C.E.P.R.E.M.A.P February 1993

GROWTH AND EXTERNAL DEBT

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N°9302

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ABSTRACT

The paper surveys the literature on external debt that has been developped over the past decade. The first stage in the literature emphasized the intertemporal nature of a balance of payments. It reflected the view that balance of payments movements were an equilibrium phenomenon reflecting either transitory disturbances or permanent transfers of capital towards the poor countries. The second stage emphasized the risk of debt repudiation and set up the theory of optimal credit ceilings imposed on a sovereign debtor. The third stage analyzed the effect of a "debt overhang" on domestic investment. The last stage analyzed how a sovereign debt could be best reduced.

CROISSANCE ET DETTE EXTERIEURE

RESUME

L'article offre un *survey* de la litterature sur la dette extérieure telle qu'elle a été développée au cours de la dernière décennie. La première étape de cette littérature a consisté à analyser la balance des paiements d'un point de vue intertemporelle. Pour cette littérature, la balance des paiements était le reflet d'un ajustement d'équilibre, soit à des chocs transitoires, soit à un besoin permanent de transferts de richesses vers le pays pauvres. La seconde étape de la littérature a mis en lumière l'effet du risque de répudiation sur le rationnement du crédit à des Etats souverains. La troisième étape a analysé l'effet d'un excès de dette sur les décisions d'investissements des entreprises. Le dernière étape a porté sur l'analyse de la meilleure façon de réduire la valeur faciale de la dette.

Key words : Debt, Growth, Balance of Payments.

Mots clés : Dette, Croissance, Balance des Paiements.

JEL : 431,433

INTRODUCTION

The theory of external debt has been booming over the past decade and a half, under the obvious pressure of events. It essentially went through four stages. The first stage portrayed external debt as a vehicle for smooth intertemporal arbitrages. The last stage investigated how best it should be written off.

The first stage of the literature emphasized the intertemporal nature of a balance of payment. It reflected the view, popular in the seventies, that world excess savings (brought by the oil shocks) were efficiently recycled to the developing countries. According to this view, current account deficits of the developing countries were an "equilibrium" phenomenon which enabled these countries to raise productive capacities, out of which, it was hoped, their debt could be smoothly repaid.

The eighties were the decade when external debt became a bitter component of the developing countries'life. World interest rates shoot up and the time horizon of the lenders consequently got shorter. The eighties became the decade during which the developing countries had to transfer (in net terms) resources to the rich countries. Correlatively, the theory of debt repudiation became the main tool of analysis of the developing countries'debt. Theoretically and empirically, one wandered what was the mix of stick and carrots that the lenders could threaten or attract the debtors with in order to induce them to pay their debt. Whatever the specific of these instruments, it now appears, a decade later, that the net ressources that developing countries were willing to transfer abroad never much exceeded 3% of GDP. This gives an indirect measure of the costs perceived to be associated with debt repudiation.

It soon appeared, in general, that the stock of debt accumulated in the seventies and in the early eighties exceeded the present value of expected transfers that the debtor countries were willing to pay. The theory of external debt reflected this situation and investigated the potential effects of the debt crisis on the pattern of growth of the debtor countries. The "debt overhang" was soon to be portrayed as a potential tax on the countries' ressources, with its negative effect on capital accumulation. While it is unambigously the case that, in the great majority of cases, domestic investment of the large debtors went below the levels that were reached in the seventies, there is a theoretical and an empirical dispute on the chain of causality. Some argued that the countries which were hard hit by external shocks were simultaneously led to reduce their domestic investments and to let their external debt go out of control. One also made the point that the seventies were not an appropriate benchmark (given the cheap cost of credit during that decade).

Finally, as we moved into the nineties, the key question became that of efficiently writting down the face value of the debt. Getting the "right" price at which to undertake these deals was one dimension where academic research became quite active. A key distinction between the average price at which *one* individual investor would be willing to sell its debt and the *marginal* price at which lenders as a whole would sell (when internalizing the effects of their decisions on the aggregate value of the debt) set the agenda of the debate in the late eighties.

The paper will proceed to follow these four stages of the literature. First, it will spell out the conditions under which one can view a country's balance of payments in the same fashion as the cash flow of an infinitely lived individual. It then proceeds to investigate the consequences of the risk of debt repudiation on the credit constraint that a country is subject to. Third, it investigates the implications of such credit ceilings on the pattern of growth of a debtor country. Finally, the paper reviews how the market price of a sovereign nation's debt helps determining how an efficient write-off of the debt should proceed.

I - INTERTEMPORAL BUDGET CONSTRAINTS FOR INDIVIDUALS AND FOR NATIONS

The analysis of a country's balance of payments in an intertemporal framework was renewed by the work of Bazdarich (1978), Dornbusch and Fischer (1980), Sachs (1981), and Razin and Svensson (1983). The guiding line of these papers was to apply the permanent income theory to the case of a nation portayed as an infinitely lived agent and to interpret the so-called "disequilibria" of the balance of payments as an equilibrium phenomenon. Further models paid a specific attention to the problem of aggregating the intertemporal budget constraints of an infinite number of finitely lived agents. Such work have applied the structure of the overlapping generation model to the case of a small open economy. The key papers include Buiter (1981), Dornbusch (1985), Weil (1985) and the work by Frenkel and Razin (1989). Let us now proceed to summarize in an integrated model the issues that are dealt with in these models and specify the cases when it is meaningful to aggregate all individual budget constraints of the agents inhabiting a nation into one an aggregated balance of payment.

For any finitely lived individual, the budget constraint which he is subject to is unambiguously defined by the following constraint : at the time when the agent dies, he must left no unpaid debt. Call i such an individual and let us assume that he has a free access to the world financial markets. Call r the riskless rate of interest on these markets. Let W_t^i be the financial wealth of the individual i at time t, call ω_t^i the endowment he receives at time t, and let C_t^i be his consumption during that time. The law of motion of individual i 's wealth can be written :

(1) $\dot{W}_t^i = r\ W_t^i + \omega_t^i - C_t^i$

(in which the dot represents the time derivative).

Assume that the time horizon of the agent is a deterministic interval $[t_i, T_i]$. Agent i's solvency constraint is then to be written :

(2) $W_{T_i}^i = 0$

Equation (2) should actually be written as an inequality. Assuming no satiation of consumption, and assuming that there are no transfers of assets across individuals, it its obviously legitimate to write the budget constraint as an equality.

On the other hand, writing equation (1) in present value terms, delivers, for all pairs (t,T):

$$(3) \qquad W_T^i e^{-r(T-t)} + \int_t^T C_s^i e^{-r(s-t)} ds = \int_t^T C_s^i e^{-r(S-t)} ds + W_t^i$$

which, together with (2), implies that:

$$(4) \qquad \int_t^{\infty} C_s^i e^{-r(s-t)} ds = \int_t^{\infty} \omega_s^i e^{-r(S-t)} ds + W_t^i.$$

with the obvious convention that $C_s^i = \omega_s^i = W_s^i = 0$ if the agent is not alive at time s.

Let us now see how the individual agents' intertemporal budget constraints can be aggregated over the economy. Call

$$C_t = \sum_i C_t^i \; ; \; \omega_t = \sum_i \omega_t^i \; ; \; W_t = \sum_i W_t^i$$

respectively, the aggregate consumption, income and wealth of the country at any time t. W_t is nothing else but the net external asset of the country. Aggregating all equations (3) together, we get :

$$(5) \; W_T e^{-r(T-t)} + \int_t^T C_s e^{-r(s-t)} ds = \int_t^T \omega_s^i e^{-r(s-t)} ds + W_t \; .$$

If the *economy* has a finite life, i.e., if *all* agent die before a given terminal time T, it follows immediately from (2) that

$$W_T = 0$$

At the end of the economy's time horizon, all it external debt will have been reimbursed.

What happens instead when the economy has an infinite horizon? Can we proceed to show that :

$$\lim_{t \to \infty} W_t e^{-rt} = 0 \quad ?$$

which is the corresponding budget constraint that an infinitely lived individual is subject to? The answer is : it depends.

When T -> ∞, it is always true that (5) implies that:

$$(5') \lim_{T \to \infty} W_T e^{-r(T-t)} + \int_t^{\infty} C_s e^{-r(s-t)} ds = \int_t^{\infty} \omega_s e^{-r(s-t)} ds + W_t$$

and we also know from aggregating (4) over all agents that :

$$(4') \int_t^{\infty} C_s e^{-r(s-t)} ds = \int_t^{\infty} \omega_s e^{-r(s-t)} ds + W_t$$

Yet these two equalities do not always imply (by substraction) that $\lim_{T \to \infty} W_T e^{-r(T-t)} = 0$. Indeed, one needs to distinguish two cases.

1) When the wealth of the nation is *finite*, i.e, when

$$\int_t^{\infty} \omega_s e^{-rs} ds < + \infty$$

then it does follow by substraction of (4') from (5') that the "transversality condition "

$$(6) \lim_{t \to \infty} W_t e^{-rt} = 0.$$

is satisfied.

This condition states that the present discounted value of aggregate wealth is zero (i.e. non negative) in the long run. It is the standard constraint which is imposed on an infinitely lived individual as an equivalent form to his budget constraint.

2) If the country's wealth is *infinite*, then (4') reads : $+\infty = +\infty$ and we cannot proceed to show that (6) is satisfied. Consider for instance the simple case of an overlapping generation model in which each agent i save S when young and dissave S(1+r) when old. Let N_t be the number of young agents and N_{t-1} the number of old agents. Take $N_t = (1+n)^t N_0$. The aggregate external position of the country is the stock of assets accumulated by the young agent, i.e. N_t S. When $n > r$, one sees that the present discounted value of the country's external wealth goes to infinity. When $S < 0$ (the young agents borrow) the country -as a whole- does not reimburse its debt (in present value terms) even though *each* individual agent does.

In the sequel to this paper, we shall only proceed to analyze the case when the wealth of the nation is finite. In that case, aggregating each individual budget constraint does deliver that the country -as a whole- repays its debt to the rest of the world (in present value terms). For all practical matters, the balance of payments does follow an intertemporal pattern which mimicks the cash flow of an infinitely lived individual which is subject to an intertemporal budget constraint.

II - THE RISK OF DEBT REPUDIATION

The analysis of the risk of debt repudiation is the second stage of the modern literature on external debt. It has been brought to life by the work of Eaton and Gersovitz (1981). Early work on the topic also include Kharas (1984), Kletzer (1984), Krugman (1985), Ozler (1986) and Sachs and Cohen (1985). One can read the useful survey by Eaton, Gersovitz and Stiglitz (1986) as well as the other papers in the special issue of the *European Economic Review* (June 1986) for an overlook of the state of the theory in 1985. An earlier useful survey is McDonald (1982). More recently a second generation of models of debt repudiation have applied the tools of modern bargaining theory to the analysis of debt rescheduling. The pioneering paper, here, is Bulow and Rogoff (1989a). Other early papers in this area include O'Connell (1988), Eaton (1989) and Fernandez and Rosenthal (1988).

The key to all such analyses is to determine the determinants of debt repayment, when taking account of the risk of debt repudiation. What kind of sanctions are necessary to induce a country to repay its debt? What are of the lessons of the debt crisis of the 1980's for asseesing their empirical magnitude? These are the questions that I would now want to adress.

1 - <u>An infinite horizon benchmark with a frictionless acess to the world financial market</u>

For simplicity of the analysis, let us assume from now on that the country is inhabited by a representative consumer who is endowed each period with a quantity $(Q_t)_{t\geq 0}$ of the numeraire. We assume that Q_t is a continuous process whose present discounted value (at world interest rates) is finite. Let us start by assuming that the country (i.e. its representative agent) has a free access to the world financial market.

Let us take the utility of the representative agent to be of the following separable form :

$$(7) \qquad U = \int_0^{\infty} e^{-\delta t}\, u(C_t)\, dt \qquad \text{with } u(C_t) = \frac{1}{\gamma} C_t^{\gamma}$$

$$\text{if } \gamma \neq 0 \text{ and } u(C_t) = \text{Log } C_t \text{ if } \gamma = 0.$$

with $\gamma = 1-1/\sigma$ and σ the intertemporal elasticity of substitution.

The agent's debt follows a law of motion :

$$(8) \qquad \dot{D}_t = r\, D_t + C_t - Q_t$$

and is subject to the transversality condition : $\lim_{t \to \infty} e^{-rt} D_t = 0$

The first order condition has the form :

$$(9) \qquad \dot{C}_t / C_t = \sigma \, [r - \delta]$$

so that three cases emerge.

1) $r < \delta$, the country is more "impatient" than the representative investor in the world financial market. In that case, the growth rate of consumption is negative and, asymptotically, the country drives itself to starvation by accumulating an external debt whose services eventually eats out the country's resources.

2) $r > \delta$

The reverse situation occurs. The country is more patient than the rest of the world and -asymptotically- owns the entire world. The assumption that the country is "small" with respect to the world financial market could obviously not be maintained in this case. It is a case that we shall not investigate here since -at any rate- the country is asymptotically a creditor rather than a debtor.

3) $r = \delta$

This is the threshold case when the country's subjective discount factor coincides with the world rate of interest. The country (i.e., again its representative agent) seeks to maintain a flat pattern of consumption over time.

2 - The risk of debt repudiation

Let us now assume that the country has the option of repudiating its external debt. We do not investigate, here, the bargaining implications of debt repudiation and simply assume that the country defaults whenever the level of welfare that it would reach by servicing its debt goes below the reservation level of welfare that it would have access to by defaulting. Let us now describe such a reservation level.

When a country defaults, we shall assume that the creditors cut all access of the country to the world financial market either as a debtor or as a creditor. This implies, in particular, that the country cannot accumulate reserve after it has defaults. This is an important restriction as the work by Bulow and Rogoff (1989b) has shown (see below). *Second*, we also assume that a defaulting country loses a fraction λ of its income so that its post-default pattern of consumption is simply :

(10) $$C_t = (1-\lambda)\, Q_t$$

The particular case $\lambda = 0$ is of interest in its own right and corresponds the case when the creditors' sanction against a defaulting debtor amounts to imposing financial autarky forever after the debtor has defaulted. We now want to investigate what is the equilibrium pattern of consumption under this threat of potential repudiation.

Let us call $\bar{D}_t$ the credit ceiling that the creditor will have to impose on the country so as to avoid default.

Call

(11) $$\underline{U}_t = \int_t^{\infty} e^{-\delta(s-t)}\; u[Q_s(1-\lambda)]\, ds$$

the reservation level of welfare that the country has access to by defaulting. $\bar{D}_t$ must be set so as to guarantee that

(12) $$\forall t \geq 0\ ,\ U_t \geq \underline{U}_t$$

in which $U_t = \int_t^{\infty} e^{-\delta(s-t)}\; u\,[C_s]\, ds$ measures the level of welfare associated with "servicing" the debt. In order to characterize $\bar{D}_t$ (and to definie more specifically how the "service" of the debt is optimally spread out by the creditors), we shall prove the following :

Proposition 1 :

On any time interval]a,b[on which the constraint (12) binds, the country services $P_t = \lambda Q_t$ to its creditors.

In the particular case when $\lambda=0$, Proposition 1 shows that the country will not service its debt on those time intervals during which it is rationed. In a different framework (when the country *can* accumulate reserves after it has defaulted) Bulow and Rogoff (1989b) have shown that short of direct sanctions ($\lambda=0$) a country will never service its debt. This is not quite what proposition 1 shows. In the framework that we analyze, it can indeed very well be the case that the country will decide to service its debt on those time intervals when it is *not* rationed (see below). In Bulow and Rogoff's analysis, these intervals correspond to the times when the country would accumulate reserves.

Proof - The proof of Proposition 1 is straightforward. Assume that

$$\int_t^{\infty} e^{-\delta(s-t)} u(Q_s(1-\lambda)) \, ds = \int_t^{\infty} e^{-\delta(s-t)} u[C_s] \, ds$$

on a time by interval]a,b[. Differentiating both sides yields:

$$u\,[Q_t(1-\lambda)] = u(C_t)$$

so that $C_t = Q_t(1-\lambda)$.

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Going from Proposition 1 to determining the credit ceiling $\bar{D}_t$ is not -in the general case- a straightforward exercice and very much depends on the nature of the problem. In the cases when the credit ceiling binds forever after the first moment when it started to bind, then one knows for sure that :

$$(13) \quad \bar{D}_t = \int_t^{\infty} e^{-r(s-t)} \lambda Q_s \, ds$$

since the service of the debt will -in this case- never exceeds λQ_s every period. This will typically be the case when δ is big and when (Q_t) does not exhibit much volatility. In this case indeed the debtor is "impatient" to consume and not too much concerned with the problem of making consumption less volatile than output. Consider instead the other extreme case when $\delta = r$ and when output is volatile. In this case there will be periods when output is high enough that the country will always *voluntarily* want to service its debt so as to leave open the possibility of borrowing when output is low. (On this point, see the useful survey by Eaton, 1991; a counter example, in a model with imperfect information, is offered by Atkeson ,1991). In such circumstances, the service of the debt may exceed $P_t = \lambda Q_t$. Consider for instance the case when λ=0. In that case, whenever the credit ceiling binds, one knows for sure that the debtor will not transfer anything and will consume C_t=Q_t. On the other hand, when the credit ceiling does *not* bind, we know (since δ=r) that the country will consume a flat amount. The pattern of consumption of the country is then a sequence of periods during which consumption equals output and a sequence of time intervals when the country does perfectly smooth out the fluctuations of output.

In all cases, however, we know for sure that $\bar{D}_t$ such as defined in (13) is a *lower bound* to the credit ceiling imposed on the country. Indeed, for sure, the creditors always know that they can recapture λQ_t every period (since, at worse, the country would then become indifferent between servicing the debt and defaulting).

3 - The solvency of a growing economy

Take the case of an economy which is exogenously growing at a constant rate $n > 0$: $Q_t = Q_0 e^{nt}$. If $\delta > r$, we know that the credit ceiling will be binding one day or the other. Indeed, consumption would otherwise fall to zero while the productive capacity of the country would grow exponentially. For any value of $\lambda < 1$, defaulting has to become a superior option. Conversely, when the credit ceiling starts to bind, we also know that it will bind forever. Indeed, given the homogeneity of the utility function it is straightforward to show that the credit ceiling constraint is simply growing exponentially at the rate n. We can then simply characterize the credit ceiling $\bar{D}_t$ through equation (13) and get :

$$(13') \quad \bar{D}_t = \frac{\lambda\ Q_t}{r - n}$$

Another simple way to characterize the lenders' behavior in this case is to write (13') as:

$$\lambda = (r-n)\ \frac{D_t}{Q_t}$$

When the credit constraint binds, the net service of the debt (λ) is equal to the amount of ressources which are needed to stabilize the debt-to-GDP ratio. This equation, which essentially amounts to deflate the interest rate by the growth rate in order to measure the cost of servicing the debt, was the key to early analysis of the debt crisis such as performed in Cline (1983) or Cohen(1985). It was coined by Dornbusch (1989) as the Avramovic-Cline model. Dornbusch and Fischer (1985) and Feldstein (1986) offer insightful implications of these dynamics.

Over the years 1983-90, the severely indebted middle-income countries transferred about 3% of their GDP to their creditors. Indirectly, this gives us an idea of the value of λ, the (direct) cost of debt repudiation. Domestic budgetary problems, however, should also be taken into account (see Reisen, 1989 and the studies in Sachs, 1989b).

III - PATTERNS OF GROWTH OF A DEBTOR COUNTRY

As the debt build up of the seventies unfolded its effects in the eighties, it soon appeared that the debt was too large to be serviced in full. It is in this context that the idea of a "debt overhang" was applied to the cases of the developing countries (see Sachs, 1989a). Debt becomes a "tax" on the countries 'ressources. As Krugman (1988) was to put it, it may then give rise to a debt-Laffer curve effect. This analogy between debt and tax for analyzing debt-equity swaps was developped by Helpman (1990) or Froot (1989). The implications of the risk of debt repudiation on growth are also examined in Marcet and Marimar (1991).

A Model of Growth and External Debt

Let us now proceed to analyze explicitly the (endogenous) pattern of growth of a debtor country which is subject to a credit ceiling constraint and investigate the extent to which the Laffer-curve effect is potentially important. The model that we use is derived from Cohen and Sachs (1986). It follows the "AK" structure which was popularized by Rebello (1991).

Assume that production in the economy arises from a linear technology of production:

(14) $$Q_t=aK_t$$

in which Q_t represents output at time t and K_t the stock of installed capital. The law of motion of capital is

(15) $$\dot{K}_t=-dK_t+I_t$$

in which the dot is the time derivative, d is the depreciation rate and I_t is the flow of newly installed capital. We follow Abel (1979) and Hayashi (1982) and assume that installing I_t new units of capital requires the firms to spend J_t such as :

(16) $$J_t = I_t(1+ \frac{1}{2} \phi \frac{I_t}{K_t})$$

in which $\frac{1}{2} \phi \frac{I_t^2}{K_t}$ represents an installation cost. Because the technology for installating capital and for producing the goods exhibits constant returns to scale, this model will yield an endogeneous growth equilibrium of the variety examined in Romer (1986).

We keep assuming that the economy is inhabited by a representative consumer whose utility is of the form (7).

Before analyzing specifically the pattern of growth of a country which is subject to a credit constraint, let us first analyze the two extreme benchmarks when the economy is closed and when it has a free access to the work financial markets.

1 - <u>Financial autarky</u>

When the economy has no access to the world financial market, domestic saving is the only source of finance for capital accumulation. One can readily analyze the closed economy equilibrium through the equilibrium value of the domestic interest rate. Call r_0 the financial autarky interest rate. Households determine the equilibrium growth rate of consumption through :

$$\dot{C}_t/C_t = \sigma\,[r_0-\delta]$$

On the other hand, the firms choose their investment rate so as to maximize the present discounted value of their cash flows :

$$\underset{(J_t)_{t\geq 0}}{\text{Max}} \int_0^{\infty} e^{-r_0 t}\,[Q_t-J_t]\,dt.$$

Given the linearity imbedded in the model, this program amounts to determining a domestic investment rate

$$x_0 = \frac{I_t}{Q_t}$$

and -equivalently- a growth rate of GDP :

$$n_0 = a\,x_0 - d$$

which are a solution to:

$$x_0 = \text{Arg} \max_x \frac{1 - x(1+1/2\ \phi\ a\ x)}{r_0+d-ax}$$

From the producers' side, x_0 is a decreasing function of r_0, and so is n_0 while, from the consumer's side, the rate of growth of consumption is an increasing function of r_0. The equilibrium is consequently (at best) uniquely determined as the rate for which output and consumption grow at the same rate. We assume, here, that the conditions are satisfied which guarantee such a unique solution.

In this model with a representative consumer and no externality, it is obviously equivalent to solve the social planner problem and to get directly the equilibrium investment and growth rates as the rates which maximize the consumer welfare. From this latter perspective, one can directly characterize financial autarky as the solution to the following system :

$$(17) \quad \begin{cases} n_0 = a\ x_0 - d \\ x_0 = \text{Arg} \max\limits_x \dfrac{1}{\gamma} \dfrac{[1 - x(1+\frac{1}{2}\ \phi\ a\ x)]^{\gamma}}{\delta - \gamma(a\ x\ -d)} \end{cases}$$

We assume that n_0 is positive.

2 - Free access to world financial markets

Let us now assume that the country is unexpectedly open to the world financial markets, on which a constant interest rate r prevails.

If the access to the financial market is totally free, the country obeys the Fisherian maxim and separates its decision to invest from its decision to consume. Focusing here on the decision to invest, the firms will choose their investment strategy so as to maximize the wealth of their shareholders, when measured at world interest rates.

Here again one can show that the equilibrium strategy amounts to selecting a fixed investment rate x^*, which is a solution to :

$$\max_{x} \int_{0}^{\infty} e^{-rt} [Q_t - J_t] \, dt$$

subject to (15), or equivalently find a solution to:

$$x^* = \underset{x}{\text{Argmax}} \frac{1 - x(1 + 1/2 \, \phi \, a \, x)}{r + d - a \, x} \qquad (18)$$

Whenever $r < \delta$ (which we shall assume) and when n_0 in (17) is positive, one can prove (see appendix 1) by comparison to (17) that the equilibrium investment rate and the corresponding growth rate -in (18)- are larger in the open economy than in the closed one.

3 - Credit Rationing

Let us now assume that the access to the world financial market is not entirely free but is subject to an aggregate credit rationing constraint. Following our earlier analysis, let us assume that the country can choose to repudiate its external debt and --subject to a penalty which the creditors impose on its domestic production-- return to financial autarky. Let us then assume that the post-default technology of production is characterized by the following :

$$Q_d(t) = a(1-\lambda) \, K_t \quad ; \quad 0 < \lambda < 1$$

all other things remaining equal. The country which has defaulted would then choose an investment and growth strategy which is a solution to (17) when $a(1-\lambda)$ is substituted to a. In order to avoid default, the banks must impose an aggregate credit ceiling on the country's external debt (since we imposed $r<\delta$). In order to determine how the credit ceiling constraint is imposed, we need to know how the banks monitor the repayments made by the country at the time when the credit ceiling binds. We shall distinguish here two regimes of repayments. In each case, we shall look for the loosest credit ceiling that the banks may impose without inducing the debtor to default.

a - Smooth repayments

Let first us assume that when the credit ceiling binds and sets at the maximum that is compatible with the non-repudiation of the debt, the lenders can monitor the growth strategy of the borrower(subject to the constraint of avoiding default). One can show (see appendix 2) that the banks can reach their constrained first best by requiring the debtor to pay :

$$P_t = z^*[r-n]\ Q_t$$

in which z^* is a constant which is the maximum one that the country can accept without defaulting (and is therefore an increasing function of λ, the cost of debt repudiation); r is the opportunity cost of funds for the banks, and n is the endogeneous growth rate that the country selects in response to this rescheduling strategy. The corresponding equilibrium investment rate is chosen by the country so as to

$$\underset{n}{\text{Maximize}}\ \frac{1}{\gamma}\ \frac{[1-z^*[r-n]\ -\ x(1+1/2\ \phi\ a\ x)]^{\gamma}}{\delta\ -\ \gamma\ n}$$

subject to $n = a\ x - d$.

One also show (in appendix 2) that the new equilibrium investment rate is always *below* the rate that would prevail when the country has a free access to capital markets. It is, however, *above* the rate which is obtained in the financial autarky case. In fact, investment can be shown to be an increasing function of the transfers z^* which the country has to make. In that case, the service of debt crowds *in* investment above the financial autarky level. When such a regime prevails, the larger λ, the larger the credit ceiling, the larger the observed debt, and the faster the growth rate! The intuition behind this paradoxical result is simply the following : the creditors are less impatient than the debtors, and they consequently value growth more than the debtor itself.

The larger λ and the larger their command on the domestic economy. In the extreme case when $\lambda=1$, z^* is at its maximum value and the creditors choose the socially efficient growth rate, the rate which maximizes (at world prices) the country's wealth.

b - Forced repayments

Assume now that the banks *cannot* monitor the investment strategy of the country nor that they can *commit* their rescheduling strategy to follow a given rule . In that case they can only make the payments they ask contingent upon the country's current resources. They therefore ask for a payment $P_t = b^* Q_t$ in which b* is small enough to keep the country from defaulting. (This argument is based on Cohen and Michel (1988)'s technique for calculating a "time-consistent" equilibrium). The country's response to this rescheduling strategy is one in which it chooses investment and growth as a solution to :

$$\text{(A7)} \quad \begin{cases} n = a\, x_{b*} - d \\ x_{b*} = \underset{x}{\text{Arg Max}}\ \dfrac{1}{\gamma} \dfrac{[1-b^* - x(1+1/2\ \phi\ a\ x)]^{\gamma}}{\delta + \gamma\ d - \gamma\ a\ x} \end{cases}$$

The comparison of this equilibrium to the one which is obtained under financial autarky shows that the new growth rate is necessarily below the financial autarky level.

This case of forced repayment may be identified with the "debt overhang" idea. Here, indeed, the larger the "debt tax" (mesured by b*), the lower the investment rate. Neglecting the adjustment cost, one can show that the equilibrium investment rate can be approximated by :

$$\text{(19)} \quad y_{b*} = y_0 - \sigma\, b^*$$

in which σ is the intertemporal eslasticiy of substitution, y_0 is the investment rate which prevails at financial autarky, and y_{b*}, is the investment rate which prevails when the debtor must pay b^*Q_t each period to its creditors. As one sees, under this regime the service of the debt crowds *out* domestic investment by a factor which is nothing else but the intertemporal elasticity of substitution. Importantly, if $b^* < 0$, i.e if the country *receives* foreign funds in a constrained fashion, equation (18) will also prevail.

Empirically, the work by Warner (forthcoming) challenges the view that debt caused the investment slowdown. He shows indeed that the terms of trade fluctuations go a long way toward explaining that decline. Cohen (*forthcoming a*) estimates an equation such as (19). When compared to a financial autarkic level, one does find that investment was crowded *out* by the net transfers that the countries were asked to perform. The crowding out coefficient was found to be "relatively" small, however, and worth 1/3 which corresponds -along the interpretaion suggested by equation (19)- to an identical value for the intertemporal rate of substitution (which is reasonnable). Interestingly, one also finds that, *in the sixties*, investment was crowded *in* by the *in*flows of foreign finance by a (statistically) identical factor of 1/3. (In quite a different setting Chenery and Syrkin, 1985, found a similar number.)

4 - The transition to the steady state

Let us now analyze the transition from a starting point where the country has no initial debt to the point where the country has reached its credit ceiling.

The analysis of the equilibrium growth rate is best undertaken through the analysis of the domestic interest rate. As long as the credit ceiling does not bind, the domestic interest rate is simply equal to the world interest rate. When the credit ceiling is hit, it jumps to the level which is consistent with the equilibrium investment rate which is reached in either of the two cases. If the smooth repayment regime prevails the domestic interest rate will be above the world interest rate but below the autartic rate. If instead the forced repayment regime prevails, the domestic interest rate will be above each of these two rates.

Whichever of these two rates prevails when the credit ceiling binds, the transitional dynamics now simply amount to investigating the effect on capital accumulation of a perfectly anticipated jump of the interest rate. With adjustment costs, investment is gradually declining from a level which is necessarily below the "free access" case to a level which is above or below the autarkic rate, depending on which regime of repayment prevails.

From a longitudinal view point it is now necessarily the case that *more* debt implies *less* investment (which would not have been the case, in a cross section analysis, if the smooth repayment regime had prevailed). Time series analysis of the debtor country which were performed along these lines (eg. Borensztein,1990) do find such a negative correlation.

IV - HOW TO WRITE OFF THE DEBT ?

Debt repurchases have played an important role in the solution of the debt crisis of the thirties on the 30's, (see Eichengreen and Lindert, 1989 and Eichengreen and Portes, 1986). Secondary markets (or at least secondary market pricing) have now become, once again, the core of many proposals to end the debt crisis (and indeed is already a key part of the Brady plan). (An early proponent of debt write-off was Kenen, 1983 ; in defense of voluntary debt write-off,see Williamson, 1988). We now turn to review briefly their potential role such as it has been couched in the recent literature on the subject and, especially, such as this role has been criticized in the academic literature by Bulow and Rogoff (1988), or Dooley (1989)). We then proceed to give some empirical evidences on the issue.

1 - A theoretical background: marginal and average prices

To set up the ideas in an explicit model, let us simplify the analysis undertaken thus far and consider a one period model of a country which owes a debt at the end of the period. Assume that the country always has the option to repudiate its debt and -again- also assume that the banks can (credibly) impose - in retaliation- a sanction that amounts to a fraction λ Q of the country's income. Finally, assume that the banks can always get the country to pay that fraction λ Q that the country would forego by defaulting. Call dF(Q) the density of the (random) distribution of the country's income. Let us take the banks to be risk-neutral. One can write the (beginning of the period) market value of a debt whose contractual value is D to be :

$$V(D) = \left[\int_0^{D/\lambda} \lambda\, Q\, dF(Q) + \int_{D/\lambda}^{\infty} D \,.\, dF(Q) \right]$$

The first term in the bracket represents how much the banks can get when the income of the country is so low that the country would rather default than servicing the debt fully (λ Q$\leq$ D). The second term measures the expected payments that accrue to the banks when the country honors the contractual value of the debt (an event which has a probability 1-F(D/λ)).

The market price of the debt (such as observed on the secondary market) can simply be written as :

$$q(D) = \left[\int_0^{D/\lambda} \frac{\lambda Q}{D}\, dF(Q) + 1-F\,(D/\lambda) \right]$$

If a country were, say, to repurchase one dollar of its debt on the secondary market, this is the price that it would have to pay. If instead the country wants to repurchase an amount B and is *known* to be willing to do so, then -as Dooley (1989) first pointed out- the price at which the transaction will be undertaken can only be the *ex-post* equilibrium price. (Otherwise, no lenders will actually sell its claim). One then gets that the price for the transaction has to be :

$$q(D-B) = \left[\int_0^{(D-B)/\lambda} \frac{\lambda Q}{D-B}\, dF(Q) + 1-F\,[(D-B)/\lambda] \right]$$

Obviously, if a debtor country is known to be willing to repurchase *all* of its debt (B=D) then the only price at which the transaction will be undertaken is q=1.

This crucial remark makes it very undesirable to set up, say, an institution -endowed with a given amount of money- which would operate openly to repurchase LDC debt. Such an institution would immediately raise the price and defeat its own purpose.

The point which is made by Bulow and Rogoff radicalizes this critique. Assume that the country (or an institution acting on its behalf) repurchases a small fraction of the debt so that, say, the measure the benefit that is captured by the country. For the country, what matters is the reduction of the market value of the debt, i.e :

$$\rho(D) \equiv V'(D) = 1-F(D/\lambda)$$

which is strictly (perhaps much) lower than q(D). So even if the country was repurchasing a fraction B of its debt one dollar after the other, repeatedly taking the creditors by "surprise" (i.e they never expect that the next dollar will be repurchased, but they always know -at each point in time- what is the exact stock of debt), it would still be over paying its debt since it would pay :

$$\rho = \int_{D-B}^{D} q(D)\, dD$$

which is strictly more expensive that :

$$\Delta V = V(D) - V(D-B) = \int_{D-B}^{D} \rho(D)\, dD$$

Bulow and Rogoff (1991) concluded that this wedge between the cost of a debt buy-back and its real effect on the market value of the debt makes it unlikely to turn buybacks into a profitable investment (see also the survey in Diwan and Claessens, 1989). Does this reasoning apply to the debt crisis of the 30s and lead to interpret the large buy-backs which were then performed as an unworthy investment? Not necessarily. As we pointed out in Cohen and Verdier (1990) a buy-back can be good if it is done *secretly*. If -say- Morgan repuchases Brazil's debt -held by Citicorp- on Brazil's behalf without revealing for whom the purchase is made, there are no limits to the extent of the repurchases which can be made by Morgan at the given price. (It is only when Brazil's actions are discovered that the price rises since only in that case the reduction of its outstanding external debt raises the price.) (Another argument in favor of buy-backs as an insurance device is offerred in Van Wijnbergen, 1990b).

Yet, as far as the open buy-backs such as those that the Brady deal encourages, it is obviously crucial to make sure that the price at which the buy-back is undertaken is appropriately priced. This involves a comprehensive *ex ante* agreement with the creditors, so that none of them can free-ride on the others. This is exactly what the Brady deal has done. In a process called "novation", it was agreed that all the previous debt had to be exchanged against one of the three options which were open.

In order to evaluate empirically how the Brady deal has worked I will first analyze how the distinction between average and marginal price can be reconstructed empirically.

2 - Econometric estimates

Previous econometric estimates of the secondary market involve Purcell and Orlanski (1988), Sachs and Huizinga (1988), Fernandez and Ozler (1991), Huizinga and Ozler(1992). I will rely here on Cohen (1992).

To the extent that we are interested in distinguishing the average from the marginal price of the debt, we want to estimate a price equation which yield explicitly such a distinction. In order to do that, I will use a logistic function of the prices to account for this discrepancy. Specifically, I obtain (for 1989 data):

$$(20) \quad \text{Log}\,\frac{q}{1-q} = -\,2.71 - \underset{(-3.44)}{1.47}\ \text{Log}\ D/Q + \underset{(5.31)}{5.48}\ \text{HUN} \;; R^2 = 0.72$$

in which D is the stock of the debt, Q is per capita income (such as measured by Summers and Heston, in % of 1980 US per capita income). HUN is a proxy for Hungary (Hungary is controlled for because it is the only country in the sample which did not reschedule its debt).

By differentiating both sides, we get :

$$\frac{dq}{q} = - 1.47(1-q) \frac{dD}{D}.$$

Call V = qD the market value of debt, one gets

$$(21) \quad \frac{dV}{V} = [1 - 1.47 (1-q)] \frac{dD}{D}$$

There is consequently a threshold price for which the elasticity of price with respect to debt is (in absolute value) smaller than one. The price, here, is

$q^* = 0.32$ cents.

In part coincidently, this price is not significantly different from the average price (=0.35) of the representative middle income debtor at the end of 1989.

One can also rewrite equation (21) as:

$$\frac{dV}{V} = 1.47 [q-q^*] \frac{dD}{D} ,$$

or equivalently, we can write that the marginal price is :

$$\rho = 1.47 (q-q^*) q.$$

Below that price q^* there is a case of "debt Laffer curve" : reducing the face value of the debt may *raise* its market value. As I emphasized in my earlier paper, however, there are only very few countries for which -with 95 % confidence- this mechanism is bound to appear. Around that threshold point, however, we can take the marginal price of the debt to be nil. Lenders, as a whole, are essentially indifferent between one more or one less dollar on their books. For countries which would repurchase their debt to the left of the price q^*, the deal would offer the bankers a "boondogle", as Bulow and Rogoff have put it for the Bolivian buy-back which occurred in 1987. Empirically, using similar tools of analysis the work by Diwan and Kletzer (1990) or by Van Wijnbergen (1990a)have shown that the Brady deal did succeed to price the debt appropriately.

Another illustration of equation (21) comes as follows. Consider a debt which is originally priced at 32 cents. Assume that the debt is unilaterally written down by 50 %. What is the real cost for the bankers of such a write-down ? Using equation (21), one gets that the 50 % write-off would bring the price to 0.57 so that the market value would go from 0.32 to 0.285. This only represents a 11 % write-off in real terms. In nominal terms, the result is more spectacular : a 50 % write-off only cost 3.5 % of the original value of the debt ! With a debt-to-GDP of 100 % (which is the average middle-income debtor level) this represents 3.5 % of GDP. (Similar conclusions are reached in the simulation studies of Bartollini and Dixit, forthcoming and Cohen, forthcoming a).

V - WHAT WILL BE THE FIFTH STAGE ?

As we moved through the four stages of the debt crisis we must wonder whether the debt crisis of the eighties should caution the developing countries against borrowing on the financial markets. Should we think that capital flows towards the poor countries should only be designed ,say, to smooth terms of trade fluctuations, or do we think that there is some scope for capital mobility to help the "poor" countries grow faster ? These are the questions that the fifth stage of the literature will have to adress. The new literature on growth originated in the work of Romer (1986) and Lucas (1988) will certainly offer the fifth stage its starting point. Already, Lucas(1990) has used this approach to challenge the view that capital, even if it were free of sovereign risk, should move from the rich to the poor countries. Similarly, the work by Barro and Sala-i-Martin (1991), comparing the pattern of growth of regions (free, one should think, of sovereign risks) within a nation to the pattern of growth of nations across the world rejected the view that there is much differences between them. Without entering, here, in this new and promising research agenda, one can venture hot debates, in the future, on the way one should draw the lessons of the debt crisis of the 1980s.

APPENDIX 1

FINANCIAL AUTARKY, DEFAULT AND FREE ACCESS TO THE WORLD FINANCIAL MARKETS

Let us first characterize the equilibrium to prevail *after* the country has defaulted ; i.e, when its production function is $Q_t=a(1-\lambda)K_t$. Financial autarky will appear as the particular case when $\lambda=0$. We can write the post-default level of welfare as :

$$U_\lambda = C_\lambda Q_0$$

(when t=0 is conventionnally set to be the time of default) in which C_λ is defined as :

$$\text{(A1.1)}\quad C_\lambda = \underset{x}{\text{Max}}\ \frac{1}{\gamma}\ \frac{\left[1 - \lambda - x\ (1 + \frac{1}{2}\ \phi\ ax)\right]^\gamma}{\delta + \gamma d - \gamma\ ax}$$

The first order condition for x is

$$\frac{1 + \phi\ ax}{1-\lambda-x(1+\frac{1}{2}\ \phi\ ax)} = \frac{1}{\delta + \gamma\ d - \gamma\ ax}$$

which can also be written as :

$$\text{(A1.2)}\quad \gamma(ax-d) + \frac{1-\lambda-x(1+\frac{1}{2}\ \phi\ ax)}{1 + \phi\ ax} = \delta$$

the left-hand side is a decreasing function of x ; its derivative is indeed :

$$- a(1-\gamma) - \frac{\phi a\ [1-\lambda-x(1+\frac{1}{2}\ \phi\ ax)]}{(1 + \phi\ ax)^2}$$

and it is also a decreasing function of λ. With positive growth ($ax \geq d$) the left-hand side of (A1.2) increases with γ. One consequently sees why $\gamma < 1$ and $\delta > r$ will imply that the investment rate is smaller after default ($\lambda > 0$) or under financial autarky ($\lambda=0$) than under free access to the world financial markets (which is obtained with $\gamma = 1$ and $\delta=r$).

APPENDIX 2

THE SMOOTH REPAYMENT CASE

Because of the linear structure of the model, the lenders who want to extract the maximum repayment from the borrowers must find a payment strategy $P=b^* Q$ and a constant investment rate x^* so as to solve the following problem :

$$\text{(A2.1)} \quad V_0^* = \underset{(b,x)}{\text{Max}} \int_0^\infty e^{-rt}\, b\, Q_t\, dt$$

in which : $Q_t = e^{nt} Q_0$ and $n = ax - d$

and subject to $\frac{1}{\gamma} \int_0^\infty e^{-\delta t} [1-b-x(1 + \frac{1}{2}\phi\, ax)]^\gamma Q_t^\gamma \geq C_\lambda\, Q_0^\gamma$

(Because of the linearity of the model this inequality implies that similar ones will be held in the future).

Define $\omega(x) \equiv 1/(r + d - ax)$ so that the lenders' pay-off can be written

$$\text{(A2.2)} \quad V = b\, \omega(x)\, .\, Q_0\, .$$

The problem faced by the lenders can then be written in the following more compact form :

Find z^*, the solution to :

$$\text{(A2.3)} \quad z^* = \underset{(b,x)}{\text{Max}}\; b\, \omega(x)$$

$$\text{Subject to} \quad \frac{1}{\gamma}\, \frac{\left[1 - b - x\,(1 + \frac{1}{2}\phi\, ax)\right]^\gamma}{\delta + \gamma d - \gamma\, ax} \geq C_\lambda$$

By duality this problem is simply that of finding the largest z* such that

$$\text{(A2.4)}\quad \underset{x}{\text{Max}}\ \frac{1}{\gamma}\ \frac{\left[1 - z^*\ \omega(x)^{-1} - x\ (1 + \frac{1}{2}\ \phi\ ax)\right]^{\gamma}}{\delta + \gamma d - \gamma\ ax} = C_{\lambda}$$

$$\equiv \underset{x}{\text{Max}}\ \frac{1}{\gamma}\ \frac{\left[1 - \lambda - x\ (1 + \frac{1}{2}\ \phi\ ax)\right]^{\lambda}}{\delta + \gamma d - \gamma\ ax}$$

which is what is stated in the text.

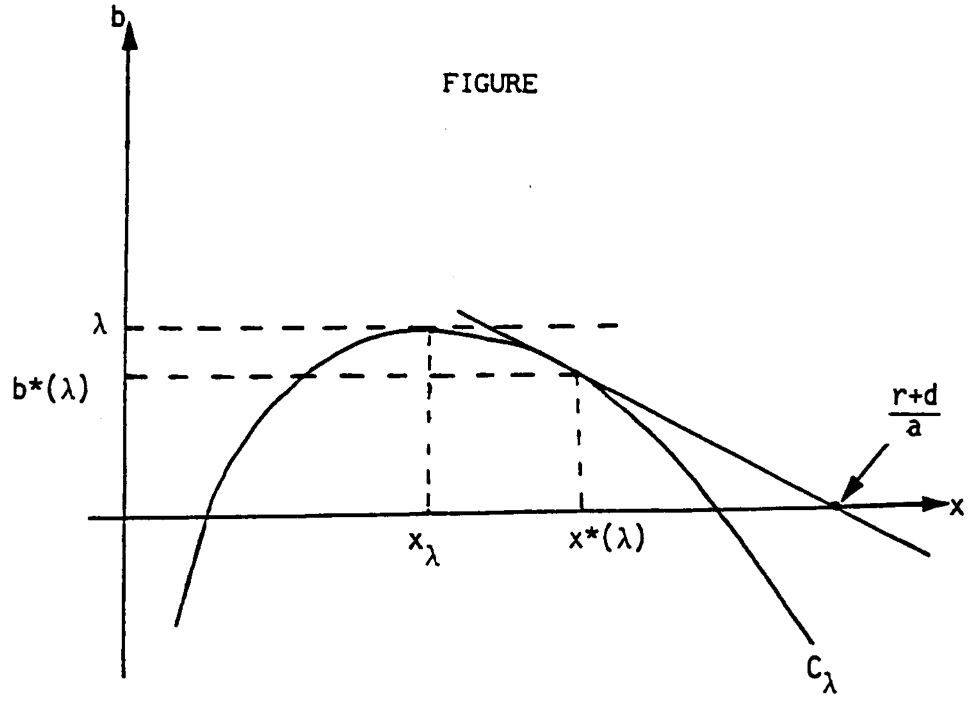
b - The geometry of the problem can readily be drawn as in the following figure in the space (x,b). The indifference curves of the debtor are :

$$\text{(A2.5)}\quad \frac{1}{\gamma}\left[1 - b - x\ (1 + \frac{1}{2}\ \phi\ ax)\right]^{\gamma} = C\left[\delta + \gamma d - \gamma\ ax\right]$$

and reaches their maxima on a line whose equation is (A1.2) and which is negatively slopped(see appendix 1). The utility C_{λ} is obtained when the maximum is at $b=\lambda$. When the lenders design the optimal repayment scheme, they choose a point $(b^*(\lambda),c^*(\lambda))$ on the indifference curve C_{λ} so as to get the largest z* such that :

$$\text{(A2.6)}\quad b = z^*\ [r+d-ax]$$

The tangency point is on the right to (λ,x_d) : it involves a larger investment rate $(x^* > x_d)$ and a lower repayment $(b^* < \lambda)$ than the post-default point.



As z* is increased (corresponding to a larger λ) the tangency point shifts towards the North-East : the country invests more and pays more, as stated in the text.

This also shows why investment is above the financial autarky rate (which corresponds to λ = 0) and below the socially efficient rate (which corresponds to λ=1).

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