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ABSTRACT

The purpose of this paper is to model the role of trade dependency in determining the access of a developing economy to the international credit market, and its desirable growth strategy. With full integration of capital markets the choice with respect to the inwardness of a technology is irrelevant: investment will be channeled to the more productive sectors, independently of their trade inwardness. With limited capital market integration, a given investment will generate two effects. The first is the standard, direct productivity effect that is associated with the change in future output. The second is the trade dependency externality, generated by the change in future bargaining outcomes due to the change in the trade dependency of the nation. With partial integration, investment that increases trade dependency is desirable. If the credit markets are disjoint due to partial defaults, higher trade dependency is disadvantageous. Thus, higher trade dependency generates a positive externality with partial integration of capital markets, and a negative externality with disjoint credit markets. We show that credit market integration is determined by the size of the indebtedness relative to the trade dependency, as reflected by the repayment burden that is supported by the bargaining outcome. The repayment bargaining outcome is determined by the sectoral composition of the economy and by the effective size of the developing and the developed economies.

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The development literature of the early sixties evolved around the two-gap models. The two-gap approach emphasized the availability of foreign exchange and external credit as relevant factors in restricting the long run growth prospects of developed nations. These considerations are relevant in determining the attractiveness of inward versus outward growth strategies, or alternatively, regarding the merits of exports promotion versus imports substituting growth strategies.[1] The expansionary experience of the late sixties and early seventies, coupled with the access of some developing countries to the credit market in the seventies, reduced the interest in these models. In the early eighties we have experienced the collapse of the credit market facing most developing nations, and the partial default of several major borrowers. These events have renewed the interest in the role of credit constraints in determining investment and growth prospects of the developing nations.

A limitation of the early discussion is the exogenous nature of the credit constraint facing developing nations. It overlooked the links between the sectoral composition of domestic supply and access to the international credit market. The purpose of this paper is to model this gap, focusing on the role of the trade dependency (or openness) of the economy in determining access to the international credit market and the desirable growth strategy. While the trade dependency of a nation is exogenously given in the short run, it is endogenously determined in the long run by the sectoral composition of investment. The purpose of this paper is to model the linkage between the investment policies of a country, the availability of external credit, and growth.

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1. For the two-gap approach see Chenery and Bruno (1962); for a critical exposition see Findlay (1973).

We consider a two-period, two blocs of nations, asymmetric world. One bloc of nations (developing) is characterized by the relative scarcity of capital and savings, and by a greater trade dependency relative to the second bloc of nations (developed). Consequently, with free mobility of capital and a competitive equilibrium, the developing nations will borrow in the first period, to finance investment. We use the competitive equilibrium as a benchmark case for an analysis of the more general equilibrium, where the mobility of capital is endogenously determined due to the presence of country risk.[2] This risk is reflected in the presumption that the effective collateral guaranteeing future repayment of external debt is the trade dependency of a nation. We assume that a partial default will trigger bargaining over the effective repayment schedule. The threat associated with such bargaining is that in the absence of agreement autarky will prevail. Thus, the bargaining is determined by the trade dependency, as measured by the magnitude of the gains from trade. We apply the fixed threat Nash bargaining framework to derive the bargaining outcome, and we study the nature of the resultant intertemporal rational expectations equilibrium.

If we start with low initial debt, our developed economy is characterized by resource transfers to the developing nations in the first period, and by resource transfers from them in the second period. This is a mutually beneficial trade. The aggregate gains from trade have two dimensions. The first is the temporal gain from trade, generated by the access of the developing nations to foreign inputs. The second is the intertemporal gain from trade, generated by the access of the developing nations to

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2. For an analysis of country risk see Harberger (1976), Kharas (1981), Eaton and Gersovitz (1981), Sachs (1984), Kletzer (1984), Dornbusch (1984), Krugman (1985), Smith and Cuddington (1985), Edwards (1985), Folkerst-Landau (1985), Diwan and Donnenfeld (1986), Dooley (1986), Aizenman (1986), Bulow and Rogoff (1987), Helpman (1987), Cole and English (1987), Krugman (1987), Alesina and Tabellini (1987), Aizenman and Borensztein (1988), Froot (1988), Calvo (1988) and Claessens and Diwan (1988).

the savings of the developed nations. These savings are financing part of the first period investment in the developing nations. The distribution of the gains from trade is dictated by the price mechanism in the competitive equilibrium, and by the relative bargaining power in the bargaining regime.

The analysis demonstrates that the choice of inward versus outward growth strategies is determined by the degree of access to the international credit market. We define three degrees of credit market integration: full integration, partial integration, and disjoint credit markets due to partial defaults. Full integration of credit markets occurs when agents anticipate that the borrower will pay in full, and that no borrowers will default. Partial integration of credit markets occurs when the borrower is not in partial default in the present, but agents anticipate that he will partially default in the future. Disjoint credit markets occur when the borrower is already in partial default, and agents anticipate him to remain so in the foreseeable future.

To facilitate the discussion we contrast three types of regimes, corresponding to the above described three types of credit markets. The first is the standard competitive world, with full integration of the international credit market. The second one is a world where the initial indebtedness is small enough in the first period, but large enough in the second. Consequently, in the second period the economy is operating in the bargaining regime, and rational agents allocate credit in the first period, while discounting the results of the second period bargaining outcome. The third regime describes an economy that starts with a substantial initial debt, such that bargaining determines the repayment in all periods. We show that the credit market integration is determined by the size of the indebtedness relative to the trade dependency, as reflected by the repayment burden that is supported by the bargaining outcome. The bargaining outcome is determined by the sectoral composition of the economy and by the effective size of the two economies. Greater relative size of the more trade dependent sector, and higher growth rates increase the repayment supported by the bargaining outcome.

We refer to the choice of inward (outward) growth strategy as a choice to invest in the sector that reduces (increases) the trade dependency of a nation. We show that the choice of the growth strategy is determined by the nature of the credit market regime in which the economy operates. With full integration of capital markets, the choice as to the inwardness of a technology is irrelevant: investment will be channeled to the more productive sectors independently of their trade inwardness. With limited capital market integration, the choice among the various sectors is more involved. A given investment will generate two effects: The first is the standard, direct productivity effect associated with the change in future output. The second is the trade dependency externality generated by the change in future bargaining outcome due to the change in the trade dependency of the nation. We refer to this effect as an externality, because the economic agent ignores it in a competitive equilibrium. Thus, optimality calls for a set of optimal taxes that will internalize these effects into the price system.

The desirability of a higher trade dependency is determined by the integration of capital markets. With partial integration, investment that increases trade dependency is desirable: it increases the credit available to the economy because it increases the future repayment supported by the bargaining outcome. If the credit markets are disjoint due to partial defaults, higher trade dependency is disadvantageous: it increases the repayment on past debt without the beneficial effect of higher contemporaneous credit. Thus, higher trade dependency generates a positive externality with partial integration of capital markets, and a negative externality with disjoint credit markets.

In Section 1 we review the building blocks of the model by characterizing preferences, production level and the intertemporal budget constraints. We characterize the equilibrium in several steps: In Section 2 we study the Pareto allocations that yield an exogenously given real transfer target; we review the equilibrium with the help of an Edgeworth box. In Section 3 we analyze the competitive global equilibrium in the absence of defaults. Next, in Section 4, we characterize the equilibrium in the presence of endogenous partial defaults, when repayment is determined by bargaining. In Section

5 we integrate the various steps to characterize the equilibrium with limited capital market integration, and contrast it to the competitive regime. Section 6 closes the paper with concluding remarks.

1. THE MODEL

We describe the model by reviewing the preferences, the production and the budget constraints[3].

1.1 PREFERENCES AND PRODUCTION

The preferences are given by:

$$(1) \quad U = C_1 + \rho C_2 \;; \quad U^* = C_1^* + \rho^* C_2^*$$

where $C_t (C_t^*)$ is the consumption at time t of the developed (developing) nations.

The final good is produced using two traded inputs (the domestic and the foreign input) and capital. The final good can be either consumed or invested domestically in period one to increase future productive capacity. Productive capital is location and sector specific. International trade occurs only at the input level, and the final good is non-traded. A production process ε of the final good is defined by the following C.E.S. function:

$$(2) \quad Z_\varepsilon(X,Y;K) = h_\varepsilon[(X)^\varepsilon + (Y)^\varepsilon]^{\beta/\varepsilon} (K_\varepsilon)^{1-\beta} \;; \quad 0 < \beta < 1 \text{ and } \varepsilon \le 1$$

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3. The model applied throughout the paper extends Aizenman (1988), which focused on the role of conditionality in an environment where we start with partial default due to a large debt overhang. The present paper allows for various levels of initial indebtedness, focusing on the dependency of the desirable investment in trade dependency and growth strategy on the initial indebtedness and on anticipations regarding future growth.

where Z_ε is the final good, X and Y are the developed and developing countries' intermediate products, and K_ε is the capital stock. Note that the elasticity of substitution between the intermediate products is given by $1/(1-\varepsilon)$. The term h_ε is a technological coefficient.

We assume that the developing countries are more trade dependent than the developed nations, and that they face a choice regarding their trade dependency. Henceforth we will refer to the sector producing Z_ε as sector ε. One way of characterizing this situation is by assuming that the developing countries have access to two technologies with different ε, denoted by $\varepsilon = \gamma$, δ; where $\gamma < \delta < 1$ [4]. The discussion is greatly simplified by assuming that the developed nations have access to a production technology that allows perfect substitutability between the various intermediate products, with $\varepsilon = 1$. We normalize productivity such that the productivity coefficient for the developing country is unity (hence $h_{\varepsilon=1} = 1$). To focus on the role of substitution flexibility in determining the trade dependency, we assume that all technologies share the same capital intensity (thus all have the same β).

1.2 THE BUDGET CONSTRAINTS

We assume a given endowment of traded inputs, and units are normalized such that the supply of intermediate products is equal to one in both blocks of nations in the first period. Thus,

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4. The supply side is using a framework related to Ethier (1982). In Ethier's model the gains from trade stem from "international" returns to scale. These scale economics are the result of an increase division of labor (and other inputs) due to the rise in the market size.

$\overline{X}_1 = 1, \quad \overline{X}_2 = 1 + \eta \qquad$ and $\qquad \overline{Y}_1 = 1, \quad \overline{Y}_2 = 1 + \eta^*$

where $\overline{X}_t$ and $\overline{Y}_t$ denote the supply at time t; η and η^* measure the growth of the traded inputs between periods. The use of X and Y by the developing (developed) countries at time t is denoted by X_t^* (X_t) and Y_t^* (Y_t), and the investment level in the developing and the developed countries is denoted by I_1^* and I_1, respectively. The use of the two intermediate products by industry ε in the developing countries ($\varepsilon = \delta$ or γ) is denoted by $X_{\varepsilon,t}$ and $Y_{\varepsilon,t}$. The periodic budget constraints are given by:

$$C_t^* + I_t^* = Z_t^* \quad ; \qquad C_t + I_t = Z_t \tag{3}$$

$$X_t^* = X_{\gamma,t} + X_{\delta,t}\,; \qquad Y_t^* = Y_{\gamma,t} + Y_{\delta,t}\,;$$

$$X_t^* + X_t = \overline{X}_t\,; \qquad Y_t^* + Y_t = \overline{Y}_t\,; \tag{4}$$

$$\overline{X}_1 = 1, \quad \overline{X}_2 = 1 + \eta; \qquad \overline{Y}_1 = 1, \quad \overline{Y}_2 = 1 + \eta^*$$

where

$$Z_t^* = h_\gamma[(X_{\gamma,t})^\gamma + (Y_{\gamma,t})^\gamma]^{\beta/\gamma} (K_{\gamma,t})^{1-\beta} + h_\delta[(X_{\delta,t})^\delta + (Y_{\delta,t})^\delta]^{\beta/\delta} (K_{\delta,t})^{1-\beta} \tag{5}$$

$$Z_t = [\overline{X}_t - X_t^* + \overline{Y}_t - Y_t^*]^\beta (K_t)^{1-\beta}\,. \tag{6}$$

We now turn to the characterization of the global equilibrium.

2. THE EQUILIBRIUM

Borrowing and investment occur in period one, and repayment is due in period two. The implicit agreement is that a default in the second period will initiate a bargaining process that will dictate the effective repayment. The bargaining outcome is derived by the Nash fixed threat bargaining framework.[5] In the absence of default we will observe a competitive equilibrium. Let us denote by R_d the repayment due in the second period, by R_b the repayment supported by the bargaining outcome, and by R the actual repayment. We assume that the default rule is that if the repayment due exceeds the bargaining outcome, partial default will occur, and only the bargaining outcome will be repaid. Consequently:

$$R = \mathrm{Min}\ \{R_d, R_b\}. \tag{7}$$

2.1 THE PARETO ALLOCATIONS

Since both the competitive and the Nash bargaining outcome result in an allocation that is Pareto efficient, we will gain further insight by focusing on the nature of the efficient allocations.[6] Note that the two inputs are perfect substitutes in the production process of the developed nations. Consequently, in a Pareto allocation the marginal product of both X and Y should be equal for all activities. This implies that Pareto

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5. See Nash (1950) and Roth (1979). The solution of this bargaining problem is obtained by the allocation that maximizes the products of the trade gains for each party (relative to the fixed threat allocation). A useful characteristic of the solution is that it is a Pareto efficient allocation [see Roth (1979)].

6. This efficiency refer only to the temporal allocations. In both the competitive and Nash bargaining equilibria, the welfare in one nation can not be raised without reducing the welfare in the second nation with exogenously given stocks of capital.

efficiency is characterized by an allocation where equal quantities of both intermediate goods are used in the production processes employed by the developing country (i.e., $X_{\gamma,t} = Y_{\gamma,t}$; $X_{\delta,t} = Y_{\delta,t}$).

For a given X, the Appendix shows that the efficient allocation is given by:

(8) $$X_\gamma = (\bar{X} - X)\, s_\gamma; \quad X_\delta = (\bar{X} - X)(1 - s_\gamma)$$

where $$s_\gamma = \frac{\tilde{h}_\gamma K_\gamma 2^{\bar{\beta}/\gamma}}{\tilde{h}_\gamma K_\gamma 2^{\bar{\beta}/\gamma} + \tilde{h}_\delta K_\delta 2^{\bar{\beta}/\delta}}$$

for $\bar{\beta} = \beta/(1 - \beta)$, $\quad \tilde{h}_\varepsilon = (h_\varepsilon)^{1/(1-\beta)}$ (for $\varepsilon = \gamma,\delta$); and

(9) $$X_\gamma = Y_\gamma \;;\; X_\delta = Y_\delta \;;\; X^* = Y^* = X_\delta + X_\gamma = Y_\delta + Y_\gamma \;;$$
$$Y = \bar{Y} - Y^* .$$

Note, too, that (9) implies that the division of intermediate inputs between sectors δ and γ is determined by the relative share of the "effective capital" (s_ε), obtained by weighting the capital stock by $\tilde{h}_\gamma 2^{\bar{\beta}/\varepsilon}$ (for $\varepsilon = \delta,\gamma$). The properties of the Pareto allocation imply that for a given X we can completely characterize the solution by equation (8) and (9).

Since X and Y are perfect substitutes in the production process of the developed nations, a free trade, competitive equilibrium is characterized by a unitary terms of trade. In the absence of default, the exports of the developing nations finance the imports and the transfer R to the developed nations:

(10) $\overline{Y} - Y^* = \overline{X} - X + R.$

Negative values of R correspond to resource transfers from the developed to the developing nations, as may occur in the first period. Applying the property of the Pareto allocation, where $Y^* = \overline{X} - X$, we derive that

(10') $R = 2X + \overline{Y} - 2\overline{X}$.

A default will move us to the bargaining regime, yielding an allocation that is characterized by a level of X, denoted by X_b. The equal proportions of X and Y in all the activities imply that X_b fully characterizes the system and the developing nations use $[X_b^*, Y_b^*] = [\overline{X} - X_b, \overline{X} - X_b]$. The bargaining allocation is obtained by the exchange of $\overline{X} - X_b$ units of the developed countries' intermediate product for $\overline{Y} - (\overline{X} - X_b)$ units of ths developing countries' intermediate product. Thus, the bargaining allocation is equivalent to a competitive allocation in which the resource transfer is given by $R_b = 2X_b + \overline{Y} - 2\overline{X}$. The term R_b defines the effective ceiling on repayment: if the repayment due exceeds R_b, the developing nations will prefer to partially default, and will transfer only R_b. Consequently, one can view X_b as the key variable in determining the smooth functioning of the international credit market. A larger X_b is associated with a world system that allows greater capital flows from developing to developed countries.

We can summarize this insight with the help of an Edgeworth Box diagram (see Figure 1), whose dimensions are given by the global endowment of X and Y, where 0 and 0* denote the origin of the developed and the developing countries, respectively. The

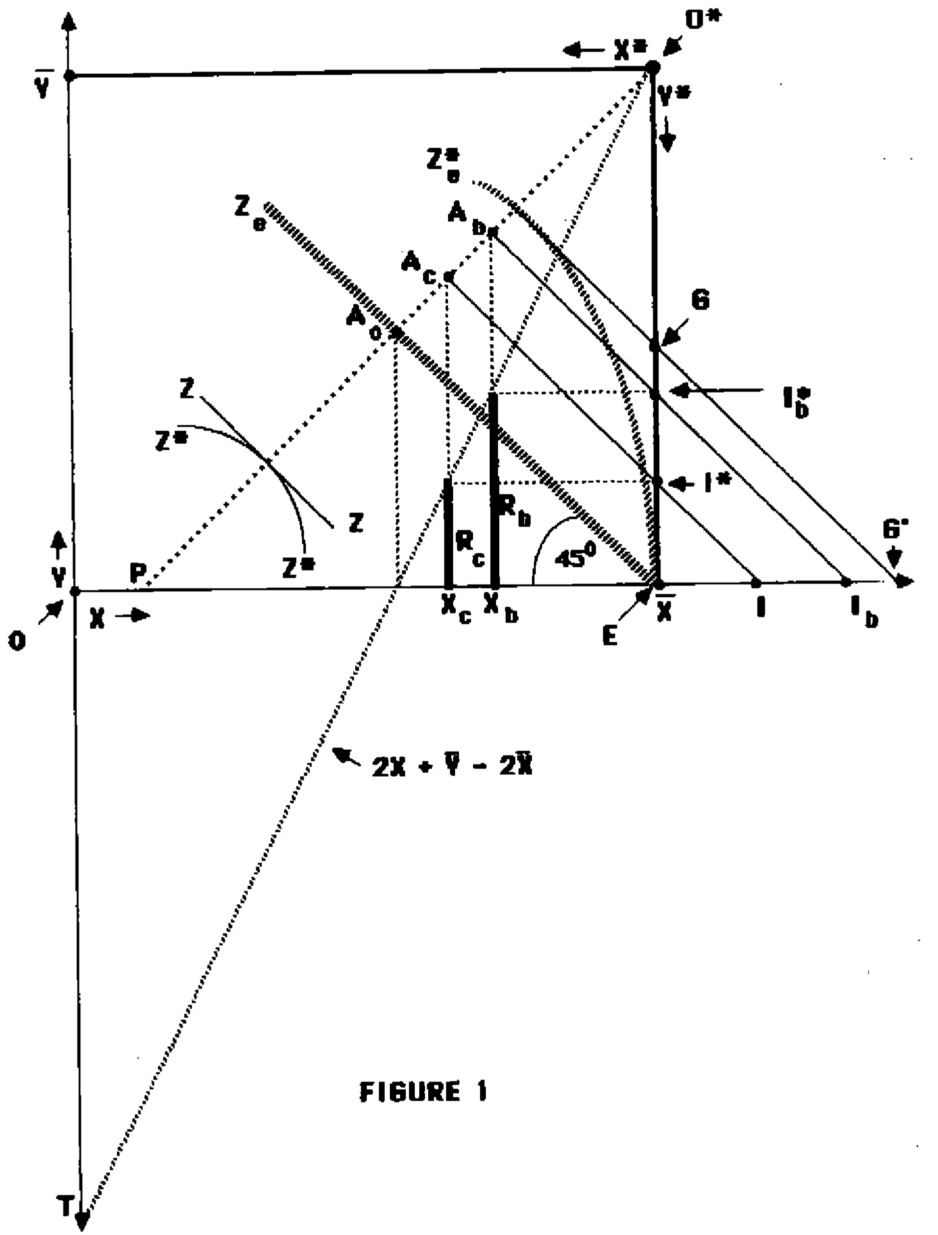

FIGURE 1

Pareto allocations are given by PO^*. [7] The line TO^* corresponds to the repayment schedule, defined by (10'). The autarky allocation is given by the endowment point E. A competitive allocation A_c corresponds to a repayment of R_c (measured by the vertical bold line). It is associated with an income level (in terms of the traded inputs) of OI for the developed nations and O^*I^* for the developing nations. Total gains from trade are measured by GE (or G'E). The allocation A_c is associated with a division of the gains from trade of GI^* and I^*E between the developing and the developed countries, respectively.

Suppose that the bargaining allocation is given by the point A_b, corresponding to $X = X_b$. The resource transfer ceiling is R_b, and the feasible range of competitive free trade equilibria with full integration of capital markets is given by those X_c to the left of X_b, in which the repayment due is R_c, with $R_c < R_b$. The bargaining defines the lowest income achievable for the developing nations, given by I_b^*. The precise location of the free trade equilibrium is characterized by the desirable level of resource transfer. In the absence of resource transfer, the equilibrium will occur at the point A_0, where $X = Y = \bar{X} - \bar{Y}/2$. A resource transfer to the developing nations will imply an equilibrium to the left of A_0. The bargaining allocation is determined, among other factors, by the curvature of the Z^*Z^* schedule. This curvature is affected by the sectoral composition in the developing nations. As we will show, higher relative weight given to the trade dependent sector (Y) result in stronger curvature, greater trade dependency and a shift of point X_b to the right. The following analysis will identify the factors determining the optimal investment strategy, which, in turn, will determine the curvature of the Z^*Z^* schedule.

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7. Curves ZZ (Z^*Z^*) describe allocations that yield a constant output in the developed (developing) countries, respectively. Curves $Z_e E$ ($Z_e^* E$) describe allocations that yield the autarky output in the developed (developing) countries, respectively.

3. FULL CREDIT MARKETS INTEGRATION: THE COMPETITIVE EQUILIBRIUM

Suppose that initial debt is small enough such that agents anticipate full repayment. We can apply the characteristics of the periodic Pareto allocations to derive the perfect foresight competitive equilibrium in the absence of default. Let us denote by r the interest rate in terms of the traded inputs, and by $\overline{B}$ the indebtedness position of the developing countries. Note that in a competitive equilibrium the relative price of X and Y is unity, because the two inputs are perfect substitutes in the production process employed by the developed countries. Applying this property we get from (5) and (8) that

$$(11)\quad Z_t(Y_t + X_t) = (Y_t + X_t)^{\beta} K_t^{1-\beta} \quad ; \quad Z_t^{*}[X_t^{*}] = (X_t^{*})^{\beta} (\tau_t)^{1-\beta}$$

where $\tau = K_{\gamma}\tilde{h}_{\gamma} 2^{\overline{\beta}/\gamma} + K_{\delta}\tilde{h}_{\delta} 2^{\overline{\beta}/\delta}$.

We can view τ as a measure of aggregate capital stock, where the physical capital (K_{γ} , K_{δ}) is weighted by the productivity coefficients ($\tilde{h}_{\gamma} 2^{\overline{\beta}/\gamma}$, $\tilde{h}_{\delta} 2^{\overline{\beta}/\delta}$). Henceforth we will

refer to these coefficients as the marginal contribution of investment to the aggregate capital stock. Equation (11) was derived for the case of international trade that allows the attainment of the Pareto allocations. In autarky we get that[8]

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8. Applying equation (8) to (5) yields the result reported in (11)-(12) regarding $Z^{*}(\overline{X} - X)$. The autarky output for the case where $\gamma < 0 < \delta \leq 1$, is obtained by noting that for the γ process both inputs must be used in order to produce anything. Thus, in autarky only the δ process is employed, yielding the $Z^{*}(0)$ in (12). If the elasticity of substitution exceeds unity in both activities (i.e. if $0 < \gamma < \delta \leq 1$) then the autarky

$$Z_t(\bar{X}_t) = (\bar{X}_t)^\beta K_t^{1-\beta};$$

(12) $$Z_t^*(0) = h_\delta(\bar{Y}_t^*)^\beta K_\delta^{\ 1-\beta} \quad \text{for } \gamma < 0 < \delta \le 1 \text{ and}$$

$$Z_t^*(0) = (\bar{Y}_t^*)^\beta(\tilde{h}_\gamma K_\gamma + \tilde{h}_\delta K_\delta)^{1-\beta} \qquad \text{for } 0 < \gamma, \delta \le 1.$$

For exposition simplicity we assume that the initial debt is zero. The trade accounts are described by:

(13) $\bar{Y}_1 - Y_1^* + \bar{B} = X_1^*$

(14) $\bar{Y}_2 - Y_2^* = X_2^* + \bar{B}(1 + r).$

Applying (4) and (9) we infer that

(15) $(1 + \bar{B})/2 = X_1^* = Y_1^*$; $(1 + \eta^* - \bar{B}(1 + r))/2 = X_2^* = Y_2^*$

(16) $Y_1 = X_1 = 1 - \bar{B}/2$; $Y_2 = (1 + \eta^* + \bar{B}(1 + r))/2$

$$X_2 = 1 + \eta - (1 + \eta^* - \bar{B}(1 + r))/2 .$$

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output is obtained by choosing $Y_{\gamma,t}$ that maximizes Z^*. The case in which the elasticity of substitution is below unity for both sectors corresponds to the case in which, in the absence of trade, output is zero in the developing nations. Because this is such an implausible outcome, our analysis ignores this possibility.

Thus, for a given interest rate, $\bar{B}$ fully determines the available traded inputs. The optimizing problem facing agents in the developing nations is to find the values of indebtedness ($\bar{B}$) and investment (I) that maximize:

$$(17) \qquad Z_1^*\left[\frac{1+\bar{B}}{2}\right] - I_\gamma - I_\delta + \rho^* Z_2^*\left[\frac{1+\eta^* - \bar{B}(1+r)}{2}\right],$$

where I_h is the investment in sector h ($h = \gamma,\delta$), and $Z_t^*[X_t^*]$ is the output produced at time t with X_t^*, given by (11).

The first order conditions characterizing an internal solution where there is investment in both activities are:

$$(18) \quad \text{a.} \qquad MP_{Z_1^*;X_1^*} = \rho^*(1+r)\, MP_{Z_2^*;X_2^*}$$

$$\text{b.} \qquad 1 = \rho^* MP_{Z_2^*;I_\gamma} \qquad\qquad \text{c.} \qquad 1 = \rho^* MP_{Z_2^*;I_\delta}$$

where $MP_{Z_t^*;h}$ is the marginal product of Z_t^* with respect to h (i.e., $MP_{Z_t^*;h} = \frac{\partial Z_t^*}{\partial h}$ for $h = X_t^*$, I_δ and I_γ).

To gain further insight we should solve for $Z_t^*[X_t^*]$. Applying (17) to (18) we get the following conditions:

$$\text{a.} \quad (X_1^*)^{\beta-1}(\tau_1)^{1-\beta} = \rho^*(1+r)(X_2^*)^{\beta-1}(\tau_2)^{1-\beta}$$

$$(18')\ \text{b.} \quad 1 = \rho^*(1-\beta)(X_2^*)^{\beta}(\tau_2)^{-\beta}\tilde{h}_{\gamma}2^{\bar{\beta}/\gamma}$$

$$\text{c.} \quad 1 = \rho^*(1-\beta)(X_2^*)^{\beta}(\tau_2)^{-\beta}\tilde{h}_{\delta}\,2^{\bar{\beta}/\delta}$$

Inspection of (18' b,c) reveals that investment will be channeled to the sector with the higher marginal contribution of investment to the aggregate capital stock (i.e., to the sector whose productivity coefficient $\tilde{h}_z 2^{\bar{\beta}/z}$, $z = \gamma,\delta$; is higher).

Similar conditions apply for the developed countries. Their problem is to choose investment I and lending $\bar{B}$ such that

$$(19) \qquad Z_1(1-\bar{B}) - I + \rho Z_2(1+\eta+\bar{B}(1+r)),$$

where I is the investment (thus $K_2 = K_1 + I$). The first order conditions characterizing the solution are:

$$\text{a.} \quad MP_{Z_1;X_1} = \rho(1+r)\,MP_{Z_2;X_2}$$

(20)

$$\text{b.} \quad 1 = \rho\, MP_{Z_2;I}$$

Applying (11), (14) to (20) we get the following first order conditions:

$$\text{a.} \quad (1-\bar{B})^{\beta-1}(K_1)^{1-\beta} = \rho(1+r)(1+\eta+\bar{B}(1+r))^{\beta-1}(K_2)^{1-\beta}$$

(20')

b. $\quad 1 = \rho\,(1-\beta)(1+\eta+\bar{B}(1+r))^{\beta}(K_2)^{-\beta}$

Equations (18' a-c) and (20' a-b) comprise a system of five equations, whose simultaneous solution determines I_δ, I_γ, r, I, $\bar{B}$. [9]

The above analysis assumed an equilibrium where the resultant indebtedness is small enough to rule out default, thus $R_b \geq \bar{B}(1+r)$. We turn now to the analysis of the equilibrium observed if the indebtedness is large enough to motivate a partial default.

4. LIMITED CREDIT MARKET INTEGRATION: THE BARGAINING EQUILIBRIUM

We now turn to the characterization of the bargaining equilibrium. We start by analyzing the periodic bargaining outcome, using the fixed threat Nash bargaining framework.

4.1 THE BARGAINING

The bargaining allocation is characterized by the X value that maximizes the products of the gains from trade. We denote by $Z(X+Y)$ and $Z^*(\bar{X}-X)$ the production level of the developed and the developing nations that is generated with an allocation of $(X, \bar{X}-X)$ of input X between the developed and the developing nations, respectively [these functions are given by (11)]. Note that the autarky production level of the developed

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9. It can be shown that:

$1+r = C\,[K_1\,(\rho)^{-1/(\beta(1-\beta))} + \tau_1\,(\rho^*)^{-1/(\beta(1-\beta))}(\tau_{2,I})^{1-\beta}]^{1/(1-\beta)}$ where

$C = (1-\beta)^{1-1/\beta}\,2^{-1/(1-\beta)}$ and $\bar{B} = \dfrac{\sigma-1}{\sigma+1}$ for $\sigma = \dfrac{\tau_1}{K_1}\,[\dfrac{\rho}{\rho^*}]^{1/(\beta(1-\beta))}(\tau_{2,I})^{-1/\beta}$.

and the developing nations is given by $Z(\bar{X})$ and $Z^*(0)$ [see (12)]. The bargaining allocation X_b is found by solving[10]:

$$(21)\quad \underset{X}{\text{MAX}} \qquad [Z(2X + \bar{Y} - \bar{X}) - Z(\bar{X})]\,[Z^*(\bar{X} - X) - Z^*(0)].$$

We focus on the case where $\gamma < 0 < \delta \leq 1$. All our results carry over to the case where $0 < \gamma, \delta \leq 1$. It is instructive to define terms that measure the relative allocation of inputs:

$\Psi = \frac{1+\eta^*}{1+\eta}$ and $\chi = X/(1 + \eta)$. The term Ψ is the relative supply of inputs, whereas χ measures the the developed nations' share of the X input. We can apply (5), (8), (11) and (12) to (21), taking a logarithmic transformation and using the definitions of Ψ and χ, obtaining that the bargaining allocation is obtained by finding χ that maximizes:[11]

$$(22)\quad \underset{\chi}{\text{MAX}} \quad \ln[(\Psi - 1 + 2\chi)^{\beta} - 1] + \ln[\left\{\frac{1-\chi}{\Psi}\right\}^{\beta}\left\{\frac{\tau}{h_{\delta}K_{\delta}}\right\}^{1-\beta} - 1].$$

The two terms measure the percentage increase in the production (relative to autarky) of the developed and developing countries, respectively. Note that the gains from trade for the developing nations depend positively on τ/K_{δ}. Inspection of (11) reveals that τ/K_{δ} depends positively on the capital ratio in the sector with the low substitutability relative to the high substitutability (i.e., on K_{γ}/K_{δ}). Thus, the developing nations' gains

10. Note that (9), (10) and (10') implies that $X + Y = 2X + \bar{Y} - \bar{X}$.

11. Henceforth we restrict our attention to the bargaining region in which there are gains from trade for both blocs of nations. In terms of (14) we assume that

$$1 - 0.5\,\Psi < \chi < 1 - \Psi\left(\frac{\tilde{h}_{\delta}K_{\delta}}{\tau}\right)^{(1-\beta)/\beta}.$$

from trade depend positively on the K_γ/K_δ ratio. The rationale for this outcome is that in autarky only sector δ is producing. Sector γ is ideal, because it can not produce without imports of X. Consequently, the gains from trade are greater for sector γ than for sector δ, and these gains are tied to the relative size of sector γ, as measured by the K_γ/K_δ ratio.

Maximizing (22) yields the following first order condition:

$$(23) \quad \frac{2\beta}{(\Psi-1+2\chi)^{\beta}-(\Psi-1+2\chi)^{1-\beta}} = \frac{\beta}{(1-\chi)-(1-\chi)^{1-\beta}\,\Psi^{\beta}\left\{\frac{h_\delta K_\delta}{\tau}\right\}^{1-\beta}}$$

The left hand side measures the percentage increase in the developed nations' gains from trade that is associated with a marginal increase of χ, and is described by curve DD (Figure 2). The right hand side measures the percentage loss in the developing nations' gains from trade associated with a marginal increase in χ, and is described by schedule GG. The feasible bargaining range is given by the shaded values of χ (Figure 2), and the intersection of both schedules gives the bargaining outcome (χ_b). At this allocation a marginal transfer of χ will cause percentage losses of the gains from trade to one party that equal the percentage gains to the other party.

The relative size of the two sectors (K_γ/K_δ) and the relative supply of inputs (Ψ) play a key role in determining the bargaining outcome. A greater trade dependency is associated with a higher relative size of the sector with lower elasticity of substitution. Basically, higher K_γ/K_δ ratios are associated with a rise in $\frac{\tau}{K_\delta}$, and an increase in the gains from trade of the developing nations. In terms of Figure 2, a higher K_γ/K_δ ratio will shift GG downward and rightward, increasing the bargaining solution. In terms of Figure 1, the resultant increase in χ_b will shift X_b rightward, raise the range of no default, and increase the resource transfer. The insight behind these results is clear: a

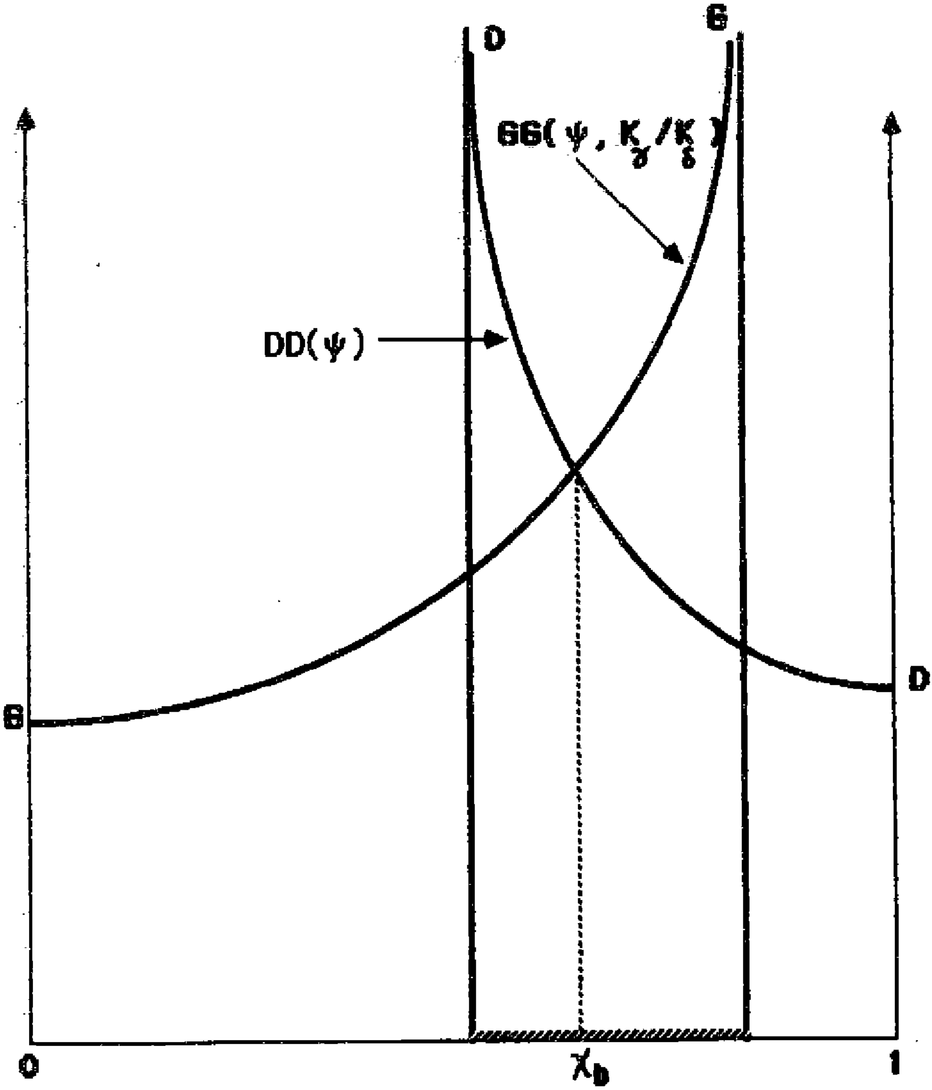

FIGURE 2

higher relative size of the sector that is more trade dependent increases the bargaining power of the developed nations, thereby increasing their willingness to supply credit and reducing the tendency of the developing countries to default.

An increase in the relative size of the developing nations is associated with a hike in Ψ (see the Appendix for further details). In terms of Figure 2, it results in shifting schedule GG leftward, thereby reducing χ. The Appendix shows that a supply expansion of both countries causes higher repayment, and that:

$$(24) \quad \chi = \chi\left(\frac{K_Y}{K_S}, \Psi\right) \; ; \; R_b = R_b\left(\frac{K_Y}{K_S}, \eta, \eta^*\right); \quad \text{where}$$

$$\frac{\partial \chi}{\partial \frac{K_Y}{K_S}} > 0, \quad \frac{\partial \chi}{\partial \Psi} < 0 \quad ; \qquad \frac{\partial R_b}{\partial \frac{K_Y}{K_S}} > 0, \quad \frac{\partial R_b}{\partial \eta} > 0, \quad \frac{\partial R_b}{\partial \eta^*} > 0.$$

5. THE EQUILIBRIUM ALLOCATION WITH LIMITED CAPITAL MARKET INTEGRATION

We turn now to the derivation of the general equilibrium allocation in the presence of endogenous defaults. We assume that agents in period one are fully informed as to the default rule and the factors determining the effective repayment, as are summarized by (7), (24). Borrowing is substantial enough, so that we operate in a regime in which the repayment in the second period is determined by R_b [see (24)]. We characterize the conditions for the optimal allocation of resources in an intertemporal equilibrium. We distinguish between two extreme cases: In section 5.1 we assume that the initial indebtedness is zero, but the first period borrowing is sufficiently large to operate in the bargaining regime in the second period, and the first period credit allocation is determined by agents who discount the second period bargaining outcome. In section 5.2 we consider the case where initial indebtedness is large enough, such that in both periods we operate in the partial default region, where repayment is dictated by the bargaining outcome and where the developing country cannot raise fresh credit. While these two cases represent polar possibilities, a comparison between them allows us to gain insight into the investment consequences of initial indebtedness.

5.1 LIMITED CAPITAL MARKET INTEGRATION WITH NO INITIAL INDEBTEDNESS

The optimizing problem facing the developing nations in the bargaining equilibrium differ from that in competitive equilibrium because repayment is determined by the bargaining outcome: $\bar{B} = R_b/(1 + r)$. Formally, the problem is to find the values of investment (I_γ, I_δ) that maximize:

$$\text{(25)} \quad \text{MAX} \;\; Z_1^*\left[\frac{1+R_b/(1+r)}{2}\right] - I_\gamma - I_\delta + \rho^* Z_2^*\left[\frac{1+\eta^*-R_b}{2}\right],$$

where Z^* is given by (11). The first order conditions for internal equilibrium for this problem are:

$$\text{(26)} \quad \begin{aligned} &\text{a.} \quad 1 = \rho^* MP_{Z_2^*;I_\gamma} + \frac{R_{b;\gamma}}{1+r} D \\ &\text{b.} \quad 1 = \rho^* MP_{Z_2^*;I_\delta} + \frac{R_{b;\delta}}{1+r} D \end{aligned}$$

where $R_{b;h} = \dfrac{\partial R_b}{\partial I_h}$ for $h = \gamma,\delta$; and

$$D = \{MP_{Z_1^*;X_1^*} - \rho^* (1+r)\, MP_{Z_2^*;X_2^*}\}/2 .$$

The term D is a measure of the 'distortion' introduced due to country risk, being equal to the intertemporal wedge between the marginal productivity of the foreign input in period one and two. Note that (18) implies that D equals zero in the absence of country risk factors[12]. Scarcity of credit implies a positive D.[13] Equation (26) has a simple interpretation: the marginal cost of investment in sector z ($z = \gamma,\delta$) should be equal to the marginal social benefit, as shown on the right hand side. The cost is measured in terms of the consumption forgone in period one. The benefit is composed of the discounted value of the marginal productivity of investment plus the externality effect of investment on the credit ceiling. A marginal investment will change the marginal funds available to the economy by affecting the bargaining outcome, as measured by $\frac{R_{b;h}}{1+r}$ (for $h = \gamma,\delta$). This will increase welfare by the distortion D times the increase in the credit ceiling ($\frac{R_{b;h}}{1+r}$), yielding the last term in (26). Note that the sign of the term $R_{b;h}$ is an indication of the trade dependency of sector h, and is positive (negative) for sector γ (δ).

To gain further insight into the optimal investment, note that

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12. Note that if D is positive there is room in a competitive equilibrium for simple arbitrage: borrow today to finance $\Delta X_1^* = 0.5$, and 'repay' tomorrow by reducing the effective use of X_2^* by $0.5(1 + r)$. This will increase welfare by D. Note that country risk considerations limit the feasibility of such arbitrage due to the unavailability of credit, which makes the cost of the marginal fund to be $1 + r^* > 1 + r$.

13. This observation follows from the fact that [applying (11) and (15) and the various definitions to D]

$$D = \left\{[1 + \frac{R_b}{1+r}]^{\beta-1} \tau_1{}^{1-\beta} - (1 + r)\rho^*[\eta^* + 1 - R_b]^{\beta-1} \tau_2{}^{1-\beta}\right\}\beta 2^{-\beta},$$

from which we infer that $\partial D/\partial R_b < 0$.

$MP_{Z_2^*;I_h} = MP_{Z_2^*;\tau}\,\tau_h$; for $h = \gamma,\delta$ and $\tau_h = \frac{\partial\tau}{\partial I_h}$. Thus, an internal equilibrium also implies that

$$(27) \qquad \rho^* MP_{Z_2^*;\tau}\left\{\tau_\delta - \tau_\gamma\right\} = \frac{D}{1+r}\left\{R_{b;\gamma} - R_{b;\delta}\right\}.$$

Note that because sector γ is biased towards trade dependency, whereas δ is biassed towards trade independence, $R_{b;\gamma} - R_{b;\delta} > 0$. When $D > 0$ we get that for an internal equilibrium the marginal contribution of investment in sector δ to the aggregate capital stock should exceed that of investment in sector γ (i.e., $\tau_\delta > \tau_\gamma$, or $\tilde{h}_\delta 2^{\bar{\beta}/\delta} > \tilde{h}_\gamma 2^{\bar{\beta}/\gamma}$) by a margin that will compensate for the negative externality generated by investing in closeness, relative to the positive externality generated by investing in trade dependency.

Recalling that in the absence of country risk considerations international borrowing will yield $D = 0$, (27) implies that with perfect integration of international capital markets the investment strategy is independent of anticipations regarding the future growth of the various countries, whereas in the presence of country risk the investment strategy will be determined by both the anticipation regarding future economic conditions and the direct productivity and the strategic effects of investment on trade dependency.[14]

If we anticipate full integration of capital markets, we invest in the technology with the higher marginal contribution of investment to the aggregate capital stock (i.e., the technology with higher τ_h, $h = \gamma, \delta$), regardless of its marginal contribution to trade dependency. If we anticipate a bargaining regime in the future, we tilt the investment towards the activities that generate greater trade dependency externality. If, for example, the productivity contribution in the less trade dependent sector marginally exceeds that of the more trade dependent sector (i.e., $\tau_\delta > \tau_\gamma$), but the trade dependency externality $R_{b;\gamma} - R_{b;\delta}$ is large enough, anticipations of a competitive equilibrium calls for investment in sector δ. Anticipation of future bargaining equilibrium will motivate diversification, channeling investment towards sector γ.

5.1.1 THE ROLE OF POLICIES

Our previous discussion adopted the central planner's point of view. We now turn to the analysis of the design of the policies needed to yield the planner allocation in developing countries with competitive domestic credit markets. As the previous analysis demonstrated, the possibility of a partial default will result in an equilibrium where the developing nations will face a credit ceiling given by the net present value of R_b. We assume that the central planner in the developing country borrows the available credit and auctions it domestically, in a competitive domestic market. We analyze the behavior of private agents in the resultant competitive equilibrium, deriving the first

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14. Anticipations regarding future growth determine the credit ceiling $[R_b/(1 + r)]$. High enough growth rates, as measured by high anticipated η and η^*, will move us from a credit rationing regime towards full integration of credit markets [see (24)].

order conditions. Optimal policies are derived by finding the set of borrowing taxes that will equate the same first order conditions of the private problem to the first order conditions of the planner's problem.

Suppose the domestic interest rate (in terms of the traded input) for consumption borrowing is r^*, whereas for investment borrowing in sector h it is r_h^*, for $h = \gamma,\delta$. The interest rate r^* is the rate that clears the domestic market for the available external credit. The wedge between r^* and r_h^* is policy driven, by investment taxes/subsidies. The problem facing the producer is to choose Y_1, X_1, Y_2, X_2, I_γ, I_δ to maximize the net present value of profits, given by:

$$(28) \qquad Z_1^* - P_{x;1}(Y_1 + X_1) + \frac{P_{x;1}}{P_{x;2}(1+r^*)}\left\{P_{z;2}Z_2^* - P_{x;2}(Y_2 + X_2) - \frac{P_{x;2}}{P_{x;1}} I_\gamma(1 + r_\gamma^*) - \frac{P_{x;2}}{P_{x;1}} I_\delta(1 + r_\delta^*)\right\},$$

where $P_{y,1}$, $P_{y,2}$ and $P_{z,2}$ are the prices of inputs in period one and two, and the price of the final good, respectively, all in terms of the first period consumption good (i.e., $P_{z,1} = 1$).[15] Similarly, the consumer problem is to maximize $C_1 + \rho^* C_2$, subject to the budget constraint:

15. In writing (28)-(29) we should take care that all interest rates are in terms of the traded inputs, whereas the consumption and production decisions are implemented in terms of the final (non-traded) good. Thus, investment I_γ is measured in terms of Z_1^*, and is associated with repayment in period two of $\frac{P_{x;2}}{P_{x;1}} I_\gamma(1 + r_\gamma^*)$.

$$(29) \qquad C_1 + \rho^* \{[P_{x;1}\ \overline{Y}_1 - \frac{C_1}{P_{x;1}}](1 + r^*) + \overline{Y}_2\} \frac{P_{x;2}}{P_{z;2}}.$$

The resultant first order conditions for an internal equilibrium are (for the investor and the consumer, respectively):

$$(30) \quad MP_{Z_1^*;X_1^*} = MP_{Z_1^*;Y_1^*} = P_{x;1} \quad ;$$

$$P_{z;2}\, MP_{Z_2^*;X_2^*} = P_{z;2}\, MP_{Z_2^*;Y_2^*} = P_{y;2}$$

$$P_{z;2}\ MP_{Z_2^*;I_\gamma} = \frac{P_{x;2}}{P_{x;1}} (1 + r_\gamma^*); \qquad P_{z;2}\ MP_{Z_2^*;I_\delta} = \frac{P_{x;2}}{P_{x;1}} (1 + r_\delta^*)$$

$$(31) \quad 1 = \rho^* (1 + r^*) \frac{P_{y;2}}{P_{y;1} P_{z;2}}.$$

Suppose now that the optimal solution yields an internal equilibrium with $D > 0$ (i.e., an equilibrium with investment in both sectors, γ and δ). The optimal domestic policies should yield the same first order conditions in (30)-(31) as in (26). These policies can be implemented by imposing interest rate taxes of α_b, α_γ, α_δ for borrowing for imports of the traded input, and investment in sector γ and δ, respectively. With these taxes the corresponding domestic interest rates are given by $[1 + r^*, 1 + r_\gamma^*, 1 + r_\delta^*] =$

$[(1 + r)(1 + \alpha_b), (1 + r^*)(1 + \alpha_\gamma), (1 + r^*)(1 + \alpha_\delta)]$. The values of the optimal taxes are given by

$$(32)\quad \alpha_b = D/[\rho^*(1+r)MP_{Z_2^*;X_2^*}]; \quad \alpha_\gamma = -\frac{R_{b;\gamma}}{1+r}\, D\,; \quad \alpha_\delta = -\frac{R_{b;\delta}}{1+r}\, D\,.$$

The value of the optimal taxes is proportional to the scarcity of funds, as measured by the distortion D. Note that assuming scarcity of funds ($D > 0$) the optimal policy calls for subsidizing investment in sectors that increase trade dependency, and taxing investment in sectors that reduce trade dependency, relative to borrowing for consumption. The magnitude of the optimal policies is proportional to the scarcity of funds, as measured by D. The role of investment policies is to internalize the strategic effect generated by the investment via its effect on trade dependency and the consequent change of the bargaining outcome. This effect is measured by the net present value of the change in the bargaining outcome ($\frac{R_{b;z}}{1+r}$ for $z = \gamma,\delta$) times the initial distortion (D).

5.2 DISJOINT CAPITAL MARKETS: THE CASE OF SUBSTANTIAL INITIAL INDEBTEDNESS

Our analysis assumed zero initial indebtedness. We turn now to the other polar case, where initial indebtedness is high enough that we operate in both periods in the bargaining regime. Contrasting the two polar cases will shed light on the consequences of partial defaults on the investment incentives. Starting with substantial indebtedness implies that all investment is domestically financed, and that in each period the developing nations transfer to the developed nations the bargaining outcome, R_b. The problem facing the developing nations in period one is given by:

$$(33)\qquad Z_1^*\Big[\frac{1-R_{1;b}}{2}\Big] - I_\gamma - I_\delta + \rho^*\, Z_2^*\Big[\frac{1+\eta^*-R_{2;b}}{2}\Big]$$

where $R_{t;b} = R_{t;b}(\frac{K_{\gamma;t}}{K_{\delta;t}}, \bar{X}_t, \bar{Y}_t)$ is the repayment dictated by the bargaining outcome in period t, given by (24). The first order conditions for internal equilibrium for this problem are:

$$\text{a.} \qquad 1 = \rho^* \widehat{MP}_{Z_2^*;I_\gamma}$$

(26')

$$\text{b.} \qquad 1 = \rho^* \widehat{MP}_{Z_2^*;I_\delta}$$

where $\widehat{MP}_{Z_2^*;I_h}$ is the marginal social product of investment in sector h ($h = \delta,\gamma$).

Formally, $\widehat{MP}_{Z_2^*;I_h} = MP_{Z_2^*;I_h} - 0.5\, MP_{Z_2^*;X_2^*} R_{2;b;h}$,

where $R_{2;b;h} = \frac{\partial R_{2;b}}{\partial I_h}$ for $h = \gamma,\delta$.

The optimal investment rule is to equate the marginal cost (the forgone consumption) to the marginal benefit. The marginal benefit is the discounted sum of the direct productivity effect, plus the external effect that operates via the investment consequence on the future bargaining outcome. For example, investment that increases trade dependency generates a negative externality: it reduces the bargaining power of the nation, thereby increasing the future repayment. In terms of our model, investment in sector γ will imply a hike of future repayment of $R_{2;b;\gamma}$, and a consequent drop in future output of 0.5 $MP_{Z_2^*;X_2^*}\, R_{2;b;\gamma}$. The resultant drop in output, in terms of the first period, is given by $\rho^* R_{2;b;z}\, 0.5\, MP_{Z_2^*;X_2^*}$.

Note that from (26') we infer that an internal equilibrium implies that

$$(27')\qquad MP_{Z_2^*;\tau}\left\{\tau_\gamma - \tau_\delta\right\} = .5\, MP_{Z_2^*;X_2^*}\left\{R_{2;b;\gamma} - R_{2;b;\delta}\right\}.$$

Recalling that $R_{b;\gamma} - R_{b;\delta} > 0$ we get, for an internal equilibrium, that the marginal contribution of investment in sector γ to the aggregate capital stock should exceed that of investment in sector δ (i.e., $\tau_\delta > \tau_\gamma$) by a margin that will compensate for the negative externality generated by investing in a sector that increases the trade dependency relative to the positive externality generated by investing in a sector that reduces trade dependency.

Further insight can be gained by comparing the optimal investment rules in the two bargaining regimes. Equation (27) corresponds to the case of zero initial indebtedness, and (27') to the case of substantial initial indebtedness. While investment in period one will affect the future trade dependency and repayment in the same way in both regimes, the welfare consequences will work in opposite directions. With no substantial initial debt, higher trade dependency generates positive externality: it will increase the willingness of creditors to supply more credit in the first period, because higher trade dependency increases the credit ceiling supported by the bargaining. With substantial initial debt, higher trade dependency generates negative externality: it will increase future repayment without generating new marginal credit. Consequently, we conclude that the switch from low to high initial indebtedness will reverse the attitude towards trade dependency in the developing nations. While in the low indebtedness regime higher trade dependency is preferable, lower trade dependency is desirable with high indebtedness regime.

An important consequence of country risk is that the investment strategy will be determined by both anticipation regarding future economic conditions as well as by the productivity and the strategic effects of investment on trade dependency. For example, suppose we start with high initial indebtedness, yielding an outcome in the bargaining regime. If we observe an internal equilibrium with investment in various sectors, we will observe higher direct productivity in the trade dependent sectors relative to sectors associated with lower trade dependency, by a margin that should compensate for the negative externality associated with higher trade dependency. Thus, high initial indebtedness introduces a bias against investment in trade dependency. Starting from such an equilibrium, anticipations of higher growth rates in the future will result in increasing R_b. If this effect is large enough relative to the initial indebtedness, it will move the economy away from the bargaining regime in the future (second period), eliminating the anti-trade bias.

6. CONCLUDING REMARKS

The key result derived in this paper is that the choice of inward versus outward growth strategy is determined by the degree of access to the international credit market. With full integration of capital markets, the choice regarding the inwardness of a technology is irrelevant. With partial integration, investment that increases trade dependency is desirable. If the credit markets are disjoint due to partial defaults, higher trade dependency is disadvantageous. Thus, higher trade dependency generates a positive externality with partial integration of capital markets, and negative externality with disjoint credit markets.

Throughout the paper we assumed away uncertainty. Allowing for uncertainty will enrich the model in several ways. First, it may explain how we switch from a regime in which we anticipated integrated capital markets, to a regime in which capital markets are disjoint due to partial defaults, and it may generate a diversification motive in investing in sectors with various degrees of trade dependency due to an insurance motive.[16] Secondly, it may enrich the policy conclusion of the paper for the case where we start with a substantial debt overhang. For example, starting with debt overhang, under certain conditions it may be beneficial for both blocks of nations to renew marginal resource transfers from the developed to the developing countries, under the terms of targeting the investment in projects that will increase the trade dependency of the developing countries. Such an investment will increase future resource transfers supported by the bargaining outcome, allowing higher repayment in the future [see Aizenman (1988)].[17] As the present paper has demonstrated, the success

16. On investment diversification motive due to anticipated embargos see Bhagwati and Srinivansan (1976) and Arad and Hillman (1979).

17. The possibility for Pareto improvement stems from the fact that with disjoint credit markets the real interest rate is higher in the developed nations. The need for conditionality stems from the fact that in a partial default regime the developing

of such a policy may hinge on the future growth of the developed nations: higher growth rates will be associated with more favorable outcomes of an outward investment of the indebted countries.[18] Thus, higher trade dependency will increase the exposure of the indebted nations to the risk associated with the business cycle of the developed countries. This may imply that the adaptation of outward growth strategies by the indebted developing nations will be facilitated by arrangements that will transfer some of the business cycle risk associated with greater trade dependency to the developed countries. Such an arrangement may be a component of the conditionality that accompanies the refinancing package.

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nations will prefer to channel investment toward reducing trade dependency. For further discussion regarding the conditions allowing for Pareto transactions see Aizenman (1988).

18. This follows from the observation that $R_{b;\gamma;\eta} > 0$.

APPENDIX

The purpose of this Appendix is to derive some of the key results reported in the text. Appendix A.1 reviews the derivations of the Pareto allocations and the bargaining outcome, and in Appendix A.2 we analyze the dependency of the bargaining outcome on the relative size and the sectorial composition of the various countries.

A.1 THE BARGAINING OUTCOME

A useful characteristic of the bargaining outcome in the Nash fixed threat framework is that it is Pareto efficient [see Roth (1979)]. We start the analysis by deriving the characteristics of the contract curve, defined by the Pareto efficient points. A point on the contract curve is defined by an allocation of X and Y among the various activities that maximize the global weighted average of output. Therefore, for a given ω, $0 < \omega < 1$ we maximize:

$$\text{(A1)} \qquad \omega Z_t + (1-\omega) Z_t^* .$$

Equivalently maximizing

$$\text{(A2)} \quad \omega[\bar{X}_t - X_t^* + \bar{Y}_t - Y_t^*]^\beta (K_t)^{1-\beta} +$$

$$(1-\omega)\{h_\gamma[(X_{\gamma,t})^\gamma + (Y_{\gamma,t})^\gamma]^{\beta/\gamma} (K_{\gamma,t})^{1-\beta} + h_\delta[(X_t^* - X_{\gamma,t})^\delta + (Y_t^* - Y_{\gamma,t})^\delta]^{\beta/\delta} (K_{\delta,t})^{1-\beta}\}.$$

The weight ω corresponds to the relative importance attached to the developed nations, and varying it will move us along the contract curve. Direct optimization (with respect to X_t^* ; Y_t^* ; $X_{\gamma,t}$; and $Y_{\gamma,t}$) gives us the following first order conditions:

$$\text{(A3)}\quad \omega[\bar{X}_t - X_t^* + \bar{Y}_t - Y_t^*]^{\beta-1} (K_t)^{1-\beta} = (1-\omega)(h_\delta[\Omega_\delta]^{(\beta/\delta)-1}(X_t^* - X_{\gamma,t})^{\delta-1} (K_{\delta,t})^{1-\beta})$$

$$\text{(A4)}\quad \omega[\bar{X}_t - X_t^* + \bar{Y}_t - Y_t^*]^{\beta-1} (K_t)^{1-\beta} = (1-\omega)(h_\delta[\Omega_\delta]^{(\beta/\delta)-1}(Y_t^* - Y_{\gamma,t})^{\delta-1} (K_{\delta,t})^{1-\beta})$$

$$\text{(A5)}\quad h_\gamma[\Omega_\gamma]^{(\beta/\gamma)-1} (K_{\gamma,t})^{1-\beta} (X_{\gamma,t})^{\gamma-1} = h_\delta[\Omega_\delta]^{(\beta/\delta)-1} (K_{\delta,t})^{1-\beta} (X_t^* - X_{\gamma,t})^{\delta-1}$$

$$\text{(A6)}\quad h_\gamma[\Omega_\gamma]^{(\beta/\gamma)-1} (K_{\gamma,t})^{1-\beta} (Y_{\gamma,t})^{\gamma-1} = h_\delta[\Omega_\delta]^{(\beta/\delta)-1} (K_{\delta,t})^{1-\beta} (Y_t^* - Y_{\gamma,t})^{\delta-1}$$

where $\Omega_\varepsilon = (X_{\varepsilon,t})^\varepsilon + (Y_{\varepsilon,t})^\varepsilon$ for $\varepsilon = \gamma, \delta$.

Taking the ratio of (A3) and (A4) yields

$$\text{(A7)}\qquad X_t^* - X_{\gamma,t} = Y_t^* - Y_{\gamma,t}.$$

Taking the ratio of (A5) and (A6) yields

$$\text{(A8)}\qquad (X_{\gamma,t}/Y_{\gamma,t})^{\gamma-1} = [(X_t^* - X_{\gamma,t})/(Y_t^* - Y_{\gamma,t})]^{\delta-1}.$$

Applying (A7) and (4) to (A8) yields

$$\text{(A9)}\qquad X_{\gamma,t} = Y_{\gamma,t};\quad X_{\delta,t} = Y_{\delta,t};\quad X_t^* = Y_t^*.$$

We can apply (A7) and (A9) to (A5), replacing the terms involving Y with the terms involving X. Solving the resulting equation for $X_{\gamma,t}$ yields (8) in the text.

A.2 INVESTMENT, RELATIVE SIZE AND BARGAINING

We now turn to the derivations of the results reported in (24). Let us denote by H the term $\left\{ \frac{\tilde{h}_\delta K_\delta}{\tau} \right\}^{1-\beta}$. Applying this notation we can rewrite the condition defining χ_b (equation 23) as

$$\text{(A10)} \quad (\Psi - 1 + 2\chi) - (\Psi - 1 + 2\chi)^{1-\beta} = 2[(1-\chi) - (1-\chi)^{1-\beta} \Psi^\beta H].$$

For simplicity it is useful to derive all the results around an initial equilibrium, where $\Psi = 1$. From which we derive

$$\text{(A11)} \qquad \frac{\partial \chi}{\partial H} = -\frac{(1-\chi)^{1-\beta}}{1-(1-\beta)(1-\chi)^{-\beta} H + 1 - (1-\beta)(2\chi)^{-\beta}}.$$

In the initial equilibrium there are gains from trade for both parties, and thus it follows from (A10) that $1 > (1-\chi)^{-\beta} H$ and $1 > (2\chi)^{-\beta}$. Thus, the denominator of (A11) is positive. From the definition of H we get

$$\text{(A12)} \qquad \frac{\partial H}{\partial \frac{K_Y}{K_\delta}} < 0,$$

and therefore $\dfrac{\partial \chi}{\partial \frac{K_Y}{K_\delta}} > 0$.

We turn now to the derivation of $\partial \chi / \partial \Psi$. From (A10) it follows that:

$$\text{(A13)} \qquad \frac{\partial \chi}{\partial \Psi} = -2\frac{2\beta(1-\chi)^{1-\beta} H + 1 - (1-\beta)(2\chi)^{-\beta}}{1-(1-\beta)(1-\chi)^{-\beta} H + 1 - (1-\beta)(2\chi)^{-\beta}} < 0.$$

From (10') and definitions it follows that

$$R_b = (1 + \eta)[\Psi - 2(1 - \chi)]. \tag{A14}$$

Thus,

$$\frac{\partial R_b}{\partial \eta} = -2\left[1 - \chi + \frac{\partial \chi}{\partial \Psi}\right]; \quad \frac{\partial R_b}{\partial \eta^*} = 1 + 2\frac{\partial \chi}{\partial \Psi}. \tag{A15}$$

Applying to (A15) equations (A10) and (A13) it can be shown that

$$\frac{\partial R_b}{\partial \eta} > 0 \; ; \quad \frac{\partial R_b}{\partial \eta^*} > 0. \tag{A15}$$

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