log\overline{B}}\,\frac{\overline{B} + I}{\overline{B}}\right) \\ &\text{b.} \quad 1 + r_{s,I} = (1 + r^*)\left(1 + \frac{d\log(1 + r^*)}{d\log I}\,\frac{\overline{B} + I}{I}\right) \end{aligned}$$

where $\overline{B}$ now measures the borrowing to finance consumption, I the borrowing to finance investment. Note that the aggregate borrowing that is relevant for determining P and Z is now the sum of the two components: $\overline{B} + I$.

The interpretation of the social interest rates in (10') is the following: the central planner will choose optimal consumption and investment using (10'a) and (10'b) as the appropriate interest rates. The private sector, however, is applying $1+r^*$ as the relevant interest rate in the absence of policies. The divergence between the social and the private interest rates stems from the externality due to the change in the probability of default (and the ensuing change in the interest rate) induced by marginal borrowing. The second term on the RHS of (10") corrects the private interest rate for this externality. Optimal policies require policies that will equate the private and the social interest rates. For example, if investment will reduce the probability of default (i.e. if $d \log(1 + r^*)/ d \log I < 0$) optimality will call for an investment subsidy at a rate defined by the RHS of (10"b), and similarly for a consumption tax at a rate defined by (10"a).

3. COUNTRY RISK WITH ENDOGENOUS DEFAULT PENALTIES

The purpose of this section is to study the role of endogenous penalties, and to assess their desirability. In section 2 we considered the case of a fixed default penalty, independent of the magnitude of the default. In that case, the borrower faced an all-or-nothing choice. In this section we allow for a penalty tied to the default rate. Let us denote by τ the default rate ($0 \leq \tau \leq 1$). With a default τ only a portion $1-\tau$ of $\overline{B}(1+r^*)$ is paid in period one. We assume that a default τ imposes costs of

$$(11) \qquad \tau^h N \qquad \text{for} \quad 1 \geq \tau \geq 0 \quad ; \quad \text{where } h \geq 1.$$

Notice that h is the elasticity of the penalty with respect to the default intensity. It measures the convexity of the penalty with respect to the default rate -- a higher h implies higher responsiveness of the penalty to the default intensity. By definition, the effective penalty does not exceed N; and it approaches N as $\tau \to 1$ (complete default). The specification in (11) is flexible enough to allow assessment of the positive and normative aspects introduced by the presence of an endogenous penalty scheme. Varying h will allow us an assessment of the role of endogenous penalties, where $h \to 1$ will bring convergence to the bench mark case of fixed penalties of section 2 (it can be shown that $h < 1$ yields the same equilibrium as

$h = 1$). With the exception of the specification of the variable cost in (11), we preserve all the other assumptions of section 2, including the distributional assumptions regarding N (see (1)).

The supply of credit in the presence of endogenous penalties is derived in several stages. First, we derive the cost minimizing default rate $\tilde{\tau}$ from the borrower's perspective for a given $\bar{B}(1+r^*)$. Next, armed with the solution for $\tilde{\tau}$ we solve for the interest r^* charged by the lenders for credit volume $\bar{B}$. We then study the dependency of the supply of credit on the penalty scheme, as summarized by h.

3.1 The Default Rate

The borrowing nation chooses in period one the default rate τ so as to maximize the gain in net income attributed to default. The 'default income', denoted by $\pi(\tau)$, is:

$$(12) \qquad \pi(\tau) = \tau\, \bar{B}(1+r^*) - \tau^h N_0 / \Psi \qquad \text{for} \qquad 0 \le \tau \le 1$$

It is composed of the benefit of partial default $[\tau\bar{B}(1+r^*)]$ minus the cost associated with the default $[\tau^h N_0/\Psi]$. Let us denote by $\tilde{\tau}$ the default rate that maximizes the default income. Direct optimization reveals that for $h \ge 1$

$$(13) \qquad \tilde{\tau} = \text{Min}\left\{ 1 \;;\; [\bar{B}(1 + r^*)/\{hN\}]^{1/(h-1)} \right\}$$

To gain further insight we plot in Figure Two the marginal cost and the marginal benefit associated with default τ. Optimal default is obtained at the intersection of the two curves. Appendix B shows that for an internal solution ($0 < \tilde{\tau} < 1$) a rise in h (the elasticity of the penalty with respect to the default intensity) will increase the default rate. In terms of Figure Two the rise in h is associated with a rightward shift of the relevant portion of the MC curve. Similarly a drop in the default penalty will shift the MC curve rightward, thus raising the default rate. Alternatively, a rise

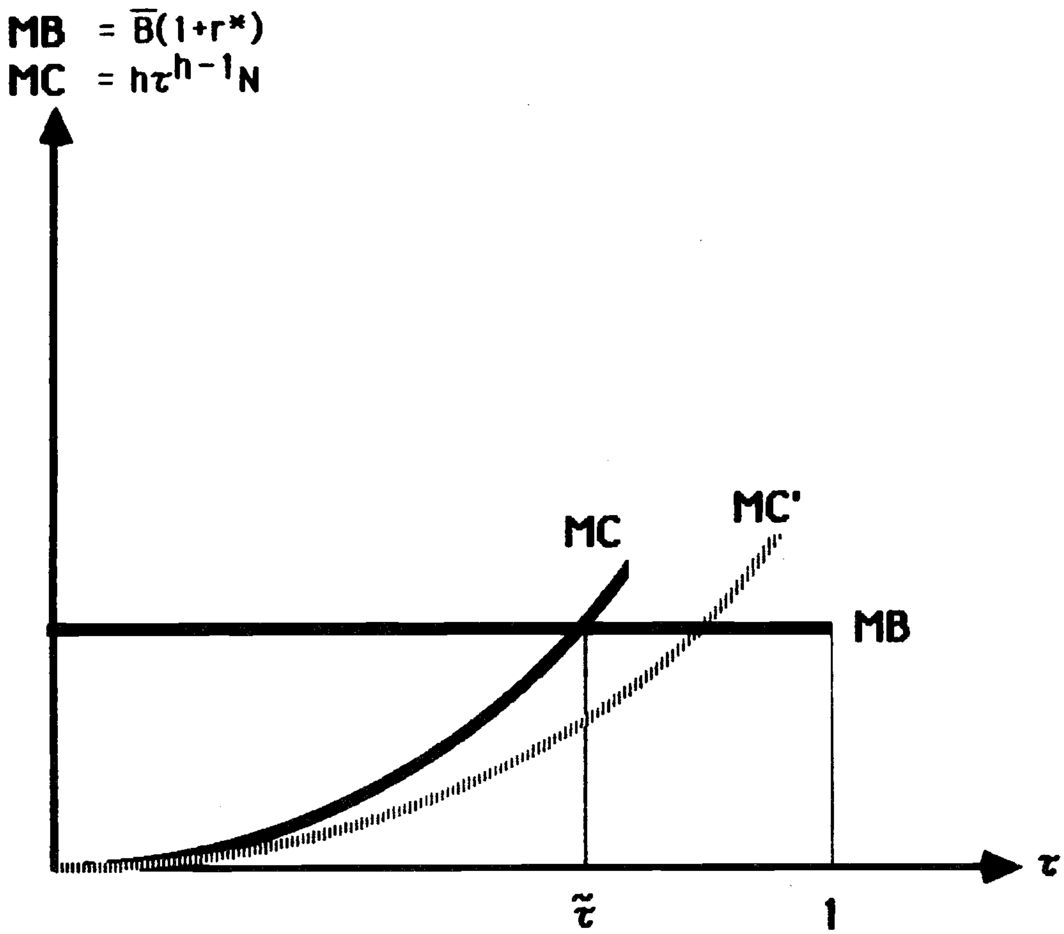

FIGURE TWO

in the gross indebtedness $(1 + r^*)\overline{B}$ will shift the MB curve upwards, being associated with a rise in the default rate.

Let us denote by Z the marginal value of Ψ associated with a complete default ($\tau = 1$). From (13) we infer that

$$(14) \qquad Z = hN_\theta / \{\overline{B}(1 + r^*)\}.$$

It is noteworthy that in the case of h = 1 the default decision degenerates to a simple rule:

$$(15) \qquad \tilde{\tau} = \begin{cases} 0 & \text{if} \quad \Psi < N_\theta/[\overline{B}(1+r^*)] \\ 1 & \text{if} \quad \Psi > N_\theta/[\overline{B}(1+r^*)] \end{cases}$$

Equation (15) corresponds to the case of a fixed default penalty. Applying (13) allows us to conclude that as we approach the case of exogenous penalties ($h \to 1$) the optimal default rate for an internal solution converges to zero. Thus, as $h \to 1$ we approach the bench mark case of section 2, where $\tilde{\tau}$ is either zero or one. We turn now to the the derivation of the supply curve, which augments the information regarding the default rate that has been derived in this section.

3.2 The Supply of Credit with Endogenous Penalties

Risk neutral lenders will require interest rate r^* such that:

$$(16) \qquad (1+r^*)(1- E(\tilde{\tau}|1+r^* ; \overline{B})) = 1+ r_f$$

where $E(\tilde{\tau}|1+r^* ; \overline{B})$ stands for the expected default intensity. Debt issuance occurs before the resolution of the uncertainty regarding Ψ. Thus, the lenders will set the interest rate according to (16), by applying the expected values of $\tilde{\tau}$ obtained from (13), yielding:

$$(17) \qquad E(\tilde{\tau}) = \int_{\varepsilon}^{Z} [\bar{B}(1 + r^*)/\{hN\}]^{1/(h-1)} g(\Psi)\, d\Psi + \int_{Z}^{\infty} g(\Psi)\, d\Psi$$

and the implied supply of credit is given by

$$(18) \qquad (1+r^*)[\int_{\varepsilon}^{Z} \{1 - [\bar{B}(1 + r^*)/\{hN\}]^{1/(h-1)}\} g(\Psi)\, d\Psi\ ] = 1+r_f$$

Appendix B evaluates the dependency of the supply schedule on the elasticity of the penalty with respect to the default intensity (h). It is shown that a rise in h shifts the supply curve leftwards, implying that a given volume of credit will require a higher interest rate. This result stems from the fact that for a given interest rate a higher convexity of the penalty scheme ($d\, h > 0$) implies a higher default rate, reducing thereby the expected yield on a given volume of indebtedness, and thus necessitating a rise in the interest rate.

To gain further insight, we now turn to a comparison between the welfare obtained subject to endogenous versus fixed penalties. This comparison will enable us to conclude with normative statements regarding the desirability of each scheme.

3.3 Endogenous Default Penalties and Welfare

Our discussion implies that allowance for endogenous default penalties is associated with a rise in the country risk, as is reflected by the rise in the interest rate associated with a given indebtedness. It is noteworthy that this observation alone does not suffice to determine the welfare effects of endogenous default penalties. That is because the adverse effects of the induced rise in the interest rate will be partly offset by the rise in the incidence of partial defaults that are associated with 'default income'.

We evaluate the welfare consequences of endogenous penalties by analyzing their expected utility. Formally, the expected utility associated with a given level of borrowing $\overline{B}$ is given by

$$(19)\quad V = u(\overline{X}_0 + \overline{B}) + \rho \int_{\varepsilon}^{Z} u(\overline{X}_1 - \overline{B}(1 + r^*) + \pi) g(\Psi)\, d\Psi + \rho \int_{Z}^{\infty} u(\overline{X}_1 - N_0/\Psi) g(\Psi)\, d\Psi$$

where π and Z are obtained from (12)-(14). Applying (19) we get that[9]

$$(20)\quad \frac{\partial V}{\partial h} = - \int_{\varepsilon}^{Z} u'(X_{1,n})\left(\overline{B}(1 - \tilde{\tau}) \frac{\partial (1 + r^*)}{\partial h}\right) g(\Psi)\, d\Psi \quad < 0$$

Consequently, a greater responsiveness of the penalty scheme to the default rate results in a drop in expected welfare. This is because the added degree of freedom introduced by a variable default cost has the consequence of raising the expected default for a given credit volume, necessitating a higher interest rate. The rise in the interest rate dominates any indirect gains associated with the greater flexibility of the default structure.

4. THE WELFARE EFFECTS OF CONTINGENT INTEREST RATES

It is useful to distinguish between contingencies tied the the borrowers' behavior and contingencies that tie prices to observed states of nature. As the previous section demonstrates, the first type of contingency may not enhance welfare. This, however, does not imply that contingent prices are not beneficial. In fact, welfare can be enhanced if the effective interest rate is made contingent upon the default penalty (Ψ). To gain further insight, we now turn to evaluate the role of contingent interest rates.

4.1 The Role of Contingencies

For example, consider the case of exogenous default penalties ($h = 1$). Suppose that the value of Ψ is public information in period one, and that we normalize N_0 such that the expected value of $1/\Psi$ is one. Let us define a contingent interest rate $r^*(\Psi)$ by

$$(21) \qquad 1 + r^* = (1 + r_f)/\Psi$$

Recalling that the default penalty is N_0/Ψ, it is evident that $1 + r^*$ is defined to be perfectly correlated with the default penalty. Applying the decision rule (3) it is evident that for $\bar{B} < N_0/(1 + r_f)$ the contingent interest rate (21) eliminates the consequences of country risk. To verify this point, note that for $\bar{B} < N_0/(1 + r_f)$ we observe that for all Ψ, $(1 + r^*)\bar{B} < N_0/\Psi$. With such a contingency pricing no default will occur. The proposed scheme is also feasible because the expected yield is equal to the risk-free interest rate ($E[(1+r_f)/\Psi] = 1+r_f$).[10] The expected welfare in such a system is given by

$$(22) \quad V = u(\overline{X}_0 + \overline{B}) + \rho \int_{\varepsilon}^{\infty} u(\overline{X}_1 - \overline{B}(1 + r^*))\, g(\Psi)\, d\Psi$$

To gain further insight into the welfare effect of this scheme consider the case where consumers are risk neutral, i.e. where the periodic utility u(X) is linear (u(X) = X). For such an economy a welfare ranking is a comparison of expected income. A comparison of (22) and (9') reveals that the gain in expected income associated with the contingent interest-rate scheme is equal to the expected penalty in the non-contingent, exogenous penalty system (given by $\int_{Z}^{\infty}[N_0/\Psi]g(\Psi)d\Psi$). The effect of making the interest rate perfectly correlated with the penalty is to eliminate the adverse effects of country risk on the expected income. With risk-averse agents the optimal contingency pricing is more complicated, because it involves also optimal reallocation of the income risk among the various parties in an attempt to reduce the volatility of income across states. But even in this case we will observe welfare gains generated by contingent interest rates. Furthermore, if the default cost is lower in bad states of nature, making the interest rate contingent upon variables correlated with the default penalty can work favorably to reduce the adverse income effects of country risk as well as to improve the allocation of income risk. Thus, the two objectives can be complementary. This point can be illustrated by a simple example.

4.2 Optimal contingencies in the presence of stochastic terms of trade

Consider an economy where the second period endowment ($\overline{X}_1$) is stochastic :

$$(23) \quad \overline{X}_1 = \overline{X}_0/\Psi$$

This will be the case, for example, if the country sell a natural resource whose supply at period one is $\bar{X}_0$ and where Ψ is the terms of trade (i.e. the relative price of consumption goods in terms of the natural resource). Suppose that the default penalty is proportional to income

$$(1') \quad N = a\bar{X}_0 / \Psi \quad ; \quad a < 1.$$

This specification captures the notion that bad states, where there is deterioration of the terms of trade, are associated with lower default penalty [11]. As before, we assume that by the appropriate normalization $E(1/\Psi) = 1$. We would like to compare two regimes. In the first the interest rate is non-contingent upon Ψ, as was the case in section 2. In the second the interest rate is made contingent upon the terms of trade, as defined in (21). This implies that in bad states (i.e. high Ψ) the country will face a lower interest rate. Note that whenever borrowing satisfies $\bar{B} < a\bar{X}_0/(1+r_f)$ no default will occur in the contingent regime. Figure 3 plots the dependency of the second period consumption on the realized values of the terms of trade. The solid line corresponds to the contingent regime, whereas the broken line corresponds to the non-contingent regime. Point Z corresponds to the level of Ψ associated with default in the first regime, whereas $\tilde{Z}$ is the value of Ψ where the consumption is equal across regimes. It can be shown that $\tilde{Z} < Z$ and that for $\Psi < Z$ the income profile is steeper in the non-contingent regime. Consequently, a contingency plan that indexes the interest rate to the terms of trade has the effect of reshuffling income from good to bad states.[12] In general, the optimal contract will provide the optimal income insurance subject to the compatibility constraint that default will occur if the penalty is lower than the debt. The above example implies that if the default penalty is lower in bad states, the objectives of minimizing country risk and stabilizing income across states tend to be complementary.

To exemplify this point it is useful to derive the optimal contingent scheme for a simple two states model. Suppose that the terms of trade $(1/\Psi)$ are either $1+q$

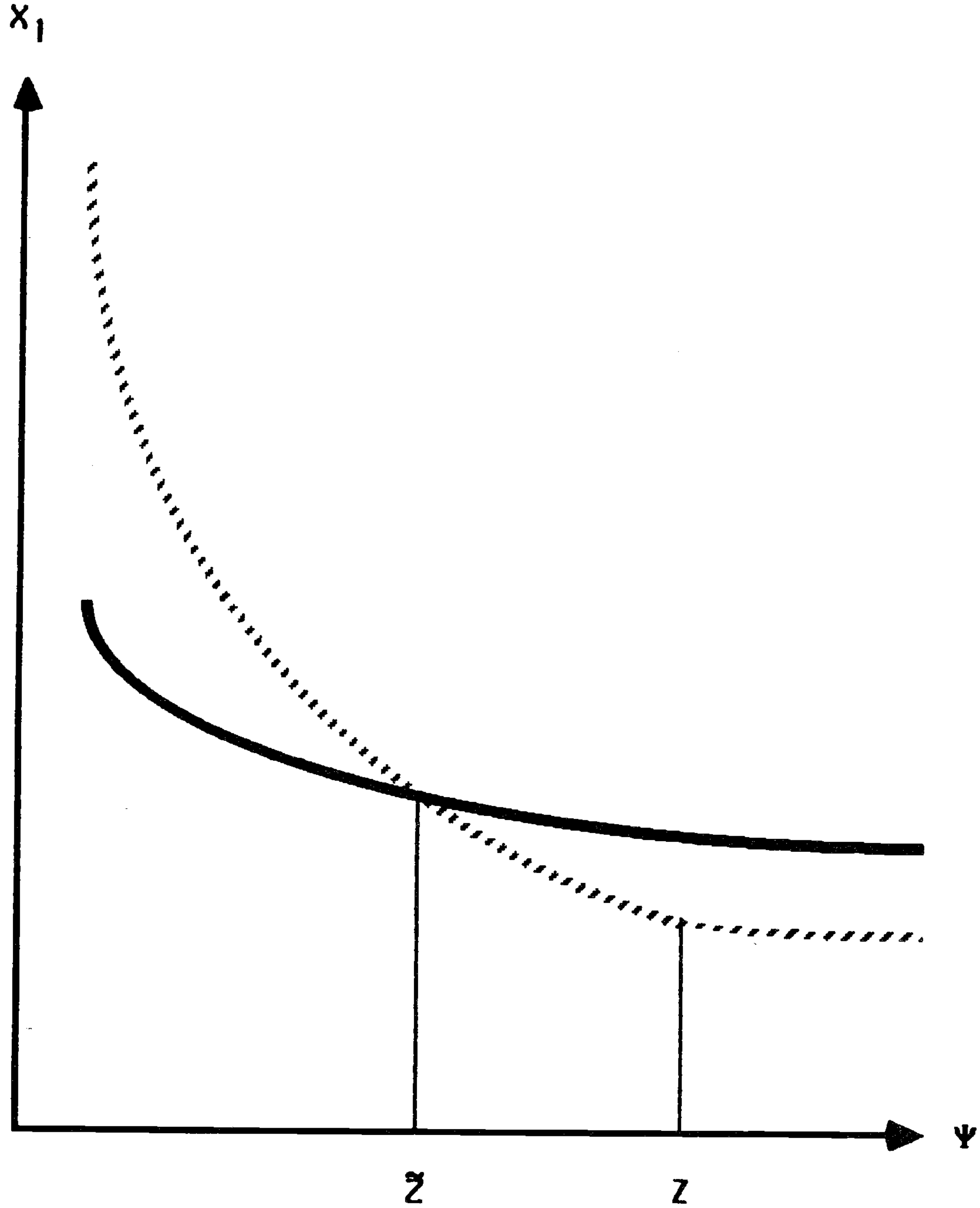

FIGURE THREE

or 1-q with probability .5, and the natural resource endowment $\bar{X}_0$ is normalized to one. We assume risk averse consumers, and we would like to compare the equilibrium with optimal contingencies and the equilibrium in the absence of a contingent interest rate. The non-contingent supply of credit is derived in the same way as in Sachs (1984), and is given by curve SS in Figure 4 (in drawing this curve we assume that $q > .33$ in order to allow borrowing with default in the bad state).

Whenever it is a feasible solution, a risk averse consumer will prefer a contingent pricing system that will equate his income across states. Let us denote by L_h and L_l the payment on indebtedness $\bar{B}$ in the good and the bad states, respectively. They are defined by the condition that the expected payment is $\bar{B}(1 + r_f)$ and by the requirement that net income is equated across states:

$$(24) \qquad .5\,(L_h + L_l) = \bar{B}(1 + r_f)$$

$$(25) \qquad 1 + q - L_h = 1 - q - L_l$$

Thus, $L_l = \bar{B}(1 + r_f) - q$ and $L_h = \bar{B}(1 + r_f) + q$. This scheme will work whenever the penalty exceeds the payment, i.e. $\bar{B}(1 + r_f) - q < a(1 - q)$ and $\bar{B}(1 + r_f) + q < a(1 + q)$. These consistency requirements imply that the above scheme is feasible only for $\bar{B} < [a - q(1 - a)]/(1 + r_f)$. For credit above this level we would not observe equality of income across states. In good states the payment L_h will be marginally below the default penalty, $L_h = a(1 + q)$. In bad states the debt payment will be such that the expected payment requirement (24) is met, implying that $L_l = 2\,\bar{B}(1 + r_f) - a(1 + q)$ for $\bar{B} < a/(1 + r_f)$. The last condition is obtained from the consistency requirement (i.e. that payments cannot exceed the penalty; $L_l < a(1-q)$). Once indebtedness reaches the expected penalty $a/(1 + r_f)$, we reach the credit ceiling. Figure 4 summarizes this information by plotting the effective interest rate paid in the good and bad states as a function of indebtedness, where the effective interest is defined by $L_l/\overline{B}$ and $L_h/\overline{B}$ in the bad and in the good states, respectively. Curve HH corresponds to the interest rate in good states, whereas curve LL corresponds to the interest rate in bad states. Comparison with the non-contingent supply of credit reveals that in the contingent scheme we pay more in good states (relative to the non-contingent scheme). At the same time whenever we do not reach the credit ceiling in the non-contingent scheme, the contingent scheme allows net transfer of income from good to bad states. This is reflected in the fact that LL is in the negative region for $\overline{B}$ below the non-contingent scheme credit ceiling. Note that for intermediate volumes of credit in the non-contingent regime (i.e. for credit below the ceiling satisfying $\overline{B} > a(1-q)/(1+r_f)$) the borrowers 'pay' the penalty in bad states, while they receive net income in the contingent scheme. An important advantage of the contingent scheme is in allowing the credit ceiling to rise from $a(1+q)/[2(1+r_f)]$ to the net present value of the penalty $(a/(1+r_f))$. For credit volume above the non-contingent ceiling this is accomplished by keeping payment in the good state marginally below the penalty, and shifting part of the burden to the bad state while still keeping it below the penalty. Consequently, the net consumption in bad states is uniformly higher in the contingent regime (relative to the non-contingent regime); and allowing for optimal contingencies has three beneficial effects (relative to the non-contingent case): raising the credit ceiling, raising the expected income, and stabilizing income across states.

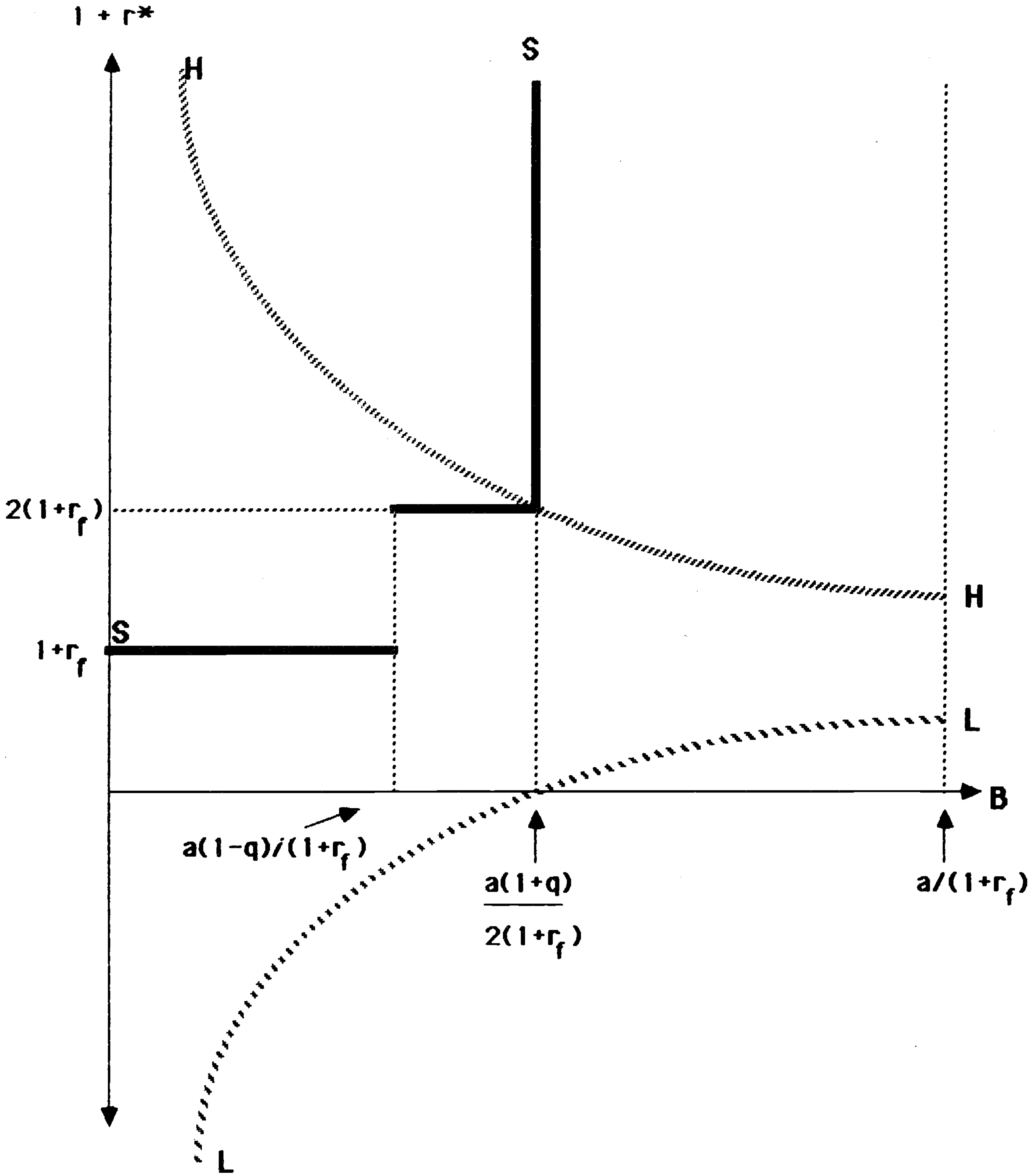

FIGURE FOUR

5. CONCLUDING REMARKS

Our discussion has focussed on the analysis of the potential welfare effects of contingency plans in the presence of country risk. The analysis shows that allowing for optimal contingencies has three effects (relative to the non-contingent case): raising the credit ceiling, raising the expected income, and stabilizing income across states. In our example optimal contingencies eliminate default (for credit volume below the ceiling). Thus, with optimal contingencies there is no need for credit market policies (like borrowing and investment taxes/subsidies). This result corresponds to the principle that there is a trade-off between the usefulness of policies and the optimal use of contingencies. Whenever incidences of default are not eliminated there may be an important role for credit market policies, and greater reliance on contingencies will tend to reduce the importance of these policies.

An example of the use of contingencies is the recent Mexican rescheduling plan (Summer 1986), where several aspects of debt servicing were made contingent upon the future price of oil. This arrangement may enhance welfare if the default cost is low in bad states of nature, when the price of exportables is low. For such an economy a contingency plan that will index the effective interest rate to the realization of the price of exportables will reduce the incidence of default and will raise the credit ceiling.

APPENDIX A

The purpose of this Appendix is to derive the condition for the optimal borrowing tax that will maximize global welfare (equation (10")). To accomplish it we should enrich the model so as to describe the lending nations. We consider the case where lenders are risk neutral, having a risk free investment technology that yields $1+r_f$ on past investment I. Let the endowment of the lenders in periods zero and one be given by $\overline{Y}_0$ and $\overline{Y}_1$, respectively. We assume that inflicting a penalty upon the borrowing nation is costly, and that enforcing a penalty N will require lenders to spend resources kN, where k is a proportionality factor. For simplicity of exposition we will assume that k is a constant. The assumption that lenders are risk neutral allows us the use of expected income as a measure of lenders' welfare:

$$\text{(A1)} \quad \overline{Y}_0 - I - \overline{B} + [\, \overline{Y}_1 + (I + \overline{B})(1 + r_f) - \int_Z^\infty k\, N\, g(\Psi)\, d\Psi \,] / (1 + r_f)$$

where I represents domestic investment and where we adjust welfare by the expected default enforcement cost. In formulating the problem we assume that the default enforcement costs are borne collectively by the lending nations, and not by the direct lenders. We proceed by deriving the borrowing tax that will maximize global welfare. We do so by maximizing the welfare of the borrowing nation subject to a compensation scheme that transfers income to lenders in such a way as to keep their welfare at a given level that is independent of the borrowers' policies. A way of designing such a scheme is to impose a lump sum transfer from borrowers to lenders in period zero equal to the net present value of enforcement costs, given by $\int_Z^\infty k\, N\, g(\Psi)\, d\Psi \,] / (1 + r_f)$. Optimal borrowing is obtained by maximizing

$$\text{(A2)} \quad V = u(\overline{X}_0 + \overline{B} - \int_Z^{\infty} k\, N\, g(\Psi)\, d\Psi\,] /(1 + r_f)) +$$

$$\rho \int_{\varepsilon}^{Z} u(\overline{X}_1 - \overline{B}(1 + r^*))g(\Psi)\, d\Psi + \rho \int_{Z}^{\infty} u(\overline{X}_1 - N_0/\Psi)g(\Psi)\, d\Psi$$

Applying (A2) we get that optimal borrowing satisfies the following first order condition

$$\text{(A3)} \qquad V'(X_0)/V'(X_{1,n}) = (1 + r^*)\left(1 + \frac{d\, \log(1 + r^*)}{d\, \log\overline{B}}\right) / (1 - k\lambda)$$

$$\text{where } \lambda = N_0\, g(Z)\left(1 + \frac{d\, \log(1 + r^*)}{d\, \log\overline{B}}\right) / [\overline{B}(1 + r_f)]$$

Equation (A3) corresponds to (10').

APPENDIX B

The purpose of this Appendix is to prove that for an internal solution for $\tilde{\tau}$ a rise in h (the elasticity of the penalty with respect to the default intensity) will increase the optimal default rate and will shift the supply of credit leftward.

Direct derivation of (13) reveals that for $0 < \tilde{\tau} < 1$

$$\text{(B1)} \quad \frac{\partial \tilde{\tau}}{\partial h} = -[h \log[\bar{B}(1 + r^*)/\{hN\}] + h - 1]\frac{1}{(h-1)^2}$$

thus, the sign of (A1) is determined by sign$\{-[h \log[\bar{B}(1 + r^*)/\{hN\}] + h - 1]\}$. Note that because $0 < \tilde{\tau} < 1$ equation (13) implies that $\log[\bar{B}(1 + r^*)/\{hN\}] < 0$. Consequently, for $h = 1$ sign$\{-[h \log[\bar{B}(1 + r^*)/\{hN\}] + h - 1]\}$ is positive. We can prove that (B1) is positive if we can demonstrate that the expression determining the sign of (B1) rises with h (because $h \geq 1$). This proof follows from the fact that

$$\text{(B2)} \quad \partial - [h \log[\bar{B}(1 + r^*)/\{hN\}] + h - 1]/\partial h = -\log[\bar{B}(1 + r^*)/\{hN\}] > 0.$$

We turn now to the derivation of the effect on the supply curve of a rise in h. We do so by evaluating the horizontal displacement of the supply schedule induced by a rise in h. From (18) we get that for a given $(1+r^*)$

$$\text{(B3)} \quad \Delta\bar{B}\,\frac{\partial[(1+r^*)(1-E(\tilde{\tau}|1+r^*;\bar{B}))]}{\partial \bar{B}} = \Delta h\,(1+r^*)\int_{\varepsilon}^{Z}\frac{\partial \tilde{\tau}}{\partial h}\,g(\Psi)\,d\Psi$$

The term multiplying $\Delta\bar{B}$ corresponds to the change in expected yield induced by a rise in indebtedness. Direct inspection of (18) reveals that this change is negative, due to the induced rise in the expected default rate. The term multiplying Δh is positive, because we showed that $\partial \tilde{\tau}/\partial h > 0$. Combining that information implies that holding $(1 + r^*)$ given

(B4) $\qquad \partial \bar{B} / \partial h < 0.$

Therefore, we conclude that a rise in h shifts the supply schedule leftward.

FOOTNOTES

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1. For a useful study on the debt problem see the World Bank Report (1986). For studies on country risk, see Harberger (1976, 1980); Eaton and Gersovitz (1981); Sachs (1984); Kletzer (1984); Edwards (1984, 1985); Dornbusch (1985); Eaton (1985); Krugman (1985); Aizenman (1986) and Bulow and Rogoff (1986).

2. A recent example is the July 22 ,1986 agreement between Mexico and the IMF, where several aspects of debt servicing were made contingent upon the future price of oil.

3. For related studies regarding the determination of the supply of credit with exogenous default penalties see Sachs (1984) and Krugman (1985), for a study on endogenous rescheduling see Gennotte, Kharas and Sadeq (1985).

4. Equilibrium in a market with partial information regarding the volume of indebtedness is the topic of Kletzer (1984).

5. It can be shown that $d \log \bar{B}/d \log (1+r^*) = (1-\eta)/\eta$; where η is the elasticity of P with respect to gross indebtedness $[\eta = -d \log P/ d \log \bar{B}(1+r^*)]$. Consequently, the supply curve is backward bending if $\eta > 1$ (for more details see Aizenman (1986)).

6. In deriving this result we use the fact that $V_Z = 0$.

7. The percentage optimal borrowing tax can be shown to equal $(1 + r^*)/\{r^* d \log \bar{B}/d \log (1+r^*)\}$.

8. It is noteworthy that as the borrowing nation approaches the inelastic segment of the supply of credit (where $d B/ d (1+r^*) \rightarrow 0$), optimality calls for the imposition of a dual exchange rate system. This system is equivalent to the imposition of a quota on borrowing (equal to the borrowing ceiling) and a tax on borrowing equal to the spread between the domestic interest rate and the supply price

of the credit ceiling. These are the optimal policies if the equilibrium occurs at the credit ceiling level (for further details see Aizenman (1986)).

9. In deriving (20) we are using the fact that $V_Z = 0$ and around the equilibrium $\partial \pi / \partial (1 + r^*) = \tilde{\tau} B$ and $\partial \pi / \partial \tau = 0$.

10. It is noteworthy that the credit ceiling with the contingent interest rate exceeds the non-contingent ceiling. To verify this point, note that in the non-contingent regime for any $\bar{B}$ the following inequalities hold:

$$\bar{B}(1+r_f) = \int_{\varepsilon}^{Z} \bar{B}(1+r^*)\, g(\Psi)\, d\Psi < \int_{\varepsilon}^{Z} (N_0/\Psi)\, g(\Psi)\, d\Psi < \int_{\varepsilon}^{\infty} (N_0/\Psi)\, g(\Psi)\, d\Psi = N_0$$

implying that the credit ceiling in a non-contingent regime is below $N_0/(1+r_f)$.

11. Several factors can account for low default costs in bad states of nature. First, the cost of a trade embargo can be lower because of the drop in the value of exports. Second, bad states may be associated with higher myopia in the policy maker, whose survival may be at risk.

12. Note that in the contingent regime the debt service drops in bad states to avoid default, implying higher consumption (relative to the non-contingent regime).

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