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INSTITUTE FOR ECONOMIC RESEARCH

QUEEN'S UNIVERSITY

Kingston, Ontario, Canada K7L 3N6

The 1988 Canada-United States Free Trade Agreement: A Dynamic General Equilibrium Evaluation of The Transition Effects

by

Richard G. Harris
Queen's University

and

Victoria Kwakwa
University of Regina

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ABSTRACT

Canada and the United States have implemented legislation to form a free trade area in the classic sense. The Canada America Free Trade Agreement, or CAFTA, is to be phased in over a ten year period which began on January 1, 1989. There are many elements to the agreement, but the most significant is the phased in reduction of tariffs on bilateral trade over a ten year period, plus removal of some significant non-tariff barriers. In addition the agreement sets out a new mechanism for resolving trade disputes involving the application of countervail and anti-dumping laws in both countries. This paper reports some estimates of the transition effect of the agreement using a sequenced general equilibrium model incorporating imperfect competition, scale economies and some labour market rigidities. Entry and exit dynamics are explicitly incorporated in the model simulations. Besides offering what we think are illuminating analyses of the agreement itself, the results in comparison to the static general equilibrium estimates offer support for the view that it is important in applied policy analysis to pay attention to adjustment and dynamics.

1. Introduction

Canada and the United States have implemented legislation to form a free trade area in the classic sense. The Canada America Free Trade Agreement, or CAFTA, is to be phased in over a ten year period which began on January 1, 1989. There are many elements to the agreement, but the most significant is the phased in reduction of tariffs on bilateral trade over a ten year period, plus removal of some significant non-tariff barriers. In addition the agreement sets out a new mechanism for resolving trade disputes involving the application of countervail and anti-dumping laws in both countries. This paper reports some estimates of the transition effect of the agreement using a sequenced general equilibrium model incorporating imperfect competition, scale economies and some labour market rigidities. Entry and exit dynamics are explicitly incorporated in the model simulations. Besides offering what we think are illuminating analyses of the agreement itself, the results in comparison to the static general equilibrium estimates offer support for the view that it is important in applied policy analysis to pay attention to adjustment and dynamics.

In this paper we also report, for reference purposes, the effects of unilateral removal by Canada of all non-agricultural tariffs and non-tariff barriers against U.S. exports to Canada. This is a useful comparison because it highlights the relative costs and benefits of protection versus a broader-based form of free trade. It also addresses directly the question raised by many critics of the deal as to what benefits Canada actually got out of the CAFTA, relative to a go-it-alone policy.

The results are broadly consistent with the earlier static results of Cox and Harris (1986) using a quite different data set. In general, because the trade barriers in levels are lower in this study the aggregate gains are lower. Second, because of the way in which tariff reductions are phased in the impact in any given calendar year are quite small. The other striking result is the rather small adjustment costs imposed by the CAFTA measured in terms of job losses. The generally benign view of adjustment costs which has been put forward in other studies of trade liberalization seems quite apparent in this model. These results appear to contradict the earlier results of Cox and Harris (1986) using a static imperfect competition G.E. model. They estimated that as much as 7 percent of the labour force would have to reallocate between sectors given a comprehensive BFT agreement between Canada and the U.S. Some commentators took these estimates to imply large transitional amounts of unemployment. This study shows this interpretation to be incorrect. Proper account of stocks and flows into and out of unemployment, shows trade-induced unemployment in any given year to be negligible. The model is strongly Keynesian in structure in the very short run so that unemployment in the short run is possible.

The orientation and theoretical structure of the model used in this paper is one focused on the medium term. It thus differs from short-run macro models, or the long-run neoclassical models of applied general equilibrium.

In the policy arena the "long-term" models have a cleaner theoretical base, but are often dismissed as being "irrelevant". The state-of-affairs is most unfortunate. The short-term models being used are extremely unsatisfactory for a number of reasons. First, and foremost, they are either not explicitly dynamic, or alternatively are dynamic but most of the important dynamics are exogenous, and not based in microeconomic decision making. A typical example would be a Keynesian demand-driven input-output model in which the timepath of the key aggregates such as consumption, investment are exogenously set. Second, many of the models focus on a very static demand view of the labour market. Unemployment and employment changes by industry are generated simply by looking at changes in industry demand. The turnover view of labour markets in which explicit attention is paid to the flows into and out of the stock of unemployment and employment is sadly lacking in these models. An important first attempt to reconcile the turnover view of unemployment with trade modelling is contained in a paper by Baldwin, Mutti and Richardson (1981). Third, the interaction between investment dynamics and employment dynamics is completely missing both on the demand and supply side. In medium term analysis this is of considerable importance for a number of reasons. Change in industrial structure through the entry and exit of firms will almost surely accompany a trade liberalization. With scale economies and indivisible capital and labour the opening or shutting down of plants will lead to significant changes in the demand for labour, and hence on wage rate and industry employment levels. The *rate* at which firms *enter* a profitable export market versus the *rate* at which firms *exit* an unprofitable import competing market will in all likelihood be an important demand determinant of the short-term impact on unemployment following a trade liberalization.[1] This is in sharp contrast to much of the conventional literature on factor demands which focuses on factor substitution. Needless to say the "entry effect" on employment will be more important the larger the share scale intensive industries have in total

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[1] Work by Baldwin and Gorecki (1985) concludes the 'turnover' rate among firms due to the tariff reductions in the 70's and early 80's was substantial, with substantial exit and entry.

economic activity. Labour market dynamics, however, "feed back" on the entry decision in important ways. The empirical literature of industrial organization emphasizes three determinants of entry and exit (i) growth in sales; (ii) profitability; and (iii) sunk costs. The labour market plays an important role in both (ii) and (iii). Profitability will hinge critically on wages the firm must pay for new and existing workers. Wages in expanding sectors, assuming labour mobility between sectors is sluggish, and can be expected to rise. This reduces profitability in expanding sectors and ceteris paribus will slow down new entry. Similarly, exits in contracting sectors will be mitigated if wages fall sufficiently to restore profitability.

A final and related problem with the short-term models is that they do not naturally integrate with the longer term models. This is in part due to the lack of any dynamics in the static models. The results of the static models are incomplete unless a sensible transition story can be told. Once the latter is accomplished a proper and appropriate methodology for estimating the dynamic costs of protection will be available, and more generally a medium term approach to welfare economics.

The model used in this paper addresses a number of these limitations through explicit dynamics both with respect to labour markets and industry exit and entry. The model does not, however, have a full intertemporal optimizing structure. The ad hoc approach to intertemporal substitution has the desirable feature of reducing computational requirements enormously in a disaggregated general equilibrium model.

The rest of the paper proceeds as follows. In section 2 a summary of the theoretical structure of the model is given. Section 3 contains a discussion of calibration and parameter values. Sections 4 and 5 discuss the CAFTA policy simulations and model sensitivity. Section 6 concludes with some remarks as to where how these results relate to those found in the literature, and the limitations of the analysis.

2. A Dynamic General Equilibrium Model of the Small Open Economy

In this section a simplified two sector version of the larger scale applied G.E. model of Canada–U.S. trade is presented. The model has a number of characteristics in common with a wide variety of disaggregated G.E. models which have been used in trade and public finance.

1. In terms of its dynamic-expectational structure it has much in common with the Hicks temporary equilibrium structure. Expectations are not fully rational and a distinction is drawn between plans and realizations.

2. The model is similar in terms of some of the basic dynamics and benchmarking procedures to the sequenced neoclassical growth models used recently in applications to U.S. tax policy.

3. On the trade side, the model retains for most commodities the basic Armington structure in which foreign and domestic goods of the same commodity type are treated as imperfect substitutes in production and consumption. [See Deardorff and Stern (1981) and Whalley (1985).]

4. Some of the basic features of imperfect competition and scale economies used in earlier static G.E. models [see Harris (1984)] are retained in this model. However these characteristics can have quite different short run as opposed to long run implications.

5. As with many of the trade policy models, the labour market is treated as having sluggish nominal wage adjustment. Unemployment though results *both* from lack of instantaneous adjustment of labour demand to labour supply, but also from turnover between the employed and unemployed. The model has both frictional or natural rate type unemployment and demand determined unemployment.

6. As is common in almost all of the applied general equilibrium models, money, asset markets, and exchange rates are ignored. To be specific the nominal exchange rate is treated as fixed. This is a modelling strategy which is obviously problematic, however it avoids a great deal of complication and controversy regarding exchange rate determination. Attention thus shifts to external balance in policy simulations.

In the miniature model there are two sectors, a constant returns to scale resource/services sector, indexed with subscript c, and an imperfectly competitive manufacturing sector, in which scale economies exist at the firm level, indexed with a subscript m. The economy is a price taker in both commodity markets and financial markets. There are three regions; Canada, U.S. and R.O.W. (superscripts c, u, and r). U.S. and R.O.W. income, supply prices, and interest rates are taken as exogenous. In addition is is assumed:

a) world nominal prices are fixed for all time periods t

b) exchange rates between regions are fixed and = 1.0 (normalized).

c) U.S. and R.O.W. real income, Y^u, Y^r, grow at a constant rate ρ

d) Canadian trend growth rate equal to ρ

e) world real interest rate = ρ^* = Canadian real interest rate

(a-e) are necessary for the model to have a non-inflationary steady-state Harrod-neutral growth path, with constant foreign debt to G.D.P. ratio,[2] as a possible equilibrium path.

Technology in both sectors 'within a period' is fixed coefficients. In

[2] The debt/GDP ratio on the steady-state path is given by $\gamma/(\rho^*-\rho)$ where γ is the ratio of the trade surplus to G.D.P.

the manufacturing sector there are N_m firms; each firm has a technology characterized by constant unit variable costs of production and fixed costs. 'Across periods' factor proportions are variable and firms can enter or exit the manufacturing sector. There are two factors of production, capital and labor. The ex ante unit isoquants are given by

$$F_c\left(a_c, b_c\right) = 1$$
$$F_m\left(a_m, b_m\right) = 1 \tag{1}$$

where F_m, F_c are 'neoclassical' production functions, and a_c, b_c are the unit output capital and labor requirements respectively. Dual to (1) are the unit cost functions

$$f_c\left(v_c, w_c\right)$$
$$f_m\left(v_m, w_m\right) \tag{2}$$

with v_c the shadow rental rate on capital in the c sector, and w_c the shadow wage rate in the c sector. To simplify notation and presentation the model is presented as if the Harrod-neutral technical change trend parameter is zero, and tariffs and taxes are zero.

Demand in the economy, within any period consists of domestic consumption, investment, and exports. For a given level of nominal domestic consumption expenditure C, and "within period" utility, UT, there is an Armington CES expenditure function $H(\circ)$ satisfying

$$H\left[\left(p_c, p_c^u, p_c^r\right), \left(p_m, p_m^u, p_m^r\right)\right]UT = C. \tag{3}$$

Demand functions, given C and the vector of prices P, are generated by

$$d_c(P,C) = \left(H_{p_c} / H\right)/C$$
$$d_m(P,C) = \left(H_{p_m} / H\right)/C. \quad (4)$$

"Capital" in the economy is distinguished by sector but otherwise is a homogeneous aggregate accumulated by purchasing a homogeneous composite investment good. The investment composite, is a CES aggregate of all foreign and domestic goods of both c and m types. Let Q(P) be the CES dual price index to the investment quantity aggregator. Given a level of investment expenditure I, the investment demand for domestic goods by commodity type is

$$n_c(P,I) = \left(Q_{p_c} / Q\right) I$$
$$n_m(P,I) = \left(Q_{p_m} / Q\right) I. \quad (5)$$

Export demands in U.S. and R.O.W. are determined by a structure similar to that generating domestic demand. Each region is endowed with an Armington unit expenditure function $H^u(P)$ and $H^r(P)$. Exports from Home are determined by

$$e_c\left(P,Y^r,Y^u\right) = \left(H^u_p / H^u\right)Y^u + \left(H^r_p / H^r\right)Y^r$$
$$e_m\left(P,Y^r,Y^u\right) = \left(H^u_m / H^u\right)Y^u + \left(H^r_m / H^r\right)Y^r. \quad (6)$$

On the government side, domestic real commodity demands, $\left(g_c, g_m\right)$ are treated as exogenous rather than nominal expenditures. Government real commodity demands grow exogenously at the rate ρ.

b) Model Dynamics/Price and Output Determination

At the *beginning* of each 'period' there is a list of endogenous variables which, from the point of view of an economic statistician, are observed as constant *over* the period. These "state" variables are listed below.

STATE VARIABLES

e_c, e_m	u_c, u_m
k_c, k_m	p^u, p^r, Y^u, Y^r
C, I, (g_m, g_c)	
(a_c, b_c), (a_m, b_m)	w_c, w_m

Given these state variables the short-run supply curve in each industry is vertical and given by

$$y_c^s = \min\left[\frac{e_c}{b_c}, \frac{k_c}{a_c}\right]$$
$$y_m^s = \min\left[\frac{e_m}{b_m}, \frac{k_m}{a_m}\right]. \qquad (7)$$

Let Y* denote (Y^u, Y^r). Demand by commodity is given by

$$y_c^d = d_c(P,C) + n_c(P,I) + e_c(P,Y^*) + g_c$$
$$y_m^d = d_m(P,C) + n_m(P,I) + e_m(P,Y^*) + g_m. \qquad (8)$$

Domestic commodity prices are determined within each period by equating demand and supply in a Walrasian fashion. These equilibrium prices depend on supply conditions in each industry, foreign prices, and aggregate expenditure plans. The "real commodity" side of the model within each period is exogenous. The dynamics of the model determine how the real side evolves.

Expectations and plans on output, prices and demand, are determined in a recursive fashion. The set of expectations and plans, while not rational, is quasi-rational in the sense that the true economic structure is used so that there is a basic consistency between plans and expectations. This will be apparent below. We start with an exogenous expectations generating mechanism on factor prices. For example using regressive expectations, expected factor prices in the m-sector are given by

$$w_m^e(t + 1) = \lambda w_m(t) + (1 - \lambda)w_m(t - 1)$$

$$v_m^e(t + 1) = \lambda v_m(t) + (1 - \lambda)v_m(t - 1). \tag{9}$$

$v_m(t)$ is the ex post rental rate on capital services in the m-sector given by $v_m = (r + \delta_m)Q + (Q - Q_{-1})/Q_{-1}$.

Expected commodity prices are determined by the equations

$$p_m^e = \psi f_m\left(w_m^e, v_m^e\right)$$

$$p_c = f_c\left(w_c^e, v_c^e\right) \tag{10}$$

$$Q^e = Q\left(P^e\right).$$

In the m-sector ψ is the gross markup on unit marginal cost. ψ is determined as in Harris (1984) by a combination of factors including the perceived elasticity of demand, and the price of competing imports. Note that in this model monopoly power is exploited only in an ex ante sense, through the determination of future supply. Prices ex post are simply market clearing.

Anticipations by firms on expenditure aggregates are generated by the following simple macro model.

$$Y^e = (1 + \rho)Y + \lambda_Y \Delta$$

$$I^e = Q^e[(\delta_c k_c + \delta_m k_m) + \rho(k_c + k_m) + \lambda_I \Delta(K/Y)] \qquad (11)$$

$$C^e = \beta Y^e$$

$$\Delta = Y(t) - (1 + \rho)Y(t - 1).$$

β is an average and marginal propensity to consume, and λ_Y, λ_I are "accelerator" coefficients on anticipated income and investment, Y is aggregate disposable income, and K is the aggregate capital stock.

Given (10) and (11) anticipated commodity demands are generated using the "true" demand relationships of the model.

$$d_c^e(p^e, C^e)$$

$$n_c^e(P^e, I^e)$$

$$g_c^e = (1 + \rho)g_c \qquad (12)$$

$$e_c^e = e(P^e, Y^{*e})$$

$$Y^{ue} = (1 + \rho)Y^u$$

$$Y^{re} = (1 + \rho)Y^r.$$

Firms set planned output by a rule of lagged adjustment towards *anticipated demand.* Planned output in the c-sector is given by

$$y_c^P = \tau\left(d_c^e + n_c^e + e_c^c + g_c^e\right) + (1 - \tau)(1 + \rho)y_c. \qquad (13)$$

In this sense the model has some important Keynesian features in that an increase in *anticipated demand* must precede an increase in actual output (above trend).

Choice of technique (ex ante factor substitution) occurs in a similar way. Firms adjust with a lag, at rate τ, towards the expected cost minimizing technique choice.[3]

$$a_c^P = \tau f_{mv}\left(w_m^e,\ v_m^e\right) + \left(1 - \tau\right)a_c. \tag{14}$$

c) The Labour Market

The labour market is the major constraint on firms achieving their plans. In the short run labour is sector specific but subject to frictional turnover using a Brechling-Hall-Feldstein type model of labour market turnover within each sector. Over time however, the stock of unemployed by sector will change as people quit searching for a job in one sector and search for jobs in the other sector. This intersectoral turnover rate is an important determinant of aggregate adjustment speed.

Desired stock labour demands are given by

$$\ell_c^P = b_c^P y_e^P \qquad \ell_m^P = b_m^P y_m^P. \tag{15}$$

Let us denote by:

- V : the number of workers who are potentially available to work in either sector c or sector m
- μ_r : intersectoral turnover rate
- μ_a : intrasectoral turnover rate.
- U : the total beginning of period stock of unemployed

V is determined according to

$$V = \mu_r U + \rho L. \tag{16}$$

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[3]f_{mv} denotes $\partial f_m(w,v)/\partial w$.

In any period however, it is assumed to be too costly to search in more than one sector. Thus while V is the stock of potentially mobile workers, a fraction α_c, of these workers will actually search for jobs in the c sector. The search process takes each worker at a minimum *one* period. α_c is determined on a fairly simple basis using relative expected wages. Thus we define

$$\begin{aligned}
\pi_c &= \frac{e_c}{e_c + u_c} && \text{: employment probability in sector c} \\
\hat{w} &= \pi_c w_c && \text{: expected wage in c} \\
s_c &= e_c/E && \text{: employment share of sector c} \\
\alpha_c &= \frac{\hat{w}_c}{\hat{w}_c + \hat{w}_m} && \text{: "relative" expected wage in sector c.}
\end{aligned} \tag{17}$$

Note that a steady-state can only occur if $w_c = w_m$ and $\alpha_c = s_c$. Thus wages across sectors must be equalized in the long run.

Flow labour demand in c is given by

$$m_c = \ell_c^P - (1 - \mu_a)e_c \tag{18}$$

and flow labour supply by

$$n_c = \varepsilon u_c. \tag{19}$$

ε is the fraction of the unemployed sector specific labour force which if offered jobs will accept. In order to get a new job offer in sector C one must be unemployed in sector C at the beginning of the period. The number of *actual* jobs created in sector c, j_c, is given by a short-side-of-market rule:

$$j_c = \min\,(n_c,\ m_c). \tag{20}$$

The employment and unemployment dynamics in each sector evolves according to the identities

$$
\begin{aligned}
e_c(t+1) &= (1-\mu_a)e_c(t) + j_c \\
u_c(t+1) &= e_c(t) - e_c(t+1) + \alpha_c V + (1-\mu_r)u_c(t) \\
&= \alpha_c V + (1-\mu_r)u_c(t) + \mu_a e_c(t) - j_c .
\end{aligned}
\tag{21}
$$

The model has the characteristic that each sector has a natural rate of unemployment given by

$$\bar{u} = \frac{\rho + \mu_a}{\rho + \mu_a + \varepsilon} , \tag{22}$$

and furthermore this is the natural rate for the economy as a whole given that the parameters $(\varepsilon, \rho, \mu_a)$ are common across sectors. A more complex model would involve sectors with different natural rates. In this case the aggregate unemployment rate would change in response to changes in the sectoral composition of output.[4]

Within the period wages are negotiated for the next period, as are commitments to take on labour, or to lay off labour. Nominal wages are set in each sector according to a sluggish wage adjustment equation

$$\frac{w_c(t+1) - w_c(t)}{w_c(t)} = \frac{K}{A_c}\left(m_c - n_c\right) \tag{23}$$

with $K > 0$ a wage adjustment coefficient common to both sectors, and $A_c = |m_c| + |n_c|$ is a scaling factor.

Since inflation in the model is identically zero, (23) can be

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[4]Lillian (1983) is one well known attempt to explain past unemployment rates using sectoral shifts.

interpreted as a type of Phelps-Friedman Phillips curve at the sector level. $m_c - n_c$ reflect deviations from the sectoral natural rate of unemployment. For example if m_c exceeds n_c then the observed unemployment rate in the c sector is likely to be below the natural rate for the sector. (23) has the advantage that it is expressed directly in terms of labour demand and supply flows which affect wage setting.

d) Capital and Entry Dynamics

Capital is accumulated via purchase of an investment composite of all foreign and domestic goods. At the sectoral level then investment involves purchases of both foreign and domestic capital goods. Investment, however, is irreversible by sector. Once investment takes place in a sector, the capital stock in that sector can only be reduced by depreciation or exits. In the competitive c-sector the desired capital stock is

$$\hat{k}_c = a_c^P y_c^P \tag{24}$$

and gross investment in sector c

$$i_c = \max\left[\hat{k}_c - \left(1 - \delta_c\right)k_c,\ 0\right]. \tag{25}$$

In the m-sector there is the additional complication that there are fixed costs and the number of firms N_m will change from period to period. Assume for simplicity that the only fixed cost is a capital service rental flow per period equal to $v_m k_f$ per period. k_f is therefore the required fixed capital stock per firm in the m-sector. Let $O_m = y_m/N_m$ denote the per firm output level, or an index of production run length in one year. Define

$$\Pi_m = \frac{p_m O_m - f_m O_m - v_m k_f}{p_m O_m}, \tag{26}$$

as the rate of excess pure profit over sales in industry m. Let

$$SG_m = \frac{Sales_m(t)}{Sales_m(t - 1)} \tag{27}$$

be the rate of industry sales growth in sector m. The entry/exit equation in sector m is given by

$$N_m(t + 1)/N_m(t) = [SG_m + \lambda_\pi \Pi_m]. \tag{28}$$

λ_π is the elasticity of entry with respect to profit/loss in the m-sector. Note that if $\Pi_m = 0$, the number of firms in the industry grows at the same rate at which sales grow.

Desired capital stocks in the m-sector are given by

$$\hat{k}_m = a_m^P y_m^P + N_m(t + 1)k_f, \tag{29}$$

and gross investment is given by

$$i_m = \max [\, \hat{k}_m - (1 - \delta_m)k_m,\ 0]. \tag{30}$$

In the event that $i_m = 0$, so an industry is contracting, the exit rate is bounded above by $(1 - \delta_m)$. This is an essentially ad hoc assumption to ensure consistency. Economically it means that in severely declining industries, exit occurs at a rate coincident with the rate of depreciation of the industry's capital stock. For industries with large numbers of firms it may not be too bad an assumption, but is obviously deficient as a micro based exit decision when firm numbers are small in a given industry. Once gross investment plans are determined actual capital stocks next period are determined via the usual accumulation equation. Capital services available for use over a period include the average services of investment goods purchased during the period.

e) Next Period's Nominal Expenditures

Agents are assumed to set nominal expenditure targets for the next period, and aggregate expenditure targets are assumed to be realized. In the case of investment, *target expenditures are set by*

$$I(t + 1) = (i_m + i_c)Q(P^e). \tag{31}$$

In the case of consumption the simple Keynesian consumption function of (11) is used, so

$$C(t + 1) = C^e. \tag{32}$$

f) Policy Simulations

The model is implemented with a full set of tax and tariff distortions. The reference equilibrium path is a steady state exponential growth path with all real aggregate variables growing at rate ρ. The model is constructed so that the steady-state growth rate of the model is *independent* of (1) tax and tariff rates, (2) trade elasticities, and (3) economies of scale parameters.

With these assumptions the emphasis is on the transition from one long-run equilibrium to another. Note that employment must return for any trade policy shock to its long-run growth path, but "real" output converges to a higher or lower long-run growth path, but with the same growth rate. Thus a trade liberalization has the potential for affecting unemployment rates *only* in the transition period from one steady state to another.

In a growth model, "static" welfare gains can be thought of as the difference between two steady-state growth paths, one before and one after the policy change.

3. Data and Benchmarking Procedure

As in all applied general equilibrium work a substantial portion of the effort involves putting together the basic data and calibrating the model, or "benchmarking" as the procedure has become known in the trade. The empirical model involves twenty-nine sectors and thirty commodities; each industry produces one commodity; commodity thirty corresponds to non-competing imports. The twenty-nine industries are divided into three mutually exclusive groups. The first group consists of the twenty manufacturing industries at the two-digit SIC level. Four of the industries correspond to the resource industries -- agriculture, forestry, fishing, and mining (including oil and gas). The remaining industries can be thought of collectively as services. The manufacturing sector is treated as potentially imperfectly competitive with increasing returns, entry and exit. Firms use capital, labour, and intermediate goods, both foreign and domestic, to produce industry output. In the resource sectors there is an additional factor which is sector specific and induces static diminishing returns to scale, and resource rents in each industry. To preserve a steady-state structure it is assumed sector-specific resource augmenting technical change occurs at the annual growth rate in each of the resource sectors. This assumption, familiar from the growth literature, ensures that resource industries do not decline relative to the rest of the economy over time. The service industries are similar to the manufacturing industries except that they are constant returns to scale and perfectly competitive. At the commodity level, as described, the Armington assumption is employed for both the manufacturing and service sectors, while foreign and domestic goods are treated as homogeneous in the resource sectors. The Canadian economy is presumed to be a price taker in its import markets, but given the imperfect substitutability between foreign and domestic goods in the manufacturing and service sectors, there are twenty-five endogenously determined domestic prices.

The basic data consists of a collection of input-output data, national accounts data, trade data, and miscellaneous data sources on Canadian industry. The first step in benchmarking was to construct a "typical" data year for the Canadian economy over the period 1977-1980. This was done by constructing geometric averages of the major product and income flows. For example an average input-output table deflated to the year 1978 was constructed by taking geometric averages of three constant dollar input-output tables from 1977, 1978, and 1979. The net result of all this was to get a data set for 1978 assuming the economy to be in steady state Harrod neutral growth.[5] The restriction on the real interest rate is imposed by the steady state growth assumption given an observed investment level, capital stock, and growth rate. In the model the implied steady state real interest rate 10.8 percent. Similarly an observed benchmark trade deficit implies the economy be a net external creditor. Steady state growth implies a constant external asset/GDP ratio.

On the production side inputs are aggregated up to capital, labour, resources, and materials sub-aggregates. The material aggregate consists of all foreign and domestic goods corresponding to the manufacturing and service industries. The top level aggregator is taken to be Cobb-Douglas. The material and resource aggregates are Leontief aggregates of each

[5]The details of the benchmarking procedure are available in Kwakwa (1988), chapter 4.

sub-component corresponding to the basic commodity level in the model. In turn each basic commodity is taken to be a C.E.S. aggregate of foreign and domestic commodities. Within the manufacturing industries fixed costs are determined by a Leontief sub-aggregate of capital and labour; there are no material or resource inputs entering the fixed cost function.

On the consumption side there are thirty basic high level commodities. In services and manufacturing each basic commodity is a C.E.S. aggregate over a domestic good, U.S. good, and R.O.W. good. The top level aggregator for the results reported in this paper was taken to be Cobb-Douglas. Export demand functions are as described in the previous section.

Elasticities of substitution between foreign and domestic goods were set using import price elasticities obtained from Hazeldine (1981). The underlying substitution elasticities in the U.S. and R.O.W. expenditure functions were parameterized using import price elasticity ranges from Stern et al. (1976). Note that in this steady-state growth framework all income elasticities are necessarily equal to unity.

The scale economies are the same as those adopted in Harris and Cox (1986). These in turn were constructed from econometric estimates and selected engineering estimates. Total cost elasticities for manufacturing plants range between 0.80 and 0.97. An important part of the pricing mechanism in the earlier work on imperfect competition involved the Eastman-Stykolt (1960) pricing hypothesis. In the model the pricing hypothesis used is similar to that in Harris and Cox (1986). The interpretation however is different from the static model in that the Eastman-Stykolt import competing price effect only acts to determine the ex ante *target* prices firms expect to be able to sell at. Ex post the actual prices are determined by supply equal demand conditions. This relatively indirect mechanism in the model substantially reduces the impact of changes in import prices on domestic prices and markups.

On the labour market side there are three important parameters. The intersectoral, and the intersectoral turnover rates, the hire rate ε (for lack of a better term), and the rate of adjustment of nominal wages to excess supply or demand in each sector. As a benchmarking strategy it was decided to take the average level of unemployment in aggregate over the three years 1977-79 as the natural rate of unemployment.[6] All the results of the model must be interpreted with the understanding that the terms of trade prevailing in both the benchmark and policy simulations are substantially different than those observed in 1985-1988 period.

There is a substantial empirical literature on turnover rates -- theoretically these turnover rates correspond with the intrasectoral turnover rate of the model. In addition there is a literature which relates to the rate at which firms acquire labour in response to excess stock demands. One is not allowed, however, freedom to choose each of these parameters, given equation (22) which determines the natural rate of unemployment. The strategy adopted has been to choose ex ante a turnover rate, and adjust the parameter ε so that (22) is consistent with the observed data. This is a

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[6] There is an obvious difficulty with this, unless one accepts the hypothesis that inflation was fully anticipated in these years. Furthermore, it was assumed that unemployment, which in the short run is sector specific, essentially mimics the aggregate within the benchmark equilibrium in each of the twenty-nine sectors. That is the natural rate of unemployment in each sector was equal to the aggregate unemployment rate. This is a dubious assumption if one is worried that either the adjustment to the high resource prices of that period was not complete, or that the high resource prices were not expected to be permanent.

standard problem with this type of modelling. It does force one to be consistent in parameter choice and to understand the limitations of any given model to mimic the data. In the model the growth rate is 3.7 percent, the natural rate of unemployment is 6.6 percent and the turnover rate is 3 percent; the latter means that one worker out of thirty changes jobs per year on average in a steady state situation. The data on turnover suggests that this is well within the range of observed turnover rates, and if anything is on the low side. More controversial is the intersectoral turnover rate. Recall this is the rate at which unemployed workers in one sector leave the sector they initially were laid off in or quit in, to search for work in other sectors. In this model 'sectors' are industries. The concept of industry specific unemployment is dubious to some if industries have a common locational and skill base. While accepting this limitation of the concept, it seems to be one which is useful and provides a tractable analytical manner to describe labour force immobilities associated with the host of factors limiting interindustry mobility. There is little direct evidence to appeal to in choosing this parameter, so for want of an alternative it was set for the central case at 0.10. Obviously carrying out sensitivity analysis on this parameter is of some importance. At a value of 0.10 it says that labour is relatively immobile between sectors, in that one out of ten unemployed workers per year will leave the sector they originated in to search for employment elsewhere. This would imply that large intersectorally-induced changes in demand through a policy shock will lead to relatively sluggish adjustment in mobility of labour between sectors, and substantial variation in unemployment rates across sectors.

Another aspect of the calibration process relates to the elasticity of entry with respect to profitability. A survey of the scarce empirical literature on this parameter suggested that it was extremely small. Many of the studies failed to detect statistical significance different from zero, as in Orr's (1974) study of entry in Canadian industry. A typical net entry equation is one specified by Deutsch (1975). The coefficient on "profit", defined as an average of annual price-cost margins over a four-year period, is given by 0.0374 with the dependent variable being the net entry rate over a four-year period. This implies an elasticity of entry with respect to profit on an annual basis of less than 0.010. The Deutsch equation fits most closely the one used in this model, although the definition of 'profit rate' is slightly different. At the outside the empirical estimates give a profitability response of less than 0.05. This means, for example, that an industry with normal growth in sales, but an excess profit rate of 100 percent on sales will see on average an additional 5 percent increase in the number of firms beyond that called for by normal industry growth. Given the importance of the rationalization of production in the transition following a trade liberalization it may seem that these modest profitability effects might mitigate the strength of the competitive process by which profits and losses induce entry and exit. In a dynamic model it must be remembered however that a great deal of this is accomplished through the rate of growth in sales. The extent to which entry lags growth or decline in sales will have some effect of scale economies achieved. In rapidly growing industries entry will lag sales growth and economies of scale will be realized. In declining industries exit will lag sales declines, and diseconomies of scale will occur in the short run. In the longer run, however, the profitability effect must ultimately impact on entry if economy wide efficiency in some crude sense is to be realized. In any case, this paper will report on simulations with entry elasticities comparable to those found in the literature, however they must be interpreted with caution.

The final key parameter value to be discussed is the rate of nominal wage sluggishness which is common across sectors. Recall that each sector is endowed with a type of Phelps-Friedman Phillips curve with wages adjusting sluggishly to above or below normal sector specific unemployment rates. There is a fairly substantial empirical literature on Phillips curves and wage adjustment, most of it concerned with the impact of inflationary expectations. This latter issue does not concern us here, but the role of 'excess demand/supply' pressures does. In the wage equation literature a large number of excess demand variables have been proposed involving measurements of vacancies and unemployment. A typical study would be one done recently for the O.E.C.D. by Coe and Gagliardi (1985). They come to the conclusion that the best excess demand variable is simply the inverse of the unemployment rate with an elasticity of wage increase of .107; that is a one percent increase in the inverse of the unemployment rate leads to a ten percent increase in the rate of wage increase. The Beveridge curve is an empirical relationship which claims that the product between vacancies and unemployment rates is a constant which in the late seventies averages between 10.0 and 12.0. [See Auld et al. (1979) for a well known Canadian study on the U-V relationship]. This implies that the Coe-Gagliardi wage coefficient on inverse unemployment rates translates into the statement that a one percent increase in the vacancy rate results in a 0.9 percent increase in wages. Given the scaling procedure used in the wage adjustment equation this number must be divided by at least two to give an approximate value for the K parameter in the wage equation, of approximately 0.045. In fact to convert the right hand side of equation (23) into a vacancy rate involves multiplying through by the ratio of twice average labor flow demand to average labor stock demand. With a growth rate of .035 and a turnover rate of 0.03 this number will be in the order of 0.26. In summary the range of plausible values for K will be somewhere in the range of 0.01 to 0.05. The upper and lower ranges can be thought of as corresponding to a relatively fast wage response regime and a relatively slow wage response regime. Obviously the model ought to have more Keynesian type features for low K and more classical features for high K. The remaining calibration corresponds to the small macro model imbedded in the firm's planning calculations. The parameters here were chosen from an average of parameters values for published small scale Canadian macro models.

Tables 3-1 through 3-3 describe the basic benchmark data and some of the relevant parameters.

Table 3-1

Base Equilibrium: Tariff Equivalent Trade Barriers

Industry	Canadian Tariffs		External Tariffs	
	U.S.	ROW	U.S.	ROW
1. Food & Beverage	0.065	0.078	0.096	0.440
2. Tobacco	0.197	0.199	0.325	2.15
3. Rubber & Plastic	0.131	0.138	0.103	0.415
4. Leather	0.150	0.171	0.118	0.096
5. Textiles	0.342	0.539	0.164	0.066
6. Knitting Mills	0.268	0.266	0.196	0.135
7. Clothing	0.226	0.256	0.206	0.135
8. Wood	0.134	0.132	0.116	0.147
9. Furniture & Fixtures	0.162	0.163	0.131	0.144
10. Paper & Allied Products	0.104	0.105	0.057	0.365
11. Printing and Publishing	0.035	0.035	0.061	0.345
12. Primary Metals	0.078	0.070	0.093	0.105
13. Metal Fabricating	0.085	0.089	0.121	0.135
14. Machinery	0.054	0.056	0.097	0.143
15. Transportation Equipment	0.068	0.088	0.030	0.059
16. Electrical Products	0.103	0.104	0.131	0.153
17. Non-Metallic	0.096	0.106	0.016	0.538
18. Petroleum & Coal	0.078	0.078	0.056	0.520
19. Chemical Products	0.082	0.080	0.074	0.541
20. Misc. Manufacturing	0.082	0.095	0.138	0.165
21. Agriculture	0.000	0.000	0.000	0.000
22. Forestry	0.000	0.000	0.000	0.000
23. Fishing	0.000	0.000	0.000	0.000
24. Mining	0.000	0.000	0.000	0.004
25. Electric Power	0.0001	0.0001	0.000	0.000
26. Transportation	0.049	0.049	0.000	0.000
27. Communication	0.052	0.052	0.000	0.000
28. Electric, Power & Gas	0.000	0.000	0.000	0.000
29. Others	0.010	0.010	0.000	0.000
Average	.091	.102	.117	.283

Table 3-1

Sources

Unpublished detailed compilation of tariff rates by commodity and trading area produced by the U.S. Special Trade Representatives Office. Information on 1976 Tariff Rates and Projected 1988 Rates under Tokyo Round. See Whalley, J.: Trade Liberalization Among Major World Trading Areas. 1985. Table 9.2 and Table D1. U.S. tariffs and NTB's on industries 21-24 were arbitrarily set equal to zero. The CAFTA left NTB's in these sectors largely intact.

Table 3-2

Base Equilibrium: Trade Price Elasticities

Industry	Import Elasticity	Export Elasticity	
		U.S.	ROW
1. Food & Beverage	-2.00	-1.38	-2.00
2. Tobacco	-2.00	-1.13	-2.00
3. Rubber & Plastic	-3.00	-3.89	-5.00
4. Leather	-2.00	-2.58	-5.00
5. Textiles	-2.00	-1.14	-2.00
6. Knitting Mills	-2.00	-1.91	-2.00
7. Clothing	-3.00	-3.92	-5.00
8. Wood	-2.00	-0.69	-2.00
9. Furniture & Fixtures	-3.00	-3.00	-2.00
10. Paper & Allied Products	-2.00	-1.00	-2.00
11. Printing and Publishing	-3.00	-3.00	-5.00
12. Primary Metals	-2.00	-1.40	-2.00
13. Metal Fabricating	-3.00	-3.59	-5.00
14. Machinery	-2.00	-1.02	-2.00
15. Transportation Equipment	-3.00	-3.28	-5.00
16. Electrical Products	-2.00	-1.00	-2.00
17. Non-Metallic Mineral Prod.	-3.00	-2.00	-5.00
18. Petroleum & Coal	-2.00	-0.96	-2.00
19. Chemical Products	-3.00	-2.53	-5.00
20. Misc. Manufacturing	-3.00	-2.06	-5.00
21. Agriculture	-2.00	-3.41	-5.00
22. Forestry	-2.00	-0.22	-2.00
23. Fishing	-2.00	-0.27	-0.80
24. Mining	-2.00	-2.90	-0.80
25. Electric Power	-2.00	-1.00	-1.00
26. Transportation	-1.00	-1.00	-2.00
27. Communication	-1.00	-1.00	-2.00
28. Electric, Power & Gas	-1.00	-1.84	-2.00
29. Others	-2.00	-1.00	-2.00

Sources: Stern, et al. (1976) Price Elasticities in International Trade, and Hazeldine (1981). Import price elasticities were adjusted to reflect high, low and medium import substitution possibilities.

Table 3-3

Steady State Base Data Set: Selected Statistics

Variable	Period			
	1	4	7	10
RGDP[1]	90671	100431	111240	123212
Unemployment Rate	0.066	0.066	0.066	0.066
Trade Balance[1]	-1516	-1679	-1861	-2060
Production Run Length Index	9.7	9.7	9.7	9.7
Markup Index[2]	1.09	1.09	1.09	1.09
GNP Deflator	1	1	1	1
Net Indebtedness[1]	-22928	-25396	-28129	-31158

[1] In thousands of constant 1971 dollars.

[2] The markup index is an output weighted average of price over marginal cost in the manufacturing industries.

Key Model Parameters:

Intrasectoral Labour Turnover Rate:	0.03
Intersectoral Labour Turnover Rate:	0.10
Elasticity of Entry with Respect to Profits:	0.05
Rate of Wage Adjustment:	0.04
ESH Weighting Parameter in Pricing Rule:	0.5
Interest Rate:	0.108
Model Growth Rate:	0.0346

4. Trade Policy Simulations

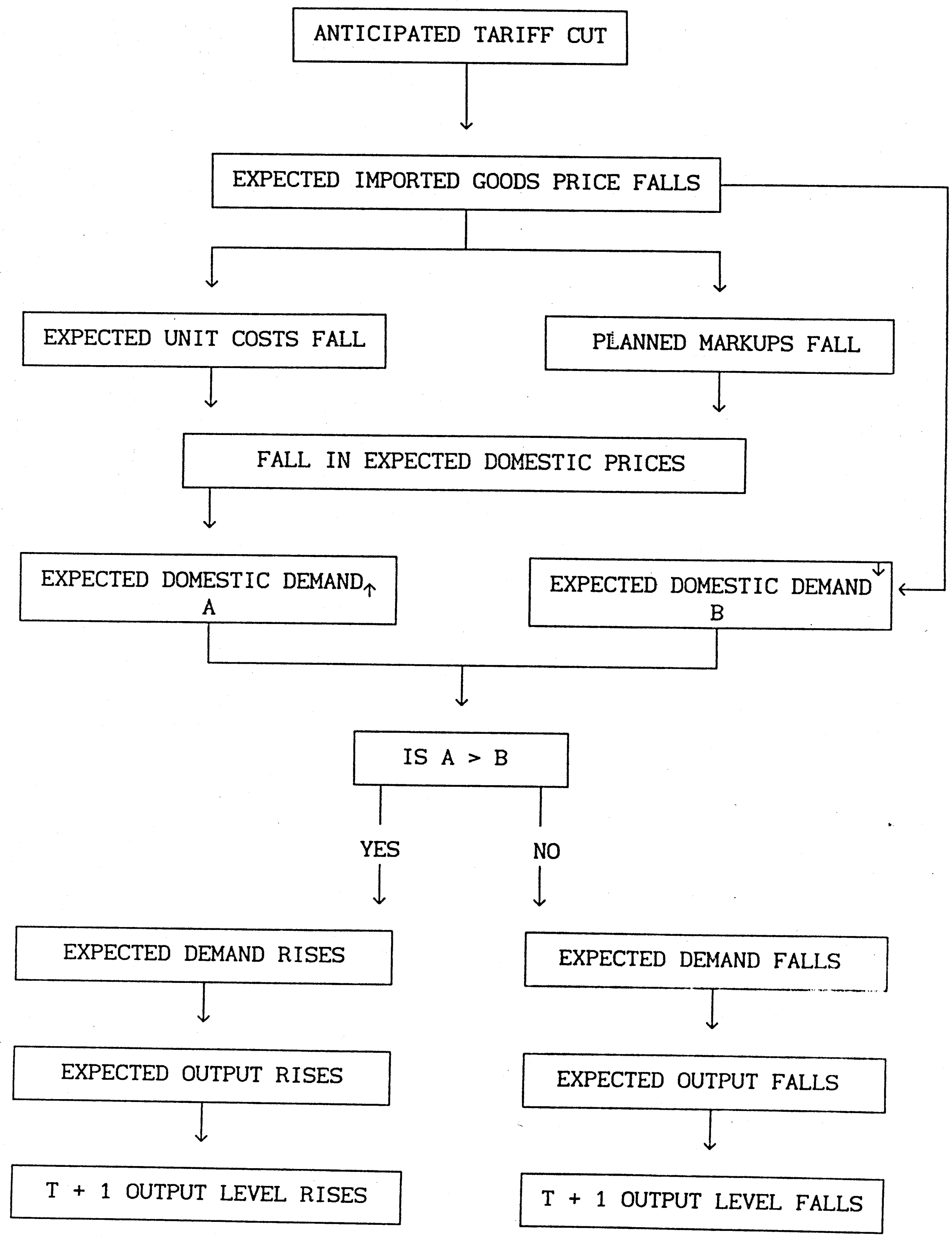
In this section we report both "unilateral tariff reduction" (UTR) defined for our purposes as removal of Canadian trade barriers against the U.S., and results of simulating some elements of the CAFTA agreement, or "bilateral free trade",(BFT). These policy experiments were simulated by the removal of relevant trade barriers through a ten-year uniform linear cut of all barriers in tariff equivalent form. Results are reported for a twenty-year period, with the transition period corresponding to the first ten years.

In conducting these trade policy simulations, we assume that the tariffs are phased out over a ten-year period. We begin in the first period, at the initial level of the tariff which in subsequent periods is reduced by a fixed amount such that by the end of the tenth period, the tariff level is reduced to zero. We assume that individual agents, both consumers and producers know the initial level of the tariff as well as the tariff cutting formula. Thus in any given period, agents know the level of the current period tariff as well as what the next period's tariff level will be. The impact of the tariff cut that actually takes place in period t, then begins in the previous period, t-1 as agents anticipate this cut and incorporate it into their current period (t-1) planning. Before presenting the results of the analysis, we discuss the main mechanism by which a tariff cut impacts on output and employment in this model. The diagram, figure 1, illustrates this transmission mechanism.

As producers anticipate lower levels of domestic tariffs on foreign goods and the consequent fall in the price of the imported substitute good, they anticipate lower unit costs. The planned markups are correspondingly lower due to the Eastman-Stykolt effect. These two effects together lead to

Figure 1

Impact of Anticipated Tariff Cuts



Note: The movement in these variables is relative to steady-state levels.

lower anticipated domestic producer prices and thus to lower expected domestic consumer prices. As the price of both the domestic good and the foreign substitute good fall, the net impact on the anticipated demand for domestic goods depends on the relative strengths of these two effects on domestic demand as well as on the extent to which domestic producer and consumer prices are expected to fall, and cannot be determined a priori. In other empirical CGE models, notably the Michigan model (Deardorff and Stern (1986)) and the Orani model (Dixon et al. 1982) the only initial impact of a cut in domestic import tariffs on demand for the domestic good, is the adverse substitution effect since the price of the domestic good does not change on impact. In the Michigan Model then such policy is contractionary in its impact on employment. In this model such a policy could be contractionary or expansionary in this regard. In the event that anticipated demand increases, there is a corresponding increase in planned output levels leading to increased demand for primary factors of production for next period which in turn leads to higher actual primary factor use levels next period and hence higher actual output levels. However, the full impact of the cut on output may not materialize since there are constraints on actual employment levels for next period. Employment levels must be consistent not only with the higher desired employment levels but also with the flow labour supply determined by labour turnover parameters,and by labour force growth. To the extent that flow demand exceeds flow supply, the full impact of the anticipated tariff cut on supply will not be realized. Thus the tariff cut that actually takes place in period t, influences supply in period t through anticipation effects in period t-1. When the cut actually occurs, the supply impact has already taken place and it impacts on period t prices such that demands are brought into equality with the new levels of supply. Though wages are treated as sticky in this model, this is not crucial to the positive impact of domestic tariff cuts. Ex ante supply is partially demand determined and to the extent that anticipated demand increases, if the labour market constraint is not excessively binding, actual output increases.

In period t, anticipated levels of the income and investment aggregates are affected by the tariff. In particular, the loss in tariff revenues impacts adversely on these aggregates and since these affect anticipated demand for domestic goods, it may offset somewhat the positive impacts of the anticipated tariff cuts for the ensuing period.

If anticipated demands decrease below steady-state levels, then the result would be the reverse of what has been described and the tariff cut could end up being contractionary. Whereas actual output each period is given, and the supply curve is vertical at the level of output determined by the predetermined factor input levels, ex ante output is completely demand determined and hence an increase in anticipated demands must precede any increases in actual output. The assumption that agents know the tariff cutting formula and incorporate them into their planning strategy allows this effect to be realized. Cuts in U.S. tariffs on domestic goods will have similar effects as those explained above.

In the manufacturing sector, a domestic tariff cut will impact adversely on industry profitability, and will lead to exit by firms thus inducing industry rationalization and greater efficiency in production. In this model, this effect may be mitigated since profits are not the sole determinants of the entry/exit decision by firms. Entry is influenced as well, by the rate of sales growth and since the actual output effect is in large part demand determined, it may have no direct relation to industry profitability and the two determinants need not move in the same direction. In the resource sectors however, planned outputs are determined from the ex ante profit function and expected prices are again extremely important in determining the output.

We now discuss the main themes evident in the results. Tables 4-1 and 4-2 give a more detailed account of each individual experiment results. In each table we report the change in the variables listed, relative to their steady-state levels.

(i) In both experiments, aggregate output, employment and labour productivity levels increase above steady state levels in most periods. The unemployment rate dips only marginally below the steady-state natural rate level in all cases. However this is consistent with the modest increases in employment levels given the larger gains in aggregate productivity. This result is at variance with the widely held notion that domestic tariff reductions will lead to job losses, increasing unemployment at the industry and possibly aggregate level. As explained above such an outcome is not inconsistent with this model but the results suggest that the opposite outcome prevails.

(ii) In all cases there is some industry rationalization but these are modest compared to those obtained in similar models eg. Harris-Cox (1984) find that under UTR and Multilateral Free Trade between Canada and her trading partners, the index of production run lengths is increased by 41% and 67% respectively in the new long-run equilibrium. In this study, the highest increase in production run length index above steady-state is 6.56% obtained

Table 4-1

Selected Statistics

Base Relative to 10 year Phased-in Tariff Reduction

by Canada on Imports from the U.S.

Aggregate	Year 2	Year 6	Year 10	Year 20
RGDP	-0.034	0.631	2.169	2.748
AEMP	0.064	0.053	0.346	-0.011
UNR	-0.001	0.000	-0.003	0.000
AGLP	0.158	1.041	2.688	4.093
TS	14.828	11.991	38.880	25.088
ATVOL	0.569	3.482	7.531	8.780
AVGW	0.213	1.702	4.233	5.182
PRLI	0.422	1.917	3.903	5.099
MKUP	-0.165	-1.375	-2.659	-3.204
GDEF	-0.079	-1.092	-1.990	-2.473
DEBT	-0.000	0.007	0.027	0.114
Percentage change in Present Value of RGDP over 20 years at 10 percent				
Percentage change in P.V. of Consumption				
Percentage change in P.V. of terminal (year 20) capital stock				
P.V. of Adjustment Cost as % of base GDP				

Note 1: All changes other than UNR are changes relative to the benchmark steady-state. In the case of the unemployment rate (UNR) the number reported is the absolute change in the rate.

Note 2: The trade surplus is in deficit in the base, so a positive number indicates a deterioration in the trade deficit.

Notes to Tables: Variable Definitions

RGDP: Change in Real GDP
AEMP: Change in Aggregate Employment
UNR: Change in Aggregate Unemployment Rate

AGLP: Change in Aggregate Labour Productivity
TS: Change in Trade Surplus
ATVOL: Change in Aggregate Trade Volume
AVGW: Change in Average Nominal Wage
PRLI: Change in Production Run Length Index (manufacturing industries)
MKUP: Change in Realized Markups
GDEF: Change in GNP Deflator

Adjustment Cost: defined as the loss in employment relative to base in each industry times base wage, summed over all all industries.

Table 4-2

Selected Statistics

Bilateral Free Trade

Base Case[1]

Aggregates	Year 2	5	10	20
RGDP	0.058	1.165	3.998	4.172
AEMP	0.095	0.296	0.689	-0.032
UNR	-0.001	-0.003	-0.006	-0.00
AGLP	0.216	1.274	3.927	5.044
TS	7.191	-0.983	31.746	37.267
ATVOL	0.912	4.499	12.454	13.609
AVGW	0.287	2.256	7.983	9.219
PRLI	0.576	2.148	5.469	6.557
MKUP	-0.084	-0.837	-2.889	-3.921
GDEF	-0.452	-0.452	-0.663	-1.106
DEBT	0.000	0.003	0.025	0.118
Percentage change in Present Value of RGDP over 20 years at 10 percent				2.190
Percentage change in P.V. of Consumption				0.673
Percentage change in P.V. of terminal (year 20) capital stock				9.795
P.V. of Adjustment Cost as % of base GDP				-1.401

1. See notes to table 4-1.

in the 20th period of the BFT experiment. One explanation for this difference is that entry/exit is also directly related to the rate of sales growth. Given such low values for the elasticity of entry with respect to profit parameter, (0.05) much of the entry and exit dynamics are determined not by profitability but by the sales growth rate which in all cases rises above steady-state levels in line with the output increases. Thus the industry details of the results indicate that in all twenty manufacturing industries, firm growth exceeds steady-state levels. Nevertheless there is still a rationalization effect since the rate of growth of firms lags behind the rate of growth of output and sales over time. Although the number of firms increases above steady-state levels, the length of production runs increase. Thus the rationalization effect referred to here is not used in the usual sense to indicate an absolute decline in the number of firms in the industry, but may be interpreted as dynamic rationalization whereby growth in the number of firms lags behind output growth rates. Markups also fall by a smaller amount than was obtained in Harris-Cox (1984). The largest percentage fall below steady-state level is 3.96% occurring in the sixteenth period of the BFT experiment. The modest fall in price-marginal cost markups may hinge on the distinction between plans and realizations in this model, highlighted by the differences in impacts on planned and realized markups. Planned markups are not reported here but fall to a larger extent than realized markups do. Presumably in a model where all plans were perfectly realized, tariff impacts would be larger.

(iii) Trade volumes increase as both imports and exports increase. In the BFT experiment, imports increase by a greater percentage than exports, leading to a deterioration the trade balance and the current account. This suggests there would be pressure for some depreciation in the value of the Canadian currency in the medium term. In the UTR experiments, the same is true. Imports increase more than exports, leading to a deterioration in the trade balance and the current account as the external asset position is eroded. In the BFT experiment, the index of intra-industry trade falls, indicating that some of the increase in trade volume is due to an increase in inter-industry as opposed to intra-industry trade. However the change in the intra-industry index is small. The terms of trade deteriorate slightly in the case of UTR, and improve slightly for BFT with the U.S.

(iv) In all experiments, an aggregate labour reallocation index hardly changes. It is striking that the impacts on output and employment occur right from the second period and are consistently positive, with the impacts getting stronger over time until the tenth period, the last period of tariff cuts. Beyond this period, the general trend in most of the variables is a leveling off relative to trend suggesting eventual convergence to a new steady state.

(v) The implementation of CAFTA gives rise to significant increases in nominal and hence real wages given the fall in imported and import competing goods prices. From a distributional perspective this suggests labor is the clearest winner from the agreement. Given that wages adjust to excess labor demand only, the sustained rise in wages implies that actual output is generally less than desired or target output for most of the ten-year phase-in period.

We expect, given the structure of the model, that employment will return to its base growth path but real output will converge to a higher long run growth path but with the same growth rate as in the base case. The UTR policy generally has a smaller impact than the BFT experiments with real GDP 2.7 percent above base after twenty years in the case of UTR versus 4.2 percent in the case of BFT. The results of alternative trade policy scenarios, indicate clearly that the short to medium term employment and unemployment impacts of such policies are not significant in aggregate. It would then appear that opposition to CAFTA on the basis of adverse employment impacts would be limited to a few industries. On the other hand, support for the CAFTA based on anticipated employment gains does not seem well founded based on these results. However, potential short to medium term gains in real output are impressive. These results are consistent with other studies in the literature. Baldwin and Lewis (1976) conclude that a substantial multilateral tariff-cutting exercise can be undertaken without causing significant adverse aggregate employment effects in the U.S. economy. They find this to be especially true when exchange rate variations are taken into account – making aggregate employment shifts minimal. Dixon et al. (1982), using the Orani model, conclude that in the short run protection does not have much to do with aggregate employment. While cuts in protection will destroy jobs in the import competing sector, activity and employment is stimulated in the export sector and the net employment impacts are found to be insignificant.

Notable in the results is the substantial improvement in labour productivity, which after ten years has risen by 3.4 percent. This productivity improvement is due largely to the improvement in scale efficiency achieved through rationalization. However the relatively slow rate of exit substantially diminishes the actual rationalization achieved.

No explicit welfare results are available because of the difficulty in using a finite horizon model to make such comparisons. At a ten percent social discount rate however, over the first ten years the BFT raises discounted aggregate Cobb-Douglas utility by 0.67 percent, and the present value of the terminal capital stock at year ten has risen by 4.8 percent. Offsetting this is a fall in the external asset/GDP ratio by 11.8 percent. It is not evident how one aggregates these effects into a single welfare statement, nor is the choice of an appropriate social discount rate.

5. Sensitivity Analysis

It is of crucial importance in light of uncertainty as to key parameter values in the model to undertake some sensitivity analysis. The parameters of particular interest are:

A. Trade Elasticities
B. Scale Elasticities
C. Labour Market Parameters
   (i) Wage Adjustment Parameter
   (ii) Labour Turnover Parameter
D. Weighting Parameter in Manufacturing Sector Pricing Rule

In each case, we computed the steady-state equilibrium of model with the different values of the parameters being considered. We then conducted the BFT simulation again, comparing results with the relevant steady-state. For each parameter, we considered two sets of values obtained by scaling the original values of the parameters upwards or downwards by some scaling factor. The results suggest that the robustness of the original results varies directly with the size of the original impacts obtained. In the case of the entry elasticity parameter and the scale elasticity parameter, results appear almost completely insensitive to differences in the parameter values. The parameters that seem to induce significant differences in impact when varied, are trade elasticities, and the weighting parameter on manufacturing sector pricing. We consider each of these in turn.

Trade Elasticities

Raising import elasticities will increase import substitution, making domestic industries more prone to import competition. This could reduce any positive effects on output and employment of the BFT. On the other hand, raising export elasticities could enhance the positive output and employment effects of U.S. tariff cuts. The case in which both elasticities are changed simultaneously could have a net impact which could go either way.

The results, presented in Tables 5-1 indicate that the higher the absolute value of trade elasticities, the larger the impact on output, employment and productivity.

The difference in impact appears larger for trade variables. In the BFT experiment, period ten trade volume impacts range from 25.4% above steady state levels when elasticities are doubled to 7.12% above steady state levels when elasticities are reduced by a half, compared to 12.5% above steady state levels obtained with the original set of elasticities.

The impact on markups in the manufacturing sector is higher with higher elasticity values and lower with lower elasticity values. In the tenth period of the BFT experiment, the fall below steady state levels in markups ranges from 5.25% when elasticity values are doubled, to 2.2% when elasticity values are cut in half, with the original impact at 2.9% below steady state levels.

The difference in impact appears pronounced in the production run length index. When elasticities are doubled, the tenth period effect in the BFT experiment is about twice as large as with the original trade elasticities. (10.1.2% versus 5.4% above steady state levels). With half the original elasticity values, this index increases by 3.4%.

Weighting Parameter in Pricing

Eastman-Stykolt (1960) pricing theory suggests that protected oligopolists set prices at world price plus tariff. The actual pricing equation is a weighted combination of monopolistic competition prices and Eastman-Stykolt prices. The weighting parameter in this section refers to the weight on the Eastman-Stykolt price.

Again the strength of the impact of various experiments are directly related to the size of this parameter. The greater the weight given to Eastman-Stykolt pricing, the larger the impact on most variables. The differences in impact appear most pronounced for the average economy-wide wage rate. With this parameter at 0.90, average wages rise 16% above steady state levels compared with the original impact of 7.9% above steady state levels, and 4.4% above steady state levels when the value of the parameter is 0.25.

Markups also fall by a bigger amount than originally (6.3% versus 2.9%). In line with this change in impact, there is a larger positive impact on production run lengths than before (the index changes by 8.6% versus 5.5%).

Labour Market Parameters

Scaling down the wage adjustment parameter slightly reduces the original output and aggregate productivity impact of BFT. However, the employment and unemployment impacts are slightly larger than previously obtained. These are reported in Table 5-3. In BFT employment levels exceed steady state levels by 1.07% in the tenth period compared to 0.69% at the original parameter value. As can be expected, the average wage increases to a much smaller extent than before. Doubling the size of this parameter gives changes in impacts in the opposite direction to those described here. What is somewhat surprising is how insensitive the path of real GDP is to changes in the wage adjustment parameter, and also the unemployment rate. Unfortunately, given the constraints on the size of the intrasectoral labour turnover parameter imposed by the theory, we could not carry out sensitivity analysis on the value of this parameter without changing other key parameters in the model--in particular the underlying growth rate of the economy. However it is possible to do sensitivity analysis on the intersectoral labour turnover parameter. The results of this analysis, presented in Table 5-4 indicate that the impacts on output, employment, unemployment and aggregate productivity are almost identical to those originally obtained. Thus the simulation results are, over the range of parameter changes contemplated quite insensitive to the parameter specification. It is of course possible by making intersectoral labour movements virtually impossible to impose larger adjustment costs on the economy.

Scale economies and entry elasticities

In table 5-5 the effect of changing the degree of scale economies in all imperfectly competitive industries is shown. In the case of BFT there is remarkably little impact due to changing the scale economies elasticity. The impact is in the predictable direction, but is slight. This result is in contrast to the results of Cox and Harris (1986) who found in that in a static model with a zero economic profits equilibrium condition that changes in the degree of scale economies affected significantly the degree of rationalization and productivity gains brought about through trade liberalization. Not reported are a set of similar results on changes in the entry elasticity. Increasing the sensitivity of entry to economic profits has remarkably little impact on the simulation results. Entry is dominated by the effect of sales growth, with significant intersectoral differences in rates of return on capital persisting well after the first ten years. These results suggest the entry equation may be implausible in the case of a structural shift caused by trade liberalization. Further work on this aspect of the model is called for.

Table 5-1

Selected Statistics
Sensitivity Analysis on Trade Elasticities
Canada/U.S. BFT - 10 Year Phase In

Aggregates (10th Period Change)	Trade Elasticities (ε_o: Central Case Value)		
	$\varepsilon = \frac{1}{2}\varepsilon_o$	$\varepsilon - \varepsilon_o$	$\varepsilon = 2\varepsilon_o$
RGDP	3.248	3.998	4.226
AEMP	0.423	0.689	1.740
UNR	-0.004	-0.006	-0.016
AGLP	3.039	3.927	5.094
TS	30.939	31.746	62.851
ATVOL	7.123	12.454	25.486
AVGW	5.031	7.983	13.823
PRLI	3.379	5.469	10.115
MKUP	-2.200	-2.889	-5.255
RELC	0.000	0.000	0.000

Table 5-2

Selected Statistics
Sensitivity Analysis on Parameter in Manufacturing Sector Pricing Rule
Canada/U.S. BFT - 10 Year Phase In

Aggregates (10th Period Change)	Value of Weighting Parameter in Manufacturing Sector Pricing Rule		
	0.25	0.50	0.90
RGDP	3.283	3.998	5.388
AEMP	0.431	0.689	1.279
UNR	-0.004	-0.006	-0.012
AGLP	3.085	3.927	5.761
TS	20.356	31.746	57.842
ATVOL	11.760	12.454	14.065
AVGW	4.383	7.983	16.084
PRLI	4.058	5.469	8.609
MKUP	-1.192	-2.889	-6.322
RELC	0.000	0.000	0.000

Table 5-3

Selected Statistics
Sensitivity Analysis on Wage Adjustment Parameter
Canada/U.S. BFT - 10 Year Phase In

Aggregates (10th Period Change)	Value of Wage Adjustment Parameter		
	0.02	0.04	0.08
RGDP	3.926	3.998	3.949
AEMP	1.077	0.689	0.324
UNR	-0.010	-0.006	-0.003
AGLP	3.355	3.927	4.313
TS	28.900	31.746	33.894
ATVOL	12.163	12.454	12.493
AVGW	5.563	7.983	9.592
PRLI	5.101	5.469	5.452
MKUP	-2.210	-2.889	-3.303
RELC	0.000	0.000	0.000

Table 5-4

Selected Statistics
Sensitivity Analysis on Intersectoral Labour Turnover Rate
Canada/U.S. - 10 Year Phase In

Aggregates (10th Period Change)	Value of Intersectoral Turnover Rate		
	0.05	0.10	0.20
RGDP	3.995	3.998	4.002
AEMP	0.688	0.689	0.690
UNR	-0.006	-0.006	-0.006
AGLP	3.964	3.927	3.870
TS	31.756	31.746	31.691
ATVOL	12.448	12.454	12.461
AVGW	8.062	7.983	7.852
PRLI	5.459	5.469	5.483
MKUP	-2.890	-2.889	-2.888
RELC	0.000	0.000	0.000

Table 5-5

Selected Statistics
Sensitivity Analysis on Scale Economies
Canada/U.S. - 10 Year Phase In

Aggregates (10th Period Change)	Scale Elasticities (ε_o: Central Case Value)		
	$\varepsilon = \frac{1}{2}\varepsilon_o$	$\varepsilon = \varepsilon_o$	$\varepsilon = 2\varepsilon_o$
RGDP	3.953	3.998	4.089
AEMP	0.673	0.689	0.725
UNR	-0.006	-0.006	-0.007
AGLP	3.921	3.927	3.969
TS	33.715	31.746	25.584
ATVOL	12.546	12.454	12.247
AVGW	7.980	7.983	7.964
PRLI	4.885	5.469	5.156
MKUP	-3.010	-2.889	-2.735

6. Conclusion

The results of the simulations on the impact of the CAFTA are interesting in a number of respects. First they suggest that employment losses due to the formation of the CAFTA are slight; for a wide range of parameter values there are actually employment gains. Second, the long run real production gains measured by constant dollar GDP are in the range of 4 to 5 percent. These results are entirely consistent with those of Cox and Harris (1986) who use a static approach but with imperfect competition and a different data set; in particular their estimates of trade barriers eliminated by a CAFTA were somewhat higher than those used here. The major factor explaining the large real gains in production are the improvements in productivity achieved in the scale economy intensive industries through a process of rationalization. Generally however the results of this paper indicate a less dramatic shift in resources on an intersectoral basis than the earlier static estimates indicated and therefore a more benign view of the adjustment costs imposed on the economy. Similarly the increase in trade volumes while substantial, being in the 13 percent range, is less than the static model suggested. While further work remains to be done our best guess as to the difference in the results hinges on the zero profit condition imposed strictly in the static models. The rationalization process as evidenced in this paper is very slow; entry and exit continues well after the ten year phase in of tariff reductions. In future work we hope to pursue this topic further.

The second broad feature of the results emerges in comparing the gains/cost to Canada of unilateral removal of its own barriers to those changes contemplated in the CAFTA. As demonstrated in the last section there are significant gains to a policy of removing domestic trade barriers alone. At least half the total real production gains to CAFTA could be had by a unilateral policy of removing trade barriers. There is no question therefore that the domestic tariff is part of the productivity 'problem' in Canada. The policy discussion in Canada has focused on the gains achieved through improved market access to the United States. These gains, while significant, are probably no larger than the gains achievable solely through rationalizing scale inefficient industries protected by Canadian tariff and non-tariff barriers to trade.

The most unsatisfactory aspect of this exercise is the particular benchmark data set, which included the high oil-resource price years of the late seventies and unusually high imports giving rise to a benchmark with a merchandise trade deficit. By long run Canadian standards this is unusual and may not be regarded as typical. The results on the CAFTA at central parameter values indicate that the trade deficit would deteriorate, and the external asset position would deteriorate in the transition period. Clearly adjustments in the exchange rate would be expected were this condition to persist leading to a different transition scenario. Before pursuing the route of moving to either flexible exchange rates, or a full intertemporal optimizing model with long run external balance conditions imposed on the model it may be useful to investigate how a change in the benchmark data set will affect the results.

As a final comment we would caution the reader again as to the relevance of these results for the actual CAFTA. In particular no allowance is made in these simulations for possible benefits achieved through the establishment of a formal dispute resolution mechanism. To the extent that anti-dumping and countervailable trade disputes between the two countries are reduced as a consequence of CAFTA, the true economic benefits will be qualitatively larger than indicated in this paper.

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