IMPLICATIONS OF THE DEBT OVERHANG FOR INTERNATIONAL AGRICULTURAL TRADE*

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Having been one of the dominant issues in North-South relations for over a decade, the international debt crisis is once again gaining prominence in international policy debates. This study seeks to examine the impacts of debt overhangs on agricultural trade. Using a partial equilibrium trade model of seven agricultural commodities, covering 10 developed and 20 developing economies, where debt impacts on supply, demand and income, a number of simulations were performed. The empirical results indicate that across-the-board debt relief, in exchange for policy reforms in debtor nations, would produce positive trade benefits for international agricultural trade and increase world welfare levels by around US$2 billion in real terms. With regard to the appropriate levels of largess, it is found that low levels of reduction (less than 20%) can have negative impacts on world trade, with some support being apparent for higher levels of write-off, in the order of 70-100% of base period debt stocks.

Keywords: debt, agricultural trade, overhang, simulation.

I. INTRODUCTION

The international debt crisis has been one of the major issues in North-South relations for nearly one and a half decades, and if unresolved, will continue to haunt the world economy for many more. The impacts on developing countries have been well documented, as have the past threats to the world financial system (see, for example, Frenkel, Dooley and Wickham; Cline; Sachs 1989). However, there is a resurgent debate on the possibilities of debt write-offs, coupled with speculation on the effects that this may have on both the debtor nations, and creditors through international linkages (see, for example, Holman; Dwyer; Van Hees; Fues; Trepand). Notable is the question of how high levels of unserviceable debt influence the production and consumption decisions of debtor nations, and how these impacts translate into world trade. In the past, the international and national effects of the debt problem have tended to be separated, with few examples of bringing these fairly independent lines of research together. This is despite the fact that both the origins and impacts of the debt problem can be seen to have clear international dimensions. The analysis of the transmission of these effects provides a useful guide to how the so-called "debt overhang" influences agricultural trade, and also insights into what additional benefits could be expected from the possible outcomes of the current policy debate on debt forgiveness.

The organisation of this article is as follows. Firstly, the issues relating to debt impacts on debtor countries are briefly surveyed, focusing, in particular, on the supply and demand effects. The modelling framework is then developed and the model structure detailed. Subsequently, the results of model simulations are presented and interpreted, prior to some conclusions being drawn for the international debt problem and the implications of the debt overhang for international agricultural trade.

II. DEBT OVERHANG HYPOTHESIS

There have been a multitude of effects associated with debtor country impacts, most of which fall under the heading of incentive arguments, where the notion of incentives is central to the behaviour of investment capacity, the decision to repudiate, levels of consumption and the ability to pay. Krugman and Sachs are often cited with providing the theoretical underpinning for a "disincentive model" through the Debt Overhang Hypothesis (see Krugman; Sachs 1990; Rogoff). The hypothesis postulates that if debtors' obligations are sufficiently large the expected value of their debt will decrease dramatically, opening the way for the mutually beneficial outcomes from debt relief (Kenen; Corden). If such a Debt Relief Laffer Curve exists, underpinning the possibility of a gain in expected value is that the ability to repay is linked closely to income, and that there are opportunities for creditors to offset concerns about lowering payoff ceilings, including mechanisms to recoup productivity gains (Rogoff, Krueger). Support for this hypothesis, while by no means universal, is provided by analyses of changes in investment behaviour. Studies by Faini and De Melo, Savvides and IMF all find strong evidence of debt disincentives on investment, whilst research by Eaton, and Hofman and Reisen is inconclusive. More rigorous attempts at macro-economy modelling in Borensztein, Morisset, and Otani and Villanueva (1989 and 1990), again emphasising investment, have demonstrated negative impacts on debtor country performance. It has been argued that many factors, including the use of smooth neoclassical investment functions, difficulties in overhang measurement, the use of average rather than marginal overhang variables, absence of bargaining costs, and the possibility of output market impacts from other forms of overhang, may have masked the true scope of performance impacts in previous analyses (see, for example, Perasso; McDonald; and Borensztein). While studies of trade impacts from the simple excess demand analyses of Sen to the SWOPSIM analysis of Gunasekera, Bowen and Andrews, and the general equilibrium analysis of MacKellar, have all suffered from various omissions, they have also shown some potential negative impacts on trade from developing country indebtedness (Saunders and Dean).

The empirical and theoretical evidence provides general support for the notion that high debt burdens impact, not only on investment and capital flows, but also, through a variety of linkages to consumption, on output and trade. The literature also provides support for there being strong differences in debt influences among countries and within countries, in keeping with the hypothesis from the theoretical research that incentives for debt relief may be best captured by a disaggregated multi-country analysis.

III. THE JUBILEE MODEL

The debt overhang hypothesis provides a convenient way of encompassing some of the previous synthesis of political and economic factors, through various avenues that impact not only on income, but also on supply and demand. These impacts are integrated into the Jubilee Model[1], a partial framework for agricultural trade analyses based on the World Food Model (WFM) of Tyers and Anderson 1992 (see also Tyers 1984, 1985, 1992, or Anderson and Tyers 1993). A debt overhang variable has been included in all the supply and demand functions of developing countries, reflecting some of the influences alluded to earlier. Income is determined by approximations of value added functions, which allow for the impacts of debt service and other endogenous model variables to feed back, at least partially, onto income levels in debtor nations

A schematic representation of the main components of the Jubilee framework appears in Figure 1. The complete structure shown, containing the debt overhang equations, only applies to the low and middle income debtor nations (as defined by the World Bank 1993, Table 2), and are detailed in Appendix Tables A.1. and A.2. Other regions are assumed to have no overhang, and thus the relevant debt influences on supply, demand and income are not included. The details of this country coverage are given in Appendix Table A.3, noting that the model covers only seven agricultural commodities; Rice, Wheat, Coarse Grains, Sugar, Dairy, Ruminant Meat and Non-Ruminant Meat. 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, and the income effect through the demand equations. The relative size of each of these will determine the corresponding 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 other regions.

The output market is based on a neoclassical model of firm supply and household demand with macroeconomic foundations similar to those of the more traditional growth models (see Appendix Table A.1). Desired supply (A1), is modified to allow for the influence of a debt overhang variable and a partial adjustment mechanism (A2) solving for the period's output on the basis of a production trend (A3). Demand is divided into direct and indirect components (A4), the former being modified to allow for debt impacts (A6), the latter described as a direct relationship to livestock numbers (A7), which are calculated on a steady-state basis (equations A8 to A11). Stocks are determined as a fixed proportion of the moving average within the production or consumption shifters (A12 and A13).

The price system works via border prices being determined directly from world indicator prices through exogenous real exchange rates (A14), with any distortion of the price system occurring within the borders of the country. Border prices are determined instantaneously as a fixed ratio of the real world price in local currency terms. Consumer and producer prices adjust toward these border prices on the basis of market distortions (A15 and A16).

In the income equations, proxies for value added, that can be summed across sectors to provide and estimate for national income, are suggested by Input-Output analysis. Following the work of MacKellar and Bherman and Klein, estimable forms of the value added equations for developing countries can be used to describe income in terms of the common variables of private consumption expenditure, government consumption expenditure, fixed investment, inventory adjustment, imports and exports. Due to data limitations, particularly those which arise from the restrictions placed by the limited scope of the partial model's output, a quasi-reduced form approach to the estimations can be taken. It is assumed that government consumption expenditure is a function of its debt service obligations, transfers from other nations, and revenue from trade. Changes in inventory, supply and demand are combined into the excess demand figure (A17), valued at border prices, termed here the monetary trade balance (A18). Expected debt service is the result of a simple value of a payment loan calculation that works out repayments on the basis of the interest rate on the loan, the loan period, and the value of the debt stock at this point (A19). In the format of the WFM surplus calculation, the government gains from protection and price transmission delays (A20). The government revenue associated with imports and that with exports, and the values of agricultural trade, are separated for importers and exporters, the final form of the income equations (A22) and (A23) included a testing a range of functional forms. Where both imports and exports appeared as reasonable explanators of income, the predicted values were averaged. The debt stock is a result of the debt at time t, the fraction not repaid which goes into the debt stock, plus new drawings (A24). The debt overhang is the ratio of debt stock to national income, as the latter is at least partially endogenously determined by DO_t in the current period, this relationship is proxied by a one period lag (A25).

The welfare changes in the Jubilee model are taken directly from the WFM equations described in Tyers and Anderson (1992). The compensated consumer surplus is given by (A26). Producer welfare changes come from four sources; land set-asides (A27), effects on livestock producers from feed prices (A28), direct output effects (A29), and random effects from the model when running in its stochastic form (A30), which are summed (A31). The welfare of stockholders arise from the income from sales, the opportunity cost of stock holding, and the unit costs of storage (A32). The government welfare calculations, based on (A20), were alluded to earlier. The net regional welfare impacts are all income equivalents, and as such can be summed together to give a proxy for national welfare changes (A35). This figure then represents the difference in welfare in the current year from changes in prices from their base values.

In order to operationalise this model the software had to be re-written from the ground up. The modified structure was ported on the Microsoft Excel® program. This method of implementation, along with a simpler total elasticity market clearing mechanism, allowed greater flexibility in terms of structural modifications. The global market clearing condition is given by equation (A36), on the basis of the excess demand defined in equation (A17). These excess demands are deemed acceptable if all meet the criteria in equation (A37), otherwise world indicator prices are adjusted in an iterative fashion via an appropriate total excess demand elasticity (A39 to A41).

A. *Data*

Given the limitations inherent in developing countries, the data set was based on annual country figures, covering a time series from 1960 to 1990. The model simulations cover 10 developed and 20 developing regions, of the latter 16 approximated the World Bank classification of low or middle income debtors (see Appendix Table A.3). Within pooled debtor regions, at times it was possible to disaggregate these to the country level, giving a maximum possible data set of 65 regions to be estimated for each commodity. In areas that described these pooled regions, this technique was used to improve the degrees of freedom, the estimates used reflecting a weighted average. The quantity data came from the USDA Production, Supply and Distribution Database (USDA 1994), while Debt data are from the World Bank's World Debt Tables on Disk (World Bank 1991). All nominal figures were converted, where appropriate, to real values via the US CPI index, income (proxied by GDP) and population figures were from the FAO State of Food and Agriculture Tables (FAO 1993).

Prices were derived from a series of world reference prices available in the FAO Production Yearbooks, ABARE Commodity Statistics Bulletins, and the World Agricultural Trends and

Indicators database (USDA 1994a). These world reference prices were converted to border prices, using the real exchange rates, and the domestic to border price ratio used in the WFM database (Tyers 1994). This border price was assumed to be the f.o.b. price experienced by the countries, and thus used as a proxy for producer prices. Consumer prices were found by adding to this a margin on the world price that represented transfer costs that contribute to the c.i.f. values. A range of trending values for this margin were tested based on data from the FAO Trade Yearbooks.

The debt overhang was proxied by the ratio of total public and publicly guaranteed debt to income (proxied by GDP). This embraces both the capacity to pay and indebtedness issues required by such a measure. Although many alternative debt service ratios are available, their formulation and theoretical underpinning are all somewhat *ad hoc*, however, this choice of proxy is consistent with the findings of a survey on these indicators by McDonald.

B. *Key Parameter Estimations*

Although the model relies heavily on the WFM's database (Tyers 1994), the modifications described necessitated the estimation of several key parameters. The first was the re-estimation of all the supply and demand equations for the developing nations with a specification that allowed for the influence of debt overhang. The second was the estimation of the income feedback loop that was designed to allow some partial endogeneity of the income effects of trade growth and debt service reduction.

For purposes of estimating the debt elasticities of supply and demand, a variety of linear and non-linear forms were tested, using ordinary least squares and corrections where appropriate. The data meant that multicollinearity and autocorrelation often prevented the derivation of meaningful results. The final estimates used for the debt elasticities of supply and demand appeared stable over data sets, and often very significant.

With regard to the debt elasticities of supply, while there were a minority of low positive debt elasticities of supply, especially in the livestock products, the majority of these were insignificant. Of the significant findings, which were the majority, there was a range of negative inelastic values, generally less than -0.5, with outliers up to -1.4 in the case of Coarse Grains in the Other Asian economies. The debt elasticities of demand, while still inelastic and sometimes insignificant, was less clearly negative, with some strong positive responses, almost unitary elasticities being found in the case of some consumers of Ruminant Meat. The results permit the drawing of a number of conclusions, the most obvious of which is that debt burdens were a significant explanatory variable of production and consumption behaviour in many of the regions studied. The estimates obtained suggest a range of inelastic negative debt responses,

the most notable of which are seen in Coarse Grains in Other Asia, and Sugar in Other North Africa and Middle East. Although the demand effect is also predominantly negative, some positive results are evident for each commodity. Whilst this may reflect the nature of consumer preferences in these countries, it is important to note that the aggregation of commodities used in the model may be disguising different goods, with different economic characteristics to each nation.

With regard to the income equation estimations, it was intended that the income specification of the model be such that changes in income from trade and debt service effects could be at least partially related back to the income level in the model. The database that was used to generate the previous elasticities was also used in this section to maintain consistency, as were the same methods of generating prices and quantities. A variety of functional forms were tested using ordinary least squares, and its associated ameliorative procedures where necessary. The predictive power of these equations appeared reasonably high, with high R-squares and low Root Means Squared Percent Forecast Errors (less than 5%) for both the imports and exports based predictions of national income.

Within these estimations, time trends were on average around -0.05 and -0.04 for imports and exports based measures, with the only positive trends in South Korea. The removal of this outlier lowered the trend elasticity to closer to -0.25. The elasticity of national income with respect to government revenue from agricultural trade was extremely low or insignificant, on average less than 0.004 in absolute values, with some strong differences between regions and the revenue from imports or exports. With respect to the changes in income based on the value of imports, it was expected that importing should represent a drain on national resources. This was shown to be generally the case, with negative elasticities at an average of -0.02. Again, there were pronounced differences between regions for these figures. Similarly, food exports appeared to have a positive influence on income, that demonstrated an inelastic and declining lagged negative response in most regions. Finally, it was found that the debt service variables would exert a negative influence on income growth, the estimations revealing the average of the sum of the two periods' elasticities being -0.09 in the case of the import equations, and -0.06 in the case of export based equations. To complete the table of estimates required by the Jubilee model structure, some of the gaps in these estimates had to be filled by using weighted averages based on similar regions.

In conclusion, whilst partial in nature, these models provide the basis for endogenising income effects in terms of the results generated within the model. As the income effects of imports and exports tend to counteract each other, their separation in the estimation process not only allows the different effects to be isolated, but it also gives a clearer picture about the sources of different determinants of income. Additionally, the findings reinforced the need for dynamics in

these equations, which are also likely to add to the stability of the estimates over the sample period. Lastly, the final structure is convenient, as it allows the completion on feedback and debt effects on income for the debt relief simulations. The modified model structure was assessed by simulating its ability to predict world food prices in the presence of exogenous shocks of production, in a manner similar to the WFM validation process. The results indicated that the *ex post* forecast errors in all cases were modest, especially in comparison to the original WFM structure.

IV. SIMULATIONS WITH THE JUBILEE MODEL

In order to determine the impact of a variety of debt relief proposals on the value of agricultural trade, the Jubilee model is used to simulate a number of different scenarios. While differing on specifics, they centre around a debt forgiveness package that synthesises many of the issues in the contemporary debt relief debate. For each such dynamic simulation, the results will be compared relative to a "no policy" baseline, the implementation of which requires a number of assumptions about the model's closure. Specifically, the time paths of exogenous variables are needed for each scenario for the length of the evaluation period. Typically the length of a simulation will cover the generation of ten annual solutions, although policy introduction does not necessarily take this long. The exogenous production shocks that were used in the stability tests of the model were included to help the model track actual world prices as closely as possible, in a manner consistent with the WFM implementation discussed in Tyers and Anderson (1992,p190).

Under the reference scenario, debt supply and demand elasticities are set at their post-crisis values, and the price and income elasticities, which are taken from the WFM database, are set to decline marginally over time. All non-debtor nations are expected to be committed to trade policy reform, implying that they will decrease their current levels of protection at a constant rate until a totally free trade target is reached at the year 2000. In the absence of relief, debtors are not expected to alter their current trade restrictions. Debt stocks follow their actual 1982-1992 levels, as the other exogenous variables, follow the schedules as described in the Jubilee and WFM model databases. This simulation, therefore, represents the no debt-relief scenario, or the experienced structural adjustment path.

Five policy simulations were evaluated, which covered a variety of issues relating to write-offs, timing, policy reforms, and targeting. Additionally, a number of simulations were carried out to provide insights into the implications of different write-offs

Scenario One considers the case of across-the-board Write-offs with Debtor Policy Reforms. Debt stocks are written-off across all debtors, at an annual 10% reduction in debt stocks from their real 1982 values over the seven years from 1983 to 1990, whereupon they reach their ceiling of 70% of their base level. In exchange for this largess, debtor countries are assumed to commit themselves to the same level of trade liberalisation as the creditor countries, that is, fully free trade targets are to be in place by the year 2000. The debt elasticities under the relief scenario are returned to their pre-crisis values, while otherwise all exogenous settings follow the same closures as in the reference scenario.

Scenario Two considers across-the-board Write-off Without Debtor Policy Reforms, to isolate the impact of trade reforms from overhang effects. The closure is as in Scenario One: however, in this simulation, debtor trade protection undergoes no change. This assumption means that Scenario Two's only departure from the previous simulation is in terms of the changes to the debt stocks of the debtor nations.

Scenario Three looks at the issue of dynamics, by considering the implications of a Single Period Debt Reduction. The reform process is once again as proposed in Scenario One, with the exception that the mooted 70% write-off with all debt relief arises in the first year, to the same level of 70%, and is thereafter constant. All other settings are otherwise as indicated for Scenario One, noting that the concomitant debtor region trade reforms remain a component of this closure, including maintaining the same rate of policy reform.

The issues of targeting are addressed in Scenarios Four and Five. In Scenario Four, relief (and therefore reforms) only occurs in highly indebted countries. That is, Bangladesh, India, Indonesia, Pakistan, Philippines, Korea, and Thailand are no longer receiving write-offs. Scenario Five is narrower again, considering Targeting of Relief to a Single Country, using the example of Brazil. Unless otherwise indicated the closures mirror that of Scenario One.

The final scenario to be considered consists of ten different simulations that were conducted to determine the most appropriate levels of debt relief. The closure is as Scenario One: however, the absolute level of relief is changed between each simulation, from a base of 10% write-offs, to a maximum of 95%. As the rate of debt relief appears to influence the level of the response (see Scenario Three) in these simulations a constant rate of relief was assumed at the 10% per annum level used previously. The implication being that 10% relief takes one year, 20% two years and so on. The usual features of trade policy reform were included as components of these simulations.

V. DISCUSSION OF RESULTS

The model, naturally, generates an enormous amount of information with a significant degree of regional and commodity detail. The results presented in this section summarise only the key features of these findings, giving an overview of the most interesting outcomes in terms of world prices, trade and welfare effects (see Tables 1 to 5). Within the aggregates shown, there was significant changes in prices from year to year stressing the importance of the dynamic nature of the Jubilee model structure (Table 1).

In Scenario One, it can be seen that the value of world trade is improved by the relief policies. On average, the real US$1.1 billion gain over 11 years is perhaps marginal compared to some trade policy reforms; however, it is nonetheless significant (Table 2). The dynamics of this response was varied, an initial negative response giving way to net positive trade growth. Although the creditors remain in net surplus to the debtor regions, there is a reduction in the value of net exports of around 5 per cent by volume, which translates into a 0.13 $US billion loss in exports in real terms to these regions over the simulation period (Table 3). On average, debtor production and consumption has increased in response to the debt relief and policy reforms, with only minimal impact on the production and consumption in the non-debtor regions. The net effect of the price and output changes on different sections are summarised by dynamic welfare effects (Table 4). In Scenario One, it can be seen that there was a net gain to world welfare over the whole simulation period in response to the policies. This was comprised of a gain in producer surplus from the higher prices, which came at a cost to consumers, and an overall gain at just under US$2 billion over the simulation period in real terms.

In Scenario Two, which was the same as the first without debtors undergoing policy reforms, a marked deviation from the reference path was again exhibited. Generally the changes in prices over time are similar to those under the trade reform case, reflecting the conventional wisdom that protection in small countries should have little impact on the world economy. The prices tend to vary here at a slightly lesser rate, with the maintenance of protection by what are mainly importing nations, having a slightly positive effect on price relative to the reference and reform scenarios (Table 1). The effects of Scenario Two on world production and consumption patterns were minor, with production almost unchanged in creditor regions and with the maximum change in consumption being less than 5 per cent, mainly comprising of slight falls in Dairy demand and rises in that for Ruminant Meat. This would appear less to do with relative price changes than the lack of change in the pattern of protection. The average benefits to trade activity are around half those achieved when the write-off was coupled with debtor policy reforms (Table 2). The principal component of this loss in trade appears to be associated with a decline in the more highly insulated Dairy trade, which stems from prices remaining closer to their reference values in this simulation period.

The most noticeable change in the welfare results for Scenario Two is the way the previously positive effects, in the absence of policy reforms, have now been transformed into a substantial net loss to the world economy (Table 4). The transformation of creditors from net export to net importers, due to the failure of debtor countries to relax their import restrictions, brought with it a substantial decrease in producer and consumer surpluses coupled with a decrease in government revenue from border trade. While this change in position has improved the relative fortunes of the debtor nations, and has actually meant a positive welfare gain compared with the previous negative, these are insufficient to outweigh the costs that are incurred by the other nations (Table 4).

In the case of the one-off relief of Scenario Three, the price results displayed a marked departure from the reference scenario, and the phased relief results (Table 1). While the end of simulation prices is approximately the same, the one-off shock produces rapid rises in prices, having a substantial positive impact on the value of trade, especially in the trade of Coarse Grains (Table 3). Underlying these changes and the increase in the volume of exports are the increases in production and consumption that have followed the reforms. It is interesting to note that, within this relatively massive increase in trading activity, debtors are on average worse off with the balance of the trade benefits, although smaller than in the phased relief case, going to the creditor regions (Table 3). As a consequence of these effects, the sustained increase in the magnitude of welfare changes from the case of phased relief (Table 4). Within the creditor regions, the changes in welfare seem to be largely associated with the increase in trade activity. Within debtor regions, the welfare changes are more closely related to the shifts in production and consumption.

In Scenario Four, where relief is targeted only to the most highly indebted regions, an overall positive effect on prices can be seen in commodities whose demand has been constrained by the overhang, whilst in others, price declines are evidenced by the removal of some of the constraints on production (Table 1). The level of world trade experiences negative growth (Table 2). This results particularly from the reduced demand from these net importers of Wheat, Coarse Grains and Dairy products, increasing the trade loss by creditors, to around -0.34 $US billion (Table 3). The welfare results of the partial write-off in Scenario Four present a disappointing result (Table 4). Welfare losses from both the point of view of the creditor and the debtor are larger than in many previous simulations, especially in comparison with marginal positive gains in Scenario One.

The changes apparent under the more narrowly focused Scenario Five are not only smaller, but also often negative, as the improvements in Brazil's production have a negative influence on world prices (Table 1) which depress production in other debtor regions, creating a net loss in

the volume of production in debtor regions of around 0.5%. A similar effect is apparent in the changes in the level of consumption, where there is a net decreases in debtor regions of around 0.6%. This is primarily due to debt elasticities of demand being often positive in this region. In this scenario, the price effects are naturally of a lesser magnitude than those recorded by more wide-ranging reforms, the net effect on the weighted average price being close to zero. Some marginal decreases in prices are observed as Brazil's net importing positions of many commodities decline. The slight lower level of exports from creditor regions is indicative of the decline in the import requirements of Brazil, coupled with the effect of some lower prices on world production (Table 3).

The welfare changes recorded demonstrate how the package that targets Brazil only has a noticeable negative impact on the world welfare, particularly through the depression of prices and outputs on producers (Table 4). Major creditors such as the United States are also net losers from this exercise. It is also interesting to note that Brazil benefits less from targeted relief than from broader scale relief, as write-off reduces its trade opportunities, and the debt elasticities of supply and demand are such that the production and consumption suffers relative to broader reforms.

The results for the final scenario are reported in Table 5 which summarises the welfare, trade and price effects for the different simulations. The level of debt write-offs, which reflects the face-value cost of such action to creditors, is also provided. As can be seen from this table, there is a steady increase in response to write-offs, which initially projects negative benefits to trade and welfare, which then becomes positive as the level of relief climbs above the 50% ceiling. While the benefits appear well below the debt costs, when considering that agriculture represents only around 10% of all trade, the marginal benefits begin to outweigh the marginal costs at the 70-80% write-off mark (Figure 2). This somewhat *ad hoc* presentation is highly conservative, as it takes no account of secondary discounts on debt and potentially significant economy-wide multiplier benefits. It does, however, lend support for the notion that write-offs will only lead to net benefits at high levels.

It would seem that the synthesis of these findings sheds a number of useful insights for policy in terms of the size and direction of debt impacts. Particularly, the results would appear to provide some clue into the appropriate forms of different write-off policies, both in terms of the appropriate levels of largess, and the issues of targeting, the requirements of policy reforms, and the dynamics of policy implementation.

VI. POLICY IMPLICATIONS

The results of the debt elasticity estimations indicate that debt burdens could be a significant factor impinging on both supply and demand in indebted countries. The variation in both positive and negative coefficients further demonstrates the importance of disaggregation when discussing these effects. Similarly, the result of the income equation estimation process also exhibit significant variation between regions, while allowing a number of inferences on income formation. The synthesis of these domestic effects is found in the interactions described in the Jubilee model simulations.

The potential advantages of across-the-board write-offs to large groups of debtors, with a constant rate debt stock reduction in exchange for trade liberalisation, was indicated in Scenario One. The result was a rounded negative impact on world prices, and a net improvement in world trade activity, especially after the initial periods. While debtor nations were able to enhance their export positions within this world trade, this was naturally at a low marginal additional cost to creditors. The most intriguing feature to note was the net improvement in the world welfare measures, that was a combination of welfare gains which went predominantly to producers in non-debtor nations.

It appears that simply removing debt burdens, without pressing for greater market reforms on debtor countries, leads to net losses to the world economy (Scenario Two). While the influence of reforms on price changes is modest, there is an obvious inter-commodity difference which reflects the nature of existing patterns of the price distortions, the combined effect of which is limiting the potential gains from write-offs by around half.

Just as forgiveness requires reforms, the issue of phasing write-offs is tied up with enforcement issues. The enormous benefits that can be realised by "nding" a positive shock in the world economy were illustrated (Scenario Three). The impulse from the one-off policy had a marked, mainly positive, effect on world prices that tends to drastically improve the welfare effects, especially for the creditor regions. This response persists for much of the length of the simulation period, which represents the length of the product cycle. Although the stability testing of the model indicated that some restraint should be used in analysing cyclical results, in addition to any Lucas critique[2] type of arguments that may apply, the finding is an interesting one. The result does, however, highlight the importance of the dynamics of response in determining the pay-offs to a policy implemented in a cyclical market, a factor which has been continually missed by previous studies (see, for example, Gunasekera et al; MacKellar).

With regard to the issue of targeting, one of the more surprising findings of this research is that targeting may impose costs on targeted and untargeted debtors, as well as on creditors. Relief

was targeted at a broad group that represented the more highly indebted countries (Scenario Four). The main effect was a reduction in excess demand in the targeted regions, which has the effect of reducing world trade activity in food products. Consumption and production figures world-wide are smaller, and world welfare significantly declines in response to these policies. While the effect on world prices, production and trade are also obviously lower, world welfare is also marginally reduced as Brazil lessens its need for imports for many of these food staples (Scenario Five). The most interesting observation is that Brazil gains less from its exclusive targeting, due to the way that it benefits greatly from the trade improvements that are fundamental to the across-the-board policy. This implies that debtor regions have the potential for significant gains if they can opt for more wide-ranging relief than a specific country approach, and therefore should be in favour of the development of debtor coalitions or the development of a multilateral debt institution. It can also be seen that the changes in production, consumption and trade in Brazil are directly proportional to the level of relief.

These issues, naturally, always beg the question of appropriate levels of relief (Scenario Six). To determine the value of the debt outstanding is, surprisingly, not a trivial exercise, and normally requires some very *ad hoc* assumptions. It would seem that despite these limitations, the higher levels of write-off are more likely to yield positive payoffs than the lower levels, which may in fact exhibit net costs.

VII. CONCLUDING COMMENTS

This study provides some useful insights into both the size and direction of a variety of debt write-off effects. It highlights the importance of discipline, timing, and targeting and levels of relief. While only partial, a few key findings keep emerging. The first is that the debt crisis is not a dead issue, especially for those debtor countries which continue to suffer after more than a decade of inadequate policy resolution. The second is that the theoretical and empirical research would point to the possibilities of debt write-offs leading to net gains to the world economy - a hypothesis that appears confirmed by this analysis on agricultural trade effects. Finally, and more importantly, this research indicates that, as the policy debate persists, there is a need for a greater focus on the impacts of widespread debt forgiveness on the world economic system.

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APPENDIX

Table A.1. - The Jubilee Model

Supply

$$q_{nt}^{p*} = q_{nt}^{pT}\prod_{i}\left\{\left(\frac{p_{nt}^{p}}{\overline{p}_{n0}^{p}}\right)^{b_{n0}}\left(\frac{p_{nt-1}^{p}}{\overline{p}_{n0}^{p}}\right)^{b_{n1}}\left(\frac{p_{nt-2}^{p}}{\overline{p}_{n0}^{p}}\right)^{b_{n2}}\right\}\left(\frac{DO_{n}}{DO_{n0}}\right)^{d_{n}} \quad \text{A1}$$

Desired production:

$$q_{nt}^{p} = q_{nt}^{pT}\left(\frac{q_{nt-1}^{p}}{q_{nt-1}^{pT}}\right)\left(\frac{q_{nt}^{p*}}{q_{nt}^{pT}} / \frac{q_{nt-1}^{p}}{q_{nt-1}^{pT-1}}\right)^{\delta_{n}} e^{\varepsilon_{nt}} \quad \text{A2}$$

Partial adjustment to target:

$$q_{nt}^{pT} = q_{n0}^{pT}(1-\mu_{nt}^{p})^{t_{nt}} \quad \text{A3}$$

Production trend:

Demand

$$q_{nt}^{d} = q_{nt}^{dD} + q_{nt}^{dI} \quad \text{A4}$$

Direct and indirect components:

$$q_{nt}^{dD} = q_{nt}^{dTD}\prod_{i}\left(\frac{p_{nt}^{i}}{\overline{p}_{n0}^{i}}\right)^{a_{ni}} \quad \text{A5}$$

Direct demand:

$$q_{nt}^{dTD} = q_{n0}^{dTD}\left(\frac{N_{n}}{N_{n0}}\right)^{\alpha_{n}}\left(\frac{y_{n}}{y_{n0}}\right)^{\beta_{n}}\left(\frac{DO_{n}}{DO_{n0}}\right)^{\lambda_{n}} \quad \text{A6}$$

Demand shifter:

$$q_{nt}^{dI} = \sum_{k}\alpha_{nk}\beta_{nk}q_{nt}^{pnk} \quad \text{A7}$$

Indirect Demand:

Steady state livestock production:

$$q_{nt}^{lpnt} = \overline{q}_{nt}^{p}\left[1+\tau_{n0}\left(\frac{q_{nt}^{p}}{\overline{q}_{nt}^{p}}-1\right)+\tau_{n1}\left(\frac{q_{nt-1}^{p}}{\overline{q}_{nt-1}^{p}}-1\right)+\tau_{n2}\left(\frac{q_{nt-2}^{p}}{\overline{q}_{nt-2}^{p}}-1\right)\right] \quad \text{A8}$$

Fraction of livestock response in each year:

$$\tau_{nv} = -\left(\frac{b_{nv}}{b_{n0}+b_{n1}+b_{n2}}\right) \quad \text{where } v \in t \text{ denoting the lag} \quad \text{A9}$$

$$\overline{q}_{nt}^{p} = \frac{1}{3}\left(q_{nt}^{p} + q_{nt-1}^{p}\frac{q_{nt}^{pT}}{q_{nt-1}^{pT}} + q_{nt-2}^{p}\frac{q_{nt}^{pT}}{q_{nt-2}^{pT}}\right) \quad \text{A10}$$

Exogenous production shifter:

$$\overline{q}_{nt}^{dT} = q_{n0}^{dTD} + \sum_{k}\alpha_{nk}B_{nk}q_{nt}^{pT} \quad \text{A11}$$

Total consumption shifter:

Stocks

$$w_{nt} = \frac{s_{nt}}{z_{nt}} \quad \text{A12}$$

Closing stocks:

$$z_{nt} = \begin{cases} \overline{q}_{nt}^{p}, & \overline{q}_{nt}^{p} > \overline{q}_{nt}^{d} \\ \overline{q}_{nt}^{d}, & \overline{q}_{nt}^{p} < \overline{q}_{nt}^{d} \end{cases} \quad \text{A13}$$

Output quantity shifter:

Prices

$$p_{nt}^{\$} = h_{nt}\frac{p_{nt}^{w}}{x_{nt}} \quad \text{A14}$$

Border price:

$$p_{nt}^{c} = p_{nt}^{\$}\overline{p}_{n0}^{\$}\left(\frac{p_{nt-1}^{c}}{p_{nt-1}^{\$}\overline{p}_{n0}^{\$}}\right)^{\left(1-\frac{\phi_{nt}^{cp}}{\phi_{nt}^{cc}}\right)}\left(\frac{p_{nt}^{\$}}{\overline{p}_{n0}^{\$}}\right)^{\phi_{nt}^{cp}} \quad \text{A15}$$

Consumer price:

$$p_{nt}^{p} = p_{nt}^{\$}\overline{p}_{n0}^{\$}\left(\frac{p_{nt-1}^{p}}{p_{nt-1}^{\$}\overline{p}_{n0}^{\$}}\right)^{\left(1-\frac{\phi_{nt}^{pp}}{\phi_{nt}^{pc}}\right)}\left(\frac{p_{nt}^{\$}}{\overline{p}_{n0}^{\$}}\right)^{\phi_{nt}^{pp}} \quad \text{A16}$$

Producer price:

Trading aggregates and income feedback

$$m_{nt} = q_{nt}^{d} - q_{nt}^{s} + s_{nt} - s_{nt-1} \quad \text{A17}$$

Excess demand:

$$MTB_{t} = -\sum_{n} m_{nt}p_{nt}^{\$} \quad \text{A18}$$

Total monetary trade balance:

$$DS_{nt} = RP_{t}\left[D_{n}\left(\frac{r^{loan}(1+r^{loan})^{yr}}{(1+r^{loan})^{yr}-1}\right)\right] \quad \text{A19}$$

Value of debt service payment:

Government revenue for a particular commodity:

$$GR_{nt} = q_{nt}^{d}p_{nt}^{c} + (s_{nt}-s_{nt-1})p_{nt}^{s} - q_{nt}p_{nt}^{p} - m_{nt}p_{nt}^{\$} \quad \text{A20}$$

Value of net imports:

$$VED_{nt} = m_{nt}p_{nt}^{\$} \quad \text{A21}$$

Income associated with imports:

$$y_{t}^{imp} = a_{0} + a_{1}T + a_{2}\Delta GR_{t-1}^{imp} + a_{3}\Delta GR_{t-2}^{imp} + a_{4}VED_{t-1}^{imp} + a_{5}VED_{t-2}^{imp} + a_{6}DS_{t-1} + a_{6}DS_{t-2} \quad \text{A22}$$

Income associated with exports:

$$y_{t}^{exp} = a_{0}^{*} + a_{1}^{*}T + a_{2}^{*}\Delta GR_{t-1}^{exp} + a_{3}^{*}\Delta GR_{t-2}^{exp} + a_{4}^{*}VED_{t-1}^{exp} + a_{5}^{*}VED_{t-2}^{exp} + a_{6}^{*}DS_{t-1} + a_{6}^{*}DS_{t-2} \quad \text{A23}$$

Debt

$$D_{nt} = D_{n0} + \sum_{t}\left[DS_{nt}\left(\frac{1-RP_{t}}{RP_{t}}\right) + DW_{nt}\right] \quad \text{A24}$$

Debt stocks:

$$DO_{nt} = \frac{D_{nt-1}}{y_{nt-1}N_{nt-1}} \quad \text{A25}$$

Debt overhang:

Welfare specifications

Consumer welfare:

$$V_{nt}^{C} = \begin{cases} \dfrac{q_{nt-1}^{dD}(p_{n0}^{c})^{-\alpha_{n}^{D}}\left[(p_{nt}^{c})^{\alpha_{n}^{D}+1} - (p_{n0}^{c})^{\alpha_{n}^{D}+1}\right]/(\alpha_{n}^{D}+1)}{q_{nt-1}^{dD}(p_{n0}^{c})^{-\alpha_{n}^{D}}\left[\log(p_{nt}^{c}) - \log(p_{n0}^{c})\right]} & \alpha_{n}^{D} \neq -1 \\ & \alpha_{n}^{D} = -1 \end{cases} \quad \text{A26}$$

$$V_{it}^{PS} = \frac{1}{2} p_{i0}^{p} u_i^{p} q_{it}^{pf} \qquad \text{A27}$$

Producer surplus from land set-asides:

Producer welfare effects of feed price changes: A28

$$V_{it}^{PC} = \begin{cases} \dfrac{\alpha_{ij}\beta_{ij} q_{it-1}^{dp} (p_{it}^{c})^{\beta_{ij}} \left[(p_{it}^{c})^{b_{ij}+1} - (p_{i0}^{c})^{b_{ij}+1} \right]}{(b_{ij}+1)} & b_{ij} \neq -1 \\ \alpha_{ij}\beta_{ij} q_{it-1}^{dp} (p_{it}^{c})^{\beta_{ij}} \left[\log(p_{it}^{c}) - \log(p_{i0}^{c}) \right] & b_{ij} = -1 \end{cases}$$

Producer welfare effects of output price changes: A29

$$V_{it}^{PP} = q_{it-1}^{p} (p_{it}^{p})^{b_{ii}} \left[(p_{it}^{p})^{b_{ii}+1} - (p_{i0}^{p})^{b_{ii}+1} \right] / (b_{ii}+1) \qquad b_{ii} \neq -1$$

Producer welfare effects of product disturbances: $V_{it}^{PD} = p_{it}^{p} (q_{it}^{s} - \bar{q}_{it}^{s})$ A30

Total producer welfare: $V_{it}^{P} = V_{it}^{PS} + V_{it}^{PC} + V_{it}^{PP} + V_{it}^{PD}$ A31

$$\Gamma_{it}^{s} = p_{it}^{s} (q_{it-1}^{s} - q_{it}^{s}) - r p_{it}^{s} q_{it}^{s} - \frac{1}{2} \theta_i \frac{(q_{it}^{s})^2}{q_{i0}^{s}} \qquad \text{A32}$$

Stockholder welfare:

Change in stockholder welfare: $V_{it}^{S} = \Delta E\{\Gamma_{it}^{s}\}$ A33

Change in government welfare: $V_{it}^{G} = \Delta E\{GR_{it}\}$ A34

$$W_{it} = \sum_i \{ V_{it}^{C} + V_{it}^{P} + V_{it}^{S} + V_{it}^{G} \} \qquad \text{A35}$$

Aggregated national welfare:

$$\Delta m_{it} = \sum_r m_{it} = 0 \qquad \text{A36}$$

Market clearing condition:

Market clearing

Condition of acceptable clearance: $\Delta m_{it} \leq 0.0001 Q_{it} \qquad \forall i,t$ A37

$$Q_{it} = \sum_r q_{it}^{pf} \qquad \text{A38}$$

where

$$p_{it}^{c,new} = p_{it}^{c,old} \left(1 - \frac{u_i}{T} \right) \qquad \text{A39}$$

Price adjustment mechanism

$$u_i = \frac{\Delta m_{it}}{Q_{it}} \qquad \text{A40}$$

where

$$T_i = \varepsilon_{ii} + \sum_{j}^{(\neq i)} \frac{u_j}{u_i} \frac{\varepsilon_{ji}}{\varepsilon_{ii}} \varepsilon_{ij} \qquad \text{A41}$$

Total elasticity

Table A.2. - Description of Notations

The subscripts i and j refer to the commodities covered by the model: Rice, Wheat, Coarse Grains, Sugar, Dairy, Ruminant Meat, and Non-Ruminant Meat. The subscripts r and t refer, respectively, to the region and the time period being modelled.

q_{it}^{p}	Supply of commodity i in country r and year t.
q_{it}^{pf}	Target supply of commodity i in country r and year t.
q_{it}^{pt}	Price independent supply trend.
Z_{it}	Normally distributed random production disturbance.
q_{it}^{lvst}	Steady state livestock output in year t.
q_{it}^{c}	Consumption of commodity i in country r and year t.
q_{it}^{dp}	Direct, non-animal feed, consumption.
q_{it}^{ap}	Consumption as animal feed for Wheat and Coarse Grains.
q_{it}^{dpp}	Price independent direct consumption shifter.
$\bar{q}_{it}^{dt}$	Total consumption shifter.
s_{it}	Closing stock of commodity i in country r and year t.
w_{ri}	Steady-state level of working stocks of commodity i, as a proportion of trend consumption in importers and of production in exporters.
m_{it}	Excess demand for commodity i in country r and year t.
p_{it}^{p}	Domestic producer price of commodity i in country r and year t.
p_{it}^{c}	Domestic consumer price of commodity i in country r and year t.
$\bar{p}_{i0}^{s}$	Base period (1980-82) average domestic price.
p_{it}^{s}	Price at which stocks are traded, the consumer or producer prices depending on where stocks are traded.
p_{it}^{b}	Border price of i in country r.
h_{ri}	The ratio of the border price of commodity i in country r, to the standard or indicator international price.

x_{rt}	Real exchange rate in US dollars per unit of local currency.
ρ^{P}_{irt}	Target nominal protection coefficient for producers of commodity i in country r
ρ^{C}_{irt}	Ratio indicating the degree to which consumer prices are distorted by government policy.
ϕ^{PSR}_{irt}	Short-run elasticity of price transmission for the producer price of i in country r
ϕ^{PLR}_{irt}	Long-run elasticity of price transmission for producer prices of i in country r.
ϕ^{CSR}_{irt}	Short-run elasticity of price transmission for the consumer price of i in country r
ϕ^{CLR}_{irt}	Long-run elasticity of price transmission for consumer prices of commodity i in country r.
μ^{x}_{irt}	Fraction by which set-aside policies shift the supply curve of commodity i in country r to the left.
μ^{s}_{irt}	Fraction by which changes in government-held stocks shift the mean level of stocks from its base period value.
p^{w}_{it}	Standard international trading price of commodity i in year t
b_{ijvr}	Elasticity of target supply of commodity i with respect to the price of j. Subscript v indicates the length of lag response.
d_{ijr}	Debt elasticity of target supply of commodity i in country r.
δ_{ir}	Partial adjustment elasticity for the supply of commodity i in country r
g_{ir}	Price independent growth rate in the trend of supply.
a_{irr}	Elasticity of direct demand for commodity i with respect to the consumer price of j.
η_{ir}	Income elasticity of demand for commodity i in country r
λ_{ir}	Debt elasticity of demand for commodity i in country r
α_{ij}	Quantity of commodity i used in the production of one unit of commodity j
β_{irt}	Fraction of the production of livestock product i which is grainfed in country r and year t.
τ_{irv}	Fraction of the total target livestock supply response which occurs v years after the price change.

r_{rt}	Real rate of interest in country r.
r^{Ave}_{rt}	Average rate of interest on debt outstanding in country r.
yr	Average term of debt outstanding in country r.
θ_{ir}	Unit costs of storage of commodity i in country r.
π_{ir}	Response of closing stocks of commodity i to expected speculative storage profits in country r.
φ_{ir}	Response of closing stocks to the carry-in level of commodity i in country r.
y_{rt}	National per capita income in country r in year t.
VED^{exp}_{irt}	The value of excess demand for each commodity in each region, from either imports or exports.
VED^{imp}_{irt}	
MTB_{rt}	Monetary trade balance in country r at time t, valued on border (f.o.b.) basis.
GR^{exp}_{irt}	Government revenues as a result of changes to agricultural production and trade from either imports or exports.
GR^{imp}_{irt}	
RP_{r}	The ratio of actual to expected repayments, based on present value calculations, that is given on average by country r
DS_{rt}	The real value of debt service payments actually made by country r in time t
DW_{rt}	New drawings of debt made in year t by country r
D_{rt}	Real stock of public and publicly guaranteed debt held by country r in time t
DO_{rt}	Overhang of public and publicly guaranteed debt held by country r in time t
z_{irt}	Production or consumption trend shift variable
q^{eq}_{irt-1}	Equivalent consumption point on the compensated demand curve
a^{c}_{irr}	Compensated own price elasticity of demand
ζ_{ir}	Consumption expenditure share
V^{A}_{rt}	Welfare of group A in region i from commodity j.
Γ^{s}_{rt}	Welfare change from the dynamic movement of stocks
W_{rt}	Aggregate welfare

Q_t	The sum of production trends across regions
u_t	Change in excess demand relative to total world production
T_s	Total elasticity
S_{sj}	Percentage change in price of s in response to percentage change in price of j
N_{rt}	Population of country r in year t.

Table A.3. Country Coverage of the Model

Australia	Canada
EC-10 - European Community	EFTA-5 - European Free Trade Association
Japan	New Zealand
United States	USSR
Spain & Portugal	Other East Europe
†Egypt	†Nigeria
South Africa	†Other sub-Saharan Africa
†Other North Africa and Middle East	†Bangladesh
China	†India
†Indonesia	†Korea
†Pakistan	†Philippines
Taiwan	†Thailand
†Other Asia	†Argentina
†Brazil	Cuba
†Mexico	†Other Latin America

Several countries have been omitted from the Tyers and Anderson (1992) specification of Other North Africa and Middle East and Other Asian group countries in order to make these predominantly debtor regions.

† Debtor nations - classed as low or middle-income debtors in World Bank 1993, Table 2.

Footnotes

1. The term "Jubilee" comes from Leviticus 25. Every 50 years the Israelites were instructed to honour the Jubilee by writing-off unserviceable debts, and returning indentured debtors to their fields. It is now 50 years since the establishment of the post-WW2 institutional multilateralism that led to the debt crisis. The parallels are not subtle ones.

2. The Lucas critique is an argument put forward by Robert Lucas in the 1970s, arguing that it should not be assumed that relationships that were observed to hold in the past would be unaffected by policy action (Lucas and Sargent). The relevance here is that the sluggish response that is responsible for the cycling behaviour, and hence Scenario Three's gains, are conditional on assumptions about expectations on price and output behaviour that may not hold if the potential effects of these policies were well known

Table 1. Changes in Average World Indicator Prices Under Different Scenarios

Scenario	Coarse Grains	Dairy	Non-Rum Meat	Rice	Ruminant Meat	Sugar	Wheat	Food Price Index
1	8	18	-3	5	5	-26	-12	-3
	(14)	(14)	(14)	(11)	(8)	(15)	(15)	(6)
2	4	5	-3	7	10	-28	-12	3
	(17)	(15)	(14)	(13)	(10)	(17)	(14)	(5)
3	15	20	-4	9	11	-39	-15	5
	(52)	(13)	(14)	(18)	(13)	(19)	(16)	(10)
4	-12	6	-3	-13	6	-20	-13	5
	(19)	(14)	(14)	(16)	(9)	(16)	(16)	(6)
5	-3	0	0	-2	-1	-2	-3	0
	(19)	(15)	(13)	(14)	(13)	(20)	(12)	(6)

Source: Jubilee model results. Figures are per cent changes in simulation average prices relative to the reference simulation, for each scenario. The standard deviations in the real price indices (1982=100) are shown in parentheses.

Table 2. Changes in World Trade Values Under Different Scenarios

Scenario	Coarse Grains	Dairy	Non-Rum Meat	Rice	Ruminant Meat	Sugar	Wheat	Total
1.	0.88	0.81	-0.03	-0.01	0.3	-0.49	-0.32	1.12
	(0.07)	(0.05)	(0.01)	(0.01)	(0.04)	(0.03)	(0.03)	(0.16)
2.	0.72	0.3	-0.03	0	0.42	-0.5	-0.3	0.61
	(0.05)	(0.03)	(0.01)	(0.01)	(0.04)	(0.04)	(0.02)	(0.10)
3.	1.76	1.02	0.16	0.03	0.75	-0.58	-0.1	2.85
	(0.22)	(0.05)	(0.01)	(0.02)	(0.04)	(0.03)	(0.04)	(0.29)
4.	0.05	0.32	-0.04	-0.14	0.35	-0.61	-0.7	-0.72
	(0.02)	(0.02)	(0.01)	(0.01)	(0.04)	(0.04)	(0.04)	(0.06)
5.	-0.1	0	-0.02	-0.04	0.01	-0.03	-0.13	-0.31
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)

Source: Jubilee model results. Figures are changes in simulation total world trade values relative to the reference simulation, for each scenario. Values are in 1986 $US billions. The standard deviations are shown in parentheses.

Table 3. Changes in the Values of Net Exports of Creditor Regions

Scenario	Coarse Grains	Dairy	Non-Rum Meat	Rice	Ruminant Meat	Sugar	Wheat	Total
1	0.22	0.61	-0.6	0.14	0.26	-0.35	-0.42	-0.13
	(0.02)	(0.04)	(0.04)	(0.01)	(0.03)	(0.03)	(0.02)	(0.02)
2	0.17	0.18	-0.65	0.2	0.47	-0.38	-0.38	-0.39
	(0.01)	(0.02)	(0.05)	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)
3	0.32	0.7	-0.83	0.23	0.56	-0.43	-0.5	0.05
	(0.03)	(0.04)	(0.04)	(0.01)	(0.03)	(0.03)	(0.02)	(0.03)
4	-0.05	0.2	-0.36	-0.04	0.36	-0.25	-0.2	-0.34
	(0.01)	(0.01)	(0.02)	(0.01)	(0.04)	(0.02)	(0.01)	(0.02)
5	-0.04	0.03	(0.06)	0.00	-0.06	-0.04	-0.08	-0.14
	(0.01)	(0.03)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)

Source: Jubilee model results. Figures are changes in simulation total world trade values relative to the reference simulation, for each scenario. Values are in 1986 $US billions. The standard deviations are shown in parentheses.

Table 4. Estimated Effects on Total Welfare Under Different Scenarios

Regions	Scenario 1	2	3	4	5	
Creditors						
Australia	0 00	0 00	0 01	0 00	0 00	
Canada	0 00	-0 02	0 05	-0 09	-0 02	
EC-10	0 04	-0 07	0 01	-0 14	-0 03	
EFTA-5	0 02	0 00	0 02	-0 02	-0 01	
Japan	-0 02	-0 04	-0 04	-0 05	0 00	
New Zealand	0 01	0 00	0 01	0 00	0 00	
Spain & Portugal	0 00	-0 01	0 00	-0 04	-0 01	
United States	0 12	-0 01	0 50	-0 51	0 12	
USSR	0 06	-0 02	0 01	0 14	0 04	
South Africa	0 00	0 00	0 01	-0 02	0 00	
China	-0 04	-0 11	-0 15	-0 35	-0 06	
Taiwan	0 00	-0 01	-0 01	0 01	0 00	
Cuba	-0 02	-0 02	-0 02	0 01	0 00	
Total Annual Change	0 17	-0 29	0 39	1 59	0 29	
Total Change over whole simulation	1 88	3 24	4 26	15 44	3 19	
Debtors						
Other CPE	-0 22	0 02	-0 27	0 46	-0 01	
Egypt	0 00	0 01	0 00	-0 01	0 00	
Nigeria	0 02	0 02	0 02	-0 01	0 00	
Other SSA	0 01	0 00	0 01	-0 02	0 00	
Other NAandME	0 15	0 02	0 14	0 10	0 00	
Bangladesh	0 00	0 00	0 00	-0 01	0 00	
India	-0 11	-0 01	-0 15	0 05	-0 01	
Indonesia	0 02	0 02	0 02	-0 01	0 00	
Korea	0 05	0 01	0 05	-0 01	0 00	
Pakistan	-0 01	0 00	-0 01	-0 01	0 00	
Philippines	-0 02	-0 01	0 02	0 01	0 00	
Thailand	-0 02	0 00	-0 02	0 01	0 00	
Other Asia	0 03	0 01	0 03	0 01	0 00	
Argentina	0 07	0 04	0 10	0 04	0 01	
Brazil	0 01	0 01	0 00	0 03	0 00	
Mexico	0 03	0 00	0 02	0 00	0 00	
Other LA	-0 02	0 01	-0 02	-0 03	0 00	
Total Annual Change	-0 13	0 05	-0 21	0 46	0 04	
Total Change over whole simulation	-1 39	0 56	-2 49	5 11	0 43	
World Total Annual Change	0 04	-0 24	0 [illegible]	1 86	0 13	
World Total Change over whole simulation	0 46	2 68	1 [illegible]	20 45	1 63	

Source: Jubilee model results. Figures represent the changes from the reference scenario of the value of total welfare. Values are in 1986 $US billions per year, except where indicated, and are totalled over all food commodities.

Table 5. Changes in Key Variables in Response to the Different Ceilings on Debt Relief in Scenario 6

Ceiling on write-offs	Welfare gains over whole period			Gain in world agricultural trade values	Av. real food price index 1982=100	Face value of debt written off relative to	
	Creditor	Debtor	Total			Reference simulation	Base year
0%	0	0	0	0	0	0	0
10%	-0 07	-2 39	2.46	-0.44	86	386	55
20%	-0 39	-2 52	-2 91	-0 37	86	441	110
30%	-0 64	-2 63	-3 26	-0 22	86	496	164
40%	-0.69	-2 65	-3 34	-0 01	86	551	219
50%	-0 41	-2 52	-2 93	0 25	86	605	274
60%	0 33	-2 16	-1 84	0 61	87	660	329
70%	1 88	-1 39	0 48	1 12	88	715	383
80%	4 83	0 15	5 01	1.95	89	770	438
90%	13 73	4 45	18 19	4 11	92	825	493
95%	29 65	21 84	51.49	12 35	106	852	520

Source: Jubilee model results. Values in 1986 $US billions.

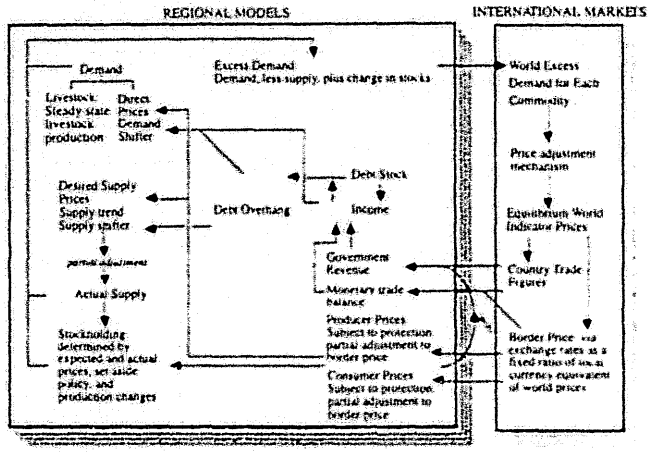

Figure 1. The Jubilee Model Components

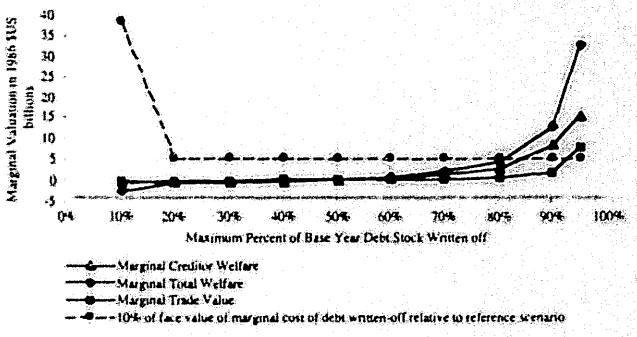

Figure 2. Marginal Costs and Benefits of Different Levels of Write-off