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# AGRICULTURAL TRADE CONSEQUENCES OF THE INTERNATIONAL DEBT CRISIS\*

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## ABSTRACT

A number of approaches to analysing the international debt crisis have been proposed in the literature. For the debtor countries the issue of how debt 'overhang' can affect economic performance has been extensively studied. For developed countries, attempts have been made to show how the decreased economic performance of debtors can affect creditors through trade and financial linkages. This paper seeks to synthesise these two perspectives in a partial equilibrium framework. It is postulated that reducing the debt level in highly indebted countries would increase the value of world trade in agricultural commodities. The findings of the study are expected to help settle the thorny issue of debt forgiveness.

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## AGRICULTURAL TRADE CONSEQUENCES OF THE INTERNATIONAL DEBT CRISIS

*His fellow servant fell to his knees and begged him, 'Be patient with me, and I will pay you back.' But he refused. Instead, he went off and had the man thrown into prison until he could pay his debt. Matthew 18:29*

The developing country debt crisis has been one of the dominant factors in North-South relations over the last decade. Whilst the origins of international debt can be traced back to the 1948 reconstruction of Europe, and rescheduling of the 1960s, the "crisis" is commonly seen to have occurred in 1982, when Mexico led a series of nations in defaulting on their loans (Cline 1984,p.17). The precipitation of this crisis stemmed from a combination of policy actions in debtor countries, macroeconomic shocks in the world economy, and a remarkable spurt of unrestrained bank lending in the late seventies (Sachs 1989,p5). Even though the world recovery began in 1984, high rates of rescheduling, reduced rates of developing economy growth, and depressed agricultural trade, have continued well into the present.

The impact of the crisis on developed countries is commonly perceived to be a result of actions designed to restore confidence in severely overexposed US financial markets (Sachs 1990,p19). Restructuring of loans was typically subject to IMF conditionality, usually involving the liberalisation of foreign exchange and import controls, devaluation of the exchange rate, strict anti-inflationary fiscal and monetary policy, and incentives for foreign investment (Todaro 1989,p420). The history of these programs has shown that, while they may have helped with the process of adjustment, they have failed to restore growth and have produced unacceptable social costs (van der Hoeven 1989,p39). This fall out of the debt crisis has had a further impact on developed countries through trade linkages. From 1981 to 1984, trade from developed to developing countries fell by nearly 30 per cent, at least in part as a result of the crisis (GATT 1990, Table A3). Most developing countries are net exporters of agricultural products, but have also been major importers of the commodities that they are unable to produce. As Shane (1988,p4) suggests, "the main effect of the debt crisis has been to constrain world trade in general, world agricultural trade as a share of total trade, and US agricultural exports as a share of its total exports". Conditionality and the need for foreign exchange have forced many countries to reduce their imports and investment in domestic industries. They have also led to calls for creditors to forgive or reify some of the debt. Although threat to the financial system is less real today than previously, due to introduction of loan loss provisions in the US, the growth prospects for highly indebted countries are still bleak (Petracco 1991,p1).

This paper seeks to develop a model which can be used to analyse the consequences of the international debt crisis on international agricultural trade. Previous analytical approaches are examined to help achieve a model that synthesises the implications of developing country debt for a debtor nation with international linkages. The theory underlying debt relief is then presented to determine the way that debt impacts on the debtor economy.

prior to a review of previous empirical findings. The final sections establish the model structure and some observations on its possible findings.

### *Analytical Approaches*

With a problem of such significance, there is little surprise over the depth of issues that have been related to the debt crisis. Most of the work focuses on the determinants of growth literature championed by Rostow in the 1960s that has become the foundations of what Todaro (1985, p.114) called the "growth game". The key premise of this "game" is that developing countries are prepared to "take off" for growth, as soon as the necessary mobilisation of domestic and foreign savings occurs. The embodiment of theoretical link between investment and economic growth was provided by the famous Harrod-Domar Growth model. Given the problems of poor infrastructure and difficulties in capital formation, few would regard the Harrod-Domar model with the same reverence as previously - except perhaps for its empirical outcomes. Nevertheless, it has served to perpetuate the interest in investment as the key to economic growth, which has been prominent in many analyses of the impact of high levels of sovereign debt. For example, Krugman (1988), Bird (1989), Frenkel, Dooley and Wickham (1989), Borenstein (1993), and Hofman and Reisen (1984), relate indebtedness directly to domestic investment problems. Travelling down an almost parallel path, have been analysts that have focussed on debt as an international trade issue. Stern (1992) and Snape (1986) both introduce the debt crisis as a major issue in trade policy, a theme which is further taken up by Kreuger (1987), Saunders (1986), Larsen (1983), Shane (1988), Gunasekera, Bowen and Andrews (1990), Evans (1991), Bahwani (1992), Dornbusch (1989) and Evans (1991). There is clearly a dichotomy between the approach with a domestic focus and that with an international focus. Although some have tried to synthesise these two by using traditional or modified trade models (see, for example, Gunasekera et al 1990, MacKellar 1987, Dattas and O'Brien 1991), or by presenting a collection of smaller studies (see, for example, Cline 1984), as yet there seems to be little work linking the impact of the developing country debt on the debtor's economy with the burden on trade.

Added to this is the continual flux in the policy debate. It was ten years ago when Cline (1984, p.vii) noted that public policy on this issue was at a turning point, yet today there are still hundreds of policy proposals on the table (Faber 1990). The 1985 Baker Plan was introduced with much fanfare, but little in the way of new policy initiatives, focusing again on pursuit of partial adjustment policies, increased concerted lending and dispersion of public loans amongst international institutions (Alchin 1990, p1). In 1989, this initiative was superseded by the Brady Plan, a descendant of the Miyazawa Plan, which indicated recognition that countries could not repay their debts and had to be relieved of some of this burden (Biner and Kletzer, 1989). Although still criticised by many (see Petrucci 1991), it has, at least, served to raise interest in forgiveness of debt, and the creation of some international institution to take care of this (see symposium in Rogoff 1990).

In sum, it seems that there is much interest in the impact that debt has on economic growth in the developing countries, and growth of the world economy through intercountry linkages. This interest has led to many developments in policy, both realised and proposed, that are hampered by a shortage of empirical analyses that encompass both growth and trade impacts. Perhaps one of the reasons for this dearth of empirical work is the fact that the theory of debt relief, as will be seen in the next section, is still subject to contention.

### *Theory of Debt Relief*

As Corden (1991, p135) suggests, when discussing the theoretical issues of sovereign debt, it is useful to distinguish between debt relief and debt reduction. Debt relief is any action that reduces the present value of payments due, whilst debt reduction is any action that reduces the present value of debt payments due. Creditors may be unwilling to accept debt reduction as it simply lowers their maximum possible outcome. But may support debt relief if a reduction in the face value of debt increases the actual repayments made: effectively bringing a Pareto improvement. There also arises confusion about whether or not debt reduction is actually a worthwhile action from the point of view of the debtor. For example, the exchange of debt for equity merely transforms the type of repayment to dividends, rather than erase it completely (p137).

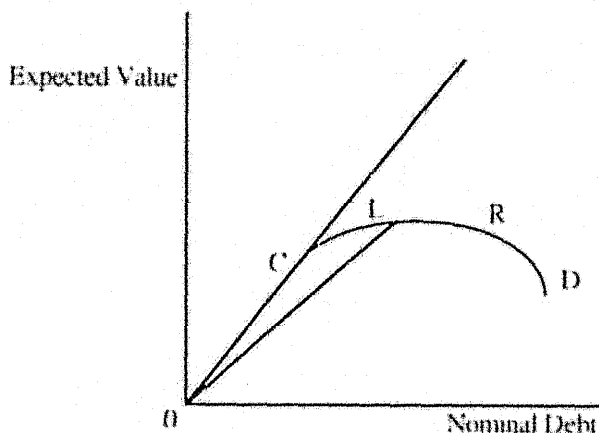
Of particular interest, then, to policy analysts is the case of the achieving a Pareto improvement, that is debt relief leading to an increase in an expected value of the repayments. Corden advances three arguments for the case (1991, p138). Firstly, it avoids costly punishment for default; secondly, it increases investment and subsequently capacity and willingness to pay; and thirdly it removes some of the unwillingness to undergo the adjustment or sacrifices necessary to facilitate repayment. Krugman adds to this the possibility of removing a debt that could take away the possible positive trade impact of currency devaluations, by making the increase in domestic currency cost of debt cause a deficit blowout (Rogoff 1990). Central to the possibility of a gain in expected value is that the ability to repay is linked closely to income. Although the exact nature of this relationship is controversial, it is an outcome of any reasonable incentive based theory (Rogoff 1992, p476). What is also strongly debated is whether these possibilities for gain are of sufficient resilience to displace concerns creditors have about lowering payoff ceilings.

It becomes apparent from above, that the notion of incentives is central to the behaviour of investment capacity and the decision to repudiate. Krugman and Sachs are often cited with providing the theoretical underpinning for a "disincentive model" through the debt overhang hypothesis (see Krugman 1989 and Rogoff 1990). If debtors' obligations are sufficiently large, then the expected value of their debt will decrease dramatically. Therefore, debt

reduction can be mutually beneficial as a decline in the debtors' obligations increases the expected value of the creditors' claims (Kenen, 1990, p. 11).

These concepts are summed up in Krugman's Debt Relief Laffer curve, reproduced in Figure 1. If debt is at a level which is expected to be fully repaid, then its expected value would equal the face value of the debt, and the outcome would lie on the 45 degree line. As the possibility of non-payment grows, so too the expected value will fall below the face value of the debt, following the curve CLRD. At any point, such as L, the ratio of expected value to nominal debt is given by the slope of the ray from the origin, which could be seen as an approximation of secondary market price for debt. If there was a reduction in debt by forgiveness at L (that is, a movement to the left around the CLRD curve), there would be a decline in the expected value of the debt, and creditors would have been ill-advised in their generosity. If, however, the reduction took place on the right hand side of the curve (if at point R, for example), the subsequent movement around the curve would increase the expected value of the debt, implying a distinct payoff from forgiveness.

FIGURE 1  
*The Debt Relief Laffer Curve*



Whilst it would not be contentious which side of the curve many highly indebted countries (HICs) are on, Krugman acknowledges that this is a difficult device to use in practice. There are, however, some useful insights provided by this framework, namely that there are some cases when debt should be forgiven, equally so, there are some cases when it should not. Both forgiving and financing an overhang are appropriate under different circumstances (see Krueger, 1987, p163-164). As secondary discounts cannot always be passed on to debtors (if at point L, for example), the market based debt reduction schemes may not work. In fact, from the

curve, Krugman argues that the conditions for success of alternative debt reduction schemes are the same as those for forgiveness.

It appears, then, that the theory of debt relief points to the possibility of forgiveness actually bringing about gains to all players through removal of a debt overhang. This provides the link between high levels of indebtedness and economic growth that have been the focus of many analysts' concerns. In the next section the support for the debt overhang hypothesis is discussed, to establish the foundation for its inclusion in the developing country model.

#### *Previous Approaches And Findings*

Support for the Debt Relief Laffer Curve is by no means universal, its existence perhaps being as controversial as its namesake (see discussion in Rogoff 1992,p477). As many authors have noted, the hypothesis is broadly consistent with theory and with observations of falling investment that coincided with increasing debt burdens (Rogoff 1992 p476; Perasso 1991,p6; Savvides 1992,p363). However, as Morisset (1991,p641) notes, empirical analyses are rare, and follow two general directions. The first direction looks at the responsiveness of the face value of debt with the secondary market price (a negative correlation between these indicates being on the "wrong side" of the overhang). The second explores investment and savings behaviour to determine the influence of debt burdens (Hofman and Reisen 1991,p281).

Of the former type of analysis, Perasso (1991,p11), regressed secondary market prices of debt on variables that indicate indebtedness, to find the results to be inconclusive with regard to the presence of a debt overhang. Claessens (1990,p373) examined the same relationship for 29 countries in 1988, and found only five were on the "wrong" side of the curve. Summing up this approach, Hofman et al (1991,p281), argue that the common finding of secondary market price being inelastic to the debt face value, lends support to the idea that there is no debt overhang, although realistically these studies appear to be consistently inconclusive.

The second type of analysis looks at the impact of debt on investment behaviour, often using very simple investment function specifications. Eaton (1990,p48) calculates the marginal tax rates on increments of GDP imposed by commercial creditors to be around 1.1 per cent, which he admits is inconclusive, though indicative of no debt burdens. Against this, Fain and De Melo (1990) and IMF (1989) all find evidence of a debt disincentive on investment. Partly in response to the simplicity of the IMF study, the analysis by Hofman et al (1991) specifies more complex functional forms for investment and consumption, which they claim yield results that reject the debt overhang, when actually they are inconclusive. The model of Savvides (1992) incorporates the impact of foreign capital inflows on investment, which shows that, while commercial capital

inflows are significant, the debt overhang is also found to exert a significant negative impact on investment, supporting the IMF conclusions. As noted by Savvides (1992,p364), the problem with measuring the impact of debt on investment is that it is hard to isolate the debt overhang from other factors, perhaps only indirectly related to the debt level. Continuing in this vein, Borensztein (1990) uses simulations from a rational expectations growth model to demonstrate that credit rationing could be just as important a cause of investment slowdown as debt overhang. Morisset (1991), in a more complex macroeconomic model of Argentina, indicates investment, and consequently economic growth, are quite responsive to debt reduction programs through both reduction in the stock of external debt and an incentive effect on private investment (p641).

Whilst the focus of the preceding material is on models that have linked debt to countries through an overhang model, there have been other studies that focus more on the impact of the debt as a drain on expenditure. The Otam and Villanueva model (1989 and 1990) is a macroeconomic growth model, built for debt analysis, that treats debt in this fashion. Although their empirical results are inconclusive, the authors conclude that the interest rate on debt, which is one of the main determinants of a debt burden, has a detrimental impact on long-term growth, and they support calls for additional finance and structural assistance in this area (Otam and Villanueva 1990, p778,780).

In a multi-country, multi-commodity framework, Gunasekera et al use the SWOPSIM model to determine impact of debt reduction on agricultural trade (1990). Whilst investment and consumption are not modelled explicitly, relief policies are treated as shocks to permanent income (proxied by changes in interest payments on debt) and higher growth rates of GDP. Although the results for different countries were varied, they strongly indicated an increase in all commodity prices following a debt write-off. Another multi-country analysis was constructed by Ditus and O'Brien (1991) who developed macroeconomic models of four major Latin American debtors, and simpler models for other HICs, which were integrated into the structure of the OECD's INTERLINK model. Although not explicitly used for analysis of debt policies, it has been used to illustrate the relationships between OECD nations and debtor countries. The general equilibrium trade model established by MacKellar (1987) was constructed for debt analysis by incorporating seven less developed country (LDC) regions into the Wharton Econometrics World Econometric Model, with an explicit model of a debt "sector". Although the model had some forecast problems, a simulation of a comprehensive debt-relief policy package in 1980 indicated that the Latin American crisis could have been avoided. Some of the assumptions in the policy package he considered were rather unrealistic. However, the analysis presents some support for the findings of the partial equilibrium analysis of Gunasekera et al (1990).

The empirical analyses examined above contain some significant problems that are yet to be fully addressed. Perasso (1991,p20) suggests that there is a distinct form of the overhang called the social debt overhang, which represents the reduction of government spending on social purposes like education and health. Although his



empirical analysis does not clearly support this claim, it is possible to consider that outstanding debt could act as a tax on human capital formation. Another issue that has not really been considered is the way the "tax" from the overhang could be carried by different groups, introducing an equity dimension to the distribution of debt impacts (Borensztein 1990,p331). Additionally, Borensztein indicates ways in which debt overhang may be underestimated by both using smooth neoclassical investment functions, and ignoring significant bargaining costs (1990,p331).

A problem also relates to the measurement of the debt overhang which, in effect, is the difference between the face value of the debt outstanding and its market value (Hofman and Reisen 1991,p283). The size of the debt outstanding is not an effective measure of this, the disincentive effect only arising when a country cannot meet its contractual obligations. As a result, commonly used overhang measures are debt to export, debt to GDP, or various debt service ratios (described in McDonald 1982), which are all endogenous to some extent (Savvides 1992,p373). Related to this problem of measurement, is the issue of using these values against investment. It is implicitly the average effect of the debt overhang that is being examined. As Borensztein (1990,p331) points out, for purposes of computing the tax on investment, it is the marginal effect of the debt overhang that is of interest, and thus it is the change in these variables that should be considered rather than their absolute values.

Of the previous research into the impact of high levels of sovereign debt, several observations become apparent. The first is that the conclusive studies are those which specify investment functions allowing for the influence of debt loads. The second is that analyses on international trade linkages have indicated potentially high gains from removal of these burdens. Perhaps due to the complexity of the interactions being observed, all these studies suffer from problems relating to the nature of the debt impacts, specification and definitional issues.

There are still many additional questions about the effect of debt reduction. However, it appears that there is scope for forgiveness removing some of the impediments to LDC growth and creating a Pareto improvement. Whilst it may be argued that these results are generally supportive of a debt overhang having impact on investment behaviour, they also lend support to the idea that the impact is through the interaction of a number of mechanisms (as postulated by Morisset 1991,p641). Previous findings lend support for using specified functions for investment and consumption, and the movement away from single equation methods where possible. The literature surveyed in this section is strongly supportive of the need for further empirical modelling of the impact of the debt crisis, in a framework that incorporates the debt overhang, so that the repercussions for trade can be examined. A simultaneous equation model consistent with these requirements is proposed in the next section. The hypothesis to be tested is that the reduction in debt levels will result in an increase in the value of world trade, and therefore incomes, for both debtor and creditor nations.

## *Model*

In this section a simple model is established that addresses the issues raised above. It captures the essence of the impact of the debt crisis on a microeconomic model of a LDC economy based on macroeconomic underpinnings. The model has three broad components: an output market, input markets, and a simple trade model, the derivations of which are described below. A schematic representation of the model appears in Figure 2.

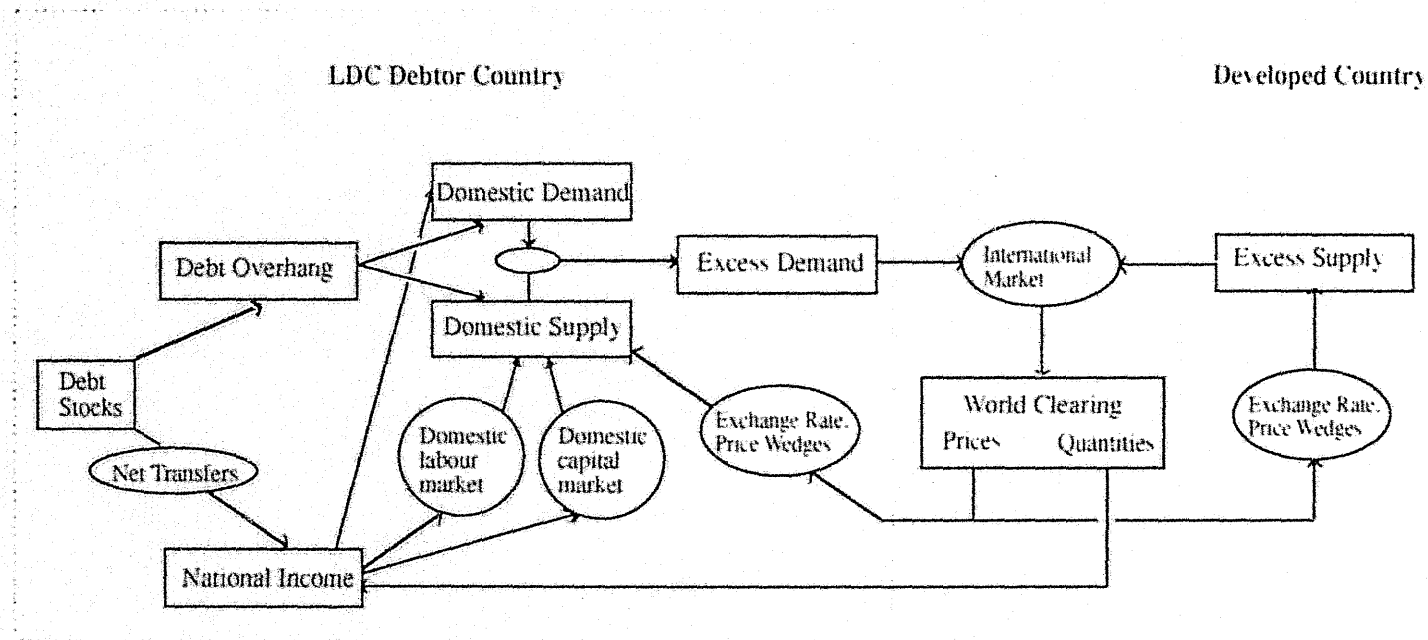
### *Output Market*

The output market is based on a neoclassical microeconomic model of firm supply and household demand with macroeconomic foundations similar to those of the more traditional growth models. Supply and demand functions which are influenced by the presence of a debt overhang are derived and are then used to determine excess demand in the reduced form of the model. These two relationships are described independently.

Looking firstly at the supply side, it has been widely accepted that, whilst the major problem facing industrial countries is deficiency of aggregate demand, LDCs suffer primarily from constraints on production. When analysing supply in LDCs a number of issues have been raised. Dualism in the labour market should be explicitly incorporated (Behrman and Hanson 1979); aggregation may disguise the impact of policies on relative prices, and potential policy variables are often overlooked, for example, exchange rate overvaluations which are subject to policy revision. The importance of retained earnings for investment and direct flows are often discarded by ignoring the dysfunctional nature of capital markets. There is little attempt to integrate the short-run income determination models with long-run development models - including dismissing human and social capital. There is also a tendency to ignore economy-wide disequilibrium.

When considering the production functions for agricultural goods in these countries careful attention must be given to the treatment of labour and capital. Looking at the treatment of labour, human capital has been recognised as a major determinant of output in many developing countries by several studies. It is often hypothesised that this problem stems from the importation of production technologies that require a high level of skilled labour inputs, shortages of which can be a significant limitation on the possibilities for production. Skilled workers or levels of human capital are normally assumed to be linked to spending on education by governments.

FIGURE 2  
Model Components



Incorporation of capital constraints is important in capturing the supply side rigidities that are observed in developing countries. Technology which was purchased during times of freely available capital, because of the "putty-clay" nature of investment, exacerbates the bottlenecks imposed by capital shortages. The central importance of capital stock growth (investment) is highlighted by many growth models, which follow to some extent from the Harrod-Domar framework (for example, 2 and 3 gap models), where output is closely related to investment. The main underpinning of the debt overhang hypothesis is that investment is "taxed" by high levels of sovereign debt.

The model developed for supply in the developing countries uses a production function that includes capital, labour and education as inputs (the latter in the tradition of Jamison and Lau's work on education and farm efficiency, 1982). With regard to functional forms, most authors use the restrictive but nevertheless robust Cobb-Douglas (C-D) type of specification, or alternatively, a constant elasticity of substitution (CES) analysis. Shih, Hushak and Rask (1977) have argued that a better alternative (based on empirical investigations in Taiwan) is the transcendental log function (translog), which relieves many of the restrictive assumption of the C-D, without introducing the computational difficulties of other forms. Following on from this observation, a translog function is adopted.

$$(1) \quad \ln Q_p = a_0 + a_1 \ln L + a_2 \ln K + a_3 (\ln L)^2 + a_4 (\ln K)^2 + a_5 (\ln L \cdot \ln K) + \epsilon_1 \ln E + \mu$$

where  $Q_p$  represents quantities produced, L is labour, K is capital, and E is level of education or extension services. Note that regional and commodity subscripts are omitted (that is, Q refers  $Q_{rj}$ , where r=region, j=commodity).

The marginal productivities for L, K, and E are as follows

$$(2) \quad MP_K = \frac{Q \cdot \partial \ln Q}{K \cdot \partial \ln K} = \frac{Q}{K} (a_2 + 2a_4 \ln K + a_5 \ln L)$$

$$(3) \quad MP_L = \frac{Q \cdot \partial \ln Q}{L \cdot \partial \ln L} = \frac{Q}{L} (a_1 + 2a_3 \ln L + a_5 \ln K)$$

$$(4) \quad MP_E = \frac{Q}{E} \epsilon_1$$

where the coefficients draw their definitions from (1), for example,  $\epsilon_1$  is the elasticity of production with respect to the government spending on education or extension. To capture the process of investment in the supply process, a simple neoclassical investment model is used (see Junankov 1972, and Plasman 1975) which derives demand for investment through maximisation of a profit function subject to a production constraint and an identity which describes investment (similar to Oit, Oit and Yoo 1975).

The profit function takes the general form

$$(5) \quad \pi = p^o Q - p_k I - wL - p_e E - tax$$

where  $p^o$  indicates the price the producer receives for his output,  $p_k$  = the price per unit capital,  $w$  = wage,  $p_e$  = the price of extension or education services, and  $tax$  refers to that on investment. The firm is assumed to maximise profit over time subject to the production constraint (1) and the investment identity  $K(t) = I(t) - \delta K(t)$ ,

where  $\delta$  is the rate of depreciation of capital stock. The derived demands for  $E$ ,  $I$  and  $L$  from this optimisation are then substituted back into the profit function. Taking the derivative with respect to output, the supply curve is established. If we make the simplifying assumption that the change in growth rate of capital price is not influenced by a change in output (a weak form of small country assumption), the general form of the subsequent supply function can be written as

$$(6) \quad Q^s = f(p^o, p_k, p_{k,t-1}, \ln p_k, u, \epsilon_t, \delta, ip, \ln w, \Delta)$$

where  $\Delta$  is the year, acting as a technical change proxy,  $u$  is the tax rate on investment, and  $ip$  is the before tax rate of return on investment. If we assume that the tax rate on investment due to the debt overhang is a linear function of the debt overhang,  $D$ , in time  $t$  this can be re-written as

$$(7) \quad Q^s = f(p^o, p_k, p_{k,t-1}, \ln p_k, D, \epsilon_t, \delta, ip, \ln w, \Delta)$$

Equation (7) forms the basis for the supply side of indebted countries in this model.

In a manner analogous to the supply side derivations, the demand side of the output market is based on a neoclassical model of aggregate household demand. Demand considerations in developing countries have generally stimulated less interest than those of supply, partly as a result of the dismissal of aggregate demand (and government for that matter) in many of the growth models of the 1960s. The LDC's have distinctive economic characteristics which often make the transferral of demand models from industrialised economies inappropriate. Several hypotheses on consumption in LDC's have been proposed

- Because of the existence of a large number of individuals near subsistence levels, consumption may not be proportional to income, even in the long-run - if true, this high marginal propensity to consume (MPC) at low income levels may imply a high multiplier.
- Retained business earnings may be an important source of savings (therefore analyses should distinguish between retained and unretained sources of income in business).
- The MPC of income generated by export sectors may be higher than elsewhere. Therefore the inclusion of a separate argument of income from exports may be desirable. This modification would further increase the impact of the foreign sector on stabilisation.
- If interest rates are controlled, then a policy model should include the effect of their de-control on consumption. Controlled interest rates may increase the substitution between foreign and domestic saving.

- Many authors have noted the significance of the permanent income hypothesis in relating consumption patterns in developing countries; Gunasekera et al 1990, Hofman et al 1991, both utilise this in their studies. The maintained hypothesis is that the borrower will divide consumption between now and the future, with permanent consumption being a function of permanent income (Hofman et al 1991, p289-90).

The alternative specification of debt chosen in this model is that debt acts like a tax on future consumption. The argument supporting this is that if there exists a debt overhang, for debtors who reduce consumption now by facing up to the necessary adjustment, the benefits will be taken by the creditors. Therefore, the overhang discounts the future value of permanent income streams of consumers. The discussion below describes the derivation of demand curves for a commodity that encapsulates subsistence consumption needs and a consumer's decision to consume on the basis of permanent income.

Consider a region (assumed to be analogous to the household in behaviour) that borrows for consumption purposes. Two factors are considered when determining the form of the demand function, the first is the nature of the utility function which is to be maximised, and the second the form of the maximisation process. The Stone-Geary function has found considerable acceptance in developing countries due to the provision it has for subsistence levels of consumption. Its derived demand counterpart is the linear expenditure system. However, as with the supply equations, it is important to consider the consumption decision as a function of wealth over time if we are to encapsulate the dynamic constraints (alluded to by Eaton 1993) and the permanent income hypothesis. The major contribution to this area is that of Luch's (1970) extended linear expenditure system, as discussed in Powell (1974), and with revisions in Johnson, Hassan and Green (1984).

Luch begins with a consumer, with discount rate  $\rho$ , who is trying to maximise the stream of utility over  $n$  periods of time

$$(8) \quad U = \int_0^n e^{-\rho t} u[Q(t)] dt$$

This is maximised subject to the a lifetime wealth constraint, composed of a stream of earnings from initial endowment of labour (or other non-financial productive assets), and an exogenously given time path for prices, which is stationary over the planning period. An initial endowment of other wealth,  $w(0)$ , earns a market rate of interest, and accumulates according to the following relationship

$$(9) \quad \dot{w}(t) = r w(t) + v(t) - p^1 Q(t)$$

in which  $\dot{w}(t) \equiv \frac{d[w(t)]}{dt}$ ,  $v(t)$  is the stream of earnings on productive assets,  $r$  is the rate of market interest, and  $p^1 Q(t)$  is the total expenditure in the planning period

Assuming consumption is positive and there are no bequests from the end of the planning period (that is,  $w(T)=0$ ). The lifetime budget constraint can be reduced to the following stock balance

$$(10) \quad p^T \int_0^T Q(t) e^{-\rho t} dt = w(0) + \int_0^T y(t) e^{-\rho t} dt$$

Carrying out the Lagrange-Euler optimisation and assuming a Stone-Geary Instantaneous Utility function of the form

$$(11) \quad u(Q(t)) = \sum_{j=1}^k \beta_j \log(Q_j(t) - \gamma_j) \quad (0 < \beta_j < 1; j = 1, \dots, k)$$

where again  $j$  denotes a commodity,  $\gamma$  is the subsistence (committed) consumption,  $p^T \gamma$  is the committed expenditure for purchases of base amounts of all goods, and  $p^c$  represents a price paid by consumers. The solution can be reduced to

$$(12) \quad p_j Q_j = p_j^c \gamma_j + \frac{\rho \beta_j}{r} [z - p^T \gamma]$$

Dividing through by  $p_j^c$ , and dropping planning time by considering replanning as a continual and costless exercise

$$(13) \quad Q_j^c = \gamma_j + \frac{\rho \beta_j}{r p_j^c} [z - p^T \gamma]$$

In the demand equation above,  $z$ , represents a permanent income variable, where

$$(14) \quad z_t = Y_t + L_t(v)$$

that is, permanent income is income in time  $t$  plus the present value of change expected in income from factors of production owned by household. Assuming that the disincentive impact of debt overhang acts on permanent income through this latter variable, in as much as the expectation on  $v$  is a simple linear function of the debt overhang at time  $t$ ,  $D_t$ , the demand can be expressed as

$$(15) \quad Q_j^c = \gamma_j + \frac{\rho \beta_j}{r p_j^c} [Y_t + f(D_t) - p^T \gamma]$$

If we aggregate this household model up to the regional/country level, and include a population as an independent variable ( $N$ ), the above equation can be expressed more generally as

$$(16) \quad Q_j^c = \int \left( \gamma_j, \frac{\rho}{r}, \frac{1}{p}, Y, D, p^{c*}, \gamma^{c*}, N \right)$$

where the "sub" superscript indicates that parameter belongs to a commodity that is a substitute to good  $j$ .

### *Domestic Input Markets*

The first submarket considered is the capital market where the price of capital, effectively the domestic interest rate, is determined. Edwards and Khan (1985) have observed that research into the determination of interest rates has come to greater prominence with the growing realisation that it is influenced by world activity, and the

growing emphasis being placed on financial liberalisation in developing countries, perhaps due to realisation of its links with economic growth (Fry 1980). Although the exact nature of interest rate formation is extremely complex (see, for example, discussion in Bottomley 1975) and depends on the degree of openness of the economy, a model for empirically evaluating the determination of the nominal interest rate which allows for greater or lesser degree of openness has been proposed by Edwards and Khan (in Edwards et al 1985, and Khan 1985). The general form for the model, which is adopted here, is as follows

$$(17) \quad p_A = r^d = f(r^w + e, \ln Y, \ln m_{t,t-1}, \pi^e, r_{t-1}^d)$$

where  $r^d$  = nominal domestic interest rate,  $r^w + e$  = world interest rate plus the expected rate of change of exchange rate,  $y$  = real GDP,  $m_t$  = narrow money balances, and  $\pi^e$  is the expected rate of inflation.

The key foundation of the labour market emanates from the classical formulation from Lewis (1955) and apparent in the works of Harris and Todaro (1969). As MacKellar (1987, p27) suggests, these models usually consist of a surplus of labour from stagnation of agriculture and high population growth rates, which can be hired or persuaded to migrate for a near subsistence wage. Once this pool of labourers is used up, an upward sloping supply curve emerges. Contrary to the common perceptions, Harris and Todaro (1969) established that wage movements and economic growth does play an important role in the firm's employment decision in developing countries. Economou and Panaretou (1976) emphasise the role of effective demand expansion in eroding structural unemployment that is not considered by the application of traditional (Phillip's Curve) models of employment (p121). One of the key problems in determining the wage rate is that there exists a high availability of unskilled labour, whereas human capital is relatively scarce; however few models have been able to account for this. It would also be preferable if the labour market were disaggregated, but this market is commonly in a highly aggregated form due to data problems created by a large informal sector. MacKellar (1987, p27) suggests that common variables employed in equations defining wage rates are the rural subsistence wage ( $w_{sub}^r$ ), the level of urban unemployment ( $U$ ), inflationary expectations built into wage negotiations, the government minimum wage ( $w_{min}^g$ ), and real activity. Although data limitations are the major constraint on this formulation, the wage determining equation takes the general form of the above. That is

$$(18) \quad w = f(w_{sub}^r, U, \pi^e, w_{min}^g, Y)$$

#### *Developed Countries Models*

As the focus of this analysis is on the impact of debt on the developing economy, there is no explicit formulation of supply and demand for the developed economies. Instead excess supply functions are specified as a change in previous exports depending on a dynamic function of prices in equation (19).



$$(19) \quad T_{rj} = \alpha_0 + \alpha_1 T_{rj(t-1)} + \alpha_2 P_{rj}^p + \alpha_3 P_{rj}^p(t-1)$$

where  $T_{rj}$  = trade or excess supply from region  $r$  of commodity  $j$ . Prices and their lags are defined as in equations (21) and (22).

### Trade Model

The previous domestic market specifications are linked to the rest of the world through a simple, non-spatial, price equilibrium model which assumes that the world market price is determined simultaneously by the supply and demand balance of all trading regions, such that the global market clears. The solution gives these prices and net trade of each region but not source-destination trade flows. This was chosen for both its simplicity and ability to easily account for the extensive domestic market detail (Thompson 1981,p15). Prices in all regions are linked to a "world market price" for each commodity, which is translated via exchange rate movements and price "wedges" which account for trade barriers, in the tradition of the SWCPSIM model (Rommgen 1991). The necessary equations are found in (20) to (23). The trade identity is given by

$$(20) \quad T_{rj} = S_{rj} - D_{rj}$$

and price equations are as follows

$$(21) \quad P_{rj}^c = CSW_{rj} + ER_r P_j^w$$

$$(22) \quad P_{rj}^p = PSW_{rj} + ER_r P_j^w$$

where  $P^c$  is a price faced by a consumer,  $P^p$  a producer price, which is linked to  $P^w$ , the world price, via the exchange rate, ER (domestic currency equivalent of the dollars used in world price). The terms CSW and PSW are consumer and producer price wedges which represent different transfer costs from protection or otherwise.

The world market clearing identity is represented by

$$(23) \quad \sum_r T_{rj} = 0 \quad \forall j = 1, \dots, k$$

In addition to the above equations, allowance has to be made for the income created by increased trade and reduced net transfers increasing a country's income. For simplicity, this is represented by the volume of exports minus net transfers (NT) as shown in (24)

$$(24) \quad Y_r = \sum_j T_{rj} + NT_r$$

Although the interrelationships that have been captured in this model are complex, the main motivation is to develop a framework that sufficiently encapsulates our present understanding of how debt acts on an economy with a system that can determine the effect of debt relief on world clearing prices and quantities. The key parameters, then, are the elasticities of supply and demand with respect to changes in the debt overhang measure, given in equations (7) and (16), and the income effect through net transfers in equation (24), acting on

demand equation (16). The relative size of each of these will determine the resultant changes in excess supply or demand, which in turn have repercussions for the whole system through income and price linkages, depending on the elasticities of excess supply or demand from the developed nations (19). If the overhang acts as a greater tax on supply than demand, then relief will increase excess supply, which will have a depressing effect on world trade, and perhaps prices. On the other hand, the income effect may be such that the excess demand will shift out, supporting previous findings of increased output and perhaps an increase in price.

The model presented above provides an integrated framework for analysing the impact of debt levels on domestic production and prices in a debtor country, and on trade through a simple world trade model. Previous models either treated debt as purely a drain on income or looked at changes in trade from shifts in country incomes. In contrast, the contribution of this model is that it integrates the view that debt impacts not only on income, but also on investment and consumption. An additional contribution of this model is that while the data needs are extensive, the use of a partial equilibrium framework makes its application much easier than that of general equilibrium models, which suffer from exhaustive data and modelling requirements.

#### *Possible Findings*

Recent claims for forgiveness of debt burden could be examined through this model by conducting simulations to determine the trade responses to simultaneous changes in the debt overhang variable and changes in the value of net transfers. Removal of the debt overhang is expected to have a significant positive impact on both supply through equation (7), and demand through equation (16). Lowering of net transfers, and any subsequent increase in excess supply, has an income effect through equation (24), which acts as a direct positive influence on demand through (16) and an indirect negative effect on supply through the input markets, increasing wages in equation (18) and lowering the price of capital in equation (17). The resultant movements in supply and demand alter the excess demand of the developing nations which then interact with the excess supply of developed nations, equation (19), which itself is not directly affected by the debt reduction. The world market price adjusts until the world excess supply equals the world excess demand for each commodity, clearing each market equation (23). These world price changes are linked back to domestic prices via exchange rates and protection "wedges" through equations (21) and (22).

If these gains can be quantified, they will have strong implications for trade and development policy debates. Firstly, they would indicate that debt forgiveness is an appropriate policy for addressing the problems associated with the debt crisis. Secondly, the results would indicate the level of impact that the debt overhang has on supply and demand through taxation of investment and consumption. Thirdly, the results would indicate the extent to which these gains in economic activity are transmitted to developed nations through the trade

mechanism. Additionally, the model could be used to indicate the distribution of gains from the debt relief policies, identifying which countries are likely to capture the most benefits from their higher sensitivity to debt. This could be used to shed light on how relief policies might be able to be targeted at countries which will gain the most in economic activity. If gains are diffuse in their occurrence, their distribution will have implications for the debate on the establishment of a debt institution to overcome the market failures associated with capturing the benefits of relief.

### *Conclusions*

Out of all the attempts that have been made to analyse the impact of the debt crisis, there has been a traditional dichotomy among approaches which have looked at how debt affects the developing economy, and those which have treated this as an international trade problem. Of the former approaches, the concept of the debt overhang seems to be the most widely accepted link between developing country debt and economic performance. In an attempt to synthesise the debt overhang with a trade model, this paper presents an outline for a simple partial equilibrium model of debt impacts, which could be used to demonstrate the possibility of gains or losses in income from world trade for both debtors and creditors as a result of debt forgiveness. The findings of the study are expected to help settle the vexed issue of debt forgiveness by demonstrating the magnitude and distribution of potential gains or losses.

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