

Université de Montréal

**A Dynamic General Equilibrium Evaluation of the Federal
Goods and Services Tax for the Province of Quebec**

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Goods and Services Tax for the Province of Quebec

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SUMMARY

We try, with this study, to evaluate the impacts of the upcoming federal sales tax reform (The Goods and Services Tax) for the province of Quebec. The tax will replace the present federal manufacturers' sales tax which is regarded by many as being inefficient. Using a dynamically recursive general equilibrium framework, where expectations are myopic, we perform two simulations for this reform: one including direct transfers to households as GST credit payments, and one excluding them. The ensuing results are small but significant. They agree only in part with expected theoretical outcomes of such a reform. In general, they show that the GST will have a small negative effect on the Quebec economy specially in the immediate post-reform period. Although investments increase, aggregate exports decrease, specially for a high value of price elasticity of export demand. Similarly, household consumption decreases due to the decrease in real wages. On the other hand, the reform causes important intersectoral reallocations that result in the betterment of some sectors such as agriculture, construction and finance, and in the disadvantaging of the sectors of manufacturing, wholesale commerce and retail commerce. In addition, results also indicate that GST credit payments to lower income households are very effective in offsetting the regressivity of the tax. Furthermore, we are able to conclude that, except for exports and imports, the results of simulations for almost all other macroeconomic variables are not very sensitive to different price elasticities of export demand.

RESUME

Le but de cette étude est l'évaluation des impacts de la réforme fiscale fédérale, soit la taxe sur les produits et services, sur l'économie Québécoise. En effet, cette taxe vient remplacer la taxe fédérale actuelle sur les ventes des manufacturiers qui était vue, depuis plusieurs années, comme ayant beaucoup de défauts. Ainsi, puisqu'elle s'applique à un large éventail d'intrants des entreprises, elle se retrouve indirectement dans le prix de tous les biens et services vendus au Canada bien que la plupart de ces biens ne sont pas directement taxés. Ceci accroît le coût des équipements ainsi que le prix des exportations canadiennes rendant ces dernières moins compétitives sur les marchés internationaux. Autres désavantages de la taxe sont, par exemple, qu'elle s'applique à une assiette fiscale très étroite et qu'elle comporte des taux multiples et de nombreuses exonérations qui favorisent la discrimination entre produits et nuisent à l'allocation efficace des biens. Quant à la taxe sur les produits et services, celle-ci s'appliquera à une assiette beaucoup plus large à un taux unique de 7% et aura la forme d'une taxe à la valeur ajoutée. Ainsi, bien que les entreprises se trouvant tout au long de la chaîne de production et de distribution factureront la taxe sur leur vente, elle vont aussi avoir droit à un crédit au titre de la taxe payée sur leurs achats utilisés comme intrants dans leur produits. Donc, la taxe sera totalement éliminée au niveau de la production ce qui va abaisser le coût des exportations et le coût des équipements qui va à son tour, encourager l'investissement pour améliorer l'économie canadienne à long terme.

Une question se pose : quels sont les effets possibles de cette réforme pour le Québec ?

Pour répondre à cette question, nous avons utilisé un modèle d'équilibre général dynamique à anticipations myopes qui est une version modifiée de l'étude statique faite récemment par Lefebvre et Mayer¹ et qui traite du même sujet. Notre analyse s'étend sur une période de dix années et fait les hypothèses suivantes: il y a six catégories de ménages, dix secteurs productifs, neuf types de biens finaux, une catégorie de travail et une catégorie de capital. Comme dans l'étude de Lefebvre et Mayer, nous supposons l'existence de deux paliers gouvernementaux, fédéral et provincial, et deux secteurs extérieurs, soit le reste du Canada et le reste du monde. En plus, nous faisons l'hypothèse que tout le capital est détenu par les ménages et que l'accroissement du stock de capital se fait par l'intermédiaire de l'investissement privé. Finalement, nous fixons l'offre du travail ainsi que les dépenses d'investissement public au Québec.

Notre modèle d'équilibre général dynamique comprend plusieurs paramètres pour lesquels des valeurs ont été trouvées utilisant une technique appelée "calibration". Ainsi, les données des variables macroéconomiques québécoise pour l'année 1984, se trouvant en forme de comptes de dépenses et de revenus dans la matrice de comptabilité sociale pour le Québec, ont servi de base pour trouver les valeurs de ces paramètres. Les taux des différentes taxes ont été trouvés de la même façon.

En utilisant donc ce type de modèle, nous pouvons déceler les effets redistributifs de la taxe dans les cadres intersectoriel et intertemporel. En faisant deux types de simulations, une comprenant des paiements directs de crédits d'impôts aux ménages à bas revenu, et l'autre en négligeant cet aspect de la réforme, nous constatons

¹ Lefebvre, P. and Mayer, F., "Les effets d'un régime national de taxes de vente dans une petite économie ouverte: le cas du Québec", *Canadian Tax Journal*, 37, no.5, 1989, pp.1241-1255.

que la régressivité de la taxe à la consommation est bien contrée par ces transferts. De plus, en simulant dans les deux cas avec deux valeurs différentes d'élasticité prix de demande d'exportations ($\epsilon = 2$ et $\epsilon = 25$), nous testons pour chaque simulation la sensibilité des résultats à la valeur de ce paramètre important. Or, nous constatons que, exception faite des exportations elles-mêmes ainsi que les importations, les autres variables macroéconomiques du modèles sont peu sensibles à la valeur de cette élasticité.

Nos résultats nous montrent qu'en général, bien que la réforme s'avèrera bénéfique pour quelques secteurs de l'économie québécoise, soit l'agriculture, la construction, les finances ainsi que les transports et les utilités publiques, certains autres secteurs seront défavorisés sous le nouveau système fiscal dont les secteurs manufacturiers, celui du commerce de gros ainsi que celui du commerce de détail. De plus, les salaires réels baissent entraînent une diminution dans la consommation agrégée des ménages. Cependant, même à court terme, les investissements croissent raisonnablement, assurant la baisse du prix du capital d'année en année.

Pour conclure, il semble que les effets négatifs de la réforme sont plus prononcés immédiatement après la réforme qu'à long terme surtout pour quelques unes des variables macroéconomiques. Nous constatons aussi que son impact distributif intersectoriel sera assez important pour l'économie québécoise mais que, graduellement, avec le temps, ceci tendra à se stabiliser.

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LIST OF SYMBOLS AND ABBREVIATIONS

- CD(X,Y) : Cobb-Douglas Function of X and Y
CES : Constant Elasticity of Substitution
CGE : Computable General Equilibrium
FST : Federal Manufacturers' Sales Tax
GST : Goods and Services Tax
TRQ : Federal Transfer Payments to the Quebec Government

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DEDICATION

To my family

SECTION I

INTRODUCTION

Since its implementation in Canada in 1924, the federal manufacturer's sales tax has constantly been criticised for having many faults. Thus beginning with the Rowell-Sirois Commission in 1940, to the Carter Commission in 1966, to the Federal Sales Tax Review Committee (the Goodman Committee) in 1983, serious concerns were expressed about the structure of the federal sales tax and various recommendations were made as to the necessary changes. While, subsequently, some improvements were made, none was to be as important a change as the upcoming 1991 reform.

This latest results from the June 1987 'White Paper'¹ tax reform proposals put forward by the Canadian Minister of Finance, and consists of replacing the manufacturers' sales tax with a multi-stage federal sales tax. Under this new system, which is of value-added form, the taxable base would be broadened to include most goods and services in Canada. In addition, exports would be exempt from the tax whereas imports would be taxable at the time of importation.

The federal government argues that this new system will be highly beneficial to the country as a whole as well as to its provinces, each to a different extent. It is indeed this matter that our study is concerned with. In specific, we conduct an evaluation of the consequences of the proposed Goods and Services Tax (GST) for the province of Quebec.

¹ 'The White Paper, Tax Reform 1987', Ministry of Finance, June 18, (1987).

A study within our field of interest was recently completed by Lefebvre and Mayer² for the same province within a general equilibrium framework. In it the emphasis was laid on the welfare effects of the new tax and on the resulting income redistribution patterns. Although the study results are very interesting, the authors also point out that certain aspects of their model could be modified to further enrich the discussion on indirect taxation. Such a change, they suggest, could come from the introduction of capital accumulation, that is dynamics. Since static models take into account only the intersectoral and interclass resource shifts, valuable information is lost pertaining to intertemporal reallocations. This is highly undesirable since any gains or losses in efficiency due to changes in the taxation system are in large part dynamic³.

Our model is thus a dynamic computable general equilibrium model representing the economy of Quebec. Although there are some similarities to Lefebvre and Mayer's model, as we use the latter as our point of departure, fundamental differences also exist between the two. First and foremost, as already mentioned, our model is recursively dynamic. We assume that households have myopic expectations with respect to the future rate of return on capital and solve for the dynamic sequences of single period equilibria over a time horizon of ten periods. The reason why myopic expectations are used instead of rational ones (which would have been the better alternative) is purely numerical. Since rational expectations general equilibrium models are inherently more non-linear than its myopic counterparts, one would have to resort to highly sophisticated numerical and calibration techniques to solve for intertemporal equilibria.⁴

² Pierre Lefebvre and Francine Mayer, "Les effets d'un régime national de taxes de vente dans une petite économie ouverte: le cas du Québec", Canadian Tax Journal, vol.37, no.5, 1989, pp.1241-1255.

³ Supra footnote 2

⁴ See Jean Mercenier and M.C. Sampaio de Souza, "A decentralized multisector general equilibrium evaluation of Brazil's protectionism", Research paper no.5289, C.R.D.E., Université de Montréal, (1989).

Second, we assume labour and capital are homogeneous and distinguish ten productive sectors of activity and six different income classes of households. Third, our production function uses Cobb-Douglas technology instead of a combination of Cobb-Douglas and Leontief production functions to allow for greater flexibility with regard to substitution amongst intermediate goods. Fourth, we fix government investment in volume and assume capital is owned by the private sector only. Finally, unlike Lefebvre and Mayer, we do not use the value of transaction method and the "black-box" pre-specified equation generating software GAMS-HERCULE in which it suffices to introduce a well organised social accounting matrix. That is, we do not explicitly describe the economy in terms of accounts of revenues and expenditures. Instead, we program each equation - the first order conditions resulting from the maximization problems of individual agents, the dual tax-augmented price equations, the relevant behavioural and technical constraints and so on - using the GAMS software. This ensures a better comprehension of the general equilibrium framework and gives more flexibility in adapting the model for empirical use to simulate the proposed reforms. The data used for this analysis comes from the social accounting matrix of Quebec⁵ for the year 1984 and the empirical implementation of the model is done using the non-linear mathematical programming computer algorithm MINOS.

The paper is organised as follows. In section II we discuss some theoretical and practical issues concerned with the different taxes involved in our analysis. In the following section we give a brief overview of the literature on computable general equilibrium models (hereafter CGE models). Section IV explains the structure of our model in detail. Finally, in section V, we discuss simulation results and compare to a other results available in the literature on the GST reform. Section VI provides a brief conclusion.

⁵ P. Lefebvre, F. Mayer and C. Morin, "*Matrice de comptabilité sociale du Québec 1984: Un ensemble de micro-données cohérentes pour l'analyse d'équilibre général*", Cahier de recherche no.8816L, Université du Québec à Montréal, (1988).

SECTION II

II.1 The Issue of Reform

In his White Paper⁶ of June 1987, Canada's Minister of Finance, Michael Wilson, put forward some fiscal reform proposals to be enacted during the following years. These reforms would be implemented in two stages: The first would consist of a series of changes to the personal and corporate income taxes, as well as of a few minor changes to the federal manufacturers' sales tax (FST), whereas the second would abolish this same manufacturers' sales tax to replace it with a federal goods and services tax (GST). The first stage reforms are already in place, since January 1988. As for the more important change, the replacement of the FST by the GST, this is to take effect the first of January of 1991. A question comes to mind immediately : what will the possible effects of this reform be for Canada's individual provinces ? Our study is thus concerned with this issue. More specifically, our objective is to evaluate these effects for the province of Quebec.

However, to be able to proceed with this analysis, one has to get better acquainted with both types of taxes involved.

II.2 The Federal Manufacturers' Sales Tax

The FST, implemented in Canada in 1924, has the particularity of being applied only to the selling price of manufactured domestic goods and to the duty-paid value of imports. Its actual tax base is very narrow so that only about one-third of all goods and services purchased by Canadians are subject to this tax. Also, rates of taxation vary strongly from product to product. In 1990, the rates are

⁶ Supra footnote 1

13.5%	for most taxable goods
9%	for construction goods
19%	for alcohol and tobacco
11%	for telecommunication services

The tax rates are high specially for alcohol and tobacco which are two of the four products that contribute forty per cent to total sales tax revenue and which account for only 15 per cent of consumption. The other two are automobiles and auto parts and motor fuels.

Other than the high rates, the present FST has many shortcomings introducing efficiency losses and strong distortions in relative prices. These limit economic growth, lower incentives to invest and render local exports internationally less competitive. Indeed, effective tax rates vary largely from one product to another so that in a group of 600 commodities, no two are found to have the same effective rate⁷. This means that comparable products may vary in price quite dramatically which would distort consumer choices and, at the same time, impair the ability of certain products to compete in the marketplace. It is believed that this variation is a result of the tax being levied at an intermediate trade level. Since, in addition to the selling price of the manufactured good, the tax applies also to a large collection of inputs of various domestic firms, the selling price of final products and services necessarily reflect the existence of these supplementary costs. The same is true also for exports, though they are not directly taxable. Therefore, domestic goods are found to be effectively taxed, on average, about one-third of a fraction higher than comparable imports⁸.

⁷ The effective tax rate is the percentage that tax represents in the final sale of a product. For more information on the FST effective rates, see the '*Federal Sales Tax Survey*' (1985) conducted by Woods Gordon on behalf of the department of Finance.

⁸ For a detailed comparison of domestic effective rates with those of imports, see '*Sales Tax Reform*', Ministry of Finance, June 18, 1987, pp. 15-18.

Other problems with the FST, as the government argues, are issues like its excessive complexity as it carries four different tax rates and a host of exemptions which bring about a range of administrative and legal difficulties. Similarly, it discourages efficient allocation of resources by favouring the shifting of activities such as marketing and distribution beyond the point of taxation.

In the same line of reasoning, the FST distorts consumer choices because, if commodity taxes are imposed at the final sales level, one can correctly "*assume that real private sector incomes are reduced in proportion to consumer spending on taxed goods, with some minor exceptions*"(Due, 1967)⁹. However, if sales taxes are applied to goods prior to the final sale, as is the case with the manufacturers' sales tax, such a claim could not be made about its distributional patterns. This is because it is indeed difficult to know how much federal tax consumers are paying at the retail level.

In conclusion, and in the light of the above arguments, it can be said that by public finance standards, the FST is not a suitable sales tax for Canada's economy. In fact, for many years now the question has been debated in Canadian public finance circles as to what the nature of the federal sales tax should exactly be, or to what level of production it should be applied.¹⁰ The issue has finally been settled with the decision that it would be replaced and that the replacing tax would be of the form of a goods and services tax.

⁹ See John F. Due, 'Application of Sales Taxes to Producers' Goods', (1967), 17 Canadian Tax Journal, pp. 354-360.

¹⁰ For a full discussion of the debates and recommendations made, see Jean-Marie Dufour and François Vaillancourt, 'Provincial and Federal Sales Taxes: Evidence of their effect and prospect for change', Canadian Tax Paper no. 66, pp.408-443,(1982), and, Malcolm Gillis, 'Federal Sales Taxation: A Survey of Six Decades of Experience, Critiques and Reform Proposals', 33 Canadian Tax Journal, pp.68-98, (1985).

II.3 The Goods and Services Tax

The GST is first and foremost a value-added tax. In concept it is similar to the single stage retail sales tax in that both are meant to apply to the final consumption of goods and services in Canada. However, their operational aspects somewhat differ. A retail sales tax is levied at only one point - at the time of purchase. In contrast, under a multi-stage system, tax is levied and collected via the whole production and distribution chain. Businesses are required to charge tax on their sales but will receive credit for any tax paid on their purchases. Therefore, tax is collected only on value-added by each firm. With the same coverage and rate, both types of taxes would yield an equivalent amount of revenue. However, a multi-stage tax has one major advantage over the other which is with regard to tax evasion. Since what one firm buys necessarily appears in the invoice of the selling firm, there is much less room for tax avoidance activity. The main disadvantage of a value-added tax resides in the accrued administrative costs of the system.

The Operation of the GST

Having said this, we now turn to the applicability of the GST to the Canadian economy. The tax will apply at the unique rate of 7% to a very broad range of goods and services sold in Canada. Under this system, once a taxable service or good is sold, the vendor will remit the difference between tax collected on sales and tax paid on purchases. Eventually, he/she will also get back the tax paid on inputs via an input tax credit. Some items, such as basic groceries, prescription drugs and medical devices will be tax-free meaning that vendors will have a right to claim input tax credits but will not charge any tax on the final sale price of their product, whereas residential rents and some services will be tax-exempt. That is, though the vendors will not charge tax on their sales, they will not be able to claim input tax credits for the GST paid on their inputs.

In addition, low income households will receive a GST credit that will be indexed to increases in the consumer price index (CPI) in excess of 3 percentage points. This is expected to counter any possible regressivity of the GST¹¹.

The Advantages of the GST

The federal government claims that with the new system in place, there will be virtually no tax distortion between imported and domestic goods as well as between goods and services. This is because the GST will eliminate tax on business inputs thereby removing any cascading of taxes, ensure uniform effective tax rates on the final selling price of products, remove all hidden taxes from Canadian exports and treat imports on the same footing as domestic goods.

The Possible Macro Effects of the GST

However, from the macroeconomic point of view, many important issues arise with the replacement of the FST by the GST such as: what will be the final effects on relative prices, on investment and on balance of payments ? To answer these questions, evidently, the main issue is to know whether the replacing tax is fully passed on or absorbed¹². If passed on, it is indeed a consumption tax, but if it is absorbed, it becomes a tax on wages and profits which would yield adverse effects. Elasticity of demand will also decide the extent of tax shifting for the economy. For those goods that have an inelastic demand, such as petrol and tobacco, chances are the tax will be shifted fully forward. With other goods, the results could be more ambiguous.

¹¹ 'Goods and Services Tax, Technical Paper', Ministry of Finance, august 1989, pp.13-17.

¹² Alan A. Tait, *Value-Added Tax*, McGraw-Hill, U.K. pp. 71-93, (1972).

Keeping the above discussion in mind, we now turn to the possible effects of the GST on macroeconomic variables. The impact of the GST on inflation will depend on the resulting wages and prices, as well as, on government monetary policy. If the sales tax is shifted forward to consumers, inflation could rise in the short run¹³. Still, the overall impact depends on whether a relaxed monetary policy will be adopted or whether, to curb inflation, the government will approve a tight one possibly occasioning higher interest rates and lower output.

On the other hand, due to the value-added structure of the GST the price of exports will decline rendering exports more competitive internationally and as the bias favouring imports will be removed, we could expect the trade balance to improve. Again, because of the value-added form of the GST, the cost of capital should decline and domestic investments are expected to rise. This could eventually lead to capital inflow and the latter two effects could approximately cancel out to leave the balance of payments unaffected.

Finally, from a more microeconomic angle, we can discuss effects on income distribution. These are understandably related to the indexed GST credit, specially for lower income households. Even a small increase in the sales tax credit, Hamilton and Whalley¹⁴ find, would dominate the redistributive effects of the sales tax change, food included in the tax base.

¹³ Jack Mintz and John Whalley, *'The Economic Impacts of Tax Reform'*, Canadian Tax Paper no. 84, p.20, (1989).

¹⁴ Bob Hamilton and John Whalley, *'Reforming Indirect Taxes in Canada'*, 22 no.3 Canadian Journal of Economics, pp. 561-575, (1989).

SECTION III

III.1 Introduction to CGE models

For two decades now, multisector economy-wide input-output and linear programming type models have been used as tools for development planning and new policy implementation analyses. However, given their structure, these models are better suited to analyse situations where a central authority makes all the optimisation decisions relevant to the economy given the existing constraints. Therefore, to achieve a better description of a real market economy where households and firms make their own separate optimisation decisions subject to their respective behaviour and technical constraints, a decentralised framework is needed where endogenous prices and quantities interact. The class of models we are making reference to are known as computable general equilibrium (CGE) models. These models are sometimes also known as price-endogenous models because all prices adjust until final and intermediate demand decisions are consistent with the production decisions of firms. Thus, horizontal interaction among different economic agents and market-clearing processes concur.

Although the basic notion of general equilibrium goes back to Walras, the empirical implementation of the models started only with Johansen¹⁵ who linearised his Norwegian model and solved it via matrix inversions. Scarf was soon to follow with an algorithm constructed to solve for economic equilibria¹⁶. Since then, various computer solution methods have been developed to give rise to an abundance of CGE models.

¹⁵ Leif Johansen, *A Multi-Sectoral Study of Economic Growth*, North-Holland, Amsterdam, (1960).

¹⁶ Herbert E. Scarf, 'On the Computation of Equilibrium Prices', in *Ten Economic Studies in the Tradition of Irving Fisher*, (1967).

With the availability of these tools, a number of CGE models have been developed focusing on international trade, public finance and other such issues. All of them have the same basic structure which we will explain in the next section.

The Basic Structure of CGE Models

All CGE models have a formal theoretical structure¹⁷. Typically, there are consumers, producers, and a redistributing agent (the government) all of which take prices and possibly quantity constraints as given externally to them. Consumers then maximise their utility functions subject to their budget constraints and producers maximise profits or shareholders' wealth given their technological constraints. To the resulting consumption and production plans, consistency is imposed via market balance equations. These are, for example, that aggregate supply cannot exceed aggregate demand, that investment cannot exceed total saving, and so on. The system of equations as a whole satisfies Walras' law. Commodity market demands thus depend on all prices, are continuous, homogeneous of degree zero in prices. On the side of production, technology is usually described by constant returns to scale and factor earnings are linearly homogeneous in prices. This means that absolute price levels have no effect on the equilibrium outcome and that only relative prices are of any importance. Production technology is generally described by a CES or Cobb-Douglas function, whereas intermediate production is most often generated by a fixed coefficient technology. This is a somewhat arbitrary assignment casually used in all typical CGE models; however, as Dervis, De Melo and Robinson point out,

¹⁷ For a fuller description of the structure of CGE models refer to V. Ginsburgh and J. Mercenier, "Macroeconomic models and microeconomic theory-The contribution of general equilibrium theory" in Challenges for Macroeconomic Modelling, North - Holland, 1988, pp. 291-335.

"Given the necessity of aggregating sectors in any applied economy-wide model into a relatively small number, it should be made quite clear that the production functions are only very rough representations of actual technical production processes."¹⁸ It is also true that specifying more elaborate production functions leads to a proliferation of parameters that must be estimated and one should consider the trade-offs between adequate econometric estimation and suitable structural specification. Furthermore, each product in the economy is associated with a production sector where we find a single representative firm. Perfect competition is also assumed in factor markets as a general rule. Finally, some further assumptions are made on factor mobility depending upon the objectives of the modeler.

The Empirical Functioning of CGE models

Applied general equilibrium analysis then consists of using a numerically specified CGE model for policy evaluation. Choosing parameter values to this effect can be very difficult. The economic literature contains various different values estimated for the same parameter and the task of the modeler then becomes finding the "best" value for the parameter in question. Some parameter values are chosen by calibration ; these are basically scale parameters. Indeed assuming that the economy is at a "benchmark" equilibrium, these parameters are assigned values such that the model will reproduce the benchmark year data. However, as Shoven and Whalley¹⁹ point out, problems may also exist for the benchmark year data. Since benchmark equilibria are constructed from national accounts and other official data sources, often information is inconsistent and one has to make some adjustments to the base year data in order to make it homogeneous.

¹⁸ K. Dervis, J. De Melo, and S. Robinson, *General Equilibrium Models for Development Policy*, Cambridge University Press, (1982), p. 139.

¹⁹ J. Shoven and J. Whalley, "Applied General Equilibrium Models of Taxation and International Trade: An introduction and survey", 23, *Journal of Economic Literature*, 1984, pp. 1018-1019.

Sometimes, along with the calibration, some values for particular elasticities are chosen from the literature but this becomes more troublesome when there are a large number of parameters in the model to find values for. Once the calibration is complete, the policy change is introduced in the form of a modification of a specific parameter and the calculated equilibria are then compared with the benchmark year data. One refers to this as a "counterfactual" experiment.

III.2 CGE Tax Models

Applied general equilibrium tax models are usually derived, one way or another, from Harberger's classic model²⁰. In that tradition, taxes are usually modeled as ad valorem and government budget is assumed to be in equilibrium. Emphasis is placed on the efficiency and distributional impacts of changes from new tax policies. The main departures from the basic Harberger structure come with the treatment of time and of financial assets. For example, Ballard, Fullerton, Shoven and Whalley²¹ incorporate time via the dynamic sequencing of single period Harberger-type equilibria. Our model will be a variant of this type of model.

III.3 The Model of Lefebvre and Mayer

Recently a study was completed by Lefebvre and Mayer²² concerning the effects of the sales tax reform for the province of Quebec. Emphasis was placed on the welfare and redistributive effects of the new tax. Using the method of the value of transactions, which consists of describing the economy by a series of accounts of revenues and expenditures such as typically found in the social accounting matrix, they construct

²⁰ Arnold C. Harberger, 'The Incidence of the Corporation Income Tax', *Journal of Political Economy*, 70(3), (1962), pp. 215-40.

²¹ Cited in Shoven and Whalley (1984), p. 1031.

²² *Supra* footnote 2

a static general equilibrium model to simulate for the effects of a federal sales tax at the retail level that would replace the FST. Simulations are carried out under two different values of export demand elasticity ($\epsilon=1$ and $\epsilon=25$). We summarise the authors' results for aggregate variables in tables III.3.1 and III.3.2 below. The first table shows that under both elasticity values the consumer price index, volume of aggregate investment and exports increase whereas real consumption decreases. On the other hand, the sign of the effect on aggregate production is sensible to the value of export elasticity : real GDP (at factor cost) increases slightly (0.7 %) under elasticity value of 25 but decreases by 0.1 % when $\epsilon=1$.

Table III.3.1

Lefebvre and Mayer simulation results when retail sales tax replaces the FST
Effects in macroeconomic aggregates (**) % deviations from base case
for the two alternative values of price elasticity of exports

MACROECONOMIC VARIABLES	$\epsilon = 1$ (*)	$\epsilon = 25$ (*)
GDP at factor cost	-0.1	0.7
Private Consumption	-2.2	-0.5
Consumer Price Index	2.5	2.9
Private Investment	4.3	3.3
Exports	0.8	1.9
Imports	0.0	0.7

(*) ϵ = Price elasticity of export demand

(**) All variables are real unless specified otherwise

Table III.3.2 shows changes in real value-added at the sectoral level. Under the higher elasticity value variations are more significant (which is of course not surprising !). More importantly, intersectoral variance increases. The sectors of agriculture, construction and finance seem to be the greater benefitors at the expense of the wholesale and retail industries. For the case of low export elasticity value, the major benefitor is the construction industry while the other sectors show some decline, or at best, insignificant increase in production.

Table III.3.2

Lefebvre and Mayer simulation results when retail sales tax replaces the FST

Effects on real sectoral value-added in % deviations from base case

for the two alternative values of price elasticity of exports

INDUSTRIAL SECTORS	$\varepsilon = 1$ (*)	$\varepsilon = 25$ (*)
Agriculture	0.4	3.7
Primary Industry	0.3	0.8
Manufacturing	0.2	0.1
Construction	3.6	3.4
Transport, Public Utilities and Communication	-0.7	0.5
Wholesale Commerce	0.1	-2.0
Retail Commerce	-1.5	-0.4
Finance, Insurance and Real Estate	-0.8	7.2
Services	-0.7	0.5

(*) ε = Price elasticity of export demand

It should be mentioned that for each of the simulations, tax rates were calculated a priori, such that, after the reform, government revenues remained constant. We conclude from the results of Lefebvre and Mayer that the strongest impact of the tax seems to be the improvement of the trade balance because of the deterioration of the terms of trade. However, this effect comes to compensate the decrease in household consumption which seems to be a direct result of increased consumption prices.

To our knowledge, no such other attempt at evaluating the impact of fiscal reform exists for the province of Quebec, let alone in dynamic context. Therefore, using the model of Lefebvre and Mayer as a point of departure, we make a series of modifications to it in order to accommodate dynamics as well as the use of the computer algorithms of GAMS and MINOS. The next section explains our model in greater detail.

SECTION IV

THE MODEL

IV.1 Overview of the Model

Our model distinguishes between six classes of households (differentiated by their respective incomes) (see table 1), ten sectors of production, nine consumption goods as well as federal and provincial direct and indirect taxes (see table 2). Production technology is a nested Cobb-Douglas function. It therefore accommodates some substitutability between all individual inputs: primary and intermediate. All capital is held by households who, given their budget constraints, maximise a Cobb-Douglas utility function and consume accordingly. There are two foreign sectors: the rest of the world and the rest of Canada. Finally, total saving in the economy including saving by households, by both governments and by the two foreign sectors, finances total private and public investment. In addition we assume that there is perfect competition in both commodities and factor markets. Both factors, capital and labour, are mobile across sectors but immobile internationally, and labour supply is assumed fixed.

Table 1
Simulation - GST replacing the FST
Description of Household Categories according to income classes

CATEGORIES	INCOME BRACKETS	No. OF HOUSEHOLDS
Household 1	< 11,000 \$	503,850
Household 2	11-19,999 \$	311,040
Household 3	19-24,999 \$	485,680
Household 4	25-32,999 \$	448,350
Household 5	33-51,000 \$	458,980
Household 6	> 51,000 \$	312,500

Table 2
Simulation - GST replacing the FST
The different Federal and Provincial Tax Types introduced in the model

	FEDERAL TAX TYPES	PROVINCIAL TAX TYPES
1.	Unemployment insurance and public pension plans	Employment accidents and public pension plans
2.	Corporate income taxes	Corporate Income taxes
3.	Personal income taxes	Personal Income taxes
4.	Manufacturers' sales taxes	Retail sales taxes
5.	Excise taxes	Taxes on capital
6.	Customs	Property Taxes
7.	Taxes from non-residents	Other indirect Taxes
8.	Subsidies to corporations	Subsidies to corporations
9.		Licences, Permits & Fuel taxes

IV.2 Nomenclature

Before going into the finer details of the model, we would like to explain the nomenclature and the few other conventions used in this study. For example, with the exception of the export function, all the other functions in the model are of Cobb-Douglas form. This convention was adopted to allow for some degree of substitution amongst inputs and consumption bundles while still keeping the model complexity to a minimum. Thus, although CES type functions could have been more appropriate in terms of their flexibility in assigning a specific value to the elasticity of substitution (different than unity), there would have ensued a proliferation of parameters to estimate or calibrate for. Similarly, all taxes, exception made of personal income taxes, are of ad valorem form in the tradition of Harberger (1962, 1966). Finally, all tax rates are designated by the greek letter θ and all prices

augmented by tax carry the superscript T. In order to avoid tedious repetition, and as a general example, we will expose the treatment of a Cobb-Douglas function and the corresponding price equations.

Given two inputs X and Y with prices P_x and P_y , the Cobb-Douglas (CD) technology in producing Z is given by

$$Z = A (X)^\alpha (Y)^{1-\alpha}$$

where A is a scaling factor. Minimising costs subject to a given level of production yields the following demand equations

$$\begin{aligned} X &= \alpha (P_z Z) / P_x \\ Y &= (1-\alpha) (P_z Z) / P_y \end{aligned}$$

where P_z is the shadow price associated with the production constraint and which is expressed in terms of input prices as follows

$$P_z = (P_x)^\alpha (P_y)^{1-\alpha}$$

Thus P_z is the (fictitious) aggregate price of the optimal bundle of inputs X and Y. Supposing now that to the selling price of Z a tax rate were applied, such that $P_z^T = (1+t)P_z$, total tax perceived by the government would be $T_z = t(P_z Z)$ which is of ad valorem form. We also note that one of the characteristics of the Cobb-Douglas function is that the share of expenditure in each input is constant (and sum to one). Thus,

$$\alpha = (P_x X) / (P_z Z)$$
$$(1 - \alpha) = (P_y Y) / (P_z Z)$$

This greatly facilitates the task of calibrating for α specially when the data are organised as a group of expenditure and revenue accounts. In fact, we make use of this technique quite extensively to calibrate for our model parameters.

IV.3 Model Description

In what follows, we give an intuitive and schematic presentations of each agent's behaviour (figures 1 to 7). References will then systematically be made to a block of equations of the complete system consigned to the end of the section (together with a complete list of variable definitions).

PRODUCTION

The production technology has the form of a nested CD function, thus each representative firm in sector i ($i = 1, 2, \dots, 10$) passes through two stages to produce the good X_i each time minimising costs or maximizing profits (The structure of production is schematised in figure 1). At the lowest level, it combines capital and labour for which it pays respectively r and w augmented by ad valorem taxes T_{Ki} and T_{Li} . The resulting value-added has the form $Y_i = CD(L_i, K_i)$ on which the firm pays the sectoral share of federal and provincial sales taxes T_{VA} and T_{VP} . Note that provincial taxes are levied on the expense augmented by federal taxes; this will be the case throughout the model. In a second stage, Y_i is combined with domestic and imported intermediate goods using a Cobb-Douglas technology to produce the industrial good X_i (see equation 1.23 at the end of the section) to which corresponds a price P_{xi} (see equation 1.16). At this point, firms receive some subsidy payments but also pay indirect taxes to both governments such as licences and excise taxes. The selling price of X_i now becomes P_{xi}^T (equation 1.17). The formalised description of the production technology and the optimal decisions made by the profit maximising firms constitute the first block of the system of equations (equations 1.1 to 1.23).

CONSUMPTION GOODS

Industrial goods cannot be used for final consumption. Thus they are further combined by a Cobb-Douglas technology (equation 2.11) to form the final goods p (p

= 1,2,..9), (see figure 2). To these production costs (given by the price P_{fp}) are added federal and provincial consumption taxes which also include the share of sales taxes that falls to the consumer (equations 2.7 and 2.9). The price of the final good C_p^T settles at P_{cp}^T given by equation 2.5.

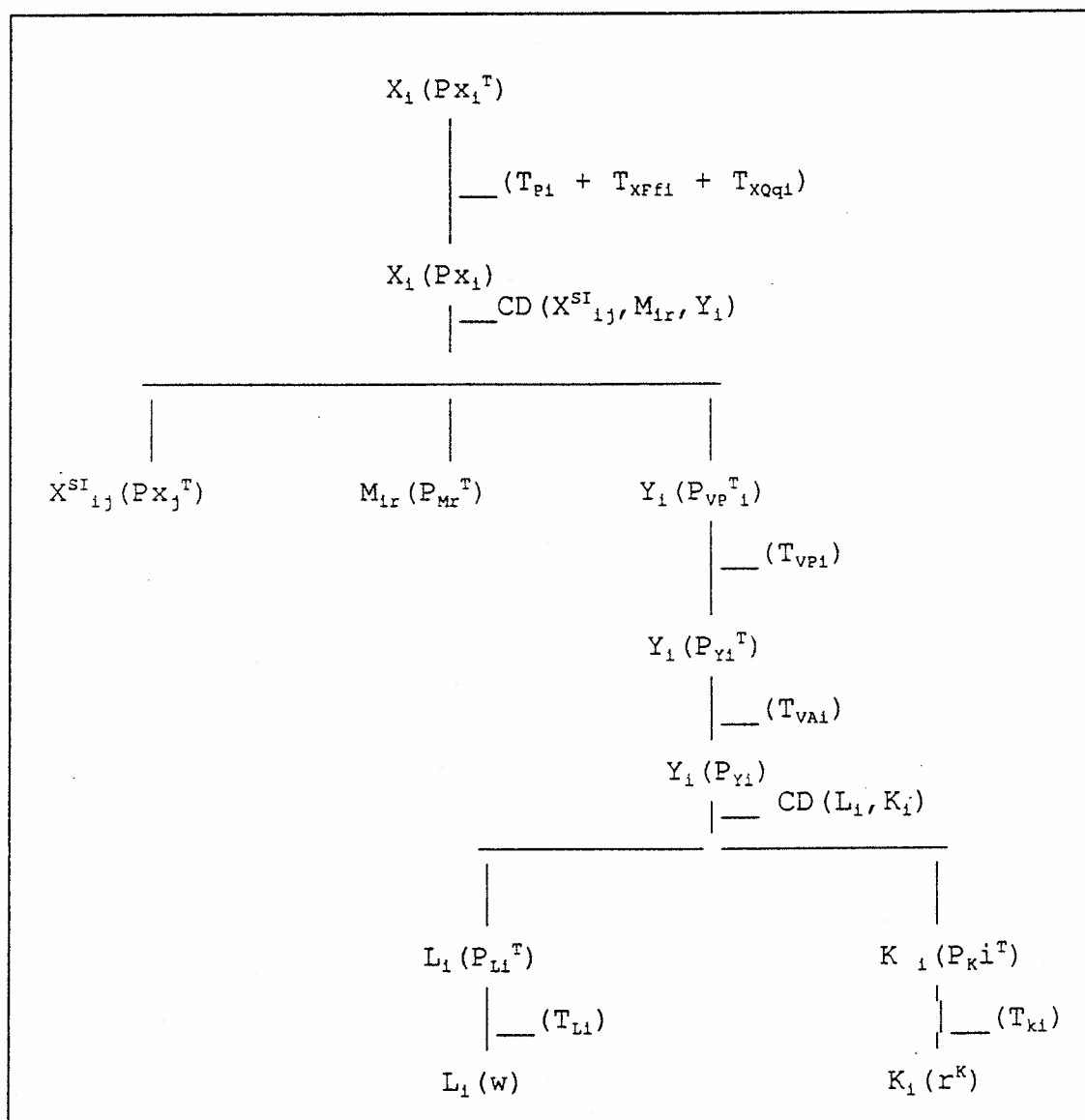


Figure 1 THE STRUCTURE OF PRODUCTION

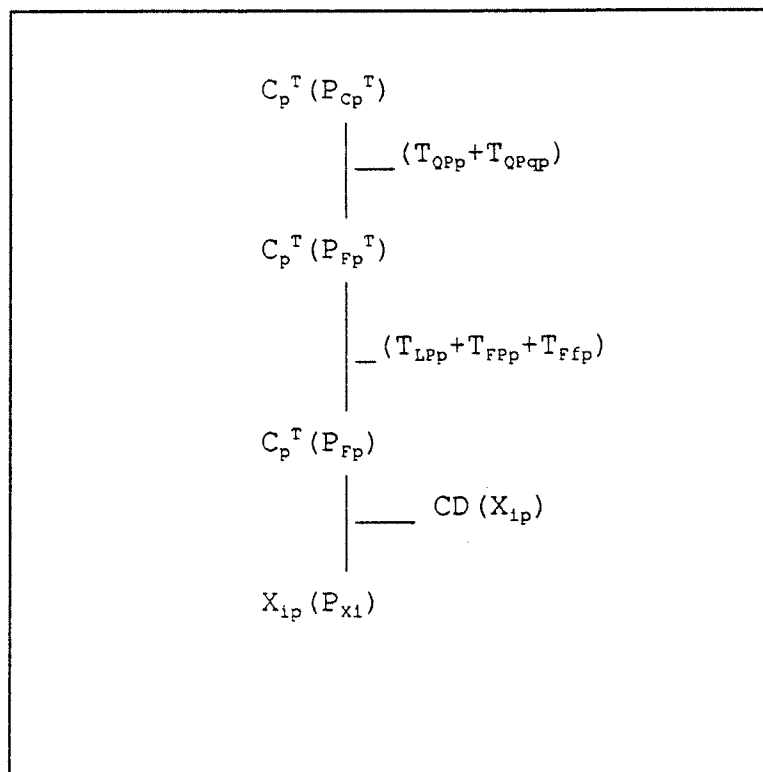


Figure 2 The STRUCTURE OF CONSUMPTION GOODS

HOUSEHOLD CONSUMPTION

Given its budget constraint, each household h ($h = 1, 2, \dots, 6$) maximises a Cobb-Douglas utility function to choose its optimal consumption pattern. This is modelled by equations 3.1 to 3.8 and schematised in figure 3. The demand for consumption goods for each h is given by equation 3.1 and aggregate consumption by C_h^d in equation 3.4. All available consumption goods have to be consumed by the households (equation 3.5). The revenue of h consists of its share of labour and capital service remuneration, direct federal and provincial transfers, as well as servicing of public debt. This revenue is spent on consumption, direct income taxes, other transfers to the rest of the world, private investment and net saving.

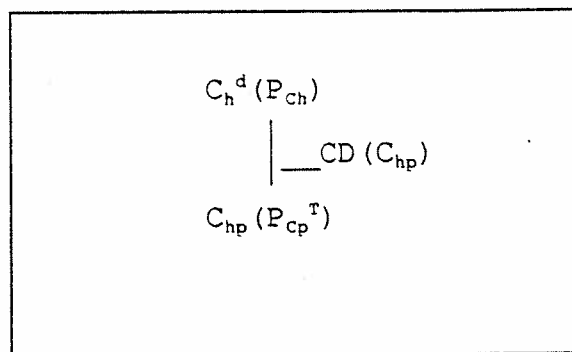


Figure 3 THE STRUCTURE OF HOUSEHOLD CONSUMPTION

THE INVESTMENT SECTOR

Industrial goods are demanded both by households (figure 4) and by the Quebec government (figure 5) for the purposes of local investment. These patterns are modelled by equations 4.1 to 4.13. We assume that total public investment I^{PUB} is fixed in volume and that it is, like total private investment I^{PR} , a Cobb-Douglas aggregation of sectoral investment (equations 4.1 and 4.2). Federal and provincial ad valorem taxes apply to both these totals to increase the aggregate price of investment. Finally, the level of investment is decided by the total amount of saving in the economy which includes saving by both foreign sectors in Quebec (equation 4.13)

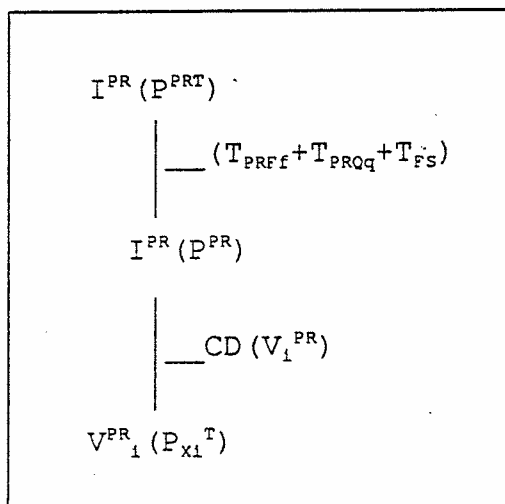


Figure 4 THE STRUCTURE OF PRIVATE INVESTMENT

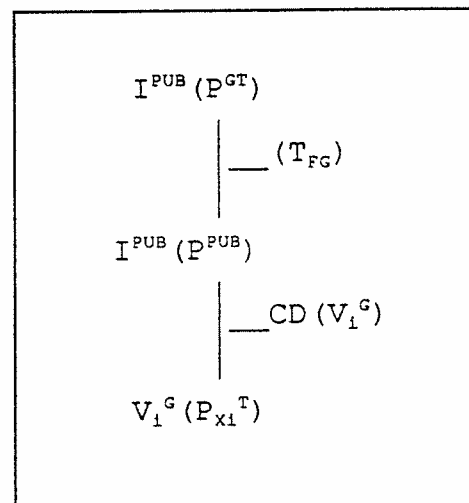


Figure 5 THE STRUCTURE OF PUBLIC INVESTMENT

THE FOREIGN SECTOR

Each foreign sector r ($r = 1,2$) has a balanced budget such that its revenue from total exports to Quebec minus its import expenses equals net transfers (equation 5.3) which includes an exogeneous transfer to the federal government by the non-residents. Import demand from each r is given by equation 1.12 in the production section, whereas exports to the rest of Canada and the world are a function of the relative domestic and foreign prices (equation 5.1). The price elasticity of export demand decides the extent to which exports react to changes in the relative prices. Only federal taxes apply to imports, one of which is the federal sales tax (equation 5.5). The price of the rest of the world assumed fixed, we use it as a numeraire in the model.

THE GOVERNMENT SECTOR

Unlike the household sector, both governments demand industrial goods for consumption (figures 6 and 7). Thus, total consumption for each is a Cobb-Douglas aggregate of sectoral consumption (equations 6.1 and 6.2). Also, total revenue for each is the sum of respective taxes levied in the economy. We impose that all revenue be spent, in proportions fixed by the expenditure shares of the base year, on consumption, direct transfers to households, servicing of public debt and saving. In addition, the provincial government has an expenditure account for investment whereas the federal makes a transfer payment to Quebec (TRQ) which is a fixed proportion of its revenue.

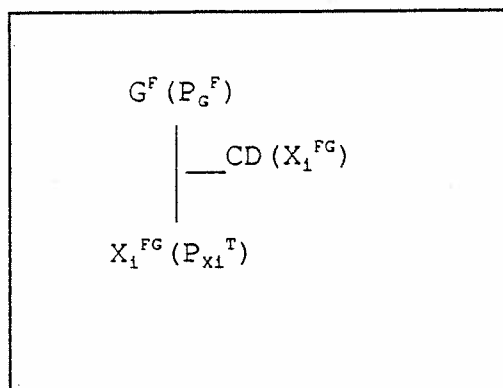


Figure 6 THE STRUCTURE OF FEDERAL CONSUMPTION

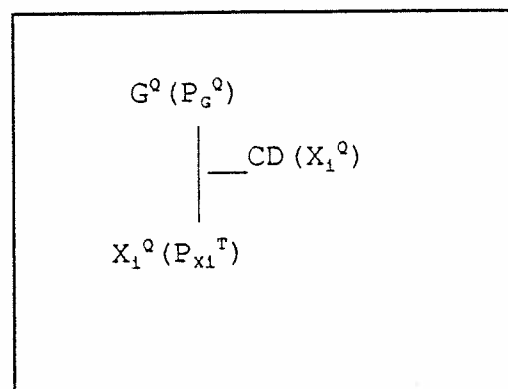


Figure 7 THE STRUCTURE OF QUEBEC CONSUMPTION

EQUILIBRIUM CONDITIONS

Finally, there are the equilibrium conditions that ensure coherence between individual decisions of all agents in the economy. They imply that total sectoral supply of industrial goods should be equal to total demand in the economy (equation 7.1). There is one such equilibrium market condition for each good. Similarly, in the factors markets, total supply also equals total demand. Since our model satisfies Walras' law, one equation is redundant. Thus, we omit writing explicitly the budget equation for the rest of the world.

RECURSIVE DYNAMICS

To the above system of equations we add an equation of periodic capital accumulation :

$$K_{t+1}^s = I_t^{PR} + (1-\delta)K_t^s$$

(delta is the constant depreciation rate of capital). The equation says that the increase in production capacities equals net investment

This completes the description of the model. In the next few pages we present the full system of equations followed by the variable definitions.

STATIC MODEL - EQUATIONS

1. PRODUCTION

A) *Factors of production :*

$$L_i = \alpha_i (P_{Y_i} Y_i) / P_{L_i}^T \quad [\text{index } i = 1, 2, \dots, 10] \quad (1.1)$$

$$K_i = \beta_i (P_{Y_i} Y_i) / P_{K_i}^T \quad (1.2)$$

$$\left\{ \begin{array}{l} (\alpha_i + \beta_i) = 1 \end{array} \right. \quad (1.3)$$

$$\text{where } \left\{ \begin{array}{l} P_{L_i}^T = (1 + \theta_i^L) w \end{array} \right. \quad (1.4)$$

$$\left\{ \begin{array}{l} P_{K_i}^T = (1 + \sum_k \theta_{ki}^K) r^K \end{array} \right. \quad [\text{index } k = 1, 2, 3, 4] \quad (1.5)$$

$$\left\{ \begin{array}{l} P_{Y_i} = (P_{L_i}^T)^{\alpha_i} (P_{K_i}^T)^{\beta_i} \end{array} \right. \quad (1.6)$$

$$\left\{ \begin{array}{l} T_{L_i} = \theta_i^L (w L_i) \end{array} \right. \quad (1.7)$$

$$\left\{ \begin{array}{l} T_{K_{ki}} = \theta_{ki}^K (r^K K_i) \end{array} \right. \quad (1.8)$$

$$\text{and } Y_i = A_i^Y (L_i)^{\alpha_i} (K_i)^{\beta_i} \quad (1.9)$$

B) *Gross production :*

$$Y_i = v_i^{VP} (P_{X_i} X_i) / P_{VP_i}^T \quad (1.10)$$

$$X_{ji}^{SI} = v_{ji}^{SI} (P_{X_i} X_i) / P_{X_j}^T \quad [\text{index } j = i, = 1, 2, \dots, 10] \quad (1.11)$$

$$M_{ri}^M = v_{ri}^M (P_{X_i} X_i) / P_{M_r}^T \quad [\text{index } r = 1, 2] \quad (1.12)$$

$$\text{where } \left\{ \begin{array}{l} (v_i^{VP} + \sum_j v_{ji}^{SI} + \sum_r v_{ri}^M) = 1 \quad (1.13) \\ P_{Y_i}^T = (1 + \theta_i^{VA}) P_{Y_i} \quad (1.14) \\ P_{VP_i}^T = (1 + \theta_i^{VP}) P_{Y_i} \quad (1.15) \end{array} \right.$$

$$\text{and } \left\{ \begin{array}{l} P_{X_i} = (P_{VP_i}^T)^{v_i^{VP}} \pi(P_{X_j}^T)^{v_{ji}^{SI}} \pi(P_{M_r})^{v_{ri}^M} \quad (1.16) \\ P_{X_i}^T = (1 + \theta_i^P + \sum_f \theta_f^{XF} + \sum_q \theta_q^{XQ}) P_{X_i} \quad [\text{index } f = 1, 2] \quad (1.17) \\ T_{VA_i} = \theta_i^{VA} (P_{Y_i} Y_i) \quad [\text{index } q = 1, 2, 3] \quad (1.18) \\ T_{VP_i} = \theta_i^{VP} (P_{Y_i}^T Y_i) \quad (1.19) \end{array} \right.$$

$$\left\{ \begin{array}{l} T_{P_i} = \theta_i^P (P_{X_i} X_i) \quad (1.20) \\ T_{XF_{if}} = \theta_{if}^{XF} (P_{X_i} X_i) \quad (1.21) \\ T_{XQ_{iq}} = \theta_{iq}^{XQ} (P_{X_i} X_i) \quad (1.22) \end{array} \right.$$

$$\text{and } X_i = A_i^X (Y_i)^{v_i^{VP}} \pi(X_{ji}^{SI})^{v_{ji}^{SI}} \pi(M_{ri})^{v_{ri}^M} \quad (1.23)$$

2. CONSUMPTION GOODS

$$X_{ip}^F = \delta_{ip} (P_{F_p} C_p^T) / P_{X_i}^T \quad [\text{index } p = 1, 2, \dots, 9] \quad (2.1)$$

$$\left\{ \begin{array}{l} (\sum_i \delta_{ip}) = 1 \end{array} \right. \quad (2.2)$$

$$P_{F_p} = \pi(P_{X_i}^T) \delta_{ip} \quad (2.3)$$

$$\text{where } \left\{ \begin{array}{l} P_{F_p}^T = (1 + \theta_p^{LP} + \theta_p^{FP} + \sum_f \theta_{fp}^F) P_{F_p} \end{array} \right. \quad (2.4)$$

$$\left\{ \begin{array}{l} P_{C_p}^T = (1 + \sum_q \theta_{qp}^Q + \theta_p^{QP}) P_{F_p}^T \end{array} \right. \quad (2.5)$$

$$\left\{ \begin{array}{l} T_{LP_p} = \theta_p^{LP} (P_{F_p} C_p^T) \end{array} \right. \quad (2.6)$$

$$\left\{ \begin{array}{l} T_{FP_p} = \theta_p^{FP} (P_{F_p} C_p^T) \end{array} \right. \quad (2.7)$$

$$\left\{ \begin{array}{l} T_{F_{fp}} = \theta_{fp}^F (P_{F_p} C_p^T) \end{array} \right. \quad (2.8)$$

$$\left\{ \begin{array}{l} T_{QP_p} = \theta_p^{QP} (P_{F_p} C_p^T) \end{array} \right. \quad (2.9)$$

$$\left\{ \begin{array}{l} T_{Q_{qp}} = \theta_{qp}^Q (P_{F_p} C_p^T) \end{array} \right. \quad (2.10)$$

$$\text{and } C_p^T = A_p^F \pi(X_{ip}^F) \delta_{ip} \quad (2.11)$$

3. HOUSEHOLD CONSUMPTION

$$C_{hp} = \gamma_{hp} (P_{C_h} C_h^d) / P_{C_p}^T \quad [\text{index } h = 1, 2, \dots, 6] \quad (3.1)$$

$$\text{where } \left\{ \begin{array}{l} (\sum_p \gamma_{hp} = 1) \end{array} \right. \quad (3.2)$$

$$P_{C_h} = \pi (R_{C_p}^T)^{\gamma_{hp}} \quad (3.3)$$

$$\text{and } \left\{ \begin{array}{l} C_h^d = A^H \pi (C_{hp})^{\gamma_{hp}} \end{array} \right. \quad (3.4)$$

$$C_p^T = \sum_h C_{hp} \quad (3.5)$$

$$\left\{ \begin{array}{l} \text{REV}_h = \text{REVL}_h + \text{REVK}_h + \text{REVF}_h + \text{REVQ}_h + \text{SFDET}_h \\ \quad + \text{SQDET}_h \end{array} \right. \quad (3.6)$$

$$\left\{ \begin{array}{l} \text{EXP}_h = (P_{C_h} C_h^d) + \text{EXPF}_h + \text{EXPQ}_h + \text{TRROW}_r + S_h \\ \quad + (I^{PR_P PRT}) \end{array} \right. \quad (3.7)$$

$$\left\{ \begin{array}{l} \text{REV}_h = \text{EXP}_h \end{array} \right. \quad (3.8)$$

4. INVESTMENT SECTOR

$$\left\{ \begin{array}{l} V_i^{PR} = CV_i(I^{PR}P^{PR}) / P_{X_i}^T \end{array} \right. \quad (4.1)$$

$$\left\{ \begin{array}{l} V_i^G = GV_i(I^{PUB}P^{PUB}) / P_{X_i}^T \end{array} \right. \quad (4.2)$$

$$\text{where } \left\{ \begin{array}{l} P^{PR} = \pi(P_{X_i}^T)^{CV_i} \end{array} \right. \quad (4.3)$$

$$\left\{ \begin{array}{l} P^{PUB} = \pi(P_{X_i}^T)^{GV_i} \end{array} \right. \quad (4.4)$$

$$\left\{ \begin{array}{l} P^{PRT} = (1 + \sum_f \theta_f^{PRF} + \sum_q \theta_q^{PRQ} + \theta^{FS})P^{PR} \end{array} \right. \quad (4.5)$$

$$\left\{ \begin{array}{l} P^{GT} = (1 + \theta^{FG})P^{PUB} \end{array} \right. \quad (4.6)$$

$$\left\{ \begin{array}{l} T_{PRF_f} = \theta_f^{PRF}(I^{PR}P^{PR}) \end{array} \right. \quad (4.7)$$

$$\left\{ \begin{array}{l} T_{PRQ_q} = \theta_q^{PRQ}(I^{PR}P^{PR}) \end{array} \right. \quad (4.8)$$

$$\left\{ \begin{array}{l} T_{FS} = \theta^{FS}(I^{PR}P^{PR}) \end{array} \right. \quad (4.9)$$

$$\left\{ \begin{array}{l} T_{FG} = \theta^{FG}(I^{PUB}P^{PUB}) \end{array} \right. \quad (4.10)$$

$$\left\{ \begin{array}{l} \sum_i CV_i = 1 \end{array} \right. \quad (4.11)$$

$$\left\{ \begin{array}{l} \sum_i GV_i = 1 \end{array} \right. \quad (4.12)$$

$$(I^{PR}P^{PRT}) + (I^{PUB}P^{GT}) = \sum_h S_h + S^F + S^Q + \sum_{r=1}^2 S_r^{ROW} \quad (4.13)$$

5. FOREIGN SECTOR

$$E_{ir} = E_{ir}^0 \left[\frac{P_{M_r}^w}{P_{X_i}^T} \right]^\varepsilon \quad (5.1)$$

$$P_{M_r}^T = (1 + \sum_f \theta_{fr}^{MF} + \theta_r^{FM} + \theta_r^D) P_{M_r}^w \quad (5.2)$$

$$P_{M_r i}^w (\Sigma M_{ir}) + TRROW_r = P_{X_i}^T (\Sigma E_{ir}) + S_r^{ROW} + GFTN_r \quad (5.3)$$

$$\text{and } \left\{ \begin{array}{l} T_{MF_{fr}} = \theta_{MF_{fr}} (P_{M_r}^w \Sigma M_{ir}) \quad (5.4) \\ T_{FM_r} = \theta_{FM_r} (P_{M_r}^w \Sigma M_{ri}) \quad (5.5) \\ GFDN_r = \theta_r^D (P_{M_r}^w \Sigma M_{ri}) \quad (5.6) \end{array} \right.$$

6. GOVERNMENT SECTOR

$$X_i^{FG} = \eta_i^F (P_G^F G^F) / P_{X_i}^T \quad (6.1)$$

$$X_i^Q = \eta_i^Q (P_G^Q G^Q) / P_{X_i}^T \quad (6.2)$$

$$\text{where } \left\{ \begin{array}{l} (\sum_i \eta_i^F = 1) \end{array} \right. \quad (6.3)$$

$$\left\{ \begin{array}{l} (\sum_i \eta_i^Q = 1) \end{array} \right. \quad (6.4)$$

$$\text{and } \left\{ \begin{array}{l} P_G^F = \pi(P_{X_i}^T) \eta_i^F \end{array} \right. \quad (6.5)$$

$$\left\{ \begin{array}{l} P_G^Q = \pi(P_{X_i}^T) \eta_i^Q \end{array} \right. \quad (6.6)$$

$$\left\{ \begin{array}{l} G^F = A^F \pi(X_i^{FG}) \eta_i^F \end{array} \right. \quad (6.7)$$

$$\left\{ \begin{array}{l} G^Q = A^Q \pi(X_i^Q) \eta_i^Q \end{array} \right. \quad (6.8)$$

$$TFREV = \sum_{i=1} [\sum_{k=1} T_{K_{ki}} + T_{VA_i} + \sum_f T_{XF_{fi}}] + \sum_p [T_{LP_p} + T_{FP_p} + \sum_f T_{F_{fp}}] \quad (6.9)$$

$$+ \sum_h EXPF_h + [\sum_f T_{PRF_f} + T_{FS} + T_{FG}] + L1(\sum_i T_{L_i}) \quad (6.10)$$

$$+ \sum_r [GFTN_r + GFDN_r + \sum_f T_{MF_{fr}} + T_{FM_r}] - TRQ \quad (6.11)$$

$$TQREV = \sum_{i=2}^4 [\sum_{k=2} T_{K_{ki}} + T_{VP_i} + \sum_q T_{XQ_{qi}} + T_{P_i}] + \sum_p [T_{QP_p} + \sum_q T_{Q_{qp}}] \quad (6.12)$$

$$+ \sum_h EXPQ_h + [\sum_q T_{PRQ_q}] + (1 - L1)(\sum_i T_{L_i}) + TRQ \quad (6.13)$$

$$\text{EXPF} = (P_G^F G^F) + \sum_h \text{REVF}_h + S^F + \sum_h \text{SFDET}_h \quad (6.14)$$

$$\text{EXPQ} = (P_G^Q G^Q) + \sum_h \text{REVQ}_h + S^Q + \sum_h \text{SQDET}_h \quad (6.15)$$

$$\text{where } \begin{cases} \text{TFREV} = \text{EXPF} & (6.16) \\ \text{TQREV} = \text{EXPQ} & (6.17) \end{cases}$$

7. EQUILIBRIUM EQUATIONS

Goods market equilibrium

$$X_i = \sum_j X_{ji} + \sum_p X_{ip}^F + X_i^{FG} + X_i^Q + V_i^{PR} + V_i^G + \sum_r E_{ir} \quad (7.1)$$

Factor market equilibria

$$L^S = \sum_i L_i \quad (7.2)$$

$$K^S = \sum_i K_i \quad (7.3)$$

Equation Variables - Definitions

PRODUCTION

For each sector of production i

- L_i - labour demand
- (L^S) - total labour supply
- K_i - capital demand
- K^S - total capital supply
- Y_i - value-added per sector
- X_{ji}^{SI} - intermediate good j demanded per i
- M_{ri}^M - import good r demanded per i
- X_i - industrial good supplied per i
- T_{L_i} - labour tax
- $T_{K_{ki}}$ - capital tax of type k

- T_{VA_i} - FST payable by sector i
- T_{VP_i} - QST payable by sector i
- $T_{XF_{if}}$ - indirect federal taxes
- T_{P_i} - indirect provincial tax
- $T_{XQ_{ia}}$ - indirect provincial taxes
- w - wages
- r^K - rate of return on capital

- $P_L^{T_i}$ - post-tax sectoral price of labour
- $P_K^{T_i}$ - post-tax sectoral price of capital
- P_{Y_i} - pre-tax sectoral price of value added
- $P_Y^{T_i}$ - P_{Y_i} augmented by FST rate
- $P_{VP}^{T_i}$ - $P_Y^{T_i}$ augmented by prov sales tax rate
- P_{X_i} - pre-tax industrial good price
- $P_X^{T_i}$ - P_{X_i} augmented by indirect tax rates

CONSUMPTION GOODS

For each final good p

- X_{iP}^F - intermediate industrial good i used by p
- C_p^T - total supply of good p
- T_{LP_p} - indirect federal consump tax
- T_{FP_p} - indirect federal consump tax
- $T_{F\phi}$ - indirect federal consump taxes
- T_{QP_p} - indirect provincial consump tax
- $T_{Q\phi}$ - indirect provincial consump taxes
- P_{F_p} - pre-tax commodity price
- $P_F^{T_p}$ - P_{F_p} augmented by federal indirect taxes
- $P_C^{T_p}$ - $P_{F_p}^{T_p}$ augmented by prov indirect taxes

HOUSEHOLD CONSUMPTION

For each household h

- C_{hp} - demand for commodity p
 - C_h^d - total commodity demand per household
 - P_{C_h} - aggregate consumption price per h
 - REV_h - total revenue per h
 - $REVL_h$ - revenue labour
 - $REVK_h$ - revenue capital
 - $REVF_h$ - federal transfers
 - $REVQ_h$ - provincial transfers
 - $SFDET_h$ - federal servicing of debt
 - $SQDET_h$ - provincial servicing of debt
-
- EXP_h - total household expenditure
 - $EXPF_h$ - federal income tax
 - $EXPQ_h$ - provincial income tax
 - $TRROW_r$ - household foreign transfers
 - S_h - net household saving

INVESTMENT SECTOR

- V_i^{PR} - private investment ϵ i
 V_i^G - public investment ϵ i
 I^{PR} - total private investment
 (I^{PUB}) - total public investment
 T_{PRF_f} - federal indirect private investment taxes
 T_{PRO_q} - provincial indirect private investment taxes
 T_{FS} - federal sales tax on total private investment
 T_{FG} - federal sales tax on public investment
 P^{PR} - pre-tax total private investment price
 P^{PRT} - P^{PR} augmented by taxes
 P^{PUB} - pre-tax total public investment price
 P^{GT} - P^{PUB} augmented by taxes
 S^F - total federal saving
 S^Q - total provincial saving

FOREIGN SECTOR

- E_{i_r} - export demand per i
 P_M^W - foreign world price
 P_M^T - import price
 T_{fr}^{MF} - indirect imports federal taxes
 T_{fr}^{FM} - indirect imports federal tax
 $GFDN_r$ - indirect imports federal tax
 $GFTN_r$ - non-residents' federal taxes

GOVERNMENT SECTOR

- X_i^{FG} - federal consumption of good i
 $X_i^{Q_i}$ - provincial consumption of good i
 G^F - total federal consumption
 G^Q - total provincial consumption
 P^{F_g} - federal aggregate consumption price
 P^{Q_g} - Provincial aggregate consumption price
 $TFREV$ - total federal revenue
 $TQREV$ - total provincial revenue
 $EXPF$ - total federal expenditure
 $EXPQ$ - total provincial expenditure

IV.4 Description of the Data

The data, as we mentioned earlier, are derived from the social accounting matrix of Quebec for the year 1984²³. We use the stream of income and expenditure accounts therein to find the base year values of our parameters. These include all shift and share function parameters as well as all the base year tax rates. Because we use a fair amount of aggregation, it comes as no surprise that the base year values obtained for the tax rates by the calibration procedure do not entirely correspond to nominal tax rates officially announced. Therefore, in simulating any changes in the tax rates, instead of using absolute rate changes we make use of relative variations.

Similarly, given the actual federal tax system with all its various rates and exemptions, it certainly would have been more desirable to have had a finer disaggregation of each of the productive sectors into subsectors with regard to the differing rates and exemptions. However, numerical difficulties limit us to the distinction of ten sectors only, which is why our simulation percentages are only approximations of the true tax rates for the categories in question. Finally, our distinction of households is made according to the respective income categories (see table 1) regardless of the number and age of the members of each household. Hence, any simulations of transfer payments to households are demonstrative showing different scenarios of tax credit payments which, in spite of not entirely reproducing the reality, are still quite informative of the virtue of these types of transfers in general.

Therefore, taking all of these facts into account, any results should be interpreted with caution.

²³ Supra footnote 5

IV.5 Generation of the Base case

A few words are in order concerning the dynamic calibration and the value of delta. Given that there is no reliable information as to the value of the depreciation rate of capital and given our base year private investment rate of 6.5 %, it is convenient to fix the value of delta equal to the base year rate of investment. This has the advantage of keeping the model on a stationary path throughout the base case which eases computation without loss of generality. If we also assume that all other exogenous variables stay on their respective stationary paths, delta will be constant on the whole time horizon. Once this procedure is completed, we can then proceed with the dynamic simulations fixing the value of delta to its calibration value and solving for the reform equilibrium path. In this way, we help keep the dynamic system under control.

Note that in our model public investment does not contribute to the available stock of capital, instead, it is regarded purely as a periodic expense for the provincial government (although it could have entered the production function as an externality; but in absence of reliable information on the externality parameter, we would have fixed it to zero).

SECTION V

QUANTITATIVE EVALUATION OF THE TAX REFORM

V.1 Design of the Experiments

We have chosen to perform two types of simulations for the fiscal reform : one including direct transfer payments to households in the form of GST tax credits and one excluding them. The aim of this exercise is to show how much of an effect these payments have on total consumption for each household category i.e. on the utility level (see equation 3.4). For the case including transfer payments, we assume the following scenario. Instead of making a full direct transfer to the Quebec government, the federal government decides to pay a quarter of this amount to Quebec households as GST tax credits where lower income households obtain a higher percentage of the available tax credits than those with higher income. (Table 3 shows the share of the transfer for each household for the first period).

Table 3
Simulation - Replacing the FST by the GST
Post-reform Detail of Transfers to Households for the First Year

	TRQ PROPORTION	TRANSFER AMOUNT(\$)
HOUSEHOLD1	0.35	206.3
HOUSEHOLD2	0.25	238.7
HOUSEHOLD3	0.22	134.5
HOUSEHOLD4	0.18	119.2
HOUSEHOLD5	0.0	0.0
HOUSEHOLD6	0.0	0.0

TRQ is the proportion each household category gets of the total GST credits to be distributed.

Concerning the tax rates themselves, in every simulation θ^{VA} are set to zero for all sectors and the appropriate percentage increases or decreases are applied to the consumer tax rates θ^{FP} except for the tax rates of the sectors of tobacco and alcohol which remain unchanged.

All simulations are carried out using two different values for price elasticity of export demand ($\varepsilon = 2$ and $\varepsilon = 25$) to test for the sensitivity of results to this important parameter.

To facilitate comparisons, we aggregate most of the variables. These are done keeping the base year real structure of the economy constant (following a Laspeyres index).

V.2 The Results

All results are expressed as percentage changes of variables with respect to their base year values. Tables 4 to 7 summarise the results of the tax reform for macroeconomic aggregates. Thus, % changes for factor costs, the consumer price index and real aggregates are presented for a time horizon of ten periods. In Table 4 we show the simulation results in the absence of GST credit payments to households and with the value of price elasticity of demand equal to 2. Table 5 depicts results of the same simulation but with the value of ϵ fixed at 25. The same simulations carried out in the presence of GST credit payments are presented in tables 6 and 7 with elasticity values of ϵ of 2 and 25 respectively.

As expected, both wages and consumer price index (CPI) increase in table 4 ; the former, because labour demand increases for a fixed labour supply, and the latter, due to the shifting of the tax burden onto the consumers. Real wages, calculated by deflating nominal wages with the CPI, show the net of the two effects. In the first four periods the GST creates a slight decrease in purchasing power but, in the long run, real wages increase though by a very small amount (0.15 %). In the immediate post-reform period, the rate of return on capital also increases (by 1.77 %) but declines in subsequent years to reach 0.2 % by the tenth period. This is due to the dynamic accumulation of capital stock meaning that supply is increased each period.

Similarly, because tax cascading is fully removed from industrial goods, investments increase strongly (initially by 4 % to reach 4.5 % in the long run). On the other hand, contrary to expectations, aggregate exports decline slightly. The explanation to this will be more evident when we examine sectoral price increases in industrial goods and export structure for Quebec. The bias favouring imports now removed, these also decline but not enough to create an improvement in the trade balance.

Table 4
 The Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Absence of GST credits to households
 Price Elasticity of Export Demand equals 2

	SELECTED PERIODS				
	1	4	7	10	
PRICES & FACTOR COSTS					
Consumer Price Index	1.77	1.69	1.62	1.55	
Nominal Wages	1.53	1.60	1.66	1.71	
Real Wages	-0.24	-0.09	0.04	0.15	
Rate of Return on K	1.77	1.16	0.64	0.20	
REAL AGGREGATES					
Gross Domestic Product	-0.57	-0.35	-0.15	0.01	
Consumption	-0.89	-0.73	-0.60	-0.48	
Private Investment	4.09	4.26	4.41	4.54	
Exports - ROW	-0.57	-0.44	-0.33	-0.23	
- ROCAN	-0.66	-0.54	-0.42	-0.33	
Imports - ROW	-0.25	-0.19	-0.13	-0.08	
- ROCAN	-0.16	-0.09	-0.02	0.03	

ROW = Rest of the World
 ROCAN = Rest of Canada

Table 5
 Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Absence of GST credits to households
 Price Elasticity of Export Demand equals 25

	SELECTED PERIODS				
	1	4	7	10	
PRICES & FACTOR COSTS					
Consumer Price Index	1.60	1.59	1.59	1.59	1.59
Nominal Wages	1.19	1.38	1.54	1.67	1.67
Real Wages	-0.40	-0.21	-0.06	0.08	0.08
Rate of Return on K	1.66	1.23	0.85	0.52	0.52
REAL AGGREGATES					
Gross Domestic Product	-1.03	-0.80	-0.61	-0.43	-0.43
Consumption	-0.90	-0.70	-0.53	-0.38	-0.38
Private Investment	3.88	4.08	4.25	4.41	4.41
Exports - ROW	-3.96	-3.77	-3.60	-3.46	-3.46
- ROCAN	-5.69	-5.61	-5.55	-5.50	-5.50
Imports - ROW	-2.55	-2.41	-3.00	-2.19	-2.19
- ROCAN	-1.88	-1.72	-1.57	-1.46	-1.46

ROW = Rest of the World
 ROCAN = Rest of Canada

Table 6
 Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Existence of GST credits to households
 Price Elasticity of Export Demand equals 2

	SELECTED PERIODS				
	1	4	7	10	
PRICES & FACTOR COSTS					
Consumer Price Index	1.77	1.69	1.62	1.56	
Nominal Wages	1.53	1.60	1.66	1.71	
Real Wages	-0.24	-0.09	0.04	0.15	
Rate of Return on K	1.77	1.16	0.64	0.20	
REAL AGGREGATES					
Gross Domestic Product	-0.57	-0.34	-0.15	0.01	
Consumption	-0.96	-0.81	-0.68	-0.56	
Private Investment	4.07	4.24	4.39	4.51	
Exports - ROW	-0.58	-0.45	-0.33	-0.24	
- ROCAN	-0.66	-0.53	-0.42	-0.33	
Imports - ROW	-0.23	-0.16	-0.11	-0.06	
- ROCAN	-0.07	0.01	0.07	0.12	

ROW = Rest of the World
 ROCAN = Rest of Canada

Table 7
 Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Existence of GST credits to households
 Price Elasticity of Export demand equals 25

	SELECTED PERIODS				
	1	4	7	10	
PRICES & FACTOR COSTS					
Consumer Price Index	1.60	1.59	1.59	1.59	1.59
Nominal Wages	1.19	1.38	1.53	1.67	1.67
Real Wages	-0.39	-0.21	-0.06	0.08	0.08
Rate of Return on K	1.66	1.23	0.85	0.53	0.53
REAL AGGREGATES					
Gross Domestic Product	-1.03	-0.80	-0.61	-0.43	-0.43
Consumption	-0.97	-0.78	-0.61	-0.46	-0.46
Private Investment	3.86	4.10	4.23	4.38	4.38
Exports - ROW	-3.96	-3.77	-3.61	-3.47	-3.47
- ROCAN	-5.68	-5.61	-5.55	-5.49	-5.49
Imports - ROW	-2.55	-2.41	-2.29	-2.19	-2.19
- ROCAN	-1.87	-1.71	-1.57	-1.45	-1.45

ROW = Rest of the World
 ROCAN = Rest of Canada

The welfare index in our model is given by aggregate household consumption. Table 4 shows that the GST, without tax credit payments, slightly disfavours households. Initially, aggregate consumption falls (-0.9 %) to increase very slowly to -0.5 % at the end of the time horizon considered in the model. This is due to the decrease in real wages as well as an increase in saving. As for the real gross domestic product, it experiences a small initial decrease of the order 0.5 % possibly because of decreased consumption demand and lower exports. With periodic increases in investment and the small improvement in exports, the negative effect on the GDP is canceled by the tenth period.

Table 5 depicts results for $\epsilon=25$. In this case, GDP decreases by 1 % initially to reach -0.4 % by the tenth period. This is probably due to the strong decline in exports (4 % to 3.5 % in the long run for the rest of the world and 5.7 % to 5.5 % in the case of the rest of Canada), and lower real wages.

In the presence of GST credit payments to lower income households, table 6 shows very similar results to those in table 4. Similarly, table 7 results are almost identical to those in table 5. Surprisingly, in both cases, aggregate consumption decreases slightly more in this case than when no GST credit payments exist. This is because patterns of consumption differ from one household category to the other in the presence or absence of GST credits thus creating distinct aggregate prices for each category (tables 10 to 13 show household consumption prices and quantities for each of the classes).

Percent deviations in sectoral value-added are reported in tables 8 and 9. These include price changes and variations in production volume for each of the sectors. Both tables present results where GST credit payments were made to lower income households ; table 8 reports results for the case when $\epsilon=2$ whereas table 9 contains results for $\epsilon=25$.

A close examination of table 8 reveals that in the immediate post-reform period, the industries of agriculture and construction are the greatest benefitors by way of reduced output price and accrued production. By the tenth period, the primary, transportation and finance industries also increase in production with the decrease in their relative prices. Contrariwise, the manufacturing and retail industries increase slightly in price and drop in production volume. This is undesirable specially for the manufacturing sector which is the most important sector for Quebec. It represents 82 % of aggregate exports to the rest of the world for the base year and 66 % to the rest of Canada. Accordingly, a price increase in this sector immediately reflects itself in diminished aggregate exports which is precisely the case in tables 4 and 6.

With a price elasticity value of 25 this negative effect is made even worse (table 9). Thus, even with a smaller increase in manufacturing price, production volume drops by 2.6 % in the first period for this sector. Consequently, aggregate exports to both destinations (rest of the world and rest of Canada) suffer 4 to 5.5 % declines respectively. However, agriculture, construction and finance industries do even better under this elasticity value than when $\epsilon=2$ specially in the long run. Contrariwise, the primary, wholesale and retail industries are further disadvantaged.

Table 8
 Effect of Replacing the FSF with the GST - (% deviations w.r.t. base case)
 Case of Payments of GST credits to households
 Price Elasticity of Export Demand equals 2

Disaggregate Results in Gross Production Sector

	SELECTED PERIODS			
	1	4	7	10
PRICES				
Agriculture	-1.22	-1.31	-1.39	-1.46
Primary Industry	0.05	0.0	-0.05	-0.09
Manufacturing	0.29	0.23	0.17	0.12
Construction	-2.26	-2.35	-2.44	-2.51
Transportation, Comm. & Public Utilities	-0.09	-0.18	-0.25	-0.31
Wholesale Industry	0.29	0.21	0.15	0.10
Retail Industry	0.40	0.31	0.22	0.15
Owner-occupied Buildings	0.02	0.0	0.0	0.0
Finance & Insurance	-0.83	-0.99	-1.13	-1.25
Services & Others	-0.05	-0.13	-0.20	-0.25
REAL GROSS PRODUCTION				
Agriculture	1.42	1.59	1.74	1.86
Primary Industry	-0.16	-0.04	0.06	0.15
Manufacturing	-0.40	-0.27	-0.16	-0.06
Construction	3.20	3.36	3.49	3.60
Transportation, Comm. & Public Utilities	-0.15	0.01	0.14	0.26
Wholesale Industry	-0.46	-0.32	-0.20	-0.09
Retail Industry	-1.16	-0.99	-0.85	-0.72
Owner-occupied Buildings	-0.38	-0.30	-0.23	-0.17
Finance & Insurance	-0.01	0.24	0.46	0.65
Services & Others	-0.72	-0.57	-0.45	-0.34

Table 9
 Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Payments of GST credits to households
 Price Elasticity of Export Demand equals 25

Disaggregate Results in Gross Production Sector

	SELECTED PERIODS				
	1	4	7	10	
PRICES					
Agriculture	-1.36	-1.39	-1.41	-1.43	
Primary Industry	-0.07	-0.07	-0.07	-0.07	
Manufacturing	0.17	0.16	0.15	0.15	
Construction	-2.45	-2.45	-2.46	-2.46	
Transportation, Comm. & Public Utilities	-0.28	-0.28	-0.28	-0.28	
Wholesale Industry	0.10	0.11	0.11	0.12	
Retail Industry	0.17	0.18	0.19	0.20	
Owner-occupied Buildings	-0.26	-0.16	-0.08	0.07	
Finance & Insurance	-1.00	-1.07	-1.13	-1.18	
Services & Others	-0.24	-0.23	-0.23	-0.22	
REAL GROSS PRODUCTION					
Agriculture	3.19	3.41	3.61	3.77	
Primary Industry	-1.70	-1.58	-1.48	-1.39	
Manufacturing	-2.61	-2.46	-2.34	-2.23	
Construction	3.36	3.54	3.70	3.84	
Transportation, Comm. & Public Utilities	0.58	0.70	0.79	0.88	
Wholesale Industry	-1.95	-1.92	-1.89	-1.87	
Retail Industry	-1.25	-1.09	-0.94	-0.82	
Owner-occupied Buildings	-0.28	-0.18	-0.10	-0.02	
Finance & Insurance	5.84	6.52	7.12	7.64	
Services & Others	-0.47	-0.33	-0.22	-0.18	

The last group of tables (tables 10 to 13) summarise results for consumption prices and volume in a more disaggregate form. In the absence of GST credit payments, simulations were carried out for values of price elasticity of export demand equal to 2 and 25. Results are presented in tables 10 and 11 respectively. On the other hand, tables 12 and 13 report results for the same elasticity values but for the case where the credit payments exist.

The GST credit effect :

Household aggregate consumption declines due to the decrease in real wages specially during the first four periods. Comparing tables 10 to 12 and tables 11 to 13, where simulations vary only by the fact that GST credit payments are made to lower income households or not, we can see a significant change in consumption quantity by each household category even though prices are unchanged. In the absence of GST credits there are some effects of regressivity by the tax, however, with transfers to lower income households, this drawback is completely avoided.

Another interesting thing to note is that making GST tax credit payments to households affects significantly only household and government aggregate consumptions. This is because the federal government now transfers the proportion TRQ to lower income households where initially the sum would have been destined to the provincial government. Thus, although the regressivity of the tax is satisfactorily countered by these transfers, there is no other important feedback resulting from this in the economy. Any additional consumption by households is because of an approximate reduction in government consumption.

Table 10
 Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Payments of GST credits to households
 Price Elasticity of Export Demand equals 2

Disaggregate Results in Consumption

CONSUMPTION PRICES	SELECTED PERIODS				
	1	4	7	10	
Household1	1.60	1.52	1.45	1.39	
Household2	1.57	1.49	1.42	1.36	
Household3	1.58	1.50	1.43	1.37	
Household4	1.71	1.63	1.56	1.50	
Household5	1.71	1.63	1.56	1.50	
Household6	1.96	1.87	1.80	1.74	
REAL CONSUMPTION / HOUSEHOLD CATEGORY					
Household1	0.87	1.03	1.17	1.29	
Household2	-0.02	0.14	0.27	0.39	
Household3	-0.64	-0.48	-0.35	-0.24	
Household4	-0.84	-0.68	-0.55	-0.44	
Household5	-1.05	-0.89	-0.76	-0.65	
Household6	-1.30	-1.14	-1.01	-0.90	

Table 11
 Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Payments of GST credits to households
 Price Elasticity of Export demand equals 25

Disaggregate Results in Consumption

CONSUMPTION PRICES	SELECTED PERIODS				
	1	4	7	10	
Household1	1.42	1.42	1.42	1.42	1.42
Household2	1.39	1.39	1.39	1.39	1.39
Household3	1.41	1.41	1.41	1.41	1.41
Household4	1.54	1.54	1.53	1.53	1.53
Household5	1.54	1.54	1.53	1.53	1.53
Household6	1.78	1.78	1.78	1.78	1.77

REAL CONSUMPTION / HOUSEHOLD CATEGORY	1	4	7	10
Household1	0.96	1.17	1.35	1.51
Household2	0.02	0.21	0.39	0.54
Household3	-0.63	-0.44	-0.26	-0.12
Household4	-0.86	-0.66	-0.49	-0.34
Household5	-1.07	-0.88	-0.71	-0.56
Household6	-1.31	-1.12	-0.95	-0.80

Table 12

Effect of Replacing the FST with the GST - (% deviations w.r.t. base case)
 Case of Absence of GST credits to households
 Price Elasticity of Export Demand equals 2

Disaggregate Results in Consumption

CONSUMPTION PRICES	SELECTED PERIODS				
	1	4	7	10	
Household1	1.60	1.52	1.45	1.39	
Household2	1.57	1.49	1.42	1.36	
Household3	1.58	1.50	1.43	1.37	
Household4	1.71	1.63	1.56	1.50	
Household5	1.71	1.63	1.56	1.50	
Household6	1.96	1.87	1.80	1.74	
REAL CONSUMPTION / HOUSEHOLD CATEGORY					
Household1	-1.29	-1.13	-1.00	-0.87	
Household2	-1.05	-0.90	-0.77	-0.65	
Household3	-0.83	-0.67	-0.54	-0.42	
Household4	-0.85	-0.69	-0.56	-0.45	
Household5	-0.77	-0.61	-0.48	-0.37	
Household6	-1.01	-0.86	-0.72	-0.61	

Table 13
 Effect of Replacing the FST with the GST -(% deviations w.r.t. base case)
 Case of Absence of GST credits to households
 Price Elasticity of Export Demand equals 25

Disaggregate Results in Consumption

	SELECTED PERIODS				
	1	4	7	10	
CONSUMPTION PRICES					
Household1	1.42	1.42	1.42	1.42	1.42
Household2	1.39	1.39	1.39	1.39	1.39
Household3	1.41	1.41	1.41	1.41	1.41
Household4	1.54	1.54	1.53	1.53	1.53
Household5	1.54	1.54	1.53	1.53	1.53
Household6	1.78	1.78	1.78	1.78	1.77
REAL CONSUMPTION / HOUSEHOLD CATEGORY					
Household1	-1.19	-0.99	-0.81	-0.66	-0.66
Household2	-1.02	-0.82	-0.65	-0.50	-0.50
Household3	-0.82	-0.62	-0.45	-0.30	-0.30
Household4	-0.87	-0.67	-0.50	-0.35	-0.35
Household5	-0.79	-0.60	-0.43	-0.28	-0.28
Household6	-1.03	-0.83	-0.66	-0.51	-0.51

Sensitivity to elasticity value (ϵ) :

Carrying out simulations under different values of export demand elasticity has the aim of checking to see if the essence of the results change with each different value of ϵ . Accordingly, when we compare results from table 4 to those from 5 and from table 6 to results in table 7 we note that only exports and imports vary significantly. GDP also shows some sensitivity to this parameter and this seems to be a direct effect of the general equilibrium structure of the model.

At this point, a small comment is in order. Lefebvre and Mayer use the values $\epsilon=1$ and $\epsilon=25$ in their simulations (where ϵ is the symbol for export demand elasticity value). In our simulations, we use the values of $\epsilon=2$ and $\epsilon=25$. Although, it would have been preferable for us to have used the Lefebvre and Mayer values for ϵ (for the sake of direct comparisons), our model did not converge under an elasticity value of 1 possibly because it did not satisfy some numerical stability condition (similar to the Marshall-Lerner condition). Still, $\epsilon=2$ is not a bad approximation to an elasticity value of one given that variables are very little sensitive to ϵ .

Comparisons to the Lefebvre and Mayer model :

For the case of a small value of export elasticity ($\epsilon=2$; see tables 4 & 6) to the results of Lefebvre and Mayer for $\epsilon=1$ (see table III.3.1), we note that private investment, real consumption, real gross domestic product and consumer price index all vary in the same direction. Still, the decrease in consumption is less drastic and the increase in CPI less dramatic in our case. As for exports and imports, our simulations show a net decline contrary to the results reported by Lefebvre and Mayer.

In the case of $\varepsilon=25$, our results vary quite differently from those of Lefebvre and Mayer specially concerning the CPI, exports and imports. Although the consumer price index increases significantly in our case, exports decline by an average of about 4.5 % which, in turn, affects GDP (-1.03 %). As we will see in the dynamic analysis, in subsequent periods exports essentially remain at the same level and as capital accumulates, GDP slightly improves.

Prices of industrial goods are influenced basically by two opposing weights: increased factor prices and decreased production taxes. Because GST credit payments to households hardly affect any other variables except for consumption, we include only results where these payments are present (under two elasticity values ; see tables 8 and 9). For the case where $\varepsilon=25$, we notice that, immediately after reform, all prices decrease except for the sectors of manufacturing, wholesale and retail. Those industrial goods that decrease in price are fewer when export elasticity is low. This, even though federal sales taxes are removed from the production level for all the sectors. Therefore, input substitution possibilities and factor intensities mostly determine sectoral gross production price effects. The sectors of agriculture, construction and finance thus increase production following a decrease in their prices whereas the sector of manufacturing decreases its supply due to an increase in price specially when $\varepsilon=25$. As we mentioned earlier, this sector constituting approximately 80 % of exports in the base year, it is no surprise that aggregate exports decline significantly in our simulations.

Overall, our results project a less optimistic outcome for Quebec than do Lefebvre and Mayer in the event of the GST replacing the FST. Eventually, in the long run, these negative effects are somewhat alleviated but not importantly. For a longer time horizon we could imagine a steady improvement in all the sectors and macroeconomic variables disadvantaged by the GST but this progress would be slow.

We can thus conclude by saying that results agree only partly with the outcomes of the Lefebvre and Mayer model, that direct tax credit payments to lower income households do counter the regressivity of the tax but do not create an important feedback in the economy, that except for trade variables other aggregates are only slightly sensitive to different values of export demand elasticities, and finally, that variables tend to stay approximately constant via the time horizon.

SECTION VI

CONCLUSION

We try, with this study, to have an insight into the short and long run effects of the proposed goods and services tax for the province of Quebec. We show that there are some setbacks to be had from the reform plan but that these are small. On the one hand, our results confirm those of Lefebvre and Mayer in that investments will rise, that private consumption will decrease slightly, and that aggregate consumption prices will increase as well. However, on the other hand, we find aggregate exports will decline specially for a high price elasticity of export demand. In addition, and concerning household welfare, we find that the GST is regressive but agree with Hamilton and Whalley that GST credit payments to lower income household counter nicely this side-effect. Furthermore, our results indicate that effects are less negative in the long run than in the immediate post-reform period. With the increase in capital stock, the rate of return on capital quickly declines lowering production costs in the process. Consequently, investments and exports cost less and rise in quantity. Moreover, final good prices also decline promoting, in turn, household consumption.

With respect to intersectoral redistributive aspects, our results coincide with the federal point of view. Since the manufacturing sector was already exempt from the FST, less benefits accrue to it relative to other non-manufacturing sectors upon the enactment of the proposed sales tax reform. Consequently, being a highly manufacturing region, Quebec stands to gain less from this sector after tax reform than other provinces. In contrast, the supply of agricultural and construction goods increases, in addition, the sectors of finance and public utilities also prosper under the new tax system.

Finally, unlike the conclusions of Lefebvre and Mayer, the study has shown us that exception made of the exports and imports, macroeconomic variables are not very sensitive to different values of price elasticity of export demand.

In closing, we would like to point out one more possible improvement to this model, and that is changing the model anticipations from myopic to rational. In essence, this means that, instead of saving a fixed fraction of their income each period, which goes to finance investment, households maximise an intertemporal utility function subject to their intertemporal budget constraints so as to choose their saving pattern. On the other side, firms maximise the sum of discounted future profits subject to their technical constraints. The ensuing investment decisions are then confronted with the intertemporal savings decisions. In fact, we already developed such a model and were able to obtain the calibration and counterfactual equilibrium time paths for eight periods of five years' duration each using fictitious data of an economy having 3 sectors, 3 goods, 2 households, 2 governments and 2 foreign sectors. Unfortunately, with the much larger model of Quebec with its numerous sectors, goods, households and taxes, considerable numerical problems originated too complex for our algorithm to solve. We therefore leave this option open for future research.

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