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Tax Policy and Trade Liberalization: An Application to Mexico

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Abstract

We construct a dynamic general equilibrium model of an open economy and use it to examine issues of trade liberalization in Mexico. In particular, we consider the fiscal implications of quotas and tariffs and, accordingly, their removal. We show that, in the short run, there may be negative revenue effects from tariff liberalization, so that it may be necessary to raise domestic taxes to compensate for the tariff reduction.

We also show that these results are highly sensitive to behavioral shifts in exports. Since such shifts are quite likely given the nature of the trade reform currently being undertaken, it is important that we qualify our results accordingly.

JEL Classification Numbers
C68, E62, F14

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Summary

In 1985, Mexico embarked on an ambitious program of trade liberalization, which involved, in particular, gradually replacing quantity restrictions with tariffs. Tariff rates were, in turn, reduced and their coverage and range made more uniform. The results have been very positive. Productivity of the export sector has improved steadily, and, until 1990, the trade balance remained positive while the volume of imports increased. Moreover, total revenues from import duties have remained approximately constant in real terms while overall budgetary revenues have risen. This paper develops a model to analyze the effects of these changes in the trade regime and examines the macroeconomic effects of the tariff reduction policies incorporated in the North American Free Trade Agreement (NAFTA).

The model incorporates aggregate import quotas and tariffs. The shadow price of the quotas is calculated, and a measure of the true cost to consumers of the restricted imports is derived. The model is calibrated to the macroeconomic outcomes of the quota regime, that is, to the pre-1985 trade policy. Then the relaxation of quotas and their replacement by tariffs are imposed to test whether the model accurately predicts the outcomes of the trade reforms.

The paper then analyzes the effects of tariff elimination in 1990-91 to capture the desired outcome of the NAFTA. Government revenues are predicted to decline by 0.8 percent of GDP in 1990 and by 0.9 percent in 1991 in response to the tariff reduction. The budget deficit rises by 0.5 percent and 0.6 percent of GDP in 1990 and 1991, respectively. At the same time, the deficit in the trade balance--1.2 percent and 2.4 percent of GDP in 1990 and 1991, respectively--grows to 1.5 percent and 2.8 percent, respectively, after tariffs have been removed.

The paper supposes that the Government compensates for the tariff relaxation by increasing corporate and personal income tax rates by 1 percent. As a result, revenues rise by 0.6 percent of GDP in 1990 and 1991. The overall budget deficit declines to 5.5 percent of GDP from 5.9 percent in 1990 and to 2.6 percent of GDP from 3.0 percent in 1991. The trade deficit, on the other hand, does not improve. The increase in domestic tax collection is accompanied by an appreciation in the real exchange rate, thereby putting pressure on the trade balance.

It is difficult to compensate for the loss in tax revenue after tariff liberalization while neutralizing the trade account. If there is no change in the exchange rate regime, then reduction in the budget deficit brings about an appreciation in the real exchange rate, negating any positive effects that fiscal austerity may have had on the trade balance. The Government therefore needs to coordinate its exchange rate policy with the new fiscal regime in order to avoid this appreciation.

I. Introduction

Starting in 1985, Mexico embarked on an ambitious program of trade liberalization. In particular, quantity restrictions were gradually removed and were replaced by tariffs. Tariff rates were, in turn, reduced and made more uniform in both their coverage and range. 1/ The results have been very positive: there has been a steady improvement in the productivity of the export sector; while, until 1990, the trade balance has remained positive even while the volume of imports has increased. At the same time, total revenues from import duties have remained approximately constant, in real terms, while overall budgetary revenues have risen. Our aim in this paper will be to develop a model that can be used to analyze the effects of these changes in the trade regime. We will then carry our analysis a step further and attempt to examine the macroeconomic effects of the tariff reduction policies incorporated in the North American Free Trade Agreement (NAFTA).

We will construct a model that incorporates aggregate import quotas, as well as tariffs. We will implicitly calculate the shadow price of the quotas, and will thereby derive a measure of the true cost to consumers of the restricted imports. 2/ Using estimates of the behavioral parameters of our model, we will carry out a set of numerical simulations. We will calibrate the model to the macroeconomic outcomes of the quota regime, that is, the pre-1985 trade policy. We will impose the relaxation of quotas and their replacement by tariffs that have occurred in Mexico in order to see if our model accurately predicts the outcomes of the trade reforms.

We will then use our model to analyze the effects of tariff elimination. In particular, we will consider how the loss of revenue from tariff reductions may be compensated for by domestic tax changes. This is an important issue since Mexico currently collects revenues equal to approximately 1 percent of GDP from import duties. 3/ Indeed, a number of authors, such as Tanzi (1989), note the possibility of a short-term revenue loss resulting from tariff reduction. It is often claimed, on the other hand, that in the medium and long run, that tariff liberalization will lead to increased government revenues. 4/

The next section will be a description of a simple dynamic model we will use to analyze the Mexican situation. Section III will use a numerical version of our model to derive certain policy conclusions about tariff reduction and domestic taxation. The final section will be a conclusion.

1/ The average tariff rate was reduced from 25 percent in 1985 to approximately 12.5 percent in 1990. At the same time, the number of tariff categories was reduced from 10 to 3.

2/ Feltenstein (1983) uses a static general equilibrium model to compute the tariff equivalents to disaggregated quotas.

3/ This represents approximately 8 percent of total tax revenues, excluding those revenues accruing from PEMEX, the state petroleum company.

4/ Blejer and Cheasty (1988), on the other hand, draw less optimistic conclusions about the long-run effects of trade liberalization on government revenues.

II. Model Description

We will construct a two-period general equilibrium system in which all agents exhibit perfect foresight. 1/ This model is based upon Feltenstein and Morris (1990), Feltenstein (1992), and Feltenstein and Shah (1992), but, in incorporating trade restrictions, differs from those papers. We need to specify the behavior of private production and consumption, as well as the behavior of government expenditure, taxation, and deficit financing. Given the objectives of our study, we must also derive a methodology for incorporating import quotas into our model.

1. Production

There are seven factors of production and financial assets.

1. Capital
2. Urban labor
3. Money
4. Domestic bonds
5. Foreign bonds
6. Rural labor
7. Land

An input-output matrix, A, is used to determine intermediate and final production. Each non-agricultural sector in the input-output matrix produces value added using capital, land, urban and rural labor. We will suppose that the agricultural sector uses land and rural labor, while all other sectors use capital and urban labor in the production of value added. Our data source for the input-output matrix is Matriz de Insumo-Producto Año 1978 (1983). Here a 72-sector matrix is derived which represents Mexico's technology for 1978. We have aggregated the technology to seven sectors by adding corresponding rows and columns. We have not attempted to update the matrix for the years of our simulations, although, given the various oil shocks, such a revision might prove to be useful.

Here we treat imports as a single product that is distinct from domestic production. 2/ We will introduce quotas on imports in the following way. There is a limit, set either in terms of physical units or in terms of foreign currency value, on the volume of imports that will be permitted by the government. This quota may thus be viewed as an allocation of a scarce resource, the resource being the right to import. Accordingly, if the quota is binding, there will be a positive shadow price on a unit of rights to import. The interpretation of this shadow price is the amount an importer would be willing to pay to import one additional unit. The rents to quota rights may accrue to either the importer or to the government. Clearly, from the point of view of public revenues, the correct program for the government would be to auction quota rights.

1/ See Shoven and Whalley (1984) for a general survey of open economy general equilibrium tax models.
2/ See Armington (1969) for this approach.

Value added in the jth sector in time i, va_{ij}, is given by a Cobb-Douglas production function that uses inputs of capital, labor, and land existing in that period. In particular, the sector chooses the cost-minimizing mix of factors, given the period's prices, to produce a unit of value added. Suppose now that we consider sector j at time i. Its production structure is then given by a column:

$$(va_{ij}, \alpha_{qj}, \alpha_{1j}, \alpha_{2j}, \ldots, \alpha_{mj}) \quad \alpha_{qj} = \alpha_{mj} \tag{1}$$

where α_{kj} represents the required inputs good k to sector j in order to produce one unit of sector j's output. The term α_{qj} represents the required inputs of quota rights, while the term α_{mj} represents required inputs of imported goods. The two must be equal, since one unit of quota rights is required for each unit of imports. Thus, for example, if the sector uses 100 units of imports for its production, then it also uses 100 units of quota rights. 1/

Investment in Mexico is financed by a variety of sources, including foreign capital. Our model will incorporate foreign capital flows which, indirectly, may finance domestic investment. This foreign borrowing is incurred by the domestic consumer, who changes it into domestic currency. We will therefore assume that investment in our model is directly financed by domestic borrowing, even though it may be indirectly funded by foreign sources. Accordingly, the investor equates the cost of borrowing, given by the domestic interest rate, with the anticipated future returns on capital.

Suppose, then, that the rental price of capital in period i+1 is $P_{K(i+1)}$. If C_{Hi} is the cost-minimizing cost of producing the quantity of capital, H_i, then future debt obligations must be equal to the return on new capital. Hence:

$$C_{Hi} = \frac{P_{K(i+1)} H_i}{1 + r_i} \tag{2}$$

where r_i is the interest rate in period i, given by:

$$r_i = \frac{1}{P_{Bi}} \tag{3}$$

1/ Alternatively, if the aggregate quota is determined in terms of U.S. dollar values of imports, then imports of $1,000 require inputs of 1,000 units of quota rights.

where P_{Bi} is the price of a bond in period i. Hence, the level of private investment depends on both the current interest rate and the perfectly anticipated future return on capital. Government and private bonds are viewed as being identical. 1/

All sectors in the economy pay both income and profit taxes, and may also pay tariffs. Feltenstein and Morris (1990) derive profit-maximizing outcomes for individual firms as functions of tax rates. In addition, the government levies value-added taxes which are collected at the time of final sale. Value-added taxes are thus, in our model, paid by the consumer and are not directly assessed to the firm. Taxes are collected by the central government, which uses them to finance its own expenditure activities. 2/

Along with its spending on interest obligations, to be discussed shortly, the government produces public goods using capital and labor as inputs to production. The government's target for the output of public goods is determined exogenously as a percentage of GDP in each time period. There is thus no attempt to model an optimizing government. In addition, unlike Feltenstein and Morris (1990), we suppose that public goods have no direct effect on private productivity or consumer welfare. 3/

2. Consumption

There are two types of consumers, representing rural and urban labor. We suppose that both consumer classes have the same demand patterns for goods, and that their demands for the seven different types of goods are given by constant fractions of their incomes. The consumers differ, however, in their initial allocations of scarce resources and financial assets.

The consumers maximize intertemporal utility functions, which have as arguments the levels of consumption and leisure in each of the two periods. As in Feltenstein (1992), we permit rural-urban migration which depends upon

1/ In order to incorporate a distinction between public and private bonds it would be necessary to have a notion of risk. Otherwise our model would always generate corner solutions in which one or the other, but never both, of the two assets were held in the consumer's portfolio.

2/ Our model treats public enterprises as being part of the private sector, which pays taxes to the government. Thus, for example, PEMEX, the state petroleum corporation, is not included in our definition of the public sector.

3/ Feltenstein and Morris (1990) conclude that there is a positive elasticity of sectoral private investment with respect to the stock of public infrastructure. Since, in this paper, we will hold government spending constant and focus on tax and tariff policy, these elasticities may be ignored.

the relative rural and urban wage rate. 1/ The consumers maximize these utility functions subject to intertemporal budget constraints. The consumer saves by holding money, domestic bonds, and possibly foreign currency. He requires money for transaction purposes, but his demand for money is sensitive to changes in the interest rate. The consumer receives income from his labor, from the rental on any capital or land that he owns, and from the interest payments on bonds that he has purchased. We will also allow the possibility that the consumers own quota rights. Thus the consumer would receive income from ownership of quota rights if the quotas are binding. Finally, the consumers pay value-added taxes on the goods they consume, as well as tariffs on imported goods.

Here, and in what follows, we will use x to denote a demand variable and y to denote a supply variable. We suppose that the consumer receives utility from consumption of goods and leisure. His utility function is time separable, and in our applications will have constant consumption shares in each period, with the intertemporal allocation of consumption being determined by a non-zero rate of time preference. The consumer's maximization problem is thus:

$$\max U(x), \quad x = (x_1, x_{Lu1}, x_{Lr1}, x_2, x_{Lu2}, x_{Lr2}) \tag{4}$$

such that:

$$(1+t_i) P_i x_i + P_{Lui} x_{Lui} + P_{Lri} x_{Lri} + P_{Mi} x_{mi} + P_{Bi} x_{Bi} + e_i P_{Bfi} x_{BFi} = C_i \tag{4a}$$

$$P_{K1} K_0 + P_{A1} A_0 + \gamma P_{Q1} Q_1 + P_{Lu1} L_{u1} + P_{Lr1} L_{r1} + P_{M1} M_0 + r_0 B_0 + P_{B1} B_0 + e_1 P_{BF1} B_{F0} + TR_1 = N_1$$

$$P_{K2} (1-\delta) K_0 + P_{A2} A_0 + P_{Q2} Q_2 + P_{Lu2} L_{u2} + P_{Lr2} L_{r2} + P_{M2} x_{M1} + r_1 x_{B1} + P_{B2} x_{B1} + e_2 P_{BF2} x_{BF1} + TR_2 = N_2$$

$$C_i = N_i$$

1/ This approach is motivated by the Harris and Todaro (1970) model of rural-urban migration, in which movement to the city depends upon relative urban/rural wage rates, as well as the probability of finding work in the city. Van Wijnbergen (1984) presents a recent view of the "Dutch Disease" that is also related to our approach.

$$\log P_{Mi}x_{Mi} = a + b\log(1+t_i)P_ix_i - c\log r_i \qquad (4b)$$

$$\log P_{Bi}x_{Bi} - \log e_iP_{BFi}x_{BFi} = \alpha + \beta(\log r_i - \log\frac{e_{i+1}}{e_i}r_{Fi}) \qquad (4c)$$

$$\log(L_{ui}/L_{ri}) = a_1 + a_2\log\frac{P_{Lui}-P_{Lri}}{P_{Lui}+P_{Lri}} \qquad (4d)$$

if $P_{Lui} \geq P_{Lri}$; otherwise $\log(L_{ui}/L_{ri}) = 0$

(if the representative household is rural, otherwise labor holdings are constant)

$$P_{B2}x_{B2} = s(1+t_2)P_2x_2 \qquad (4e)$$

where:

P_i = price vector of consumption goods in period i.

x_i = vector of consumption in period i.

C_i = value of aggregate consumption in period i (including purchases of financial assets).

N_i = aggregate income in period i (including potential income from the sale of real and financial assets).

t_i = vector of sales tax rates in period i.

P_{Lui} = price of urban labor in period i.

L_{ui} = allocation of total labor to urban labor in period i.

x_{Lui} = demand for urban leisure in period i.

P_{Lri} = price of rural labor in period i.

L_{ri} = allocation of total labor to rural labor in period i.

x_{Lri} = demand for rural leisure in period i.

a_2 = elasticity of rural/urban migration.

P_{Ki} = price of capital in period i.

K_0 = initial holding of capital.

P_{Ai} = price of land in period i.

A_0 = initial holding of land.

γ = consumers share of quota rights.

P_{Qi} = price of one unit of quota rights at time i.

Q_i = total import quota time i.

δ = rate of depreciation of capital.

P_{Mi} = price of money in period i. Money in period 1 is the numeraire and hence has a price of 1. A decline in the relative price of money from one period to the next represents inflation.

x_{Mi} = holdings of money in period i.

P_{Bi} = discount price of a domestic bond in period i.

r_i = domestic interest rate in period i.

x_{Bi} = quantity of domestic bonds purchased in period i.

e_i = the exchange rate in terms of units of domestic currency per unit of foreign currency in period i.

P_{BFi} = foreign currency price of foreign bonds in period i.

x_{BFi} = quantity of foreign bonds purchased in period i.

TR_i = transfer payments from the government in period i.

a, b, c, α, β = estimated constants.

Thus, the left-hand side of equation (4a) represents the value of consumption of goods and leisure, as well as of financial assets. The next two equations contain the value of the consumer's holdings of capital, labor, and quota rights, as well as the principal and interest that he receives from the domestic and foreign financial assets that he held at the end of the previous period. The equation $C_i = N_i$ then imposes a budget constraint in each period. Equation (4b) is a standard money demand equation in which the demand for cash balances depends upon the domestic interest rate and the value of intended consumption. Equation (4c) says that the proportion of savings made up of domestic and foreign interest-bearing assets depends upon relative domestic and foreign interest rates, deflated by the change in the exchange rate. Finally, equation (4d) is a migration equation that says that the change in the consumer's relative holdings of urban and rural labor depends on the relative wage rates.

In the final period of the model, we impose an exogenous savings rate on the consumers, as in equation (4e). Thus, savings rates are endogenously determined by intertemporal maximization in period 1, but are fixed in period 2.

3. The government

The government collects income, profit, and value-added taxes, as well as import duties. It also may receive income from the sale of quota rights if it, rather than the public, owns such rights. It pays for the production of public goods, as well as for subsidies. In addition, the government must cover both domestic and foreign interest obligations on public debt. The deficit of the central government in period 1, D_1, is then given by:

$$D_1 = G_1+S_1+r_1B_0+r_{F1}e_1B_{F0}-T_1-\mu P_{Q1}Q_1 \tag{5}$$

where S_1 represents subsidies given in period 1, G_1 is spending on goods and services, while the next two terms reflect domestic and foreign interest obligations of the government, based on its initial stocks of debt. T_1 represents tax revenues while the final term is the income accruing to the government from the sale of quota rights. If quota rights belong to the public, then μ=0. If, on the other hand, they belong entirely to the government, then μ=1.

Tax revenues include sales taxes, as well as the personal and corporate income taxes. A major source of Mexican public revenue comes from PEMEX, the state petroleum company. As we mentioned earlier, we treat the petroleum sector in our model as part of the private sector. Accordingly, we have a narrower definition of the public sector than is used in official statistics.

The resulting deficit is financed by a combination of monetization and domestic and foreign borrowing. If Δy_{BG1} represents the face value of domestic bonds sold by the government in period 1, and C_{F1} represents the dollar value of its foreign borrowing, then its budget deficit in period 2 is given by:

$$D_2 = G_2+S_2+r_2(\Delta y_{BG1}+B_0)+e_2r_{F2}(C_{F1}+B_{F0})-T_2-\mu P_{Q2}Q_2 \tag{6}$$

where $r_2(\Delta y_{BG1}+B_0)$ represents the interest obligations on its initial domestic debt plus borrowing from period 1, and $e_2r_{F2}(C_{F1}+B_0)$ is the interest payment on the initial stock of foreign debt plus period 1 foreign borrowing.

The government finances its budget deficit by a combination of monetization, domestic borrowing, and foreign borrowing. As in Feltenstein (1992), we assume that foreign borrowing in period i, C_{Fi}, is exogenously determined by the lender. The government then determines the face value of its bond sales in period i, Δy_{BGi}, and finances the remainder of the budget deficit by monetization. Hence:

$$D_i = P_{Bi}\Delta y_{BGi} + P_{Mi}\Delta y_{Mi} + e_i C_{Fi} \tag{7}$$

4. <u>The foreign sector and exchange rate determination</u>

The foreign sector is represented by a simple export equation in which aggregate demand for non-oil exports is determined by domestic and foreign price indices, as well as world income. We take the dollar value of oil exports to be exogenous. The specific form of the non-oil export equation is:

$$\Delta X_{no} = \sigma_1 [\frac{\pi_1}{\Delta e_i \pi_{Fi}}] + \sigma_2 \Delta y_{wi}$$

where the left hand side of the equation represents the change in the dollar value of Mexican non-oil exports in period i, π_i is inflation in the domestic price index, Δe_i is the percentage change in the exchange rate, and π_{Fi} is the foreign rate of inflation. Also, Δy_{wi} represents the percentage change in world income, denominated in dollars. Finally, σ_1 and σ_2 are corresponding elasticities.

The combination of the export equation and domestic supply responses then determines aggregate exports. Demand for imports is endogenous and is derived from the domestic consumers' maximization problems. Foreign lending has not been modeled, but has been taken to be exogenous. Thus, gross capital inflows are exogenous, but the overall change in reserves is endogenous.

The government also attempts to adjust the exchange rate. The supply of foreign reserves y_{FGi}, available to the government in period i is given by:

$$y_{FGi} = y_{FG(i-1)} + X_i - M_i + x_{F(i-1)} - x_{Fi} + C_{Fi} \tag{8}$$

Here x_{Fi} represents the demand for foreign assets by citizens of the home country, so $x_{F(i-1)}-x_{Fi}$ represents private capital flows. C_{Fi} represents exogenous foreign borrowing by the home government.

The government has a demand for foreign assets which, we suppose, is determined by an exchange rate rule. Let y_{Fi} represent whatever the government feels to be the critical level of foreign reserves in period i. 1/ The government wishes to peg the exchange rate in period i, e_i, at its level of the previous period, e_{i-1}. It will, however, adjust the exchange rate if its stock of reserves, y_{FGi}, deviates from its target, y_{Fi}. When reserves exceed the government's target, the government leaves the exchange rate as is or revalues it only slightly. When reserves are below the

1/ Thus, for example, the government might desire a stock of foreign reserves equal to three months of exports. We let this level be a policy parameter and do not derive it from optimizing behavior.

government's target, the government devalues the exchange rate substantially. 1/ Thus, the nominal exchange rate is a function of the instantaneous stock of foreign reserves, rather than just the trade balance.

Finally, changes in the money supply in period i, ΔM_{Si}, are now given by:

$$\Delta M_{Si} = \Delta y_{Mi} + e_i y_{FGi} - e_{i-1} y_{FG(i-1)}$$

where Δy_{Mi} is determined in equation (7) from the government's financing its budget deficit, while the remainder of the right-hand side represents the domestic currency value of the balance of payments, determined by equation (8).

III. Numerical Examples

Since our model does not permit an analytical solution, we will use a numerical solution method to derive certain qualitative conclusions about government policies. We then derive a fixed point that corresponds to an intertemporal equilibrium. 2/ This equilibrium thus represents a set of prices in each period at which all factor and financial markets clear, and for which the quota constraints are satisfied.

1. Calibration

In order to simulate our model, we have used parameter estimates reported in Feltenstein and Morris (1990) and Feltenstein (1992). 3/ These represent behavioral equations for consumption parameters, money demand, and portfolio allocation, as well as production coefficients and non-oil export elasticities. In addition, parameter estimates representing the migration equation are also used. Re-estimating the behavioral parameters here would permit the addition of only two new observations of annual data, so we have chosen not to do so.

In order to simulate the estimated form of our model, we have taken initial allocations, for our first simulation, to be the stocks at the end of 1983. As a first experiment, we wish to see how well our model replicates the historical reality of 1984-85. These were the last years in which the full system of quotas and other quantity restrictions were in place. Since we do not have disaggregated information on sectoral quota allocations, we have

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1/ This may thus be interpreted as a "leaning against the wind" exchange rate policy in which the government changes the rate to compensate for movements in reserves. The speed of adjustment is a policy parameter set by the government.

2/ A program that solves this model, written in FORTRAN by the author, is available upon request and runs on a 386 or higher PC.

3/ These parameter estimates are, in turn, derived from Alberro (1989a,b), Jarque (1988), Jung (1988), and Zedillo (1986).

incorporated a single quota restriction on aggregate imports. We then set the quota for 1984 at a level meant to correspond to the regime in place in that year. 1/ In 1985 the quota is relaxed so as to correspond to the trade liberalization in effect for that year.

We then carry out a simulation for 1984-85 in which all exogenous parameters, including oil prices and oil export quantities, take on their actual historical values for those years. Table 1 gives the outcome of this simulation.

Table 1. Benchmark Simulation for 1984-85 with Pre-Reform Quotas

(Numbers in parentheses are historical values)

	1984		1985	
Nominal GDP [a]	28.7	(28.7)	49.0	(45.6)
Real GDP [b]	44.4	(44.4)	45.9	(45.6)
Government spending [a]	6.9	(6.7)	12.6	(11.8)
Revenues [a]	5.1	(4.8)	8.4	(7.8)
Government budget deficit [a]	-1.8	(-1.9)	-4.2	(-4.0)
Exports [a]	3.8	(4.1)	6.7	(5.7)
Imports [a]	3.1	(2.0)	5.0	(3.9)
Trade balance [a]	0.7	(2.1)	1.7	(1.8)
Inflation rate [c]	70.4	(70.4)	59.8	(53.5)
Interest rate [d]	49.3	(49.3)	73.5	(63.2)
Exchange rate [e]	167.8	(167.8)	222.9	(256.9)
Real exchange rate [f]	100.0	(100.0)	120.3	(100.3)
Scarcity price of quota [g]	11.9	...	1.7	...

Sources: Historical values from Cuentas Nacionales de México, Indicadores Económicos, International Financial Statistics, and public sector accounts made available by the Mexico Division of the World Bank.

Notes:

[a] In 1000 x billions of pesos.

[b] In 1000 x billions of 1985 pesos.

[c] Rate of inflation in the wholesale price index.

[d] In percent.

[e] In pesos/US$.

[f] Defined as WPI/e where WPI is the wholesale price index and e is the nominal exchange rate.

[g] The scarcity price of the quota is calculated as the ratio, in percent, of the quota price to the final price of the import, not including tariffs. The scarcity price thus represents the share of the import price attributable to the quota.

1/ There is also no direct information on aggregate quotas. We have therefore adjusted the quota level so that, combined with observed tariff rates, it causes the level of imports to approximate reality.

Let us make the following observations. Tax revenues are the sum of sales taxes, profit and income taxes, and tariffs. In addition, we attribute part of the income accruing from quota rights to the government. These revenues correspond to the collections of the Federal Government and thus do not represent as broad a coverage as given in the accounts of the consolidated public sector. Expenditure represents expenditure of the Federal Government.

We observe that our model generates a reasonably accurate approximation of the equilibrium for the two years in question. In particular, real GDP growth rates and budget deficits are quite close to their actual values. We overestimate the value of imports in each year, possibly because we have not fully incorporated the nontariff barriers in place in the two years. In addition, our simulated real interest rate is higher than its actual value in 1985, thus causing the real exchange rate to appreciate more rapidly than it did in reality.

It is interesting to notice the price effects of the quotas imposed in the two years. We see that in 1984 the quota has a simulated price representing almost 12 percent of the domestic price of the imported good. By 1985, in response to the relaxation of the quota, the price of the quota represents only 1.7 percent of the import price. Since we have no direct observations on the shadow prices of quotas, it is not possible to make direct comparisons between simulated and actual values. Nonetheless, the simulated values seem plausible, and their direction of change corresponds to expectations.

As a second exercise, let us suppose that by 1986 all quotas have been removed and replaced by tariffs. We then take initial allocations to have the corresponding values from the end of 1985. All government policy parameters, such as tax rates, tariffs, and expenditures take their historical values. When we simulate our model with these new parameters, we obtain the following results.

Table 2. Benchmark Simulation for 1986-87

(Numbers in parentheses are historical values)

	1986		1987	
Nominal GDP [a]	79.4	(79.4)	189.6	(195.6)
Real GDP [b]	44.6	(44.6)	48.2	(47.4)
Government spending [a]	18.4	(22.8)	47.2	(43.6)
Revenues [a]	10.8	(10.9)	24.7	(25.6)
of which: import duties	0.7	(0.6)	1.8	(1.6)
Government budget deficit [a]	-7.6	(-11.7)	-22.5	(-18.0)
Exports [a]	11.6	(10.2)	28.5	(28.9)
Imports [a]	8.7	(7.2)	23.3	(18.0)
Trade balance [a]	2.9	(3.0)	5.2	(10.9)
Inflation rate [c]	88.4	(88.4)	120.9	(131.8)
Interest rate [d]	88.6	(88.6)	89.4	(103.1)
Exchange rate [d]	611.8	(611.8)	1,580.6	(1492.2)
Real exchange rate [f]	100.0	(100.0)	85.5	(95.0)
Scarcity price of quota [g]	--		--	

All footnotes in Table 1 apply here.

We see that our model again offers a reasonable approximation to Mexican reality. We underestimate the trade surplus in 1987, possibly because our assumption that trade barriers were fully removed may not be realistic. It would seem, then, that the model is able to capture both the quota and post-quota regimes with some accuracy.

Let us now ask what the effect would be of removing tariffs entirely. This would be, of course, one of the eventual goals of the free trade agreement currently being negotiated between the U.S. and Mexico. Accordingly, we will simulate our model for the two-year period 1990-91, the most recent time for which data are available. We will then remove all tariffs and observe the loss of public revenue resulting from the reduction in tariffs. Finally, we will experiment with alternative tax regimes designed to replace the lost revenue.

Table 3 gives the outcomes of the historical experiment based on 1990-91 data. Initial endowments of financial assets, capital, and labor are given by the corresponding amounts at the end of 1989. Fiscal and monetary policy parameters are given their actual values for the two years in question. Thus, the portion of the deficit that is monetized takes on historical values in this and subsequent simulations. Since less than 100 percent of the deficit is monetized, there is not a one-to-one connection between changes in the deficit and changes in the rate of inflation.

Table 3. Benchmark Simulation for 1990-91

(Numbers in parentheses are historical values)

	1990		1991	
Nominal GDP [a]	668.7	(668.7)	842.4	(839.6)
Real GDP [b]	52.4	(52.4)	57.1	(54.8)
Government spending [a]	170.7	(174.5)	197.2	(196.5)
Revenues [a]	134.3	(135.7)	176.8	(168.8)
of which: import duties	9.7	(6.0)	13.8	(9.2)
Government budget deficit [a]	-36.4	(-38.8)	-20.4	(-27.7)
Exports [a]	113.9	(84.3)	153.1	(93.2)
Imports [a]	122.0	(86.9)	173.4	(113.3)
Trade balance [a]	-8.1	(-2.6)	-20.3	(-20.1)
Inflation rate [c]	25.9	(25.9)	15.7	(18.9)
Interest rate [d]	34.8	(34.8)	65.4	(19.3)
Exchange rate [d]	2,812.6	(2,812.6)	3,552.9	(3,018.4)
Real exchange rate [f]	100.0	(100.0)	91.6	(110.8)
Scarcity price of quota [g]	--		--	

All footnotes in Table 1 apply here.

We thus observe that, with two exceptions, our simulation offers a reasonably accurate replication of outcomes for the two years. The exceptions are in the areas of foreign trade and interest rates. We overestimate both exports and imports, although the simulated trade balances are fairly accurate, both in level and direction of change. A possible reason for this discrepancy is that, in completely eliminating quotas, we exaggerate the extent to which trade barriers have actually been removed. We also simulate a more-rapid-than-actual nominal exchange rate depreciation, as well as a real depreciation, rather than the real appreciation that actually occurred. This would tend to stimulate exports to grow more rapidly than actually occurred. Since we have overestimated imports, we also exaggerate revenues coming from import duties.

We simulate an increase in the nominal interest rate, although there was actually a decline in the interest rate over the two years. The discrepancies between simulated and actual values for interest and exchange rates may be related. We are using behavioral parameters based on estimates using data up to 1988. It is possible that the economic reforms of the current government have caused there to be a shift in these parameters, in response to a perceived change in regime. Accordingly, there may have been an increase in demand for domestic assets, caused by confidence in the reforms. 1/ Such an increase would cause domestic interest rates to fall and the real exchange rate to appreciate, relative to our simulated values. If, indeed, such a regime shift has occurred, it will be quite difficult to capture in the estimated parameters, given the short time span of the new system.

2. Counterfactual simulations

As our next experiment, let us consider the impact of a removal of all tariffs. This is thus intended to capture the desired outcome of the North American Free Trade Agreement. 2/ We would expect that the government would be concerned about changes in at least two endogenous variables, the budget deficit and the trade balance, caused by the tariff reduction. When we resolve the model the following outcomes occur.

1/ This is, of course, purely a conjecture since we have no empirical evidence that there has been a behavioral shift in attitudes toward Mexican financial assets. The under-prediction of private demand for these assets by a model that previously was quite accurate may, nonetheless, offer some indication that a shift has taken place.

2/ This complete elimination is, of course, an exaggeration since there will continue to be certain tariffs and trade restrictions even after full implementation of NAFTA.

Table 4. Tariff Elimination in 1990-91

	1990	1991
Nominal GDP [a]	690.9	876.3
Real GDP [b]	52.4	56.9
Government spending [a]	174.1	203.0
Revenues [a]	133.5	176.4
of which: import duties	--	--
Government budget deficit [a]	-40.6	-26.6
Exports [a]	121.8	166.5
Imports [a]	132.1	190.7
Trade balance [a]	-10.3	-24.2
Inflation rate [c]	19.7	16.6
Interest rate [d]	35.6	66.9
Exchange rate [d]	3,007.7	3,885.4
Real exchange rate [f]	88.9	80.2
Scarcity price of quota [g]	--	--

All footnotes in Table 1 apply here, with the exception of references to historical values, which are not used here.

There are several obvious changes in the result of this exercise, as compared to that of Table 3. Government revenues have declined by 0.8 percent of GDP in 1990 and by 0.9 percent of GDP in 1991. The budget deficit has risen by 0.5 percent of GDP in 1990 and by 0.6 percent of GDP in 1991. At the same time the deficit in the trade balance, which was 1.2 percent of GDP in 1990 and 2.4 percent of GDP in 1991, has grown to 1.5 and 2.8 percent, respectively, after tariffs have been removed. Finally, there has been a slight decline in real GDP in 1991, as demand has shifted in favor of cheaper imports at the expense of domestic production, in response to a real appreciation in the exchange rate.

The changes brought about by the removal of tariffs are thus not disastrous, but they nonetheless might be considered significant by a government concerned with fiscal control. Let us now suppose that the government attempts to compensate for the tariff relaxation by changing domestic tax rates. There are clearly a great number of possible changes, but we will consider increases in the corporate and personal income tax rates. 1/ The collections from these taxes represent approximately one third of Mexican tax revenues, so that, in the absence of increased evasion, it may be possible to realize significant revenue increases with relatively small rate changes.

1/ An increase in the value-added tax would be another obvious way to make up for the lost revenue.

Our model uses average effective tax rates as exogenous variables. 1/ Therefore, we raise, as an experiment, the average effective rates for both personal and corporate taxes by one percentage point. The following outcome results.

Table 5. Tax Increase and Tariff Elimination in 1990-91

	1990	1991
Nominal GDP [a]	678.0	855.4
Real GDP [b]	52.2	56.8
Government spending [a]	172.2	199.3
Revenues [a]	134.6	177.0
Government budget deficit [a]	-37.6	-22.3
Exports [a]	119.4	161.8
Imports [a]	129.5	185.1
Trade balance [a]	-10.1	-23.3
Inflation rate [c]	28.7	15.8
Interest rate [d]	34.9	65.1
Exchange rate [d]	2,948.7	3,757.5
Real exchange rate [f]	97.5	88.6
Scarcity price of quota [g]	--	--

All footnotes in Table 1 apply here with the exception of references to historical values, which are not used here.

There are some clear changes, as compared with Table 4. We observe that revenues have risen by 0.6 percent of GDP in 1990 and 1991. The overall budget deficit has declined from 5.9 to 5.5 percent of GDP in 1990 and from 3.0 to 2.6 percent of GDP in 1991. Indeed, the overall budget deficit is now only slightly higher than in the base simulation in Table 3. The trade deficit, on the other hand, remains at about its level in Table 4, in real terms, and slightly above the level of the base simulation in Table 3. 2/ We should note that there is a slight appreciation in the nominal exchange rate, compared with Table 4, because of an improvement in the balance of payments, which is not shown here. Recall that the exchange rate depends upon total reserve changes rather than only the trade balance. As might be expected, the increase in domestic tax collection has brought with it an appreciation in the real exchange rate, as compared with Table 4, thereby putting pressure on the trade balance. Finally, the rate of growth in real DGP declines in 1990, compared with Table 4, but increases in 1991. This leads to the observed increase, followed by a decline in the inflation rate.

1/ In practice the government would, of course, set statutory rates. We are not able to simulate the connection between statutory and effective rates, however.

2/ The higher budget deficit, as compared with Table 3, negates the effect of the slight real exchange rate depreciation.

It is, of course, quite possible that the structure of foreign trade may change after trade liberalization. There might, for example, be an upward shift in the export equation, reflecting reductions in nontariff barriers that are not included in our model. 1/ As a final exercise, we will therefore suppose that the constant term in the export equation increases by 10 percent. This is an arbitrary assumption but should give some notion of the sensitivity of our conclusions to changes in parameters. The following outcomes result.

Table 6. Tax Increase and Tariff Elimination in 1990-91, Combined with Shift in Export Equation

	1990	1991
Nominal GDP [a]	681.8	851.2
Real GDP [b]	52.4	57.0
Government spending [a]	173.3	199.1
Revenues [a]	136.3	178.6
of which: import duties	--	--
Government budget deficit [a]	-37.0	-20.5
Exports [a]	118.7	155.3
Imports [a]	123.0	171.5
Trade balance [a]	-4.3	-16.2
Inflation rate [c]	28.4	14.8
Interest rate [d]	35.3	65.9
Exchange rate [d]	2,663.2	3,296.0
Real exchange rate [f]	107.7	99.9
Scarcity price of quota [g]	--	--

All footnotes in Table 1 apply here with the exception of references to historical values, which are not used here.

We thus observe that a relatively minor shift in the export equation has had a significant impact upon the results of our model. If we compare the outcomes to those in Table 5, we see a significant improvement in the trade balance even while there is an appreciation in the real exchange rate. There is a slight increase in real GDP and the budget deficit declines slightly. We may thus conclude that our results are highly sensitive to any changes in export behavior, changes that might quite likely occur in response to the reforms currently under way.

1/ An underlying assumption of NAFTA is that the overall effect of trade liberalization will be to increase the volume of trade by more than would be predicted by simply looking at relative price elasticities, based on previous behavior. That is, there will be structural changes in the economies involved.

IV. Conclusion

We have constructed a dynamic general equilibrium model of an open economy and have used it to examine issues of trade liberalization associated with the North American Free Trade Agreement. In particular, we consider the fiscal implications of quotas and tariffs for Mexico and, accordingly, their removal. We first calibrate the model so as to generate reasonable replicas of both the pre- and post-quota regimes. We then use the model to simulate macroeconomic outcomes for 1990-91, the most recent years for which data are available.

We carry out counterfactual simulations to examine the effect of tariff removal on the government budget deficit. We show that, in the short run, there may be negative revenue effects from tariff liberalization, so that it may be necessary to raise domestic tax rates in order to compensate for the tariff reduction. We also note that these results are highly sensitive to behavioral shifts in exports. Since such shifts are quite likely, given the nature of the trade reform currently being undertaken, it is important that we qualify our results accordingly.

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