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A Partial Equilibrium Analysis of NAFTA and its Impact on U.S. Beef Trade With Canada and Mexico

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A PARTIAL EQUILIBRIUM ANALYSIS OF NAFTA AND ITS IMPACT ON U.S. BEEF TRADE WITH CANADA AND MEXICO

by

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ABSTRACT

A Partial Equilibrium Analysis of North American Free Trade Agreement

and Its Impact on U.S. Beef Trade with Canada and Mexico

by

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In September 1993, the United States Congress formally ratified the North American Free Trade Agreement (NAFTA) in conjunction with the legislatures of Canada and Mexico. NAFTA phases out tariff barriers between the United States, Canada, and Mexico over a period of several years.

The primary purpose of this study is to provide an empirical tool for evaluating the effects of NAFTA on beef trade between Canada, Mexico, and the United States. Trends were identified in U.S. beef exports and imports to Canada and Mexico over a period of several years. From the data on import/export quantities and prices, relevant elasticities were estimated for the the three trading partners using a partial adjustment modeling technique.

Given the elasticities, relevant statistical tests were performed to determine the significance of price and quantity changes. This was done to determine whether changes in trading practices were consistent.

Finally, policy recommendations were developed based on the assessment of NAFTA on U.S. beef trade. An overall direction of trade among the three countries was determined. Policies and implications based on economic theory were developed.

(68 pages)

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Srinidhi Ananthramiah

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CHAPTER I

INTRODUCTION AND BACKGROUND

The study of international trade has been an integral and highly debated part of economics for many years. Trying to keep pace with the changing international environment has become a major concern for national economic policymakers. The economies of numerous countries are closely linked through the international trade of goods and services.

Basic trade statistics illustrate the importance of international trade to the U.S. economy. From the 1960s through the 1980s, exports and imports both rose as a share of GNP, more than doubling between 1965 and 1980 (International Monetary Fund). However, between 1980 and 1987, exports plunged relative to GNP, while imports remained relatively constant. As recently as 1988, another export boom occurred. Since the 1980s and continuing into the 1990s, the implications of international trade have been widely discussed relative to domestic economic policy. The long-term trend for the U.S. appears to be towards increasing trade with other countries.

There is a strong economic rationale for trade, namely an increase in total output benefiting all trading partners. Trade economists such as Caves, Frankel, and Jones; Krugman and Obstfeld; Ethier, etc., argue that international trade is beneficial in that there are overall gains from trade. The argument is that when countries sell goods and services to one another, they do so for mutual gain. Trade provides benefits by allowing countries to export goods produced from resources that are locally abundant while importing goods produced from resources that are locally scarce.

Two important economic concepts related to trade are (1) comparative advantage and (2) absolute advantage. The law of comparative advantage suggests that a country's trade pattern will be determined by how efficiently it produces goods and services *relative* to other nations. The law of absolute advantage refers to a country's ability to produce a unit of output with fewer physical units of input. While the concept of absolute advantage is of some theoretical interest, it is generally rendered impractical because of resource constraints. Even though a country may be able to produce many goods with fewer physical units of input, it often cannot do so because it generally faces a limited supply of those inputs. Nations have different advantages because of varying resource deposits and associated opportunity costs. In studying trade among nations, the concept of comparative advantage is more relevant than that of absolute advantage.

Trade permits countries to specialize through the principle of comparative advantage and to produce a narrower range of goods, with all participants being made better off. International trade can also result in the creation of an integrated market that is larger than any one country's market, which makes it possible for all market participants to consume a greater variety of products.

The issue of trade barriers is closely tied to that of trade. Trade barriers are policies or practices enforced by governments that result in an inhibition of free trade of goods and services among nations. The most common example of a trade barrier would be the imposition of a tariff, or a tax, on imported goods. Examples of nontariff barriers include quotas and environmental or health regulations. Governments often claim to be worried about the effect international competition has on the performance of certain domestic industries and have tried to shield these industries from foreign competition by either imposing tariffs (taxes) or placing quotas on imports. Sometimes the claim is made that tariffs or quotas are placed on goods or services deemed to be critical to national interest. To elicit political support from its citizens, a government might even impose tariffs under the pretext of protecting the national interest from foreign intrusion. When couched in these terms, it has to be viewed strictly as a political move. Krugman and Obstfeld even suggest that one of the primary reasons for imposing a tariff is to collect revenue for the government. Regardless of the justification, tariffs restrict the free flow of goods and services and reduce aggregate production or output, thereby reducing overall welfare.

Statement of the Problem

In September 1990, the United States and Mexico opened negotiations to establish a free trade zone in North America. They were joined subsequently by Canada, and negotiations led to the establishment of the North American Free Trade Agreement (NAFTA) in June of 1991 (Rempke, Spiller, and Petersen). In November 1993, the United States Congress formally ratified this agreement, as did the legislatures of Mexico and Canada (Rempke, Spiller, and Petersen). NAFTA became effective in January 1994.

NAFTA essentially phases out tariff and most nontariff barriers over a period of several years. The agreement liberalizes trade and investment policies. Over a period of 15 years, NAFTA is designed to establish free trade in agricultural products between the United States and Mexico and opens new investment opportunities in key Mexican industries. Finally, it calls for the elimination of all tariffs and quotas of regional trade in textiles, a heavily protected sector in each of the participating countries.

Despite the numerous attractions of NAFTA, there has been considerable political debate over its acceptance. The main criticism by special interest groups centers on labor and environmental issues. Will NAFTA create more jobs than those lost as the mix of goods and services change? What will be the impact of negative externalities such as pollution? These, and numerous other issues, have been and continue to be debated within Mexico, Canada, and the United States.

Study Objectives and Procedures

The primary purpose of this study is to provide an empirical basis for evaluating the effects of NAFTA on the beef trade between Canada, Mexico, and the United States. The specific objectives of this study are to:

1. Identify the trends in U.S. beef exports and imports for Mexico and Canada.
   a. Collect pre-NAFTA data on beef import/export quantities and prices.
   b. Collect post-NAFTA data on beef import/export quantities and prices.
2. Determine the relevant elasticities for the beef trade among the U.S., Canada, and Mexico.
   a. Use a partial adjustment modeling technique to estimate import/export demand elasticities for U.S., Canada, and Mexico.
   b. Compare and contrast pre- and post-NAFTA elasticities for the three countries by testing the following hypothesis:

$$H_0: B_1^{1993} = B_1^{1994} = B_2^{1993} = B_2^{1994} = B_k^{1993} = B_k^{1994} = 0$$

$$H_A: B_1^{1993} \neq B_1^{1994} \neq B_2^{1993} \neq B_2^{1994} \neq B_k^{1993} \neq B_k^{1994} \neq 0$$

3. Given the elasticities, determine whether changes in trading practices are consistent and estimate the resulting changes in imports and exports following the implementation of NAFTA.
    a. Perform relevant statistical tests on pre- and post-NAFTA data to determine the significance of price and quantity changes.
    b. Project changes in imports and exports attributable to NAFTA.
4. Develop policy recommendations based on the assessment of NAFTA on U.S. beef trade.
    a. Use the results from objective (3) to determine the overall direction of trade among the three countries.
    b. Recommend policies and implications based on these results.

CHAPTER II

THEORY AND METHODOLOGY

In today's world, international trade is taking place but generally under accords whereby countries accord differential treatment to their trading partners. This treatment occurs by way of economic integration, where countries join together to create a larger economic unit among the members. When countries form economic coalitions, they move towards free trade among the partners. Each participating country attempts to obtain some of the benefits of a more open economy without sacrificing control over the goods and services that cross its borders and over its production and consumption structure. Actions taken to integrate economies often take place in stages. There are four basic types of formal regional economic arrangements.

The most common type of economic integration is known as a free trade area (FTA). Under this type of integration, members of the group remove tariffs on each other's products while each member keeps its independence in establishing trading policies with nonmembers. The members of a FTA can maintain individual tariffs and other trade barriers for the rest of the world. When each participating country in a FTA sets its own external tariff, nonmember countries might find it profitable to export a product to the member country with the lowest level of outside barriers, then through it to other members whose trade barriers might be higher. There are typically no rules of origin regarding the source country of a product. Hence, nonmembers could use this transsshipment strategy to escape some of the trade restrictions in the more highly protected member countries.

Another example of economic integration is known as a customs union (CU). In this level of integration, all tariffs are removed among members, and the group adopts a common external commercial policy toward nonmembers. The group behaves as one body in the negotiation of all trade agreements with nonmembers. The presence of a common external tariff takes away the possibility of transshipment by nonmembers. This is a closer step towards economic integration than that associated with a free trade area.

The third type of economic integration is known as a common market (CM). In this case, all tariffs are removed among members and a common external policy is adopted towards nonmembers. In addition, all barriers to factor movements among the member countries are removed. This free movement of labor and capital among members represents a higher level of national integration. The best example of this type of economic integration has been the European Common (EC) Market.

The most comprehensive form of economic integration is the formation of an economic union. It includes all the characteristics of a common market but also has the unification of economic institutions and the coordination of economic policy throughout all member countries. While they are independent political units, an economic union establishes supranational institutions whose decisions are binding upon all members. When such a union adopts a common currency, it becomes a monetary union. While this type of union has been aspired to by several European nations, member countries find it politically difficult to give up domestic sovereignty.

Economic integration has differential treatment for member countries as opposed to nonmember countries. This leads to shifts in the pattern of trade between members and nonmembers. Therefore, there are both static and dynamic effects of economic integration. While there is movement to free trade on the part of member countries, economic integration can lead to the diversion of trade from a lower cost nonmember source to a member source. The two static effects of economic integration are called trade creation and trade diversion. Viner defined trade creation as taking place whenever economic integration leads to a shift in production origin from a domestic production whose resource costs are higher to a member producer whose resource costs are lower. Presumably, this type of movement towards a free trade allocation of resources is beneficial. Trade diversion occurs whenever there is a shift in product origin from a nonmember producer to a member producer whose resource costs are higher. This type of shift could reduce welfare. The static effects of economic integration are also referred to as the short-run effects or the partial equilibrium effects since they encompass a time period occurring directly on the formation of an economic integration.

The static effects of an economic integration can be observed graphically. In figure 1, D_A is the demand curve by *country A*'s consumers for the good, and S_A is the supply curve of *country A's* home producers.

Before economic integration, assume that the price of good in *country A* is $1.50 (which equals the $1.00 price in *country B* plus the 50% tariff). With integration between *A* and *B*, the tariff is removed. *Country A* now imports 150 units (250 units - 100 units) rather than 40 units (200 - 160) from *country B*, where 60 units (160 - 100)

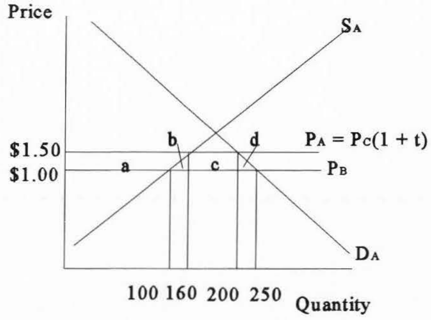

Figure 1. Trade creation and welfare

of the increased imports displace home production and 50 units (250 - 200) reflect the greater consumption facing *country A's* consumers at the new $1.00 price. The net welfare impact is the sum of areas *b* and *d*, or (½)(60)($.50) + (½)(50)($.50) = $27.50.

The assumption is that *country A* is importing the good from *country B*, as well as producing it domestically prior to the creation of the economic integration. If *country A* is the pricetaker in the world market at $1.00 per unit from *country B* and there is a 50% tariff on the traded goods, the domestic price in *A* is $1.50. The quantity consumed is 200 units, and the quantity supplied domestically is 160 units. The quantity imported by *A* from *B* is 40 units. When the tariff is removed on *country B's* goods, the price of the good in *A* falls to $1.00. The quantity consumed in *country A* rises to 50 units (250 - 200).

In this trade creation, 60 units (160 - 100) have been shifted from domestic production in *country A* to lower cost production in *country B*. Consumers also gain from a larger quantity consumed. In this case, the welfare impact on *country A* is positive. Consumers have received the additional surplus of areas "*a+b+c+d*." Area *a* is a transfer of producer surplus from *country A's* suppliers while *c* is a transfer of tariff revenue that now accrues to *A's* consumers. The net welfare gain for *country A* consists of areas "*a+d*." In this example, *b* = (½)(60 units)($0.50 per unit) = $15.00, and *d* = (½)(50 units)($0.50 per unit) = $12.50. *Country A* has increased its welfare by $15.00 + $12.50 = $27.50.

It is possible to have a trade diversion that results in a loss as a consequence of economic integration. Figure 2 shows the static effects of a trade diversion. Before integration with *country B*, *country A* has a 50% tariff on imports of the traded good. *Country C's* tariff-inclusive price in *A's* market is $1.50, and *country B's* tariff-inclusive price is $1.80. Before integration, *A* imports 50 units (180 - 130) from *C*. When union is formed with *B*, *country A* imports 100 units (200 - 100), all coming from partner *B*, which no longer faces the tariff.

Suppose there are three countries, *A, B,* and *C*. Let *A* represent the home country. *B* is the potential integration partner and *C* is the nonmember country. The production cost in *C* is $1.00, while *B* has a cost of $1.20. The product price in *A* is $1.50 because *A* has a 50% tariff in effect. Before any economic integration, *country A* will buy from *country C* since *C's* price with the tariff is lower than the tariff inclusive price of *B*, which is $1.20 + 50% = $1.80. Assume that *country A* forms an economic

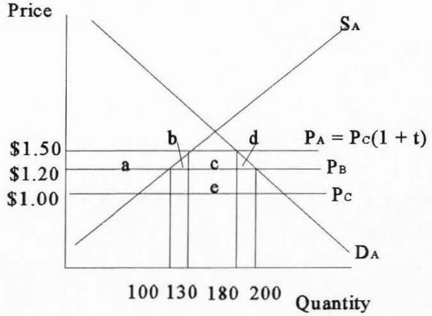

Figure 2. Trade diversion and welfare

union with *country B* and drops its protection against while maintaining its protection against *C*. *Country A* now purchases the product for $1.20 from *country B*. *Country C* has a tariff inclusive price of $1.50. *C* is still the low-cost supplier in real terms of resource costs, but it is not competitive in *A*'s market because of *A*'s preferential treatment of *B*. The impact in *country A* is to reduce the domestic price from $1.50 to $1.20, a decrease that produces a welfare gain equal to the triangles *b* and *d*. The net welfare change for *A* is the difference between areas *b* and *d* (positive effect due to lower price in *A*) and area *e* (negative effect due to lost tariff revenue by *A* that is not captured by *A*'s consumers). Welfare is reduced since $b + d = (½)(30)(\$.30) + (½)(20)(\$.30) = \$4.50 + \$3.00 = \$7.50$, while $e = (50)(\$.20) = \$10.00$.

The welfare gain captured by the sum of the areas of *b* and *d* is not the total welfare effect. The tariff revenue that was previously collected was equal to the difference between the low cost supply price in *country C* ($1.00) and the previous domestic price ($1.50) for each unit imported. The value of this revenue equals the areas of rectangles *c* and *e*. Rectangle *c* reflects the part of government revenue given up after integration. This is transferred to domestic prices through the reduction in its price. Rectangle *e* represents the difference in cost between the nonmember source and the new higher cost member source. It reflects the cost of moving to the less efficient producer in terms of lost government revenue. The net effect of economic integration between *A* and *B* depends on the sum "*b+d+e*." There is no guarantee that "*b+d*" will be larger than area *e*.

In this example, area *e* represents the difference in cost per unit between *country B* and *country C* ($1.20 - $1.00 = $0.20) times the amount of trade diverted, the original 50 units (180 - 130). The trade diversion equals ($0.20)(50) = $10.00. Areas *b* and *d* reflect the consumer surplus gain that is not a transfer from domestic producers and the government. Area *b* represents the improved efficiency effect since 30 units of the good (130 - 100) are now produced at a lower cost in *country B*. This effect has a value of (½)(30)($0.30) = $4.50. Area *d* reflects the remaining consumer surplus gain from the lower price to *A*'s consumers. This equals (½)(200 - 180 = 20)($0.30) = $3.00. The net effect of integration between *countries A* and *B* in this situation is a loss of $2.50 ($10.00 - $4.50 - $3.00). If economic integration involves trade diversion, it is possible that welfare can be reduced for the home country.

In a trade diversion context, the more closely the price in the partner country approaches the low cost world price, the more likely the impact of integration on the market in question will be positive. The impact of trade diversion is also more likely to be positive the higher the initial rate of tariff since areas *b* and *d* will be larger. The more elastic the supply and demand curves, the more likely the static effects might be positive because the more elastic the curves, the greater the quantity response by producers and consumers. This would make areas of *b* and *d* greater as well. Economic integration might be more beneficial when there are a greater number of participating countries in the union. This is because there will be a smaller group of countries from which trade can be diverted.

Along with the static or partial equilibrium effects of economic integration, there are also dynamic effects of economic integration. In this scenario, the economic structure and performance of participating countries may evolve differently than if they had not integrated. Reducing trade barriers brings about a competitive environment and possibly reduces the degree of monopoly power present prior to integration. Access to larger markets may result in economies of scale to be realized in certain export goods. These economies of scale may result internally to an exporting firm as it becomes larger in size or may be brought about from a lowering of costs due to economic integration. In both situations, they are triggered by market expansion brought about by membership in the trade association.

Gains in welfare occur when trade creation removes protected production and increases the physical trade among members. Losses in welfare occur when a preferential trade agreement causes a country to switch purchases from a more efficient to a less efficient supplier.

A preferential trading agreement tends to shift the terms of trade of each party. The members of such a union maximize their joint welfare by freeing trade among themselves and imposing an optimal tariff against outsiders. An optimal tariff minimizes the loss in welfare to the imposing nation. A member can lose if it gives preferential treatment to a partner while at the same time, its terms of trade with the outside world fail to improve. If there is an improvement, member and partner may both benefit. NAFTA is based on the theory of preferential trading agreements.

According to Krugman and Obstfeld, NAFTA can follow the example of the European Economic Community, perhaps the best modern example of a trading bloc. The EEC has created a good deal of free trade and increased the welfare of its members. To test what impact NAFTA might have on U.S. beef trade, the development of a sophisticated estimation model is required. One methodology suggested in a study on the export demand for U.S. cotton is that of distributed lag models (Duffy, Richardson, and Wohlgenant).

Distributed Lag Model (Partial Adjustment Model)

According to Kmenta, one of the most popular forms of a distributed lag model is a geometric lag model known as the *partial adjustment* or *habit persistence* model. It is based on the reasoning that in a regression model, the expected value of a dependent variable, $E(Y_t)$, is a function of an explanatory variable Y_t^* at time t-1, or Y_{t-1}. An example of this might be a simple relationship where the desired level of consumption may be a linear function of wealth. A formation of such expectations is based on the idea that current expectations can be derived by modifying previous expectations. The values of Y_t^* are not observed directly, but the assumption is made that the actual level of Y will reach the desired level of Y, but not necessarily in one period. Hence, there is only a *partial adjustment* in any one period. There may be various reasons why a complete adjustment of Y to $Y^*$is not achieved in one period, including the persistence of habits, technological constraints, institutional rigidities, etc. The major task in relation to the partial adjustment model is to determine if there exists an adjustment mechanism process whereby economic agents (i.e., consumers or producers) use past experiences to determine future behavior. Partial adjustment or habit persistence models are distributed lag models that assume current expectations of quantities and prices are influenced by previous expectations. The economic rationale for a partial adjustment model is the assumption that there exists an adjustment mechanism process whereby economic agents use past experience to determine future behavior.

With respect to the current study, there will be an adjustment time and process that take place in order for the desired level of activity to be realized following the implementation of trade policy. This adjustment time is often modeled using a distributed lag (partial adjustment) mathematical model, one that is common to export and import quantities.

Suppose that the desired level of a good at time period *t* is given by a function of some explanatory variable X_t as

$$Y^*_t = \alpha + \beta X_t \qquad (1)$$

The relationship between the actual and the desired level of *Y* may be specified by the following:

$$(Y_t - Y_{t-1}) = (1 - \gamma)(Y^*_t - Y_{t-1}) + \epsilon_t \qquad (2)$$

where $0 \leq \gamma < 1$. The coefficient $(1-\gamma)$ is the adjustment coefficient since it shows the adjustment from Y to Y^*. This coefficient allows us to determine the number of periods required to close a proportion *p* of the gap between Y^*_t and Y_t. After one period, $(1-\gamma)$ is closed so that γ of the gap still remains. After two periods, the amount of the closure is $(1-\gamma) + \gamma\,(1-\gamma) = 1-\gamma^2$, with γ^2 remaining. After *n* periods, the proportions of the gap that is closed can be represented as

$$1 - \gamma^n = \rho \qquad (3)$$

The required number of periods to close the gap is

$$n = \frac{\log(1-\rho)}{\log \gamma} \qquad (4)$$

Solving equation (2) for Y_t and substituting into equation (1) gives

$$Y_t = \alpha(1-\gamma) + \beta(1-\gamma)\,X_t + \gamma Y_{t-1} + \epsilon_t. \qquad (\cdot)$$

Equation (3) describes a geometric lag form of

$$Y_t = \alpha + \beta(1 - \gamma)\,(X_t + \gamma X_{t-1} + \gamma^2 X_{t-2\,t} \ldots) + \xi_t, \qquad (6)$$

where $\xi_t = \epsilon_t + \gamma\epsilon_{t-1} + \gamma^2\epsilon_{t-2} + \ldots$.

Consider the problem of estimating the parameters of a geometrically distributed lag model, i.e., $\gamma_t = \alpha + \beta_0\,(X_t + \lambda - X_{t-1} + \lambda^2\,X_{t-2} + \ldots) + \epsilon_t$, where ϵ_t is a random normal variable with mean zero and variance and that the disturbances are normally distributed and $E(\epsilon_t\epsilon_s) = 0$ (where $t \neq s$). However, the distributed lag model is not appropriate for estimation in its original form because it has an infinite number of regressors. By applying the Koyck transformation, it can be written

$$Y_t = \alpha + \beta\,(1-\gamma)X_t + \lambda(Y_{t-1}) + \epsilon_t - \lambda\epsilon_{t-1} \tag{7}$$

or

$$Y_t = \alpha_0 + \beta_0 X_t + \lambda Y_{t-1} + \eta_t \tag{8}$$

where $\alpha_0 = \alpha(1-\lambda)$, $\beta_0 = \beta(1-\lambda)$, and $\eta_t = \epsilon_t - \lambda\epsilon_{t-1}$. The trouble with the disturbance term is that it is correlated with Y_{t-1}, which is an explanatory variable, in the following manner:

$$E(\eta_t\, Y_{t-1}) = E(\epsilon_t - \lambda\epsilon_{t-1})(\alpha + \beta(X_{t-1} + \lambda X_{t-2})) + \epsilon_{t-1} \tag{9}$$

Using ordinary least squares estimation for this type of model would yield inconsistent results.

Consistent estimates of the coefficients under the assumption specified in Equation (9) can be obtained in various ways. Kmenta has suggested the method of instrumental variables. In this study's estimation of the import demand equations for the U.S., Canada, and Mexico, there are two relevant explanatory variables. They are the price ratios and the lagged values of the quantities of beef imported. Two instrumental variables with respect to the two explanatory variables could be used, say Z_1 and Z_2. They should satisfy the following conditions:

1. $plim - \sum_t (Z_{1t} - \bar{Z}_1)\eta_t/n = 0 \text{ and } plim \sum_t (Z_{2t} - \bar{Z}_2)\eta_t/n = 0$
2. $plim - \sum_t (Z_{1t} - \bar{Z}_1)X_t/n = 0 \text{ and } plim \sum_t (Z_{2t} - \bar{Z}_2)Y_{t-1}/n = 0$ (10)

with both being finite numbers different from zero.

To illustrate this type of model used in this study, it is assumed that there is an equilibrium, or long-run, or desired amount of imported beef. Assume that this quantity of the good at time period t is a linear function of the explanatory variable,

$$Y_t^* = \beta_0 + \beta_1 X_1 + \mu_t , \qquad (11)$$

where Y_t^* is the quantity of beef, X_t is the relative priced of beef, μ_t is the disturbance term with the following specifications:

$\mu_t \sim N(0,\sigma^2)$	(normal distribution with zero mean and constant variance)
$E(\mu_t) = 0$	(zero mean)
$Cov\ (\mu_i\ \mu_j) = 0$ for $i \neq j$	(nonautocorrelated)
$Var\ (\mu_t) = \sigma^2$	(homoscedastic)

Since the desired level of output is not directly observable, Nerlove (Kmenta 1986) postulated the following partial adjustment hypothesis:

$$Y_t - Y_{t-1} = \gamma(Y_t^* - Y_{t-1}) \qquad (12)$$

where $0 < \gamma < 1$. γ is known as the partial adjustment coefficient and where $Y_t - Y_{t-1}$ is the actual change and $(Y_t^* - Y_t)$ is the desired change.

Equation (12) postulates that the actual change in commodity stock in any given time period t is some fraction of the desired change for that period. If $\gamma = 1$, the actual change in demand is equal to the desired change in demand. This means that the actual adjusts to the desired level in the same time period. If $\gamma = 0$, that means nothing changes since the actual quantity at time t is the same as that observed in the previous time period. γ is expected to lie between two extrtemes, 0 and 1, because the adjustment to the desired level is incomplete because of such factors as contractual obligations. The adjustment mechanism in equation (12) can also be expressed as

$$Y_t = \gamma Y_t^* (1-\gamma)Y_{t-1} \quad (13)$$

showing that the observed demand at time *t* is a weighted average of the desired demand at that time and the quantity demanded in the previous time period, *t-1*, with γ and $(1-\gamma)$ being weights. Substitution of (12) into (13) yields

$$Y_t = (\beta_0 + \beta_1 X_1 + \mu_t) \text{ and } (1-\gamma)Y_{t-1}$$

$$= \beta_0 + \beta_1 X_1 + (1-\gamma)Y_{t-1} + \mu_t$$

$$\therefore \; Y_t = \alpha_0 + \alpha_1 X_1 + \alpha_2 Y_{t-1} + v_t \quad (14)$$

where $\alpha_0 = \gamma\beta_0$, $\alpha_1 = \gamma\beta_1$, $\alpha_2 = (1 - \gamma)$, and $v_t = \gamma\mu_t$. Equation (14) is to be estimated. To determine the method of estimation, we need to examine the properties of v_t, the disturbance term where $v_t = \gamma\mu_t$ and $\mu_t \sim N(0, \sigma^2)$.

$$E(v_t) = E(\gamma\mu_t) = \gamma E(\mu_t) = 0 \quad \text{(zero mean)} \quad (15)$$

$$Cov(v_i\, v_j) = E[\gamma_i - E(\gamma_i)]\,[\gamma_j - E(\gamma_j)] = E[v_i, v_j] = E[\gamma\mu_i, \mu\gamma_j]$$

$$= \gamma^2 E(\mu_i, \mu_j) = 0 \quad \text{for } i \neq j \quad \text{(nonautocorrelated)} \quad (16)$$

$$Var\,(\gamma_i) = E[v_i - E(v_i)]^2 = E(v_i)^2$$

$$= E(\gamma\mu_i)^2 = \gamma^2 E(\mu_i)^2 = \gamma^2\sigma^2 \quad \text{(homoscedastic)} \quad (17)$$

The above analysis shows that v_i is also white noise like μ_t. The OLS method can therefore be used for estimation of parameters.

Because (12) represents the long-run demand for beef imports, (14) can be called the short-run demand function. In the short-run, the existing demand for beef may not be equal to its long-run level. Once the short-run function is estimated, we obtain the estimate of the adjustment coefficient γ. Then, the long-run elasticity of demand can be drieved in the following manner:

$$Y_t^* = \frac{\alpha_2}{1 - \alpha_3} = \frac{\gamma\beta_1}{1 - (1 - \gamma)} = \frac{\gamma\beta_1}{\gamma} = \beta_1 \tag{18}$$

β_1 refers to the long-run elasticity of demand. If Y_t^* and X_t are logarithms of the quantity demanded and the prices, respectively, β_1 indicated the long-run elasticitiy of demand after all adjustments take place in response to a change in X_t, which is the relative price of beef.

The partial adjustment model can be shown diagramatically, as in figure 3. In this figure, Y_t^* is the desired level of imported beef and Y_1 is the current actual level. To illustrate this point, assume that $\gamma = .5$, implying that the importing nation plans to close one half of the gap between the actual level of imported beef and the desired level. In the first period, it moves to Y_2, with imports equal to $(Y_2 - Y_1)$, which is half of $(Y^* - Y_1)$. In each subsequent period, it closes half the gap between the imported beef at the beginning of the period and the desired level Y^*.

To estimate the parameters in equation (14), we use the least squares method. Note that the long-run coefficient β_1 is not unbiased because "unbiasedness does not carry over" via nonlinear functions (Kmenta, p. 486). Although the small sample properties are not met, the desirable asymptotic properties hold. The determination of the variance of $\hat{\beta}_1$ is somewhat more complicated. We will use the Kmenta approximation, which is obtained by using Taylor expansion. In this case, $\hat{\beta}_1 = \frac{\hat{\alpha}_2}{1 - \hat{\alpha}_3}$.

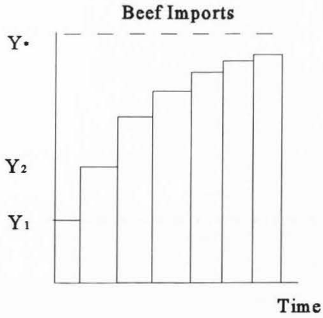

Figure 3. The gradual adjustment of the beef imports to price changes

To estimate the variance of $\hat{\beta}_1$, we use the following formula:

$$Var(\hat{B}_1) = \left[\frac{1}{1-\alpha_3}\right] Var(\alpha_2) + \left[\frac{\alpha_2}{(1-\alpha_3)}\right] Var(\hat{\alpha}_3) + 2\left[\frac{1}{(1-\alpha_3)}\right]\left[\frac{\alpha_2}{(1-\alpha_3)^2}\right] Cov(\hat{\alpha}_2, \hat{\alpha}_3) \qquad (19)$$

The above formula can be used to determine the large sample variance of β_1. Note that the variances of $\hat{\alpha}_2$ and $\hat{\alpha}_3$ are estimated in the usual manner. The parameters of equation (14) are computed by using OLS.

Predictive Chow Test

The predictive Chow test is used for time series data to see if additional obervations come from the same population as the first *n* observations. In this study, two sets of regressions were made to determine pre- and post-NAFTA elasticities of import prices and past imports. The null hypothesis we are testing is that the estimated parameters are the same for the two sets against the alternative hypothesis that they are different. The predictive Chow test statistic takes the form

$$\frac{(SSE_R - SSE_1)/m}{SSE_1/(n-K)} \sim F_{m,n-K} \tag{20}$$

where SSE_R is the restricted sum of the squares of least squares residuals (which includes the residuals of the post-NAFTA regressions), SSE_1 is the sum of of the squares of least squares of the original set of observations (which includes the regressions of the pre-NAFTA observations), m is the additional number of observations (which would be 1 since there is only one additional observation for import prices and quantity of imports), n is the original number of observations in the time series, and K is the number of parameters that have been estimated. There are 28 original observations and four parameters including the intercept in the regression.

The focus of this study on NAFTA and its impact of U.S. beef trade with Canada and Mexico will involve the static or partial equilibrium analysis of the free trade agreement. This is because the analysis is directed towards the immediate impact on the trading patterns upon the implementation of this particular economic union. The long-term impact of NAFTA on the beef trade among the three countries can take place over a number of years. With sufficient variables and data corresponding to these variables, a general equilibrium model can be constructed to determine the long-term implications of NAFTA's effects. However, this study is primarily interested in the short-term effects.

CHAPTER III

LITERATURE REVIEW

The literature available on the effects of NAFTA is quite broad. Hence, only the most relevant studies will be referenced here. A review of relevant literature on U.S. agricultural trade and distributed lag models is also given.

NAFTA Literature

Segarra made a qualitative assessment of the effects of NAFTA on trade in livestock products between the U.S. and Mexico. He concluded that the U.S. had a competitive advantage in the production of livestock products because of lower feed grain costs and better infrastructure. According to his research, the U.S. livestock products most likely to experience increased exports include high quality beef and pork. He further concluded that increases in the export of Mexican livestock products to the U.S. are unlikely to occur. The exports of live cattle to the U.S. will remain high in the short run, but not necessarily so in the long run.

Barkema conducted a descriptive analysis of the impact of NAFTA on U.S. agriculture by using secondary data from the USDA. He concluded that an expanded Mexican economy would result in an increase in the demand for foodstuffs. The major beneficiaries in the U.S. will be the feed grains and soybean sectors, but the U.S. livestock sector was also shown to benefit slightly.

Burfisher, Robinson, and Thierfelder analyzed the economic effects of NAFTA on the agriculture of the U.S. and Mexico using a 28-sector and two-country computable general equilibrium (CGE) model. The focus of the model was on raw and processed agricultural products. They concluded that the total agricultural exports from the U.S. to Mexico would increase, as would U.S. imports. However, imports did not increase as much as exports, thus improving the U.S. trade balance with Mexico. The real GDP of both nations tended to rise as a result of trade liberalization.

Hinojosa-Ojeda, Robinson, and Moulton analyzed the potential economic effects of the removal of trade barriers between the U.S. and Mexico using a three-country and seven-sector CGE model. They discovered that the lowering of trade barriers by itself had a minor impact on the U.S. economy. The impact on the Mexican economy was greater. The authors suggested that these results were to be expected since the existing trade barriers between the U.S. and Mexico were relatively small, and one would not expect large aggregate economic effects by removing them.

Krisoff, Neff, and Sharples focused specifically on the effects of trade liberalization on the agricultural subsectors of grain, livestock, and horticulture using a static, partial equilibrium model. Their results showed that the U.S. agricultural exports would increase, with grain and oilseeds accounting for most of this expansion. Horticultural products would account for over half of Mexico's expansion of exports to the U.S., and there would be an increase in Mexican exports of feeder cattle. Total U.S. beef exports would also increase but only slightly in comparison to grain and oilseeds.

In a report commissioned by the Congressional Budget Office (CBO), an overview of Mexico's agriculture and the recent history of agricultural trade among the U.S. and Mexico was presented. The CBO paper was a descriptive analysis that assessed the effects of the free trade agreement on three different agricultural sectors: (1) grains and oilseeds, (2) animal and animal products, and (3) fruits and vegetables. The study concluded that under NAFTA, U.S. exports of grains and oilseeds to Mexico would grow. U.S. exports of dairy products would increase and U.S. beef producers would also benefit from this agreement because of the competitive advantage the U.S. has in the Mexican market relative to other nations.

In a descriptive study of the Mexican dairy industry and the impacts of NAFTA, Hallberg provided an economic analysis of the institutional structure of the Mexican dairy industry. They concluded that there would be an expanded demand for U.S. exports of dairy animals and related equipment. The primary U.S. export opportunities for dairy products would be in nonfat dry milk and butter oil. Mexican demand for higher quality manufactured dairy products would probably benefit milk producers in South Texas.

In a paper presented at the Brookings Institution, Josling examined the welfare effects of NAFTA from agricultural trade. He observed that the main effects would be concentrated in grains, particularly corn, and in fruit and vegetable production in northern Mexico. Environmental regulations would have an important effect on the quantitative magnitude of the trade between the U.S. and Mexico. Overall, there would be a net welfare gain to both the United States and Mexico but the distribution of these gains would differ. According to Josling, U.S. grain producers would gain from higher exports, but consumers would face higher prices. In Mexico, producers would lose and consumers would gain. He concluded that agriculture was a case where the net gains to the U.S. would exceed those to Mexico.

Brown, Deardorff, and Stern used a five-country, 29-sector CGE model to analyze changes in employment that would be required across sectors in the U.S. economy as a result of NAFTA. Their results revealed that the U.S. would experience economic welfare gains, along with an increase in its overall wage rate. With respect to agriculture, U.S. agricultural output and employment would both increase. The authors concluded that under NAFTA, there would appear to be very little displacement of U.S. workers.

In a similar study presented for the Brookings Institution, Hinojosa-Ojeda and Robinson examined the potential effects of NAFTA on wages and employment in Mexico and the U.S. The authors used a two-country, 29-sector CGE model to capture the effects of shifts in the sectoral structure of trade, output, and employment. According to the authors, the removal of restrictions on trade in agricultural products would induce a large migration of workers within Mexico from rural to urban areas. Subsequently, there might be a rise in migration to the U.S. In the U.S., they observed an increase in the wage rate of all workers, skilled and unskilled. However, Hinojosa-Ojeda and Robinson concluded with a note of caution. Although CGE models are quite effective in describing the long-term direction of change, adjustment costs were thought to be seriously understated. They suggested that policymakers should consider actions to facilitate adjustment and to provide compensation for those workers who would be displaced.

U.S. Trade

Morey et al. examined the effects of U.S. and foreign agricultural policies on trade, utilizing a macroeconomic analysis of U.S. farm policy. They concluded that the trade effects of such policies depended on the demand for U.S. products in world agricultural markets. The authors also examined the relationship between agriculture and trade in both developed and developing economies. They looked at protectionist measures for producers and consumers in exporting and importing countries. Finally, the authors examined the linkages and influences of the rest of the economy on U.S. agriculture. They concluded that macroeconomic factors such as interest rates, inflation, and the value of the U.S. dollar affected the price of U.S. farm products overseas and the ability of other nations to pay for U.S. farm exports.

In a study commissioned by the World Food Institute, Wang and Wisner examined the U.S. share of global agricultural trade. They projected a steady growth rate for U.S. agricultural exports through 1996 based on past trends, particularly for beef and poultry products. The authors argued for more liberal trade policies as proposed by the GATT negotiations. They concluded that with the continuing advances in biotechnology leading to efficiency in livestock feeding, U.S. agricultural exports would continue to contribute to the improved health of U.S. agriculture.

In a statistical report of the U.S. Department of Agriculture, current and historical data on U.S. foreign trade in agricultural products were summarized. The study highlighted commodity and country information, including dollar values, quantities, principal markets for agricultural exports, and import sources.

Southard analyzed the trends and outlook for trade in U.S. livestock and poultry. His study paralleled the study of Wang and Wisner. He also projected a steady growth rate for U.S. agricultural products, particularly beef and poultry.

In a similar study by Dwyer, Carter, and Greene, the authors concentrated on the outlook for U.S. agricultural exports. They estimated that the total value of agricultural exports in 1994 would remain relatively unchanged from 1993. They forecasted that the commodities with the largest gains in terms of exports would be livestock, poultry, and dairy products. Beef, pork, and variety meats were expected to account for most of the gain as exports to the two neighboring nations, Canada and Mexico, continue to rise. The authors concluded that greater foreign demand for U.S. meats will be a continuing trend for the next two years because of rising foreign incomes, the apparent reduction in trade barriers, and a desire of consumers to add more protein to their diets in the form of meats.

CHAPTER IV

THE MODEL

The model utilized in the current analysis is based on the following theoretical form:

$$\ln (Ms_{ij}{}^{d}) = \sigma^{*} \ln (b_{ij}) - \sigma^{*} \ln (P_{ij}/P_{i}) \tag{20}$$

where $Ms_{ij}{}^{d}$ is the desired quantity of imports from country *j* into country *I*, and σ^{*} is the long-run elasticity of import demand. The relationship between the actual and desired quantity of imports is expressed as

$$\ln Ms_{ij}{}^{*}(t) - \ln Ms_{ij} (t-1) = \gamma \{\ln Ms_{ij}{}^{d} (t) - \ln Ms_{ij} (t-1)\} \tag{21}$$

where the coefficient γ is the adjustment coefficient, and *t* indicates the time period. Substituting (20) into (21) and rearranging leads to

$$\ln Ms_{ij} (t) = \gamma\sigma^{*} \ln (b_{ij}) - \gamma\sigma^{*} \ln P_{ij} (P_{i}) + (1-\gamma)\ln Ms_{ij} (t-1) \tag{22}$$

where $\gamma\sigma^{*} = \sigma$ is the short-run elasticity of import demand. To account for possible changes over time that are unrelated to relative prices, a trend can also be included in the estimates. In this study, it is assumed that the intercept, b_{ij}, is a function of time (T), so that

$$b_{ij} = A_{ij}T_{ij}{}^{\beta} \tag{23}$$

Substituting (22) into (23) leads to the following functional form to be estimated.

$$\ln Ms_{ij} (t) = \gamma\sigma^{*} \ln (A_{ij}T_{ij}{}^{\beta}) - \gamma\sigma^{*} \ln (P_{ij}/P_{i}) + (1-\sigma) \ln Ms_{ij} (t-1) \tag{24}$$

This equation was used as the import demand equation for the three countries included in this study. Time-series data for the years 1966-1993 were used in the estimation of import demand equations. The data were log-linearized prior to the regression to facilitate the calculation of the respective elasticities. The logs of the actual quantity of beef imports were regressed on the logs of the actual beef imports of the three countries. Following Nerlove's partial adjustment framework, import demand equations for beef can be estimated.

Data

Trade data for U.S. beef exports/imports to Canada and Mexico were collected from the U.S. Department of Commerce (1994) through its Bureau of Census Report. The data for the Canadian/Mexican beef trade were obtained through the Canadian Ministry of Finance and the Mexican Department of Commerce. These trade data are given in appendix tables 5 through 10 (shown later). The data are expressed in millions of pounds and the average price per pound is in U.S. dollars. The price indices for beef in the three countries were obtained from the *United Nations Food and Agricultural Production* (United Nations) and are provided in table 11 (shown later). The data cover a period of 28 years, 1966-1993.

Results

Export and import beef demand equations were estimated for each of the three countries under study, with the results summarized below. The estimated coefficients are the parameter estimates, which can be interpreted as elasticities. The t-statistics are shown in parentheses for each estimated parameter.

The results for each of the demand equations are summarized in table 1. In the economic analysis of import demand for Canada, Mexico, and the U.S., it is necessary to look at the estimated elasticities of import prices and past imports. In the past 30 years, Canadian imports of U.S. beef have shown a positive trend as is evidenced by the estimated trend coefficient of 0.63. With respect to the Canadian beef imports from the U.S., the coefficient sign was negative, which would be consistent with economic theory, and the absolute value of the price elasticity coefficient was 0.64. This implies that the import price elasticity of beef from the U.S. is relatively inelastic. For a 1% increase in the price of beef from the U.S., Canadian beef imports would be expected to decline by 0.64 million pounds. Past import levels also have a significant impact on current import levels as shown by the estimated lagged import coefficient value of 0.31. This suggests

Table 1. Estimated Import Demand Function Coefficients, 1966-1993

Source Country	Destination Country	Constant	Trend	Price Ratio	Lagged Imports	R^2 F-Stat
U.S.	Canada	-2.50	0.63	-0.64	0.31	.91
		(.603)	(5.24)	(-5.56)	(2.89)	73.67
U.S.	Mexico	-4.65	0.54	-0.75	0.24	.89
		(-9.28)	(8.38)	(-8.54)	(2.42)	61.35
Canada	U.S.	1.32	0.29	-0.47	0.35	.25
		(0.97)	(5.19)	(-6.97)	(2.08)	4.03
Mexico	U.S.	-16.11	1.20	-2.46	0.45	.88
		(6.03)	(7.37)	(-5.62)	(4.15)	56.40
Mexico	Canada	-2.97	0.09	-0.35	0.29	.93
		(-4.01)	(4.90)	(-3.54)	(2.11)	100.75
Canada	Mexico	-2.21	0.59	-0.34	0.15	.98
		(-1.66)	(1.76)	(-1.49)	(11.41)	715.01

that 31% of current imports can be directly related to past import levels. The overall explanatory power for this import demand function is relatively good with an R^2 of .91 and an F-statistic of 73.67.

In the past 30 years, Mexican imports of U.S. beef have also shown a positive trend, as shown by the estimated trend coefficient of 0.54. The absolute value of the price elasticity coefficient was 0.75. This indicates that the import price elasticity of beef is relatively inelastic. For a 1% increase in the price of beef from the U.S., Mexican beef imports would be expected to decline by 0.75 million pounds. Past imports also have an impact on current levels as evidenced by the estimated lagged import coefficient value of 0.24. This suggests that 24% of current imports can be directly related to past import levels. The overall explanatory power of this import demand function is relatively good with an R^2 of .89 and an F-statistic of 61.35.

For U.S. imports of Canadian beef in the past 30 years, the estimated trend coefficient has been positive, as shown by an estimate of 0.29. The absolute value of the price elasticity coefficient was 0.47. This suggests that the import elasticity of beef from Canada is relatively inelastic. For a 1% increase in the price of beef from Canada, U.S. beef imports would be expected to decline by 0.47 million pounds. Past import levels also have an impact on current import levels. The estimated lagged import coefficient value was 0.35, which suggests 35% of current imports can be related to past import levels. The overall explanatory power for this import demand function is relatively poor with an R^2 of .25 and an F-statistic of 4.03.

With respect to U.S. imports of Mexican beef, the estimated trend coefficient has been positive at 1.20. The absolute value of the price elasticity coefficient was 2.46. This implies that import elasticity of beef from Mexico is relatively elastic. For a 1% increase in the price of beef from Mexico, U.S. beef imports would be expected to decline by 2.46 million pounds. The estimated lagged import value was 0.45, which suggests that 45% of current imports can be related to past import levels. The overall explanatory power for this import demand function was relatively good with an R^2 of .88 and an F-statistic of 56.40.

With respect to U.S. imports of Mexican beef, the estimated trend coefficient has been positive at 1.20. The absolute value of the price elasticity coefficient was 2.46. This implies that the import elasticity of beef from Mexico is relatively elastic. For a 1% increase in the price of beef from Mexico, U.S. beef imports would be expected to decline by 2.46 million pounds. The estimated lagged import value was 0.45, which suggests that 45% of current imports can be related to past import levels. The overall explanatory power for this import demand function was relatively good with an R^2 of .88 and an F-statistic of 56.40.

In the past 30 years, Canadian imports of Mexican beef have shown a slightly positive trend at 0.09. The absolute value of the price elasticity coefficient was .35. This suggests that import elasticity of beef from Mexico is relatively price inelastic. For a 1% increase in the price of beef from Mexico, Canadian beef imports would be expected to decline by .35 million pounds. The estimated lagged import value was 0.29, suggesting that 29% of current beef imports can be related to past import levels. The overall explanatory power for this import demand function was relatively good with an R^2 of .93 and an F-statistic of 100.75.

For Mexican imports of Canadian beef, the estimated trend coefficient was positive at 0.59. The absolute value of the price elasticity coefficient was .34, suggesting that the import elasticity of Canadian beef to Mexico is relatively inelastic. For a 1% increase in the price of beef from Canada, Mexican beef imports would decline by .34 million pounds. The estimated lagged import value was 0.83, suggesting that 83% of current beef imports can be related to past import levels. The overall explanatory power for this import function was relatively good with an R^2 of .98 and an F-statistic of 715.01.

The results of this analysis of the short-term implication of NAFTA show that the effects of removing trade barriers on beef has the greatest impact on Mexican beef exports to the U.S. The import demand elasticity of -2.46 suggests that given a price decrease of 1%, the Mexican export of beef to the U.S. would increase by 2.46 million pounds. The study that most closely resembles this result was done by Krisoff, Neff, and Sharples. They also used a static, partial equilibrium model to study the effects of trade liberalization on the agricultural subsectors of grain, livestock, and horticulture. They concluded that Mexican exports of beef would increase. U.S. beef exports would also grow but only slightly in comparison to grain and oilseeds. In most of the studies done on NAFTA's impact on U.S. agricultural trade, the U.S. appeared to be the main beneficiary in increased beef exports after the liberalization of trade. The results of this study also parallel the work of Hinojosa-Ojeda, Robinson, and Moulton, who analyzed the potential economic effects of the removal of trade barriers between the U.S. and Mexico. They concluded that the impact on the Mexican economy was larger.

Segarra's study showed that because the U.S. had a competitive advantage in the production of livestock products, the U.S. livestock products most likely to experience increased exports included high-quality beef and pork. The U.S., Canada, and Mexico are likely to experience increases in their beef trade between one another.

The U.S./Canada beef trade has shown an import price demand that has been relatively inelastic. For Canadian beef imports from the U.S., the absolute value of the price elasticity coefficient has been relatively inelastic. For Canadian beef imports from the U.S., the absolute value of the price elasticity coefficient has been 0.64, while the U.S. beef imports from Canada has been 0.47. The implication is that Canadian imports of U.S. beef are relatively more elastic than U.S. imports of Canadian beef. Even though the U.S. might have a comparative advantage in beef production to Canada, it is possible that when the price of beef imported from the U.S. increases in Canada, Canadians could substitute other meat products or domestically produced beef for American beef products. With respect to U.S. beef imports from Canada, it is possible that Canadian beef is going to certain regions of the U.S. where transportation and distribution costs are cheaper relative to beef producing regions in the U.S. Hence, a percentage increase in the price of Canadian beef would result in less than a 1% decrease in the imports of beef from Canada. Assuming that this is true, this would be a possible explanation for the lower import price elasticity facing the U.S. from Canada. When trade barriers are removed, U.S. beef exports would be expected to increase to Canada relative to increases in Canadian beef exports to the U.S.

With respect to the U.S./Mexico beef trade, the absolute value of the price elasticity coefficient facing U.S. imports of Mexican beef has been relatively elastic at 2.46. This implies that Americans can readily substitute domestically produced beef and other meat products if the price of Mexican beef in the U.S. increases. The higher elasticity implies competition in the American beef market. For Mexican imports of U.S. beef, the import demand elasticity has been relatively inelastic at 0.75. The quality of beef imported by Mexico from the U.S. might be higher than domestically produced beef. The U.S. has a comparative advantage in beef production to Mexico. With the removal of trade barriers, the results indicate that given a decrease in beef prices, Mexican beef exports to the U.S. would increase relatively to an increase in U.S. beef exports to Mexico.

With respect to the Canada/Mexico trade over the past 30 years, the magnitude of the beef trade between the two countries has not been as significant in relation to the beef trade these two countries have had with the U.S. The estimated price elasticity for Canadian imports of Mexican beef has been -.35 while the Mexican imports of Canadian beef has been .34. This implies that with the removal of trade barriers, neither of the two countries would increase beef exports more than the other.

To test the significance of pre- and post-NAFTA prices and quantities, data on beef trade for 1994 among the three countries were collected. This represented the post-NAFTA prices and quantities. Import demand equations were once again estimated for the time period 1966-1994 (table 2).

The results of the post-NAFTA regressions look almost identical to the pre-NAFTA estimates. To test if the parameters of the pre- and post-NAFTA estimates are the same or significantly different, a statistical test known as the predictive Chow test is performed.

Prior to performing the predictive Chow test, we need to look at the problem of forecasting the value of the dependent variable, in this case, the quantity of beef imports, for a given set of explanatory variables. Let the given values of the explanantory variables be X_{02}, X_{03},..., X_{0k}, and let the corresponding value of the dependent variable be Y_0. Forecasting Y_0 is of interest here.

Table 2. Estimated Import Demand Function Coefficients, 1966-1994

Source Country	Destination Country	Constant	Trend	Price Ratio	Lagged Imports	R^2 F-Stat
U.S.	Canada	-2.50	0.63	-0.64	0.31	.91
		(.617)	(5.38)	(-5.69)	(2.95)	87.39
U.S.	Mexico	-4.65	0.54	-0.75	0.24	.89
		(-9.49)	(8.60)	(-8.77)	(2.53)	69.37
Canada	U.S.	1.32	0.29	-0.47	0.35	.25
		(.97)	(5.27)	(-7.09)	(2.10)	4.21
Mexico	U.S.	-16.16	1.23	-2.47	0.45	.88
		(6.03)	(7.47)	(-5.74)	(4.30)	59.42
Mexico	Canada	-2.95	0.09	-0.33	.30	.93
		(-4.07)	(4.99)	(-3.29)	(2.14)	103.80
Canada	Mexico	-2.21	(.59)	-0.34	0.16	.98
		(-1.70)	(1.76)	(-1.53)	(11.65)	720.02

The best predictor of Y_0 is $E(Y_0)$, because the variance of Y_0 around $E(Y_0)$ is smaller than around any other point. Since $E(Y_0)$ is not known, we use Y_0, the least squares fitted value of Y_0, in its place. Since

$$\hat{Y}_0 - \hat{\beta}_1 + \hat{\beta}_2 X_{02} + \hat{\beta}_3 X_{03} + \ldots + \hat{\beta}_k X_{0k}, \tag{25}$$

it follows that Y_0 is normally distributed with mean

$$E(\hat{Y}_0) = B_1 + B_2X_{02} + B_3X_{03} + \ldots + B_kX_{0k}.$$

The variance of Y_0 is

$$Var(\hat{Y}_0) = o^2_{Y0} - \sum (X_{0k}-\bar{X}_k)^2 Var(\hat{B}_k) + 2\sum_{k<j}(X_{0j}-\bar{X}_j)(X_{0k}-\bar{X}_k)Cov(\hat{B}_j,\hat{B}_k) + \frac{\sigma^2}{n} \tag{26}$$

for all j, k = 2,3,..., K; j < k.

The forecast error is $(Y_0-\hat{Y}_0)$. This random variable is normally distributed with mean $E(Y_0-\hat{Y}_0) - 0$ and variance $\sigma^2_F - Var(Y_0-\hat{Y}_0) - Var(Y_0) + Var(\hat{Y}_0) - 2Cov(Y_0,\hat{Y}_0)$, where $Var(Y_0) - \sigma^2$, $Var(\hat{Y}_0) - \sigma^2_{\hat{Y}0}$, and $-2Cov(Y_0,\hat{Y}_0) - -2E[Y_0-E(Y_0)][\hat{Y}_0-E(Y_0)]--2E[\hat{Y}_0-E(Y_0)] - 0$. Therefore,

$$\sigma^2_F - \sigma^2 + \frac{\sigma^2}{n} + \sum_k (X_{0k}-\bar{X}_k)^2 Var(\hat{B}_k) + 2\sum_{j<k}(X_{0j}-\bar{X}_j)(X_{0k} - \bar{X}_k)Cov(\hat{B}_j,\hat{B}_k). \tag{27}$$

The shorter the distance between the given values of the explanatory variables and their respective sample means the smaller the variance of the forecast error. An unbiased estimator of σ^2_F can be obtained by replacing σ^2 by s^2. If we denote the resulting estimator by s^2_F, then

$$\frac{Y_{-}-\hat{Y}_0}{S_F} \sim t_{n-K}. \tag{28}$$

From this result, we can construct a forecast interval that will contain the actual value of Y_0 with whatever probablity we choose. Designating one minus the chosen probability level by $(0<a<1)$, we have

$$Y_0 - t_{n-K,\, a/2}s_F < Y_0 < t_{n-K,\, a/2}s_F. \tag{29}$$

In this study, we have estimated regression equations for the import demand for beef among Canada, Mexico, and the United States. Six regression equations were estimated. The sample consisted of 28 observations covering the period 1966-1993. Since NAFTA became effective in 1994, six regression equations were estimated for the period covering 1966-1994. The observed variables were the quantity of beef imports, the prices of these imports, and the lagged values of the quantity of beef imports. Table 3 summarizes the observed values and the forecasted values for the log of beef imports covering the period 1966-1994.

The estimated regression equation for Canadian beef imports from the United States is

$$MIJC1_i = -2.50 + .629TIJ1_i - .64PRC1_i + .31MIJCL_i, \quad (30)$$

where MIJC1 is the log of the imported quantity of beef, TIJ1 is the log of the trend, PRC1 is the log of the price ratio, and MIJCL is the log of the lagged values of beef imports.

Table 3. Observed and Forecasted Values for the Log of Beef Imports, 1966-1994

Source Country	Destination Country	Observed Value	Forecasted Value	95% Confidence Interval	Conclusion
U.S.	Canada	2.51	2.47	-1.75...6.69	No difference
Canada	U.S.	2.36	2.46	1.99...2.93	No difference
U.S.	Mexico	-2.94	-2.97	-3.03...-2.90	No difference
Mexico	U.S.	.12	.25	-.47... .97	No difference
Canada	Mexico	-4.12	-4.41	-4.78...-4.04	No difference
Mexico	Canada	-1.72	-1.74	-1.72...-1.74	No difference

The problem is to decide whether the demand function has changed since the time of the previous imports of beef. Since NAFTA's implementation, we can look at the observed and predicted values for Canadian beef imports from the U.S. In 1994, the following were the observed values:

$$MIJC1_{1994}=2.509 \quad TIJ1_{1994}=3.367$$

$$PRC1_{1994}=-3.301 \quad MIJCL1= 2.501$$

The predicted value for MIJC1 is 2.474. This is also the forecast value of MIJC1. The estimated variance of the forecast error is

$$s^2_F = 4.22$$

$$s = 2.05.$$

The 95% confidence interval for $MIC1_{1994}$ can be constructed by noting that the tabulated value of $t_{25,.025}$ is 2.060. Therefore,

$$2.474 -(2.06 *2.05) < MIJC1_{1994} < 2.474 +(2.06*2.05)$$

$$-1.749 < MIJC1_{1994} < 6.697. \quad (31)$$

This interval covers the observed value $MIJC1_{1994} = 2.51$.

The estimated regression equation for Mexican beef imports from the U.S. is

$$MIJM1_i = -4.65 + .54\ TIJ1_i - .75PRM1_i + .24MIJML1_i, \quad (32)$$

where MIJM1 is the log of Mexican beef imports from the U.S., TIJ1 is the log of the trend, PRM1 is the log of the price ratio, and MIJML1 is the log of the lagged values of beef imports. In 1994, the following were the observed values:

$$MIJM1_{1994} = -2.94 \quad TIJ1_{1994} = 3.36$$

$$PRM1_{1994} = -.81 \quad MIJML1 = -2.96$$

The predicted or forecast value for MIJM1 is -2.97. The variance of the forecast error is

$$s^2_F = .001$$

$$s = .032.$$

The 95% confidence interval for $MIJM1_{1994}$ is

$$-2.97 - (2.06 * .032) < MIJM1_{1994} < -2.97 + (2.06 * .032)$$

$$-3.03 < MIJM_{1994} < -2.903. \qquad (33)$$

The interval covers the observed value $MIJM1_{1994} = -2.937$.

The estimated regression equation for U.S. beef imports from Canada is

$$USIC1_i = 1.32 + .293TIJ1_i - .47PRUSC1_i - .35USICL1_i, \qquad (34)$$

where USIC1 is the log of the quantity of U.S. beef imports from Canada, TIJ1 is the log of the trend, PRUSC1 is the log of the price ratio, and USICL1 is the log of the lagged values of beef imports. The following were the observed values in 1994:

$$USIC1_{1994} = 2.36 \; TIJ1_{1994} = 3.36$$

$$PRUSC1_{1994} = -4.92 \;\; USICL1 = 2.36$$

The predicted value for USIC1 is 2.46. The variance of the forecast error is

$$s^2_F = .052$$

$$s_F = .229.$$

The 95% confidence interval for USIC1 is

$$2.46 - (2.06 * .229) < USIC1_{1993} < 2.46 + (2.06 * .229)$$

$$1.99 < USIC1_{1994} < 2.93. \qquad (35)$$

The interval covers the observed value USIC1 = 2.36.

The estimated regression equation for U.S. beef imports from Mexico was

$$USIM1_i = -16.16 + 1.23TIJ1_i - 2.47PRUSM1_i + .45USIML1_i, \qquad (36)$$

where USIM1 is the log of the quantity of U.S. beef imports from Mexico, TIJ1 is the log of the trend, PRUSM1 is the log of the price ratio, and USIML1 is the log of the lagged values of the beef imports. The following are the observed values for 1994:

$$USIM1_{1994} = .12 \quad TIJ1_{1994} = 3.36$$

$$PRUSM1_{1994} = -4.970 \quad USIML1 = .11.$$

The predicted value for USIM1 is .25. The variance of the forecast error is

$$s^2_F = .052$$

$$s_F = .229.$$

The 95% confidence interval for USIM1 is

$$.250 - (2.06 * .351) < USIM1_{1994} < .250 + (2.06 * .351)$$

$$-.473 < USIM1_{1994} < .97. \qquad (37)$$

This interval covers the observed value $USIM1_{1994} = .12$.

The estimated regression equation for Canadian beef imports from Mexico was

$$CAME1_i = -2.95 + .09TIJ1_i - .35PRC1_i - 2.97CAMEL1_i, \qquad (38)$$

where CAME1 is the log of the quantity of Canadian beef imports from Mexico, TIJ1 is the log of the trend, PRC1 is the log of the price ratios, and CAMEL1 is the log of the lagged values of beef imports. The following are the observed values for 1994:

$$CAME1_{1994} = -1.72 \quad TIJ1_{1993} = 3.36$$

$$PRC1_{1994} = -5.55 \quad CAMEL1 = -1.62.$$

The predicted value for CAME1 is -1.736. The variance of the forecast error is

$$s^2_F = .0047$$

$$s_F = .069.$$

The 95% confidence interval for CAME1 is

$$-1.74 - (2.06 * .069) < CAME1_{1994} < -1.74 + (2.06 * .069)$$

$$-1.88 < CAME1_{1994} < -1.57. \quad (39)$$

The interval covers the observed value $CAME1_{1994} = -1.72$.

The estimated regression equation for Mexican beef imports from Canada was

$$MECA1_i = -2.21 + .59TIJ1_i - .34PRM1_i + .15MECAL1_i, \quad (40)$$

where MECA1 is the log of the quantity of Mexican beef imports from Canada, TIJ1 is the log of the trend, PRM1 is the log of the price ratios, and MECAL1 is the log of the lagged values of beef imports. The following were the observed values for 1994:

$$MECA1_{1994} = -4.11 \quad TIJ1_{1994} = 3.32$$

$$PRM1_{1994} = -4.62 \quad MECAL1 = -4.02.$$

The predicted value for MECA1 is -4.41. The variance of the forecast error is

$$s^2_F = .03$$

$$s_F = .18$$

The 95% interval for MECA1 is

$$-4.41 - (2.06 * .18) < MECA1_{1993} < -4.41 + (2.06 * .18)$$

$$-4.78 < MECA1_{1994} < -4.04. \quad (41)$$

This interval covers the observed value $MECA1_{1994} = -4.11$. The conclusion from these results is that the import demand functions for the three nations have not significantly changed since the implication of NAFTA.

In this study, two sets of regressions were made to determine pre- and post-NAFTA elasticities of import prices and past imports. The null hypothesis that was tested is that the estimated parameters are the same for the two sets against the alternative hypothesis that the estimated parameters are different. In this study, the SSE_R includes the residuals of the post-NAFTA regressions. There are 28 original observations and four parameters including the intercept in the regression. For this particular predictive Chow test, the critical value for $F_{(1,24)}$ at significance level of .05 is 4.24. The calculated values for this F-statistic using the test for all of the six regression equations were less than the significant value. The null hypothesis, that the parameters of the pre-NAFTA elasticities are the same as the post-NAFTA parameters, is accepted in all of the six equation estimates. The conclusion is that there is no significant initial change in the elasticities of price imports and market share after the implementation of NAFTA.

Long-Run Elasticities and Net Welfare Gains

Since the implementation of NAFTA, there has been considerable debate on the impact of exports, imports, and job creation. As a result of trade liberalization, tariffs between Canada, Mexico, and the United States will be phased out, and there will be greater accessibility to the markets among the three countries. There will be both exports and imports. When tariffs are removed, it is important to see the net national gain of removing the tariffs in a particular sector. Table 4 summarizes the net national gains from the removal of trade barriers on beef among the three countries.

Table 4. Long-Term Elasticities and Net National Gains from Trade Liberalization

Source Country	Destination Country	Long-Run Import Demand Elasticities	Change in Quantity Imported (mil. of lbs.)	Change as % of Current Imports	Dollar Value of Net Welfare Gains (mil. of U.S.$)
U.S.	Canada	-2.06	.037	.003	.010
U.S.	Mexico	-3.12	.053	.900	.011
Canada	U.S.	-1.34	.297	.028	.022
Mexico	U.S.	-5.47	.157	.137	.840
Canada	Mexico	-2.27	.005	.277	.001
Mexico	Canada	-1.21	.006	.333	.020

In this study, the focus is the impact of the liberalization of the beef trade. According to the U.S. Department of Commerce (1994), the effective rate of tariff on beef imports for the U.S. was 5%. According to the Canadian Ministry of Finance, the effective tariff rate on Canadian beef imports was 2%. According to the Mexican Department of Commerce, the effective tariff rate on Mexican beef imports was 5%.

With respect to Canadian beef imports from the U.S., the estimated import elasticity of demand was relatively inelastic at -.64. With the removal of the tariff, the change in the quantity of beef imported would increase by .037 million pounds. The net national welfare gain to the Canadian economy as a result of removing the tariff on beef imports from the U.S. was calculated to be \$.002 million. The calculation of the national gain is shown in the appendix.

With respect to Mexican beef imports from the U.S., the import elasticity of demand was estimated to be relatively inelastic at -.75. With the removal of the tariff, the change in the quantity of beef imported would increase by .053 million pounds. The net national gain to the Mexican economy as a result of removing the tariff on beef imports from the U.S. was calculated to be $.078 million.

With respect to U.S. beef imports from Canada, the import elasticity of demand was estimated to be relatively inelastic at -.47. With the removal of the tariff, the change in the quantity of beef imports would decrease by .297 million pounds. The net national gain to the U.S. economy as a result of removing the tariff was calculated to be $.006 million.

With respect to U.S. beef imports from Mexico, the import elasticity of demand was estimated to be relatively elastic at -2.46. With the removal of the tariff, the change in the quantity of beef imports frm Mexico would increase by .157 million pounds. The net national gain to the U.S. economy was calculated to be $.003 million.

With respect to Canadian beef imports from Mexico, the import elasticity of demand was calculated to be relatively inelastic at -.35. With the removal of the tariff, the change in the quantity of beef imports from Mexico would increase by .006 million pounds. The net national gain to the Canadian economy was calculated to be $.001million.

With respect to Mexican beef imports from Canada, the import elasticity of demand was calculated to be relatively inelastic at -.34. With the removal of the tariff, the net change in the quantity of beef imports would be .005 million pounds. The net national gain to the Mexican economy was calculated to be $.001 million.

The long-run elasticity of import demand was also estimated for the three countries. For Canadian beef imports from the U.S., it was estimated to be relatively elastic at -2.06. For Mexican beef imports from the U.S., the elasticity of demand was estimated to be relatively elastic at -3.12. For U.S. beef imports from Canada, the long-run elasticity of demand was relatively elastic at -1.34. For U.S. beef imports from Mexico, the long-run elasticity of demand was relatively elastic at -5.47. For Canadian beef imports from Mexico, the long-run elasticity was relatively elastic at -1.21. For Mexican beef imports from Canada, the long-run elasticity was relatively elastic at -2.27.

The results of the estimation of the long-run elasticity of demand for beef imports were consistent with economic theory. In the long run, demand tends to be more elastic because of the ease of substitutability of competing products in the market.

With respect to net national gain, the gains to the consumers were greater in the long run after the removal of trade barriers. For U.S. beef imports from Mexico, the long-run gain to the U.S. economy was calculated to be \$.84 million. This was the most significant gain among the three countries in the long run. For U.S. beef imports from Canada, the long-run net national gain was calculated to be \$.22 million.

In the long run, the net national gain for Canadian beef imports from the U.S. was calculated to be \$.010 million. For Mexican beef imports from the U.S., the result was similar with the net national gain being \$.011 million.

With respect to the Canadian/Mexican beef trade, the net national gain to the Canadian economy was the most significant. It was calculated to be \$.020 million. For Mexican beef imports from Canada, the long-run gain was \$.001 million.

Summary and Conclusions

The results of this study show that, in the short run or the years immediately following the implementation of NAFTA, there will not be significant changes to the beef trade among the three countries. The long-run implication of the implementation of NAFTA shows that Mexican beef exports to the U.S. and, hence, U.S. beef imports from Mexico, will gain the most, as reflected in the estimation of the elasticities and the calculation of net national gains. With the removal of trade barrires on beef imports, all three nations will have positive gains to their respective economies.

The results of the analysis appear to conform with economic theory. In the long run, the elasticities are more elastic than in the short run. This is because, after the trade barriers have been lifted, agents can more easily adjust to price changes over time. There is more ease of substitutability in the long run than in the short run. In the short run, the import elasticities of the three importers, U.S., Canada, and Mexico, are relatively inelastic. The exception is U.S. beef imports from Mexico, which are relatively elastic in both the short and long runs. A possible explanation for this might be that American importers of Mexican beef can easily substitute other beef or meat products both in the short and long runs. Because Mexico is considered a lesser developed country (LDC), its beef products might not be of the same quality as those of more developed nations.

From this study, it is also interesting to see that Mexico will be the largest winner in terms of export gains, followed by the U.S. and then Canada. Among the three trading partners, Mexico is the LDC. A common characteristic among LDCs is that the income elasticity of demand for food items such as beef is higher since food amounts to a greater share in the household budgets of the agents of these countries. With the removal of trade barriers on beef, it is apparent that the export gains will mean more gains for the Mexican economy in the long run.

There may be various reasons why Canada may gain the least. The geographical location of Canada as compared to Mexico might give it a disadvantage with respect to the accessibility to the American market for beef. The beef quality of Canada might not be the type that is demanded by American beef importers. The U.S. probably has the highest quaity of beef products. With the quality of beef comes the variety of beef products. Canada may not be producing the variety that is demanded by U.S. beef importers.

What is not evident from this study is the impact of NAFTA on other products that could be substituted for beef. The focus of this study was the impact of NAFTA on the U.S. beef trade with Canada and Mexico. The time frame for the adjustments to take place after the removal of trade barriers on beef is not known either.

Policy Implications

The policy implications for the United States from this study are that it is in the best economic interest to remove the trade barriers on beef with our neighbors—Canada and Mexico. From both a theoretical and practical perspective, the removal of barriers on beef benefits the American consumers in terms of net welfare gains in the long run. What is not directly observable is the time frame for the adjustments to occur as a result of the removal of trade barriers.

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APPENDIX

(1) Import demand elasticity

$$i_d = \frac{\frac{\Delta M}{M}}{\frac{\Delta P}{P}} \quad \text{or} \quad \frac{\Delta M}{M} - i_d\left(\frac{\Delta P}{P}\right) \quad \text{or} \quad \Delta M - M i_d\left(\frac{\Delta P}{P}\right)$$

where M = quantity of imports, ΔM = change in the quantity of imports, P = price of imports, and ΔP = change in the price of imports.

(2) Net national welfare gain = NG = ½ (t) (ΔM)

where t = tariff in dollars per pound, and ΔM = change in the quantity of imports.

Table 5. U.S. Beef Exports to Canada (1966-1993)

Year	Quantity (millions of lbs.)	Avg. Price per Lb. (U.S.$)
1966	2.90	1.45
1967	2.00	3.00
1968	0.81	4.44
1969	2.70	1.52
1970	2.50	2.00
1971	2.60	5.27
1972	3.20	6.28
1973	2.40	9.38
1974	1.80	9.67
1975	1.60	8.25
1976	4.90	5.35
1977	2.00	7.20
1978	2.33	6.99
1979	2.57	4.90
1980	6.78	2.73
1981	10.52	1.83
1982	11.00	2.39
1983	12.00	2.67
1984	10.80	2.53
1985	11.60	2.86
1986	12.40	3.25
1987	12.00	3.03
1988	10.90	3.59
1989	11.20	4.22
1990	11.70	4.22
1991	11.90	4.24
1992	12.10	4.23
1993	12.20	4.22

Source: U.S. Department of Commerce (1994).

Table 6. U.S. Beef Imports from Canada (1966-1993)

Year	Quantity (millions of lbs.)	Avg. Price per Lb. (U.S.$)
1966	13.40	.32
1967	4.86	.31
1968	12.70	.35
1969	5.00	.40
1970	13.70	.42
1971	12.50	.51
1972	11.60	.59
1973	10.40	.64
1974	9.10	.69
1975	9.20	.63
1976	8.70	.62
1977	8.50	.57
1978	7.90	.68
1979	8.20	1.02
1980	8.50	1.12
1981	9.30	1.09
1982	9.10	1.01
1983	8.70	1.12
1984	9.20	1.14
1985	10.00	1.06
1986	10.40	.98
1987	10.20	1.08
1988	10.70	.90
1989	11.10	.84
1990	10.50	.82
1991	10.55	.83
1992	10.57	.82
1993	10.50	.83

Source: U.S. Department of Commerce (1994).

Table 7. U.S. Beef Exports to Mexico (1966-1993)

Year	Quantity (millions of lbs.)	Avg. Price per Lb. (U.S.$)
1966	.018	8.390
1967	.021	7.000
1968	.020	14.150
1969	.034	8.030
1970	.033	9.090
1971	.017	30.000
1972	.018	33.890
1973	.016	34.810
1974	.022	29.540
1975	.018	42.870
1976	.037	27.300
1977	.046	26.300
1978	.052	30.000
1979	.026	68.460
1980	.034	54.710
1981	.030	60.670
1982	.025	66.000
1983	.027	65.190
1984	.036	44.720
1985	.037	42.700
1986	.034	53.530
1987	.042	65.000
1988	.041	64.390
1989	.043	63.950
1990	.044	63.860
1991	.046	65.210
1992	.050	61.000
1993	.052	59.040

Source: U.S. Department of Commerce (1994).

Table 8. U.S. Beef Imports from Mexico (1966-1993)

Year	Quantity (millions of lbs.)	Avg. Price per Lb. (U.S.$)
1966	.484	.337
1967	.152	.368
1968	.172	.360
1969	.084	.369
1970	.045	.511
1971	.670	.283
1972	.700	.385
1973	.760	.421
1974	.800	.463
1975	.820	.500
1976	.870	.482
1977	1.000	.470
1978	1.210	.463
1979	1.610	.378
1980	1.000	.585
1981	1.220	.650
1982	1.220	.610
1983	1.230	.552
1984	1.250	.624
1985	1.270	.637
1986	1.310	.611
1987	1.160	.793
1988	1.160	.784
1989	1.150	.756
1990	1.120	.794
1991	1.120	.794
1992	1.110	.796
1993	1.130	.789

Source: U.S. Department of Commerce (1994).

Table 9. Canadian Beef Imports from Mexico (1966-1993)

Year	Quantity (millions of lbs.)	Avg. Price per Lb. (U.S.$)
1966	.281	.320
1967	.267	.344
1968	.278	.317
1969	.250	.380
1970	.267	.374
1971	.275	.440
1972	.281	.445
1973	.279	.444
1974	.300	.440
1975	.288	.444
1976	.270	.481
1977	.290	.455
1978	.305	.442
1979	.310	.445
1980	.320	.440
1981	.310	.451
1982	.320	.453
1983	.330	.454
1984	.322	.448
1985	.328	.454
1986	.332	.470
1987	.335	.472
1988	.340	.468
1989	.360	.444
1990	.361	.449
1991	.358	.444
1992	.360	.447
1993	.361	.448

Sources: Canadian Ministry of Finance (1994), and Mexican Dept. of Commerce (1994).

Table 10. Mexican Beef Imports from Canada (1966-1993)

Year	Quantity (millions of lbs.)	Avg. Price per Lb. (U.S.$)
1966	.001	1.062
1967	.002	1.267
1968	.002	1.000
1969	.002	1.111
1970	.002	1.050
1971	.002	1.200
1972	.002	1.140
1973	.003	1.140
1974	.003	1.250
1975	.004	1.250
1976	.005	1.400
1977	.006	1.330
1978	.009	1.330
1979	.011	1.360
1980	.013	1.230
1981	.012	1.420
1982	.011	1.550
1983	.012	1.330
1984	.014	1.210
1985	.013	1.310
1986	.015	1.270
1987	.014	1.430
1988	.016	1.250
1989	.018	1.170
1990	.019	1.210
1991	.017	1.290
1992	.018	1.280
1993	.018	1.280

Sources: Canadian Ministry of Finance (1994), and Mexican Dept. of Commerce (1994).

Table 11. Beef Price Indices in Canada, Mexico, and U.S. (1966-1993)

Year	Canadian Index	Mexican Index	U.S. Index
1966	80.55	40.28	82.08
1967	82.27	44.31	85.60
1968	84.35	47.25	89.67
1969	86.50	51.15	91.55
1970	87.60	56.29	92.65
1971	89.44	60.37	90.72
1972	90.65	64.55	94.65
1973	91.25	68.73	96.76
1974	92.62	72.91	95.65
1975	95.35	76.69	95.14
1976	99.23	81.40	100.98
1977	100.93	87.99	101.06
1978	98.91	95.83	99.27
1979	97.44	96.79	97.55
1980	100.75	99.23	100.27
1981	102.09	105.53	102.21
1982	105.71	100.87	101.46
1983	104.25	114.56	104.71
1984	106.43	112.41	104.29
1985	108.12	112.23	106.75
1986	106.87	116.62	108.36
1987	106.60	113.26	107.92
1988	112.08	124.97	110.11
1989	110.71	129.41	109.64
1990	112.59	129.45	109.96
1991	113.20	129.48	110.20
1992	113.50	129.80	111.10
1993	114.10	130.20	113.30

Source: U.S. Department of Commerce (1994).