

THE IMPACT OF NAFTA ON U.S. EMPLOYMENT: A PARTIAL EQUILIBRIUM APPROACH

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ABSTRACT

In this paper we compare arguments made during the pre-NAFTA debate to post-NAFTA data to see whether, in fact, those arguments were borne out by actual events. More specifically, our focus in this study is on the estimation of changes in the pattern of trade and integration and the potential impact of these changes on U.S. sectoral and aggregate employment gains and losses.

INTRODUCTION

The U.S. Congress approved and implemented the North American Free Trade Agreement (NAFTA) on January 1, 1994 after an intense political debate. Opponents of NAFTA argued that imports from Mexico, accompanied by surging capital flows to Mexico, would destroy jobs in the United States. Supporters of NAFTA, on the other hand, argued that trade liberalization would create gains from increased trade based on comparative advantage. They pointed out that cheaper imports from Mexico would help U.S. Consumers (in purchases of final goods) and producers (in purchases of intermediate goods). In the long run, as Mexico's economy expanded and demanded more goods and services, there would be an expanding market for U.S. exports. Furthermore, they pointed out that NAFTA would have a relatively small impact on the U.S. economy because Mexico had a small share of U.S. trade and U.S. tariffs against Mexico were already low. In conclusion, they argued that exports to Mexico were good for the U.S. since they created jobs.

In this paper¹ we compare arguments made during the debate to Post-NAFTA data to see whether, in fact, they were borne out by actual events². More specifically, our focus in this study is on the estimation of changes in the pattern of trade and integration and the potential impact of these changes on U.S. sectoral and aggregate employment gains and losses.

The Model

Many post-NAFTA studies describe the effects of increased U.S. imports on jobs. In this section we use a partial equilibrium model to analyze the effects that changes in imports from Mexico have on U.S. demand for domestic production and therefore U.S. employment.

Our analysis starts off with the assumption that imported and domestically produced goods are imperfect substitutes, an assumption widely used in international

trade analysis. The analysis follows closely the treatment in Paul Armington³ (1969a, 1969b).

$$1. \quad Q = f(M, D)$$

where Q is aggregate commodity, M is imports and D is domestic product shipments net of exports.

$$2. \quad e_q = -(\partial Q / \partial P) \cdot (P/Q)$$

where e_q is the elasticity of demand for aggregate commodity, Q , with respect to a change in its price, P .

$$3. \quad P_m = \pi_m (1 + t_m) \cdot R$$

where P_m is the domestic price of imports, which equals world price, π_m times one plus the tariff rate, t_m , times the exchange rate, R .

$$4. \quad E_{d,m} = (\partial D / \partial P_m) \cdot (P_m / D)$$

where $E_{d,m}$ is the cross elasticity of demand for domestic production, D , with respect to a change in the price of the imported good, P_m .

$$5. \quad \sigma = (\partial D / \partial M) \cdot (M/D)$$

where σ is a constant elasticity of substitution (CES) between imported and domestically produced goods that holds at the base period.

$$6. \quad S_m = (P_m \cdot M) / (P \cdot Q)$$

where S_m is the share of imports in the value of total domestic demand.

It is important to note that equation 4 depends on three variables: (i) the elasticity of substitution, σ ; (ii) the elasticity of demand for aggregate good, e_q ; and (iii) the share of imports in the value of total domestic demand, S_m . After a lot of algebraic manipulations, equation 4 can be written as:

$$7. \quad E_{d,m} = (\sigma - e_q) \cdot S_m$$

Using a hat (^) to denote the rate of growth of a variable, substituting equation 7 into equation 4, implies

$$8. \quad \hat{D} = (\sigma - e_q) S_m \cdot \hat{P}_m$$

Let us see how the application of equation 8 works. Consider two special cases. First, assume that the domestic and imported goods have a trade elasticity of substitution of

zero; i.e., they are perfect complements. For instance, assume that, for some reason, we import left shoes from Mexico and produce right shoes in the United States. In this case, $\sigma = 0$, and from equation 8, decreasing the price of imported good will actually raise the demand for the domestic good (assuming a non-zero elasticity of demand for pairs of shoes). The reason is that the decrease in the price of imported left shoes lowers the cost, and hence price P , of pairs of shoes. The result is increased demand for pairs of shoes (depending on the elasticity of demand, e_q), and hence also for domestically produced right shoes. In general, this complementarity effect will operate for any sector in which the elasticity of substitution is lower than the price elasticity of demand for aggregate good (i.e., $\sigma < e_q$).

Second, at the opposite extreme, if the domestic and imported goods are perfect substitutes, equation 8 collapses: any change in import price will cause the domestic industry to contract or expand dramatically, leading either to its complete elimination or to its complete dominance. In this case, any increased imports fully displace domestic production.

The assumption of perfect substitutability is inherently implausible and inconsistent with a great deal of empirical evidence. There is now a large body of empirical work estimating trade substitution elasticities for the United States at various levels of aggregation. The results typically yield substitution elasticities that range from 0.02 to about 3.5 with most sectors having elasticities clustering between 0.5 and 1.0 – indicating that the assumption of imperfect substitutability is both plausible and important. Estimates of the impact of increased imports on domestic production and employment that assume perfect displacement will be widely off the mark.

Equation 8 is the basic equation we would like to use to estimate the impact of changes in import prices on domestic production and employment. But the approach requires extensive price and demand elasticity data. The U.S. International Trade Commission (USITC) utilizes a variant of this approach on their “COMPAS” model⁴ analyzing selected sectors at a very micro level. Focusing on particular sectors, they are able to collect the price and demand data they need, and to use sensitivity analysis on estimates of elasticities.

In our case, we look at all sectors of U.S. economy. For many sectors, we are unable to estimate aggregate demand elasticities and, in any case, do not have the necessary price data. We therefore approach the problem by allowing prices to remain offstage. We do not know the change in prices, but we do observe a change in the value of imports and so can analyze quantity changes. Totally differentiating the Armington import aggregation function, we get

$$9. \quad \Delta Q = (\partial Q / \partial M) \cdot \Delta M + (\partial Q / \partial D) \cdot \Delta D$$

Solving this equation for the change in domestic demand yields:

$$10. \quad \Delta D = - [(\partial Q / \partial M) / (\partial Q / \partial D)] \cdot \Delta M + [1 / (\partial Q / \partial D)] \cdot \Delta Q$$

In this equation, the change in the domestic demand is decomposed into two parts, a “displacement” effect due to change in imports holding Q constant, and a “demand” effect due to a change in demand for the aggregate good, Q .

We do not have time series data after 1992 on changes in consumption of composite goods, however we estimate

$$Q = \text{GDP} - \text{Exports} + \text{Imports}$$

or

$Q = D - X + M$ for subsequent years. In an initial scenario, we hold total demand (Q) constant and estimate only the import displacement effect. This approach of assuming that Q is fixed will lead to an upper bound on the estimate of the impact of changes in imports on demand for the domestic substitute as import prices fall (due to lower tariff rate under NAFTA). In subsequent scenarios, we vary labor productivity and then Q to more accurately represent actual changes.

We compute the “displacement” effect by using the CES form for the Armington import aggregation function:

$$11. \quad Q = A \cdot [\delta M^{-\rho} + (1 - \delta) D^{-\rho}]^{-1/\rho}$$

where Q , D and M are already defined above, A is a constant representing technology, δ is the share parameter and ρ is parameter that depends on the elasticity of substitution, σ : $\rho = (1/\sigma) - 1$.

Solving the CES function for D (domestic production for domestic consumption) yields:

$$12. \quad D = \left[\frac{(Q/A)^{-\rho} - \delta_{MX} M_{MX}^{-\rho}}{1 - \delta_{MX}} \right]^{-1/\rho}$$

The parameters of the CES function for each sector are computed by using estimated values of the substitution elasticity σ , taken from USITC⁵ estimates, and then computing the other parameters from the base data. The share parameters, δ , can be computed from initial data on value shares under the assumption that the initial data represent market equilibrium. The relationship is given by:

$$13. \quad \frac{\delta}{1 - \delta} = (S_m / S_d)^{1/\sigma}$$

where, assuming initial prices are one by assumption:

$$14. \quad S_m = (M / Q), \text{ and}$$

$$15. \quad S_d = 1 - S_m$$

Solve the equation for δ :

$$16. \quad \delta = [(S_m / S_d)^{1/\sigma}] / [1 + (S_m / S_d)^{1/\sigma}]$$

We calculate the constant A, from initial data. Calculate D_0 (domestic consumption) as:

$D_0 = Q - M_w$, where w denotes the “world”, and A is given by:

$$17. \quad A = \frac{Q}{[\delta_w M_w^{-\rho} + (1 - \delta_w) D_0^{-\rho}]^{-1/\rho}}$$

Note there is a separate A for each 4-digit sector.

Substituting into the CES function (equation 12) the variables A , Q , q , δ_{MX} , M_{MX} gives the desired domestic consumption, D , for a given year with respect to Mexican imports.

Three scenarios will be estimated for each sector:

- Scenario 1: Q is held constant, Employment Requirement Coefficients (i.e. labor – output ratio or ERC_s) are held constant, and M_i varies.
- Scenario 2: Q is held constant, ERC_s vary and M_i varies.
- Scenario 3: Q varies, ERC_s , vary, and M_i varies.

These scenarios are estimated first with respect to imports from Mexico and then with respect to Canada.

By varying imports from only one country, in effect we ignore the possibility that an increase in Mexican imports will cause a decline in imports from other countries, leaving domestic demand unchanged, i.e., we assume trade diversion⁶ is zero. Our measure of “displacement” effect thus will tend to **overstate** the effect of increased imports from a single country (here, Mexico) on domestic sales. Since there is a growing evidence of trade diversion under NAFTA, this overestimate may be significant in some sectors.

Employment Effect

We estimated the number of jobs lost due to “displacement” effect resulting from Mexican-produced goods, the vector of 4-digit sectors M_{MX} , by computing the change in D between any two years (1993-2000) and multiplying this difference by direct and indirect ERC_s , erc^i , that we obtained from IMPLAN input-output model⁷.

Jobs lost due to displacement resulting from imports, JM , are estimated as:

$$18. \quad JM^i_{t+\Delta t} = D^i_t \cdot erc^i_t - D^i_{t+\Delta t} \cdot erc^i_{t+\Delta t}$$

for every tradable sector i

Jobs supported by exports, JX , are estimated as:

$$19. \quad X^i_{t+\Delta t} = X^i_t \cdot erc^i_t - X^i_{t+\Delta t} \cdot erc^i_{t+\Delta t}$$

for every tradable sector i .

Results of Potential Employment Impact of Trade with Mexico and Canada

Table 1 presents the summary results from the baseline import scenario. Our investigation leads to the conclusion that the job impact is relatively small, with the total estimated potential job impact in the United States from 1993-2000 due to imports from Mexico at 299,000 and from Canada at 458,000, or an average of 94,625 jobs lost per year due to increased Mexican and Canadian trade. To put this number in perspective, we note that the United States economy has generated over 200,000 jobs per month during this period of 1993-2000.

Other studies⁸ have reached similar conclusion: NAFTA had no discernible effect on United States aggregate employment. Our findings in Table 2 also show that the jobs supported by United States exports to Mexico and Canada have been 609,000 and 828,000, respectively over this period. There are three implications for United States labor market of Mexican growth. **First**, as United States exports to Mexico increase, there are potential employment gains in the United States. **Second**, as Mexico’s economy grows, there will be less migration pressure on United States labor markets. **Third**, applying more realistic productivity and demand changes experienced since NAFTA significantly reduces the potential United States job losses due to imports.

TABLE 1

Potential Import Impact on U.S. Employment
Given Fixed Productivity and Fixed Demand

	1993	1994	1995	1996	1997	1998	1999	2000
Mexico								
Direct Impact	15,504,750 (13,256)	15,491,494 (21,007)	15,470,487 (21,255)	15,449,232 (19,909)	15,429,323 (20,197)	15,409,126 (1,798)	15,410,924 (17,444)	15,393,479 (111,271)
Indirect Impact	24,771,625 (14,702)	24,756,923 (31,044)	24,725,879 (33,170)	24,692,708 (33,049)	24,659,660 (38,421)	24,621,239 (13,918)	24,607,321 (23,429)	24,583,892 (187,733)
TOTAL	40,276,375 (27,958)	40,248,417 (52,051)	40,196,366 (54,425)	40,141,940 (52,957)	40,088,983 (58,618)	40,030,365 (12,120)	40,018,245 (40,873)	39,977,372 (299,003)
Canada								
Direct Impact	17,146,954 (11,871)	17,135,082 (30,226)	17,104,856 (18,682)	17,086,174 (24,083)	17,062,092 (26,413)	17,035,678 (15,659)	17,020,019 (14,734)	17,005,285 (141,669)
Indirect Impact	28,196,582 (8,916)	28,187,666 (57,630)	28,130,036 (62,078)	28,067,958 (63,824)	28,004,134 (59,211)	27,944,923 (25,331)	27,919,592 (39,076)	27,880,516 (316,066)
TOTAL	45,343,536 (20,788)	45,322,748 (87,856)	45,234,892 (80,760)	45,154,132 (87,907)	45,066,225 (85,624)	44,980,601 (40,990)	44,939,611 (53,810)	44,885,802 (457,734)

TABLE 2

**Potential Employment Impact from U.S. Exports
Given Fixed Productivity**

	1993	1994	1995	1996	1997	1998	1999	2000	Net '93-2002
Mexico									
Direct Impact	176,513	206,028	261,490	262,939	320,721	292,171	369,235	438,891	262,378
Indirect Impact	236,823	283,209	349,903	349,958	429,489	379,431	470,458	583,542	346,719
TOTAL	413,336	489,237	611,393	612,896	750,210	671,602	839,694	1,022,432	609,097
Change with respect to previous year		75,901	122,157	1,503	137,314	(78,608)	168,092	182,739	
Canada									
Direct Impact	439,329	447,282	475,508	523,236	582,365	637,040	664,060	755,444	316,115
Indirect Impact	664,858	688,489	724,066	797,394	902,675	984,418	1,034,580	1,176,813	511,955
TOTAL	1,104,187	1,135,770	1,199,575	1,320,629	1,485,041	1,621,458	1,698,640	1,932,257	828,070
Change with respect to previous year		31,584	63,804	121,055	164,411	136,417	73,182	232,616	

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