A QUANTITATIVE ANALYSIS OF THE EFFECTS OF TARIFF AND NON-TARIFF BARRIERS ON U.S.-MEXICO POULTRY TRADE

A Thesis

by

DAVID MAGAÑA LEMUS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2005

Major Subject: Agricultural Economics

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Approved by:

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ABSTRACT

A Quantitative Analysis of the Effects of Tariff and Non-Tariff Barriers on U.S.-Mexico Poultry Trade. (August 2005)

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Chair of Advisory Committee: Dr. Victoria Salin

Since the inception of the North American Free Trade Agreement (NAFTA) in 1994, tariff restriction to U.S. poultry products entering the Mexican market has decreased significantly. While poultry trade from the U.S. to Mexico has increased considerably, Mexican chicken exports to the U.S. face a sanitary restriction. This concerns chicken producers in Mexico. Consequently, the Mexican government negotiated with the U.S. government an extension, from 2003 to 2008, of the tariff rate quota (TRQ) on U.S. chicken leg quarters entering the Mexican market.

The purpose of this study was to estimate the economic impact of trade policies restricting the chicken trade between Mexico and the U.S. Two trade policy scenarios were analyzed: (1) a removal of the Mexican tariff rate quota (TRQ) on U.S. chicken leg quarters, and (2) a removal of the TRQ and, in addition, a removal of the U.S. sanitary restrictions to Mexican chicken. A cost minimization mathematical programming model was used to estimate the optimum levels of production, consumption and trade, subject to policy restrictions.

The study found that if the Mexican TRQ on U.S. chicken leg quarters is eliminated, chicken production in Mexico would shrink by 51% compared to the actual

level of production as of 2003. A less drastic effect on Mexican production of chicken was found when, in addition to the TRQ removal, the U.S. sanitary restriction on Mexican chicken is eliminated. In this second scenario total production in Mexico would decrease by 24%. Under both scenarios chicken production in the U.S. is estimated to have an increase, 8% and 4% for the first and second scenarios, respectively. These new levels of production would affect trade levels and prices for chicken and chicken parts in both countries.

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I would like to thank my major professor and the chair of my committee, Dr. Vicky Salin, for her guidance and stimulating insights on the thesis writing process. I would also like to thank the members of my committee, Dr. Gary Williams and Dr. Andy Vestal, for their valuable contributions to this thesis.

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A heartfelt thank you to my parents and family members for their confidence and patience as they endure economic hardship. In spite of the financial constraint they never denied to me nor to my brothers the opportunity to obtain a college education.

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CHAPTER I

INTRODUCTION

Market integration in North America presents opportunities and threats for agricultural producers in the countries involved. Producers have the opportunity to export their products to new markets, but, at the same time, they face a higher level of competition from foreign producers.

As tariff barriers among nations have declined in recent years due to free trade agreements, non-tariff barriers (NTB) have increasingly become the way that governments restrict trade. Recently, sanitary and phytosanitary barriers (SPS) have been widely used either to protect public health, or to protect domestic farm sectors from foreign competition (Doan et al. 2004).

Regarding the case of trade between the United States (U.S.) and Mexico, still some tariff barriers and sanitary restrictions impede the theoretical ideal level of production, consumption and prices in both countries. In other words, these policies delay or impede some business possibilities. For example, in the specific case of poultry products, given the differences between Mexico and United States consumer tastes and preferences for chicken products, there are potential increases for business between these countries, yet current policies are restrictive. Mexican chicken is restricted by a sanitary restriction imposed by the U.S. (Salin, Hahn, and Harvey, 2002); while U.S. chicken faces a tariff rate quota entering Mexico (Mexico, Presidencia de la Republica, 2003).

This thesis follows the style and format of the *American Journal of Agricultural Economics.*

U.S. consumers prefer white chicken meat (chicken breast) while in Mexico the consumers prefer dark meat (drums, thighs, whole legs and leg quarters). The difference in consumer preferences between Mexico and the U.S. opens up the opportunity to trade poultry products both ways. Beneficial trade for both countries is expected, provided restrictive trade barriers are mitigated (Salin, Hahn, and Harvey, 2002).

As far as production and trade is concerned, the U.S. poultry industry is the largest in the world, and this industry is not only the largest producer of poultry meat, but also the largest exporter of these products (U.S. Department of Agriculture, 2004a). Poultry production in the U.S. in 2003 was 17.5 million tons, and valued at more than $23 billion. Approximately 14% of total U.S. production of chicken is exported (USDA, 2004a). On the other hand, poultry production in Mexico in 2003 was 2.2 million tons. Mexico imported 328,233 tons of chicken and chicken parts in 2003, mainly from the United States. Mexican imports of chicken represent around 15% of the total national chicken production, while exports from Mexico to the U.S. are restricted due to a sanitary barrier (Gallardo Nieto et al., 2004).

Justification

Chicken trade policy between Mexico and the U.S. has changed in recent years. Mexican tariff rate quota on U.S. chicken was renegotiated in 2003, i.e. a new 98% over-quota tariff was imposed to chicken leg quarters from the U.S. instead of the 0% over-quota tariff agreed in the original NAFTA negotiations for that year. Similarly, the process of sanitary certification by the U.S. for producing Mexican regions has advanced. Since this changes in trade policy have not been evaluated in the known literature this thesis is justified by the need of: (1) estimate the effectiveness of the new TRQ, as of 2003, in protecting the Mexican chicken industry from foreign competition, and (2) estimate the potential Mexican chicken exports assuming the removal of sanitary restrictions for regions with low risk of chicken disease, in other words, the goal is to estimate the missing business for not pressuring the U.S. government to speed up the certification of the states in Mexico that have low risk of chicken diseases.

Research Objectives

The main research objective is to quantify the economic impact of tariff restrictions (TRQ) and sanitary restrictions to chicken trade between Mexico and the U.S. This will be achieved by using 2003 data in production, consumption and prices of chicken in the U.S. and Mexico within a cost minimization mathematical programming model. This main objective can be divided into the following specific objectives:

- Measure the economic impact that the Mexican tariff rate quota on U.S. chicken leg quarters has on the poultry industries in both countries.
- Estimate the foregone trade opportunities for the Mexican chicken industry from not obtaining the sanitary certification to export chicken to the U.S.

Procedures

In order to estimate the potential trade levels of poultry products between Mexico and the United States in the event tariff and non-tariff restrictions to trade were removed, a mathematical programming model was used. A modification of the North American Trade Model for Animal Products (NATMAP), an existing model developed by Hahn (1993) and modified by Salin, Hahn, and Harvey (2002) was utilized.

In order to analyze the situation of poultry trade between Mexico and the U.S. as of 2003, the following procedures will be used. First, data for 2003 on production levels, prices, trade, and modifications on the Mexican tariff rate quota (TRQ) were used to update and extend the model of Salin, Hahn, and Harvey. Second, new areas declared by Mexican officials as free of poultry diseases in Mexico were added as potential exporter regions of chicken meat to the United States. This updates represent a substantial extension of the model used by Salin, Hahn, and Harvey.

Organization of the Thesis

The first Chapter of this thesis presents an introduction, research objectives and procedures. Moreover, this Chapter contains a literature review. The second Chapter provides a description of the poultry industries and chicken meat consumption patterns in the U.S. and in Mexico. A brief description of chicken trade between Mexico and the U.S. is also included in the second Chapter. The third Chapter provides the expected results of this study based on trade theory. Chapter four includes a description of the quantitative model used in this research work. The results of this study are described in Chapter five. Finally, Chapter six presents a summary and the conclusions of this thesis.

Literature Review

In this part of the Chapter a brief analysis of previous research work related to the evaluation of restrictions to trade is provided. There are two main types of studies included in this section: (1) studies that deal with restrictions to trade for several countries and (2) studies that address the particular topic of restrictions to chicken trade between Mexico and the U.S. In the last part of this Chapter a description of consumer elasticity of demand for chicken is provided.

As described by Beghin and Bureau (2001) there are several methods to quantify the effects of a non-tariff barrier (NTB) on trade. These authors classify these methods in two groups: (1) the methods that measure the trade impacts only and (2) the methods that evaluate welfare in addition to trade effects. Examples of the former methods include: gravity models, surveys and methods based on price-wedge estimation. To the second group belong methods based on comparative statics, cost-benefit analysis and general equilibrium analysis. Welfare-based approaches are conceptually superior since they take into consideration a larger range of effects (Beghin and Bureau). The method used in the present thesis belongs to the second group since a cost minimization model, subject to a utility (welfare) constraint, is used.

An example of a study that considers the effects of removing tariff and non-tariff barriers to trade on several linked products was developed by Haveman and Thursby (2000). They used a variation of a sector equilibrium analysis using data from the Trade Analysis and Information System (TRAINS) data bases for the years 1994 and 1998 evaluating the effects of reducing tariff and non-tariff barriers to trade. They considered 20 agricultural and processed food products for each of the 34 importers that appear in each TRAINS panel of data and for 67 exporters. These authors concluded that the effects of reducing non-tariff barriers are significantly large and greater than the effects from tariff reduction. This finding is relevant to the present thesis because the effects of removing tariff and non-tariff barriers to trade are to be assessed.

Regarding previous research conducted on the specific topic of poultry trade, a few of them are to be discussed. Peterson and Orden (2004) developed a perfectly competitive spatial partial equilibrium model with differentiated goods to evaluate the effects of four alternative policy changes on world poultry trade. In this model, the poultry products are divided into high-value (mostly white meat) and lower value (mostly dark meat), which are jointly produced but have different patterns of trade among the regions considered in the study. The regions considered are: the U.S., Brazil, the European Union, Japan, China, Russia, a rest-of-world poultry importing region and a rest-of-world poultry exporting region. The different scenarios Peterson and Orden considered were: (1) remove all tariffs and tariff-rate quotas but leave sanitary and phytosanitary (SPS) restrictions; (2) remove only the SPS barriers; (3) free trade, in other words, the removal of all the barriers simultaneously; and (4) a Russian ban on poultry imports from the United States.

By using this model, Peterson and Orden found that removing all barriers in a simultaneous way has a larger impact on trade than only removing tariffs and tariff-rate quotas. Another finding is related to the imposition of sanitary barriers against U.S. poultry products by Russia. The authors found that the change in the Russian policy would shift trade flows but it would not have a considerable net impact on poultry producers in the U.S. What was notable in this study was the attempt to estimate the effects of policy change in a poultry trade model with differentiated meat products. A similar approach of a model dealing with differentiated chicken products is used in this thesis. And, similar to Peterson and Orden, this research considers them economic impact of tariff removal and removal of other barriers to trade simultaneously.

An example of a study conducted on the effects of removing sanitary restriction on poultry trade is Salin, Hahn and Somwaru (2003). They quantified how chicken prices, chicken trade and chicken production would change if Mexico and Brazil were allowed to export chicken to the U.S. and Canada. The model these authors used is a partial equilibrium model that uses mathematical programming. The model solves for the optimum level of production, trade and, therefore, prices in each of the four countries involved. The model developed by Salin, Hahn and Somwaru takes into consideration five chicken commodity products, including: (1) whole birds, (2) white meat (breast), (3) dark meat (legs, thighs), (4) other cuts (wings, backs, necks) and (5) mechanically deboned meat (MDM). Value-added chicken products such as boneless, skinless and processed products for restaurants are also considered. The driving factor for trade is the difference in consumer preference. In other words, in Mexico and Brazil dark meat is preferred, while in the U.S. and in Canada white meat and value-added products are preferred over dark meat.

The main findings from the study developed by Salin, Hahn and Somwaru are summarized here. First, if Brazil and Mexico are allowed to ship chicken to the U.S. and Mexico, U.S. chicken exports to Canada would be displaced by the Brazilian and Mexican exports. Second, the price of white meat in Canada and in the U.S. would decline due to the imports of white meat from Brazil and Mexico. Conversely, the price of white meat would increase in Brazil and Mexico, increasing the total value of chicken in these countries. In response to a higher price for chickens Brazil and Mexico would expand production.

The specific topic of chicken trade involving just Mexico and the U.S. has been addressed in two previous studies: (1) Salin, Hahn and Harvey and (2) Union Nacional de Avicultores (UNA). Salin, Hahn and Harvey examined sanitary requirements and the regulations on Mexico-U.S. chicken trade. Their main finding indicates that if the Mexican states of Sonora and Sinaloa are allowed to export chicken to the U.S., the economic impacts on the U.S. market would be minimal. They assumed that the Mexican chicken production industry would have the ability to react rapidly to the removal of the sanitary restriction. These authors conducted a sensitivity analysis finding that, if at least 15% of the Mexican production of dark meat is exported, and given the expected expansion of the Mexican chicken production, Mexican production of dark meat would displace U.S. chicken dark meat imports. However, total U.S. exports of dark chicken meat would decrease by just 3%. Similarly, the effect of allowing Mexican chicken white meat into the U.S. on U.S. prices for this product is a decrease by less than 1%. The study conducted by Salin, Hahn and Harvey considers only the effects of removing the U.S. sanitary restriction on Mexican chicken, but it does not take into consideration the tariff barriers that affect U.S. chicken entering the Mexican market.

On the other hand, one of the few studies developed in Mexico regarding this topic was conducted by UNA (2003). The UNA study included a forecasting of the Mexican chicken dark meat imports from the U.S. To forecast the level of imports for 2003, UNA (2003) used a deterministic trend line type forecast. This forecast was based on the rate of growth in imports observed during the first five months of 2002. The UNA study predicted that as a result of the reduction of the Mexican import tariff on U.S. chicken, the level of imports in 2003 would increase by more than 200% percent compared to the level of imports in 2002.

The study conducted by the UNA concluded that the Mexican poultry industry requires an additional period of five years of tariff protection to solve the problems derived from the differences in the patterns of consumption in Mexico and the U.S. and of the lack of access of Mexican poultry products into the U.S. market. Mexico is not allowed to export chicken to the U.S. due to a sanitary barrier. According to UNA estimations in case of not having established this safeguard, the industry would have lost 30% of national production because of the increased level of imports.

Figure 1.1 shows the actual increase in Mexican chicken dark meat imports from 1997 to 2002. The increase in the level of Mexican chicken imports is a consequence of the tariff reduction schedule agreed in the context of the North American Trade Agreement (NAFTA). Figure 1.1 also shows the forecasted level of imports for 2003 assuming no tariff rate quota (TRQ) in place.

Based on the results of the UNA study, the Mexican government pressured the U.S. government to negotiate a safeguard to protect the Mexican poultry industry. Eventually, the officials of the U.S. and Mexico signed a safeguard. More details on this trade policy modification are discussed in the section on poultry trade between Mexico and the U.S. in the next Chapter.

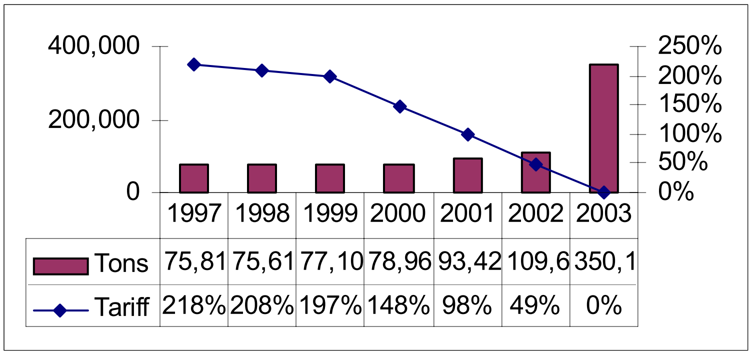

Figure 1.1. Relation between reduction of tariff and increase of Mexican dark meat imports from the U.S. * Forecasted Source: UNA, 2003.

Review on Estimations of Own-Price Elasticity of Demand for Poultry

Own-price elasticities play a fundamental role in economic analysis by measuring the responsiveness in quantity demanded that results from a change in the price of the analyzed product. This key parameter is important in the quantitative modeling to be developed in Chapter IV; hence existing published estimates are of importance.

In the U.S., several studies have been conducted to quantify the own-price elasticity for poultry meat products. Table 1.1 presents the own price elasticities for poultry calculated in nine studies developed over the last two decades. The periods of time that were analyzed in each study vary as well as the method used to calculate the elasticities. The range among the calculated own price elasticities of demand goes from a low responsiveness of -0.14 (Hahn, 1988) to a higher level of price responsiveness of -0.94 (Alston & Chalfont, 1993). Nevertheless, all the estimations of elasticities are (in absolute value) higher than zero and lower than one, which means that in the U.S.

poultry products are inelastic in terms of own-price elasticity of demand. Because all the estimated own price elasticities for chicken are negative but higher than -1, i.e. values between 0 and -1, the demand for chicken in the U.S. is classified as inelastic.

On the other hand, the availability of this type of studies in Mexico is limited. One of the more recent estimations of own-price elasticity of demand for chicken products was developed by Gonzalez Sanchez (2001).

This author found that chicken has an inelastic own-price elasticity of demand. Table 1.2 presents a summary of the estimations made by Gonzalez Sanchez. While Gonzalez Sanchez conducted a comprehensive study in examining various quantitative techniques used to estimate demand elasticities, he did not considered the possibility of differentiated chicken meat products in the market (i.e. chicken white meat and chicken dark meat) and determine precisely how Mexican consumers respond to price increases for the particular products. The elasticities estimated by Gonzalez Sanchez are similar to those assumed in this thesis, but given the lack of available published data, a sensitivity analysis will be conducted in the quantitative part of this study. The objective of the sensitivity analysis is to estimate the impacts of changing demand elasticity for chicken in Mexico.

Table 1.1. Own-Price Elasticity of Demand for Poultry in the U.S. (A Review of Economic Studies)

Study No.	Author (s)	Price Elasticity	Time Period	Model
1	Alston & Chalfont (1993)	-0.94	1967-1988 Quarterly	Rotterdam
2	Brester & Wohlgenant (1991)	-0.296	1962-1989 Annual	Interrelated Demand
3	Capps et al. (1994)	-0.893	January 1986 to June 1987 Weekly	Retail Demand Functions
4	Eales, J. (1994)	-0.63	1966-1992 Quarterly	Inverse Lewbel Demands
5	Hahn, W. (1994)	-0.299	1981-1992 Monthly	Random Coefficient
6	Hahn, W. (1988)	-0.14	1960-1987 Quarterly	Income Differences
7	Moschini & Meilke (1989)	-0.10	1967-1987 Quarterly	Structural Change
8	Thurman (1987)	-0.64	1955-1981 Annual	Demand Stability
9	Wohlgenant (1989)	-0.42	1956-1983 Annual	Complete System

Source: USDA. Food Safety and Inspection Service (1999).

Table 1.2. Estimation of Own-Price Elasticity for Chicken in Mexico

Own-Price Elasticity	Estimation method
-0.503	Stone Index
-0.649	Divisia Index
-0.207	Seemingly Unrelated Regression
-0.396	Ordinary Least Squares with one lag

Source: Gonzalez Sanchez (2001).

Chapter Summary

This Chapter provides a review of literature on economic impact analysis due to modifications in trade policies. Recent studies on the topic of measuring the effects of tariff and non-tariff restrictions to trade were described. As mentioned by Houck (1986, p.22), governments regulate trade in products potentially injurious to public health. However, this argument sometimes is used arbitrarily to protect the profitability of a particular industry, even when there is no health risk.

Regarding the specific topic of chicken trade between the U.S. and Mexico two studies were presented in this Chapter: (1) Salin, Hahn and Harvey study on the effects of removing the U.S. sanitary restriction on Mexican chicken; and (2) UNA (2003) on the elimination of the Mexican tariff restriction on U.S. chicken. Because the Mexican tariff restriction to trade on U.S. chicken was modified in 2003, a new study is needed to evaluate the impacts of restrictions to trade under current situations. The present study includes an analysis of removing tariff and sanitary restrictions to chicken trade between the U.S. and Mexico and its effects on production, consumption and trade.

CHAPTER II

INDUSTRY BACKGROUND

This Chapter presents a general background of the chicken industries in the U.S. and in Mexico. The first aspect to be discussed is chicken production in both countries. Then, the trends in chicken consumption in the U.S. and in Mexico are also presented. Finally, a description of chicken trade and existing restrictions to chicken trade between Mexico and the U.S. is provided.

Poultry Production in the United States

The U.S. is the largest world producer and exporter of poultry meat. Approximately 14% of total U.S. chicken production is exported. U.S. production of chicken in the United States is primarily concentrated on the Atlantic coast from Delaware to Georgia. Alabama, Mississippi and Arkansas are also major poultry producing states (USDA, 2004a). Not only has there been steady growth in this industry over the last fifty years, but continued expansion is expected in the future (USDA, 2004a). This expansion is being driven by increased demand for chicken meat in both the domestic and foreign markets. In the U.S. domestic market, the increase in demand is attributed to the fact that poultry is an easily obtainable, relatively low cost product with recognized health benefits. The growth in foreign demand has been influenced by free trade agreements, both bilateral and multilateral, and by advantageous currency fluctuations and economic growth in importing countries (USDA, 2004a).

Vertical integration in the chicken industry entails breeding, hatching, raising, processing, distributing and marketing chicken. The U.S. broiler industry is highly vertically integrated. This integration has resulted in this industry as being one of the most efficient and profitable in the agricultural market sector. Producers have utilized vertical integration by controlling breeding, processing and marketing, thus assuring uniform quality and associated brand identification. Clearly, vertical integration in the U.S. broiler industry has resulted in the production of cheaper, better poultry products (Martinez, 1999).

Figure 2.1 illustrates the U.S. chicken market share for the leading firms in the industry. According to records obtained from Pilgrim's Pride, more than 70% of the U.S. market share is held by nine companies. Tyson Foods and Pilgrim's Pride are the two biggest players in the U.S. chicken industry and their sales represent almost 40% of the U.S. total market. The rest of chicken producers together hold almost 30% of the market share (Pilgrim's Pride, 2005).

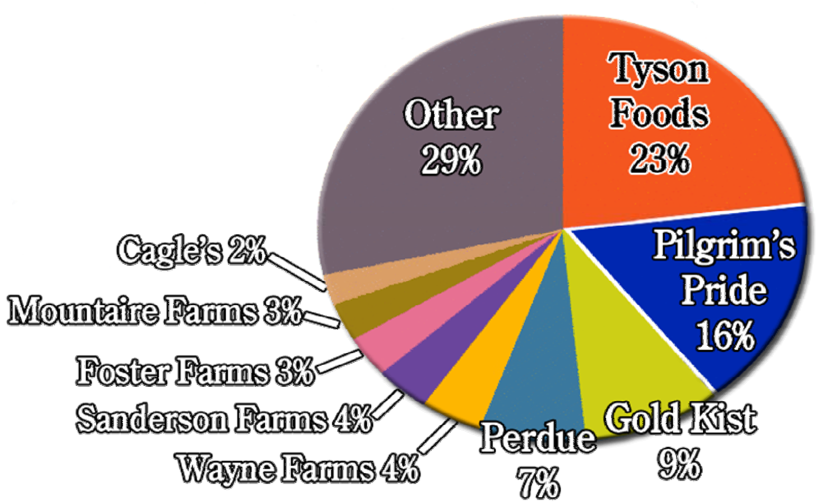

Figure 2.1. Chicken market share in the U.S. by company

Source: Pilgrim's Pride (2005).

Poultry Production in Mexico

According to the Secretaria de Agricultura, Ganaderia, Desarrollo Rural, Pesca y Alimentacion of Mexico (SAGARPA), since 1997 chicken production volume has surpassed beef production in Mexico. Figure 2.2 shows the trend in production levels for the main three types of meat in Mexico (beef, chicken and pork) from 1995 to 2003. Chicken production has increased by 68.3% from 1.3 million tons in 1995 to 2.3 million tons in 2003. This is an annual average growth rate of 7.6% in chicken production, whereas beef and pork production in Mexico have increased just by 6% and 12.5%, respectively, over the same time period (SAGARPA, 2004). According to Gallardo Nieto et al. (2004), the growth in chicken production can be explained by increased efficiency in production, which is a consequence of more vertically integrated companies operating in the chicken industry; and by an increased demand for chicken meat in Mexico.

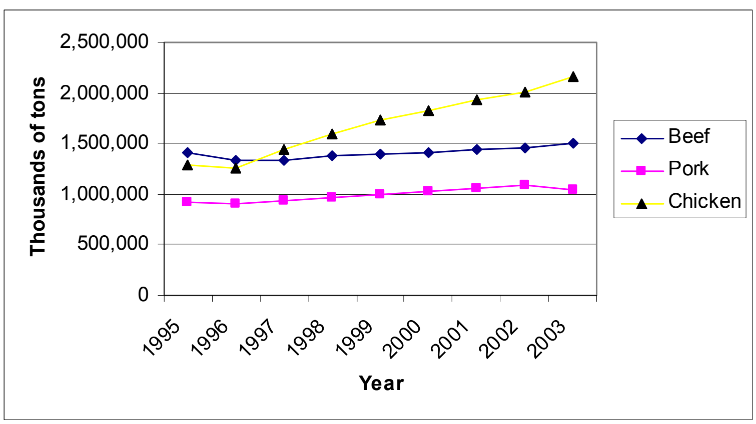

Figure 2.2. Production of pork, beef and chicken in Mexico, 1995 - 2003

Source: Based on data from SAGARPA 2004

There have been several attempts to classify the Mexican poultry industry. One author, Garcia Vega (1995), affirmed the structure of the Mexican poultry industry as given by Garcia Cruz et al. This description divided the industry in four kinds of producers. “1) small individual producers with 2,000 to 10,000 birds that do not produce their own feed and that have little or no access to the main marketing channels; 2) associated producers, owners of 10,000 to 50,000 birds that mix their own feed and that have access to genetic material; 3) semi-integrated producers with 50,000 to 100,000 birds; and 4) large integrated enterprises with more than 100,000 birds.” Unfortunately, this classification fails to enumerate the number of firms in each category. The National Poultry Association of Mexico (UNA), on the other hand, has classified the industry into three categories; big, medium and small companies. In addition, UNA provides the number of producers in each category as well as the associated production percentage. However, UNA did not define the criteria used to establish the divisions which are presented below. In 1996, 2 companies produced 33% of Mexican chicken production (Table 2.1). Chicken production in Mexico by the large companies increased dramatically in the five year period indicated. Over the same period, the number of small producers declined, in effect, concentrating the Mexican poultry industry. By 2002, there were three large firms that produced more than fifty percent of the national production (Table 2.2).

Another classification regarding the type of companies within the Mexican chicken industry was made by Juárez Zárate (2004). This author considers the existence of three types of production systems: highly vertically integrated, semi-integrated and rural or backyard production. The highly vertically integrated production system is characterized by a high level of technology involved, with vertical integration from feed production to meat processing. Examples of this production system can be found throughout almost the whole country. The production under this method represents around 70% of the national chicken output.

Table 2.1. Structure of the Mexican Chicken Industry

Classification	Number of Companies		Production Share	
	1996	2001	1996	2001
Large	2	3	33%	52%
Medium	27	33	40%	34%
Small	181	161	27%	14%

Source: UNA (2003).

Table 2.2. Major Chicken Producers in Mexico as of 2001 (% of National Production)

Bachoco	28.92%
Pilgrim's Pride	12.46%
Tyson	10.86%

Source: UNA (2003).

The semi-integrated systems present a wide range of technology and are less efficient than the highly vertically integrated firms. The farms under this regime have some deficiencies in feed quality, facilities and sanitary practices. The production of these farms represents almost 20% of the total national production of chicken. Lastly, the rural or backyard production systems are found throughout the country, especially in rural areas. The production under this system is aimed mainly for own-consumption. The share of the national production corresponding to these "farms" is just 10% (Juarez Zarate, 2004). Vertical integration practiced in the industry allows poultry producers to reduce their costs associated with purchasing feed from secondary processing plants; obtain the optimal quality specific to an individual company's production demand; insure internal standardization; and avoid the expense of value added feed (Gallardo et al, 2003).

Mexico - U.S. Production Cost Comparison

Because of the confidential nature of the data on production costs, finding reliable information on this topic is not an easy task. However, there are some attempts that intend to illustrate the differences in production costs between Mexico and the U.S. Table 2.3 compares the costs of four Mexican chicken companies located in the Gulf of Mexico against the national average cost of producing chicken in the U.S. According to the cost estimation made by Garza de la Fuente, chicken production cost in Mexico is higher than in the U.S. The main source of difference comes from feed cost, which indicates that chicken producers in Mexico face higher feed costs than chicken producers in the U.S. This estimation is consistent with the fact that Mexican producers consume

U.S. feed, which needs to be shipped south, increasing the total cost. However, there are some items in the table that appear not to be consistent with reality. For example the cost of labor (salaries and supervision), as it is presented by this author, is more expensive in Mexico than in the U.S. The main conclusion of this cost estimation is that production cost in Mexico is higher than in the U.S.

Table 2.3. Mexico – U.S. Poultry Production Costs Comparison (Mexican Pesos to Produce One Kg. of Chicken)

Item	Mexico	United States	Difference
Cost of Chicks	**0.76**	**0.84**	**-0.08**
Salaries and Supervision	**0.15**	**0.11**	**0.04**
Depreciation	**0.04**	**0.00**	**0.04**
Gas/Electricity	**0.40**	**0.36**	**0.04**
Other	**0.04**	**0.00**	**0.04**
Feed	**4.10**	**3.16**	**0.94**
Vaccinations	**0.17**	**0.07**	**0.1**
Total Cost	**5.66**	**4.54**	**1.12**
Cost Difference			**1.12 Pesos**

Source: Garza de la Fuente (2002).

Salin, Hahn, and Harvey (2002) describe that chicken production cost is lower in Mexico than in the U.S. However, these authors do not provide any data to support their claim. They assumed that U.S. producers have an advantage because they have access to feed at lower prices, while Mexican producers have access to cheaper labor. Nevertheless, more research is needed on this topic in order to have better estimates.

Given unavailability of reliable data on production costs, this thesis follows the production and processing cost functions used by Salin, Hahn, and Harvey. For further details see the production section in Chapter IV.

Chicken Demand

The preference for chicken meat among U.S. consumers has increased considerably in the last 30 years. Figure 2.3 shows per capita consumption of meats in the U.S. from 1970 to 2003. Per capita consumption of beef and pork has decreased slightly. Beef per capita consumption has decreased by 19%, from 114.3 pounds in 1970 to 92.9 pounds in 2003. Similarly, pork per capita consumption has lessened by 8%, from 72.9 pounds in 1970 to 66.8 pounds in 2003. Conversely, chicken per capita consumption has grown by more than 150%, from 36.9 pounds in 1970 to 94.9 pounds in 2003 (USDA, 2004b).

The significant increase in per capita chicken consumption can be explained by a lower price of chicken relative to pork and beef prices. The lower level of fat content in chicken meat compared to the fat content of pork and beef is also a factor that has influenced the increased level of chicken consumption; especially because nowadays people in the U.S. are more health conscious than they were years ago (Salin, Hahn, and Harvey, 2002). Furthermore, during the last 2 decades chicken breasts are getting more expensive relative to chicken legs. Figure 2.4 shows the increasing differential in chicken parts prices. This difference in prices can be explained by a high consumer preference for white chicken meat over dark chicken meat in the U.S. (Salin, Hahn, and Harvey, 2002).

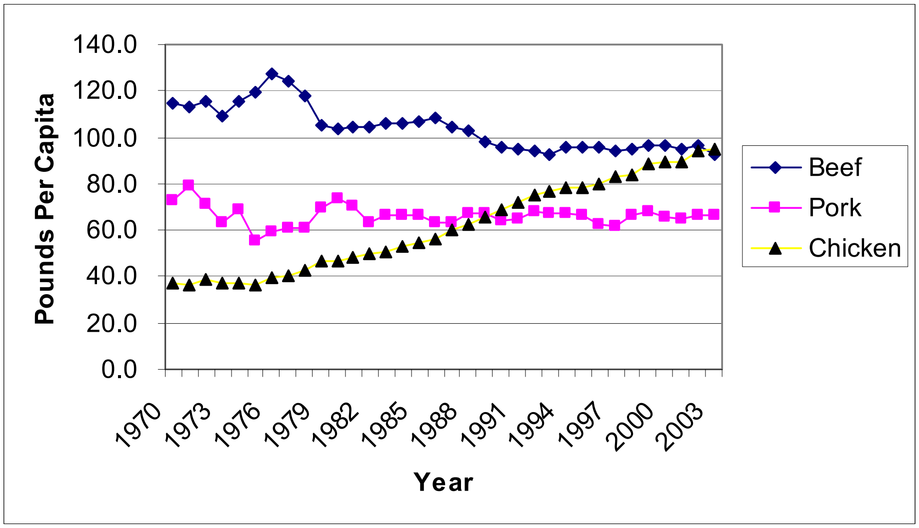

Figure 2.3. Per capita consumption of meat in the U.S., 1970 - 2003

Source: Based on data from ERS USDA 2004.

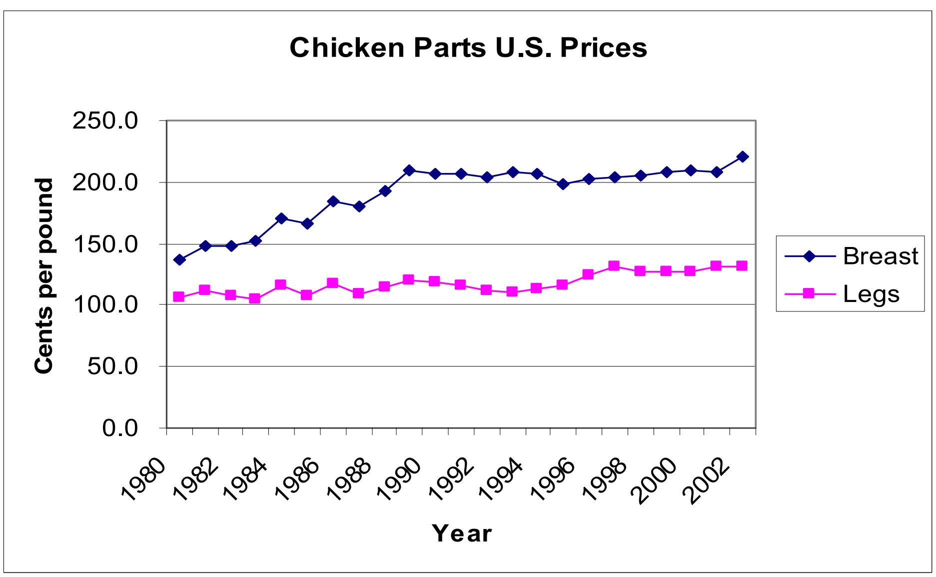

Figure 2.4. Retail prices of chicken parts in the U.S., 1980 - 2002

Source: Based on data from ERS USDA 2004.

In Mexico, per capita consumption of chicken has experienced a substantial increase from 1994 to 2003. While in 1994 per capita consumption was 13.8 kilograms, in 2003 it was 23.9 kilograms. This represents a 73% increase in chicken per capita consumption in a 10-year period. Figure 2.5 illustrates the per capita consumption trend in Mexico. The average growth in per capita consumption of chicken from 1994 to 2003 is 8.13% (Gallardo Nieto et al., 2004). Some of the factors that have influenced the increased consumption of chicken in Mexico include: an increasing per capita income, which allows Mexican consumer to diversify their diets and purchase more meats, and a higher availability of chicken in the market at lower prices, mainly because of the increasing trade liberalization on chicken products (Salin, Hahn, and Harvey, 2002). Especially interesting is the fact that in Mexico dark chicken meat is highly preferred over white meat. Mexican consumers consider that chicken breast meat is dry and tasteless (Juarez Zarate, 2003).

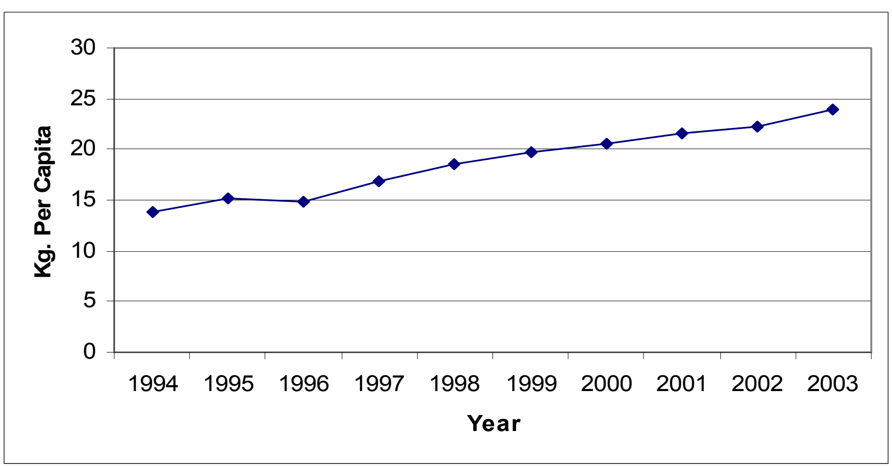

Figure 2.5. Per capita consumption of chicken in Mexico, 1994 - 2003

Source: Based on data from SAGARPA 2004.

Market Distribution

In Mexico, 29% of the established poultry producing companies are integrated with slaughterhouses, but only 16% of them sell directly to supermarkets. The rest of the companies still depend on independent live chicken sellers or public market (Garza de la Fuente, 2002). According to UNA (2003) approximately 30% of Mexico's chicken production is sold as live birds. The other 70% is marketed in different ways. Figure 2.6 shows the distribution of marketing channels for the 70% of the total production that is marketed as a slaughtered chicken.

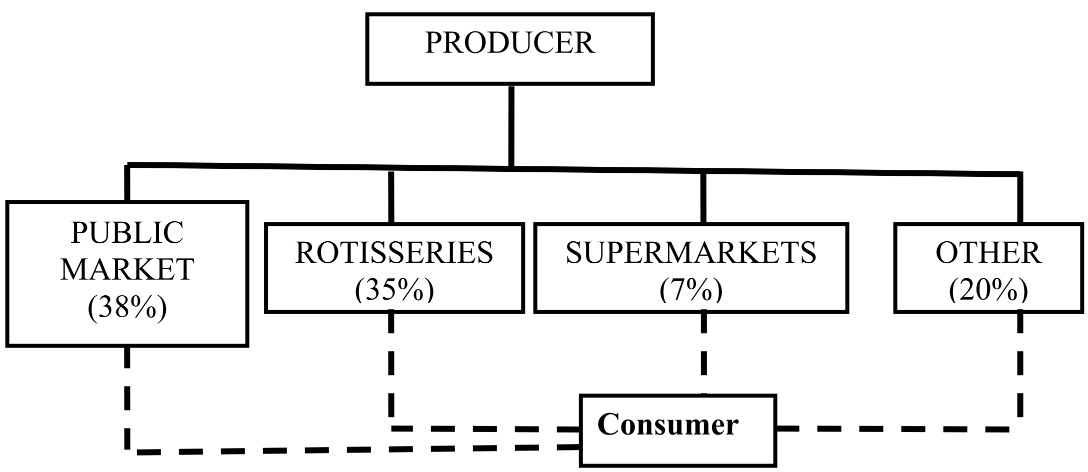

Figure 2.6. Marketing channel for slaughtered chicken in Mexico

Note: Approximately 30% of Mexico's poultry production is sold as live birds. This figure shows the distribution of marketing channels for the 70% that is commercially slaughtered.

Source: UNA 2003.

Transnational Companies in the Mexican Chicken Industry

There are two transnational companies that have production and marketing activities in Mexico and in the U.S.: Tyson and Pilgrim's Pride. While Tyson is the largest chicken producer in the U.S. and the third largest chicken producer in Mexico, Pilgrim's Pride is the second largest chicken producer in both countries. Bachoco is the leading chicken producing company in Mexico.

For the fiscal year ending on October 2, 2004, Pilgrim's Pride's net sales were $5,363,723,000. Sales in Mexico for this company represent almost 8% of its total net sales for that fiscal year. Pilgrim's Pride has several production and processing facilities in Mexico where they focus on production of fresh chicken, i.e. this company does not deal with chicken value added products in Mexico. (U.S. SEC, Pilgrim's Pride Corporation Form 10-K FY 2004).

Tyson Foods Inc. also has a considerable contribution to the chicken production in Mexico, for the year 2003 chicken production by Tyson represented almost 11% of the total Mexican production of chicken (UNA, 2004). Tyson Foods Inc. is planning to expand its business into further processed chicken products in Mexico (U.S. SEC, Tyson Foods Inc. Form 10-K FY 2004).

Mexico - U. S. Poultry Trade Policy

The North American Free Trade Agreement (NAFTA) is an agreement between the United States, Mexico, and Canada to remove all trade barriers, including those on agricultural products, over a 15-year period (1994 - 2008). Since Canada excluded its poultry sector from the agreement, NAFTA provisions affect poultry trade only between the United States and Mexico (Mexico, Presidencia de la Republica, 2003).

The Mexican import trade policy for U.S. poultry products before NAFTA required import licenses and tariffs of 10% (USDA, 1995). When NAFTA went into effect, Mexico converted its import licensing regime for fresh, chilled, and frozen poultry imported from the U.S. to a transitional tariff-rate quota. This tariff-rate quota was in effect for 10 years, from 1994 to 2003. The initial duty-free quota into the Mexican market was set at 95,000 metric tons (mt) of poultry. As adopted in the treaty this quota would increase at a 3% annual rate. Amounts over the quota would face tariff barriers, initially high, but scheduled to fall as NAFTA was implemented. Table 2.4 shows the import tariff reduction schedule for U.S. poultry products to Mexico, as negotiated under NAFTA (Mexico, Presidencia de la Republica, 2003).

As described in the Decree published by the Mexican Government on July 24, 2003, starting from July 2003 Mexico imposed a NAFTA safeguard on U.S. chicken leg quarters that will remain in effect until December 31, 2007. The safeguard takes the form of a tariff-rate quota on chicken leg quarters and preserves market access for U.S. exporters at levels achieved in recent years. At the time of this negotiation, Mexico agreed to provide compensation to the United States, including a commitment not to impose any additional import restrictions on U.S. poultry products and to eliminate certain sanitary restrictions on U.S. poultry products.

Table 2.4. Mexican Tariff Reduction Schedule for U.S. Chicken

Tariff Reduction Schedule Agreed in the Original NAFTA negotiations.		**Five Year Safeguard Negotiated in 2003.**	
Year	**Import Tariff**	**Year**	**Import Tariff**
1994	249.6%	2003	98.8%
1995	239.2%	2004	97.0%
1996	228.8%	2005	59.3%
1997	218.4%	2006	39.5%
1998	208%	2007	19.8%
1999	197.6%	2008	0.0%
2000	148.2%		
2001	98.8%		
2002	49.4%		

Source: Mexico, Presidencia de la Republica, 2003.

The safeguard on chicken leg quarters allows for duty free access of 100,000 mt in 2003, and continues through 2007 with 1% growth in quota amount allowed each calendar year. An over quota duty of 98.8 % is applied in 2003, with a 20 percentage point reduction occurring annually through 2007. By 2008, neither import tariff nor quota will apply. This safeguard applies only for chicken leg quarters imports, other poultry products were not affected.

Sanitary Restrictions to Trade

Exotic Newcastle disease (END) and highly pathogenic avian influenza are two highly infectious diseases that restrict poultry trade (Salin, Hahn, and Somwaru, 2003). Any country that wants to export chicken to the U.S. would need to fulfill the requirements of the U.S. government. The procedure required for a country to be included on the list of eligible countries to export chicken and chicken products to the U.S. requires two approaches: (1) a recognition by the Animal and Plant Health Inspection Service (APHIS) that the country has low risk of an outbreak of a poultry disease, and (2) a certification to export issued by the Food Safety and Inspection Service (FSIS) of the USDA. Mexico has faced sanitary restrictions on its access to the U.S. market due to concerns about the transmission of exotic Newcastle disease (Salin, Hahn and Harvey, 2002).

Since 1999, some regions of Mexico have been determined by FSIS to be eligible to export chicken to the U.S. However, market access is still limited and there are restrictions yet to be satisfied for food safety considerations (USDA FSIS, 1999). Tables 2.5 and 2.6 present recent events on the U.S. sanitary restrictions on Mexican chicken and chicken products. They show the current situation on the negotiations that may lead to an eventual sanitary restriction removal. Table 2.5 illustrates the process of recognition of Mexican regions by the U.S. government as disease free regions. This process can take several years. For example, the case of recognition for the Mexican states of Coahuila, Chihuahua, Durango and Nuevo León started in 1998 when SAGARPA requested APHIS to recognize these states as chicken disease free. In May

2004 SAGARPA sent to APHIS more information regarding the sanitary status of these states. While this progress towards satisfying U.S. sanitary regulations is notable, as of January 2005 the recognition of Coahuila, Chihuahua, Durango and Nuevo León was still pending. Table 2.6 also shows, as an example, the certification of a slaughtering plant, another U.S. requirement that Mexico needs to fulfill (UNA, 2005). So, upon removal of regional restrictions, it will be important for Mexican industry to take necessary steps for the processing facilities to satisfy requirements of the U.S. export market.

Chapter Summary

In this Chapter the importance of the chicken industries in Mexico and the U.S. has been demonstrated. In Mexico, the volume of chicken production has surpassed the production volume of pork and beef since 1997. Per capita consumption of chicken in Mexico and the U.S. has increased considerably in the last few years. Currently, U.S. per capita consumption of chicken is higher than per capita consumption of beef and pork. Another relevant topic discussed in this Chapter is chicken trade. The restrictions to chicken trade between Mexico and the U.S. are: (1) a Mexican TRQ on U.S. chicken leg quarters and, (2) a U.S. sanitary restriction on Mexican chicken and chicken products. The analysis in the next section will address economic concepts to be used in estimating the effects of removing these trade barriers.

Table 2.5. Recent Events in Mexican Regions Recognized by the U.S. as Disease Free

July-98	SAGARPA of Mexico sent a request to the Animal and Plant Health Inspection Service (APHIS) for the recognition of Coahuila, Chihuahua, Durango, Nuevo León and Region Lagunera as disease free regions.
Mar-00	Sonora and Sinaloa are recognized as free of Newcastle Disease by the U.S. *9CFR Part 94 (Docket No. 98-034-2) March 23, 2000*
Jan-04	The Yucatan Peninsula (Campeche, Quintana Roo and Yucatan) is recognized as free of Newcastle Disease by the U.S. *9 CFR Part 94 (Docket No. 02-036-2) January 27, 2000*
Apr-04	SAGARPA requests APHIS to recognize the state of Nayarit as a region free of Newcastle Disease.
May-04	SAGARPA delivered additional information about the status of Coahuila, Chihuahua, Durango, Nuevo León and Region Lagunera. This represented a progress towards satisfying U.S. sanitary regulations.
May-04	SAGARPA requests APHIS to recognize Baja California and Baja California Sur as states free of Newcastle Disease.

Source: UNA (2005).

Table 2.6. Certification Process for the Inspection System in Chicken Slaughter Facilities in Mexico

1993	SAGARPA petitioned to the Food Safety and Inspection Service (FSIS) of the USDA for the certification of the slaughter process in Mexico.
2001	The FSIS sends questionnaires about the slaughtering process, animal health, sanitation, inspection and additional information.
May-02	SAGARPA sends the completed questionnaires to the FSIS.
Jun-03	Sanjor (a slaughter plant in Mexico) requests that SAGARPA visit its TIF (Federally Inspected Slaughter facility) facility.
Dec-03	FSIS visits the Sanjor facility for inspection.
Apr-04	FSIS sends the official visit report focusing on the requirements the facility has to fulfill.
May-04	Sanjor fulfills the FSIS requirements.
Jun-04	SAGARPA visits Sanjor for verification purposes.

Source: UNA (2005)

CHAPTER III

ECONOMIC THEORY

Economic theory suggests that there are substantial potential gains to overall economic welfare from trade. As it has been described in the previous section, the U.S.-Mexican poultry sectors do not currently experience free trade. This Chapter will include a presentation of trade analysis that is suitable for understanding the impact of the policies in place. The changes in trade policy to be analyzed are: (1) the removal of the Mexican TRQ on U.S. leg quarters and (2) the removal of sanitary restrictions to Mexican chicken entering the U.S. A graphical analysis of the policies will be the basis for the hypothesis to be tested with the quantitative model.

The products to be considered in the analysis are (1) whole chicken, (2) dark chicken meat, (3) white chicken meat and (4) backs and necks. The level of production of whole chicken determines the level of chicken parts to be available, because dark chicken meat, white chicken meat and other chicken parts are produced in fixed proportions. Figure 3.1 illustrates the trade of chicken and chicken parts between Mexico and the U.S. Panel 1 represents the market for whole chicken. As of 2003 the price for whole chicken was higher in the U.S. (P_{m0}) than the price for whole chicken in Mexico (P_{x0}). The level of whole chicken production (Q_0) in each country is represented by the intersection of the supply and demand curves (S_{C0} and D_{C0}). In spite of the fact that Mexico has a lower price of whole chicken, Mexico is not allowed to export whole chicken or any chicken parts to the U.S. due to a sanitary restriction. The solid vertical line in the right graph of panel 1 represents the sanitary restriction on Mexican exports to the U.S.

Panel 2 in Figure 3.1 illustrates the situation for dark chicken meat. The supply curve for dark chicken meat and for other chicken parts is vertical because the availability of chicken parts depends on the level of whole chicken production. The fixed proportions supply linkage between whole chickens and parts is illustrated with a vertical dashed line connecting the whole chicken product market with the markets for chicken parts. The key feature of the modeling framework is that change in supply of one traded joint product cannot be isolated from the primary product.

Two distinct trade policies affect this market: (1) the TRQ on chicken leg quarters entering Mexico and, (2) the sanitary restrictions that, as of 2003, was an effective ban on any chicken meat products from Mexico entering the United States. The TRQ only applies to chicken leg quarters, part of the chicken carcass that represents almost 80% of the dark meat found in a chicken carcass. Because almost 99% of the Mexican imports of chicken from the U.S are chicken leg quarters (Mexico, Presidencia de la Republica), in this analysis the TRQ is assumed to affect all the Mexican imports of chicken dark meat from the U.S. The TRQ is represented in panel 2 by the bold ED_{D0} curve. As long as the quantity imported is below the quota amount of $Q_{Dq,}$ excess demand by Mexico follows the curve that would occur under free trade. Once imports reach the quota amount, Q_{Dq}, a tariff is levied on subsequent imports. This over-quota tariff is modeled graphically as a reduction in the excess demand, shown by the bold line that is a parallel shift below the free trade excess demand for dark meat. Under the TRQ the traded quantity of dark meat in $Q_{D0,}$ less than the quantity that would have been shipped under free trade Q_{DF}. This TRQ causes the price of dark meat in Mexico to remain at a higher level (P_{m0}), and the price for dark chicken meat in the U.S. remains at P_{x0}. The level of chicken dark meat trade under the TRQ system is restricted to Q_{D0}.

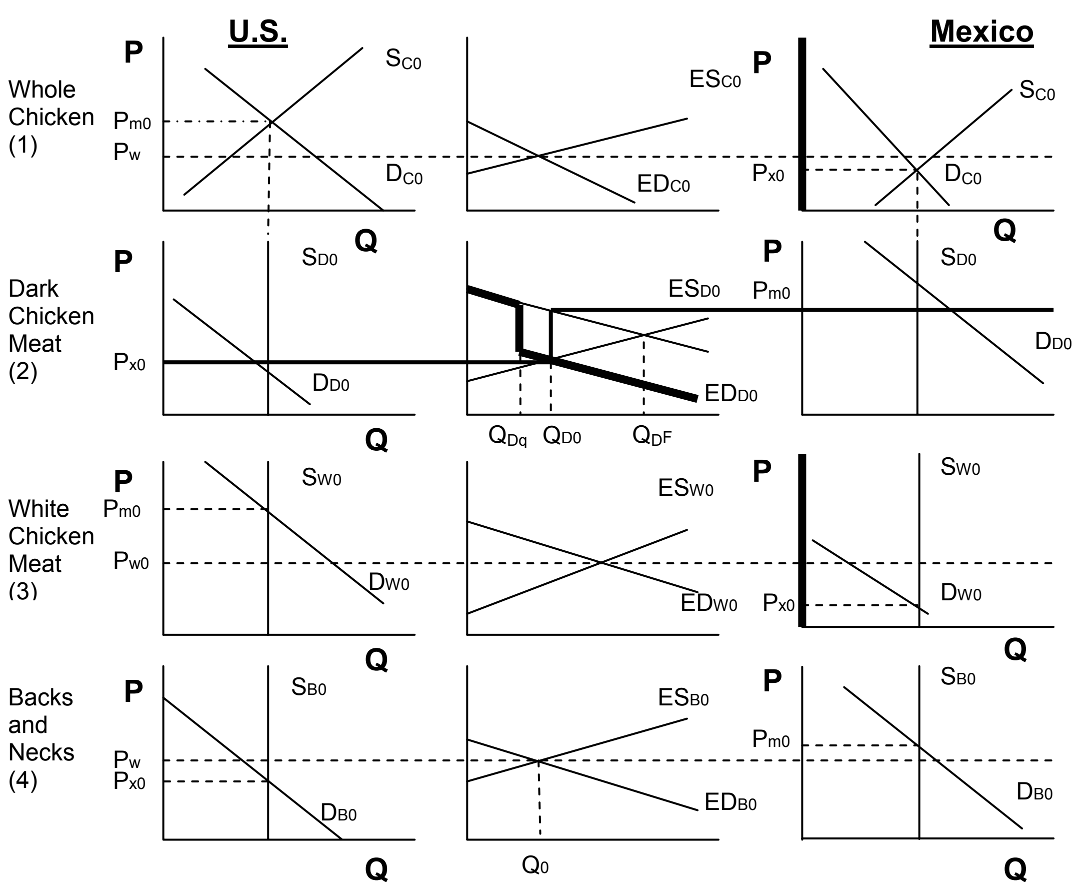

Figure 3.1. Model baseline (actual market situation as of 2003)

Note that the level of chicken dark meat traded to Mexico in this baseline (Q_{D0}) is beyond quota limit (Q_{Dq}). This set up matches the real situation. The Mexican quota for chicken imports from the U.S. in 2003 was 100,000 tons, and the actual level of chicken imported by Mexico in 2003 was 328,233 tons (Gallardo Nieto, 2004). According to UNA (2004) 95% of the Mexican chicken imports come from the U.S.

Panel 3 in Figure 3.1 represents the trade of chicken white meat between the U.S. and Mexico. As of 2003, the price of white meat in Mexico was lower (P_{x0}) than the price of chicken white meat in the U.S. (P_{m0}). By having a lower price, Mexico is a potential exporter of chicken white meat, but in this baseline trade is not possible due to a sanitary restriction. Panel 4 in Figure 3.1 illustrates the trade of chicken backs and necks. Because the U.S. has a lower price for chicken backs and necks (P_{x0}) and no trade restrictions are in place, the level of U.S. exports of this product to Mexico is Q_0.

As a summary of this baseline, the U.S. is an exporter of chicken dark meat and chicken backs and necks, while Mexico is a potential exporter of whole chicken and white chicken meat. Upon removal of the TRQ on leg quarters, the level of U.S. chicken dark meat exports to Mexico increases from Q_{D0} to Q_{D1}. By allowing free access of U.S. chicken dark meat to the Mexican market the price for chicken dark meat would change in both countries.

Price in the U.S. would increase from P_{x0} to P_{w1}, and price of dark meat in Mexico would decrease from P_{m0} to the international price P_{w1}. The change in the price for dark meat would have consequences on the demand and supply for whole chicken and for other chicken parts.

The demand for whole chicken is considered to be a function of price of whole chicken, price of chicken dark meat, price of white chicken meat, price of chicken backs and necks, and other factors. Price of whole chicken is expected to have a negative relationship with the quantity demanded of whole chicken because is assumed to be a normal good.

Since chicken parts are considered to be substitutes for whole chicken, the relationship of price of chicken parts (dark meat, white meat, and chicken backs and necks) with quantity demanded of whole chicken is positive. Other factors affecting the demand for whole chicken are assumed to remain constant. The predicted relationships are summarized as:

$$Q_{DWhole}= f\,(\overset{-}{P_{whole}}, \overset{+}{P_{Dark}}, \overset{+}{P_{White}}, \overset{+}{P_{B\&N}})$$

As a consequence of an increased price of chicken dark meat in the U.S., the demand for whole chicken shifts to the right (D_{C1}). In other words, whole chicken is expected to have a higher demand at any price, because more processors in the U.S. will be willing to cut chicken into parts. Conversely, in Mexico the price of chicken dark meat would decrease, causing a shift in the demand for whole chicken to the left (D_{C1}). By having a lower price of chicken dark meat, consumers would prefer to buy chicken dark meat and the demand for whole chicken by consumers in Mexico would decrease.

Regarding the supply side of the market, the quantity supplied of whole chicken is a function of price of whole chicken, price of chicken dark meat, price of white chicken meat, price of chicken backs and necks, and other factors. The prices of chicken and chicken parts have a positive relationship with the quantity supplied of whole chicken. Other factors affecting the supply of whole chicken are assumed to remain constant. The predicted signs of the supply shifts for whole chicken are:

$$Q_{SWhole} = f(\overset{+}{P_{whole}}, \overset{+}{P_{Dark}}, \overset{+}{P_{White}}, \overset{+}{P_{B\&N}})$$

Given an increase in the price of chicken dark meat in the U.S., the supply curve of whole chicken in the U.S. shifts to the right (S_{C1}). Conversely, the price of chicken dark meat in Mexico would decrease due to the elimination of the TRQ, causing a shift to the left in the supply curve (S_{C1}) of whole chicken in Mexico.

The shifts in the supply and demand curves for whole chicken in both countries create a new level of production of whole chicken. As explained before, the availability of chicken parts depends on the level of whole chicken production due to the fixed proportions of each type of meat in a chicken carcass. Consequently, the supply curve of chicken parts shifts to the right in the U.S. (curves S_{D1}, S_{W1} and S_{B1} for the U.S. in Figure 3.2); and to the left in Mexico (curves S_{D1}, S_{W1} and S_{B1} for Mexico in Figure 3.2)

This analysis of the predicted impact on whole chicken production and trade due to removal of the Mexican TRQ on leg quarters is made under the condition that sanitary barriers remain in place. The predicted effect of TRQ removal on supply of whole chicken in the U.S. is clearly positive as a result of an increased domestic price for chicken dark meat. Demand for whole chicken in the U.S. is also predicted to increase following removal of the TRQ. Growth in U.S. chicken production and processing is to be expected as more dark meat is shipped to Mexico. It is interesting to note that other chicken parts, white meat and backs and necks, are expected to become more available. This will result in a lower U.S. price for white chicken meat upon removal of the TRQ.

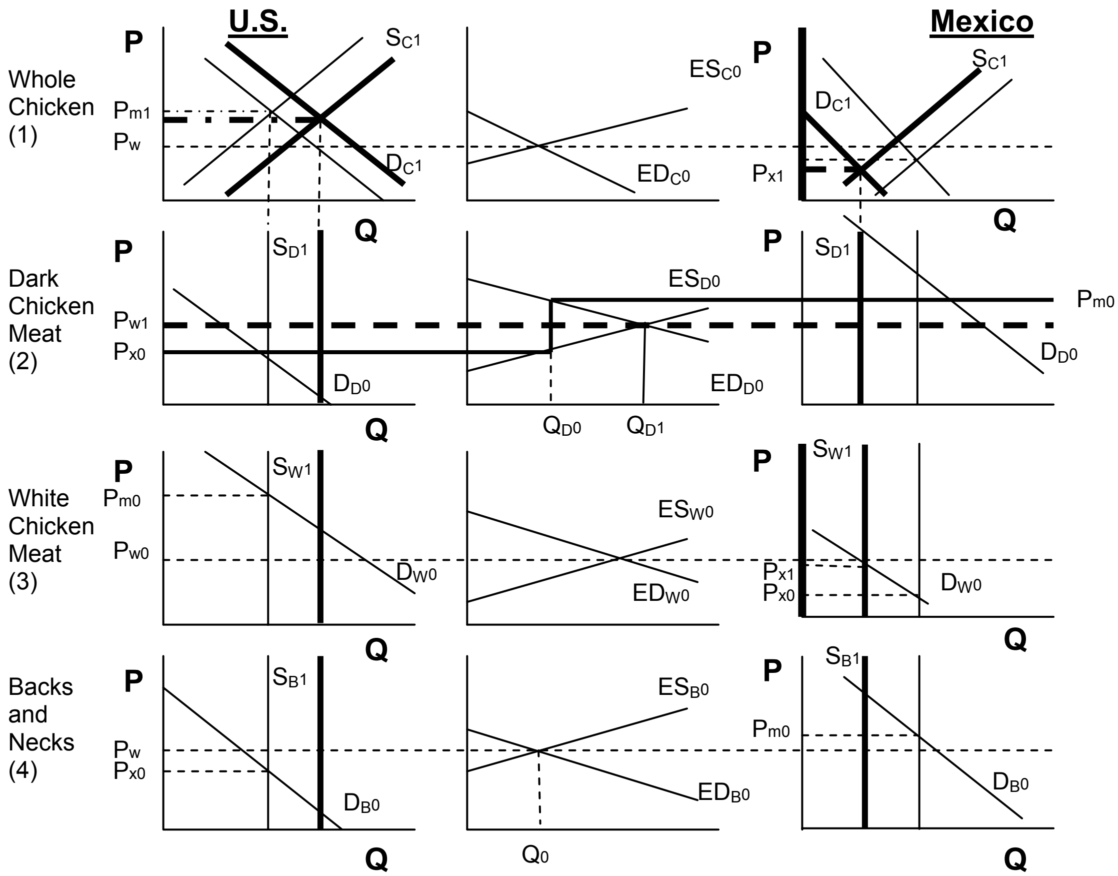

Figure 3.2. Effects of removing the tariff rate quota (TRQ) (part A)

Given the new levels of production and demand in the U.S. whole chicken is expected to have a lower price (P_{m1}) than before. Similarly, Shifts on supply and demand curves for whole chicken in Mexico would generate a new price (P_{x1}). These changes in whole chicken prices cause a shift in the excess demand and excess supply of whole chicken. The new curves are denoted by bold lines in the middle graph of panel 1 (Figure 3.3). Regardless of the changes in the excess demand and excess supply curves, whole chicken trade is still not possible because of the sanitary restriction.

Regarding chicken dark meat trade (panel 2, Figure 3.3), a larger amount of Mexican dark meat imports from the U.S. (Q_{D2}) are expected. This expected increase in Mexican chicken dark meat imports is explained by two events: (1) a shift to the right of the U.S. excess supply of dark meat; and (2) a shift to the right of the Mexican excess demand for dark meat. Panel 3 in Figure 3.3 illustrates: (1) the shift to the left of the Mexican excess supply of white meat, and (2) the shift to the left of the U.S. excess demand for chicken white meat. These shifts reduce the potential opportunity for Mexico to export chicken white meat to the U.S. in case the sanitary restriction is removed.

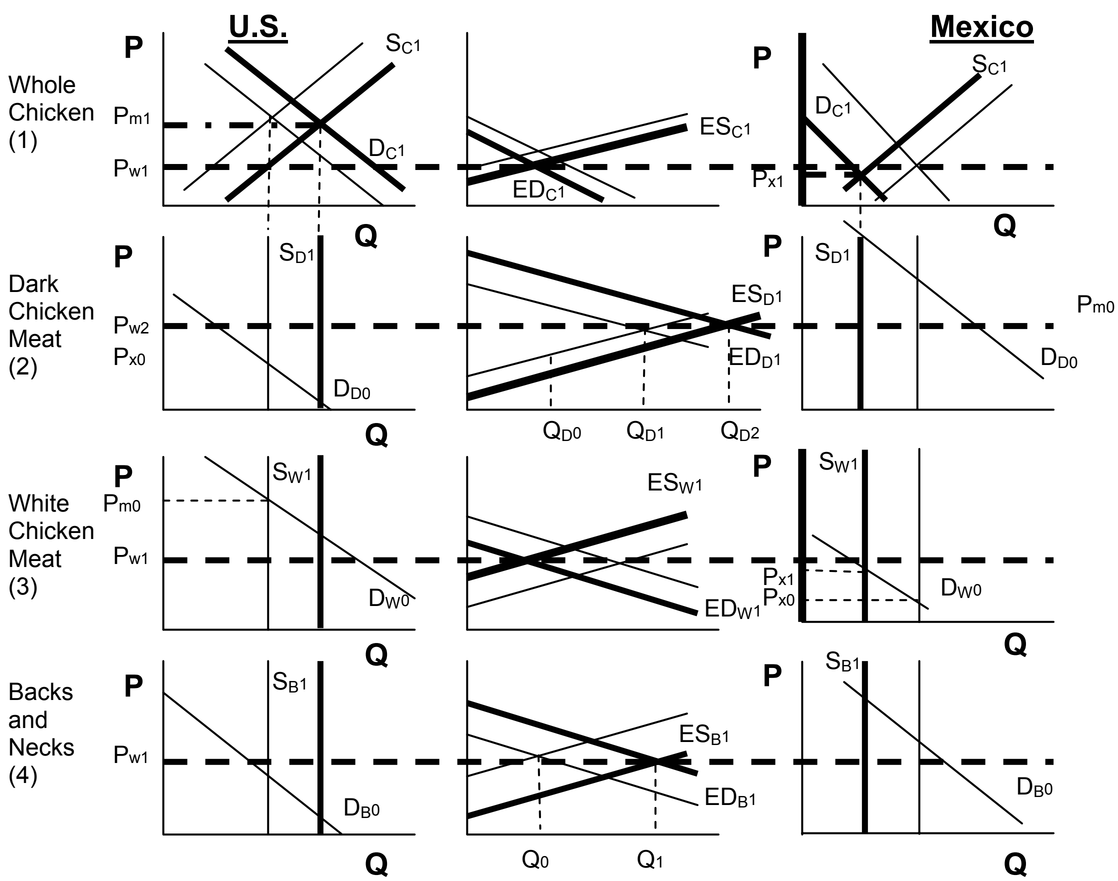

Figure 3.3. Effects of removing the tariff rate quota (TRQ) (part B)

Trade of chicken backs and necks is also expected to be affected by the removal of the TRQ on chicken dark meat. Excess demand for chicken backs and necks in Mexico (ED_{B1} in panel 4, Figure 3.3) shifts to the right due to a decreased domestic chicken production in Mexico. Excess supply of chicken backs and necks in the U.S. shifts to the right due to the increased domestic production of chicken and chicken parts. These changes are expected to cause an increase in the U.S. exports of chicken backs and necks to Mexico (illustrated in the middle graph of panel 4 as a change from Q_0 to Q_1).

The impacts of removing the Mexican TRQ on U.S. chicken dark meat are illustrated in Figure 3.4. Whole chicken price in the U.S. is expected to be P_{m1}, which is lower than the previous domestic price (P_{m0}) of whole chicken shown in Figure 3.1. Price of whole chicken in Mexico would also decrease to P_{x1}. Panel 1 in Figure 3.4 shows the international price just as a reference, i.e. it is not showing the level of trade because Mexico is not allowed to export chicken to the U.S. For that reason, there is a difference in whole chicken prices in the U.S. (P_{m1}) and Mexico P_{x1}.

Mexican chicken dark meat imports from the U.S. are expected to increase considerably (panel 2, Figure 3.4). White meat price in the U.S. is expected to decrease to P_{m1}; while in Mexico the price of chicken dark meat is expected to increase to P_{x1}. Because of sanitary restrictions the price of chicken white meat in Mexico and in the U.S. is not expected to equal the international price, since chicken trade from Mexico is not allowed (panel 3, Figure 3.4). Lastly, trade of chicken backs and necks from the U.S. to Mexico is expected to increase for the explanation given above.

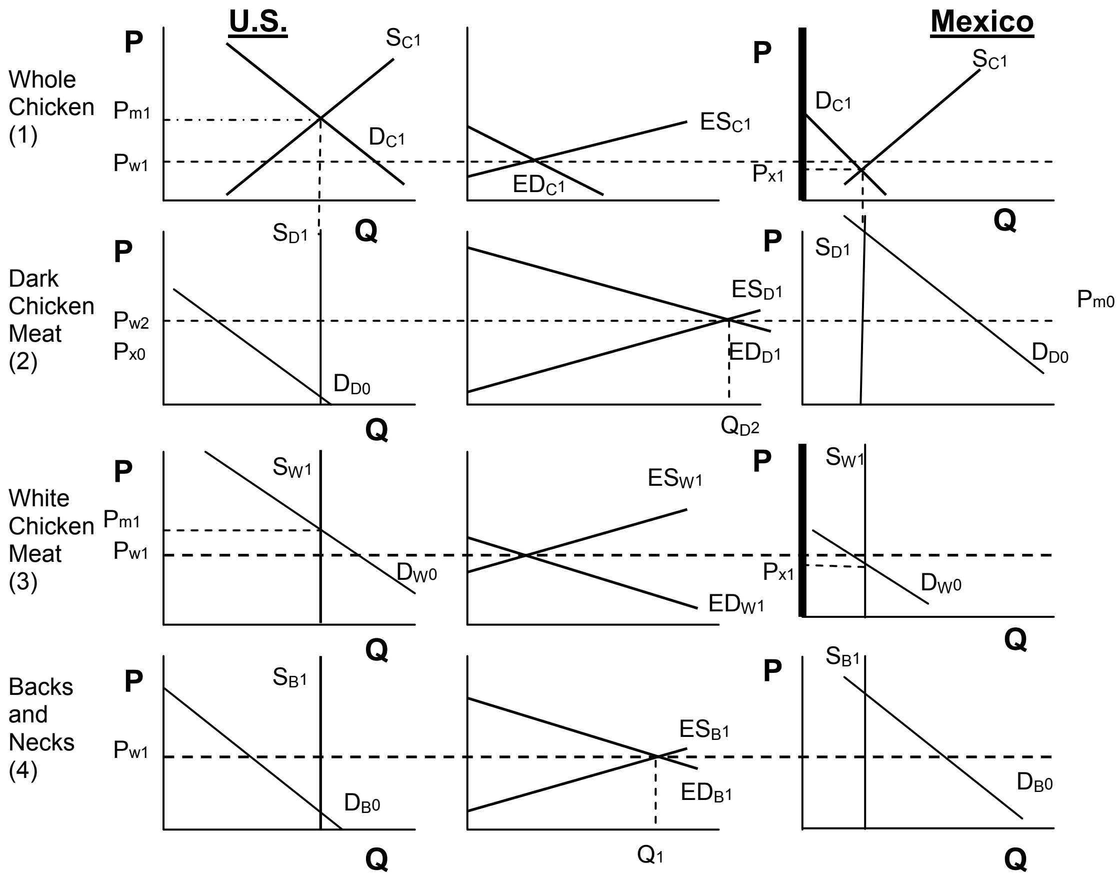

Figure 3.4. Final effects of tariff rate quota (TRQ) removal

Once the effects from the TRQ removal have been described, the next step is to analyze the potential effects of allowing Mexico to export chicken to the U.S. The results of this analysis will be an estimate of the cost for Mexican producers of not speeding the negotiations to be able to export. Figure 3.5 illustrates the potential for Mexican chicken exports to the U.S. The products that Mexico would be able to export are: (1) whole chicken (Q_{C1} in panel 1, Figure 3.5) and, (2) white chicken meat (Q_{W1} in panel 3, Figure 3.5).

Production of whole chicken in Mexico is expected to increase as a consequence of the opportunity to export to the U.S. In other words, the price for whole chicken in Mexico would be the international price (P_{w1}), which is higher than the domestic price of whole chicken price in Mexico (P_{x1}). Recalling the assumption that quantity supplied of whole chicken has a positive relationship with price of whole chicken, an increase in production of whole chicken in Mexico is expected once the sanitary restriction is removed.

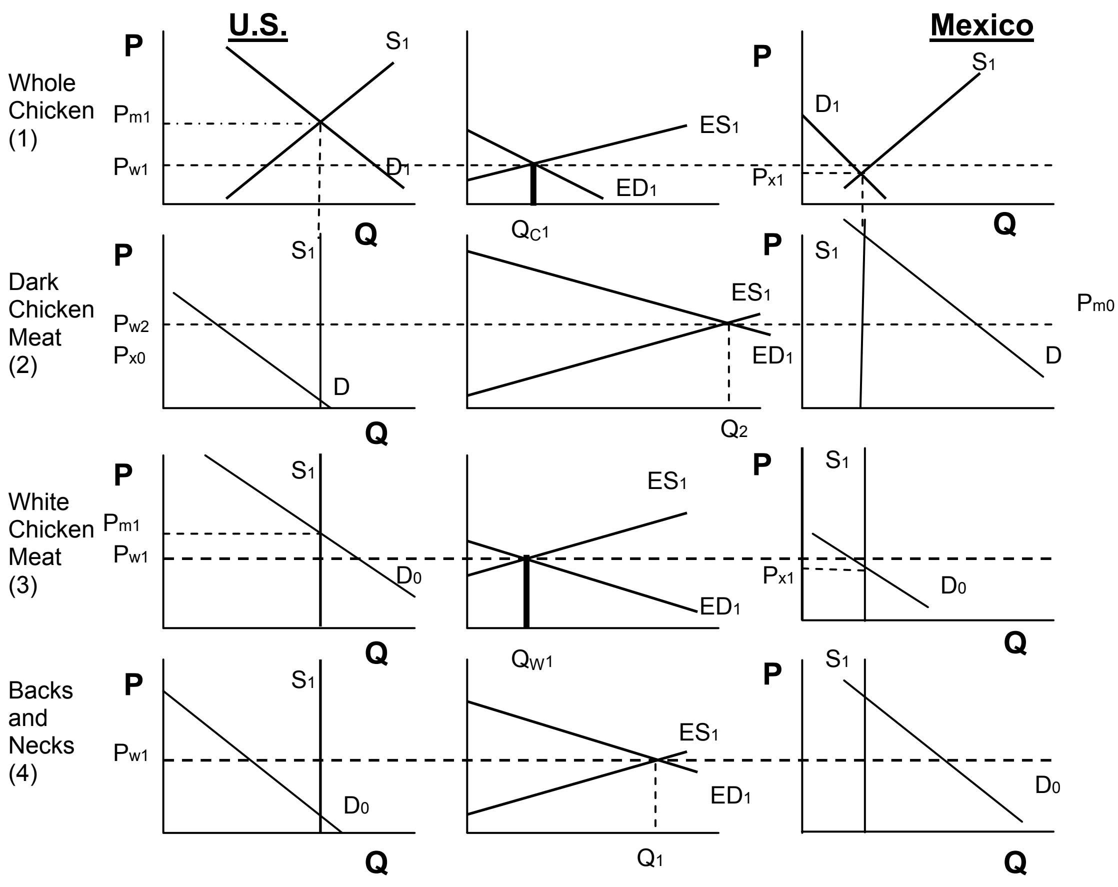

Figure 3.5. Sanitary restriction removal

Chapter Summary

This Chapter provides the predicted economic impact from a change in trade policy. Two trade policies were analyzed: (1) removal of the Mexican TRQ on U.S. chicken leg quarters and, (2) removal of U.S. sanitary restriction on Mexican chicken.

The predicted effects of removing the Mexican TRQ are: (a) an increased level of production of chicken in the U.S.; (b) shrinkage of Mexican chicken production; (c) Mexican imports of chicken leg quarters from the U.S. are expected to increase considerably. As a consequence of the changes in production and trade, prices for chicken and chicken parts are expected to change as well. In the U.S., price of chicken dark meat is predicted to increase and price of chicken white meat would decrease. In Mexico, price of chicken dark meat would decrease compared to the baseline price. The price of white meat would increase.

By allowing Mexican chicken into the U.S. market, Mexican production of chicken would be able to increase (compared to the production level with no TRQ yet a sanitary restriction in place). Mexico would be able to export whole chicken and chicken white meat to the U.S. once the sanitary restriction is removed. The analytical prediction in this Chapter provides the hypotheses, which are then examined more in detail with the results from the quantitative model. The description of the model is provided in Chapter IV, while the results are explained in Chapter V.

CHAPTER IV

MODEL DESCRIPTION

This Chapter provides a brief background of the model to be used in the estimation of policy analysis. Then, a description of the model is provided, which is divided into: supply, demand, trade, restrictions to trade and transportation costs. The information and data used to develop the baseline is also provided in this Chapter. Finally, the scenarios to be developed in order to analyze chicken trade policy between Mexico and the U.S. are presented.

Model Background

The analysis conducted in the previous Chapter follows the standard international trade assumptions, such as no transportation costs, and the assumption that the goods produced in both countries have no difference in quality, i.e. the products are identical. While in this Chapter and for the rest of this thesis the assumption of identical products is kept, the assumption on transportation cost is relaxed. The model used in this thesis considers transportation cost within a mathematical programming model.

The basis for mathematical programming applied to international trade refers back to the work of Samuelson (1952). Figure 4.1 shows how Samuelson approached international trade between two countries. Note that the graph is displaced to represent the transportation cost of shipping products from country 1 to country 2. In this case the transportation costs are represented by T_{12}. For country 1 the domestic equilibrium price is at the level represented by a_1. If trade were not possible, the price would remain at that level. The point represented by A_1 on the excess supply curve is the autarky price for country 1. Similarly, the domestic equilibrium price in country 2 is represented by a_2 and A_2.

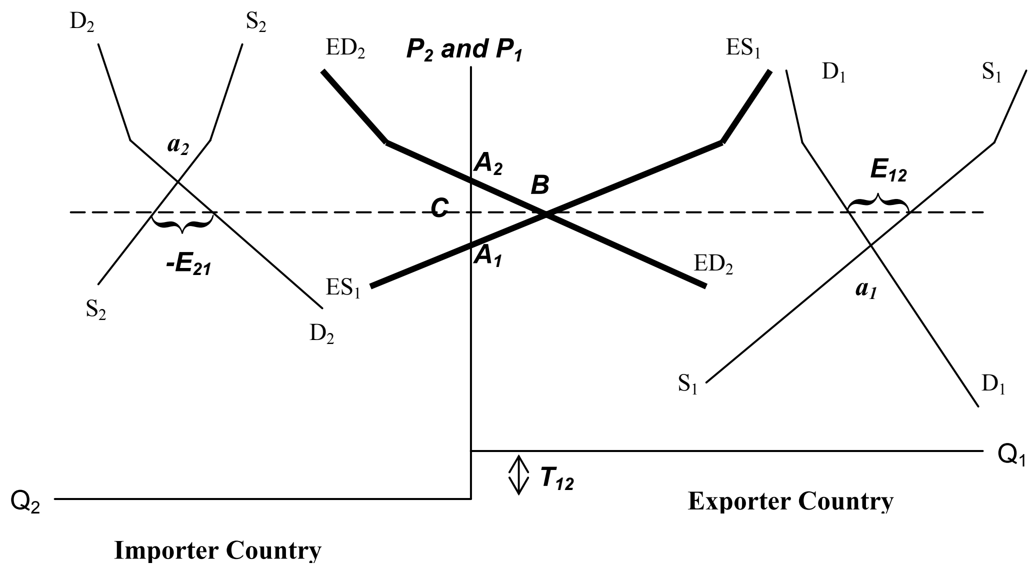

Figure 4.1. International trade between two countries considering transportation costs Source: Adapted from Samuelson (1952).

If trade is permitted, the global equilibrium price would be the point B. Country 1 would export to country 2 the quantity represented by E_{12}, where E represents exports. Complementarily, country 2 would import $-E_{21}$ from country 1. As explained before, T_{12} represents the transportation cost of moving products from country one to country 2, so in order for trade to exist some conditions must hold. If $a_2 \geq a_1 + T_{12}$, then a trade flow $E_{12} \geq 0$ will exist. In other words, there is an incentive to trade because the price in country 2 is at least equal to the price in country 1 plus transportation costs. This is a basic rule for trade.

However, If $a_2 < a_1 + T_{12}$ and if $a_1 < a_2 + T_{21}$, then no trade will occur between these countries. In other terms, $E_{12} = 0$ and $E_{21} = 0$. In this case trade is not an optimal solution, because the transportation cost is higher than the difference between the prices in both countries. Under these circumstances trade would not represent economic benefit for consumers, nor for producers in the countries involved.

Conversely, if $a_1 \geq a_2 + T_{21}$, then $E_{21} \geq 0$. In this case the trade flow would reverse and country 2 would be exporting to country 1. Note that the optimum solution for trade is that output which maximizes the total welfare, which is the sum of consumer surplus and producer surplus.

The principles presented above in a graphical form are the basis for mathematical programming applied to international trade. For more details and for the generalization of the model to more than two countries, see Samuelson 1952. Based on the principles set up by Samuelson, Hahn (1993) demonstrated that by using a social cost minimization equation, in other words, by maximizing the consumer surplus and producer surplus, the optimum level of exports in an international market can be calculated. The North American Trade Model for Animal Products (NATMAP) developed by Hahn is designed to predict how changes in policy will affect the long run production, trade and prices of animal products in the three North American countries (Canada, the United States and Mexico). This model also has the capability to predict how changes in income growth and costs of production can affect trade, production, and prices of animal products in the participating NAFTA countries.

A feature of this model is the combination of mathematical programming with data on demand and supply to find the levels of production and trade that maximize the consumer surplus and producer surplus in the economies involved. The NATMAP model, which is built on a General Algebraic Modeling System (GAMS) program, has been used by the Economic Research Service of the United States Department of Agriculture to analyze the potential effects of NAFTA. This model can be used to measure the economic welfare in order to identify potential gainers and losers from a particular change in policy. The data needed to build this model include prices, production, consumption, trade and some calculated demand parameters (Hahn)

Description of the Model

In this thesis a modification of Hahn's NATMAP model is used to analyze trade policy affecting chicken meat product. This model is a simplified structure having the main objective to imitate a part of a real world economy. This model allows a look at larger picture of the effects of trade policy changes. Economists theorize that competitive markets can lead to a socially ideal level of production and consumption. The social ideal outcome can be specified as the situation under which economic surplus is maximized. Economic surplus is maximized when supply equals demand, in other words, when market equilibrium is reached. The mathematical objective of the model is to minimize the cost of producing and trading chicken, subject to transportation costs, production costs, policy restrictions, and consumer demand restrictions. The cost of producing chicken is a non-linear specification (Cobb-Douglas production function and

CES-like processing parameters), while consumer demand is specified as a quadratic utility function (Hahn).

The objective function is as shown below:

Minimize Cost = $\sum_i[F_i(L_i) + G_i(W_i,C_i)] + \sum_{i,j}S_{i,j,k} * TC_{i,j,k}$

Subject to: $U_{M1} \geq U_{M0}$

Where:

L_i	Represents the poultry production level region i
$F_i(L_i)$	Represents the cost function of producing chicken in region i
W_i	Represents the level of chicken production *i* for sale as whole birds
C_i	Represents the level of chicken production to be cut up for parts in region i
$G_i(W_i,C_i)$	Represents the cost function for chicken slaughter and processing
$S_{i,j,k}$	Represents the quantity shipped from producing region i to consuming region j of chicken product k
$TC_{i,j,k}$	Represents the transportation cost of shipping chicken product k from region i to region j
U_{M0}	Utility level for a country M in the baseline.
U_{M1}	Utility level for a country M in the solution output.

Production

Chicken production within a country is divided by regions, thus the total production in a country is represented by the sum of the production by region.

$\sum L_i$ = National Production

The total production of chicken is divided into chicken to be sold as whole chicken and chicken to be cut into parts. The sum of production of chicken to be sold as whole in region i plus the sum of the production of chicken to be cut up in parts in region i should be equal to the total production of chicken in region i.

$\sum W_i + \sum C_i = L_i$

For the U.S., the assumption is that 95% of the national production of whole chicken is cut into parts, while the other 5% is assumed to be marketed as whole chicken. This is a reasonable assumption because, according to the information provided in the decree published by Mexico, Presidencia de la Republica (2003) in the U.S. more than 90% of the total production is marketed as chicken parts. Similarly, the assumption for Mexico is that 85% of the total production of whole chicken is cut into parts, while the other 15% is marketed as whole chicken.

From a chicken carcass cut into parts, 3 differentiated products are obtained: (1) white chicken meat, (2) dark chicken meat and (3) chicken backs and necks. In the model the production of chicken parts is specified as fixed proportion technology. The total chicken production destined to be marketed as chicken parts was divided as proposed by Salin, Hahn, and Harvey: 37.10% of a chicken carcass weight is white meat; 59.70%, dark meat; and 3.20%, backs and necks.

Description of Producing Regions

In order to incorporate the trade effect of transportation cost, the U.S. and Mexico were divided into supply regions and demand regions. The supply regions in the U.S. are named TEXARK, SEUSA and NEUSA. The region TEXARK includes the states of Texas and Arkansas and its name is self-explanatory; SEUSA (which stands for southeast U.S.) includes North Carolina, South Carolina, Georgia, Alabama, Missouri and Florida; NEUSA (northeast U.S.) is represented by Virginia, Delaware and Maryland. According to statistics published by USDA ERS, the percentage of U.S. chicken production for these regions is 20%, 50% and 10%, respectively. The rest of the country will be represented in the model as an aggregated region ROUSA (Rest of the U.S.). The U.S. map according to this division by regions is shown in Figure 4.2.

Figure 4.2. U.S. map divided by regions as used in the model
Source: Based on Data from the USDA.

Similarly, Mexico is divided into three supply regions in the quantitative model. They are to be called, NWMEX (northwest Mexico), NEMEX (northeast Mexico), and ROMEX (Rest of Mexico). The region NWMEX incorporates the states of Baja California, Baja California Sur, Sonora, Sinaloa, Chihuahua, Durango and Nayarit. The supply region NEMEX takes into account the states of Nuevo Leon, Tamaulipas, Coahuila and Zacatecas. The regions described above had a percentage of the national chicken production in 2003 of 14% and 10% respectively. The rest of Mexico is not considered a potential exporting region of white chicken meat to the U.S. because these regions have not been declared as disease free regions by SAGARPA, nor have they been recognized by APHIS as having relatively low risk of exotic Newcastle disease transmission. Mexican regions as used in the model are illustrated in Figure 4.3 The states of Colima, Campeche, Yucatan and Quintana Roo have been declared by SAGARPA as low risk of exotic Newcastle disease, but because these states account for a low share of total Mexican chicken production (less than 1%) they were not taken into account in this study.

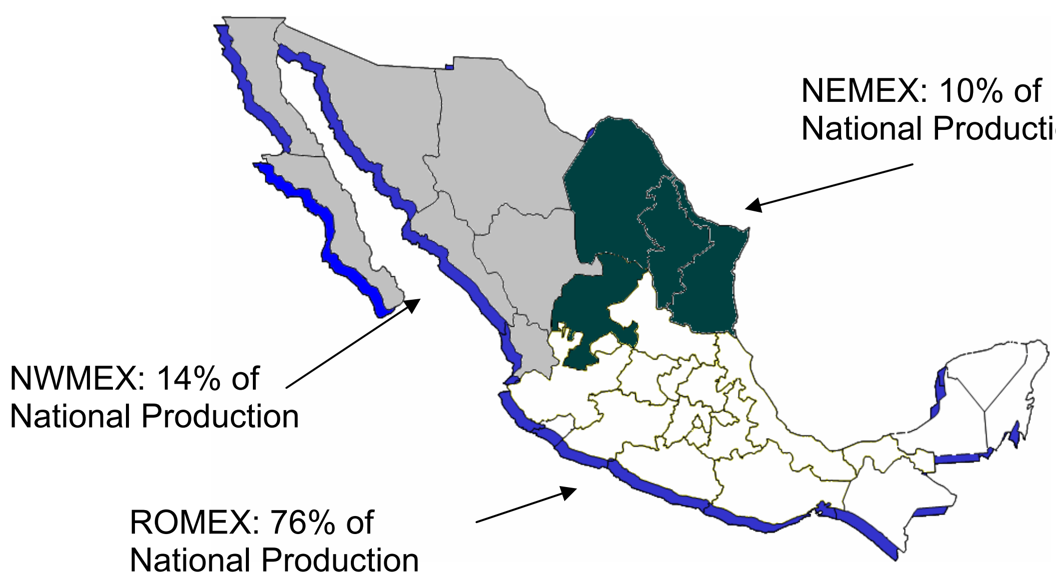

Figure 4.3. Map of Mexico divided by regions as used in the model

Source: Based on Data from SAGARPA.

The area in Mexico considered as free of poultry diseases by Salin, Hahn, and Harvey (2002) included only the states of Sonora and Sinaloa. In this study new areas in Mexico declared as free of diseases were included to expand and update the former model. According to Gallardo Nieto et al. (2004) the Mexican states now free of avian influenza, Newcastle disease and salmonella are Baja California, Baja California Sur, Chihuahua, Coahuila, Nuevo Leon, Tamaulipas, Zacatecas, Durango, Nayarit, Colima, Yucatan, Campeche, and Quintana Roo. Most of these states are considered as potential exporters of chicken white meat to the United States in this updated model.

Production and Processing Cost Function

The production relationships in the optimized cost function are modeled with farm-level supply equations for live chicken in each region, and additional features for the slaughter and processing phases of chicken meat production. Production of chicken meat is assumed to be from an industry segment that specializes in chicken, thus there is no joint-product or by-product output to consider in this production system.

Farm-level Supply

Farm-level production is incorporated into the optimization problem with a Cobb-Douglas cost function of the quantity of live birds produced. The functional form is: $TC_{LIVE} = \sum A_i (Q_{LIVE,\, i} * C_{FARM,\, i})^{\alpha i}$

where TC represents total cost of live birds, A is a scale parameter, Q represents quantities produced, and C is the farm level cost. The subscript i indicates regions in the model. This mathematical structure imposes multiplicative relationships between inputs and input prices, each of which is raised to a power (α_i). The exponent in the mathematical structure is inversely related to the elasticity of supply of that output. In application, the Cobb-Douglas setup is log-linear relationships between inputs.

The optimization is for total cost in North America, obtained by summing the cost across each region. The modeling framework allows for varying elasticity parameters at the farm level across regions. However, in this version, it assumed that all production regions have the same elasticity of supply. This assumption is reasonable because modern vertically-integrated production systems for chicken production are found in both Mexico and the U.S. and these systems are the major force that determines the supply response that results when the model optimal solution is obtained. The value of the assumed elasticity of supply is 5, which is the same value used by Salin, Hahn and Harvey.

Value-Added Product Supply

Two production steps involve adding value to the live birds: one that changes the form of the product and another that changes the location of the meat products. The live product undergoes slaughter and processing in the conversion from bird to consumer-ready meat product. The mathematical representation of the slaughter and processing steps is a CES (constant elasticity of substitution) aggregator function that combines changes in product form into a cost value-added measure that is included in the objective function. The key feature of the CES specification is that the responsiveness of supply of processed products is the same for the slaughter phase as for the further processing phases. The assumed elasticity of supply for slaughter and processing services is 8, as used by Salin, Hahn and Harvey.

Demand

The demand regions are treated as Mexico, the U.S., and "the rest of the world excess demand" which are the countries to which the U.S. and Mexico export chicken. In this version of the model the rest of the world is modeled as importing countries; exporting countries in the rest of the world were ignored. To calculate the quantity demanded of chicken for each country the following equality holds:

Quantity Demanded = Quantity Supplied + Imports – Exports

Utility Function

The quadratic utility function is represented as: $U = \theta Q + BQ^2$

A production function parameter θ was used. The θQ expression is the linear part of the quadratic utility function. There is a θ parameter for each good that is consumed, to represent the expenditure shares for each product bought by a consumer. The demanded products are a function of the expenditure share. The demanded products are whole chicken, white chicken meat, dark chicken meat, chicken backs and necks, and other products besides chicken. For the U.S. the consumer expenditure share for chicken and chicken parts was assumed to be 3% of the total income, while for Mexico this share was assumed to be 4%. Consequently, the expenditure share for other goods (besides chicken) in the U.S. is 97% and for Mexico it is 96%. This assumption on expenditure shares is reasonable because the income for a representative consumer in the U.S. is assumed to be higher than in Mexico; thus the expenditure share on chicken is lower in the U.S. (3%) than it is in Mexico (4%) because a representative consumer in the U.S. would spend a higher percentage of income on other goods besides chicken. Note that all the expenditure shares have been assumed to remain constant as a fixed proportion of the total expenditure function. According to Hahn one of the disadvantages of using a quadratic utility function is the implications of linear Engle curves, which means that consumption is a linear function of consumer income.

Utility Restrictions

Compensated or Hicksian demand functions are used in the model because these demand functions deal with an expenditure minimization given a certain level of utility. The utility restrictions require that the mixture of goods consumed by a nation's consumers gives a utility at least as great as a baseline level. The utility constraints are treated as inequalities, i.e. the utility level in the solution must be greater or equal to the utility level in the baseline. To provide a more accurate representation of the working of a free market, this model uses a utility restriction for each of the countries involved (Mexico and the U.S.) instead of an overall utility constraint. An overall utility constraint could result in shifting of consumption between countries and a redistribution of income above and beyond that caused by shifts in production and trade (Hahn).

Demand Elasticities

Table 4.1 presents the elasticities as used in the model. These are the same elasticities that Salin, Hahn, and Harvey used in their version of the model. Because the calculation of new elasticities was beyond the scope of this study, these elasticities were kept. The assumed own-price elasticity for whole chicken in Mexico (-.8) is higher than it is in the U.S. (-.1). Similarly, the own-price elasticity for dark meat is assumed to be -.8 for Mexico and -.3 for the U.S. The reasoning behind this assumption is that in the

U.S. consumers do not change considerably their level of consumption of whole chicken and chicken white meat when the prices of these goods change. Conversely, in Mexico the consumers are assumed to have a higher level of responsiveness given a change in the prices for whole chicken and chicken dark meat. Regarding cross price elasticities, for both countries, whole chicken is assumed to be a substitute for chicken dark meat and for chicken white meat. This is a reasonable assumption because it is expected that if the price of white meat goes up, consumers are likely to buy whole chicken to get the white meat from it, thus the consumption of whole chicken would increase due to an increase in white chicken meat.

Table 4.1. Demand Elasticities for the U.S. and Mexico as Used in the Model

	Elasticities for the U.S.			
	Whole	**White**	**Dark**	**Backs**
Whole	-0.1	0.04	0.05	0
White		-0.5	-0.1	0
Dark			-0.3	0
Backs				-8.0
	Elasticities for Mexico			
	Whole	**White**	**Dark**	**Backs**
Whole	-0.8	0.05	0.2	0
White		-0.5	0	0
Dark			-0.8	0
Backs				-0.9

Source: Salin, Hahn, and Harvey (2002).

Trade

The sum of the shipments from region i to any region are restricted to be less than, or equal to the production level in region i. In an abstract form: $\sum S_{i,j} \leq L_i$

If price of product k in region i plus transportation cost of product k from region i to region j is less than or equal to the price of product k in region j, then shipments of product k from region i to region j would be greater than zero.

If $P_{i,k} + TC_{i,j,k} \leq P_{j,k}$, $S_{i,j,k} \geq 0$

If the difference in chicken and chicken parts prices in two certain regions is bigger than the transportation cost of shipping a unit of product from one region to the other, the model would allow the region with lower price to export to the region with higher price. The model would continue shipping additional units of product from one region to the other until the difference in prices does not exceed the transportation cost. In other words, the model would solve for a certain level of trade that equalizes the prices among the regions involved. The optimum level of trade is dependent on transportation costs. This prediction is based on the analysis by Samuelson and the subsequent application of the mathematical programming framework by Salin, Hahn, and Harvey.

Transportation Costs

In order to estimate the transportation costs of shipping chicken from one region to another and from one country to the other, a specific city in each region was designated as a representative point of departure (Table 4.2). Thus, the distance between regions was assumed to be the same distance between the designated cities. Two border crossing points were considered in the model: (1) Laredo, TX, and (2) Nogales, AZ.

Villa (2005), from the Texas Transportation Institute (TTI), provided the estimated transportation cost for a refrigerated truckload from the city of origin to the destination city (Table 4.3). In Mexico the freight rate southbound and the freight rate northbound are different from one another. This is because more products are shipped southbound, representing a higher demand for transportation services southbound. On the other hand, the demand for transportation services northbound is lower and so are the freight rates (Villa, 2005). The differences in transportation cost in Mexico between southbound and northbound were included in the model.

Table 4.2. Designated Cities for Each Region

Region	Designated City to Calculate Transportation Costs
TEXARK	Dallas, Texas. USA.
SEUSA	Atlanta, Georgia. USA.
NEUSA	Richmond, Virginia. USA.
ROUSA	Los Angeles, California. USA
NWMEX	Culiacan, Sinaloa. Mexico.
NEMEX	Monterrey, Nuevo Leon. Mexico.
ROMEX	Mexico City, Distrito Federal. Mexico.

Table 4.3. Estimated Transportation Costs (USD/ KG)

	Dallas	Richmond	Atlanta	L.A.	Culiacan	Monterrey	Mexico City
Dallas	0	0.087	0.054	0.094	0.137	0.047	0.076
Richmond	0.087	0	0.034	0.175	0.195	0.105	0.134
Atlanta	0.054	0.034	0	0.148	0.144	0.077	0.105
L.A.	0.094	0.175	0.148	0	0.092	0.099	0.128
Culiacan	0.126	0.184	0.133	0.081	0	0.044	0.051
Monterrey	0.045	0.103	0.075	0.098	0.044	0	0.039
Mex. City	0.059	0.117	0.088	0.112	0.051	0.039	0

Source:Villa, 2005.

In order to estimate the transportation cost to link the rest of the cities the methodology described below was followed:

- Obtain distances between each origin and destination cities. This information was obtained from Villa (2005).

- Estimate the average cost (simple average) per mile within the U.S. and within Mexico by using the data provided by Villa (2005).
- Multiply the average cost per mile by the total distance (in miles) between origin and destination cities. The results would indicate the cost per truckload from one city to another.
- Divide the cost per truckload by 28,000 kg, which is a truck capacity, to get the cost per KG.

Policy Restrictions to Trade

The U.S. sanitary restriction on Mexican shipments requires that the shipments of chicken product k from any Mexican region i to any region j in the U.S. are zero for any price level ($S_{i,j,k} = 0$). Sanitary restrictions are treated as absolute restrictions preventing chicken exports from Mexico to the U.S. To represent the scenario in which the sanitary restrictions are removed, the supply regions in northern Mexico (NWMEX and NEMEX) are allowed to export to the U.S. Note that the rest of Mexico does not have the possibility to export chicken to the U.S.

For the baseline, the producing regions that are allowed to ship products to demand regions are specified according to sanitary policy restrictions in place in 2003. U.S. supply regions are allowed to ship chicken to the U.S., Mexico and the rest of the world (USAROW), while producing regions in Mexico are allowed to ship only within Mexico and to the rest of the world (MEXROW). In modeling the removal of sanitary restrictions for the producing regions in northern Mexico, these regions are allowed to export to the U.S. also.

Other Assumptions in the Model

This model is built on the implicit assumption that the poultry sector in both countries is a competitive industry. A key assumption is that levels of chicken production, consumption and trade as of 2003 are assumed to be the economically ideal outcome given the policy framework in place for that year, i.e. considering U.S. sanitary restriction and a Mexican over-quota tariff of 98%. By ignoring the Mexican TRQ, and solve the model to find the ideal output, the economic impact of the TRQ will be estimated. Finally, because in 2002 the Mexican imports of chicken leg quarters from the U.S. represented 99% of total Mexican imports of chicken from the U.S. (Mexico, Presidencia de la Republica), the price for leg quarters is used in this model as if it were the price for chicken dark meat. In fact, starting from this section the terms "chicken dark meat" and "chicken leg quarters" are used interchangeably.

Baseline

In the model the chicken production level is considered as slaughtered weight chicken. In order to calculate the weight of the total chicken production as carcass, the live chicken production amount was multiplied by the factor 0.70. Then, the total production was converted from tons to metric tons (mt). Consequently, U.S. chicken production in 2003 was 14.7 million mt (USDA ERS, 2004). According to the USDA (2004) U.S. chicken exports represent 14% of the national production, so in this case the level of exports entered into the baseline is 2.1 million mt. Regarding U.S. imports, the baseline level is zero. As a consequence, in the model, the level of chicken consumption in the U.S. for the year 2003 was 12.6 million mt.

For Mexico, the level of production in the baseline model was 2.1 million mt, while exports were 1,180 mt. Mexican chicken imports for the year 2003 were 307,000 mt (Gallardo et al. 2004). According to the UNA (2004) around 95% of Mexican imports of chicken come from the U.S., thus for modeling purposes the baseline level of imports coming from the U.S. was set at 307,000 mt. Levels of production, consumption and trade of chicken are summarized in Table 4.4.

Table 4.4. Levels of Chicken Production, Consumption and Trade for the U.S. and Mexico as of 2003 (1,000 mt.)

Country	Total chicken production	Chicken shipped to the U.S.	Chicken shipped to Mexico	Chicken shipped to rest of world	Total domestic chicken consumption
U.S.	14,719	12,573	307	1,839	12,573
Mexico	2,126	-	2,125	1	2,431

Source: Based on data from SAGARPA, UNA and USDA.

Data on U.S. chicken prices were provided by the U.S. Department of Agriculture (USDA, 2004b). Prices taken into consideration in the model were wholesale prices for whole chicken, breast (white meat) and for leg quarters bone-in (dark meat). The prices were the average monthly prices reported in 2003; they were reported originally in terms of cents of the U.S. dollar per pound, but for this model they were converted into U.S. dollars per kilogram (kg).

Chicken prices in Mexico were obtained from Gallardo Nieto et al. Prices as entered in the model were wholesale average prices for 2003. Originally these prices were reported in Mexican pesos per kilogram, but to standardize the units, these prices were converted to U.S. dollars per kg. The monthly average currency exchange for 2003 was 10.79 Mexican pesos per U.S. dollar (Banco de Mexico). All the conversions from Mexican pesos to U.S. dollars were calculated using that 2003 average currency exchange.

Table 4.5 presents the wholesale prices for the four different chicken products in both countries: (1) whole chicken, (2) white chicken meat, (3) dark chicken meat and (4) chicken backs and necks. As of 2003, the average annual price of chicken white meat in the U.S. was $3.43 USD/kg, whereas in Mexico it was $2.31 USD/kg, i.e. the price for white meat in the U.S. was 33% higher than it was in Mexico. On the contrary, the price of dark chicken meat in Mexico is almost threefold the price in the U.S. for dark meat. The average annual prices for dark meat in the U.S. and in Mexico were $0.50 USD/kg and $1.46 USD/kg, respectively.

Table 4.5. Average Wholesale Prices in Mexico and the U.S. for Chicken and Chicken Parts as of 2003 (USD/KG)

	Whole Chicken	White Meat	Dark Meat	Chicken Backs
U.S.	1.37	3.43	0.50	0.35
Mexico	1.19	2.32	1.46	0.45

Source: Based on data from the USDA and SAGARPA.

Calibration of Baseline Model

According to economic theory, in competitive markets where transportation costs are insignificant and barriers to trade do not exist, identical goods are sold for the same price in geographically separated markets. This feature of market equilibrium is known in the economic literature as Law of One Price (Nicholson, 1998). To find out if the model used in this study fulfills the predictions of the economic theory, specifically the law of one price, transportation costs were assumed to be zero and all the trade barriers were removed. Under these assumptions, a calibration step was undertaken to confirm that the prices for chicken parts in both countries do equalize (see Appendix 1 for output that shows the law of one price). Consequently, the model was proved to be well calibrated.

Policy Analysis

The model was run under two scenarios. The first scenario assumes no Mexican TRQ on U.S. chicken leg quarters and is intended to quantify the economic impact of this trade policy on the chicken industries of Mexico and U.S. Levels of production, consumption, trade and prices for chicken and chicken parts as of 2003 were used to estimate the economic impact of the TRQ, thus the first objective of this thesis was achieved.

The second scenario, assuming no TRQ and allowing some Mexican states to ship chicken meat to the U.S., estimates the economic impact on chicken trade, chicken prices, chicken production and chicken consumption in Mexico and in the U.S. from removing the TRQ and relaxing sanitary barriers to chicken trade between these countries. This scenario pursues the second objective of this thesis, which is to estimate the possibilities for Mexico to export chicken and chicken parts to the U.S. Under this scenario the U.S. sanitary restriction on chicken from the regions in northern Mexico was ignored.

Chapter Summary

In this Chapter the background and a description of the model used in the present study was provided. The information used to develop the baseline is also included in this Chapter. As discussed before, this thesis is basically an updated and extended version of the model developed by Hahn, and modified by Salin, Hahn and Harvey. On the topic of transportation costs, in this version of the model, more realistic data were used compared to the data used by Salin, Hahn, and Harvey. While these authors did not estimate the cost of transporting chicken within a country from one region to another, in the present study these local distribution costs were estimated and included in the model. Another contribution of this study is the inclusion of three potential exporting regions in Mexico, whereas Salin, Hahn, and Harvey only considered one. To conclude the Chapter two scenarios are proposed, which will be used to analyze the economic impact of tariff and sanitary restrictions to chicken trade between Mexico and the U.S.

CHAPTER V

RESULTS AND SENSITIVITY ANALYSIS

As stated in Chapter I, the objective of this thesis is to estimate the economic impact of changes in trade policy affecting chicken meat shipments between Mexico and the U.S. The baseline information described in Chapter IV, which is the actual situation of chicken production, trade, and consumption as of 2003, was assumed to be the outcome that maximizes social welfare given the trade policy framework for that year. This Chapter will be divided in three sections: (1) descriptions of the results obtained in the first scenario, (2) description of the results from the second scenario, and (3) description of the results from a sensitivity analysis. Each section will focus on the economic impact (estimated changes in production, consumption, prices and trade of chicken and chicken parts) from the proposed policy change.

Scenario 1: Removing the Mexican TRQ on U.S. Chicken Leg Quarters

The main goal of this scenario is to quantify the effects of removing the Mexican TRQ on U.S. chicken leg quarters. Predicted prices, quantity demanded, quantity supplied, and level of trade were obtained in the solution. In Tables presented in this section the quantities in the column specified as "Base" indicate the baseline level of production, trade consumption and prices; whereas the quantities under the label "No TRQ" specify the estimated levels for these categories assuming free trade for chicken products from the U.S. to Mexico, but not from Mexico to the U.S. In this scenario the U.S. sanitary restriction on Mexican chicken products remained in place to isolate the economic impact of removing the TRQ.

Effects on Chicken Production, Consumption and Trade

Total U.S. production of whole chicken is expected to increase by 8% as a result of the removal of the Mexican TRQ. The causes of this increased level of production are: (1) the predicted increase in demand for whole chicken to be cut into parts and, (2) the expected shift in the whole chicken supply curve due to a higher U.S. domestic price for dark meat (Figure 3.2), This is an increase of U.S. chicken production volume from 14,718,000 mt to 15,899,000 mt. (Table 5.1).

Table 5.1. Trade, Production and Consumption of Total Chicken Meat, Baseline and Predicted from Removal of TRQ

	United States			Mexico		
	Base	No TRQ	Change	Base	No TRQ	Change
	(--- 1,000 MT ---)		(%)	(--- 1,000 MT --)		(%)
Imports	0	0	0	306	1,724	462
Exports	2,145	3,448	61	1.18	3.09	162
Production	14,718	15,899	8	2,307	1,141	-51
Consumption	12,572	12,450	-1	2,432	2,862	18

No tariff rate quota (TRQ) scenario reflects free trade from the U.S. to Mexico and U.S. sanitary restriction on Mexican chicken in place.

Conversely, total production of whole chicken in Mexico is expected to decrease by 51%, from 2,307,000 mt to 1,141,000. The reduction in the Mexican production of chicken was predicted by the graphical analysis in Chapter III. The driving factors for this reduction in the total production of whole chicken in Mexico are: (1) a reduced demand for whole chicken due to a significant reduction in the price of chicken dark meat in Mexico (recall whole chicken and dark chicken meat are substitutes); and (2) a decreased supply of whole chicken due to lower prices for chicken dark meat. This simulated effect of granting free access to U.S. chicken leg quarters into the Mexican market on the level of chicken production in Mexico is consistent with the estimation conducted by UNA (2003). UNA predicted that this change in policy would cause a reduction in Mexican chicken production by 30%.

Table 5.2. Total Chicken Production by Region, Baseline and Predicted from TRQ Removal

Region	Base	No TRQ	Change
	(----------------1,000 MT	----------------)	(%)
TEXARK	2,944	3,179	8
SEUSA	7,359	7,950	8
NEUSA	1,472	1,590	8
ROUSA	2,944	3,180	8
NWMEX	406	189	-53
NEMEX	285	141	-50
ROMEX	1,616	811	-50

No tariff rate quota (TRQ) scenario reflects free trade from the U.S. to Mexico and U.S. sanitary restriction on Mexican chicken in place.

Table 5.2 contains more detail on the predicted changes in chicken production by region. All supply regions in the U.S. would increase their level of production because of the elimination of the TRQ. In contrast, Mexican supply regions, which are not allowed to export to the U.S., would have a significant reduction in the total level of chicken production. Mexican regions are exposed to unrestricted imports of chicken from the

U.S. and they would face a significant reduction in market prices of chicken leg quarters. Because of this expected decrease in prices of chicken in Mexico many Mexican chicken farms would be driven out of business, especially those with low levels of efficiency. U.S. exports of chicken dark meat (leg quarters) to Mexico, assuming no TRQ in place, are expected to increase from 143,220 mt to 1,298,620 mt.

This is an increment in the Mexican imports of dark meat from the U.S. by 1,155,400 mt. In other words, Mexican chicken dark meat imports from the U.S. are expected to increase by 807% if the TRQ is removed. This change in chicken dark meat trade is consistent with the prediction in Chapter III (Figure 3.4, panel 2). For a detailed description of baseline and predicted shipments of chicken and chicken parts under this scenario, see Table 5.3. Mexican chicken exports to the U.S. are banned by a sanitary restriction under this scenario.

Regarding consumption, in the U.S. the level of chicken white meat consumed would increase by 3%, from its baseline level of 5,169,220 mt. to 5,301,360 (Table 5.2). This increased level of consumption is due to a lower domestic price for chicken white meat in the U.S. Chicken consumption in Mexico increases by 18%, from 2,432,000 in the baseline to 2,862,000 in the scenario assuming no TRQ (Table 5.3). This change in Mexican consumption is due to the lower price for chicken dark meat.

Table 5.3. Shipments of Whole Chicken and Chicken Parts from Supply Country to Demand Country, Baseline and Predicted from Removal of TRQ

Origin	Destination	Type of Meat	Base	No TRQ	Difference	Diff.
			(-------------1,000 MT		-------------)	(%)
U.S.	U.S.	Whole	460.08	466.38	6.3	1
U.S.	U.S.	White	5,169.22	5,301.36	132.14	3
U.S.	U.S.	Dark	6,825.24	6,634.17	-191.07	-3
U.S.	U.S.	Backs	118.25	49.31	-68.93	-58
U.S.	Mexico	White		261.63	261.63	∞
U.S.	Mexico	Dark	143.22	1,298.62	1,155.4	807
U.S.	Mexico	Backs	163.68	164.30	0.61	0
U.S.	ROW	Whole	275.85	369.21	93.36	34
U.S.	ROW	White	18.39	25.88	7.49	41
U.S.	ROW	Dark	1,379.25	1,060.63	-318.61	-23
U.S.	ROW	Backs	165.51	268.43	102.92	62
Mexico	Mexico	Whole	318.77	329.45	10.67	3
Mexico	Mexico	White	670.53	300.92	-369.61	-55
Mexico	Mexico	Dark	1,078.03	481.44	-596.59	-55
Mexico	Mexico	Backs	57.83	25.95	-31.88	-55
Mexico	ROW	Whole	0.17	0.29	0.11	64
Mexico	ROW	White	0.01	0.001	-0.01	-92
Mexico	ROW	Dark	0.99	2.79	1.80	182

No tariff rate quota (TRQ) scenario reflects free trade from the U.S. to Mexico and U.S. sanitary restriction on Mexican chicken in place.

Effects on Prices for Chicken and Chicken Parts

By solving the model assuming no TRQ, the levels of production and trade flows of chicken and chicken parts are affected and so are the prices. Because under this scenario no restrictions apply for U.S. chicken dark meat to be shipped to Mexico, the level of U.S. exports to Mexico will increase as predicted in Chapter III. Under these new trade conditions the markets in both countries would have new equilibrium prices for chicken products.

White chicken meat prices in the U.S. would decrease by 11% due to an 8% increase in the level of U.S. chicken production, which means more white meat would be available in the U.S. market. Conversely, the price of dark meat in the U.S. would increase by 27% because of the increased level of exports to Mexico and to rest of the world. These results are consistent with the predicted results in Chapter III.

Regarding the effects on prices for chicken and chicken parts in Mexico, the price for white meat would increase by 31%, due to the reduction in total chicken production in Mexico and consequently the reduced availability of white meat. On the other hand, prices for dark meat in Mexico would decrease by 58% due to the increased level of dark meat imports from the U.S. Table 5.4 shows a summary of the changes in prices under this scenario.

Scenario 2: Free Trade of Chicken from the U.S. to Mexico and Removal of the U.S. Sanitary Restriction for the Chicken Producing Regions in Northern Mexico (NWMEX and NEMEX)

Under this scenario there are fewer barriers to chicken trade compared to scenario 1: the Mexican TRQ on U.S. chicken is considered to be removed and, in addition, two production regions in Mexico (NWMEX and NEMEX) are allowed to export chicken products to the U.S. The rest of Mexico is still banned to export chicken to the U.S. In other words, the sanitary restriction is assumed to be removed for those states in Mexico that are declared disease free by SAGARPA.

Table 5.4. Prices for Chicken and Chicken Parts, Baseline and Predicted from Removal of TRQ

	United States			Mexico		
	Base	**No TRQ**	**Change**	**Base**	**No TRQ**	**Change**
Product	(U.S. Dollars/ kg)		(%)	(U.S. Dollars/ kg)		(%)
Whole	1.36	1.31	-4	1.19	0.99	-17
White	3.43	3.06	-11	2.31	3.04	31
Dark	0.49	0.63	28	1.45	0.61	-58
Backs	0.35	0.37	7	0.45	0.40	-11

No tariff rate quota (TRQ) scenario reflects free trade from the U.S. to Mexico and U.S. sanitary restriction on Mexican chicken in place.

In Tables presented in this section columns denominated as “Base” indicate the baseline level of prices, production, consumption and trade. Similarly, the columns with the heading “Freer Trade” represent the predicted level of production, consumption, prices and trade as if no TRQ in place and allowing the aforementioned Mexican regions to export chicken to the U.S.

Effects on Chicken Production, Consumption and Trade

Regarding production, by allowing the Mexican regions in northern Mexico to ship chicken to the U.S., the production in these regions would increase because of the opportunity to trade. Table 5.5 illustrates the estimated changes in production by supply region. Total chicken production in the northwest Mexico region would increase by

13%, from the baseline level of 406,000 mt. to 459,000 mt. Similarly, the northeast Mexico region would increase its total production of chicken by a significant 32%, this is an increase from 285,000 mt. to 378,000 mt. The expected increase in production of chicken in the abovementioned regions is due to the opportunity to take advantage of the higher market prices for whole chicken and chicken white meat in the U.S. market. Conversely, the rest of Mexico, which is not allowed to export to the U.S., would face a decrease of 45% in its level of chicken production. The relevance of gains from trade is evident in this case, where the region that is restricted is the one that suffers the most from a production standpoint. By looking at the U.S. supply regions, a consistent 4% to 5% increase in production, compared to the baseline level of production, is expected under the freer trade scenario.

Table 5.5. Total Chicken Production, Baseline and Predicted from Freer Trade Scenario

Region	Baseline	Freer Trade	Change
	(-------------1,000 MT	-----------)	(%)
TEXARK	2,944	3,074	4
SEUSA	7,359	7,686	4
NEUSA	1,472	1,539	5
ROUSA	2,944	3,075	4
NWMEX	406	459	13
NEMEX	285	378	32
ROMEX	1,616	881	-45

Freer trade scenario reflects free trade from the U.S. to Mexico and removal of the U.S. sanitary restriction for the two chicken producing regions in northern Mexico.

As far as changes in level of imports are concerned, the U.S. would be importing more than 800,000 mt. of chicken meat (Table 5.6). U.S. estimated chicken imports include almost 500,000 mt. of whole chicken imported from Mexico (Table 5.7). U.S. imports of whole chicken from Mexico were expected to increase, based on the graphical analysis in Chapter III. In addition, the estimated imports include U.S. imports of chicken dark meat (100 mt.) and of chicken white meat (60 mt.) from Mexico. While U.S. imports of chicken white meat from Mexico were expected in the graphical analysis, the U.S. imports of dark chicken meat from Mexico were not. However, the estimated quantity of chicken dark meat shipped from Mexico to the U.S. is relatively small (Table 5.7).Regarding the expected changes in exports under this scenario, Mexico would have a remarkable increase in exports from the baseline level of exports of 1,180 mt. to 839,000 mt. (Table 5.6). On its behalf, the U.S. would also increase its level of exports by 73%. Table 5.7 illustrates the detailed shipments of chicken and chicken parts between countries.

Effects on Prices for Chicken and Chicken Parts

Under this scenario the price of whole chicken in the U.S. drops by 12%. This change can be explained by imports of whole chicken from Mexico (see Table 5.7 for detailed trade flows). A higher supply of whole chicken would drive prices for this good down.

The price for white meat is forecasted to decrease in the U.S. by 11% compared to the baseline; whereas in Mexico chicken white meat would have a price 31% higher than in the baseline. In a similar way, the changes in prices for dark chicken meat and for chicken backs are not notably different from those obtained under scenario 1. In other words, the price for dark chicken meat in Mexico would decrease by 58%; whereas dark meat in the U.S. would find its equilibrium price at 0.63 U.S. dollars per kilogram, which represents a 27% reduction compared to the baseline price. The final impact on prices of removing the sanitary restriction on the chicken coming from the indicated Mexican supply regions does not differ from the effect of just removing the Mexican TRQ on U.S. chicken. In other terms, given that the chicken industry in Mexico is much smaller than U.S. chicken industry, allowing part of the Mexican chicken production into the U.S. would not have a major impact on prices of chicken products.

Table 5.6. Trade, Production and Consumption, Baseline and Predicted from Freer Trade Scenario

	United States			**Mexico**		
	Base	**Freer Trade**	**Change**	**Base**	**Freer Trade**	**Change**
	(--- 1,000 MT ---)		(%)	(--- 1,000 MT --)		(%)
Imports	0	834	∞	306	1,983	546
Exports	2,145	3,722	73	1.18	839	71,019
Production	14,718	15,374	4	2,307	1,717	-26
Consumption	12,572	12,488	-1	2,432	2,862	18

Freer trade scenario reflects free trade from the U.S. to Mexico and removal of the U.S. sanitary restriction for the two chicken producing regions in northern Mexico.

Table 5.7. Shipments of Whole Chicken and Chicken Parts from Supply Country to Demand Country, Baseline and Predicted from Freer Trade Scenario

Origin	Destination	Type of Meat	Base	Freer Trade	Difference	Diff.
			(---------1,000 Metric Tons----------		)	(%)
U.S.	U.S.	Whole	460.08		-460.08	-100
U.S.	U.S.	White	5,169.22	5,315.60	146.37	3
U.S.	U.S.	Dark	6,825.24	6,652.33	-172.91	-3
U.S.	U.S.	Backs	118.25	50.18	-68.06	-58
U.S.	Mexico	White		359.02	359.01	
U.S.	Mexico	Dark	143.22	1,452.31	1,309.09	914
U.S.	Mexico	Backs	163.68	172.62	8.94	5
U.S.	ROW	Whole	275.85	374.08	98.23	36
U.S.	ROW	White	18.39	26.18	7.79	42
U.S.	ROW	Dark	1,379.25	1,068.87	-310.37	-23
U.S.	ROW	Backs	165.51	268.89	103.38	62
Mexico	U.S.	Whole		469.85	469.8	
Mexico	U.S.	White		0.06	0.06	
Mexico	U.S.	Dark		0.10	0.10	
Mexico	Mexico	Whole	318.77	325.10	6.33	2
Mexico	Mexico	White	670.53	206.33	-464.19	-69
Mexico	Mexico	Dark	1,078.03	329.23	-748.79	-69
Mexico	Mexico	Backs	57.83	17.80	-40.03	-69
Mexico	ROW	Whole	0.17	0.27	0.01	56
Mexico	ROW	White	0.01	0.00	-0.01	-83
Mexico	ROW	Dark	0.99	2.80	1.80	183

Freer trade scenario reflects free trade from the U.S. to Mexico and removal of the U.S. sanitary restriction for the two chicken producing regions in northern Mexico.

Sensitivity Analysis

This sensitivity analysis was conducted to determine the effects of a change in consumer responsiveness to chicken dark meat on levels of production, consumption and trade. The variable that is analyzed is the own-price elasticity of demand for chicken dark meat in Mexico. The reason to conduct this is because the responsiveness of Mexican consumers as a result of changes in the price of dark meat in Mexico is feasible to change. Given a higher availability of chicken dark meat in the Mexican market, the consumers are expected to have a lower level of responsiveness in quantity demanded of chicken dark meat when the price of this product changes. In other words, for this sensitivity analysis, the own-price elasticity of demand for chicken dark meat in Mexico (-0.8) was assumed to change to a less elastic demand (-0.7), then to a -0.6; and finally to -0.5. The sensitivity analysis was conducted assuming the same conditions as presented in the second scenario (Freer Trade), the only changing variable is the own price of elasticity for chicken dark meat in Mexico. For simplicity, in this section the aforementioned variable will be denoted with the symbol ε.

Since the elasticities were not estimated in this thesis, but they were assumed, this sensitivity analysis intends to capture the possible change in elasticity for dark meat in Mexico. According to the literature on elasticities, own-price elasticity of demand for chicken in Mexico varies from -0.207 to -0.649 (Gonzalez Sanchez). Therefore, the elasticities used in this thesis are consistent with previous estimation of own-price elasticity of demand for chicken.

Effects on Chicken Production, Consumption and Trade

By assuming a less elastic demand for dark chicken meat in Mexico, change in ε from -0.8 to -0.5, the following changes were presented for Mexico. Estimated chicken production level in Mexico decreased by 0.13% from 1,717,860 tons to 1,715,619 tons. This marginal reduction is explained by a reduction in the demand for chicken dark meat in Mexico (reduction in ε). Similarly, total consumption of chicken in Mexico decreased from 2,862,450 tons to 2,651,290 tons, which is a 7.38% reduction in the level of consumption compared to the result found in the scenario 2 (freer trade).

Table 5.8. Sensitivity Analysis: Predicted Levels of Production, Consumption and Trade Assuming a Less Elastic Demand for Chicken Dark Meat in Mexico

Country	Chicken Dark Meat Elasticity in Mexico	Production	Consumption	Imports	Exports
		(------------------1,000 Metric Tons ------------------)			
United States	Freer Trade (0.8)	15,374.03	12,480.15	834.12	3,722
	0.7	15,367.99	12,501.92	835.77	3,701.85
	0.6	15,361.89	12,515.88	835.32	3,681.43
	0.5	15,355.68	12,530.04	835.07	3,660.71
Mexico	Freer Trade (0.8)	1,717.86	2,862.45	1,983.78	839.2
	0.7	1,717.12	2,793.04	1,914.78	838.86
	0.6	1,716.37	2,722.66	1,844.81	838.52
	0.5	1,715.61	2,651.29	1,773.85	838.18

Freer trade scenario reflects free trade from the U.S. to Mexico and removal of the U.S. sanitary restriction for the two chicken producing regions in northern Mexico.

The change on imports is the most substantial change found in this sensitivity analysis. In other words, the level of imports is the item that showed the highest percentage change. Compared to the baseline, Mexican imports of chicken are predicted to grow, but more slowly, because demand for chicken dark meat is less elastic. Mexican imports are expected to decrease by 10.58%, from 1,983,780 tons to 1,773,853 tons. This change is explained by a less elastic demand for chicken dark meat in Mexico.The change in ε from -0.8 to -.05 does not significantly change results for the U.S. On production, consumption, imports and total exports, the U.S. had a change by -0.12%, 0.40%, 0.11%, and -1.65%, respectively. For more details see Table 5.8.

Effects on Prices for Chicken and Chicken Parts

First off, changes in ε would have a negligible impact on prices for whole chicken and on price of chicken backs (Table 5.8). Conversely, the prices for chicken white meat and chicken dark meat do change as a consequence of the changes in ε. In Mexico by changing ε from -0.8 to -0.5 the price for dark meat changes from $0.611 to $0.593 per kilogram, which represents a decrease in price by 2.95%. Conversely, this change in ε would cause a change in white meat price from $3.025 to $3.053, change that represents a 0.93% increase in the price of white meat in Mexico given a change in ε. Gradual changes in prices from decreasing ε from -0.8 to -0.5 can be found in Table 5.9, which presents a summary of the effects of the changes in own-price elasticity of demand for chicken dark meat in Mexico on prices of chicken and chicken parts in Mexico and in the U.S. In general, a change in ε would cause minimal changes in other chicken products. In summary, the sensitivity analysis indicates that if the elasticity parameter used in the policy analysis had been overstated, the direction of the effects simulated does not change. These are modest differences in simulated prices in Mexico when lower consumer responsiveness to price of chicken dark meat is used in the simulation.

Table 5.9. Sensitivity Analysis: Predicted Wholesale Prices Assuming a Less Elastic Demand for Chicken Dark Meat in Mexico

Country	Chicken Dark Meat Elasticity in Mexico	Whole	White	Dark	Backs
		(--------------U.S. Dollars per Kg.-------------)			
United States	Freer Trade (0.8)	1.20	3.04	0.63	0.37
	0.7	1.20	3.05	0.62	0.37
	0.6	1.20	3.06	0.62	0.37
	0.5	1.20	3.07	0.61	0.37
Mexico	Freer Trade (0.8)	1.01	3.02	0.61	0.40
	0.7	1.01	3.03	0.60	0.40
	0.6	1.01	3.04	0.59	0.40
	0.5	1.01	3.05	0.59	0.40

Freer trade scenario reflects free trade from the U.S. to Mexico and removal of the U.S. sanitary restriction for the two chicken producing regions in northern Mexico.

CHAPTER VI

CONCLUSIONS

This thesis evaluates the economic impact of modifying trade policy restricting chicken trade between Mexico and the U.S. Gains from trade are expected to benefit both the consumer and producing sectors in North America if trade is liberalized both ways, i.e. removing restrictions to trade in both countries. Two policy changes were analyzed: (1) removal of the Mexican tariff rate quota (TRQ) on U.S. chicken leg quarters, and (2) removal of the U.S. sanitary restriction on Mexican chicken entering the U.S., in addition to TRQ removal.

The Mexican tariff-rate quota (TRQ) on U.S. dark meat has the apparent effect of protecting the Mexican poultry industry by restricting imports of chicken leg quarters from the U.S. The predicted economic impacts of eliminating the Mexican TRQ on the level of chicken production in Mexico are devastating. Based on the results obtained in the first scenario, chicken production in Mexico is estimated to decrease by 51% as a consequence of granting free access to U.S. chicken leg quarters into the Mexican market. In other words, imports of U.S. chicken dark meat would replace Mexican production, particularly the less efficient producers who would not be able to compete because of the lower prices for imported chicken products in general. This estimation is consistent with the prediction conducted by the Union Nacional de Avicultores (UNA, 2003) of Mexico. UNA estimated a decrease in chicken production in Mexico by 30% due to the elimination of the TRQ.

While opening the Mexican market is expected to harm Mexican industry, this change in trade policy would benefit Mexican consumers because they would be able to buy chicken leg quarters at a price 58% lower than the prices observed in 2003. As a consequence, total chicken consumption in Mexico would increase by 18%. As predicted by trade theory, gains for consumers would outweigh the losses for producers in a way that, given trade liberalization, the total welfare for Mexico is maximized.

Regarding the economic impact in the U.S., removal of the TRQ would drive an 8% increase in total chicken production in the U.S. compared to the baseline level of production. Because of this increased level of chicken production in the U.S. the availability of white chicken meat would increase, reducing the price of white chicken meat. The decrease in prices would drive an increase of consumption of this meat. Consequently, consumers in the U.S. would benefit from this policy change by having lower prices of chicken white meat. An increase by 3% in the level of consumption of chicken white meat in the U.S. is expected after the increase in the level of total U.S. chicken production. As a brief summary, due to TRQ removal, U.S. consumers and U.S. producers would benefit from this trade liberalization.

Trade liberalization must be bilateral in order for gains from trade to be fully realized. The second part of the policy scenario includes an examination of the effects from Mexico satisfying U.S. sanitary requirements. The production of chicken in the Mexican regions that are allowed to export to the U.S. would increase, by 13% in the case of the northwest states, and by 32% in the case of northeast states. However, total Mexican production would decrease by 26%. The expected reduction of total chicken production in Mexico is due to the removal of TRQ, combined with not allowing all Mexican regions to export.

On the other hand, chicken production in the U.S. would increase by 4% compared to baseline production level. As a summary, under this scenario producers of chicken in the U.S. and in the northern regions of Mexico experience the benefits of free trade and they can expand the level of production.

Regarding consumption, consumers in both countries are expected to increase their level of consumption of chicken compared to the baseline. Total increase in chicken consumption in by removing the TRQ and the sanitary restriction is similar to that presented in when just TRQ is removed. Consumption of chicken white meat is expected to increase by 3% in the U.S. Similarly, total chicken consumption in Mexico is expected to increase by 18%, compared to the level of consumption as of 2003.

In evaluating the economic impact of removing the Mexican TRQ on chicken leg quarters, chicken production in Mexico would be affected more significantly if the U.S. sanitary restriction is in place, compared to the economic impact of removing the TRQ assuming Mexico is allowed to export chicken to the U.S. (second scenario). Consequently, based on the results obtained in this thesis, if the objective of the Mexican government is to minimize the negative impacts of trade liberalization on the Mexican chicken industry, speeding up the process of fulfilling the requirements imposed by the U.S. government to be allowed to export chicken to the U.S. would be recommended. By doing so, the U.S. sanitary restriction would progress toward eventual removal and thus the Mexican chicken industry would be in a position to take advantage of trade liberalization.

Limitations of This Study and Suggestions for Further Research

One of the objectives of this thesis was to estimate the effectiveness of having the safeguard (TRQ) in protecting the Mexican poultry industry. The year to be evaluated is 2003 because in that year the safeguard (the new TRQ) was negotiated. For this reason, the Mexican TRQ on U.S. chicken leg quarters was removed all at once instead of evaluating the gradual TRQ elimination that is indicated in the tariff reduction schedule agreed in the safeguard (Table 2.4). An opportunity for further research is to forecast levels of production, consumption and trade of chicken for the period 2005-2008, taking into consideration the gradual reduction of the Mexican TRQ on U.S. chicken leg quarters.

An updated description and classification of the Mexican poultry industry, by their size, marketing schemes, and cost structure, is another suggestion for further research. This suggested study could be used to do a qualitative and quantitative estimate of the social impacts from trade liberalization on the Mexican poultry sector.

In this study, costs of chicken production and processing were not estimated from a primary source, but the same cost structure used by Salin, Hahn and Harvey was kept. A suggestion for further research on this topic is a comparative analysis on costs of production and processing for poultry in Mexico and in the U.S.

An evaluation of the likely effects of the recent avian influenza outbreak in northern Mexico is another interesting topic to analyze. The effects of not including the state of Coahuila (which is the state where the outbreak of avian influenza occurred in March 2005) in the list of potential states to export chicken to the U.S., would be a new analysis to be made.

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APPENDIX 1

GAMS OUTPUT SUMMARY ASSUMING FREE TRADE AND NO TRANSPORTATION COSTS

Prices new chicken & part prices by country

	Whole	white	dark	backs
USA .BASE	1.366	3.434	0.497	0.353
USA .ALT	1.209	2.924	0.556	0.348
Mexico.BASE	1.195	2.316	1.458	0.459
Mexico.ALT	0.952	2.924	0.556	0.348

Total chicken production, Base and alternative

	TEXARK	NEUSA	SEUSA	ROUSA	NWMEX	NEMEX
BASE	2943.744	7359.360	1471.872	2943.744	406.135	284.932
ALT	3133.799	7834.494	1566.897	3133.799	664.522	467.028

+	ROMEX
BASE	1616.035
ALT	792.016

Demand for chicken 'parts'

	Whole	white	dark	backs
BASE.USA	460.086	5169.223	6825.247	118.253
BASE.Mexico	318.777	670.536	1221.256	221.523
ALT .USA	465.540	5486.516	7097.328	129.871
ALT .Mexico	334.594	578.960	1814.957	223.948

Simplified supply and utilization table

	Production	Import	Export	Consumption
USA .BASE	14718.720	1.100000E-4	2145.911	12572.809
USA .ALT	15668.988	1131.549	3621.284	13179.254
Mexico.BASE	2307.103	126.170	1.180	2432.092
Mexico.ALT	1923.566	2163.562	1134.667	2952.460

APPENDIX 2

TRANSPORTATION COST ESTIMATES AS PROVIDED BY THE TEXAS TRANSPORTATION INSTITUTE (TTI).

Origin:	Destination	Distance (Miles)	Cost (USD/truckload)
Laredo, TX.	Richmond, VA.	1,606	$2,544.76
	Atlanta, GA.	1,096	$1,748.24
	Los Angeles, CA.	1,366	$2,399.26
	Dallas, TX.	125	$927.12

Origin:	Destination	Distance (Miles)	Cost (USD/truckload)
Laredo, TX.	Mexico City	758	$725.00 NORTHBOUND & $1,200.00 SOUTHBOUND
	Monterrey, NL.	169	$345.00 NORTHBOUND & $385.00 SOUTHBOUND

Origin:	Destination	Distance (Miles)	Cost (USD/truckload)
Culiacan, SIN.	Nogales, SON.	169	$600.00 NORTHBOUND & $900.00 SOUTHBOUND

Origin:	Destination	Distance (Miles)	Cost (USD/truckload)
Nogales, AZ.	Richmond, VA.	2,446	$4,550.92
	Atlanta, GA.	1,973	$3,127.60
	Los Angeles, CA.	674	$1,669.43
	Dallas, TX.	1,433	$2,930.27

APPENDIX 3

PRODUCTION BY STATE IN MEXICO

Chicken meat production by state in Mexico (tons)

	2000	2001	2002	2003
Aguascalientes	95,871	123,788	112,207	121,896
Baja California	297	377	797	1,015
Baja California Sur	284	363	313	342
Campeche	6,989	7,267	7,893	8,448
Coahuila	54,329	55,980	117,551	104,991
Colima	10,319	6,217	7,613	13,544
Chiapas	79,267	110,525	63,666	85,773
Chihuahua	10,258	10,051	6,746	7,296
Distrito Federal	2,077	2,000	2,201	2,173
Durango	76,720	113,349	147,709	182,265
Guanajuato	133,799	135,304	130,797	133,959
Guerrero	13,109	10,372	11,925	13,396
Hidalgo	48,639	46,977	48,556	57,542
Jalisco	218,113	229,038	236,100	232,456
México	141,167	108,593	122,291	122,543
Michoacán	46,393	45,382	44,712	44,093
Morelos	44,257	46,682	45,501	45,994
Nayarit	15,014	16,690	24,921	25,536
Nuevo León	96,315	104,839	119,445	111,455
Oaxaca	5,279	5,436	7,763	7,842
Puebla	149,841	152,445	155,241	155,718
Querétaro	167,049	170,255	181,849	192,654
Quintana Roo	5,090	5,220	4,835	3,575
San Luis Potosí	56,664	56,557	55,335	61,550
Sinaloa	67,842	66,801	83,375	86,521
Sonora	4,807	5,403	5,234	4,928
Tabasco	13,984	23,348	23,159	23,578
Tamaulipas	385	544	562	1,043
Tlaxcala	718	824	871	831
Veracruz	175,494	176,517	228,681	228,288
Yucatán	82,099	88,382	75,226	76,501
Zacatecas	2,780	2,585	2,686	2,622
Total	**1,825,249**	**1,928,022**	**2,075,761**	**2,160,388**

Source: SAGARPA. Junio 2004.

APPENDIX 4

CHICKEN PRODUCTION IN THE U.S. BY STATE

	2001	2002	2003
		----------- 1,000 pounds ------------	
AL	5,138,800	5,361,600	5,404,900
AR	5,737,400	5,812,900	5,842,800
CA	4/	4/	4/
DE	1,494,700	1,544,400	1,507,200
FL	634,200	630,900	511,300
GA	6,236,500	6,452,500	6,302,500
HI	3,700	3,500	2,950
IA	4/	4/	4/
KY	1,292,300	1,403,500	1,489,900
MD	1,381,400	1,376,600	1,374,300
MI	4/	4/	4/
MN	219,500	229,800	228,500
MS	3,826,500	4,078,400	4,188,600
MO	4/	4/	4/
NE	18,000	20,700	22,800
NY	12,200	16,000	14,600
NC	4,202,600	4,411,200	4,320,000
OH	212,500	214,500	225,500
OK	1,111,300	1,140,700	1,115,000
OR	4/	4/	4/
PA	701,200	706,000	686,900
SC	1,049,400	1,080,200	1,144,900
TN	932,000	894,700	948,000
TX	2,714,400	2,881,700	2,947,400
VA	1,330,400	1,301,000	1,299,000
WA	4/	4/	4/
WV	368,200	358,800	357,500
WI	137,700	145,300	154,800
Other 4/	3,697,500	3,993,800	3,868,850
Total 5/	42,452,400	44,058,700	43,958,200

4/ CT, IL, IN, LA, ND, and SD, combined to avoid disclosing individual operations.

Source: ERS USDA. 2004.

VITA

David Magaña Lemus was born in the state of Michoacan, Mexico on May 26, 1977. He grew up in his home town, Puruandiro, where his family owned a diversified farm. David Magaña attended the Agricultural High School in Chapingo, Mexico. In the Fall of 1998, he started college at Universidad Autonoma Chapingo. David wrote an undergraduate thesis and graduated with honors in May 2003 with a B.S. in agribusiness. During his tenure at Chapingo he played college football as a linebacker. In 2000, David obtained the Scholar Athlete Award.

Upon completing his bachelor's degree, he attended Texas A&M University to pursue a Master of Science degree in agricultural economics. He was employed as a Teaching Assistant by the Department of agricultural economics at Texas A&M University. David Magaña Lemus graduated from Texas A&M University in August 2005; then he went back to his country to start a job as Agricultural Policy Analyst for FIRA Banco de Mexico. His permanent address is Ave. 20 de Enero # 66, La Quemada via Puruandiro, Michoacan, Mexico. 58520.