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MARKET STRUCTURE AND TRADE LIBERALIZATION:

A GENERAL EQUILIBRIUM ASSESSMENT*†

by

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DISCUSSION PAPER #584

[Rev.]

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Abstract

The paper examined the consequences of a 50 percent cut of tariff and non-tariff trade barriers within an applied general equilibrium model of the Canadian economy. The large welfare gains are explained in terms of scale economics and the procompetitive effects of import competition. Some sensitivity results are also reported.

1. INTRODUCTION

Applied general equilibrium models have now become quite commonplace and are used increasingly by both academics and policymakers as an analytical tool. One of the areas in which they have had the greatest success is in international trade, with particular reference to trade liberalization exercises. These models all have a common set of features in that for the most part they are long run models of Walrasian equilibrium.

The assumption of perfect competition, together with the explicit assumption of constant returns to scale in production, is the one I wish to draw attention to in this paper. Lack of attention to scale economies and imperfect competition implies that the models ignore a number of important factors in the analysis of trade liberalization. These include such issues as the relative magnitude of the cost of protection, and the pattern of resource reallocation in response to a trade liberalization.

Elsewhere (Harris, 1983, 1984; Cox and Harris, 1983) some results of incorporating scale economies which are internal to the firm and imperfect competition into a general equilibrium model of a small open economy have been presented. The purpose of this paper, in addition to providing results for comparison with other models in the symposium, is to provide some further explanation of why scale economies and imperfect competition turn out to have such a dramatic general equilibrium impact in the analysis of trade liberalization. The general conclusions of the work completed thus far, is that first, trade liberalization offers substantial real income gains to small open economies; in the Canadian case they are on the order of four times those estimated by Walrasian models. Second, that the pattern of resource reallocation in response to trade liberalization is significantly different than suggested by Walrasian models implemented on the same data set. In particular the protected sector, manufacturing, expands in terms of output and employment in response to a cut in protection, contrary to the conventional Hecksher-Ohlin view of tariff protection.[1] All of these results must be regarded as tentative in their general applicability as the model is yet to be implemented on a data set other than the one used in this paper. On the other hand, the results certainly suggest that the Walrasian models may be seriously misspecified.

The rest of the paper proceeds as follows. The next section gives a brief description of the analytical model used. Section 3 presents some characteristics of the benchmark equilibrium using a 1976 data set, and the results and evaluation of a 50 percent multilateral cut in tariff and non-tariff barriers, and the sensitivity of te results to key parameters, including scale elasticities and export elasticities. Section 4 contains some observations on economic and modelling issues in this type of model.

2. A GENERAL EQUILIBRIUM MODEL WITH IMPERFECT COMPETITION AND SCALE ECONOMIES

In this section a brief description of the general equilibrium simulation model G.E.T. is given. More detailed descriptions can be found elsewhere (Harris, 1984). In the interests of brevity the discussion will focus on those aspects of the model which are relatively novel.

The general equilibrium aspects of the model are all quite conventional. The model is less than a 'full' general equilibrium model as the rest-of-world (R.O.W.) is summarized by exogenous import prices and a set of export demand equations; the emphasis is on equilibrium within the small open economy.

Factor markets are competitive, as are all product markets in the non-manufacturing sectors. Prices are flexible and consequently full employment is assumed to hold.

Labour is homogeneous and mobile between industries. Capital services are homogeneous and mobile between industries and between countries. Furthermore, capital services are assumed to be in infinitely elastic supply at the world rental rate. Labour is supplied inelastically by domestic consumers. Domestic income derives from labour and capital services reflecting the endowment of domestic consumers, and net government transfers. Given that capital is mobile, balance of payments equilibrium is a current account balance concept; surplus on trade account must equal rental payments to foreign-owned capital.

Demands

On the consumption side domestic final demands are generated by a single consumer maximizing a utility function subject to a budget constraint. The utility aggregator across commodity classes is Cobb-Douglas. Within each commodity class the Armington assumption is maintained; foreign and domestic goods are imperfect substitutes as given by a CES aggregator over these two commodity groups.

Export demand is generated by a R.O.W. consumer with exogenous income who views home goods and all other goods as imperfect substitutes. This specification admits a distinction, in a less than full world general equilibrium model, between price and tariff elasticities of export demand for an 'almost' small open economy. In the model the home country is presumed to be a price maker in its export markets but a price taker in its import markets.

The final source of demand is intermediate, with domestically produced and imported intermediates as imperfect substitues within the domestic production structure. There is one commodity, non-competing imports, which has both a final and intermediate demand, but does not compete with a domestic substitute.

Production Structure

On the production side firms employ capital, labour and intermediate goods to produce the industry output. Foreign and domestic intermediate inputs are regarded as imperfect substitutes. On the output side each firm produces one product, and only in one industry.

The manufacturing sector contains those industries which are potentially non-competitive. The regulated industries are not explicitly modelled as non-competitive. Each non-competitive industry is made up of an endogenous number of representative firms; each firm has the same technology. The technology of the representative firm in the non-competitve sectors is characterized by a fixed bundle of capital and labour required to set up a firm. Long run average variable costs are independent of output, being a function solely of input prices and technology parameters. Average cost is thus declining everywhere, asymptotic to unit variable costs. The extent of unexploited scale economies is conveniently measured by the (inverse) scale elasticity defined as the ratio of marginal to average cost.

Within the competitive industries there are no fixed costs and a conventional constant returns specification is used. Functional forms, although not parameter values, are the same as used to describe variable cost in the non-competitive sectors.

Industrial Organization

The model has some features in common with the recent theoretical analyses of trade and imperfect competition (Helpman, 1981 and Krugman, 1980). The equilibrium concept employed in the imperfectly competitive industries is a modified Cournot-Chamberlain type of equilibrium at the industry level. Firms within each industry produce a homogeneous good which competes with an imperfect foreign substitute. Two hypotheses are employed in describing pricing behaviour of firms. One is a type of monopolistic competition approach with perceived demand curves. The Lerner rule is used to set prices conditional on an elasticity of a perceived demand curve. The perceived demand elasticity is constructed by having each firm conduct a hypothetical comparative statics experiment by changing its price and observing the demand response under the assumption that industry demand is evenly shared by all domestic firms. The firm's perceived demand elasticity is thus related to the underlying parameters of technology, preferences and export demand. Changes in this elasticity will change the markup of price over marginal variable cost. I refer to this hypothesis on industry pricing as the monopolistic competition hypothesis (MCH); strictly speaking this is not true given the sharing rule used. MCH implies a higher markup than would be used in a strict Cournot quantity setting industry equilibrium.

The other pricing hypothesis is motivated by the Eastman-Stykolt model of protected oligopolies in small open economies (Eastman and Stykolt, 1960). The basic idea is that the domestic firms set their prices around the collusive focal point provided by the world price plus domestic tariff of the foreign competing good. Reduction in domestic tariffs provides a direct mechanism by which domestic prices are cut. The Eastman-Stykolt Hypothesis (ESH) has been given considerable support in studies of Canadian Industrial Organization.[2]

The pricing rule used in the model simulations is a mixture of the MCH and EHS, with an exogenous weight attached to each. Sensitivity analysis on varying this weight will be reported. It is obvious that this approach to pricing is somewhat ad hoc, but it does have the virtue of being tractable. Another way of doing the same thing would be to impose an exogenous 'conjectural variation' on each industry. Freedom of entry and exit is assumed in the non-competitive industries. Entry barriers other than fixed costs are ignored. A long run equilibrium in each industry is characterized by zero economic profits in all industries, and price must equal average cost.

The assumption that the country sets prices in its export markets, but is a price taker in its import markets is problematic. While this is consistent with some of the evidence for Canada (Appelbaum and Kohli, 1979) there is an obvious logical problem. Think of the world widget industry as being potentially imperfectly competitive. Domestic firms can set prices, but within the model actions of these firms does not effect the prices set by foreign competing firms. The major defense for this hypothesis is that domestic firms face a large world industry supplying a close but imperfect substitute. Under the assumption that the total share of the world market held by domestic firms is small, the response of the world industry against price changes by the domestic firms is taken as being small.

It should be emphasized that an important feature of the model is the interaction between scale economies, pricing rules, and entry-exit by firms. Any exogenous shock which causes firms to lower the markup on unit variable cost implies existing firms must make losses on a given volume of industry output. Thus firms must exit, with the remaining firms producing a greater volume of output and achieving lower average costs. The adjustment at the extensive margin by entry or exit of firms is quantitatively the most important impact effect of many policy changes.

3. THE BENCHMARK EQUILIBRIUM AND 50 PERCENT TARIFF CUTS

In this section the results of a 50 percent cut in foreign and domestic tariffs is reported. Before reporting those results some characteristics of the data set and benchmark equilibrium are described.

Data

The model is calibrated to a 1976 data set for Canada (Harris, 1984, Appendix B). There are twenty-nine industries and thirty commodities. Twenty of the industries correspond to the manufacturing industries of Canada at the two digit SIC level. These industries are all considered as potentially noncompetitive. The degree of competition is determined endogenously by the scale economies of average plant size within the industry, and exogenously by the relative weighting of the MCH and ESH pricing hypotheses. The nine remaining industries cover services, agriculture, forestry, fishing, mining (including oil and gas), construction, transportation, electric utilities, and communications. These are all treated as constant cost competitive industries. The benchmark data set was constructed from a variety of sources including input-output data, the national accounts, trade and capital flow data, and industry data for the manufacturing industries. The usual adjustments were made in order to make each of these sources roughly consistent with each other.

In the discussion of the model attention is focused on four key sets of parameters. These include export elasticities (tariff export elasticities to be precise), import elasticities which reflect elasticities of substitution between foreign and domestic goods within the same commodity category; scale elasticities at the level of the plant within each industry; and finally the relative weighting of ESH and MCH hypotheses. Values for the first three sets of parameters were chosen based on reported econometric values in the literature. There is nothing comparable for the latter set of parameters so extensive sensitivity analysis was conducted. However casual empiricism suggests that a weight of 0.5 attached to each of ESH and MCH is approximately valid on average across all industries. Table 1 contains some of the relevant parameter values for the benchmark equilibrium.

The elasticities used are conventional but highly unreliable for all of the usual reasons. An examination of table 1 reveals export elasticities to fall in the range of -0.50 to -3.00. Import elasticities were in the range 0.0 to -3.00. These are reflected in consumption elasticities of substitution which are generally slightly greater than 1.0 in absolute value, although in some cases much larger.

A key input to the model are estimates of scale economies at the level of the individual plant. The inverse scale elasticity in the benchmark equilibrium is reported in table 1. They range from 0.75 to 0.99. The smaller the inverse scale elasticity the greater the extent of unexploited scale economies. This provides a convenient measure of the cost inefficiency an industry is subject to the benchmark equilibrium

Notice that industries such as clothing offer little in the way of unexploited scale economies (using early 1970's data). In this industry the benchmark equilibrium is characterized by a large number of firms, with low fixed to variable cost ratios. To interpret the inverse scale elasticity it might be useful to remember that a doubling of plant output with an inverse scale elasticity of 0.80 yields a 10 percent reduction in average cost.

There is substantial literature on estimating scale economies, and the related concepts of minimum efficient size and cost disadvantage ratio. The general presumption of this literature is that econometric estimates are biased downward for a number of reasons. Survivorship estimates are usually larger and engineering estimates are even larger. It is not unusual for engineering estimates to be four to six times greater than econometric estimates. In the Canadian economy the problem is compounded because the domestic tariff is presumed responsible for inefficient plant sizes, and thus estimates based on Canadian data will be particularly biased. This shows up in Canada-U.S. comparisons (Caves, Porter and Spence, 1981). The estimates used in this study are derived from a study by Fuss and Gupta, 1981, who provided comprehensive estimates for Canadian manufacutring industries at the 3-digit level. These were aggregated up to give 2-digit estimates of scale economies in the 'representative' plant. Some engineering estimators are available on a selective basis (Gorecki, 1975). Taking the comparable econometric and engineering estimates, scale economies for the benchmark equilibrium were chosen midway between the two. The average scaling factor derived from this procedure was applied to the remaining econometric estimates. This yields the scale economy estimates used in the best guess benchmark equilibrium reported in table 1. Clearly there is a great deal of imprecision attached to these estimates, but on balance they seem reasonably modest. It is of considerable importance to get some feel for the sensitivity of results to these parameters.

Table 1 also reports the output of all sectors in millions of constant 1976 Canadian dollars. In the benchmark equilibrium all producer prices are set equal to 1.0. The table also reports the ad valorem equivalent of the tariff and non-tariff barriers used in the model. These are mid 1970's estimates and do not reflect the Kennedy Round reductions. In the benchmark equilibrium the manufacturing sector has 25.6 percent of total value added, and provides 27.3 percent of total employment. Exports plus imports (total trade volume) are 56 percent of G.N.P. and the country is a net capital importer with service payments on foreign capital amounting to about 2 percent of G.N.P. The manufacturing sector is in a substantial deficit position on merchandise trade, and the primary sector is in a surplus position.

Results

Table 2 reports the effect of a 50 percent cut in foreign and dom- 'tariffs' on some aggregate model statistics. The wage rate, measured in terms of a bundle of constant price foreign goods, is the fundamental real factor price in the model. The cut in tariffs raises the wage by 9.6 percent with an accompanying increase in weighted average labour productivity of 13 percent. G.N.E. rises by 4.9 percent and real G.N.P. by 3.2 percent. The real income gain, as measured by the Hicks equivalent variation, is 3.6 percent of base G.N.E. Other characteristics of the new equilibrium are a 24 percent increase in the average length of production run within the average manufacturing plant and a total factor productivity (Divisia index) increase of 4 percent. Trade volume increases by 22 percent with a significant increase in capital service imports. Some statistics which are not reported are the terms of trade; by various calculations these are affected very little. For the economy as a whole the terms of trade improve by less than 0.10 percent.

4. EVALUATION OF MODEL RESULTS

In this section various approaches are taken towards getting a better understanding of the results reported above, and their sensitivity to parameter values.

Factor Prices, Industry Effects and Trade

The tariff cut leads to an increase in the real wage. The rise in the wage as two effects. It raises the capital-labour ratio in the competitive sectors, and raises variable costs in the manufacturing industries. The rise in the wage causes some manufacturing industries to increase their capital-labour ratio, but the dominant effect in many industries is the reduction in the use of fixed capital because of the exit of firms. Thus, while the economy as a whole is more capital intensive it uses it more efficiently. This is particularly evident in looking at manufacturing versus other sectors. Manufacturing actually moves into a trade surplus position, from the benchmark deficit position. Manufacturing after the tariff cuts accounts for 28.4 percent of employment and 25.7 percent of total value added. Thus resources have shifted from the primary sectors to the manufacturing sector. Thus, even though Canada has a factor abundance of natural resources (see Harkness, 1983) by standard calculations trade liberalization is at least as beneficial to the manufacturing sector as to the resource sectors.

What of interindustry versus intra-industry shifts? For the economy as a whole 1.7 percent of the labour force shifts intersectorally. The aggregate index of intra-industry trade declines very slightly -- less than 1 percent. Thus, the aggregate picture is of a balanced increase in both intra and interindustry trade. Within manufacturing however the disaggregated picture is quite different. There are a number of industries which contract significantly, and a number of others which expand significantly. Thus the rationalization process involves fairly significant shifts between manufacturing industries and increased specialization. The industries which do relatively well are those with high export elasticities and potential for realizing scale economies through access to the foreign market. Twelve out of twenty manufacturing industries experience increases in output of greater than 10 percent.

A slightly different picture of the intraindustry adjustment process is given by looking at the number of firms that must enter or exit the industry in response to the change in trade barriers. This adjustment at the extensive margin is an important part of the overall rationalization process. It also provides some indication of the likely adjustment costs. The picture one gets by looking at the change in the number of firms suggests that the adjustment costs within manufacturing are likely to be significant. Of the twenty manufacturing industries seventeen experience a reduction in the number of firms within the industry. Five of the industries actually experience a reduction by more than 25 percent in the number of firms. The general pattern across industries is quite varied. The unweighted average absolute percentage adjustment in the number of industry firms is 16 percent. Thus while aggregate intersectoral shifts in the labour force are relatively small there are fairly large intra-industry shifts in resources between firms, and in some cases substantial changes in industry employment.

Table 2 also reports the effects of a 25 percent multilateral reduction in tariffs. Interestingly the statistics on percentage change from base appear to be slightly less than half of those in the 50 percent cut case. Welfare gains for example are almost exactly half of those in the 50 percent cut case. The case of 100 percent cuts are also reported; the model yields welfare gains of about 8.6 percent - more than double the gains from a 50 percent cut. Other statistics such as trade volume, G.N.E., and labour productivity increase by similar orders of magnitude as do welfare gains. These results suggest that for tariff cuts of 50 percent or less the model appears to give changes in basic aggregate statistics which vary linearly with the amount of the tariff cut. For cuts of 50 percent or more the linear relationship does not seem to hold up.

Foreign Versus Domestic Tariffs

In table 3 the results on various aggregate statistics comparable to those in table 2, are presented for two model 'experiments'. In the first column results are reported for a 50 percent reduction in domestic tariffs only, holding foreign tariffs in place at their base case level. In the second column the results are given for a 50 percent reduction in foreign tariffs only, holding domestic tariffs at their base case level. The results are quite interesting. Domestic tariffs alone account for about a 2 percent welfare gain and an 8 percent labour productivity gain. Foreign tariffs alone account for about a 1.5 percent welfare gain and a 4 percent labour productivity gain. This leaves a negligible unexplained interaction effect of about 0.1 percent on welfare and 0.6 percent on labour productivity. Recall labour productivity gains from table 2 were 13 percent.

It might be suggested that the rather low welfare gain from removal of foreign tariffs casts doubt on the commonly made argument that foreign tariffs are the major cost to a small open economy -- reduction of domestic tariffs are only useful to the extent that they succeed in convincing foreigners to lower their tariffs. In my view this would be the wrong conclusion. Unilateral reduction in tariffs gives you a small but significant improvement in productivity. This is because of the rationalization/procompetitive effects on domestic industry of increasing import competition. When foreign tariffs are reduced domestic firms must be capable of penetrating export markets; i.e., they must be rationalized. The results on the foreign tariff alone demonstrate that given the continued presence of domestic protection, domestic industry would prefer, i.e., find it more profitable, to produce for the home market. Lack of import competition means that it is neither necessary that they become efficient in order to survive, nor is it necessary for them to find external markets.

Scale Economies Versus Other Production, Consumption Gains

In presenting these results in seminars most people tend to focus attention on the scale economies. The question often comes up as to how much of the 3.6 percent can be attributed to scale economies alone. In particular, since manufacturing has about a 25 percent share of total value added how is it that inclusion of scale economies within this sector alone lead to such large gains? It turns out that the answer is fairly simple. The decomposition procedure is to ask first what the gains would be in a competitive model, and then try to explain the residual on the basis of the scale economies assumed within the model.

First, what would a perfectly competitive model on the same data set yield for benefits from a 50 percent multilateral tariff reduction? For the case of a 100 percent cut this question was addressed in Harris, 1983. Implementing a competitive model on the same data set, and with the same elasticity values the combination of production, consumption and terms of trade gains accounted for a 2.4 percent gain in a move to complete free trade. For a 50 percent cut using a linear interpolation, the gains would be 1.2 percent in a competitive model. Using a Harberger- type quadratic formulae, the gains would be proportional to the square of the reduction factor, giving an estimate of 0.6 percent welfare gain for the 50 percent tariff cut. These probably provide reasonable bounds on the conventional production and consumption gains, including terms of trade effects associated with the competitive constant cost model. Thus from the 3.6 percent figure there is a residual of 3.0 to 2.4 percent to be explained by the change in model structure.

How much can scale economies account for this number? The first thing is to get an idea on the kind of cost reduction achieved with the scale economies used in the model. Taking an average inverse scale elasticity of 0.8 implies that, at constant input prices, a 50 percent increase in length of production run within the plant would yield a reduction in average cost of about 6.5 percent. It turns out that the tariff reduction gives an increase in average equilibrium plant production runs across all industries of about 25 percent. Interpolating linearly, this means that the average cost of production in manufacturing declines about 3.25 percent. It is important to remember that this cost reduction is attributable not only to scale economies, but other features of the model including, most notably, the nature of competition in the imperfectly competitive sectors.

There are various ways to think about this 3.25 percent number. One which I find useful is to ask what happens to input requirements, holding total industry output constant in manufacturing. The 3.25 percent average cost reduction means that 3.25 percent less in the way of capital, labour and intermediate goods is required to product the same output. Taking prices as constant the resources released could be sold and the surplus would show up directly as additional real income.

What's all this worth? The value of total manufacturing output in the base equilibrium is $103,000 (million constant 1976 Cdn.). A 3.25 percent reduction in the cost of producing this output gives a real income saving of $3348. Base G.N.E. is $153,000 (million 1976 Cdn.). Thus the cost saving in manufacturing gives a real income gain of 2.2 percent. Given the nature of the calculation the 2.2 percent provides one, very partial equilibrium, calculation of the gains attributable to scale economies in manufacturing using the pre-liberalization value of output in manufacturing. Using the post-liberalization value of manufacturing output, the total cost saving as a percent of base G.N.E. is 2.6 percent. My intuition suggests that this type of aggregate partial equilibrium rectangle calculation gives numbers lower than a disaggregated partial equilibrium calculation would. This is merely a guess, however, and unsubstantiated by actually doing the partial equilibrium calculations. In any case, the 3.6 percent seems to be almost fully accounted for by this procedure. A residual of, at most, 0.8 percent remains, and can be attributed to the impact of scale economies/industry structure on the inter-industry structure of the economy. The most important effect here is probably the negative impact that the increased real wage has on the grossly internationally inefficient labour intensive industries.

Sensitivity Analysis

How sensitive are these results to the parameter values chosen? This is a crucial question which is all too often evaded in the applied general equilibrium literature. Unfortunately the news is both good and bad. On the one hand the gains to tariff reduction are extremely sensitive to parameter value changes. On the other hand, if you believe the elasticities used in deriving these numbers are too low, then the gains are even larger than the ones reported above. The sensitivity analysis is reported in table 4. For each set of parameter values the percentage change relative to base equilibrium is reported for the wage, trade volume, labour productivity, and the real income gain reported as a percent of base G.N.E. The experiment in all cases is the 50 percent multilateral cut in foreign and domestic tariffs. The scaling factors across the top of each sub-table are such that the 'best guess' parameter values correspond to a scaling factor of 1.0. In the case of the weighting parameter on the ESH pricing hypothesis the 'best guess' equilibrium corresponds to a weight of 0.5.

Looking at table 3 a number of general features are apparent. First, the wage, trade volume, welfare and productivity gain are all increasing in uniform increases in export elasticities, import elasticities, and scale economies. They also increase as the weight attached to the ESH hypothesis increases. In general terms the aggregate welfare gains are sensitive to all the parameter values. In crude terms the welfare gains are a convex function of import elasticities, and a concave function of export elasticities. For sufficiently low import elasticities the gains flatten out and become relatively insensitive to assumptions about the relative substitutability of foreign and domestic goods. On the other hand, as export elasticities approach zero the welfare gains from a 50 percent cut approach zero.

With respect to scale economies it seems that the gains are almost a linear function of assumed scale economies. It is noteworthy that with extremely low scale economies the real income gains are still a significant 2.5 percent, while for scale estimates which are four times that, the gains increase to 4.5 percent. This is of some comfort since it suggests that the underlying function is reasonably flat; thus the gains to tariff reduction are reasonably insensitive to minor differences in assumptions as to the extent of scale economies.

The matter is somewhat different with respect to the weighting parameter on pricing hypotheses. The welfare gains are sensitive to which pricing hypothesis is used. Weighting towards the MCH hypothesis yields gains of 2.0 percent, while mostly towards the ESH hypothesis yields gains of 6.4 percent. Clearly one of the most important aspects of the model is the extent to which tariff reduction has pro-competitive pricing effects on domestic industry. Under the ESH hypothesis these effects are very strong. The reduction in prices imply considerable rationalization in industry, and associated efficiency gains. Under the MCH hypothesis pricing rules change only to the extent that industry shifts its output towards more elastic demands. This will happen, for example, if the industry shifts from a low elasticity domestic demand towards supplying a highly elastic export demand.

In summary the pricing behaviour of industry is an important determinant of the gains from tariff reduction in the presence of scale economies. Alternative models of the market structure of each industry are likely to lead to different conclusions as to the magnitude of welfare gains. This conclusion is mitigated to the extent that foreign and domestic goods are highly substitutable. As the import elasticities get very high this is equivalent to assuming that foreign and domestic goods are more highly substitutable. One can see from table 4 that as foreign and domestic goods become highly substitutable the welfare gains approach those associated with the ESH hypothesis. This is not quite a legitimate comparison of course since in one case tastes are changing, and not in the other. But the general point holds. Independent of what pricing behaviour the protected domestic oligopolies exhibit, with the removal of protection and severe import competition, price competition is inevitable. This will lead to the associated efficiency gains through rationalization of the industry.

5. CONCLUSION

In the conclusion, I should like to make a number of brief points about the inclusion of industrial organization features in general equilibrium models.

First, some points on the structure of the G.E.T. model and its weaknesses. The overall sensitivity of the model to parameter values means that it is important to get as reliable parameter values as is possible. Second, the a priori choice of market conduct, or imperfect competition equilibrium concept, is an important determinant of the results. I think it is fairly straightforward to consider a number of other alternatives suggested in the industrial organization literature; simple entry prevention policies such as limit pricing could easily be incorporated in a computable general equilibrium model. It has been suggested that disaggregation is desirable and may affect the numerical results significantly with the presence of scale economies; research, both theoretical and empirical, is required on this issue. The model reported in this paper does not have resource industries with increasing costs, and hence rent to industry specific factors as a source of national income. This extension has been made, and surprisingly it has little effect on the trade policy results. For other issues though, the explicit recognition of long run sector specific factors is important. Choice of functional form takes on some added twists. Scale economies were treated by introducing fixed and variable costs. Other possibilities, dealing with the factor bias of scale effects should be investigated. This question is clearly important in questions concerning the impact of industry structure on factor demands. For example the labour bias of increases in scale will be an important determinant of the employment effects of any policy attempting to promote scale, or inhibit it. Econometric research on this question is noticeable in its absence. Dimensionality is a serious technical constraint, although rapidly becoming less so. Once the number of firms becomes an endogenous variable the dimensionality of the problem goes up significantly. This is a serious constraint on the practical implementation of imperfect competition models. A final question relates to the uniqueness of equilibrium. For all the usual reasons one is never assured of getting a unique equilibrium. In my experience, I have never encountered multiple equilibrium in the G.E.T. model. Some attempt was made to find multiple equilibrium but with no success. Whether this problem is more or less severe than in competitive models, I do not know.

The importance of industrial organization features is dependent on the nature of the counterfactual experiment conducted using a general equilibrium model. One might think of questions where the presence of scale economies and imperfect competition would not be that significant. Having said that I am not sure how to distinguish a priori between situations in which they should turn out to be important, and in those in which they should not. The difficulty is that the nature of resource allocation is quite different in the two models. Adjustment at the extensive margin, the different roles attached to fixed and variable costs and the impact of changes in factor prices, and the scope for intra-industry response as opposed to inter-industry response are a few of the more obvious differences. The question of which of the two paradigms offers a more adequate description of the real world is very difficult to answer. Of one thing I am sure. In looking at trade policy in small open economies the differences are fundamental. In my view the conventional competitive models are seriously misspecified. They give an inaccurate view of the quantitative gains and losses across sectors, and the intersectoral pattern of adjustment to trade policy changes.

Notes

1. The relevant literature on scale economies, imperfect competition and trade liberalizaton is quite large. Early empirical studies include those of B. Balassa, Trade Liberalization Among Industrial Countries, (New York: McGraw-Hill, 1966), and P. Wonnacott and R.J. Wonnacott, Free Trade Between the United States and Canada: The Potential Economic Effects, (Cambridge, Mass.: Harvard University Press).

2. See Caves, Porter and Spence, with J.T. Scott, Competition in the Open Economy: A Model Applied to Canada, (Cambridge: Harvard University Press, 1980), for a summary of this literature.

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Table 1
Some Statistics for the Benchmark Equilibrium

	Export Elasticity	Foreign-Doms. Subs. Elas.	Inverse Scale Elas.	Domestic Tariff (ad valorem)	Foreign Tariff (ad valorem)	Value of Output (mil.'76 Cdn.$)
Food & Beverage	-0.88	1.28	0.79	.143	.229	17685
Tobacco	-0.78	1.10	0.91	.307	.031	909
Rubber & Plastic	-2.90	4.28	0.79	.099	.067	2340
Leather	-1.49	1.71	0.98	.166	.068	737
Textiles	-1.33	1.10	0.93	.171	.052	2757
Knitting Mills	-1.00	1.10	0.99	.331	.533	639
Clothing	-1.85	4.07	0.90	.324	.533	2658
Wood	-0.89	1.10	0.71	.108	.040	5136
Furniture/Fix.	-1.00	3.11	0.95	.066	.041	1498
Paper & Allied Pr.	-1.19	1.31	0.89	.100	.350	8471
Printing & Pub.	-2.68	3.23	0.82	.056	.314	3298
Primary Metals	-1.38	2.01	0.76	.056	.051	9237
Metal Fab.	-2.16	4.22	0.92	.087	.048	7172
Machinery	-1.12	1.10	0.95	.050	.049	4170
Transport. Equip.	-3.08	4.84	0.66	.060	.036	13809
Elect. Products	-1.15	1.10	0.97	.104	.071	5110
Non-Metallic Min.	-2.02	2.48	0.61	.076	.055	2926
Petroleum & Coal	-0.90	1.10	0.96	.028	.002	6999
Chem. Products	-2.25	2.20	0.86	.062	.062	5887
Misc. Mfg.	-1.71	2.36	0.93	.091	.068	2236
Agriculture	-1.00	1.10		.066	.462	10304
Forestry	-0.51	1.10		.004	.522	2652
Fishing	-0.48	1.10		.005	.498	428
Mining	-0.48	1.10		.137	0	14537
Construction	-1.00	1.10		.000	0	33698
Transportation	-1.00	0.10		.049	0	14297
Communication	-1.00	0.10		.052	0	5501
Electric, Power, Gas	-1.00	0.10		.000	0	5045
Others	-1.32	1.10		.017	0	107255

Table 2
Summary Statistics for 100%, 50% and 25% Multilateral Tariff Cut

	100%	50%	25% Cut
D-WAGE	.252	.096	.043
D-GNE	.126	.049	.022
WELF	.086	.036	.017
D-GNP	.070	.032	.015
D-PRL	.668	.240	.107
D-LAB.PR.	.196	.130	.058
D-TFACT	.095	.040	.018
D-TVOL	.886	.220	.153
REALLOC	.061	.017	.013

Notes to table 2:

1. D-WAGE is the relative change in the wage rate.
2. D-GNE is the relative change in gross national expenditure.
3. WELF is the Hicks Equivalent Variation measure of welfare gain relative to base G.N.E.
4. D-GNP is the relative change in real G.N.P.
5. D-PRL is the relative change in an index of average length of production runs within manufacturing plants. (Details on the index are provided in Harris, 1984a).
6. D-LAB.PR. is the relative change in aggregate labour productivity index. Labour productivity index is weighted average of output per employee across all industries. Weights correspond to shares of each industry in total base value of output.
7. D-TFACT the relative change in weighted average industry Divisia index of total factor productivity.
8. D-TVOL the relative change in the total volume of trade measured as the value of imports plus exports at border prices to domestic economy.
9. REALLOC the relative fraction of the labour force which shifts intersectorally.

Table 3
Summary Statistics on 50% Tariff Cut for Alternative Model Experiments

	Domestic Tariffs only Cut	Foreign Tariffs only Cut	Multilateral Cut with Number of Firms Constant
D-WAGE [a]	.042	.050	.092
D-GNE	.016	.032	.048
WELF	.020	.015	.035
D-GNP	.018	.014	.031
D-PRL	.171	.058	.441
D-LAB.PR.	.082	.042	.164
D-TFACT	.036	.001	.044
D-TVOL	.219	.107	.340
REALLOC	.017	.013	.022

a. See Notes to table 2 for relevant definitions of summary statistics.

Table 4
Sensitivity Analysis on 50 Percent Multilateral Tariff Reduction to Parameter Values

	Scaling parameter on export elasticities			
	0.33	0.67	1.00	2.00
D-WAGE	.062	.078	.096	.156
D-TVOL	.222	.303	.220	.481
WELF	.023	.031	.036	.054
D-LAB.PR.	.097	.113	.130	.183

	Scaling parameter on import elasticities				
	0.33	0.67	1.00	1.33	1.67
D-WAGE	.081	.086	.096	.114	.135
D-TVOL	.208	.264	.220	.443	.545
WELF	.035	.033	.036	.043	.051
D-LAB.PR.	.090	.105	.130	.165	.206

	Scaling parameter on scale economies			
	0.33	0.67	1.00	1.33
D-WAGE	.064	.078	.096	.120
D-TVOL	.260	.291	.220	.412
WELF	.025	.030	.036	.045
D-LAB.PR.	.071	.089	.130	.190

	Weighting parameter on ESH pricing rule				
	0.2	0.4	0.5	0.6	0.8
D-WAGE	.059	.082	.096	.114	.167
D-TVOL	.301	.329	.220	.360	.410
WELF	.020	.030	.036	.044	.064
D-LAB.PR.	.097	.117	.130	.145	.191

Notes to Table 4: D-WAGE is the relative change in the wage due to the multilateral 50 percent reduction in domestic and foreign tariffs; D-TVOL is the relative change in total trade volume -- the value of total exports plus total imports; D-WELF is the welfare gain due to tariff reduction measured by the Hicks equivalent variation as a percent of base equilibrium G.N.E.; D-LAB.PR. is the relative change in an index of aggregate labour productivity (see notes to table 2).