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Symposium on "Modeling and Analytical Issues in the New GATT Round," November 7, 1986

Randall M. Wigle

David Cox

Drusilla K. Brown

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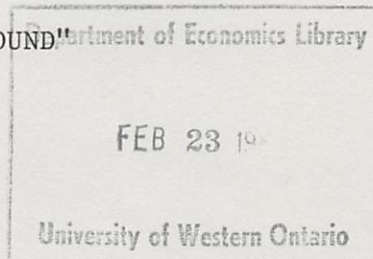
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- 6322 ✓ "Industrial Organization, Agriculture and Trade Liberalization: An Applied General Equilibrium Approach" David Cox
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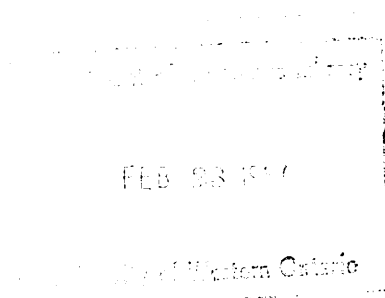
DEPARTMENT OF ECONOMICS
THE UNIVERSITY OF WESTERN ONTARIO
LONDON, ONTARIO
N6A 5C2

Symposium on

"Modeling and Analytical Issues in the New GATT Round"

The three papers contained in this compendium by Drusilla Brown, David Cox, and Randall Wigle were all presented at a symposium on trade policy modelling held in Washington, DC, November 7, 1986. This was organized by the Institute of Public Policy Studies, University of Michigan, and the Centre for the Study of International Economic Relations, The University of Western Ontario, with financial support from the Institute for Research on Public Policy, Ottawa.

The objective of the session was to explore what new directions in trade policy modelling might be appropriate in light of the new GATT trade round launched at Punta del Este, Uruguay in September 1986. Discussions ranged over the inadequacies of the set of models emanating from the Tokyo Round in covering such issues as agricultural trade, services, intellectual property, and other topics on the negotiating agenda. In their own way, each of the papers makes a distinctive contribution to the debate on how best to enhance and expand existing models for this purpose. Our hope is that making these papers more widely available in this way to a broad-ranging policy and modelling audience, more work on these issues might follow.



NUMERICAL MODELING OF GLOBAL TRADE ISSUES:

Facing the Challenge from Punta del Este

Randall M. Wigle *
Department of Economics,
University of Western Ontario,
London, Ontario
N6A 5C2

October, 1986

* Assistant Professor, Department of Economics, University of Saskatchewan, Saskatoon Canada, (on leave at U.W.O.). The author would like to thank, without implicating, Jim Markusen, John Whalley, Karl Meilke, and France St. Hilaire for useful suggestions for this paper.

INTRODUCTION

The Ministerial declaration on the "Uruguay Round" from Punta del Este was released on September 20 of this year. As well as reaffirming the commitment to a freer world trading system, and the basic principles of the G.A.T.T.; the declaration focuses on several areas of special concern. In this round, as in previous rounds, the beehive of computable general equilibrium (CGE), and numerical modeling is starting to buzz, in anticipation of addressing many novel, and interesting questions that are either already hotly debated, or likely to be raised over the next several years.

In this paper, a selection of the issues facing modelers are raised. In some cases, important alterations to the current research agenda are proposed, while in others, suggested additions to the prospective research agenda are proposed.

While discussions about trade in agricultural products are not new to the G.A.T.T. forum, the discussions ahead are not expected to resemble previous rounds. In particular, we expect to see the U.S. arguing very strongly that trade in agricultural products be treated more similarly to trade in industrial products. In a historical sense, this is somewhat ironic, since the U.S. was a major proponent of the 'special' treatment of agriculture, with its 1955 G.A.T.T. waiver for agricultural protection.

A second major area of discussion, that of trade in services results from the overwhelming interest of the U.S. in these discussions. The U.S. has a substantial surplus in the trade of services, and is anxious to improve, or at least defend its current access to foreign markets.

The ministerial declaration suggests some of the debates that are likely to occur in the process of negotiation of the Uruguay round, and this paper will investigate a selected minority of the issues that numerical modelers will be addressing in the global modeling sphere.

The list of issues raised in the declaration (though not an exhaustive list, by any means) includes the following:

- (i) High technology products
- (ii) Preferences to L.D.C.'s (and 'graduation')
- (iii) Surveillance of standstill and rollback.
- (iv) Tropical Products
- (v) Natural resource-based products
- (vi) Textiles and clothing
- (vii) Agriculture
- (viii) Safeguards
- (ix) Subsidies and Countervail
- (x) Dispute settlement
- (xi) Intellectual property (and counterfeit goods)
- (xii) Trade-related investment
- (xiii) Services

This list is extremely broad, and rather than covering them all superficially, I have chosen to discuss those issues where considerations of comparative advantage, personal interest, and policy interest were most persuasive. The issues confronted by modelers working in the areas of agriculture and services will be considered in detail in Section I, while the issues of contingent protection, and textiles, which were also raised in the ministerial declaration, will be discussed in less detail, in section I.

In Section II, technical problems in the area of numerical modeling will be discussed, along with the persistent problem of inadequate reporting of sensitivity analysis.

The major conclusion of this paper is that numerical modeling faces different problems in different policy areas. In the area of agricultural policy, work in the area of global modeling of agricultural trade needs to be intensified. Within this sub-area of study, some detailed work needs to be done to incorporate useful reproductions of different policy regimes into global models of agricultural trade. By contrast, in the area of the trade in services, CGE modeling is in the very difficult position of lacking the basic tools of analysis, since data on services is either non-existent or very poor, and the theoretical framework, as well as some of the underlying policy issues are not well developed. In this area, focusing our efforts on small-scale, issue-specific modeling efforts seems to be the most efficient allocation of resources.

While little numerical work has been done to illuminate the debate on contingent protection, some (rather tentative) suggestions for the role of numerical modeling are suggested. Finally, renewed effort to disassemble the Multi-Fibre mess is urged below, with renewed attention to the problems caused by the system of bilateral quotas and VER's that govern this trade.

I. SPECIFIC POLICY DEBATES

In this section the issues of agricultural, and services trade will be considered in detail, while the issue of textiles and the Multi-Fibre Agreement (MFA) and the issues of contingent protection will be discussed in less detail. The focus of this section will be on the basic approach to modeling, rather than specific aspects of modeling. Section II will deal with a few more narrowly defined technical issues which will face numerical modelers in the Uruguay round.

Agriculture

A few words from the declaration pinpoint two of the specific trouble areas in agricultural trade :

"Contracting Parties agree that there is an urgent need to bring more discipline and predictability to world agricultural trade by correcting and preventing restrictions and distortions including those related to structural surpluses.... "

Negotiations shall aim to improve " the competitive environment by increasing discipline on the use of all direct and indirect subsidies and other measures affecting (agricultural trade) directly or indirectly"

While the major issue is export subsidies in particular, and production subsidies generally, the problems in agricultural trade do not result solely from the use of explicit subsidies; rather, they result from tangled webs of domestic income and price support programs for agriculture. The increased use of subsidies is argued to have been a major cause of the increase in the E.E.C.'s share in export markets for many agricultural

commodities, and this is clearly the major irritant to many countries, who view themselves as lower cost producers. With flooded international markets for dairy products, grain, and sugar, attention has been focused on making the trading arrangements in agriculture fairer.

In the area of agricultural trade, the challenge for modelers, generally, is to convince governments that much of the intervention in agricultural markets is costly both because it engenders a lack of discipline that hurts everyone, and because the programs themselves often generate large domestic efficiency losses. In the context of global liberalization specifically, the crucial questions become, first, whether policies aimed at domestic agriculture have a trade-distorting effect, and second, how to discipline the use of those policies which do have a trade-distorting effect, in the pursuit of common interests in the global trading system.

Numerical modeling can contribute to the understanding, and eventual unwinding of trade-distorting programs, in the area of agriculture, in many ways. The tasks for which numerical models are best suited, in this context, are the following:

(i) Determining which policies have trade-distorting effects, and illustrating the extent to which they do have such effects, given the parameters of the programs, and the assumed structure of the economy.

(ii) Determining, and illustrating the costliness of these domestic programs to the home countries, even in the absence of any retaliatory

trade consequences.

(iii) Illustrating the beneficial effects of abandoning policies which have trade-distorting effects, and promoting rational adjustment within the agricultural sector and between agriculture and the rest of the economy. This includes illustrating that trade liberalization in agriculture can generate significant global welfare gains.

A partial survey of the modeling of agricultural policies follows, concentrating on those studies with either a broad commodity coverage, or those whose focus is primarily on the grain trade. Within this class, I concentrate on models which address the issues of global trade. Few of the existing partial or general equilibrium numerical models are able to perform the tasks outlined above. Further, even those models which closely address one or more of the issues raised above, have weaknesses in the modeling of the policy features common in the agricultural sphere.

Survey of Selected Models of Agricultural Policies

The models surveyed here are the models best suited to perform the tasks outlined above, concentrating on those with a broad commodity coverage, or concentration on grain. They fall into two groups. The first and largest group are models which quantify the impacts of price intervention in agricultural markets by modeling all intervention as involving interference with price incentives alone. These models will be referred to as "price-wedge" models. A second group will be referred to as "Policy-Evaluation models". These models address the effects of alternative forms of policy intervention on agricultural markets, and/or the world economy in general. The policy simulation models are distinctive in that they do not confine themselves to simplistic modeling of the policies (as the first class).

First of all, it is worth noting that very little of the work in agricultural modeling concerns itself with the welfare and efficiency costs of agricultural programs. Most models are intended to evaluate the expected budgetary costs of agricultural programs, or project future market conditions or analyze quantity responses to shocks, but rarely the welfare costs. Many of these models are either incapable of performing the tasks outlined above, or calculations of the trade-distorting effects of policy, or the associated efficiency costs are not reported.

Most "Price-Wedge" models address the question of the welfare costs of

agricultural policies, but do so based on the assumption that all such policies, from the CAP to voluntary set-aside programs, can be usefully modelled as simple price wedges. Welfare calculations are made in some (Bale and Lutz e.g.) via the calculation of Harberger triangles, while others use 'direct' calculations of welfare changes, given assumed consumer preferences, and explicit resource constraints (Trela, Whalley, and Wigle (1986)). Modeling the detail of agricultural programs is abandoned in favour of more carefully treating the welfare consequences of domestic and external agricultural policies, or their global implications. The models give less explicit treatment of the policies, and the decisions faced by producers.

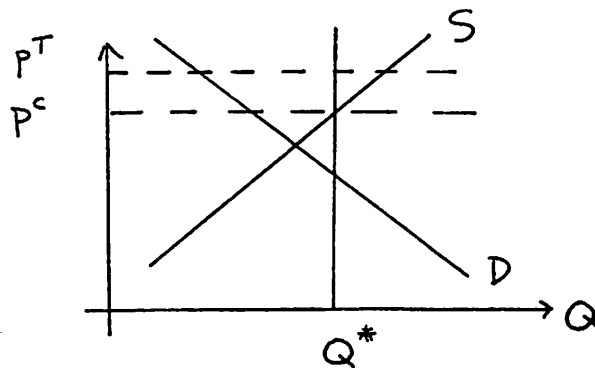
Price-wedge models include both computable general equilibrium (CGE) models, multi-market (M-M) models, and partial equilibrium (PEM) models. A partial listing of Price-Wedge models is given in Table I. Some are global models, and most are capable of making reasonable welfare calculations.

TABLE I - DESCRIPTION OF PRICE-WEDGE MODELS

Model/Author (Date)	Type	Global Model?	Major Use of Model	Welfare Calculations
Bale and Lutz (1981)	PEM	NO	Analysis of welfare costs of agricultural policies in several countries.	YES
AGRISEC Munk (1986)	CGE	NO	Analysis of changes to E.E.C. Agric. policy	(?)
Chisholm and Tyers (1982-1985)	M-M	YES	Welfare and stability effects of global agricultural 'protection'.	YES
de Janvry and Sadoulet (1986)	CGE	NO	Efficiency and growth effects of exogenous shocks or food subsidies.	YES
FAPRI Meyers et. al. (1986)	M-M	NO	Intermediate term projection of effects of exogenous yield changes.	NO
IFPRI Valdes and Zeitz (1985)	CGE	YES	Global welfare effects of liberalisation in agriculture.	YES
IIASA Parikh et al. (1986)	CGE	YES	Income distribution effects and trade effects of liberalised trade in agriculture.	YES
RUNS Burniaux (1986)	CGE	YES	Welfare and distribution effects of C.A.P.	YES
Whalley et al. (1986)	CGE	YES	Welfare effects of global liberalisation in grain sector.	YES

To evaluate the trade-distorting effects of agricultural policy, the price-wedge models have an obvious advantage. The alternative to intervention is straightforward, and making the linkage to the global market is simpler. Similarly, the models are well suited to the calculation of welfare costs, either in a partial equilibrium framework, or by more direct methods with CGE models. Unfortunately, the same simplicity that allows the price-wedge models to perform these tasks, generates a serious flaw which makes them vulnerable to criticism. In Trela, Whalley, and Wigle for example, we model the world as having price wedges between producer and consumer prices. The "wedge" tends to be positive in developed countries, and negative in developing countries. The fact that consumer prices diverge from producer prices needs not imply any welfare losses due to resource misallocation, if such programs have correctly chosen quantity restrictions on producers. This is briefly illustrated below, for the case of a deficiency payments scheme, with an auctioned production quota.

FIGURE 1



In the Figure, producer price P^T greater than consumer price P^C (equal to the world price) is consistent with efficiency if a quota of Q^* is auctioned to producers.

Simple price-wedge models would generate welfare losses from such a policy, since there is no account taken of the effects of non-price restrictions. It may well be that the program of quantity restrictions, set-asides and other delivery restrictions associated with price supports also cause welfare losses, but such welfare losses would only very fortuitously be of the same size as the calculated welfare effects attributable to 'Harberger triangle' type losses. For this reason, the price-wedge models are not likely to be taken overly seriously by academic economists. At the same time, the simple mechanics of them is more easily understood, perhaps making them more influential than they 'should' be.

Policy simulation models are models whose primary focus is the evaluation of the effects of agricultural policies, without the unduly restrictive assumption that all policies can be usefully represented as price wedges. Two examples of such models, relevant to the U.S., are the FAPSIM model, and the model of Coyle et al. (1985). To the best of my knowledge there does not exist a global 'policy-simulation' model.

In the two models mentioned, policies are analyzed with more attention to the details of the programs in place. In the case of the Coyle model, attention is paid to the importance of losses due to land-diversion. In FAPSIM, producers' decisions are modeled in great detail. This includes: the choice of acreage, the decision of whether or not to participate in set-asides, and the choice of intensity of cultivation. While in principle these models could be used to analyse the domestic welfare effects of the

programs, only the Coyle et al. model is used for this purpose. The Coyle model is used to evaluate the domestic welfare effects of U.S. commodity programs, and FAPSIM is reserved for the calculation of expected budgetary costs, and output effects of alternative support programs.

Summary - Model Review

In reviewing numerical models of agriculture, three points arise. First, little of the analysis in the area of agricultural economics focuses on the deadweight losses associated with agricultural programmes. Second, the wave of modeling of agricultural issues in a global context is very small, and within that group, NONE represent agricultural programmes other than as price-distortions. Finally, the class of models which best represent the policy distortions are not well suited to the tasks at hand, since they are not global in their coverage, and thus don't allow estimates of the global gains possible from discipline over international trade.

Summary - Agriculture

It is well known that a wide variety of agricultural intervention programs can be designed so that they have no "distorting" effects. This was illustrated very simply above. This assumes, of course, that the details of the program are carefully chosen by a disinterested economist, rather than being dictated by political considerations. Perhaps partly as a result of this proposition, the focus of much work appears to be on the quantity and stability aspects of policy, rather than the inefficiencies (both domestic and international) associated with the programs. The waste associated with land-diversion programmes is usually ignored. In a similar

vein, crops covered by land-diversion programs may generate larger surpluses than programs without them, in which case they may also be export-promoting¹. Wholesale interference in agriculture (as in the C.A.P.) will generate losses due to misallocation between agriculture and other production, but, will almost certainly imply a host of other losses. A few examples are the losses due to both E.E.C. quota allocations in dairy products, and internal non-marketing plans, which distort input proportions. In almost all cases where a commodity's domestic price is held above the world price, a complicated system of rebates or discounts is implemented for intermediated use of the products. In some cases, the administrative costs alone must be staggering.² These subsidiary features are essential to our understanding of the effects of agricultural intervention, and they should be included in models with global coverage.

While the tenor of this discussion has been quite critical, it must be remembered that more recent work seems to be going in the right direction, in that more models are available which address the issues of trade-distortion and efficiency costs. I would argue, however, that further development in the area of more detailed policy modeling of agricultural programs, in models with global coverage is essential to illuminating this area of debate.

¹ The usual presumption is that set-aside programs reduce the size of exports but this ignores the fact that producers may be qualifying for higher prices through set-asides.

² The best example of this is the Japanese system of sugar-pricing. The system of "selling-back" prices is explained in some detail in Trela et al. (1986) pages 35-37.

A final remark is warranted, on a related topic. The pace of progress in this area would be substantially improved if the competing professionals in this area (the economists, and agricultural economists) were more willing to exchange ideas on the topics relevant to agricultural support. The extent to which these two groups have ignored one another, (or are openly hostile) is a reflection of some intellectual barriers that could usefully be removed. More joint work between economists, and agricultural economists (including joint workshops, etc.) would be a valuable step in the right direction.

Services

The issue in services in the upcoming round concerns the inclusion of this rapidly expanding class of international transactions under the G.A.T.T. umbrella. Before continuing, let me be a bit more specific about what is usually meant by the trade in services. I will studiously avoid a definition of services, since even this is an unsettled matter³. Traded services include professional services, (legal services, management consulting, engineering services, and technical services), "financial" services, (which can include banking and data processing services), construction services, insurance services, and, some would argue, "trade" in intangible assets via licensing and/or franchising. It is most interesting that, while services account for almost 75% of value added in developed countries, and approximately 20% of international trade is attributable to trade in services; the attention of economic theorists has only recently turned to the particular characteristics of trade in

³ See Dobell et al. (1985) p.1ff.

services.⁴ This is reminiscent of our early neglect of trade in intermediate products, when this often accounts for more than half of observed trade flows.

The barriers to trade in services include some problems we are familiar with, including tariffs, QR's, and procurement policies. These may apply directly to the service, as in the case of repair work carried out abroad, or indirectly, in the case where goods with warranties are traded internationally. Some of the barriers to trade in services are more subtle than this. In the area of professional services, a major restriction is presented by the immigration policies of many countries (not least the U.S.), as they govern temporary immigration. The delivery of engineering services, management or technical consulting typically requires temporary emigration of trained personnel to the receiving country. The trade in financial, and insurance services is restricted by domestic regulation of these sectors. In the case of insurance, for example, many countries require that companies issuing policies hold sufficient assets, in that country, to cover claims. In this instance, it is a restriction on the free flow of capital that interferes with the trade in insurance services. Similar regulations on the provision of banking and financial services may deny the right of establishment to off-shore firms. In the areas of financial, and banking services, some countries will be concerned that eliminating barriers to trade in services should not erode their ability to regulate in domestic markets.

⁴ See Hufbauer and Schott (1985) p66. They suggest that non-governmental services account for about 50% of value added.

The first, and perhaps greatest, class of problems for modelers is a simple data problem. In many, if not most countries, adequate data on the trade in services does not exist. This is true even for Canada, a country with a well developed statistical infrastructure.

More generally, we don't have well developed, and commonly accepted analytical models to help us understand some of the issues. This is perhaps best illustrated by the fact that there is still a debate about the cause of the post-war expansion of the service sector. Even so, there is the suspicion among many theorists that liberalizing the trade in services can generate large world-wide welfare gains.

Constant-returns-to-scale models of world trade, such as the models of Deardorff and Stern; Whalley; and Mercenier and Waelbroeck, concentrated on the losses due to protectionism coming from the inefficient allocation of factors to production. These losses are usually small, compared to GNP.⁵ The work of Harris and Cox (1984,1985) on Canada, illustrates the importance of taking advantage of specific investments. In their model of Canada, tariffs cause losses attributable to over-investment in plant and equipment. In the presence of tariffs, too many firms may enter an imperfectly competitive industry, and each produces output in production runs that are too short to economize on the fixed costs of production.

⁵ Whalley (1986) finds that worldwide reduction of tariffs by 50% leads to a welfare gain equal to less than 1% of world GNP. Deardorff and Stern; and Mercenier and Waelbroeck, in the same volume report similar effects.

In the case of restrictions on trade in professional services, and intangible assets, there is a directly comparable inefficiency created by mobility restrictions. In this case, a restriction on the temporary mobility of labour leads to over-investment in specialized technical skills, or, under utilization of these 'factors of production'. Unlike the losses attributable to misallocations (as in the constant returns models); the losses due to trade restrictions on either goods with plant-specific fixed costs of production (as in Harris and Cox) or on flows of specialised skill-related services, are due to the unnecessary over investment in physical or human capital, respectively⁶.

The point made by Eastman and Stykolt (1967), and clarified by Harris and Cox, is that losses of this type can be very large, since they include rectangles of unproductive over investment, as well as the 'Harberger triangles' due to misallocation. It is interesting that there are so many ways for us to re-discover Smith's (1776) gains from the division of labour.⁷

As for the state of the art in CGE modeling, it is interesting that several of the most widely known models of global trade do not allow for the analysis of 'trade in services' issues, because they abstract from 'trade in services'. Both Whalley; and Deardorff and Stern have this distinction, as well as the VARUNA model. In each of these models, the services mentioned above are included in the 'non-tradables' category.

⁶ I am indebted to J. Markusen for a lengthy discussion of this point.

⁷ See Markusen(1986).

This, I expect, is primarily a result of the quality and availability problems with data in services.

Jean Waelbroeck uses of the term "maquette" to refer to small, simplified models which can be used to flush out the order of magnitude of the effect of a type of policy, in a reasonably short time.⁸ The Australians refer to this procedure as FOCUS modeling. A more appropriate time, or application for such modeling would be hard to imagine. While the effort on resolving data problems has dramatically increased, it would seem very unlikely that adequate data will be available by the end of the decade, making the task of incorporating new features into the large scale global models somewhat risky. At the same time, the choice of data to collect may also be guided by the evolution in theory in this area, and (if I may be so presumptuous) the results of small-scale modeling of specific issues.

At this point, maquettes can help us get a handle on the relative importance of these issues, as well as generate insights into the way the restrictions to service trade have their effects. The similarity between the losses portrayed in models with imperfectly competitive industries, and those arising in the case of professional services, or intangible assets would suggest that these two classes of issues are excellent candidates for maquettes.

My reluctance to recommend the incorporation of these features into

⁸ The use of "maquettes" to describe such models is ascribed to Malgrange.

existing multi-sector global models is motivated by an intimate knowledge of the amount of resources involved in fitting square pegs into round holes.⁹ In the case of the more detailed, larger scale models, this effort is not to be undertaken lightly, particularly when the data are so poor, and the analytics relatively immature.

Contingent Protection.

The ministerial declaration proposes that negotiations take place on the topic of safeguards, and the related area of countervail. While no numerical modeling exists to address the issues likely to arise in these negotiations, there are some aspects of the effects of contingent measures which could lend themselves to numerical modeling. In this section, I discuss some of the efficiency aspects of the current practice, and philosophy of contingent protection, and outline a possible approach to bring numerical modeling to bear on these issues.

Safeguard actions, in principle, are required to be digressive, and non-discriminatory, and take the form of tariffs (transparency). What is clear is that, as in the theory of the second best, although this prescription may be 'best', the option of discriminatory use of non-tariff safeguards barriers may be preferable to the use of non-discriminatory non-tariff barriers.

The direct effects of safeguards actions will be to restrict imports

⁹ Whalley's 8-bloc model of global trade was modified to accommodate internal economies of scale, and Canada-U.S. capital mobility. See Wigle(1986).

from all countries. If this is done via a "disappearing" tariff, the comparative advantage basis for non-discrimination is preserved, but when such actions are instituted via a system of quotas, the comparative advantage arguments in their favour are no longer likely to hold. Further, an indirect effect of the threat of safeguards actions may be for firms in exporting countries, other than the country which is the source of the injury, to over-adjust, and reduce their production, in excess of the amount suggested by new competitive pressures. In this case, the 'innocent parties' may be required to go through an unwarranted process of excessive scaling down of production, only to be followed by later expansion. To address these issues, numerical models will, however have to be equipped with more explicit treatment of the mechanics of adjustment, that would constitute a source of efficiency loss in this case. Further, the models will have to consider decisions in a setting of uncertainty. This would be new to CGE modeling, but it is not new to other forms of numerical work.¹⁰

Increased discipline over the use of contingent protection, and better surveillance of its use is of special interest to countries, like Canada, whose employment relies heavily on trade, much of which is concentrated in one (or a few) markets. Numerical models can be used to illustrate the costliness of the unpredictability of contingent measures, if they incorporated the same features discussed above.

¹⁰ See Spriggs, J. "An evaluation of the Western Grain Stabilization Act." Canadian Journal of Agricultural Economics, xx (1985) .

Recent days have painted a particularly colourful picture of the problems with the current system. Safeguards measures are being threatened against Canada in the areas of uranium exports, and less vocally, potash exports. Countervail actions are either in place, or soon to be so, regarding exports of various Canadian lumber products to the U.S. market. Canadian exporters generally, are fearful of the effects of both the application of contingent measures, and the harassment of threatened action. Such threats will be more effective when the probability of success of a threat is hard to estimate a priori.

From the global point of view, the costs of an unpredictable contingent measures system arise, first, from the possibility that efficient producers will under-invest in capacity where threats of unjustified protection may be granted. In this case, exporters must take expected adjustment costs into account when making their investment and hiring decisions. Once again, the same features are needed to use CGE models to analyse this issue. That is, we need to have producers making decisions in the presence of uncertainty, and costs of adjustment. For this question in particular, we also need some idea of the probability of success of applications for contingent protection. Existing studies, such as that of Baldwin (1985) supply some of the required data for such exercises.

The final drawback of the existing practice of safeguard protection is that it rarely has the digressivity features that are central to the G.A.T.T. approach. The efficiency costs associated with this problem,

again, come from two sources. First, there are the normal losses due to inefficient production, and where downsizing of the inefficient industry is effectively precluded, these costs are likely to be large, and recurring over the duration of the restrictions. A second class of costs arises from the interaction of two evils, non-digressivity, and non-transparent protection. In cases where safeguards are undertaken outside the G.A.T.T. framework, particularly through VER's, the possibility for excluding new lower-cost suppliers becomes greater, the longer that VER's are used to play the safeguards' role.

Efforts to improve the contingent protection articles of the G.A.T.T. suffer from the problem that philosophy and practice are so disparate. In many of the cases analyzed above, the theoretical arguments support the current view, formally retained in the G.A.T.T., but consideration of the policies as practiced, may lead to different conclusions. In any case, the methodology required to calculate the gains from either reestablishing the G.A.T.T. safeguards principle, or increasing the objectivity of the determinations (in the case of injury or countervail) appears to require only a more careful consideration of producer decisions under uncertainty, and explicit modeling of the adjustment costs associated with unexpected market developments.

Textiles and the MFA

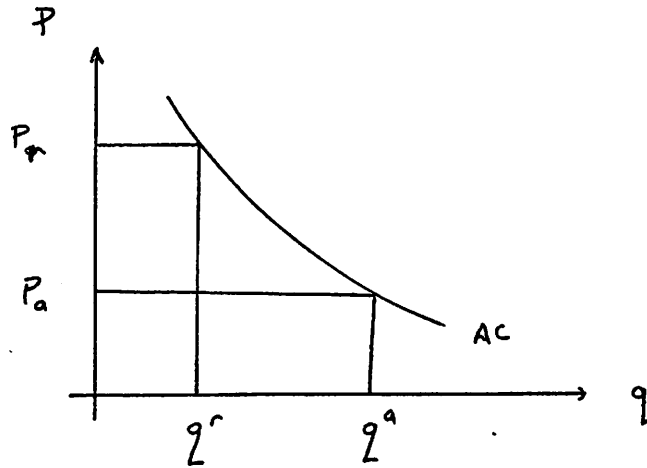
The persistence of awkward, unjust, and inefficient trade restrictions in the area of textiles seems to be an immovable problem. This is not to say that the texture of the problem has not changed in the many

years since the Short Term Agreement (STA) of 1961. Low cost producers in the far East, notably Japan, in the late 50's and subsequently, were getting a dramatically increasing share of developed markets. The STA was ostensibly intended as a temporary measure to allow the downsizing of developed world industries, and the eventual return to "tariffs-only" protection. The system of bilateral quotas, and VER's has, however, seemed remarkably immune to repeated efforts to dismantle it. Although there seems to be some progress in that trade in textiles and clothing has risen in spite of protection, a new set of problems has arisen, with the arrival of new lower-cost producers. India, and China are in the position of being largely shut out of markets where quota is already allocated to higher-cost producers. This two-tier system of protection, imposes immense costs on the producing, and consuming regions alike.

Numerical modeling can also contribute in this area to the return of textiles to G.A.T.T. safeguards principles, by carefully exposing the welfare costs associated with the current system. First, there are losses due to over-production in both developed, and intermediate-cost markets. There are added losses due to the fact that quotas are not auctioned, among producers in each supplying country.

These losses will be particularly large where there are economies of scale, and where political pressure leads to quota being distributed to many small producers. This results in large inefficiency costs in the producing countries with quota. This is illustrated in Figure II, where the allocation of too small per-firm quotas leads to large dead-weight losses.

FIGURE II



In the diagram, if per-firm quotas are q^r , whereas auctioning quotas lead to firms receiving quota of q^a , then producing countries bear costs equal to $(P_r - P_a)$ times the country's total quota allocation¹¹. As well as these dead weight losses are related distribution questions related to the final disposition of the quota rents created by the MFA, and the added possibility that some of the quota rents may be dissipated by unproductive efforts to acquire the quota rights. The extension of this type of modeling to existing models is feasible, and would provide more insight into the massive deadweight losses associated with the current system of control of trade.

II. MODEL SPECIFICATION AND REPORTING OF RESULTS

Here I look at the ongoing problems associated with poor data.

¹¹ The mechanics of this type of distortion have a striking similarity to those associated with 'collusive' pricing in Harris and Cox. The size of the welfare costs generated will not, however, rely on the theoretically weak, and empirically uncertain specification of pricing rules for the firms in question.

and limited availability of elasticities, as well as a useful, but under-utilised method of reporting sensitivity analysis of model results.

Data and Elasticities

A perpetual problem, with CGE modelling in particular, is the problem of reliable basic data. While this has been a problem for CGE modelers since early in the development of the techniques, particular data inadequacies are problematic for modeling issues in the current round.

The data on trade in services has many inadequacies. As pointed out before, the data that does exist is far from complete. In addition, due to the novelty of interest in trade in services, an accepted nomenclature, and classification system does not exist. Since a common definition of services appears to be elusive, the problem of data concordance will likely persist even as data become more widely available. Trade in services is often inextricably involved with trade in goods, or investment flows, and this will serve to confuse some of the policy issues, as well as the collection of reliable data for some time to come.

Data problems also exist in the area of agriculture, where data at the single producer level are rarely available, and where these may be necessary to determine the effects of specific agricultural programs. Similarly, and for related reasons, estimates of the single producers' production functions are not readily available, and they too constitute a valuable input into accurate modeling of agricultural policy issues. For many programs, evaluating the losses associated with the programmes relies

on knowledge of the ways in which farms differ in productivity, and the way that particular acres differ in yields over substitute crops. This class of information does not appear to be readily available. Niewouldt et al. (1976) argue that a major cost of the commodity programs in peanuts were due to the inefficient crop choice that results between commodities covered by programs, and those which are not cover

In one of the hottest areas of current modeling interest, that of industrial organization and returns to scale, more and more estimation of cost parameters is taking place, but the same can not be said for the estimation of the (more crucial) pricing or behavioral rules. The modeling work in this area suffers from the substantial cloud of skepticism generated by the somewhat ad-hoc pricing rules used. While these models represent the most influential development in some time, they appear to be taken a bit too literally, given the firmness of the empirical footing on which they are based.¹²

This is not the first, nor will it be the last, conference where CGE modelers will be heard to bemoan the poor availability of good econometric estimates of crucial model elasticities. It appears that modelers must assume the responsibility of obtaining elasticity estimates which are more closely analogous to the model parameter in question. Although a useful side-effect of the Harris and Cox work, is that government interest in the model has generated resources to accurately estimate some of the model

¹² The "Harris- Cox model GET is currently up and running in Ottawa, at our Department of Finance.

parameters, econometricians are often skeptical of the fundamental methodology of CGE models. As a result, they have not beaten down our doors with elasticity estimates that easily plug into existing, or prospective models. If we can't get "them" to do it for "us", we may have to do more of the estimation ourselves¹³.

Systematic Sensitivity

In spite of substantial advances in the area of computational speed, and algorithm efficiency, most CGE modelers restrict their sensitivity analysis to partial consideration of simple one-by-one perturbation of arbitrarily selected elasticities. While so-called "limited robustness" procedures are preferable to no sensitivity analysis at all, the alternative of systematic sensitivity procedures are both feasible, and useful.

A recommended sensitivity procedure is described in Table II below. While this procedure can become cumbersome when considering many different policy experiments, the resource, and time requirements are modest when applied to central case policy experiments.

¹³ Perhaps the best way to get the attention of the econometric community is to do our own estimations very badly.

TABLE II

SYSTEMATIC SENSITIVITY PROCEDURE

- (i) Obtain econometric estimates of point estimates and standard errors of model elasticities.
- (ii) Calculate effects of one-by-one perturbation of all elasticities. (CSSA procedure)
- (iii) Choose the elasticities with the largest one-by-one effect on the variable of interest for inclusion in an unrestricted systematic sensitivity analysis. (USSA involves perturbation of all of the chosen elasticities independently. If three elasticities were to be independently varied over five different values, this would only require 125 solutions of the model. If even this is too difficult, accurate approximations to these 125 solutions can be obtained through an approximation technique due to Pagan and Shannon (1985). Sensitivity results are presented in detail in Wigle (1986).

Systematic sensitivity analysis permits a useful, easily interpreted measure of the elasticity sensitivity of model results to be presented. Extreme values, mean effects and probabilities of gain or loss are readily calculable. This contrasts with existing procedures, which offer little insight into the weight of the evidence presented one way or the other. A further advantage of the approach is that it allows model sensitivity to be represented in a compact form which fits into the policy communities frame of reference.

A common criticism of systematic sensitivity procedures is that they tend to give an unduly optimistic view of the confidence we have in estimated model results. This criticism fails to appreciate that, while

systematic sensitivity analysis is usually unable to give an estimate of the sensitivity to structural assumptions in the model, it does give us a coherent picture of an important aspect of model sensitivity. The parameter sensitivity of CGE models can be such that qualitative results are sensitive to elasticity specification, and this will not always be obvious from hit-and-miss sensitivity procedures.

CONCLUSION

The challenges laid at the feet of CGE and numerical modelers by the Punta del Este declaration are numerous, and suggest several novel applications of numerical modeling. Modelers in this round are in the fortunate position (relative to modelers in the Kennedy and Tokyo rounds), of having dramatically improved hardware and software, as well as a wider audience for their work. The level of accumulated human capital on the part of both modelers, and consumers of model results is certain to lead to wider, and more informed use of numerical analysis to help illuminate difficult policy discussions.

This paper suggests that the CGE and numerical modeling response to the upcoming round of negotiations be a combination of increased detail work in some areas (agriculture); and increased concentration on 'maquette', or single-issue modeling in the other major area of interest (services). These two suggestions would seem to afford the greatest yield to our efforts in the respective areas.

As a final remark, I would like to recall some remarks by Herb Scarf,

to a conference of 'policy-types' (p-t's)¹⁴ and modelers that took place at Columbia University in April of 1984. The proceedings of the conference were infiltrated by an undercurrent of skepticism from the p-t's, to the effect that CGE models could never be expected to affect policy for a whole host of reasons, some relating to their 'fanciful abstraction' from (for example) the reality of unemployment, and other reasons related to the danger of 'hard numbers' in the policy environment. What followed in several of the discussions were recriminations on the part of some modelers that they had, perhaps, not designed their research agenda very well, as far as having an impact in policy circles. Scarf's comment (and I am paraphrasing) was to the effect that he was puzzled by all the recriminations, and that whether or not the p-t's said that they didn't think that these models were important, a casual look at the facts would confirm that they had been influential. In particular, he pointed out that the very simple concept of scarcity, which had been in the background for so long, was now front and centre, largely because of the CGE work that emphasized it.

In the context of the upcoming round, I take Scarf's admonition to suggest that we not abandon our analysis of difficult issues. In particular, I think we must not be afraid to carry on some of the work (and I am harping back to trade in services in particular) through the practice of substantial abstraction. The major mistake we can make in this area is to too readily introduce tenuous behavioral aspects into numerical models

¹⁴ The similarity to the acronym for 'patrol and torpedo' seems entirely warranted in this context.

before their analytics are reasonably clearly understood.

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Industrial Organization, Agriculture and Trade Liberalization:

An Applied General Equilibrium Approach

by

David Cox

Queen's University

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1. Introduction

In the past, trade negotiations under the GATT have focused primarily on liberalizing trade in manufactured goods. In the event of a new GATT round it is likely that agricultural trade will also be on the agenda. If trade liberalization in agricultural products does take place, it will be useful to have available, applied general equilibrium models with which to examine the resulting impact on resource allocation and welfare.

In this paper I would like to outline some extensions of the applied General Equilibrium Trade model (GET) developed by Richard Harris, Harris (1984b), to handle some of the issues raised by liberalized trade in agriculture. The Harris model departs from applied general equilibrium models in the Walrasian tradition by incorporating economies of scale at the firm level and imperfect competition in its modelling of the manufacturing industries. The inclusion of these two features in the model, lead to predictions on the impact of trade liberalization for a small open economy which differ significantly from what a Walrasian trade model would predict (Harris 1984a). While in its treatment of the manufacturing sector the GET model departs from the Walrasian models, in its treatment of agriculture production the GET model maintains the assumption of constant returns to scale. More explicitly it is assumed that capital and labour combine with intermediate inputs to produce agricultural output at constant unit cost. This treatment of the technology ignores the fact that scarce land is also an important input into the production process. The existing specification implicitly assumes that either capital and land are perfect substitutes into the production of agricultural output or that agricultural land is a free good. It is unlikely that either of these extreme assumptions serve as a good approximation to reality.

In view of this I will indicate in this paper how a more appropriate specification of technology in the agriculture sector could be incorporated into the GET model, or indeed any computable GE model. The basic idea is to include land as another primary factor alongside

capital and labour in the production of agricultural output. Agricultural land is assumed to be sector-specific, reflecting the low opportunity cost of using the resource in another occupation, and in fixed supply. The assumption of constant returns to scale in all inputs is maintained. However, since the supply of land is fixed the industry production function will be characterized by decreasing returns to scale in the non-land inputs. As a result, marginal cost (the industry supply curve) will be an increasing function of industry output. This specification will lead to a competitive scarcity rent being earned by land. The rent accruing to land will be endogenously determined within the model. Incorporating land explicitly as a factor of production will allow the model to predict what will happen to the welfare of land owners in the advent of trade liberalization.

The organization of the paper is as follows. The next section gives a description of the GET model. The third section of the paper reviews how the inclusion of scale economies and imperfect competition, at the industry level, modifies the traditional Heckscher-Ohlin view of how a small open economy reacts to trade liberalization. Section four of the paper discusses the extension of the model to include agricultural land as a factor of production. Some final observations conclude the paper.

2. Model Description

The GET model was formulated specifically to examine the impact of trade liberalization on a small open economy, with particular focus on the manufacturing sector. It is an applied general equilibrium model which has been calibrated to a Canadian data set. In this section a brief overview of the model will be presented. For a more detailed description of the model including the equations of the model, see Harris (1984b).

The GET model consists of 29 domestic industries. Of these, 20 are modelled as imperfectly competitive industries characterized by economies of scale at the firm level. These

industries correspond to the Canadian manufacturing industries identified at the two digit level of the SIC code. The other 9 industries consist of the natural resource (including agriculture) and service sectors of the Canadian economy. These industries are modelled as perfectly competitive, constant returns to scale industries. In the model 30 commodity aggregates are distinguished which are used in both final and intermediate demand categories. Twenty nine of these aggregates consist of a domestically produced good, corresponding to the domestic industry of the same name, and a foreign imported good. Following Armington (1969), in each commodity category the domestic and imported good are assumed to be close but imperfect substitutes in each demand category. As a result, intraindustry trade or "cgross-hauling" is a feature of the model. The thirtieth commodity category refers to "noncompeting imports". This category consists of an imported good which has no domestically produced counterpart.

In the foreign sector, the economy is modelled as an "almost" small open economy. In the market for imports, domestic consumers and producers face a perfectly elastic supply curve at the world price of the commodity, gross of any tariffs. In the export market domestic producers are price makers facing a downward sloping demand curve for their product. The elasticity of export demand facing producers will vary across industries.

There are two primary (non-produced) factors of production in the model: capital and labour. Each factor is homogenous and mobile across industries and firms. Capital is internationally mobile and assumed to be in perfectly elastic supply to the domestic economy at the world rental rate. Labour is internationally immobile. The domestic wage rate is determined in a perfectly competitive labour market. The resource endowment of the economy consists of a fixed (perfectly inelastic) supply of labour and capital.

The GET model is a real trade model which incorporates no purely monetary variables. Trade is modelled as barter between the domestic economy and the rest of the world. As a consequence there is no independent role for an exchange rate between domestic and foreign

currencies. All domestic prices are measured in terms of a commodity basket of goods imported from abroad at constant prices. There is no international borrowing or lending incorporated in the model so that trade must be balanced, i.e., the current account must be in balance. Current account balance means that the surplus on the merchandise trade account must equal the rental payments to foreign-owned capital which is employed in the domestic economy. In the model, current account balance is always maintained as a consequence of Walras' Law.

The model takes account of a number of tax and tariff distortions in the Canadian economy. All tax, tariff and subsidy rates are expressed in ad valorem form. Among the domestic taxes incorporated into the model are sales taxes on final domestic consumption, taxation of the use of intermediate goods by different sectors at different rates, producer subsidies, and export taxes. Tariff rates, both domestic and rest of world, are inclusive of ad valorem equivalents of non-tariff barriers.

The demand side of the model consists of exports, intermediate demand and consumption by domestic consumers. The demand by foreigners for Canadian exports is given by a set of export demand functions, one for each commodity, which characterizes the foreign response to changes in the "landed" price of Canadian exports. Intermediate demand arises from the use of a given industry's output as an input into the production process of another industry. It is assumed that firms choose intermediate inputs (domestic and foreign) along with primary factors to minimize the cost of producing their output. Domestic final demand for each commodity (domestic and foreign) is assumed to be generated by a single consumer maximizing an aggregate utility function. Given prices for all commodities and the disposable income of the consumer, the demand for each commodity is derived from the utility maximization hypothesis. The disposable income of the consumer is derived from three sources: ownership of the domestic resource endowment -- labour and domestically owned capital, possible economic profits accruing to domestically owned firms in non-competitive industries, and government

transfer income. Government revenue is raised through the system of taxes, tariffs, and subsidies in place. All government revenue raised in this manner is returned to the consumer in the form of a lump sum transfer.

In the competitive industries the technology of the industry is represented by a unit cost function which, given constant returns to scale, is independent of the level of industry output. The cost function is defined over all intermediate and primary factor input prices. The condition that profits be zero in equilibrium requires that price in each competitive industry be equal to unit cost.

In the manufacturing sector each industry is made up of an endogenously determined number of representative firms. It is assumed that within an industry all firms are identical, meaning that each firm has access to the same technology and that all firms follow the same behavioral rule in setting prices for their output. The technology of a representative firm is represented by a cost function which consists of both variable and fixed costs. Variable costs are assumed to be independent of output and consist of intermediate input expenditures (on domestic and imported goods) and expenditures on variable capital and labour. The fixed costs of a firm consist of only capital and labour. The existence of fixed costs in the firm's cost structure is explained by an indivisibility; a fixed amount of capital and labour is required to set-up a plant of minimum size. The specification of constant per unit variable costs plus a fixed cost component leads, at constant input prices, to declining average costs that asymptotically approach unit variable cost. In this situation the minimum efficient scale (MES) of the firm is defined as the level of output at which average costs are within 1 percent of unit cost. A measure of the steepness of the average cost curve is given by the cost disadvantage ratio (CDR), which measures the percentage by which average cost at an output level one-half of MES exceeds average cost at MES.

Firms in each of the non-competitive industries are viewed as price-makers. Firms set their price by choosing a markup on unit variable cost. Within the model two alternative hypotheses are considered by which firms might select the markup. The first approach is based on the Negishi (1960) perceived demand curve approach. It is postulated that the firm perceives a constant elasticity demand curve for its product. Given this demand curve the firm chooses the price of its product to maximize profit. This procedure will be referred to as the monopolistic pricing hypothesis (MPH). The other pricing hypothesis considered is referred to as the Eastman-Stykolt hypothesis (ESH). Following the suggestion of Eastman and Stykolt (1966), the domestic price within an industry is set equal to the foreign price of the industry's import competing good, plus the domestic tariff. This is a collusive type of pricing arrangement in which the foreign price plus domestic tariff serves as a "focal point" for the domestic industry. In the simulations of the model, the actual prices charged by the domestic industry is assumed to be a weighted average of the MPH price and the ESH price.

Firms are assumed to enter and exit the industry in response to the existence of pure profits or losses. In equilibrium the actual number of firms in an industry is determined by a zero profit condition. This implies that, in equilibrium, price is approximately equal to average cost. Under the MPH, industry equilibrium also requires that the perceived elasticity used by firms is equal to the elasticity of the firm's "true" demand curve.

A general equilibrium for the economy as a whole is obtained when all industries are in equilibrium earning zero profits, all product markets clear, factor markets clear and the balance of payments is in equilibrium.

The algorithm used to compute the equilibrium of the model proceeds in two steps. First a short-run equilibrium is computed in which the number of firms and markups in the manufacturing industries are held constant. Conditional on this industrial structure a wage rate and set of commodity prices are found which clear both the labour and commodity markets. The

second step in the computation process involves adjusting the number of firms and markups (under the MPH) so as to ensure each manufacturing industry is characterized by earning zero profits. Steps one and two of the algorithm continue until a general equilibrium for the economy is found.

In published versions of the model to date (Harris (1984a,b), Cox and Harris (1985, 1986)) the model has been calibrated to a 1976 data set constructed for Canada. Construction of the data set and the actual calibration procedure used is detailed in Harris (1984b, Appendix B). Among the important parameters of the model are the export elasticities characterizing the foreign demand functions, import elasticities which are used to scale the elasticity of substitution between domestic and imported goods within a commodity aggregate, economy of scale estimates which are used to calibrate the cost functions of the firms in the manufacturing industries, and lastly the parameter which weights the two pricing hypotheses (ESH and MPH) which are used in the manufacturing industries. Values for the first three parameters were obtained from searching the econometric literature. The last parameter represents a behavioral hypothesis for which reliable econometric evidence is not available. A "best guess" value of one half has typically been used for this parameter. In the case of all parameters extensive sensitivity analysis has been undertaken.

3. Resource Allocation with Imperfect Competition and Scale Economics

The GET model was constructed to examine the impact on the Canadian economy of possible trade liberalization policies. In this section, I would like to briefly discuss some of the features of the model which distinguish it from the class of Walrasian trade models, and also review some of the experience we have had with the model.

The most important feature of the model is that it relaxes the assumption of constant returns to scale in the manufacturing sector. Cost functions characterized by decreasing unit cost

are postulated at the firm level. This is consistent with much of the evidence found by researchers who have examined the cost structures of Canadian manufacturing plants (Eastman and Stykolt (1966), Fuss and Gupta (1981)). In addition the assumption of perfect competition is relaxed and market structures within the manufacturing sector are modelled to be imperfectly competitive; firms are price-makers rather than price takers. The interaction between economies of scale in production and imperfect competition in the output market are important features of the GET model. These two features combine to introduce another mechanism, in addition to the usual comparative advantage effects, by which the model economy can react to trade liberalization initiatives. What is allowed for is the possibility that industries will “rationalize”, as a response to tariff reductions, by reducing the number of firms contributing to the production of a given volume of output. As a consequence, this means that the absolute efficiency with which resources are used within an industry becomes an endogenous variable. The means by which this rationalization effect works is through changes in the markup of price over variable costs set by firms. Beginning from an industry position of zero profits, any change in the firms’ markup will result in profits or losses being earned. Entry or exit of firms will ensure until a situation of zero profitability is restored. In the model, changes in the firms’ markup will occur either through the direct effect of the ESH pricing hypothesis or indirectly, under the MPH pricing hypothesis, through changes in the elasticity of the firm’s demand curve.

In summary, the GET model incorporates two distinct routes through which resource re-allocation may occur, in the advent of trade liberalization. There is inter-sectoral resource adjustment, as resources shift between industries on the basis of comparative advantage considerations. Secondly, there is intra-sectoral resource adjustment, as the number of firms present in an industry adjusts to maintain zero profitability. The resource allocation which is observed in equilibrium will be determined by the interaction of these two effects.

The general conclusion which has emerged from our work with the model is, that the inclusion of scale economies and imperfect competition leads, to trade liberalization having significant real income gains for a small open economy. In comparing the predictions of a Walrasian trade model and the GET model on the same 1976 Canadian data set, Harris (1984a) found that the real income gains differ by a factor of four. The pattern of resource reallocation induced by trade liberalization also differs across models. The GET model predicts an expansion of the manufacturing sector relative to the rest of the economy. In the Canadian case this is opposite to what one might expect by taking a Heckscher-Ohlin view of comparative advantage. The existing evidence (Harkness 1983) suggests that the manufacturing sector is at comparative disadvantage vis-a-vis the resource sector.

The findings of the model to date have only been examined for one data set and for one country, so that we must be cautious in drawing sweeping generalizations from these results. However they do suggest, in the case of small open economies, that there may be significant quantitative differences between the predictions of applied general equilibrium models of the Walrasian type and those of models which incorporate economies of scale and imperfect competition.

4. Incorporating Agriculture into the GET Model

(i) Partial Equilibrium

In this section I would like to examine in a partial equilibrium setting the impact of trade liberalization in the agricultural sector. This will serve to focus attention on the agricultural sector and also as a motivation for undertaking a full general equilibrium analysis. In the analysis I will assume that the market for agricultural goods is perfectly competitive. This ignores the fact that many agricultural markets are dominated by domestic marketing boards and quo-

tas; a more serious treatment would necessarily include these important features of agricultural markets.

Equilibrium in the domestic agricultural market is represented in Figure 1. The upward sloping supply curve for the industry represents the long-run marginal cost of producing agricultural output when land is in fixed supply to the industry and labour, capital and intermediate goods are available at prices w^o , r^o and P_M^o respectively. Maintaining the assumption that domestic and imported goods are imperfect substitutes the demand function for domestic output is given by the curve labelled D^o . This demand curve is drawn on the assumption that domestic and foreign agricultural tariffs are in place. The equilibrium price and output are P^o and Q^o . The rent accruing to land is measured by P^oAO .

Consider first, a reduction in the domestic tariffs on agricultural imports. The impact effect of the tariff reduction would be to shift to the left the demand curve as consumers substitute into the lower priced import competing good. The equilibrium price and quantity would fall to P' and Q' and returns to land to $P'BO$. However, this neglects any induced general equilibrium effects on the wage rate and prices of intermediate goods, which might shift the supply curve up or down, and cause further shifts in the demand curve. This omission may be particularly important if reduction of agricultural tariffs is accompanied by further reductions in manufacturing tariffs. Previous experimentation with the GET model has suggested that removal of domestic tariffs across all sectors would be accompanied by increased wages and lower domestic commodity prices. Taking into account these general equilibrium effects it is conceivable that the demand curve could shift out to D^2 and the supply curve shift down sufficiently to S' so that equilibrium price and output would increase to P^2 and Q^2 . The rent to land would also increase to P^oC0 .

In figure 2, the impact of a reduction in foreign agricultural tariffs is considered. Beginning at the initial equilibrium represented by Point D, with price and output at P^o and Q^o

and land rent equal to P^oDO , a fall in the foreign tariff would have the immediate effect of shifting out the domestic demand curve. A new equilibrium at point E would be established involving a higher price and output in the agricultural sector and higher land rents. Again it is difficult to say how the general equilibrium effects would work themselves out in the context of the GET model. It is likely however that the demand curve would shift out even further as a result of a general increase in domestic real income brought about by multilateral trade liberalization. In the case of the supply curve it is difficult to predict what would happen, however it is likely it would shift back as a result of the substantial increases in the real wage likely to accompany multilateral trade liberalization. A possible final equilibrium is indicated by point F.

The analysis of trade liberalization in the agriculture sector outlined above, in particular when it is carried out in conjunction with tariff removal in the manufacturing sector, suggests a general equilibrium approach is essential for predicting the impact on resource allocation and welfare in that sector. In the next section of the paper we outline an extension of the GET model to incorporate the agriculture sector.

(ii) Amendments to the Model

In this section the amendments to the GET model to incorporate sector specific land into the agriculture sector are outlined.

The technology of the agriculture industry is assumed to require the use of capital, labour, intermediate goods, and sector specific land. The industry is modelled as perfectly competitive and land is in fixed supply. The production function is assumed to have the form:

$$Y = F(x)^\gamma S^{1-\gamma} \quad 0 > \gamma < 1 \quad (4.1)$$

where Y : output

$X = (x_1, \dots, x_n, K, L)$: vector of non-resource inputs -- capital, labour and

a vector of n intermediate composite goods.

S : sector specific land.

$F(X)$: a linear homogeneous input aggregator

γ : share type co-efficient on non-resource inputs

The Cobb-Douglas form is assumed for the aggregator $F(\cdot)$.

$$F(X) = A x_1^{\alpha_1} \dots x_n^{\alpha_n} L^{\alpha_L} K^{\alpha_K}$$

$$\sum_{i=1}^n \alpha_i + \alpha_L + \alpha_K = 1 \quad (4.2)$$

The intermediate composite good x_i is an aggregate formed from the domestic and imported good within each commodity category. The aggregator chosen for each composite good is also assumed to have the Cobb-Douglas form. Since the supply of the sector specific resource is fixed, it is convenient to substitute (4.2) into (4.1) so that the production function can be re-written as:

$$Y = A^* x_1^{\gamma \alpha_1} \dots x_n^{\gamma \alpha_n} L^{\gamma \alpha_L} K^{\gamma \alpha_K}$$

with $A^* = A^\gamma S^{1-\gamma}$

$$\gamma \left(\sum_{i=1}^n \alpha_i + \alpha_L + \alpha_K \right) = \gamma < 1 \quad (4.3)$$

The fact that the share co-efficients of this Cobb-Douglas production function sum to the value γ , less than one, indicates that the technology is characterized by decreasing returns to scale in the non-land inputs. The cost function dual to this production function will also have the Cobb-Douglas functional form (see Varian (1984), pp. 28-29). Expressed in log-linear form the cost function is:

$$\begin{aligned} \log C(P, Y) = & \beta + \sum_{i=1}^{29} \alpha_i \log w_i \\ & + \alpha_{30} p_{30}^* + \alpha_L \log w \\ & + \alpha_K \log r + \left(\frac{1}{\gamma}\right) \log Y \end{aligned} \quad (4.4)$$

$$P = (p_1, \dots, p_{29}, p_1^*, \dots, p_{30}^*, w, r)$$

where w is the wage rate, r is the capital rental, p_{30} is the price of the non-competing import and w_i is the price index of the composite input consisting of the domestic and foreign good within commodity category i . The aggregator w_i has the functional form:

$$\log w_i = \beta_i \log p_i + (1 - \beta_i) \log p_i^* \quad (4.5)$$

where p_i and p_i^* are the price of the domestic good i and imported good i respectively.

Assuming price-taking behavior in the input markets the vector of inputs for the agriculture industry can be derived by applying Shepard's lemma to the cost function.

Turning now to the supply decision of the agriculture industry it is assumed that the industry behaves so as to maximize industry profits in a competitive manner. Given an output price and a set of input prices the profit maximization problem facing the industry is:

$$\begin{aligned} \max_{\{Y\}} & p \cdot Y - c(P) \cdot Y^{\frac{1}{\gamma}} \\ \text{where } & c(P) = C(P, Y) / Y^{\frac{1}{\gamma}} \end{aligned}$$

The first order necessary conditions for a solution to this problem requires that output be selected such that price equals marginal cost:

$$\begin{aligned} p_i &= \frac{1}{\gamma} \cdot Y^{\frac{1-\gamma}{\gamma}} c(P) \\ &= \eta \cdot c(P) \end{aligned} \quad (4.6)$$

where $\eta = \frac{1}{\gamma} Y^{\frac{1-\gamma}{\gamma}}$

The first order conditions for this maximization problem can be solved to yield the industry's supply function:

$$Y(p) = \left[\frac{\gamma P}{c(P)} \right]^{\frac{\gamma}{1-\gamma}} \quad (4.7)$$

The elasticity of the supply curve is given by $\gamma / 1 - \gamma$. Substitution of the supply curve into the objective function yields an expression for the industry's profit function:

$$\pi(P) = P \left[\frac{\gamma P}{c(P)} \right]^{\frac{\gamma}{1-\gamma}} - c(P) \left[\frac{\gamma P}{c(P)} \right]^{\frac{1}{1-\gamma}} \quad (4.8)$$

The profit generated by a natural source industry will be interpreted as the return or rent to land used by the agriculture industry.

If we maintain the Armington assumption that domestic and foreign agricultural products are imperfect substitutes then equilibrium in the agriculture industry requires that there exist an output price such that demand equals supply. All of the other equilibrium conditions in the model remain unchanged. The definition of income accruing to the consumption sector will have to be amended to include the rent earned by agricultural land.

(iii) Calibration of Model and Computation of Equilibrium

The modelling of the agricultural industry as an increasing cost industry introduces some extra parameters into the model which must be calibrated. Specifying the production function to be Cobb-Douglas, separable between non-land and land inputs, necessitates calibrating the share parameter γ . In addition the amount of land S in the agriculture sector must be specified. Once values for these parameters have been selected the rest of the parameters in the production structure can be calibrated in a straightforward manner (Harris 1984b).

A natural way to impute the amount of land available for agriculture production will be to identify it as the amount of rent which accrues to land in the benchmark data set. Assuming the implicit rental rate of the resource is equal to one in the benchmark year we can interpret the dollar measure of the resource rent as a real magnitude indicating the flow of land services available. Unfortunately, in the Canadian input-output tables rent to land in the agriculture sector is not treated as a separate income category, rather it is lumped together with capital income in the category "surplus". This necessitates imputing the rent earned by land. This can be done by obtaining an independent estimate of capital income (ie. multiplying the appropriate rental rate times the sector capital stock) and then subtracting this figure from "surplus" to obtain land rent. Once a value for S , the land endowment, is found the share parameter α can be imputed by setting it equal to the ratio of expenditure on non-land inputs to the value of sector output.

Once the parameters of the model are calibrated the equilibrium of the model can be computed. Modelling the agriculture industry as an increasing cost industry requires a modification of the algorithm used to solve the model. The basic problem is that unit cost is no longer independent of the level of output. In the constant cost case, industry price is given by the value of unit cost which depends only on input prices; industry output is demand determined. With increasing costs, industry price and quantity must be determined simultaneously. The way this can be overcome is by augmenting the variables over which the algorithm explicitly searches, to include the output level of the agriculture industry. The amended algorithm is outlined in Table 1.

5. Summary and Concluding Comments

It seems likely that agricultural trade will be on the agenda of a future GATT round. In this paper we have outlined a method of incorporating the agricultural sector into an applied general equilibrium model which takes into account the technology of the industry is best de-

scribed as being of an increasing cost nature. Treating the industry in this manner will allow the model to investigate the impact trade liberalization will have on the rents generated in the agriculture sector, something which applied GE models maintaining the constant returns to scale specification cannot do. The obvious next step in the analysis is to implement this approach on a real data set.

The research reported in this paper is a part of a larger research program which is being undertaken to update and amend the current version of the GET model. In addition to the possibility of a new GATT round, the model is being amended to be able to address the economic issues raised by the current negotiations being carried on by Canada and the United States, over the possibility of a free trade arrangement being implemented between the two countries. The model is in the process of being benchmarked to a more current data set (1981). Also a substantial disaggregation of the model is being undertaken with the number of manufacturing industries in the model increasing from twenty to sixty-three. Finally econometric research is being undertaken to get estimates, from more recent data sets, of the elasticities and economies of scale parameters used in the model. It is hoped that these refinements of the model will make it a better tool for analyzing future exercises in trade liberalization.

Figure 1

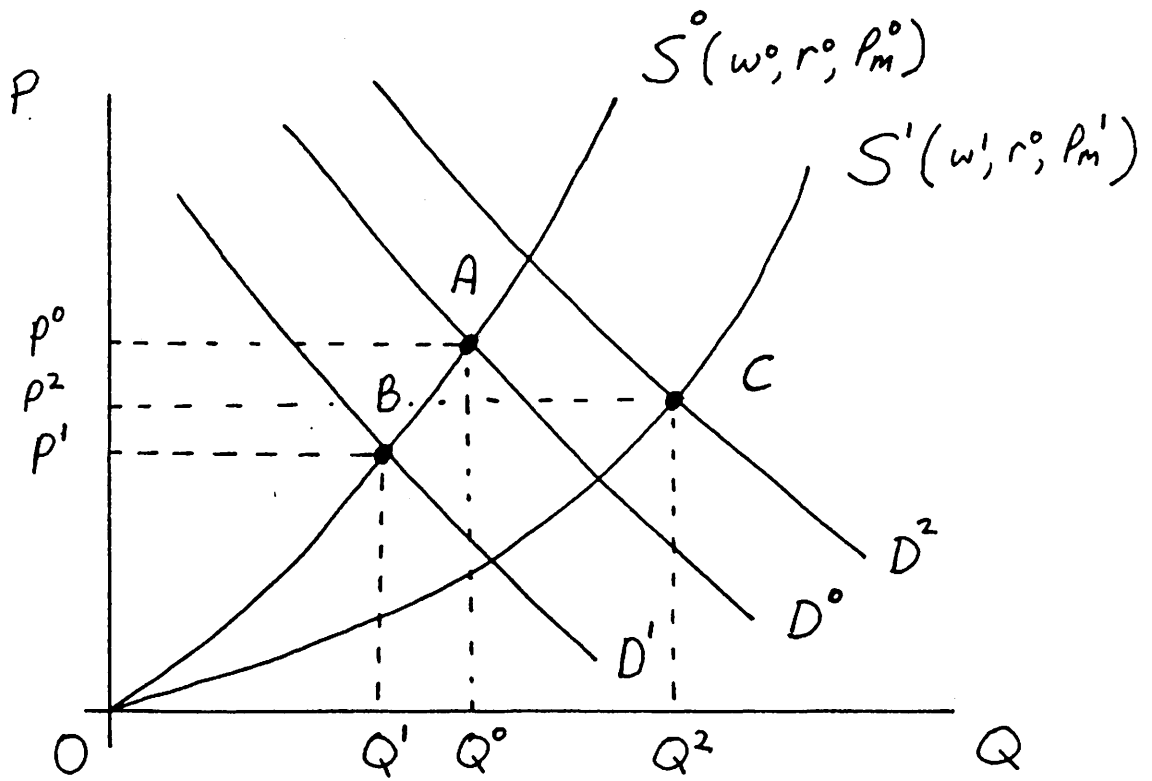


Figure 2

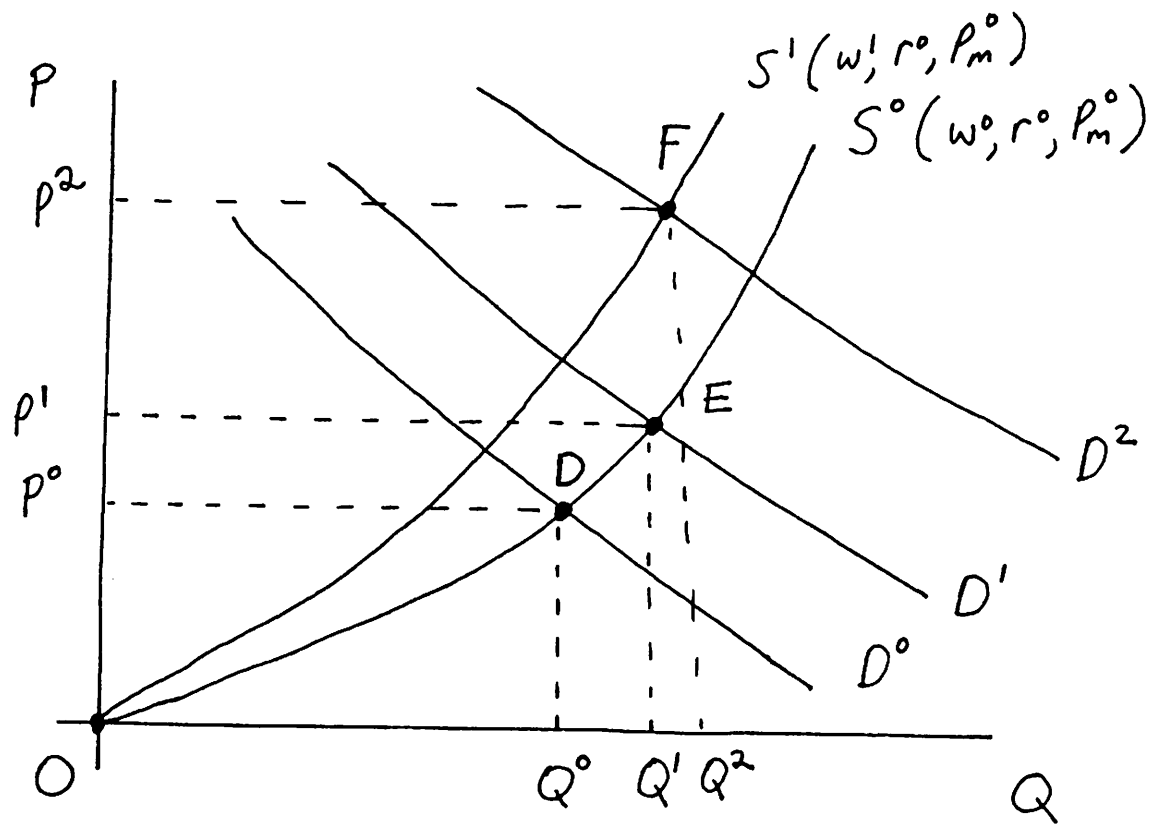
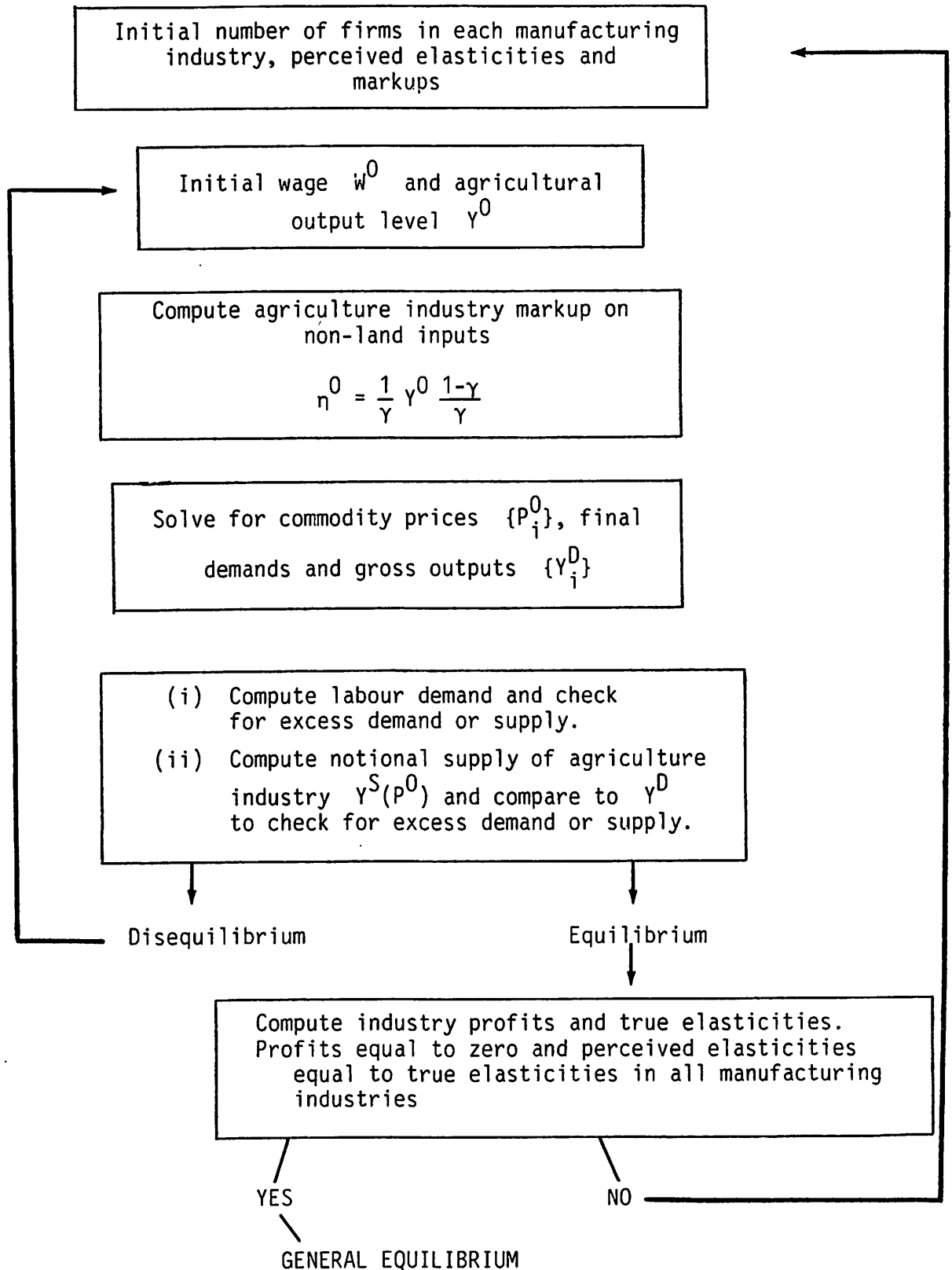


TABLE 1: Flow Chart for Equilibrium Computation



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Modeling Nontariff Barriers in World Agricultural Trade

by

Drusilla K. Brown
Tufts University

I. Introduction

Agriculture is virtually certain to be on the table during the next round of trade talks. The models we build to evaluate negotiations on agriculture are going to depend, though, on how meaningful and successful we expect the discussions to be.

There is reason to expect movement in this area due both to pressure from exporters and the domestic needs of importers. Japan and the EEC have come under increasing pressure from the U.S. to liberalize their agricultural markets. The U.S. has complained bitterly about the effects of the accession of Spain into the Community and about the allegedly predatory take-over of the U.S. grain markets during the recent period in which the U.S. dollar was over-valued. Japan, of course, is under pressure to liberalize in all areas in order to reduce its growing trade surplus.

Internal pressures for reform, however, may provide the more meaningful impetus towards liberalization. Take, for example, the Common Agricultural Policy (CAP) of the EEC. The EC Commission has become increasingly concerned with the agricultural situation in the Community, particularly with regard to the accumulation of large stocks of excess production. As a result, the Commission has indicated the intention of moving agricultural markets in the Community closer to free market conditions.

Several reforms of the CAP are under consideration and have been tried experimentally, such as the establishment of

'guarantee thresholds' in the grain markets. This is a mechanism by which the price guaranteed to the seller is lowered following a year in which a pre-determined level of Community production is exceeded. The guarantee threshold was exceeded in 1983-84. Consequently, in the 1984-85 market year the intervention price (price floor) was lowered 1%, after several years in which the price floor had been steadily raised.

Secondly, the effectiveness of the CAP has been eroded as a result of the import of close substitutes of central CAP products. For example, manioc, cassava, and oil seed cakes are replacing cereals as livestock feed. The EEC is unable to control the import of substitutes because the tariffs on these products are bound at zero under the GATT. The EEC may thus be willing to trade off some protection of the central CAP products in exchange for greater protection of the feed substitutes.

The computable general equilibrium (CGE) trade models previously used to evaluate the Tokyo Round of trade negotiations were constructed primarily for the purpose of evaluating tariff reductions on industrial products, with minimal attention to the effects of nontariff barriers (NTBs) or the types of import restrictions characteristic of the agricultural sector. This modeling orientation was appropriate given the limited success in negotiations concerning NTBs. Whalley (1985) represents all NTBs by their nominal tariff equivalent in the base period. Deardorff and Stern (1986) model all NTBs as quotas, with the tariff equivalent determined endogenously in the model. Further, the

sectors most heavily controlled by NTBs are highly aggregated so that the potential for detailed analysis of domestic and border policies was limited. All trade in agriculture was typically aggregated into one or two product categories.

The question today is how applicable are the current global models of trade and agriculture to study the agriculture sector? On the surface, it may appear that these models are highly inappropriate for this purpose. It is hard to imagine how a model designed primarily to evaluate tariff protection could adequately accommodate the complexity of protection in agriculture. A few examples of the types of intervention used in the CAP are

- import taxes, both fixed and variable
- export subsidies, both fixed and variable
- intervention buying
- subsidies to inputs
- subsidies to production
- deficiency payments to producers
- consumer subsidies
- quantitative restrictions on intervention buying, production, deficiency payments, and export subsidies
- concessional sales, and
- preferential tariff rates.

In order to be useful in evaluating a meaningful round of trade discussions, a model would have to have sufficient industry and institutional detail to capture both the current structure of

protection and possible changes in the policy regimes, such as the substitution of a producer subsidy for an intervention buying program.

Despite the apparent limitations of these models, it is possible to incorporate most of the types of trade policies which are likely to be at issue in the next round within the current modeling framework with a proper reinterpretation of parameters and a change in product aggregation. Recently, several modeling efforts, using both partial and general equilibrium techniques, have more thoroughly developed the agricultural sector, such as Valdes and Zietz (1980), Bale and Lutz (1981), Tyers (1985), Fischer, Frohberg, Kromer, Morovic, and Zeold (IIASA)¹ (1985), and Trela, Whalley, and Wigle (1986). These models, though themselves not appropriate for evaluating trade discussions, are helpful in indicating the proper course for adapting the global CGE models for this purpose.

Below, the features which characterize the new agriculture models are discussed with regard to their usefulness in resolving some of the difficulties encountered in modeling the next GATT round. Modeling problems, nevertheless, remain. These will be discussed, as well, followed by conclusions.

II. The New Agricultural Models

A common feature of the new agriculture models is the

¹This work is part of the linked system of the Food and Agriculture Program of the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria.

assumption of product homogeneity. Net exports (or imports) is given by the difference between domestic supply and demand. This differs significantly from the CGE models of Deardorff and Stern and Whalley. In both of these models some degree of product heterogeneity is assumed. Whalley uses the Armington (1969) approach so that all products are differentiated by place of production. Deardorff and Stern differentiate both between imports and the domestically produced good, and between goods produced for domestic consumption and goods produced for export. This type of disaggregation is designed to accommodate cross-hauling and to insulate the domestic price system from the world price system.

Despite the assumption of product homogeneity in the agriculture models domestic prices are still partially insulated from the world price system. For example, in the model developed by Tyers and Chisholm (1982), the world price is filtered through a transmission equation. The parameters of the transmission equation are the world price, specific import taxes, ad valorem import taxes, the exchange rate, shipping costs, a parameter to capture access to concessional sales, and a 'pass-through coefficient' which is the elasticity of the domestic price with respect to the world price. The IIASA model is constructed similarly.

The world price transmission equation facilitates the modeling of several different types of market intervention. Its most obvious application is in the modeling of a variable levy on

imports which adjusts to counter any fluctuations in the world price. In this case the pass-through coefficient is set at zero. The pass-through coefficient would be raised to unity if the variable levy were bound as a result of negotiations.

Capturing the insulating property of the policies used to control agriculture will improve the quality of the estimates obtained from both perfectly competitive and imperfectly competitive CGE models. To see this in a competitive model, consider the effect of multilateral liberalization. Several studies (e.g., Trela, Whalley and Wigle, Valdes and Zietz, etc.) have concluded that meaningful liberalization in the grain market will increase the world price of grains by 10% or more. Nominal protection of variable levy protected markets would decline as a result of the increase in the world price, while remaining constant in tariff protected markets. Thus, the failure to capture the insulating property of the variable levy will result in under-estimation of the trade effects of the next round.

The effect of subsidization of exports to the EEC will also vary depending on the degree of insulation. The variable levy, unlike an ad valorem tariff, automatically prevents export subsidy-induced changes in the prevailing world price from altering the domestic price and raising EEC imports. In this case, failure to model the insulating properties of the CAP will result in over-estimation of the trade effect of reducing export subsidies.

Within an imperfectly competitive model, the distinction

between tariff and variable levy protection may also have implications for the modeling of third country suppliers. The variable levy significantly reduces the price elasticity of demand for imports by the EEC. As a result, third country suppliers have an incentive to price discriminate, charging a higher price to the EEC, and thus capturing some of the levy revenue. However, to avoid this outcome, the EC Commission bases the variable levy calculations on trading prices on the Chicago wheat market when it appears that the offer price to the EEC is deviating from the price offered to other buyers.

To be effective, collusion would have to take the form of reducing supply and raising the price to all wheat importers. Given the domination of the world wheat market by a few North American suppliers and Australia, this is a distinct possibility. Thus, negotiations which result in binding the EEC's variable levy will raise the price elasticity of world demand for wheat, resulting in greater supply at a lower price than would otherwise have been the case.

A second possible use of the transmission equation is to model state trading. In this case the state agency will make a judgement as to the degree of world price fluctuation which is passed on to the domestic market. Consequently, the pass-through coefficient will be set between zero and one.

The effect of policy distortions in the new agriculture models is captured by comparing producer and consumer prices to world prices and imputing ad valorem equivalents of border

controls. The price paid by the consumer and the price received by the producer may be separated by consumption taxes and producer subsidies. Net trade is given by the difference between domestic demand and supply at the transmitted price adjusted for domestic taxes and subsidies. Thus, the facility exists for incorporating consumption taxes, producer subsidies, deficiency payments, and other forms of domestic intervention which distort trade.

Very few of the new agriculture models are fully general equilibrium, and thus lack an adequate input-output structure necessary for handling intervention in the input markets. However, the final demand equations of the agriculture models can be introduced into the existing CGE models so that input subsidies and taxes can be incorporated.

Employing the agriculture models to evaluate various negotiating proposals can be difficult despite the increased industry and policy detail. It is not always possible to translate a policy change into parameter changes in the transmission equation or the domestic pricing rule. The transmission equation in the IIASA model, for example, is regarded as a reduced form of the policy making process, and thus the parameters are empirically estimated, rather than drawn from the legal code. Such a model can be used to evaluate the effect of complete or partial liberalization of the current distortions. How a change in the structure of protection, however, might alter these parameters is not at all clear.

The problem is not resolved even in the more specific Tyers-Chisholm model. The implication of the homogeneity assumption is that within a product category a country must be either an importer or an exporter. Consequently, such a model will erroneously indicate that changes in import controls have no effect on the trade of a net exporter, and change in the export subsidies will have no effect on the exports of a net importer.

The problem with this procedure can be illustrated by the EEC's trade in wheat. A casual look at the prevailing price of wheat in the EEC reveals the fact that the internal price appears to be determined not by the threshold price for imports, but rather by the price at which domestic intervention buying takes place, despite the fact that the EEC imports large quantities of wheat. This occurs because, contrary to the common perception, there is a great deal of product differentiation in this market. The variable levy applies to imports of high quality wheat from North America, but is prohibitively high on the type of wheat grown within the EEC. Thus, the world price and the variable levy determine only the price of imported wheat and the volume of imports, while the intervention price and any export subsidies available determine the supply price and exports.

The agriculture models can be adjusted for this purpose simply by differentiating between the import and domestically produced variety and reinterpreting the coefficients in the transmission equation. The transmission equation on the imported variety will be unaffected, but the parameters on the

transmission equation of the domestic variety should be altered to transmit the world price of the domestic variety of wheat, adjusted by the ad valorem equivalent of the export subsidy. The pass-through coefficient should reflect the degree to which the export subsidy is adjusted to account for fluctuations in the price of exports. Exports would be given by the difference between domestic production and consumption of the domestically produced good. Imports would be treated as a separate market.

This market is depicted in Figure 1. The quantity of imports, M_0 , is determined in part (a) where the threshold price, P_{th} , intersects the demand for imports, D_m . In the market for the domestically produced good, part (b), domestic production, S_0 , and consumption of the domestically produced good, D_0 , are determined where the intervention price, P_I , intersects the supply and demand curves, respectively. Any excess production is held as stock or exported by the intervention agency.

How would a negotiated reduction in the variable levy affect this market? Small changes would certainly stimulate imports by lowering the threshold price, but would probably have little effect on the price received by domestic producers. Thus, production would not be affected. Substantial reductions in border protection, on the other hand, would undermine the price support, requiring a reduction in the intervention price. If the threshold price were lowered below the intervention price then the intervention price must also be reduced to the same level. Liberalization, then, would be modeled in the market for the

domestically produced good in terms of its effects on the feasible internal support price.

An attractive feature of this formulation is that if liberalization lowers the internal price below the intersection of supply and demand for the domestic variety, trade will be reversed. The EEC would then become an importer of both high quality North American wheat and domestically-grown common feed wheat. Removal of the variable levy in Figure 1(b) would require that the domestic price fall to the world price, P_w , resulting in net imports of the domestic good. Use of this model simply requires sufficient institutional knowledge to form a judgement as to which of these policies is determining production and consumption at the margin.

A similar adjustment can be made when quantitative restrictions are imposed on production, intervention buying, or export subsidies. Imposing quantitative limits is attractive as a negotiating proposal since farm price support could be provided without stimulating excess production and exports. In the case of the production quota, output is determined by the quota at the margin, not by the intervention price or the rate of subsidy. Thus, in the model domestic price fluctuation should be constrained to affect demand only.

Restrictions on intervention buying and export subsidies have a slightly different effect. In this case intervention buying would serve merely to raise demand rather than to determine the domestic price. For example, the EEC restricts

intervention buying in the bread wheat market to 3 million metric tons in the first three months of the marketing year. As a result the market price typically slumps below the price floor. Modeling of this type of policy requires that exports be set exogenously to be equal to the intervention quota. A second adjustment, however, is also necessary. The domestic price would be determined to equate domestic demand plus the export quota to domestic supply, rather than by the transmission equation. In other words, the price of the domestic variety of this good would be determined in a manner similar to the price of nontraded goods.

Suppose, for example, that intervention buying in Figure 2 is maintaining the domestic price at P_I , requiring purchases of ac by the intervention agency. However, if intervention buying were limited to the quantity ab , then the internal price would fall to P_d .

The drawback to the approach of distinguishing between imports and the domestic variety is that it implies that changes in import controls will not directly affect the price received by domestic suppliers. While this may be appropriate in some cases, whether this technique should be used in all cases is not clear.

Take, for example, the beef market in Japan. Surprisingly, Japan is both an importer and an exporter of beef. In fact, Japanese beef, being grass-fed rather than grain-fed, is considered to be of higher quality than imported beef. If we follow the above example, exports would be modeled as the

difference between demand for and supply of domestic beef and imports would be modeled as a separate market, controlled by an import quota.

However, this modeling strategy would miss the essence of market control in Japan. The beef import quota, rather than being fixed, is actually adjusted quite frequently. The Japanese government establishes prices for both buyers and sellers in the domestic market. The objective in setting the import quota is to supply enough beef to bridge the gap between supply and demand at the administered prices. Consequently, modeling imports and the domestic good as separate markets would grossly misrepresent the actual intent of beef policy in Japan.

Somewhat more difficult modeling problems emerge when more socially responsible methods of income support for farmers are adopted. For example, intervention buying could be replaced by a production subsidy. In this case the consumer price would fall to the point where domestic demand is sufficient to absorb total domestic output forthcoming at the subsidized price. In Figure 3 a production subsidy would shift the supply curve from S to S' . The consumer price would fall from the intervention price, P_I , to P_d , where supply equals demand.

However, given the substantial degree of subsidization currently in place and the relatively low elasticity of demand for farm products, it is possible that the domestic market clearing price would be below the prevailing world price (P_w in Figure 3). At this point domestic suppliers would prefer to

supply the world market rather than to continue to sell on the domestic market. Thus, the domestic price is bounded below by the world price of the domestic variety.

One possible solution to this problem is to differentiate between domestic producers which supply to the domestic market and exporters. The price received by the exporter would be the world price plus any subsidies which may apply and the price received by the seller to the domestic market would be determined by equating supply and demand in the domestic market. The drawback of this approach is that it will exaggerate the effect of the policy switch on exports in the event that the domestic price is greater than the world price, but predict a smaller volume of exports if the domestic price is below the world price.

A similar problem emerges when a domestic support price scheme is replaced with a deficiency payment at the same time that import taxes are reduced. As a result of the deficiency payment the consumer price must, again, fall to equate demand to the supply forthcoming at the subsidized price. However, if the tariff reduction pushes the import price below the price obtaining on the domestic market then imports become positive. Consequently, the domestic price is bounded from below by the world price plus the import tariff.

Again, one could model imports and the domestically produced good of the same variety as differentiated, with a large value for the cross-price elasticity between the domestic variety and the import. A more attractive solution, however, is to construct

a model in which the market clearing condition is endogenous. The domestic price would be set to equate domestic supply and demand as long as the domestic price is above the world price. Otherwise, the domestic price would be equal to the world price and trade would be determined by the difference between domestic supply and demand at the world price.

An endogenous structure is not used in any of the global CGE models or the specialized agriculture models. However, it appears to have been accomplished by Keyzer (1986) in his model of the Bangladesh economy. In the Keyzer model the domestic price is bounded from above by the price of imports and below by the price of exports. The net trading position of the country, as an importer, exporter, or nontrader, is endogenous depending on the domestic price level. It is not clear, though, whether it is feasible to build such complexity into the large scale global models.

III. Conclusions and Remaining Problems

Problems in modeling the next round remain, nonetheless. In particular, certain refinements are ignored by the current models. First, it may be difficult to determine the marginal effects of certain policies. For example, it is an open question as to how set-aside programs in the U.S. affect the level of production. Similarly, it is common for aid to the agricultural sector to be conditional. Price support operations, for instance, may be undertaken only during periods in which the

market price is at or near the price floor. However, in many cases this will occur only during certain times of the year. The proper treatment of this case is not clear. Changing the price floor would presumably affect supply only during the part of the year in which support operations are undertaken.

Second, these models do not differentiate between production controls which are allocated optimally through competitive bidding, and those allocated based on previous market share. Underestimation of the welfare loss of protection or underestimation of newly imposed quantitative restrictions may result.

Third, endogenous pricing rules may be operationally impossible to implement. Fourth, these models are based on a perfectly competitive market structure, which may not be entirely appropriate for some product categories.

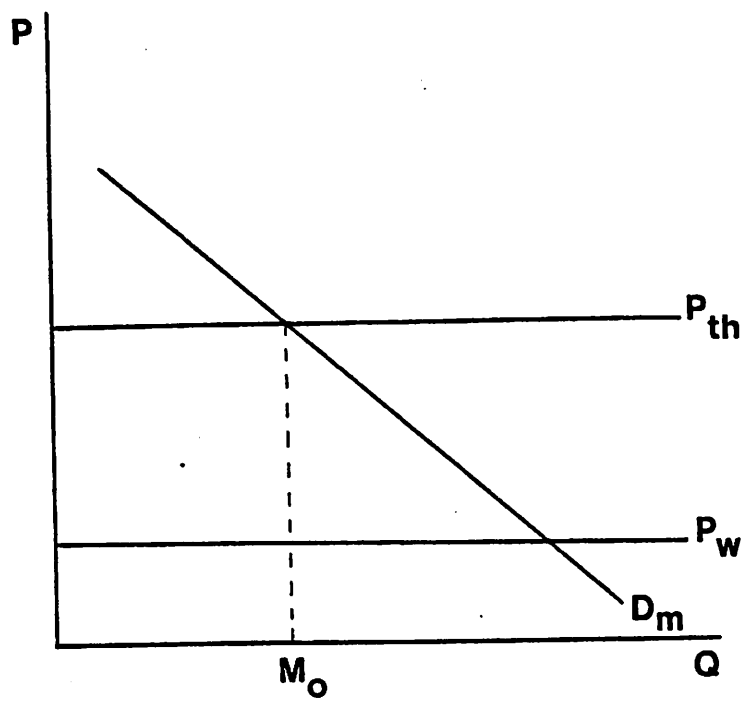
A second set of problems concerns the availability of empirical data. This problem is particularly acute when production in a country is controlled by a quota. First, it is hard to find reliable estimates of the supply elasticity in these cases. Second, and more importantly, it is impossible to find one price-quantity pair on the supply curve since production is constrained. As a result it is difficult to determine how a price change would affect production. Small price reductions may have no effect, but at some point output will begin to fall. It is impossible to determine this critical point without knowing one point on the supply curve.

Despite these problems, it appears that a hybrid of the existing models would be very useful in evaluating the trade and welfare effects of various negotiating proposals which may be considered in the next GATT round. It is possible to reasonably represent the various types of intervention if each product is modeled individually. This would require much greater product detail than exists even in the specialized agriculture models and greater structural flexibility than is currently built into the CGE models.

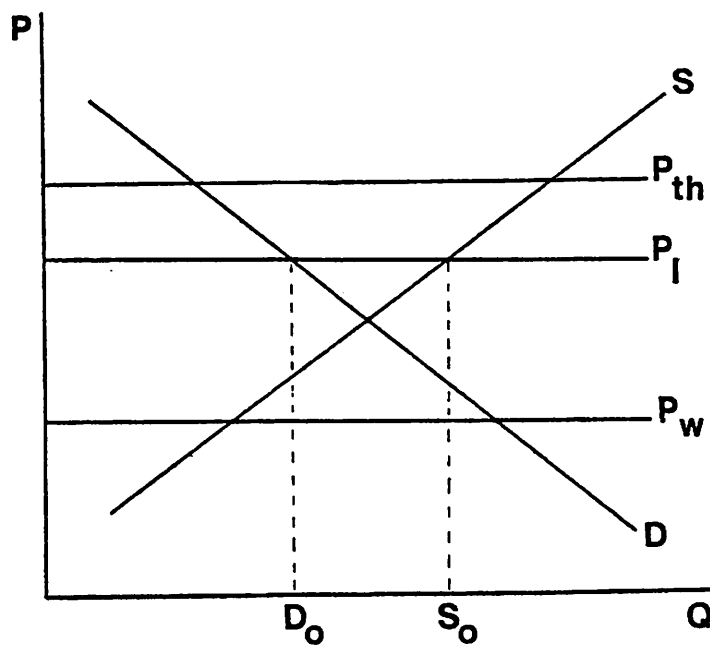
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(a)



(b)

Figure 1

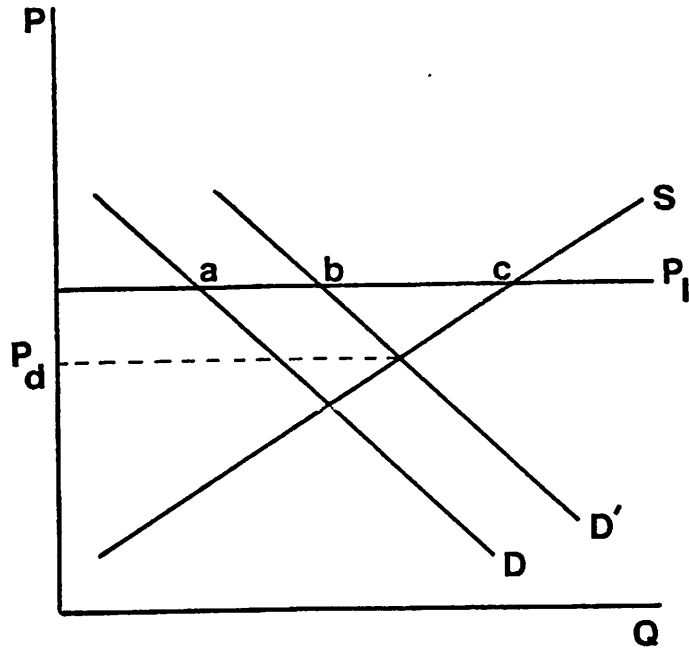


Figure 2

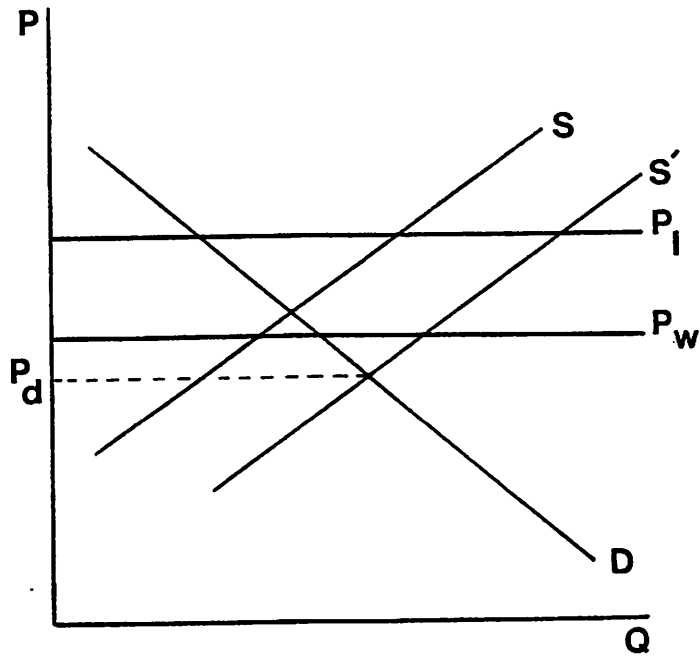


Figure 3