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COMPUTABLE GENERAL EQUILIBRIUM ESTIMATES OF THE GAINS FROM U.S.-CANADIAN TRADE LIBERALIZATION*

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Abstract

We have constructed a computable general equilibrium model to analyze the economic effects of the bilateral tariff reductions that will be implemented in the U.S.-Canadian Free Trade Agreement (FTA). The model includes the United States, Canada, 32 other countries combined, and the rest of world. There are 22 tradable sectors and 7 nontradable sectors in each country/region. The market structures for industries in the United States and Canada are classified according to the degree of competition, degree of product differentiation, and the ease with which new firms can enter a market.

Our results indicate that bilateral tariff removal in the FTA will increase U.S. imports by $6 billion and exports by $7.3 billion, based on 1976 trade. Canada's imports increase by $8.3 billion and exports by $8.5 billion. U.S. welfare rises by $1.5 billion, which is 0.1% of U.S. GSP in 1976. Canada's welfare rises by $2 billion, which is 1.1% of its 1976 GDP. On a sectoral level, the results suggest that there will be increases in inter-industry as well as intra-industry trade together with changes in scale economies due to industry rationalization and derationalization in the two nations. Output and employment effects in the United States appear to be relatively small while some potentially sizable changes may occur in a number of sectors in Canada.

I. Introduction

The purpose of our paper is to provide some estimates of the economic effects of the elimination of bilateral U.S. and Canadian tariffs that will be implemented as the result of the U.S.-Canadian Free Trade Agreement (FTA) that was negotiated in 1986–87 and is currently (May 1988) awaiting legislative approval in the two nations. While we focus on bilateral tariff elimination, it should be emphasized that the FTA deals with a number of nontariff barriers (NTBs) as well. These include, for example, the elimination of certain bilateral agricultural and related NTBs, removal of Canadian provincial wine restrictions, removal of U.S. countervailing duties on shakes and shingles, removal of voluntary restraints on Canadian steel exports to the United States, and a lower threshold for bidding on government procurement contracts for specified entities in the two nations. However, as we will note later in the paper, these changes in bilateral NTBs appear to be of comparatively minor importance.

Aspects of the agreement concerning the administrative governance of bilateral trade may ultimately prove to be the most interesting and significant. These include: new and possibly more liberal and transparent rules and procedures involving bilateral trade and investment in automobiles and parts, energy products, and services; certain clarifications and guarantees involving nondiscrimination in foreign direct investment; and some potentially very important arrangements for the settlement of trade and investment disputes that might arise in bilateral relations.

Bilateral removal of tariffs and certain NTBs can be analyzed in quantitative terms. But it is unfortunately very difficult to quantify the economic benefits that may arise from improvements in the rules and procedures governing international trade and investment transactions. Such benefits may nonetheless be substantial from the standpoint of both the United States and Canada, and must be factored into an overall assessment of the FTA.

To evaluate the FTA, we first review in Section II the various effects that the FTA might have on the United States and Canada. In Section III, we discuss the findings of previous studies of the effects of the FTA. We then describe in Section IV the computational model that we have developed for the purpose of analyzing the effects of the FTA, and we present our empirical results in Section V. We conclude in Section VI with a summary assessment.

II. Analyzing the Economic Impacts of the FTA

An indication of the size and sectoral characteristics of post-Tokyo Round bilateral Canadian and U.S. tariffs and NTBs is given in Table 1. It is evident from this table that Canadian bilateral tariffs and NTBs are noticeably higher for most sectors as compared to the United States. If we assume that these tariffs and NTBs are to be removed in the course of the implementation of the FTA, what will the effects be?

It is possible analytically to identify three main channels by which the removal of tariffs and NTBs would affect the two nations. These include: (1) inter-sectoral specialization effects; (2) rationalization effects; and (3) macroeconomic effects. In addition, the changes brought about by the FTA in the rules and procedures involving bilateral trade and investment may result in a reduction in the uncertainty of policies and therefore provide additional elements of potential benefit to the two nations.

Inter-Sectoral Specialization

A central issue in evaluating the FTA is how bilateral tariff removal may affect the allocation of factors of production among sectors of the economy. Depending on the relative levels of tariffs and NTBs in the two countries, some of the tradable goods sectors will expand whereas others will contract as the FTA liberalization takes effect. Productive resources will thus presumably be allocated more efficiently as compared to the pre-FTA position as each country specializes in the production of tradable goods in which it has a comparative advantage.

We might also expect a shift in production of tradable goods away from the production of nontradables (e.g., goods and services that are limited spatially because of transportation costs and other characteristics that require close proximity between production and consumption). The bilateral elimination of tariffs will result in reductions in consumer prices due to the lower costs of imported goods as well as reductions in the prices of imported inputs that firms use in the production process. Lower prices of inputs will result in lower costs to firms and possibly lower prices of goods to consumers as well. Both of the foregoing effects will result in a shift towards tradable goods whose prices will fall relative to nontradables.

In analyzing these various effects, there are some interesting and important modeling issues that arise when characterizing the U.S. and Canadian economies and the relations between them and with third countries. For example, suppose that we assume a world in which the goods being produced and traded are homogeneous across firms and countries, there are constant returns to scale in production, and goods markets are perfectly competitive. Assume further that Canada is a small country economically speaking, so that the formation of an FTA would not affect equilibrium world prices.

In such a model, Canada would gain unambiguously from the formation of a FTA. As a result of preferential treatment, Canada would receive the world price plus the U.S. tariff on any exports to the U.S. These are more favorable terms of trade than Canada could obtain from sales either to any other market or to the U.S. market in the absence of the FTA.

While this outcome may seem intuitively plausible, it involves an important difficulty. With preferential trading, the small country may trade only with the large country and will cease to trade with the rest of world.

In order to avoid this implausible outcome, it has been common to assume that the products of the trading nations are differentiated nationally according to where they are produced. Allowance for "love of variety" in the utility functions of consumers

guarantees that all bilateral trade flows will continue in the event that a preferential trading bloc is formed.

This formulation, however, has proven to have difficulties as well. Under national product differentiation, the relative sizes of the national tariffs and NTBs will determine how the two countries might be affected by an FTA. As we have seen, Canadian tariffs are noticeably higher than U.S. tariffs. Consequently, the United States will penetrate Canadian markets more deeply in a number of sectors as compared to Canada's penetration of U.S. markets. In these circumstances, the relative demand for the variety of each good produced by Canada will fall, leading to a decline in its price. Canada will thus experience a deterioration in its terms of trade and it is conceivable that Canadian welfare could decline.

This feature of models in which goods are distinguished by country of origin arises because each country has a monopoly in the supply of the particular varieties of goods that it trades in world markets. Since market power can be exploited through the use of a tariff, optimal tariffs may therefore be relatively large, even for small countries. Preferential as well as multilateral trade liberalization may therefore result in significant changes in the terms of trade. These terms of trade changes, rather than efficiency gains from intersectoral reallocation of resources, may accordingly dominate the welfare conclusions.

If a model of this kind were to be used to analyze the U.S.-Canadian FTA, the results would then be predisposed towards a terms of trade decline and welfare reduction of the country with the relatively higher tariffs. Thus we would expect that Canada's welfare would decline while U.S. welfare would rise.

In seeking alternatives to national product differentiation, one possibility might be to assume that there is product differentiation at the firm level. In this case, bilateral trade flows would be sustained with a preferential trading arrangement since no two firms in the world would sell the same variety. Another alternative is to assume that all firms

supply a homogeneous product but that national markets are segmented so that firms make separate price and supply decisions for each national market. If firms behave as Cournot followers, taking output by other firms as fixed, then preferential trading would leave all of the bilateral trade flows intact.

It will be evident in these cases that the firms involved can exercise some degree of market power. This means that it is no longer possible to maintain the assumption of perfect competition, and that it is necessary accordingly to proceed in a framework in which there are imperfectly competitive firms. Once we make allowance for imperfect competition, this raises the possibility that there may be economies of scale and changes in product variety at the firm level that have to be taken into account.

Rationalization Effects

Proponents of a U.S.-Canadian FTA have placed great emphasis on the gains that might be obtained from the realization of scale economies and the increased product variety that mutual market access will make possible. In addition, it is believed that the influx of tariff-free imports will improve the competitive environment for firms selling domestically, requiring these firms either to shut down and leave the industry or to increase their efficiency. Bilateral free trade can thus be expected to result in a rationalization of the production process by increasing output per firm and lowering average total cost.

According to this line of reasoning, there is a presumption that Canadian manufacturing firms especially will undergo rationalization as the consequence of the FTA. This is because Canadian tariffs may have sheltered domestic firms historically, with the consequence that plants may be of suboptimal size and a large variety of products may be produced by individual firms. With the removal of bilateral tariffs and NTBs, Canadian firms will be induced by increased competitive pressures and profit considerations to take advantage of enhanced market opportunities by expanding output and reducing the number of product varieties. It is contended that the United States is less likely to gain

from rationalization because the attainment of optimal plant size and concentration on a limited number of product varieties are more feasible in the U.S. market because of its comparatively large size.

While there may well be rationalization as the result of a U.S.-Canadian FTA, questions arise about the actual importance of rationalization and the economic factors that will govern its realization. The relatively low tariff rates noted in Table 1 suggest that U.S. and Canadian firms already enjoy substantial access to each other's markets. Furthermore, Canadian firms have had to adapt to the multilateral tariff reductions implemented during the 1970s and 1980s as the result of the Kennedy and Tokyo Round negotiations. Finally, we may note that many Canadian firms are already being subjected to the efficiency-stimulating experience of having to compete with U.S. firms in the U.S. market. How large the benefits from rationalization will be as the result of the FTA is therefore unclear.

If there already exist significant pro-competitive effects in the trade relations between the United States and Canada, the issue is whether and how rationalization may occur in response to the bilateral removal of the existing relatively low tariffs. As we argue below, whether or not small tariff changes lead to rationalization will depend on the factor-intensity characteristics and cost structure of the firms and industries involved. This insight is potentially important because it implies that there may be a significant amount of *inter-industry* resource reallocation as the result of an FTA in contrast to the mainly *intra-industry* changes that have been emphasized in previous research.

Macroeconomic Effects

We have already mentioned that the bilateral elimination of tariffs and NTBs will lead to reductions in consumer prices, which may in turn result in an increase in the real disposable income of consumers. If this leads to increased consumer spending, the economies are operating at less than full employment, and domestic macroeconomic policies remain unchanged, then there will be an increase in real GNP, output, trade, and

employment in both countries in the short-to-medium run. To the extent that these macroeconomic changes occur, they will reinforce the microeconomic benefits stemming from lower consumer prices, improvements in resource allocation, and the realization of economies of scale.

Reduction in the Uncertainty of Policies

In addition to the readily quantifiable effects of trade liberalization, there may be a number of potentially important benefits resulting from changes in the rules and procedures governing international trade and investment relations between the United States and Canada. These include the agreements that limit the use by Canada of investment performance requirements for foreign affiliates of U.S. firms, the guarantee of national treatment and rights of establishment for foreign firms investing in most industries, the removal of Canadian duty remission schemes that had been condoned in the U.S.-Canadian Auto Pact, and less nationalistic and potentially discriminatory Canadian energy and agricultural policies.

New dispute settlement procedures will also be established that are especially important to Canada. They are designed to depoliticize the investigation of trade and investment disputes and to reduce the likelihood that politically driven and therefore damaging actions will be taken by the United States. The costs of conducting trade and investment transactions may thus be materially reduced as the result of the FTA.

Having considered in general terms the economic effects that may result from the bilateral elimination of existing trade barriers, let us now review briefly what previous studies of a U.S.-Canadian FTA have concluded.

III. What Do Previous Studies Suggest About The Effects of the FTA?

In order to determine the importance of existing restrictions and policies and thus to determine what the economic effects might be of removing the restrictions and bringing about changes in policies, it is necessary to rely on some kind of economic model. In

choosing an economic model for purposes of analysis, it is imperative that the analyst make clear what the important assumptions and limitations of the model are. This includes a complete and careful statement of the theoretical foundations of the model being used, how the parameters of the model have been selected, and a description and documentation of the data used in implementing the model. These are obviously important matters that should be insisted upon by those who will be using the model in question and are depending on it to obtain numerical results that are to be trusted in evaluating the policy options involved.

Broadly speaking, there are two classes of models that can be used. The first is an econometric model that is based on historical relationships that can be presumed to remain unchanged in the relevant policy horizon. If an econometric model is constructed and it fits the data well, it can then be used to make forecasts of how important variables such as output, trade, and employment might be affected by the FTA. It should then be possible ex post to compare the model forecasts with actual values to determine how accurate the forecasts may have been.

Unfortunately, many of the changes that will come about as the result of the FTA depend on a variety of complex microeconomic behavioral relations and intersectoral and inter-country interactions. Constructing an econometric model that adequately captures these intricate microeconomic relationships is not currently feasible. Nonetheless, as will be noted below, a number of efforts have been made to adapt existing macroeconometric models of the Canadian economy for the purpose of estimating the effects of the FTA. However, it is by no means clear how the results are to be interpreted since the models used do not have well articulated microeconomic structures.

Instead of using an econometric approach, an alternative is to construct a general equilibrium model that will incorporate the important behavioral and interaction effects and that can be solved computationally so as to yield numerical results relating to the potential impacts of the FTA. In recent years, there has been considerable progress made

in developing and using general equilibrium computational models, and a number of such models have been adapted to analysis of the FTA.

It should be emphasized that these computational models do not provide predictions that can be compared against actual outcomes. Rather, the numerical results of the models are to be interpreted in the light of their assumptions, parameters, and data. This means that, in evaluating model results, tests should be conducted to determine how sensitive or robust the results are to changes in different aspects of the model.

The general equilibrium models that have been used to date to estimate the effects of a U.S.-Canadian FTA include Harris and Cox (1985), Hamilton and Whalley (1985), Markusen and Wigle (1987), Wigle (1988), and Brown and Stern (1987). The Canadian Government's Department of Finance (1988) has used the Harris-Cox model, with adaptations of some key parameters and more recent data on tariffs and NTBs to provide some other estimates of the effects of the FTA.

The Harris-Cox and Department of Finance models refer only to the effects of the FTA on Canada since the United States and the rest of world are not modeled explicitly. The Hamilton-Whalley, Wigle, Markusen-Wigle, and Brown-Stern models identify separate effects of the FTA for Canada, the United States, and the rest of world.

Some key results are summarized in Table 2 together with estimates based on macroeconometric models of the Canadian economy that have been adapted especially for the purpose of analyzing the impact of the FTA on Canada. It should be noted that in each case the bilateral tariffs were assumed to be eliminated all at once rather than being phased in over a ten-year period as called for in the actual implementation of the FTA. Thus, in any given year during the implementation process, the effects of the FTA would be a cumulative fraction of the ultimate effect over the entire period.

The estimate based on the Harris-Cox (1985) model suggests that the real income (welfare) gains resulting from the FTA could approach nearly 9% of Canadian GNP. The

size of this gain depends crucially on the parameters that Harris and Cox use to represent rationalization effects and the assumed pricing rules for Canadian manufacturing firms.

Two imperfectly competitive market structures were adopted by Harris and Cox. Under the assumption of monopolistic competition, profit-maximizing firms set price as a mark-up over marginal cost. The size of the mark-up depends on the firm's perceived market power. Alternatively, firms within an industry may tacitly collude, by adopting a "focal price" which is charged by all firms. Harris and Cox set the focal price equal to the world price plus the import tariff. The actual price charged by each firm is assumed to be a weighted average of the monopolistically competitive and focal prices.

The effect of tariff liberalization on firm output can be determined by evaluating the impact on each component of the pricing rule. Tariff reductions increase import competition. For monopolistically competitive firms, increased competition raises the perceived elasticity of demand so that the profit-maximizing mark-up over marginal cost falls. The focal price of collusive firms also declines, since this price is equal to the world price plus the tariff. Free entry is assumed. Therefore, a fall in price must be accompanied by an increase in firm output to satisfy the zero-profits condition.

The version of the Harris-Cox model used by the Canadian Department of Finance suggests an estimated real income gain of 2.5%, which is considerably less than the original Harris-Cox result. Rationalization effects nonetheless remain the driving force, resulting from the amalgamated pricing behavior being assumed for the imperfectly competitive Canadian manufacturing firms.

The results obtained by Wigle and by Markusen and Wigle further illustrate the sensitivity of this approach to the precise theoretical and parametric specification. In both studies, monopolistically competitive and collusive behavior are modeled as in Harris and Cox. However, each industry is specified as *either* monopolistically competitive *or* collusive. Markusen and Wigle find that Canada's welfare would rise by 0.6% of national income, which is only one-quarter of the increase calculated by the Department of Finance, and

that U.S. welfare would rise by 0.1%. Wigle finds that bilateral tariff removal will result in a *decline* in welfare for Canada of 0.1% of national income and welfare for the United States will rise by 0.1%. The decline in welfare for Canada appears to be the result of a deterioration in the terms of trade.

Hamilton and Whalley's results are considerably smaller than those obtained especially by Harris and Cox and the Department of Finance. Hamilton and Whalley use a model in which there is perfect competition and constant returns to scale, and they allow for national product differentiation. Brown and Stern use a somewhat different modeling approach, but they also assume perfect competition, constant returns to scale, and national product differentiation.

It is noteworthy that Hamilton and Whalley obtain a positive welfare gain for Canada equal to 0.6% of GNP and a welfare loss of 0.04% for the United States as the result of the bilateral removal of tariffs whereas Brown and Stern report a welfare *loss* of 0.3% of GNP for Canada and a welfare *gain* of 0.03% for the United States. Given the relatively higher Canadian tariffs, it would have been expected that Canada might well experience a decline in its terms of trade and thus in welfare, which is what Brown and Stern found to be the case. It is therefore not clear why Hamilton and Whalley obtained the results noted.

The macroeconometric approach can be used for the purpose of analyzing the effects of the FTA by first determining the amount by which the import and export prices and volume of trade of the two countries may change. These factors are then entered as exogenous changes in the model and a solution is obtained for changes in the variables of interest.

Since the macroeconometric models used do not have well articulated microeconomic structures, it cannot be readily determined how the aggregate results obtained correspond to the results based on the general equilibrium trade models. To illustrate this point, we may note, for example, that the Economic Council of Canada

(Magun et al., 1987, 1988) used the CANDIDE econometric model of the Canadian economy to carry out two simulations of the effects of the FTA. The first simulation considered only the macroeconomic impacts of the bilateral removal of tariffs and certain NTBs while the second simulation involved an adjustment to take into account the possible rationalization (scale) effects that might occur in Canada. This necessitated decomposing the aggregate effects by sector on the basis of a Canadian input-output table and applying rationalization coefficients estimated for individual industries. The results thus reflect the structure of the CANDIDE macroeconometric model in combination with the Canadian input-output structure and scale economy parameters, but without explicit behavioral relations linking the various factors.

Several of the studies noted in Table 2 provide detailed results indicating how trade, output, employment, and the returns to capital in individual sectors in Canada and the United States might be affected by the FTA. Considerable interest is attached to the sectoral results insofar as they indicate which industries may expand or contract as a consequence of the FTA. However, because the studies noted in Table 2 vary substantially in terms of their modeling methodology and the particular assumptions made concerning market structure, pricing behavior, and the choice of elasticity and scale parameters, their sectoral details are bound to be different. We shall not dwell therefore on sectoral comparisons at this point. Instead, what we propose now is to turn to our own computational model that we have developed to estimate the economic effects of the U.S.-Canadian FTA. When we present our sectoral results below, we shall have occasion to comment on how they differ from those in some of the studies noted in Table 2.

III. The Computational Model

The review of previous modeling efforts reveals a number of modeling choices which caste doubt on the robustness of the results obtained. First, national product differentiation has been adopted in all of the general equilibrium trade models discussed above for the purpose of identifying the bilateral trade flows to receive preferential

treatment. However, this assumption gives rise to terms of trade considerations that dominate the welfare conclusions of tariff liberalization. In view of the strong implications and artificial nature of this assumption, we have chosen to allow intra-industry trade to emerge naturally as the result of strategic firm behavior. National product differentiation is adopted only in perfectly competitive sectors in which firm behavior does not lead to intra-industry trade.

Second, the use of "focal pricing" to model collusive behavior by firms predisposes the model to the conclusion that tariff liberalization increases output per firm. However, this market structure has been strongly criticized as unsustainable in the presence of free entry. We have not adopted the focal pricing mechanism here, but rather adhere more closely to those market structures that are more robust theoretically.

Third, industry organization varies according to the degree of competition or market power, the degree of product differentiation, and the ease with which new firms can enter a market. Therefore, a variety of possible market structures have been integrated into the model to accommodate competitive differences.

The model has some features in common with previous general equilibrium models used to analyze the FTA. However, we capture a broader array of imperfectly competitive market structures in *both* nations and do so without relying on the ad hoc firm behavior and national product differentiation assumptions that have driven the results of previous work.

The model consists of four trading regions. Canada, the United States, and a group of 32 other countries are modeled explicitly,[1] and the rest of the world constitutes an abbreviated fourth region.

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[1]The 32 countries include 16 industrialized countries —Australia, Austria, Belgium-Luxembourg, Denmark, Federal Republic of Germany, Finland, France, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom — and 16 newly industrializing countries — Argentina, Brazil, Chile, Colombia, Greece, Hong Kong, India, Israel, Mexico, Portugal, Singapore, South Korea, Spain, Taiwan, Turkey, and Yugoslavia.

Sectoral coverage includes 22 tradable product categories based on three-digit ISIC industries and 7 nontradable categories based on one-digit ISIC industries.[2] Each industry in the model can be characterized by one of five market structures, including: (1) perfect competition; (2) monopolistic competition with free entry; (3) monopolistic competition without entry; (4) market segmentation with free entry; and (5) market segmentation without entry.

An overview of the model is provided below. For those readers interested in the technical details, the equations and variables of the model are set out in the appendix to the paper.

To elaborate on the different market structures, it will be recalled from our earlier discussion that, in order to identify bilateral trade flows that are to receive preferential treatment, one approach is to assume that products can be differentiated either by country of origin or by firm. Both the perfectly competitive and monopolistically competitive industries in our model are characterized accordingly by some degree of product differentiation. In the case of perfect competition, products are assumed to be differentiated by *country*, while in the monopolistically competitive industries products are differentiated by *firm*.

In both cases, we adopt the approach to product differentiation suggested by Dixit and Stiglitz (1977) and Spence (1976). Consumers and producers are assumed to use a two-stage procedure for allocating expenditure across differentiated products. At the first stage, expenditure is allocated across goods, without regard for the country of origin or the producing firm. At this stage the utility function is taken to be Cobb-Douglas, and the production function requires inputs in fixed proportion.

The appendix below contains the proportionately differentiated version of the model, with the circumflex indicating proportionate change. Final and intermediate

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[2]Our country and sectoral coverage correspond to that used in various adaptations of the Michigan Model of World Production and Trade. See Deardorff and Stern (1986), Brown (1988), and Brown and Stern (1987).

demands for tradable good j in country i are given by equations (1) and (3) and final and intermediate demands for nontradable good j are given by equations (2) and (4). Final and intermediate demand are aggregated to form total demand for tradables and nontradables in equations (5) and (6).

In the second stage, expenditure on each good chosen in the first stage is allocated among the competing varieties. The aggregation function at this stage is CES. The demand for each variety, conditional on the level of the aggregate chosen in the first stage, is given in equation (7). For perfectly competitive industries, equation (7a) is demand in country i for the variety produced by country r. For monopolistically competitive industries, equation (7b) gives demand in country i for the variety produced by a representative firm in country r. These equations differ in that entry in an industry will reduce the demand for other competing firms.

Perfectly competitive firms set price equal to marginal cost, as given in equation (19a). However, monopolistically competitive firms maximize profits by setting price as a mark-up over marginal cost, as given in the second term in equation (19b). It will be noted that the more elastic is demand, the smaller will be the difference between price and marginal cost.

Imperfectly competitive industries in which all firms produce a homogeneous product are modeled following Venables (1985). In this case, each firm behaves as a Cournot follower and assumes that national markets are segmented. The firm establishes a set of profit-maximizing prices, one for each national market, assuming that output by other firms is fixed. It can be shown, under these conditions, that a representative firm's sales to country r is given by equation (7c).

Turning to the factor markets, the variable input requirements are taken to be the same for all market structures. Primary and intermediate input aggregates are required in fixed proportion to output. Expenditure on primary inputs is allocated between capital and labor, assuming that a CES function is used to form the primary input

aggregate. This assumption implies conditional labor and capital demands given by equations (10a) and (11a). In imperfectly competitive industries, an additional fixed input of capital is required, thus yielding conditional factor demands in equations (10b), (10c), (11b), and (11c).

Capital and labor are assumed to be perfectly mobile between sectors. The return to capital is determined to equate demand to a fixed supply of capital, as given by equation (27). The return to labor is fixed. However, total expenditure is set endogenously to maintain the demand for labor to a fixed supply of labor, as given by equation (28).

The number of firms in each industry is determined by the zero-profit condition. In the free-entry versions of the monopolistic competition and market segmentation market structures, the number of firms is determined to guarantee that price equals average total cost, as given by equations (24b) and (24c). In all other cases, the number of firms is assumed not to change.[3]

Equilibrium prices are determined in world markets. In the perfectly competitive industries, total demand for each national variety must equal national output as in equation (31a). For monopolistically competitive industries, total demand for the variety produced by each firm must equal supply by that firm, as in equation (31b). In the case of market segmentation, total supply by all firms to each national market must equal demand in that market, as given by equation (31c).

Tariffs and exchange rates link equilibrium prices determined in the world system to prices paid by consumers or received by sellers in the country system. In the perfectly competitive and monopolistically competitive industries, the price determined in the world system is the price received by the seller denominated in the numeraire currency, which is the U.S. dollar. The price paid by the consumer, then, is the world price, plus changes in the exchange rate and tariffs, as can be seen in equations (14a) and (14b). In the case of

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[3]Under perfect competition, technology is characterized by constant returns to scale. Therefore, the number of firms is indeterminant. However, the threat of entry guarantees marginal cost pricing and zero profits.

market segmentation, the price determined in the world system is the price paid by the consumer denominated in the numeraire currency. The price received by the seller is the world price, plus changes in the exchange rate, but *minus* the tariff applied by the importing country, as is shown by equation (14c).

The exchange rates for Canada and the group of other countries are determined to maintain the trade balance at its level in the base period. This is shown by equation (30i), where the trade balance is defined by equation (29). With the U.S. dollar taken as the numeraire, the price of the dollar is thus held constant as in equation (30i'). In the case of the rest of the world, the currency is assumed to be pegged to a market basket of currencies, but an import licensing scheme is adopted to hold the current account at the base level. The tariff equivalent of an import license is calculated endogenously, as in equation (34).[4]

The model is in linear form and thus can be solved by matrix inversion. The base year is 1976 for data on production, employment, and trade for the United States, Canada, and other countries, and the rest of the world. Input-output coefficients for the production function were derived from the U.S. input-output table for 1972 and the Canadian table for 1976.

The market structure assignments by industry are listed in Table 3. These assignments represent our judgment of the industrial organization characteristics of each industry.[5] It may be that other analysts would choose different characteristics than the ones that we have selected. In this event, we could enter these alternative characteristics and solve the model accordingly.

The key parameters of the model are reported in Tables 4A, 4B, and 4C for the United States, and Tables 5A, 5B, and 5C for Canada. The bilaterally trade-weighted

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[4]See Deardorff and Stern (1986, pp. 22–23) for a discussion of the role of import licensing in the Michigan Model of World Production and Trade.

[5]We are indebted to Lynne Pepall for assistance in selecting the industry characteristics.

tariff averages for each industry involved in U.S.-Canada trade are listed in the last column of these tables.[6]

For the imperfectly competitive industries, the elasticity of demand, share of capital that is fixed, variable cost share of total cost, and the mark-up of price over marginal cost are all derivable from the theoretical structure of the model. Details are given in Brown and Stern (1988). The only data required are labor's share of primary input cost and primary input share of total cost, which were obtained from the input-output tables, and an indicator of the elasticity of substitution among different varieties of each good. The elasticity of substitution is set at 15.[7]

IV. Computational Results

We have used the model described above to investigate the economic welfare effects of bilateral tariff removal on the United States and Canada, assuming that the existing bilateral tariffs are to be removed all at once rather than in stages. An overview of the results is presented in Table 6. U.S. imports increase by $6 billion and exports increase by $7.3 billion based on trade in 1976. Canada's imports rise by $8.3 billion and exports rise by $8.5 billion. Welfare, as measured by the equivalent variation,[8]

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[6]These tariff averages do not correspond to those listed in Table 1 because of differences in industry classification and the year chosen for trade weighting. Also, we have not taken into account the ad valorem equivalents of the NTBs noted in Table 1. According to Magun et al. (1988, pp. 24–34), only minor modifications are to be made in existing NTBs in the course of implementation of the FTA. Nonetheless, some of our sector results for bilateral tariff removal will be overstated to the extent that the existing NTBs will serve to dampen the impact of the tariff removal.

[7]Values of the elasticity of substitution below 15 imply a value for fixed capital's share of total capital outside the interval (0,1).

[8]The equivalent variation is the income change valued at base period prices that yields the same change in welfare as the tariff reductions. The welfare calculation has two components. First, ex ante and ex post utility are calculated for each country using the explicit utility function and then converted to the equivalent variation. (See Shoven and Whalley (1984), p. 1014, equation (13)). Second, changes in real international debt are calculated by deflating the nominal trade balance by the change in the price level.

increases for both countries as well. Canada's welfare rises by $2 billion, which is 1.1% of GDP in 1976, despite a deterioration in its terms of trade of 0.2%. U.S. welfare rises by a smaller $1.5 billion which is less than 0.1% of U.S. GDP in 1976. The other countries of the model experience a trivially small decline in welfare of $143 million.

Sectoral results for the United States and Canada are reported in Tables 7 and 8, respectively. For each country, the perfectly competitive industry results appear in section A of each table, the monopolistically competitive industry results in section B, and the segmented market industry results in section C.

The percent changes in exports, imports, and bilateral imports by sector are reported in the first three columns of each table. U.S. imports from Canada generally rise. The industries with the largest increases include textiles (101.0%), clothing (228.4%), footwear(130.3%), nonferrous metals (167.5%), and glass products (107.4%). The only sector that does not show a significant change in bilateral trade is transportation equipment (0.1%), which is already duty free under the Auto Pact. There are several industries in which U.S. imports from Canada decline, including wood products (−2.0%), paper (−23.4%), printing and publishing (−7.5%), nonmetallic mineral products (−19.2%), and petroleum products (−11.4%). Canada's imports from the United States increase in every sector, with the largest changes occurring in textiles (179.9%), clothing (283.4%), footwear (254.6%), furniture and fixtures (179.5%), paper products (103.1%), metal products (114.4%), and rubber products (100.9%). Given that existing bilateral tariffs are highest in textiles, clothing, and footwear, the computations suggest that there could be a dramatic increase in bilateral trade in these sectors unless this trade were to be restrained by some sort of intervention.

We mentioned in our previous discussion that there are two sources of welfare gain from liberalization. The first is inter-industry specialization. The import and export results indicate that the FTA would bring about substantial increases in intra-industry trade. However, considerable inter-industry specialization can also be expected.

The specialization results can be inferred from the percent changes in industry output reported in column 4 of each table. The chemicals and transportation equipment industries are the only sectors in which output increases in both countries. There are only three sectors that contract in both countries: agriculture, food, and nonelectrical machinery. Specialization will thus be occurring in the remaining seventeen tradable sectors. There are five sectors in which output in the United States declines while output in Canada rises. These include leather products, footwear, nonferrous metals, iron and steel, and miscellaneous manufactures. Nonferrous metals is the industry most dramatically affected, with a decline in output in the United States of 13.6%, and an increase in Canada of 152.4%. Canada's iron and steel industry may undergo a significant expansion, with output rising by 28.5%.

The United States, as the larger country, would evidently specialize in a broader range of product categories. Thus, output in the United States would increase while output in Canada would decline in twelve sectors, including: wood products; textiles; clothing; furniture and fixtures; paper products; printing and publishing; nonmetallic mineral products; metal products; electrical machinery; rubber products; glass products; and petroleum products. In most cases, the increase in U.S. output is less than one percent. The exceptions are textiles (3.9%), paper products (3.2%), and electrical machinery (1.2%). The impact on Canadian producers appears, however, to be more noticeable. For example, Canadian textile production declines by 35.4%, paper products by 19.3%, nonmetallic mineral products by 16.8%, and electrical machinery by 14.2%.

The second source of welfare gain is the rationalization effect, which involves increasing output per firm, thereby realizing economies of scale in the industries with declining average cost. The change in output per firm can be determined by comparing the percent change in industry output, in column 4 of each table, to the percent change in the number of firms in each industry, in column 5. Of the 24 imperfectly competitive industries, output per firm in the United States rises in ten, falls in five, and remains

unchanged in nine. In Canada, output per firm increases in sixteen industries and falls in eight.

The determinants of output per firm vary by industry. In cases in which there are barriers to entry, firm output depends only on industry output. Therefore, industries that are expanding in response to inter-industry specialization will also experience an increase in output per firm. The United States, as the larger of the two countries, will specialize in a broader range of product categories. Firms in these sectors will increase output. Indeed, half of the industries that rationalize in the United States fall into this category. Textiles, chemicals, petroleum products, rubber products, and glass products are all sectors that are characterized as having barriers to entry and that record increases in industry output.

On the other hand, firms in heavily protected industries, which contract with liberalization, will reduce output. This effect accounts for most instances of de-rationalization in Canada. Since trade liberalization will lead Canada to specialize in a smaller number of products, output in many industries will decline. For contracting industries in which there are barriers to entry, output per firm will fall. This effect accounts for five of the seven tradable sectors that de-rationalize in Canada. These include textiles, petroleum products, rubber products, glass products, and nonelectrical machinery.

However, if entry or exit of firms can occur, then firm output will depend on the interaction between the firm's perceived demand and average total cost curves. The zero-profit condition requires tangency between demand and average total cost. Therefore, if either curve changes shape, the point of tangency will occur at a new level of output. Relative factor prices determine the shape of average total cost.[9] However, the computational results indicate that the wage-rental ratio will be barely affected insofar as

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[9]For a detailed discussion of the role of factor prices and factor intensities in determining output per firm, see Brown and Stern (1988).

the return to labor is held fixed and the return to capital in both the United States and Canada declines by only 0.1%. Therefore, *demand* side considerations are paramount.

In monopolistically competitive industries, liberalization affects the firm's demand curve in two ways. Domestic tariff reductions increase import competition for domestic firms selling to the domestic market. The increase in competition emerges in the model as an increase in the elasticity of demand by domestic consumers for the domestically produced good. Domestic firms are led to reduce the mark-up of price over marginal cost and raise output, thereby reaping economies of scale. This is frequently referred to as the 'pro-competitive' effect of tariff liberalization.

Foreign tariff reductions have the opposite effect. Domestic firms gain an improved competitive advantage in the foreign market. The greater market power emerges as a fall in the perceived elasticity of demand for exports. Firms respond to the fall in the perceived elasticity of demand by increasing the mark-up over marginal cost on exports and reducing output.

On balance, the firm's perceived elasticity of demand may rise or fall as a result of bilateral liberalization so that output per firm may rise or fall. The pro-competitive effect is apparently very strong in Canada, with output per firm increasing in nine of the eleven monopolistically competitive tradable industries in which entry can occur. The only exceptions are paper products and printing and publishing, for which output per firm falls.

Rationalization effects in the United States are slightly weaker. Output per firm remains unchanged in five of the eleven monopolistically competitive tradable sectors and falls in one.

There are instances in which the pro-competitive effect is so strong that exit occurs in both the United States and Canada even when the industry is expanding. For example, output of the footwear industry in Canada rises, but the number of firms declines. Expansion is brought about entirely by increasing output per firm. Footwear production in the United States declines, but the fall in the number of firms is so great that

output per firm rises. Similarly, output in the furniture and fixtures and electrical machinery industries expands in the United States, but contracts in Canada. However, the number of firms falls in both countries and output per firm increases.

It is more common, however, that increases in industry output are accomplished by a combination of increasing the number of firms and increasing firm output. For example, in the United States, production of food, clothing, nonmetallic mineral products, and metal products expands entirely as a result of entry. Output per firm is virtually unaffected. Interestingly, these same four industries contract in Canada as a result of exit, but output per firm rises. Canada's relatively deep tariff reductions give rise to a strong pro-competitive effect on Canadian firms. This may account for the fact that rationalization occurs more frequently in Canada than in the United States.

The percent changes in employment in the last column in Tables 7A-7C and 8A-8C more or less mirror the percent changes in output noted in column 4 of the tables. In the United States, the employment changes are less than one percent, with the exception of textiles (3.9%), paper products (3.1%), nonferrous metals (−13.6%), and electrical machinery (1.2%). This suggests that the United States would not experience major disruptions in labor markets, especially when it is recalled that the tariff reductions would be phased in over a ten-year period. On the other hand, in Canada, there are sizable percent increases in employment in leather products (4.9%), chemicals (17.9%), nonferrous metals (152.4%), miscellaneous manufactures (7.3%), and iron and steel (28.5%), and sizable percent reductions in employment in agriculture (−5.6%), wood products (−6.1%), textiles (−35.4%), clothing (−6.4%), paper products (−19.3%), nonmetallic mineral products (−16.8%), metal products (−7.1%), electrical machinery (−14.2%), and petroleum products (−11.6%).

Our computational results thus suggest that there will be a significant increase in inter-industry specialization, especially in Canada, as a result of the FTA. Strong pro-competitive effects emerge in many Canadian industries in which entry and exit occur due

to Canada's relatively deep tariff reductions. There may be sizable labor reallocation effects in Canada, although the phasing in of the tariff removal would mitigate some of the adjustment problems that might occur otherwise. In the aggregate, nonetheless, our results indicate that economic welfare would be increased in Canada and in the United States with the bilateral removal of tariffs.

VI. Summary Assessment of the FTA

It seems appropriate to ask in conclusion how our results compare to those obtained in other studies. As noted in Table 2, the two classes of studies of the effects of the U.S.-Canadian FTA include those based on general equilibrium models and those based on macroeconometric models. It is important to note that our present study as well as most previous ones suggest that the FTA will be beneficial to both Canada and the United States, although there is some disagreement as to how large the benefits may be.

A welfare gain as the result of bilateral tariff removal in the range of one to two percent of national income for Canada but less than one percent for the United States seems plausible. Significantly larger welfare gains for Canada obtained by some studies were revised downward in light of new information concerning the proper specification of key parameters.

Some models obtained negative welfare results for one or the other of the countries. However, this can be traced to the doubtful assumption that intra-industry trade is generated by national product differentiation. It is nonetheless comforting to know that even under such a pessimistic assumption the possible welfare loss is only a small fraction of one percent of national income.

It is difficult to interpret the results based on the macroeconometric models because these models do not capture the essential microeconomic behavior that governs the responses of firms to the changes in relative prices and competitive pressures that the FTA would engender. We are skeptical accordingly of the detailed industry results that

are obtained, for example, in the Economic Council of Canada studies by Magun et al. (1987, 1988).

We noted in our earlier discussion that the FTA entails some minor bilateral modifications in certain existing NTBs, and, more importantly, a variety of potentially far-reaching changes in the rules and procedures governing bilateral trade and investment relations that would reduce the uncertainty of policies and lower the costs of transactions. We have not been able to quantify the effects of these changes. But when their potential is viewed in conjunction with the benefits that will be realized as the result of the bilateral elimination of tariffs, our overall assessment of the FTA is that it will enhance economic welfare in both the United States and Canada. It is very likely that the rest of the world will benefit as well since they are affected in only a minor way by the bilateral tariff elimination and they may benefit from the improvements in the bilateral trading environment that carry over to the multilateral trading system.

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Table 1

Comparison of Post-Tokyo Round Canadian and U.S. Trade Barriers

Industry	Canada		United States	
	Tariff rate (%)	NTBs (tariff equivalent) (%)	Tariff rate (%)	NTBs (tariff equivalent) (%)
Agriculture	2.2	11.9	2.2	6.9
Forestry	0.0	0.1	0.2	0.2
Fishing and trapping	0.2	0.0	1.4	0.0
Metal mines	0.1	0.0	0.2	0.0
Mineral fuels	0.4	0.0	0.3	0.0
Non-metal mines and quarries	0.5	0.0	0.1	0.4
Food and beverage	4.2	9.0	3.5	8.5
Tobacco products	16.0	0.0	10.1	0.6
Rubber and plastics products	8.9	0.0	8.4	0.4
Leather products	12.0	4.2	7.9	0.0
Textiles	8.9	0.0	7.3	0.4
Knitting mills	21.5	0.0	12.6	0.4
Clothing	17.2	0.0	10.7	0.4
Wood products	2.7	0.0	1.4	12.9
Furniture and fixtures	12.6	0.0	3.0	0.8
Paper and allied products	4.0	0.0	0.9	0.3
Printing and publishing	1.4	0.8	0.5	0.2
Primary metals	4.0	1.3	2.2	4.2
Metal fabricating	6.8	0.9	3.2	1.0
Machinery	4.7	0.9	2.5	3.0
Transportation and equipment	2.3	0.0	0.5	0.0
Electrical products	6.1	0.9	3.7	0.1
Non-metallic mineral products	3.4	0.0	2.9	0.0
Petroleum and coal products	0.5	0.0	0.4	0.0
Chemicals and chemical products	5.6	0.0	2.2	1.2
Misc. manufacturing	6.2	0.9	3.5	0.2
Weighted average	3.8	1.0	2.3	1.8

Source: Adapted from Magun, Rao, and Lodh (1987, pp. 25 and 141–153).

Table 2

Summary of Studies of Estimated Changes in Real Income Resulting from a U.S.-Canadian Free Trade Agreement

Study	Change in Real Income		
	Canada (%)	United States (%)	Other Countries (Mill. $)
General equilibrium models			
Harris and Cox (1985)	8.9		
Canadian Department of Finance (1988)	2.5		
Markusen and Wigle (1987)	0.6	0.1	Negative
Wigle (1988)	−0.1	0.1	
Hamilton and Whalley (1985)	0.6	−0.04	Negative
Brown and Stern (1987)	−0.3	0.03	−19.8
Macroeconometric models			
Informetrica (1985)	3.0		
Institute for Policy Analysis (1985)	3.3		
Wharton Econometrics (1987)	3.1		
Economic Council of Canada			
(1987)	3.3		
(1988)	2.5		

Notes: The estimates reported are sensitive to the degree of response of exports and imports to changes in relative prices. The results in the Harris and Cox and Department of Finance analyses are sensitive to the price response of import-competing manufacturing firms to the reduction of domestic trade barriers. Estimates for a given study vary due to different assumptions about the extent of trade liberalization and the size of the rationalization gain resulting from freer trade. The complete citations for the studies noted are given in the list of references.

Source: Adapted in part from Government of Canada, Department of Finance (1988, p. 32).

Table 3

Industry Structure of the Model

Sector	Market Structure	Entry
Tradable Industries		
Agriculture	Perfect Competition	Free
Food	Monopolistic Competition	Free
Textiles	Monopolistic Competition	None
Clothing	Monopolistic Competition	Free
Leather Products	Perfect Competition	Free
Footwear	Monopolistic Competition	Free
Wood Products	Perfect Competition	Free
Furniture & Fixtures	Monopolistic Competition	Free
Paper Products	Monopolistic Competition	Free
Printing & Publishing	Monopolistic Competition	Free
Chemicals	Monopolistic Competition	None
Petroleum Products	Market Segmentation	None
Rubber Products	Market Segmentation	None
Nonmetallic Min. Products	Monopolistic Competition	Free
Glass Products	Market Segmentation	None
Iron & Steel	Market Segmentation	Free
Nonferrous Metals	Monopolistic Competition	Free
Metal Products	Monopolistic Competition	Free
Nonelectrical Machinery	Monopolistic Competition	None
Electrical Machinery	Monopolist Competition	Free
Transport Equipment	Monopolistic Competition	None
Misc. Manufactures	Monopolistic Competition	Free
Nontradable Industries		
Mining & Quarrying	Market Segmentation	None
Utilities	Market Segmentation	None
Construction	Perfect Competition	Free
Wholesale Trade	Monopolistic Competition	Free
Transportation	Monopolistic Competition	Free
Financial Services	Monopolistic Competition	None
Personal Services	Perfect Competition	Free

Table 4A

Parameters of the Model: United States
Perfect Competition

Sector	Labor Share of Primary Input Cost	Elasticity of Substitution	Tariff on Canadian Exports
Tradable Industries			
Agriculture	0.19	15.00	1.60
Leather Products	0.87	15.00	2.50
Nontradable Industries			
Wood Products	0.62	15.00	0.20
Construction	0.79	15.00	
Personal Services	0.90	15.00	

Table 4B

Parameters of the Model: United States
Monopolistic Competition

Sector	Demand Elasticity	Variable K Share of Total K	Variable Input Cost Share	Labor Share of Primary Input Cost	Elasticity of Substitution	Tariff on Canadian Exports
Tradable Industries						
Food	-14.73	0.55	0.93	0.48	15.00	3.80
Textiles	-15.08	0.18	0.93	0.81	15.00	7.20
Clothing	-13.48	0.90	0.93	0.88	15.00	18.40
Footwear	-11.47	0.44	0.91	0.86	15.00	9.00
Furniture & Fixtures	-14.37	0.19	0.93	0.79	15.00	4.60
Paper Products	-14.62	0.40	0.93	0.70	15.00	0.0
Printing & Publishing	-15.01	0.33	0.93	0.79	15.00	0.30
Chemicals	-15.56	0.64	0.94	0.56	15.00	0.60
Nonmetallic Min. Products	-14.67	0.58	0.93	0.66	15.00	0.30
Nonferrous Metals	-13.80	0.13	0.93	0.74	15.00	0.50
Metal Products	-14.78	0.40	0.93	0.74	15.00	4.00
Nonelectrical Machinery	-15.97	0.47	0.94	0.76	15.00	2.20
Electrical Machinery	-14.65	0.24	0.93	0.81	15.00	4.50
Transport Equipment	-14.61	0.33	0.93	0.71	15.00	0.0
Misc. Manufactures	-13.89	0.75	0.93	0.48	15.00	0.90
Nontradable Industries						
Wholesale Trade	-14.90	0.77	0.93	0.58	15.00	
Transportation	-14.88	0.75	0.93	0.61	15.00	
Financial Services	-14.91	0.87	0.93	0.29	15.00	

Table 4C

Parameters of the Model: United States
Market Segmentation

Sector	Mark-up Over MC			Variable K Share of Total K	Variable Input Cost Share	Labor Share of Primary Input Cost
	U.S.	Other	Canada			
Tradable Industries						
Petroleum Products	0.05	0.05	0.05	0.91	0.99	0.43
Rubber Products	0.05	0.05	0.05	0.63	0.93	0.63
Glass Products	0.05	0.05	0.05	0.57	0.93	0.69
Nontradable Industries						
Iron & Steel	0.05	0.05	0.05	0.24	0.93	0.77
Mining & Quarrying	0.05			0.98	0.99	0.33
Utilities	0.05			0.98	0.99	0.28

Table 5A

Parameters of the Model: Canada
Perfect Competition

Sector	Labor Share of Primary Input Cost	Elasticity of Substitution	Tariff on U.S. Exports
Tradable Industries			
Agriculture	0.24	15.00	2.20
Leather Products	0.83	15.00	4.00
Wood Products	0.76	15.00	2.50
Nontradable Industries			
Construction	0.64	15.00	
Personal Services	0.61	15.00	

Table 5B

Parameters of the Model: Canada
Monopolistic Competition

Sector	Demand Elasticity	Variable K Share of Total K	Variable Input Cost Share	Labor Share of Primary Input Cost	Elasticity of Substitution	Tariff on U.S. Exports
Tradable Industries						
Food	−13.44	0.31	0.93	0.60	15.00	5.40
Textiles	−10.38	0.06	0.90	0.76	15.00	16.90
Clothing	−11.17	0.06	0.91	0.80	15.00	23.70
Footwear	−10.15	0.69	0.90	0.86	15.00	21.50
Furniture & Fixtures	−14.35	0.26	0.93	0.79	15.00	14.30
Paper Products	−19.91	0.67	0.95	0.63	15.00	6.60
Printing & Publishing	−12.27	0.47	0.92	0.71	15.00	1.10
Chemicals	−12.95	0.49	0.92	0.58	15.00	7.90
Nonmetallic Min. Products	−15.43	0.69	0.94	0.58	15.00	4.40
Nonferrous Metals	−14.08	0.30	0.93	0.77	15.00	3.30
Metal Products	−13.11	0.41	0.92	0.70	15.00	8.60
Nonelectrical Machinery	−11.27	0.08	0.91	0.69	15.00	4.60
Electrical Machinery	−11.59	0.19	0.91	0.57	15.00	7.50
Transport Equipment	−13.68	0.02	0.93	0.70	15.00	0.0
Misc. Manufactures	−12.44	0.33	0.92	0.69	15.00	5.00
Nontradable Industries						
Wholesale Trade	−13.44	0.68	0.93	0.67	15.00	
Transportation	−14.07	0.58	0.93	0.66	15.00	
Financial Services	−13.83	0.84	0.93	0.34	15.00	

Table 5C

Parameters of the Model: Canada
Market Segmentation Model

Sector	Mark-up Over MC			Variable K Share of Total K	Variable Input Cost Share	Labor Share of Primary Input Cost
	U.S.	Other	Canada			
Tradable Industries						
Petroleum Products	0.05	0.05	0.05	0.76	0.98	0.43
Rubber Products	0.05	0.05	0.08	0.38	0.94	0.78
Glass Products	0.05	0.05	0.15	0.40	0.89	0.66
Iron & Steel	0.05	0.05	0.20	0.03	0.93	0.76
Nontradable Industries						
Mining & Quarrying			0.05	0.93	0.96	0.21
Utilities			0.07	0.88	0.93	0.32

Table 6

Summary Results of a U.S.-Canadian Free Trade Area: Changes in Country Imports, Exports, Exchange Rates, Terms of Trade, and Welfare (Trade and Welfare in Millions of U.S. Dollars)

Country	Imports*	Exports*	Exchange Rate**	Terms of Trade Percent Change	Equivalent Variation
United States	6,018.4	7,348.0	−0.0	0.1	1,540.6
Other	−8,783.6	−3,415.5	0.4	−0.1	−142.7
Canada	8,272.6	8,544.0	−1.1	−0.2	2,077.0

*Dollar value of change in trade volume
**(+) indicates depreciation of currency.

Table 7A
Sectoral Effects on the United States of U.S.-Canadian Bilateral Tariff Elimination
Perfect Competition
Percent Change

Sector	Exports	Imports From		Output	No. Firms		Elasticity	Capital	Rental Rate	Employment
		World	Canada		U.S.	World				
Tradable Industries										
Agriculture	-0.9	3.9	15.9	-0.4	0.0	0.0	0.0	-0.4	-0.1	-0.5
Leather Products	2.1	4.4	36.3	-0.6	0.0	0.0	0.0	-0.5	-0.1	-0.6
Wood Products	2.1	0.1	-2.0	0.6	0.0	0.0	0.0	0.6	-0.1	0.5
Nontradable Industries										
Construction				-0.0	0.0		0.0	0.1	-0.1	-0.0
Personal Services				-0.0	0.0		0.0	0.1	-0.1	-0.0

Table 7B

Sectoral Effects on the United States of U.S.-Canadian Bilateral Tariff Elimination
Monopolistic Competition
Percent Change

Sector	Exports	Imports From		Output	No. Firms		Elasticity	Capital	Rental Rate	Employment
		World	Canada		U.S.	World				
Tradable Industries										
Food	7.7	7.2	46.2	0.0	0.0	-0.0	0.0	0.2	-0.1	-0.0
Textiles	33.1	5.4	101.0	3.9	0.0	0.0	-0.0	0.8	-0.1	3.9
Clothing	51.3	3.8	228.4	0.7	0.7	0.6	0.0	0.8	-0.1	0.7
Footwear	82.1	4.4	130.3	-0.5	-0.6	-0.4	0.1	-0.4	-0.1	-0.5
Furniture & Fixtures	85.9	25.0	60.8	0.8	-0.8	-1.0	1.5	-0.3	-0.1	0.8
Paper Products	17.8	-21.2	-23.4	3.1	1.9	0.8	1.1	2.5	-0.1	3.1
Printing & Publishing	11.7	1.7	-7.5	0.2	0.0	0.0	0.2	0.2	-0.1	0.2
Chemicals	9.3	14.8	84.2	0.8	0.0	0.0	9.6	0.6	-0.1	0.8
Nonmetallic Min. Products	18.2	-2.2	-19.2	0.9	0.9	0.7	0.0	1.0	-0.1	0.9
Nonferrous Metals	-0.0	62.6	167.5	-13.6	-13.6	-5.6	-0.0	-13.4	-0.1	-13.6
Metal Products	28.7	11.7	51.2	0.7	0.7	0.6	0.0	0.8	-0.1	0.7
Nonelectrical Machinery	3.4	12.1	35.1	-0.3	0.0	0.0	0.1	-0.1	-0.1	-0.3
Electrical Machinery	14.2	4.9	55.5	1.2	-0.4	-0.5	1.5	0.0	-0.1	1.2
Transport Equipment	-0.5	0.3	0.1	-0.0	0.0	0.0	1.9	0.0	-0.1	-0.0
Misc. Manufactures	3.9	6.0	33.5	-0.5	0.1	-0.2	-0.5	-0.3	-0.1	-0.5
Nontradable Industries										
Wholesale Trade				-0.0	0.0		0.0	0.2	-0.1	-0.1
Transportation				0.0	0.1		0.0	0.2	-0.1	-0.0
Financial Services				-0.0	0.0		0.0	0.1	-0.1	-0.1

Table 7C

Sectoral Effects on the United States of U.S.-Canadian Bilateral Tariff Elimination
Market Segmentation
Percent Change

Sector	Exports	Imports From		Output	Firms	Price	Marginal Cost	Capital	Rental Rate	Employment
		World	Canada		U.S.					
Tradable Industries										
Petroleum Products	0.3	-4.8	-11.4	0.4	0.0	-0.1	-0.1	0.5	-0.1	0.2
Rubber Products	28.3	15.1	72.0	0.1	0.0	-0.3	-0.2	0.2	-0.1	0.1
Glass Products	20.8	23.5	107.4	0.4	0.0	-0.1	-0.1	0.4	-0.1	0.4
Iron & Steel	9.3	10.3	53.8	-0.5	-0.5	-0.1	-0.1	-0.3	-0.1	-0.5
Nontradable Industries										
Mining & Quarrying				-0.4	0.0	-0.1	-0.1	-0.3	-0.1	-0.5
Utilities				-0.1	0.0	-0.1	-0.1	0.0	-0.1	-0.3

Table 8A

Sectoral Effects on Canada of U.S.-Canadian Bilateral Tariff Elimination
Perfect Competition
Percent Change

Sector	Exports	Imports From		Output	No. Firms		Elasticity	Capital	Rental Rate	Employment
		World	U.S.		Canada	World				
Tradable Industries										
Agriculture	-3.6	23.8	33.7	-5.5	0.0	0.0	0.0	-5.5	-0.1	-5.6
Leather Products	10.8	4.7	27.7	4.9	0.0	0.0	0.0	5.0	-0.1	4.9
Wood Products	-4.2	28.4	34.5	-6.1	0.0	0.0	0.0	-6.1	-0.1	-6.1
Nontradable Industries										
Construction				1.1	0.0		0.0	1.2	-0.1	1.0
Personal Services				0.6	0.0		0.0	0.7	-0.1	0.5

Table 8B

Sectoral Effects on Canada of U.S.-Canadian Bilateral Tariff Elimination
Monopolistic Competition
Percent Change

Sector	Exports	Imports From		Output	No. Firms		Elasticity	Capital	Rental Rate	Employment
		World	U.S.		Canada	World				
Tradable Industries										
Food	16.3	40.5	82.7	-1.9	-2.7	-2.5	0.1	-2.4	-0.1	-1.9
Textiles	19.5	82.2	179.9	-35.4	0.0	0.0	-5.1	-2.1	-0.1	-35.4
Clothing	81.6	38.1	283.4	-6.4	-8.6	-6.8	0.7	-8.3	-0.1	-6.4
Footwear	90.1	15.3	254.6	2.2	-1.4	-1.0	2.0	1.2	-0.1	2.2
Furniture & Fixtures	59.9	118.8	179.5	-2.5	-13.6	-12.1	9.3	-10.5	-0.1	-2.5
Paper Products	-23.5	96.8	103.1	-19.3	-19.1	-17.2	-1.0	-19.2	-0.1	-19.3
Printing & Publishing	-8.3	23.0	25.2	-3.2	-3.1	-2.7	-0.6	-3.1	-0.1	-3.3
Chemicals	83.3	9.1	35.0	17.9	0.0	0.0	59.0	9.0	-0.1	17.9
Nonmetallic Min. Products	-22.9	51.9	73.7	-16.8	-17.2	-13.5	-0.2	-16.8	-0.1	-16.8
Nonferrous Metals	151.6	34.8	52.2	152.4	150.3	-8.4	0.3	150.9	-0.1	152.4
Metal Products	31.1	83.6	114.4	-7.1	-9.0	-7.8	0.5	-8.1	-0.1	-7.1
Nonelectrical Machinery	25.2	15.3	25.7	-1.2	0.0	0.0	2.5	0.1	-0.1	-1.2
Electrical Machinery	27.0	60.6	94.8	-14.2	-18.1	-13.7	2.1	-17.3	-0.1	-14.2
Transport Equipment	-0.1	1.0	0.9	0.5	0.0	0.0	0.3	0.1	-0.1	0.5
Misc. Manufactures	31.2	12.1	37.8	7.3	-13.2	-5.3	17.1	-6.3	-0.1	7.3
Nontradable Industries										
Wholesale Trade				0.5	0.3		0.0	0.7	-0.1	0.5
Transportation				0.5	0.3		0.0	0.6	-0.1	0.5
Financial Services				0.5	0.0		0.0	0.5	-0.1	0.4

Table 8C

Sectoral Effects on Canada of U.S.-Canadian Bilateral Tariff Elimination
Market Segmentation Model
Percent Change

Sector	Exports	Imports From		Output	Firms Canada	Price	Marginal Cost	Capital	Rental Rate	Employment
		World	U.S.							
Tradable Industries										
Petroleum Products	-11.9	0.1	9.7	-11.5	0.0	-1.2	-0.6	-8.5	-0.1	-11.6
Rubber Products	67.1	49.2	100.9	-1.2	0.0	-3.0	-1.9	0.1	-0.1	-1.2
Glass Products	81.1	39.8	64.7	-3.9	0.0	-4.5	-1.2	-1.5	-0.1	-3.9
Iron & Steel	34.2	44.0	92.4	28.5	7.2	-2.9	-0.9	7.9	-0.1	28.5
Nontradable Industries										
Mining & Quarrying				-1.0	0.0	-0.5	-0.5	-0.8	-0.1	-1.1
Utilities				0.3	0.0	-0.2	-0.2	0.4	-0.1	0.1

Copies of the technical appendix can be obtained by sending a self-addressed mailing label to:

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