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REGIONAL EFFECTS OF TAXES IN CANADA: AN APPLIED GENERAL EQUILIBRIUM APPROACH

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ABSTRACT

This paper reports on an applied general equilibrium regional model for Canada which is used to investigate the regional effects of taxes. Earlier, literature on regional tax effects is reviewed and the main features of the model are briefly described. Existing literature on regional tax effects is largely non-quantitative, and does not discuss several important regional features of taxes, such as taxes which are predominantly on products or industries located in particular regions. Results suggest that regional effects of taxes can be significant, and in the Canadian case at least, do not tend to counterbalance one another. In general, richer regions tend to lose and poorer regions gain from federal taxes, but other regional characteristics such as manufacturing/non-manufacturing, or resource/non-resource can be important.

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I. Introduction

Only a small segment of existing public finance literature deals explicitly with the regional effects of taxes, and little of it is numerical in orientation. And yet in many countries the regional dimensions of economic policy are increasingly coming to the fore in debates on both tax and other issues. Taxes which affect products heavily produced in particular regions are often seen as regionally unfair. Regional tax exporting is a further contentious issue, either through deductibility of regional or local taxes at national level, or through tax induced changes in the interregional terms of trade. And there is further debate as to the effects of taxes on regional factor mobility.

In part, the lack of literature dealing with these issues is a reflection of the difficulties of regional modelling. Data is often poor, and the most appropriate analytic structure within which these issues, and especially interregional factor mobility, can be adequately captured is not clear from existing literature. But despite these problems the importance of regional dimensions in tax policy design remains.

These considerations motivate the use in this paper of a Canadian applied general equilibrium regional model to analyze some of the more prominent regional effects of taxes.[1] In the sections which follow we comment on previous literature, describe the structure of our model, and report model results. These suggest that regional effects of taxes, at least in the Canadian case, can be pronounced, and, importantly, do not counterbalance one another across different taxes to yield a regionally balanced tax system. In the main, the regional effects of federal taxes appear to be self-reinforcing, benefiting poorer and/or non-manufacturing regions at the expense of richer and/or manufacturing regions. Regional impacts of provincial taxes tend to be in favour of larger regions which can export part of their taxes through effects on the interregional terms of trade, but these are smaller than for federal taxes. One implication of these results would seem to be that the regional effects of federal taxes in Canada are part of a wider system of interregional redistribution, in which taxes partially compensate for the interregional effects of other federal policies, such as trade and industrial policies.

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[1] This model is described in more detail in Jones and Whalley (forthcoming) and in Trela and Whalley (1986), where its application to a variety of other regional issues is also discussed. The volume by Trela and Whalley also presents some preliminary calculations of regional tax effects which are taken substantially further in this paper.

II. Regional Effects of Taxes

The regional effects of both national and sub-national taxes have been a topic of policy debate in federal states for many years. In Canada, limits were placed on the taxing powers of provincial governments at the time of Confederation in 1867. Indirect taxes on commodities such as wheat were viewed as taxes which could potentially be shifted onto other regions through changes in the interregional terms of trade, and so provincial taxing powers were limited to direct taxes, i.e., taxes seen as borne directly by the regions paying the tax. Although provinces now use indirect taxes such as retail sales taxes, the issue of which taxing powers various levels of government should be allowed to use has been an ongoing theme of Canadian policy debate.

In analyzing what regional effects both national and sub-national taxes can have, a variety of factors come into play, and as we mention in our Introduction these have been little analyzed in previous literature. Existing literature on regional effects of taxes seems to have three distinct strands.

First there are regional tax incidence calculations, examining the incidence effects across regions of both national and regional taxes. This work seeks to evaluate the regional effects of taxes using shifting assumptions and associated distributive series.[1] Gillespie (1980, p. 141), for instance, reports regional tax incidence calculations for Canada by income class by region, where five regional versions of the distributive series commonly used in national calculations are employed. The picture that emerges is that, outside of the Prairie regions, regional incidence patterns by income range are broadly similar to national patterns. Although no behavioural impacts (terms of trade effects, induced mobility responses, etc.) are captured by such analyses, these results suggest that regional effects of taxes are not that significant.

A second strand of literature derives from McLure's (1967) work on interstate effects of corporate taxes in the U.S. This literature emphasizes the deductibility of state and local taxes from federal taxes, and the resulting ability of subnational jurisdictions to have other jurisdictions share in the financing costs of locally provided services. Since McLure's paper, this same theme has reappeared in a number of studies of fiscal federalism in the United States; a recent example, for instance, is Morgan and Mutti (1985).

[1] This approach to national tax incidence issues has been widely employed in the public finance literature for many years. Pechman and Okner's (1974) work on the U.S. tax system is some of the best known in this tradition.

A third strand of literature attempts to determine the interregional incidence effects of taxes using Harberger-type general equilibrium models. These models capture tax exporting effects through impacts on the interregional terms of trade, but this literature is exclusively theoretical and uses strong assumptions on interregional factor mobility to obtain clear analytical results. McLure (1969), for instance, presents a general equilibrium analysis of the interregional incidence effects of several types of taxes[1] levied in one region in a larger country, assuming that labour is interregionally immobile, capital interregionally mobile, and with the residence of both workers and capital owners assumed fixed.

Relatively neglected in all this literature are: the interregional terms of trade effects associated with national rather than regional taxes, the effects of taxes on interregional factor mobility, the effects of national taxes which apply to industries heavily concentrated in particular regions, and other issues such as regional effects of taxes which affect interregional transportation costs.

Most of these are contentious issues in the Canadian case. Since manufacturing industry is heavily concentrated in Central Canada, the regional implications of the manufacturers' sales tax, the corporate tax, or the lower corporate tax rate on manufacturing and processing are much discussed. Also, with differences in regional income per capita, progressive national income taxes clearly tend to redistribute income between regions. In addition, since hinterland regions import significant amounts of commodities from large central regions which act as price makers in interregional trade, taxes which raise transportation costs are seen as being borne more heavily by hinterland regions. Excise taxes on gasoline and other related taxes, such as vehicle registration fees, can therefore have significant interregional effects.

Also, little work has been done which explicitly takes interregional factor mobility into account in evaluating the interregional effects of taxes. This is an especially difficult issue, since what one means by a region is no longer so clearly defined once interregional factor mobility is allowed.

If capital is both internationally and interregionally mobile, and if all regions are takers of rental prices on world capital markets, then the only effect of a regional tax applying to inward capital flows is to discourage capital investment in the region, with no effects on other regions. If capital is not internationally mobile but remains interregionally mobile, the effect of such a tax is to change the interregional allocation of capital, having effects

[1] Taxes on factor inputs, on consumption, and on production.

on other regions.

Labour is generally believed to be only partially interregionally mobile in Canada. In part this reflects costs of relocation and the search process accompanying induced adjustments as external shocks affect regional economies, but locational preferences of individuals also come into play. Capturing this in a convincing modelling framework is the challenge.

The Canadian regional general equilibrium model which we outline in the next section is designed to capture many of these effects, and is thus used here to analyze regional dimensions of Canadian tax policy.

III. An Applied General Equilibrium Regional Model of Canada

The Canadian regional general equilibrium model we use is closely related to the applied models already used to analyze taxation and international trade policy issues (see the survey paper by Shoven and Whalley (1984)). A more detailed description of the model appears in Jones and Whalley (forthcoming), the appendix of which contains a statement of the model in full algebraic form.

The model operates both in basic variant form, and with a series of extensions available which each enhance the modelling capability, but at a cost in terms of computational complexity. The main features of the basic variant of the model are summarized in Table 1.[1] A series of regions are specified, each with a demand and production structure, and interregional trade in commodities takes place. In contrast to existing international trade models a series of further interactions (such as intergovernmental transfers) occurs between regions. Also, the assumption of interjurisdictional factor immobility commonly made in trade models is not made here.

Regions and Products

In the basic model variant a single period (static) model is used, representing six Canadian regions: Atlantic Canada, Quebec, Ontario, Manitoba/Saskatchewan, Alberta, and British Columbia. Interregional trade in goods and interregional factor flows both occur. A seventh region represents the rest of the world (ROW), with whom all Canadian regions engage in international trade.

Each Canadian region has 13 industries[2], each of which produces a single output and uses both primary factors (capital services, labour services, and natural resources) and intermediate products (other commodities) as inputs. The ROW also has 13 industries, but production involves only capital and labour services, with no intermediate inputs. Regionally provided public services are included as one of the 13 produced goods in each region; this being the only good which is not interregionally traded.

Armington Assumption

The 13 produced goods in each region are treated as qualitatively different from sim-

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[1] The various model extensions available are discussed in Jones and Whalley (forthcoming), and in Whalley and Trela (1986).

[2] These are: agriculture; fishing and trapping; mines and quarries; food, beverages and tobacco; light manufacturing; lumber, paper and printing; metal and machinery; vehicles; energy; transportation; utilities; personal and business services; and government services.

Table 1

Main Features of the Basic Variant Canadian Regional General Equilibrium Model

1.	Regional Structure:	Six Canadian Regions identified along with the rest of the world (Atlantic, Quebec, Ontario, Manitoba/Saskatchewan, Alberta, B.C.).
2.	Production:	Each of six regions in Canada produces 13 goods using both primary factors and intermediate products as inputs. Thirteen goods are also produced abroad. Each of the 13 goods is assumed qualitatively different both across regions and internationally (Armington Assumption)
3.	Demands:	Final demands in each region are derived by maximizing a five-level nested CES/LES utility function subject to a regional budget constraint. Intermediate demands reflect cost minimization across sources of supply.
4.	Taxes and Transfers:	Both regional and federal levels of government are identified, each with taxes and expenditures. Intergovernmental transfers are incorporated.

5. Model Treatment of Factor Mobility:

(i)	capital services	- variant (a) capital is interregionally and intersectorally mobile, but internationally immobile. - variant (b) capital is interregionally, intersectorally, and internationally mobile.
(ii)	labour services	- assumed internationally immobile, intersectorally mobile within any region, but interregionally partially mobile; labour is homogeneous across regions, but consumers have locational preference leading to partial mobility between regions (see Appendix A for more details).
(iii)	resources	- assumed internationally and intersectorally immobile.

ilar commodities produced either in other regions, or abroad. This is the "Armington assumption" (from Armington (1969)), widely used in international trade applied general equilibrium analysis. The reasons for adopting this treatment here are the same as in the international trade models; i.e., the presence of cross hauling in interregional trade statistics, where the same good is shown as being both imported and exported by the same region. It is also easier to incorporate interregional trade elasticities into the model specification using this Armington treatment. The extent to which regions can change their terms of trade and shift the burden of taxes onto other regions depends critically upon the values used for substitution elasticities among the Armington products. These, in turn, reflect one's belief as to what are reasonable values for elasticities in interregional trade.

Factors of Production, and Interregional and International Mobility Assumptions

While three different factors of production (capital services, labour services, and natural resources) are used in production in the regions in the model, to simplify computation only two of these appear as inputs in the production function for any industry in any region. Non-energy industries use capital and labour services as factor inputs; energy industries use natural resources and labour services. Resource inputs are treated as internationally and intersectorally immobile. The key resource inputs appear in oil and gas (energy) industries, especially in the resource rich Western regions.

Two different factor mobility assumptions are used for capital services. In variant (a) of the model, capital is assumed to be both interregionally and intersectorally mobile within Canada, but internationally immobile. Variant (b) differs from this in also allowing for international mobility of capital. These two model variants reflect the fact that the literature is not conclusive as to whether or not perfect international mobility of capital is a reasonable assumption to make for smaller countries such as Canada, even though many economists consistently use it.[1]

The way in which interregional labour mobility is modelled is more complex, with labour assumed to be internationally immobile, intersectorally mobile, but interregionally partially mobile. Partial mobility of labour between regions is incorporated through a distribution of individuals within any region assumed, who vary by their intensity of locational preference. Individuals trade off differences in real income associated with locating

[1] See Feldstein and Horoika (1980), and Harberger (1980).

and working in various regions against their preference for remaining in their region of origin. The effect is that in response to changes in relative regional incomes, only a portion of any region's population migrates (see the more detailed discussion in Appendix A).

This partial mobility treatment is used for a number of reasons. The most important is that a model in which labour is perfectly mobile between regions is not particularly useful in analyzing whether, and by how much, regions gain or lose as a result of changes in either national or regional taxes. This is because regions, as such, are not well defined in such a model variant.[1] Treating labour as completely immobile between regions allows interregional distributional effects of taxes to be analyzed, but excludes all the efficiency issues associated with the regional movement of labour which have been so heavily stressed in recent fiscal federalism literature.[2]

Demand Side

On the demand side of the model, products produced both within and outside regions appear in the final demand functions for each region, including ROW. Final demands are based on utility maximization, with each region maximizing a nested CES/LES utility function subject to a regional budget constraint. Intermediate demands, which involve a nested CES production structure, reflect cost minimization across within-region and out-of-region sources of supply. The most important objective in designing the nesting structure is to facilitate the incorporation of key elasticity parameters into the model, including those which affect both interregional and international trade. This is discussed in more detail in Jones and Whalley (forthcoming).

Each regional budget constraint includes capital, labour, and resource income received by residents, along with intergovernmental transfers received from the federal government and federal government transfers made to persons. Taxes levied within a region appear in the region's budget constraint on the expenditure side, but also generate lump sum transfers which reappear as regional income.

Since there is no data available in Canada (or any other country to our knowledge)

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[1] Furthermore, because of this treatment of interregional partial mobility, when reporting model results showing regional impacts of tax changes one needs to distinguish between only those original residents of a region who remain after the policy change, the original residents of a region including those who migrate outwards following a policy change, and the remaining residents plus new arrivals.

[2] See, for instance, Boadway and Flatters (1982).

on interregional patterns of asset ownership, we make the strong assumption that in the base (pre-tax policy change) situation considered by the model, all capital and resource income originating in a region accrues to residents of that region.

Foreign Trade

The main characteristics of the model treatment of foreign trade are the Armington assumption and the treatment of international factor mobility, both of which are discussed above.

The way that the behaviour of foreigners is treated in applied general equilibrium models is often important for model results.[1] In the present model, their behaviour involves both their production and demand. An external sector balance condition appears as part of the characterization of equilibrium. This states that the value of imports plus the net imbalance on the capital account equals the value of exports, and is equivalent to stating that, as a country, Canada is always on its budget constraint in its international transactions.

In the data used to calibrate the model the output of each industry in the Rest of the World is set at approximately ten times the value added in the same industry for all Canadian regions combined. This approximates Canada's position viz-a-viz its largest trading partner, the U.S. The two most important parameters in this treatment of foreign trade are the values chosen for elasticities of substitution between Canadian and foreign products in demands in each region, and the size set for ROW, since these jointly determine the international import and export price elasticities which regions within Canada face.

Taxes and Other Policies in the Model

Integrated into this treatment of production, demand, and associated interregional and international trade, are both federal and provincial taxes, and a series of policies, all of which have regional effects. These are listed in Table 2 along with a brief description of their model treatment.

The main Canadian federal and provincial taxes which have interregional effects all appear in the model. The federal manufacturers' sales tax enters as an ad valorem sales tax on manufactures, with differences in tax rates by commodity reflecting the rate structure

[1] For instance, Whalley and Yeung (1984) have shown that the treatment adopted for the behaviour of the Rest of the World in single economy general equilibrium models can crucially affect the behaviour of the model, since this determines whether the economy in which one is interested is modelled as a price taker or price maker.

Table 2

Model Treatment of Taxes and Other Policies with Interregional Effects

Taxes	Model Treatment
Federal Taxes	Manufacturers' sales tax modelled as ad valorem tax on both final and intermediate purchases
	Corporate taxes modelled as ad valorem taxes on capital inputs by industry by region
	Progressive federal income taxes applying to income by region
	Excise taxes modelled as ad valorem taxes on both final and intermediate purchases
Provincial Taxes	Sales, income, and corporate taxes in each region also modelled in ad valorem equivalent form
Federal-Provincial Transfers	**Model Treatment**
Equalization	Systems of federal-provincial transfers, with payments calculated using explicit formulae
Established Programmes Financing (EPF)	Federal-provincial transfers to fund post secondary education and health care - equal per capita transfers to all regions
Canada Assistance Programmes (CAP)	Cost-shared regional transfers which partially fund welfare programmes
Federal "Nation-Building" Policies	**Model Treatment**
Tariffs	Ad valorem tax on imports (final and intermediate demands)
Transportation Subsidies	Subsidies on grain shipments from Western Canada

Energy Policies	Provincial Royalties - ad valorem regional taxes which entering production costs Price Ceilings - ad valorem consumer subsidies, ad valorem producer tax Exploration Grants - producer subsidies
<u>Regional Policies which affect Trade and Factor Flows between Regions</u>	<u>Model Treatment</u>
Barriers to free goods flows between regions	Ad valorem tariffs on imports from other regions in Canada
Capital market preferences used by regions	Subsidies to capital use within region
<u>Other Federal Policies</u>	<u>Model Treatment</u>
Non tariff trade restrictions (such as textile quotas)	Ad valorem equivalent tariff on imports
Regional Development Programs	Regional subsidies to capital use by industry within regions
Agricultural Programs	Agricultural output subsidies

in the tax. Corporate taxes are modelled as ad valorem taxes on the use of capital service inputs in each industry in each region. The manufacturing and processing incentive in the corporate tax appears as lowered corporate tax rates for manufacturing industries. Progressive national income taxes enter through different average federal income tax rates by region. Excise taxes, including both federal and provincial taxes on gasoline, enter in ad valorem form, as do provincial retail sales taxes.

In the case of most of the other policies entering the model, the treatment adopted is relatively straightforward. For instance, the tariff is treated as an ad valorem tax on imports into all regions in Canada, covering both final and intermediate demands and with rates varying across commodities.

In a few cases, the model treatment is more complex. This is the case with energy policies, where a number of different features come into play. Royalties are incorporated as ad valorem regional taxes on resource inputs (oil and gas) used in energy industries. Energy price ceilings (which were used in Canada in the base year for the model (1981)) are approximated by ad valorem consumer subsidies on energy which maintain consumer prices below world prices, and corresponding taxes on producers. The model also incorporates a Petroleum Compensation Charge which was used to finance consumer subsidies covering the difference between domestic and world prices for imports in the base year.

Implementing the Modelling Approach

To apply the model outlined above to the evaluation of the interregional effects of taxes in Canada, parameter values must be specified for the functions used in the model, and it must be solved for competitive equilibria under the various policy changes considered.

In specifying model parameter values, a calibration procedure similar to those used in other applied general equilibrium models is followed (see Mansur and Whalley (1984)). Calibration is most easily understood as the use of model equilibrium conditions and equilibrium data to solve for the parameter values used in the functions in the model. This involves selecting a set of parameters values such that data which characterizes a benchmark (or observed) equilibrium can be reproduced as a model equilibrium. Only when the model is fully specified and a policy change incorporated is the model solved for a new equilibrium solution. Evaluations of the regional impacts of taxes follow from pairwise comparisons between simulated (or new) equilibria and the benchmark equilibrium to which the model is calibrated.

Thus, two types of equilibria have to be distinguished when using the model. One is 'observed' or 'benchmark' equilibria which are given from data and to which the model is calibrated (and thus do not need to be computed). The second is 'new' or 'counterfactual' equilibria which are computed as model solutions under changes in policy.

Elasticity estimates enter this calibration process by serving as identifying restrictions, allowing the other parameter values in the model to be directly calculated. Since different elasticities produce changed values for the other model parameters, thereby affecting model results, selecting appropriate elasticity values is central to the model specification process. The values chosen and the justification for these choices are discussed more fully below.

Base Year (1981) Micro Consistent Regional Data

A base year 1981 micro consistent regional data set for Canada is used in calibrating the model. The approach adopted in constructing this data set follows that of an earlier paper by St-Hilaire and Whalley (1983) which describes the construction of a 1972 national data set for Canada.[1]

In the regional data, each region is treated as a separate economy, and the links between regions differ from those recorded between nations in international data sets. Trade between regions is incorporated, but taxes paid by regions to the federal government, intergovernmental transfers received by regions, and federal government purchases of regionally produced goods also appear. As a result, regions can be in either a surplus or deficit position in their transactions with the federal government. In turn, a surplus in transactions with the federal government can finance a deficit in a region's international and interregional trade.

Developing a micro consistent regional data set requires that all the transactions taking place in the separate markets and regions which comprise the national economy be recorded. Provincial Input-Output (PIO) Tables for 1979 produced by Statistics Canada as an extension to their National Input-Output Tables are the major building block used in assembling the micro consistent regional data set used here. The PIO data are updated to 1981 using estimates of regional economy-wide aggregates from the Provincial Economic Accounts (PEA) compiled by Statistics Canada. The PEA also provide estimates of federal government transactions with individual regions, which are integrated into the data set. Tax rates come from data on taxes paid and estimates of the relevant tax bases contained in this data.

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[1] A more recent paper by St-Hilaire and Whalley (1985) gives more detail on the present regional data set.

Elasticities

Besides the 1981 micro consistent data set, the elasticities of substitution which appear in the production and utility functions are also important for model results. Most important are four different sets of elasticities which affect commodity and factor flows in the model. These are: international trade elasticities (on both the import and export side), elasticities determining substitution effects between energy and non-energy products in both final demands and intermediate production in each region,[1] elasticities affecting interregional trade in commodities, and elasticity parameters determining the size of interregional labour mobility effects induced by tax and other policy changes.

The international trade elasticity values used are based on a compendium of estimates of trade elasticities due to Stern et al. (1976). Model estimates for Canada are based on the median point estimates for both the Canadian import demand elasticities, and the export demand elasticities which Canada faces.

A recent survey of energy demand elasticities by Kouris (1982) reviews existing estimates, and contains comments on possible ranges of energy elasticity values, although not specifically for Canada. The Kouris study produces a range of energy elasticity estimates (-.1 to -.5) only slightly lower than that suggested by Thirsk and Wright (1977) for Canada. Estimates in this range are therefore used in specifying energy demand elasticity values in the model.

Other commodities appear in the demand functions as a composite non-energy product, with substitution between the component products entering the composite. Since these are less crucial for results than other elasticities in the model, a Cobb-Douglas specification is used in the preference functions for this level of the nesting in all regions in the model. This is equivalent to setting all these elasticities to unity.

There are no current estimates of price elasticities in interregional trade in Canada since there is insufficient time series data on interregional trade flows on which to base such estimation. The approach used here for setting these parameter values is the same as Hazeldine's (1979); that is, to assume that elasticities in interregional trade are the same as those in international trade. This approach is contentious, however, since a shares approach to elasticity determination, based on a region's share of international trade, would suggest that interregional trade elasticities would be considerably higher than international trade

[1] The nesting structures in the model are identical for both final demands and intermediate production.

elasticities. Model performance based on sensitivity analysis around these values, reflecting other approaches to specifying interregional trade elasticity estimates, is discussed in Trela and Whalley (1986).

Elasticities of substitution between factor inputs in value added functions in each region are set at 0.8 for all non-energy industries in all regions, and 0.5 for energy industries. These are a little lower than the values reported in the survey paper by Caddy (1976) and used in Piggott and Whalley (1985), Whalley (1985), and Ballard, Fullerton, et al. (1985) for non-energy industries, and reflect the lack of a compatible classification link between other studies and that used in the present model. A strong assumption is made that identical values can be used for similar industries in different regions.

In the factor flow area, different treatments are used for capital services and for labour services. In the case of capital services, the two mobility assumptions discussed earlier are used: either capital is assumed to be both interregionally and internationally mobile, or it is treated as only interregionally mobile.

In the labour mobility treatment, the key parameters are those which determine the degree of partial mobility of labour between regions. These relate to the mobility formulation discussed earlier. The most recent study of interregional migration in Canada is that by Winer and Gauthier (1982) who analyze the effects of fiscal incentives on migration. In specifying the interregional mobility component of the model, it is, however, difficult to relate the Winer-Gauthier results directly to the mobility parameters which appear in the general equilibrium model. As a result, alternative values of the corresponding model parameters are chosen for compatibility with different assumptions on the elasticity of out-migration from a region with respect to interregional income differentials.[1]

[1] See the discussion in Whalley and Trela (1986).

V. Model Results On The Regional Effects Of Taxes

In this section we report results from the model which are relevant to an assessment of the interregional effects of taxes in Canada. These are shown in Tables 3, 4, 5, and 6. Table 3 reports the interregional effects of replacing various components of the federal tax system by yield preserving neutral alternatives. Table 4 reports on the sensitivity of Table 3 results to alternative model specifications. Table 5 presents results on the interregional effects of both federal expenditures (including transfers) and taxes. Results on interregional effects of regional taxes are reported in Table 6.

In all the model experiments for which results are reported, we limit ourselves to non-energy and non-trade taxes. The former removes from our analysis the regional effects of product specific energy taxes which have large interregional effects in the 1981 base year used for the model, but which have changed substantially since then. The latter removes tariffs from the analysis, which raise only small amounts of revenue but have international, and hence interregional, terms of trade effects. Tariffs are usually considered to be trade policies rather than key elements of revenue raising tax systems in advanced inudustrialized economies.

The regional effects of individual taxes do not appear in the form of a neat division between, say, manufacturing and hinterland, resource and non-resource, or rich and poor regions.[1] This is because all these regional differences come into play in determining the net outcome when any particular tax is changed. For the federal tax system in total, one interregional effect appears to be dominant: that poorer, (i.e. lower income per capita), regions gain from the tax system at the expense of the richer regions. This effect is compounded by the inter- regional effects of federal transfer policies.

Case 1 of Table 3 considers the replacement of the federal manufacturers' sales tax with a yield-preserving uniform rate final sales tax covering all goods. The welfare effects of the change are reported in terms of Hicksian equivalent variations for the original residents of each region.[2] The value in parentheses for each region gives the equivalent variation as

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[1] 1981 per capita incomes for Atlantic Canada, Quebec, Ontario, Man./Sask., Alberta, and British Columbia, respectively, implied by the data used in the model, are: $10,410; $13,585; $14,791; $13,669; $18,130; $15,303.

[2] If the residents of regions who remain following any tax change are used instead, the differences in welfare results are small both in this case and in all other experiments. We therefore consistently report results only for the total original residents of each region.

TABLE 3

REGIONAL EFFECTS OF VARIOUS FEDERAL TAXES

	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
A. WELFARE EFFECTS					
Hicksian Ev's[1] ($ millions 1981)					
Atlantic Canada	-122	-247	18	368	-18
	(-0.6)	(-1.2)	(0.1)	(1.8)	(-0.1)
Quebec	3	-1227	13	-1240	-2521
	(.0)	(-1.7)	(.0)	(-1.7)	(-3.4)
Ontario	488	1109	230	490	2145
	(0.4)	(1.0)	(0.2)	(0.4)	(2.0)
Manitoba/Saskatchewan	-175	-305	7	-378	-875
	(-0.7)	(-1.3)	(.0)	(-1.6)	(-3.6)
Alberta	-191	44	-296	-224	-682
	(-0.5)	(0.1)	(-0.8)	(-0.6)	(-1.9)
British Columbia	-76	639	82	-87	513
	(-0.2)	(1.8)	(0.2)	(-0.2)	(1.5)
Total	-52	19	86	-922	-945
	(-.0)	(.0)	(.0)	(-0.3)	(-0.3)
B. REGIONAL TERMS-OF-TRADE EFFECTS[2] (% change)					
Atlantic Canada	-0.24	-0.31	0.37	-0.94	-1.04
Quebec	-0.11	-0.46	-0.01	-1.04	-1.72
Ontario	-0.09	0.24	-0.29	-0.23	-0.49
Manitoba/Saskatchewan	-0.17	-0.29	0.47	-0.26	-0.36
Alberta	-0.02	-0.01	0.54	1.38	1.96
British Columbia	-0.15	0.37	-0.06	-0.28	-0.16
Rest of the World	0.20	-0.02	0.30	-0.26	0.37

Case 1: Replacement of the Manufacturers' Sales Tax with an equal yield sales tax; capital both internationally and interregionally mobile.
Case 2: Replacement of the Personal Income Tax; as in case 1 above.
Case 3: Replace the Corporate taxes on non-energy goods with an equal yield factor tax. Capital internationally immobile.
Case 4: Removal of all federal non-energy taxes except for those of cases 1, 2, and 3, and except for the federal tariff; with replacement by an equal yield sales tax. Capital internationally immobile.
Case 5: All federal non-energy taxes except tariffs and corporate taxes on energy industries replaced by an equal yield sales tax. Capital internationally immobile.

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[1] Values in parentheses are Hicksian E.V.'s as a percentage of regional income (as a percentage of GNP for the Total).

[2] Calculated using new equilibrium trade flows as weights.

a percent of regional income, with the total change for Canada reported as a percent of GNP.

Ontario gains $488 million from this change, Quebec $3 million, while all other regions lose. B.C. loses $76 million while the others each lose over $100 million. All regions suffer a terms-of-trade deterioration, since the sales tax applies more heavily to commodities which Canada imports, and the model uses a non-small economy assumption. Ontario and Quebec gain from the replacement of a tax concentrated on manufacturing by a more broadly based tax.

Case 2 of Table 3 reports the interregional effects of replacing the federal personal income tax by a yield preserving sales tax. Replacing this tax in this way results in a gain for the high income regions--Ontario, Alberta and B.C.--and a loss for the low income regions. The small overall gain to Canada reflects the fact that this model does not explicitly incorporate labour supply and savings effects of taxes. Thus, in this model the personal income tax redistributes without imposing major distorting costs.

Case 3 reports results from replacing the corporate income tax on all non-energy industries. In contrast to cases 1 and 2, the replacement involves a yield-preserving tax on value added (rewards to factor inputs) within each region, and the change is made under an assumed international immobility of capital. This replacement tax is used since the policy change involves the removal of production side taxes. International capital immobility is assumed in order to weaken any international terms-of-trade effects which arise in this case due to the non-small economy assumptions.[1]

The results indicate welfare gains for all regions, except Alberta. While Ontario shows the largest terms-of-trade deterioration, it is the largest gainer from the change. This is because Ontario is the largest producer of manufacturers in Canada, and this industry group is where incorporation is the heaviest. While Alberta has the largest terms-of-trade gain, it loses the most because of the large corporate taxes on the energy industry (which remain in place).

Case 4 involves the removal of all federal non-energy taxes, excluding those of cases 1, 2, and 3, and excluding the federal tariff. The most important taxes removed in this case are the excise taxes. The results here show losses for the hinterland regions, with the exception of Atlantic Canada, suggesting the major tax effects enter through demand side effects across regions via differential regional consumption of taxed commodities.

[1] Sensitivity of the model results to these model features is reported in Table 4.

Case 5 reports the interregional impacts of removing all federal non-energy taxes, excluding tariffs and all corporate taxes on the energy industry. Capital is treated as internationally immobile in this experiment, and the replacement tax is an equal yield sales tax. All regions lose, except Ontario and B.C. While Ontario is the largest gainer, Quebec is the largest loser.

Since case 5 involves the same policies as considered separately in cases 1 through 4 combined, the results are approximately the sum of those from the individual cases. The large gain to Ontario arises mainly because of the removal of the personal income tax, while smaller gains occur from the removal of the manufactures' sales tax and "other" taxes. The cases for which Quebec loses are the removal of the personal income tax and the removal of "other" taxes. The large loss to Canada as a whole in case 5 can be explained by the removal of "other" taxes with which there is an associated terms of trade deterioration. Case 5 also differs from cases 1 to 4 in its combination of assumptions underlying the tax change. For this experiment the change is made with capital internationally immobile and with an equal yield sales tax.

Table 4 reports results for case 5 from Table 3 for which alternative assumptions have been used: Case 1 reports the results for case 5 if an equal yield factor tax is used in the policy replacement, case 2 for the case if capital is internationally mobile, cases 3 and 4 for alternative values of Canadian import demand elasticities.

The losses for Canada reported in case 1 are similar to those of case 5 of Table 3. The major difference from using alternative tax replacement schemes is in the allocation of gains and losses by regions; in this case gains are larger or losses smaller for every region except Alberta, which loses more.

Case 2 differs most in the estimated total welfare change for Canada. The loss to Canada increases by over $500 million due to substantially different terms of trade effects. In case 2, the terms of trade deterioration is higher for Canadian regions, while the terms of trade improvement for the ROW is larger. Under an international capital immobility assumption, federal capital taxes are borne by the Canadian regions. Under an alternative international capital mobility assumption, some of the burden of these taxes are shifted to the ROW, and removing them results in a larger terms of trade improvement for the ROW.

Cases 3 and 4 involve alternative specifications for import demand elasticities in Canadian regions. These experiments have been performed to further study the effect of the

TABLE 4

SENSITIVITY OF TABLE 3 RESULTS TO
ALTERNATIVE MODEL ASSUMPTIONS AND PARAMETER VALUES

	CASE 1	CASE 2	CASE 3	CASE 4
A. WELFARE EFFECTS				
Hicksian Ev's[1] ($ millions 1981)				
Atlantic Canada	506	-40	-13	-10
	(2.5)	(-0.2)	(-0.1)	(.0)
Quebec	-2049	-2658	-2486	-2461
	(-2.8)	(-3.6)	(-3.4)	(-3.3)
Ontario	2496	1970	2224	2281
	(2.3)	(1.8)	(2.0)	(2.1)
Manitoba/Saskatchewan	-747	-919	-871	-869
	(-3.1)	(-3.8)	(-3.6)	(-3.6)
Alberta	-1112	-688	-682	-683
	(-3.1)	(-1.9)	(-1.9)	(-1.9)
British Columbia	557	527	520	526
	(1.6)	(1.5)	(1.5)	(1.5)
Total	-956	-1510	-816	-725
	(-0.3)	(-0.5)	(-0.3)	(-0.2)
B. REGIONAL TERMS-OF-TRADE EFFECTS[2] (% change)				
Atlantic Canada	-0.88	-1.60	-0.99	-0.96
Quebec	-1.68	-2.42	-1.63	-1.57
Ontario	-0.56	-1.25	-0.37	-0.28
Manitoba/Saskatchewan	-0.38	-0.97	-0.34	-0.33
Alberta	1.83	2.45	1.92	1.89
British Columbia	-0.21	-0.62	-0.11	-0.08
Rest of the World	0.47	1.31	0.24	0.15

Case 1: As in case 5, table 3 except with a yield-preserving factor tax.
Case 2: As in case 5, table 3 except with capital internationally mobile.
Case 3: As in case 5, table 3 but with the import demand elasticity in Canada equal to 3.0.
Case 4: As above, except Canadian import demand elasticity equal to 5.0.

[1] See footnote 1, Table 3.

[2] See footnote 2, Table 3.

international capital immobility assumption on the strength of the terms-of-trade effects. The value used in the base case is 1.3, while the value for case 3 is 3.0 and for case 4 is 5.0. In these cases, the results of the change show a smaller loss to Canada as the value increases and the terms-of-trade improvement for the ROW decreases. This is because Canada moves closer to being a price-taker in world goods markets.

Table 5 reports results from policy experiments in which federal government expenditures as well as tax policies are changed. For these experiments, we report the effects of policy changes on labour mobility instead of the terms-of-trade effects, in part to demonstrate the model's capability to yield estimated impacts on interregional migration. The net labour migration into each region is reported as the total labour inflow from other regions minus the outflow from the region. The units are millions of 1981 dollars of labour income, and are measured in terms of the labour units in each region implicit in the benchmark equilibrium data set. The actual values reported for these cases are small due to a relatively small value of the labour mobility elasticity parameter used,[1] reflecting the assumption that labour is only partially mobile between regions.

Cases 1, 2, and 3 report results of changing various elements of the federal government's system of transfers to the regions. These transfers include Equalization payments, the Canada Assistance Plan, and the Established Programs Financing (Health Care and Post Secondary Education). In case 1, intergovernmental transfers from the federal government to regional governments are removed, with federal expenditures kept constant through an equal yield subsidy applying to final purchases in all regions.

Removal of these programs results in gains for the high income provinces (Ontario, Alberta, and B.C.) and losses to the low income regions (Atlantic Canada, Quebec, and Manitoba/Saskatchewan). The large losses for Quebec, and in particular for Atlantic Canada, are due to the regional concentration of the Equalization program on these two regions. The pattern of migration follows that of welfare gains or losses, since labour migrates from the major Equalization receiving regions to the higher income regions.

Case 2 involves the removal of federal government transfers to persons using an equal yield replacement as in case 1. These transfers include old age security, unemployment insurance (UI), and welfare. All regions except Alberta and B.C. lose when these transfers

[1] We use a value of 0.05 as the elasticity of the number of people who wish to remain in their initial region with respect to a given change in the labour income outside a region, holding within region incomes constant.

TABLE 5

REGIONAL EFFECTS OF BOTH FEDERAL TAXES AND EXPENDITURES

	CASE 1	CASE 2	CASE 3	CASE 4
A. WELFARE EFFECTS				
Hicksian Ev's[1] ($ millions 1981)				
Atlantic Canada	-1952	-1364	-3693	-3368
	(-9.5)	(-6.6)	(-18.0)	(-16.4)
Quebec	-1265	-157	-1605	-4273
	(-1.7)	(-0.2)	(-2.2)	(-5.8)
Ontario	2074	-826	1468	3717
	(1.9)	(-0.8)	(1.3)	(3.4)
Manitoba/Saskatchewan	-361	-177	-590	-1487
	(-1.5)	(-0.7)	(-2.4)	(-6.2)
Alberta	808	1992	3007	2078
	(2.2)	(5.5)	(8.4)	(5.8)
British Columbia	631	336	1073	1572
	(1.8)	(1.0)	(3.0)	(4.5)
Total	-35	-169	-261	-1200
	(-.0)	(-0.1)	(-0.1)	(-0.4)
B. NET INTERREGIONAL LABOUR MOBILITY EFFECTS				
(+ indicates inflow)[2]				
Atlantic Canada	-100	-27	-131	-102
	(0.8)	(-0.2)	(-1.0)	(-0.8)
Quebec	-133	-10	-147	-267
	(-0.3)	(-.0)	(-0.3)	(-0.6)
Ontario	153	-55	97	250
	(0.2)	(-0.1)	(0.1)	(0.3)
Manitoba/Saskatchewan	-23	-11	-36	-49
	(-0.2)	(-0.1)	(-0.2)	(-0.3)
Alberta	62	86	157	87
	(0.3)	(0.4)	(0.7)	(0.4)
British Columbia	40	17	60	80
	(0.2)	(0.1)	(0.3)	(0.3)

Case 1: Remove intergovernmental transfers from Federal government; Equal yield subsidy on final demand; capital internationally mobile.
Case 2: Remove interpersonal transfers; replacement as in case 1.
Case 3: Remove intergovernmental and interpersonal transfers; replacement as in case 1.
Case 4: Remove all federal transfers and federal non-energy taxes excluding tariffs and corporate taxes on energy industries; equal yield sales tax; capital internationally immobile.

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1 See footnote 1, Table 3.

2 Units are in $ millions of labour (as in the benchmark equilibrium data). Values in parentheses are net migration as a percentage of region's original labour use.

are removed. Atlantic Canada loses the most, reflecting the concentration of UI and welfare payments in this region. Ontario loses since it has an older population and receives a large share of these transfers. Outward labour migration again generally occurs from the welfare losing regions.

Case 3 reports results for the joint removal of both intergovernmental and interpersonal transfers. Welfare effects and net labour flows for each region are approximately the sum of the results from cases 1 and 2, indicating no major interaction between these two policy changes.

Case 4 involves the simultaneous removal of federal taxes as in case 5 of Table 3, and the removal of all intergovernmental and interpersonal transfers as in case 3 of this table. The welfare results are approximately the sum of those for the two cases. Major gains accrue to higher income regions, with losses for lower income regions.

Table 6 reports the results of various changes in regional taxes. In case 1 we duplicate, at a regional level, the federal policy change for case 5 of Table 3. Non-energy taxes, excluding corporate taxes on the energy industry, are replaced in each region by a yield-preserving sales tax. Capital is assumed internationally immobile, and since the rates modelled here are low, interregional tariff barriers are removed.

The results indicate that all regions except Atlantic Canada and Alberta lose from this change. Ontario's loss of $1.6 billion and the losses of $642 million and $448 million for Quebec and B.C., respectively, outweigh the gains to other regions and, as a result, Canada in total loses. These results indicate that regional tax systems benefit Canada, due to the impact of the regional taxes on international terms of trade, with the greatest benefit accruing to Ontario.

Case 2 reports results for a similar change except that only the personal income tax, corporate income tax (excluding taxes on the energy industry), and indirect taxes are replaced in each region. These results indicate that over one-half of the impact on Ontario in case 1 is accounted for by these taxes.

Cases 3 and 4 duplicate the tax changes considered in cases 1 and 2, respectively, but only Ontario's taxes are altered. The results for the case 3 change show a large loss for Ontario, with Quebec gaining the most, and overall Canada loses from the change. Case 4 shows that the three tax components considered account for most of both Ontario's loss in case 3, and the other regions' gains.

TABLE 6

REGIONAL EFFECTS OF REGIONAL GOVERNMENT TAX POLICIES

	CASE 1	CASE 2	CASE 3	CASE 4
A. WELFARE EFFECTS				
Hicksian Ev's[1] ($ millions 1981)				
Atlantic Canada	29 (0.1)	167 (0.8)	203 (1.0)	161 (0.8)
Quebec	-642 (-0.9)	-257 (-0.3)	756 (1.0)	600 (0.8)
Ontario	-1606 (-1.5)	-991 (-0.9)	-2569 (-2.4)	-1881 (-1.7)
Manitoba/Saskatchewan	-87 (-0.4)	-34 (-0.1)	193 (0.8)	172 (0.7)
Alberta	148 (0.4)	235 (0.7)	274 (0.8)	241 (0.7)
British Columbia	-448 (-1.3)	-285 (-0.8)	141 (0.4)	121 (0.3)
Total	-1642 (-0.5)	-271 (-0.1)	-599 (-0.2)	-222 (-0.1)
B. TERMS-OF-TRADE CHANGE[2] (% change)				
Atlantic Canada	0.05	0.97	2.09	1.73
Quebec	-1.04	-0.56	2.21	1.83
Ontario	-0.97	-0.60	-3.01	-2.55
Manitoba/Saskatchewan	0.05	0.12	2.12	1.80
Alberta	4.64	2.45	2.40	1.52
British Columbia	-1.43	-1.06	1.50	1.30
Rest of the World	0.54	0.61	0.22	0.36

Case 1: Remove non-energy taxes in all regions, excluding the corporate taxes on energy industries; equal yield sales tax for each regional government; capital internationally immobile.

Case 2: Remove the personal, corporate (excluding energy industry), and indirect taxes in each region. Replacement as in case 1.

Case 3: Remove Ontario non-energy taxes, excluding the corporate taxes on the energy industry; equal yield sales tax; capital internationally immobile.

Case 4: Remove the personal, corporate (excluding energy industry), and indirect taxes in Ontario. Replacement as in case 3.

[1] See footnote 1, Table 3.

[2] See footnote 2, Table 3.

VI. Conclusion

This paper reports on an attempt to use an applied general equilibrium regional model for Canada to investigate the regional effects of taxes. In the paper, literature on regional tax effects is reviewed and the main features of the model are briefly described. Existing literature on regional tax effects is largely non-quantitative, and does not take up several important features, such as taxes which are predominantly on products or industries located in particular regions. Results suggest that regional effects of taxes can be significant, and in the Canadian case at least, do not tend to counterbalance one another. In general, richer regions tend to lose and poorer regions gain from federal taxes, but other regional characteristics such as manufacturing/non-manufacturing, or resource/non-resource can be important.

APPENDIX A
INTERREGIONAL LABOUR MOBILITY

A novel feature of the model, and one which differentiates it from other applied general equilibrium models, is its treatment of labour mobility between regions. We assume that there is a distribution of individuals within each region who differ only by their intensity of locational preference. Their utility function parameters reflect this difference in a systematic way across the original (pre-policy change) population in each region.

The utility function for any agent in any region is specified as the maximum of two separate subutility functions. This is described in Section 1 of Table A-1. The U_i^H function gives the utility from consuming a given bundle of goods if individual i remains in his original region. The U_i^F function gives the utility from consuming the same bundle of goods if the individual moves outside the region. If it is assumed that all individuals are identical within any region, then in response to a changed income differential between regions all individuals in a region would either leave or stay, and no partial labour mobility would occur. To incorporate partial mobility, the U_i^F function is assumed to vary systematically across individuals within a region, who are ranked in terms of their intensity of locational preference. The U_i^F function thus incorporates the locational penalty which individuals are assumed to bear should they leave and which is of increasing severity across individuals. To simplify things, the strong assumption is made that an individual leaving one region and moving to another maintains the same preference structure across goods associated with all residents in his original region. Individuals do not therefore acquire the preferences of residents of the other region after relocating.

These features, and an assumption that goods prices faced by each region are the same, allow us to employ the two indirect utility functions shown in Section 2 of Table A-1 in determining an individual's location decision. $\bar{U}_0^H$ gives the utility from goods consumption if individual 0 remains in the region. Since the subfunction U_i^H does not reflect any locational preference (there is no penalty for staying in the home region), $U_i^H = \bar{U}_0^H$.

Location preferences enter through the function U_i^F, which varies systematically across the initial population within any region. The parameter δ, shown in Section 3 of Table A-1, reflects the utility penalty any individual incurs under out-migration. The product of the parameter δ and the index i defines the intensity of locational preferences as one moves from 0 to N through the index of the original population in any region. In the original

Table A-1

Model Treatment of Partial Labour Mobility

1. Location specific preferences

$$U_i = \max\left[U_i^H (X),\ U_i^F (X)\right]$$

U_i^H = utility for individual i from consuming bundle of goods X inside region.

U_i^F = utility for individual i from consuming bundle of goods X outside region.

2. Indirect utility functions

$$\bar{U}_i^H = I^H \cdot g(P)$$

$$\bar{U}_i^F = I^F \cdot g(P)$$

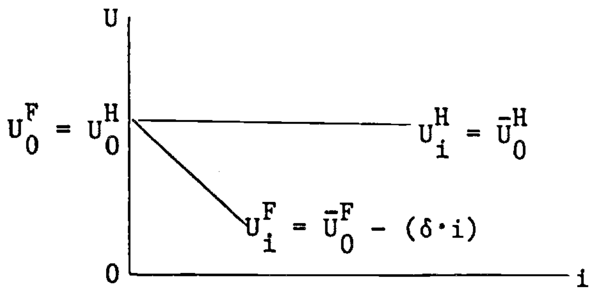
I^H = income if located in own region.

I^F = income if located outside own region.

g(P) = true cost of living (price) index for consumption by individuals from region. P is assumed to be the same over all regions.

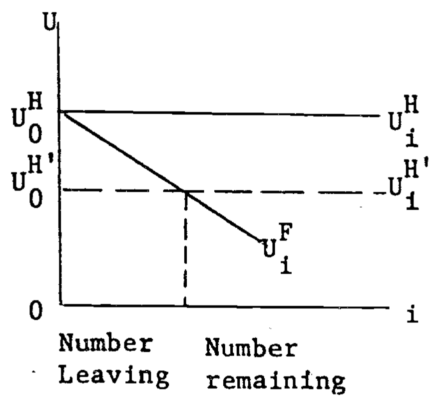
3. Distribution of individuals within regions by intensity of preference for remaining in the region

$$U_i^F = \bar{U}_0^F - (\delta \cdot i) \quad i=0, \ldots, N$$



Individuals trade off income differentials across regions against intensity of locational preference given by δ. As drawn, individual 0 is the only individual on the margin between staying and leaving the region.

4. Implication of Reduction in I^H



Individual on margin shifts beyond individual 0. Size of out migration determined by slope of U_i^F function.

equilibrium situation to which the model is calibrated, only the first individual ($i = 0$) is on the margin between staying and leaving. All others are beyond the margin and have an unambiguous preference for remaining in their region of residence. If relative incomes change across regions, then some residents will be induced to relocate because the income differential across regions will outweigh their locational preference.

In Section 4 of Table A-1, when a decrease in income in the home region occurs, U_i^H shifts down as indicated, and some of the individuals initially in the region leave. Out-migration will also occur when an increase in income in other regions results in an upward shift in U_i^F. In both cases, the size of out-migration depends upon the slope of the function, which in turn depends on the parameter δ. A simple fixed coefficient treatment is used to specify how individuals leaving a region locate in other regions, but a CES distribution function could also be used.

In this way the model captures the effects on migration decisions of regional differences in wage rates, transfer payments to regions, and regional taxes.

BIBLIOGRAPHY

Armington, P.S. "A Theory of Demand for Products Distinguished by Place of Production." *International Monetary Fund Staff Papers* XVI (1969): 159-76.

Ballard, C., D. Fullerton, J. Shoven and J. Whalley. *General Equilibrium Analysis of U.S. Tax Policy.* Chicago: University of Chicago Press for the National Bureau of Economic Research, 1985.

Boadway, R.W. and F.R. Flatters. *Equalization in a Federal State: An Economic Analysis.* A study prepared for the Economic Council of Canada. Ottawa: Minister of Supply and Services Canada, 1982.

Caddy, V. "Empirical Estimation of the Elasticity of Substitution: A Review." Industries Assistance Commission, Melbourne, Australia, 1976. (Mimeographed.)

Feldstein, M. and C. Horoika. "Domestic Saving and International Capital Flows." *Economic Journal* 90 (June 1980): 314-29.

Gilliespie, W.I. *The Redistribution of Income in Canada.* Ottawa: Gage Publishing, Ltd., 1980.

Harberger, A.C. "The Incidence of the Corporation Income Tax." *Journal of Political Economy* 70 (June 1962): 215-40.

———. "Vignettes on the World Capital Market." *American Economic Review* 70 (May 1980): 331-37.

Hazledine, T. "The Economic Costs and Benefits of the Canadian Federal Customs Union." In *The Political Economy of Confederation.* Proceedings of a joint workshop sponsored by the Institute of Intergovernmental Relations (Queen's University), and the Economic Council of Canada. Ottawa: Minister of Supply and Services Canada, 1979.

Jones, R. and J. Whalley. "A Canadian Regional General Equilibrium Model and Some Applications." *Journal of Urban Economics.* (forthcoming).

Kouris, G. "Energy Demand Elasticities in Industrialized Countries: A Survey." A paper drafted on the basis of background material collected for the demand chapter of the *World Energy Outlook*, IEA, October 1982.

Mansur, A., and J. Whalley. "Numerical Specification of Applied General Equilibrium Models: Estimation, Calibration and Data." In *Applied General Equilibrium Analysis*, pp. 69-127. Edited by Herb Scarf and John Shoven. Cambridge: Cambridge University Press, 1984.

McLure, C.E., Jr. "The Interstate Exporting of State and Local Taxes: Estimates for

1962." *National Tax Journal* 20 (March 1967): 49-77.

__________. "The Inter-Regional Incidence of General Regional Taxes." *Public Finance* 24 (1969): 457-483.

Morgan, W.E. and J.H. Mutti. "The Exportation of State and Local Taxes in a Multilateral Framework: The Case of Business Type Taxes." *National Tax Journal* 38 (June 1985): 191-208.

Pechman, J.A. and B.A. Okner. *Who Bears the Tax Burden.* Washington: The Brookings Institute, 1974.

Piggott, J.R. and J. Whalley. *Applied General Equilibrium Analysis of U.K. Tax Policy.* Cambridge, Cambridge University Press, 1985.

St-Hilaire, F. and J. Whalley. "A Microconsistent Equilibrium Data Set for Canada for Use in Tax Policy Analysis." *Review of Income and Wealth* 29 (June 1983): 175-204.

__________. "A Microconsistent Equilibrium Data Set for Canada for Use in Regional General Equilibrium Policy Analysis." Centre for the Study of International Economic Relations, University of Western Ontario, 1985. and forthcoming in the *Review of Income and Wealth.*

Shoven, J.B. and J. Whalley. "Applied General Equilibrium Models of Taxation and International Trade." *Journal of Economic Literature* XXII (September 1984): 1007-51.

Statistics Canada. *National Income and Expenditure Accounts, 1968-82.* Cat. No. 13-201. Ottawa: Minister of Supply and Services Canada, 1983a.

Statistics Canada. *Provincial Economic Accounts, 1966-1981.* Cat. No. 13-213. Ottawa: Minister of Supply and Services Canada, 1983b.

Statistics Canada. *The Input-Output Structure of the Canadian Economy, 1971-1980.* Cat. No. 12-201E. Ottawa: Minister of Supply and Services Canada, 1984.

Stern, R.M., and J. Francis, and B. Schumacher. *Price Elasticities in International Trade: An Annotated Bibliography.* London: MacMillan, for the Trade Policy Research Centre, 1976.

Thirsk, W.R., and R.R. Wright. "The Impact of the Crude Oil Subsidy on Economic Efficiency in Canada." *Canadian Public Policy* 3 (Summer 1977): 355-64.

Trela, I, and J. Whalley. *Regional Aspects of Confederation.* Volume 68 for the Royal Commission on the Economic Union and Development Prospects for Canada. Toronto: University of Toronto Press, 1986.

Whalley, J. *Trade Liberalization Among Major World Trading Areas.* Cambridge: MIT Press, 1985.

____________. and B. Yeung. "External Sector 'Closing' Rules in Applied Equilibrium Models." *Journal of International Economics* 16 (February 1984): 123-28.

Winer, S., and D. Gauthier. *Internal Migration and Fiscal Structure: An Econometric Study of the Determinants of Interprovincial Migration in Canada.* Ottawa: Economic Council of Canada, 1982.