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REGIONAL IMPACTS OF TARIFFS IN CANADA: PRELIMINARY RESULTS FROM A SMALL DIMENSIONAL NUMERICAL GENERAL EQUILIBRIUM MODEL

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and

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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the author.

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REGIONAL IMPACTS OF TARIFFS IN CANADA: PRELIMINARY RESULTS FROM A SMALL DIMENSIONAL NUMERICAL GENERAL EQUILIBRIUM MODEL

Rich Jones and John Whalley of the University of Western Ontario and Randall Wigle of the University of Saskatchewan
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Introduction

This paper presents some preliminary results from a small dimensional applied general equilibrium model of U.S.-Canadian trade which incorporates regional effects within Canada, and explores impacts of changes in federal trade policies in Canada on interregional trade. Unlike the recent general equilibrium work by Harris (1984) on Canadian trade policy no scale economy features are included.

Regional Dimensions of Canadian Trade Policy

Since Confederation most Canadian policy debates have involved discussion of their regional effects. Regional economic structures among Canadian provinces are sharply differentiated, and as a result the impacts of federal policies can be quite pronounced across regions.

Interprovincial trade is dominated by exports of manufactures by Central Canada (Ontario and Quebec) to Western and Atlantic Canada in return for resources and agricultural products. In international trade Canada is a net importer of manufactures, and a net exporter of resources. ¹ Tariff protection is primarily on manufactures and has traditionally been viewed as hurting the West and Atlantic Canada and helping Central Canada since manufactures from Central Canada can be sold to the West behind the protection of a tariff barrier.

Several policy elements besides the tariff have regional effects. Price controls on energy products under the National Energy Program hurt the West and help Central Canada. Grain transportation subsidies help the West. Equalization payments transfer money to low income provinces. Unemployment insurance benefits Atlantic Canada. The federal income tax redistributes against higher income provinces. The federal manufactures sales tax is thought to be harmful to Central Canada, although this effect is partially offset by the manufacturing and processing incentive in the corporate tax which lowers corporate tax
rates for manufacturing.

In short, Canada is a patchwork quilt of conflicting regional interests which come into play in debate on almost every national policy issue. Provinces not only have substantial autonomy but frequently form coalitions on an issue by issue basis to promote or block various policy initiatives. The role of the provinces in policy making in Canada is therefore pivotal and the perception as to what are the regional impacts of policies such as the federal tariff is key to the Canadian policy process.

Regional Impacts of the Canadian Tariff

The conventional wisdom on the regional impact of the Canadian tariff is that it increases the Canadian market price for manufactures, forcing Western buyers to pay higher gross of tariff prices for manufactures. In more popular discussion, the increased employment and income generated in Central Canada's manufacturing industry are seen as the major benefit of the tariff.

In the sparse academic literature on this subject, a small number of attempts have been made to both identify and quantify these effects. Most of this literature examines regional consequences of a unilateral abolition of tariffs by Canada, although it is well recognized in Canada there are sharp differences between a unilateral and multilateral tariff abolition.

One of the best known studies of regional impact is that by Hazledine (1978) who models Canada as a small open economy (SOE) in trade in resources and agricultural goods. His model seeks to have Canada as a price taker for resources and agriculture, but a price maker for manufactures. Estimates of changes in manufacturing shipments by province under a tariff change are generated using shipments elasticities, and form the basis for estimates of employment changes both nationally and by province. Changes in GNP, GDP, and GRP, and changes in absorption resulting from unilateral tariff abolition and other policy experiments are all calculated.

The regional consequences of unilateral tariff abolition by Canada in Hazledine's model are decreased employment and GRP in all regions (with the highest reduction in Atlantic Canada and Ontario). Somewhat paradoxically, absorption (in all regions) is financed by increased trade deficits (or reduced surpluses) since there is no trade balance condition to restrict imports. The policy implication seems to
be that tariffs help maintain employment everywhere in Canada, but reduce welfare in all regions since trade deficits fall and consumption is reduced. No clear interregional effects emerge from Hazledine's calculations since effects among regions are dominated by national effects.

A further study of interregional effects of the tariff is that by Pinchin (1979) who estimates that unilateral abolition of tariffs by Canada would lead to a 19 percent reduction in manufacturing employment (or a 4 percent reduction in total employment), along with a 10 percent devaluation of the Canadian dollar. The pattern of interregional transfers implied by the tariff is strongly in favour of Ontario and Quebec, at the expense of the Prairies, British Columbia and the Atlantic region. Aside from the interregional transfers which this reallocation would imply, the total losses estimated by Pinchin are so large that no federal government would reasonably be expected to argue for removing the tariff.

Despite the widely held popular perception that the tariff helps Central Canada and hurts Western and Atlantic Canada, no clear consensus emerges from this literature as to the regional impacts in Canada of a movement to a free trade, either unilaterally or bilaterally, or multilaterally. With the exception of Hazledine (1978) calculations do not come from exercises in which the equilibrium structure used and parameter values are clearly displayed. Much of the analysis involves mutually inconsistent assumptions making results difficult to interpret.

The Modelling Approach

The starting point for the present study is the 1974 Statistics Canada interprovincial trade data which give bilateral trade flows by product between provinces as well as trade outside Canada, and 1974 provincial input-output tables (also obtained from Statistics Canada) which give demand, production, and value added data by province. These are combined with information from a previously constructed 1972 micro consistent data set for Canada for general equilibrium tax policy due to St-Hilaire and Whalley (1983) to provide a micro consistent data set for regional applied general equilibrium analysis. Previous studies of the interregional effects of the federal tariff have had the disadvantage of working with provincial manufacturing shipments data which do not allow researchers to identify interprovincial trade in agriculture and resources, or the destination of interprovincial shipments. The destination by province of imports from outside Canada is also unknown from this
We use our data in a small dimensional interregional applied general equilibrium model similar to the trade models described in Shoven and Whalley (1984). Three regions appear, representing Eastern Canada (Canada from the Manitoba-Ontario border East), Western Canada (Canada from the same border West) and a residual rest of the world (ROW). Both interregional and international trade occur in three commodities; manufactures, and non-manufactures, and services.

As with other benchmark data exercises, constructing this regional data set requires a number of modifications to meet the conditions required for micro consistency. Trade balance by region and demand supply equalities for commodities are all imposed. For example, it is necessary to assure that in the benchmark data the total production of Eastern Canada Manufacturing goods is exactly equal to direct and indirect use at home and abroad. A similar condition holds for all other products.

The computer code used is based on the seven-region international trade model used by Whalley (1982) to investigate trade liberalization issues in the global economy. This model is best thought of as an empirical analogue of a Heckscher-Ohlin trade model, although similar products produced by different regions are treated as qualitatively different (cars in the U.S. and Japan), and technology, which is country specific, is represented by different parameter values in each country. The model uses nested CES production and demand functions with the hierarchies chosen to allow the key substitution possibilities which enter the model. The assumption of product heterogeneity by country (the 'Armington' assumption) is used to accommodate cross-hauling in bilateral trade flow data. This allows literature estimates of trade elasticities to be more adequately incorporated into the approach than is possible in a homogeneous products trade model. Two factors of production are considered and are mobile among industries within each region, but are immobile between regions.

In adapting the code to the regional issues analyzed here the Armington structure in demand is retained, as are the factor mobility assumptions. This formulation thus allows East and West manufactured and non-manufactured output to be close but not perfect substitutes, and the elasticity of substitution between types of commodities to be varied within the model.

One necessary modification arises from the treatment of each
region as an independent state in the international trade model. Revenues generated by a given region's government equal expenditures of that same authority. In the current model application the relevant constraint is that total revenue accruing to the federal government from both the East and the West of Canada equal total expenditures by the federal government.

Three sources of revenue exist for the federal government in this model. First, a manufacture's sales tax of 12 percent is levied on final demand in both Canadian regions for all manufactured goods, including imports from ROW. Second, there are factor taxes on capital and labour in the three sectors in each of the Canadian regions. Similar rates are assumed for both East and West, determined from the 1972 micro consistent data set. Third, are the tariffs on non-manufactured and manufactured goods imported from ROW.

At the time our modelling work was done, interprovincial trade data was unavailable for years other than 1974 (it has since become available for 1979). It was therefore impossible to estimate the elasticities of demand in interprovincial trade for use in the model. As a result, the same elasticities are assumed to apply to international and interprovincial trade, with their values set equal to a best guess estimate of these values from econometric literature. Values for the rest of the world are assumed to be U.S. estimates. It is well known that results of numerical trade models are sensitive to these elasticities. Sensitivity analyses on results are therefore also performed.

In setting tariff rates in the model further problems arise. For aggregate manufacturing our procedure for estimating the tariff rate is to calculate the total duty payable on manufactured imports and determine this as a proportion of the pre-tariff value of imports. This procedure cannot be applied separately for each region, even though the average tariff on manufactures in Eastern Canada tends to be lower than that on manufactures in the West due to the higher proportion of autos and auto parts in the former (duty free under the U.S.-Canada auto pact). Subsequent sensitivity analysis also investigate this issue.

The procedure used to analyse policy changes in the model follow the calibration/counterfactual equilibrium analysis approach outlined in Mansur and Whalley (1984). This is outlined in Figure 1. Once the functional forms for production and utility functions are specified, and elasticities are set, the model is calibrated to the 1974 benchmark data set. Calibration determines the values of the share
Figure 1
Flow Chart of Model Use

Choice of Functional Form

Extraneous Specification of Elasticities

Calibration to 1974 Benchmark Data

Replication Check

Policy Change Specified

Further Policy Changes To Evaluate?

Policy Appraisal—Pairwise Comparison of Counterfactual Equilibrium to Benchmark Data
parameters consistent with the elasticities and the observed data set, using the assumption that firms are minimizing cost and consumers are maximizing utility subject to their budget constraints. The accuracy of the computer code is checked by confirming that the equilibrium outcomes of cost minimization and utility maximization given the inferred share parameters correspond to the original data. The desired policy change is then introduced and a counterfactual equilibrium solution computed. Policy appraisal proceeds using a pairwise comparison of the benchmark equilibrium data and each counterfactual equilibrium solution.

**Interregional Impacts of the Federal Tariff**

Results are presented in Table I for a unilateral elimination of tariffs in Canada. This change worsens both welfare and the terms of trade for both the East and West, with an improvement in the Rest of the World.

To a large extent these results reflect the values of the trade elasticities used. Canada is not modelled as a small open economy, and the ROW obtains a welfare gain at the expense of both Canadian regions as a result of the unilateral tariff abolition by Canada. This result can be seen simply as an illustration of the well known optimal tariff argument that countries which can influence their terms of trade will typically suffer a terms of trade deterioration by setting their own tariff to zero. In this case, results suggest that existing tariffs in Canada are closer to optimal tariffs than are zero tariffs.

The more interesting feature of Table I is that, while as expected the East experiences a larger terms of trade deterioration, the West appears to lose almost as much from tariff abolition as the East. This is opposite to the belief that in relative terms the East gains interregionally from the tariff at the expense of the West.

This latter result, however, is a direct consequence of the treatment of government revenues in the model. Regions are given a share of federal revenues equal to the amount paid by the region in the 1974 benchmark data. Since the East imports more than the West, their relative contribution of tariff revenues to the federal government is large. When Canadian tariffs are eliminated this reduces the West's share of tariff revenues returned to them in lump sum form. This is larger than the West's actual tariff payments, and thus the West loses from tariff elimination. This result therefore suggests that the way in which the revenues raised by the tariff are redistributed, interregion-
Table I
Unilateral Abolition of the Federal Tariff

A. Specification

- government revenue redistributed to regions proportion-
al to regional benchmark contribution to total federal
benchmark revenues

- elasticity of substitution between own and external
goods (other province production) in both intermediate
production and consumption set equal to literature
estimates of national import price elasticities

B. Results

<table>
<thead>
<tr>
<th>REGION</th>
<th>WELFARE EFFECTS$^1$</th>
<th>TERMS OF TRADE CHANGE$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td>-.98</td>
<td>-4.20</td>
</tr>
<tr>
<td>West</td>
<td>-.88</td>
<td>-1.18</td>
</tr>
<tr>
<td>ROW</td>
<td>.11</td>
<td>4.75</td>
</tr>
</tbody>
</table>

$^1$Change in welfare measured as the Hicksian equivalent variation as a percentage of GRP.

$^2$Percentage change in index of export to import producer prices (+ve indicates improvement).
ally may be a more important determinant of the regional impacts of the tariff than the conventionally discussed price effect from protection on the interregional terms of trade.

In Table II we report results for the unilateral elimination of tariffs by Canada where we make an adjustment to the model so that the reduction in revenues received is proportional to each region's import share. In this case, regional results are closer to the terms of trade effects.

The implications of these results are that the federal tariff typically will produce a relative interregional terms of trade improvement in favour of the East, but the interregional income redistribution effect from tariff revenues is also important.

Varying Elasticities of Substitution

In the results presented in Tables I and II, both Canadian regions lose from unilateral tariff removal. These results largely reflect our modelling of Canada with respect to ROW. Our a priori expectation is that the elasticity of substitution between domestic and imported commodities in demand and production in ROW should be important for the welfare and terms of trade impacts produced by the model. In the extreme case, if the elasticity of substitution between domestic products and imports in the ROW is infinite, then Canada becomes a small open economy in which case the cost of the tariff is borne exclusively by importing regions. At the opposite extreme, if Canada can influence its terms of trade, a substantial improvement could result from a tariff.

Results in Table III suggest that as the import domestic substitution elasticity in ROW gets higher, the terms of trade effects get smaller. The changes in the terms of trade effects for both the East and the West are as might be expected for the various elasticity specifications. The welfare results, however, suggest that the East gains from the removal of tariff when ROW's elasticity is high. The West continues to lose but by less.

Varying Tariff Rates by Region

In Table IV results using different relative tariffs by region are reported. These analyses are included because, due to the Auto Pact, the effective average tariff on Eastern imports of manufactures is lower than that on Western imports. In these cases the relative size of tariffs in the East is changed by reducing the tariff in the East.
Table II

Unilateral Abolition of Tariffs by Canada with Distribution of Federal Revenues Changes from Table I

<table>
<thead>
<tr>
<th></th>
<th>Revenue Returned to Region Proportional to Benchmark Contribution</th>
<th>Revenue/Change Distributed Proportional to Imports</th>
</tr>
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<tr>
<td><strong>Welfare Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Hicksian Evs as % of GRP)</td>
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<td></td>
</tr>
<tr>
<td>East</td>
<td>- .98</td>
<td>-1.19</td>
</tr>
<tr>
<td>West</td>
<td>- .88</td>
<td>- .37</td>
</tr>
<tr>
<td>ROW</td>
<td>.11</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Terms of Trade Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(% change, +ve indicates improvement)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East</td>
<td>-4.20</td>
<td>-4.42</td>
</tr>
<tr>
<td>West</td>
<td>-1.18</td>
<td>-0.67</td>
</tr>
<tr>
<td>ROW</td>
<td>4.75</td>
<td>4.69</td>
</tr>
</tbody>
</table>
Table III

Sensitivity of Results to the Import/Domestic Substitution Elasticity in ROW
(Unilateral Tariff Abolition with Government Revenue Returned to Regions as in Table I)

<table>
<thead>
<tr>
<th>Elasticity Value</th>
<th>1.66(^1)</th>
<th>10</th>
<th>20</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Welfare Impacts (Hicksian Equivalent Variations as % of Income)</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
</tr>
<tr>
<td>West</td>
</tr>
<tr>
<td>ROW</td>
</tr>
</tbody>
</table>

Terms of Trade (% change, +ve indicates improvement)

| East               | -4.20      | -.87 | -.35 |
| West               | -1.18      | -.09 | -.25 |
| ROW                | 4.75       | .86  | .45 |

\(^1\)This is the value used in Tables I and II. Values of 1.3 were used for both East and West, and are also used in this table and those following.
Table IV

Sensitivity of Table I Results to Variations in the Relative Size of East to West Tariffs
(Unilateral Tariff Abolition with Government Revenue Redistributed to Regions)

<table>
<thead>
<tr>
<th></th>
<th>East Tariff equals West Tariff</th>
<th>East Tariff equals 1/2 West Tariff</th>
<th>East Tariff equals 1/4 West Tariff</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. Welfare Impacts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Hicksian EV as % of GRP)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East</td>
<td>- .98</td>
<td>- .78</td>
<td>- .68</td>
</tr>
<tr>
<td>West</td>
<td>- .88</td>
<td>- .17</td>
<td>.20</td>
</tr>
<tr>
<td>ROW</td>
<td>.11</td>
<td>.07</td>
<td>.05</td>
</tr>
<tr>
<td><strong>B. Terms of Trade Effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(% change, +ve indicates improvement)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East</td>
<td>-4.20</td>
<td>-2.58</td>
<td>-1.75</td>
</tr>
<tr>
<td>West</td>
<td>-1.18</td>
<td>-0.79</td>
<td>-0.64</td>
</tr>
<tr>
<td>ROW</td>
<td>4.75</td>
<td>2.94</td>
<td>2.02</td>
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</table>
holding the Western tariff unchanged.

These results reflect the feature that the redistribution effect with tariffs is reversed between cases 1 and 3. In case 3, with considerably higher tariffs in the West, the majority of federal tariff revenues come from the West. When the tariff is eliminated, the West's contribution to national revenues drops by more than the transfer the West receives. In this case, unlike case 1, the West gains from the elimination of the tariff. These results therefore once again emphasize the importance of revenue redistribution effects in evaluating the regional impact of tariffs.

Conclusion

In this paper we report preliminary results from a small dimensional numerical general equilibrium model of U.S.-Canadian trade which incorporates regional effects within Canada. Under all assumptions of elasticities when revenues are redistributed by GRP, the West loses from unilateral abolition of Canadian tariffs, even though interregional terms of trade effects move relatively in their favour. Small positive gains result for the East only when the domestic import elasticity of substitution in the U.S. is high due to international terms of trade effects. The issue of how the federal government redistributes tariff revenues by region emerges as a central issue which crucially affects regional incidence.
ENDNOTES

1. Although bilateral U.S.-Canadian trade in autos and auto parts under the free trade Auto Pact accounts for 25 percent of U.S.-Canadian trade.

2. Gross Regional Product.

3. Absorption equals consumption plus capital formation and is suggested by Hazledine as a measure of the welfare impacts of the tariff change.
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