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U.S.-Mexico Broiler Trade: A Bird's-Eye View

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Abstract

Mexico, with its rising middle class, is a growing market for U.S. broilers, especially for dark meat (drumsticks, thighs, deboned leg meat, whole legs, and leg quarters). Broiler trade between the United States and Mexico has been restricted to shipments mainly emanating from the United States, with the United States shipping mostly dark meat to Mexico. This study examines sanitary requirements and regulations currently governing U.S.-Mexico broiler trade. Sensitivity analysis, using a cost-minimization mathematical programming model, detects minimal economic impact on the U.S. broiler market if Mexico is allowed to ship fresh, chilled, and frozen poultry to the United States.

Keywords: United States, Mexico, poultry, broiler, trade, sanitary and phytosanitary (SPS) regulations, sanitary measures, nontariff trade barriers (NTBs), trade barriers, North American Free Trade Agreement (NAFTA), white meat, dark meat, mechanically deboned meat (MDM), whole birds, exotic Newcastle disease (END), avian influenza (AI).

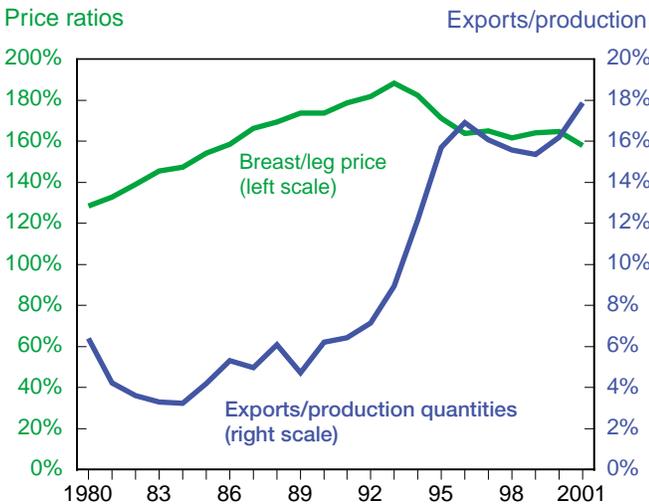
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Background

Domestic broiler consumption in the United States is predominantly of white meat. In contrast, dark meat (drums, thighs, deboned leg meat, whole legs, and leg quarters) is preferred by consumers in most foreign markets, including Mexico. Foreign demand for dark meat has increased since the early 1990s, narrowing the price difference between white and dark meat (fig. 1). Breast meat, also called white meat, normally sells at a higher price than dark meat in the United States and Canada. Over the last 5 years, breast-bone-in meat has sold for, on average, about 80 cents per pound more than leg quarters. Chicken breasts represent slightly more than one-third of the bird's dressed weight, but they are worth two-thirds more than leg quarters (figs. 1 and 2).

Figure 1
Annual broiler price and quantity ratios, 1980-2001

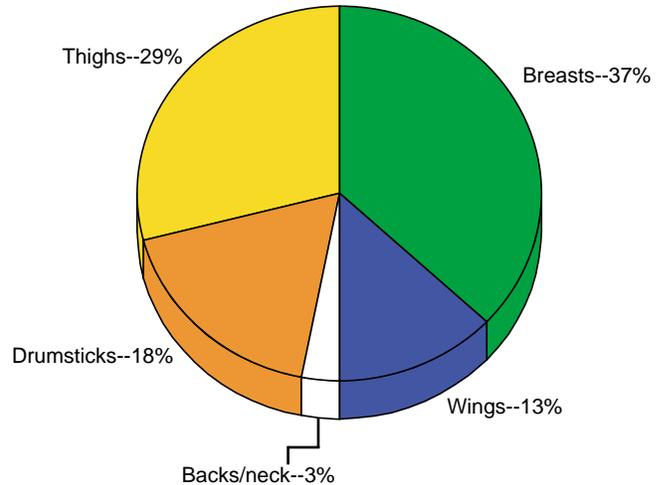


Exports include chicken feet.

Source: Economic Research Service, USDA.

Consumer preference in the United States for white poultry meat has been bolstered by marketing efforts by the poultry industry to convince consumers that white meat is a premium cut with low fat content, in keeping with a healthier diet. In addition, white chicken meat is relatively inexpensive compared with U.S.

Figure 2
Breast meat represents more than one-third of the whole chicken carcass weight, 2001



Source: Economic Research Service, USDA.

beef and pork. Moreover, white meat allows versatility in cooking, making it attractive to a population with diverse culinary preferences. Strong U.S. demand for white meat has enhanced opportunities both in the United States and abroad for value-added products from dark meat, such as ground chicken, chicken hot dogs, chicken sausages, chicken patties, and other fabricated dark meat products.

White and dark meat are produced in naturally fixed proportions in poultry production. This means that in producing and processing white meat, dark meat is generated, sometimes in more abundance than desired, given U.S. preferences. This has resulted in a condition referred to by T. O'Keefe as the "White-Dark Conundrum." These fixed proportions can differ in a given market from consumer preferences, which influence trade patterns. Mexico offers a unique market niche for addressing aspects of the white-dark conundrum. Due to its proximity and rising middle class, along with its consumer preference for dark meat, Mexico is an ideal trading partner for the U.S. broiler industry.

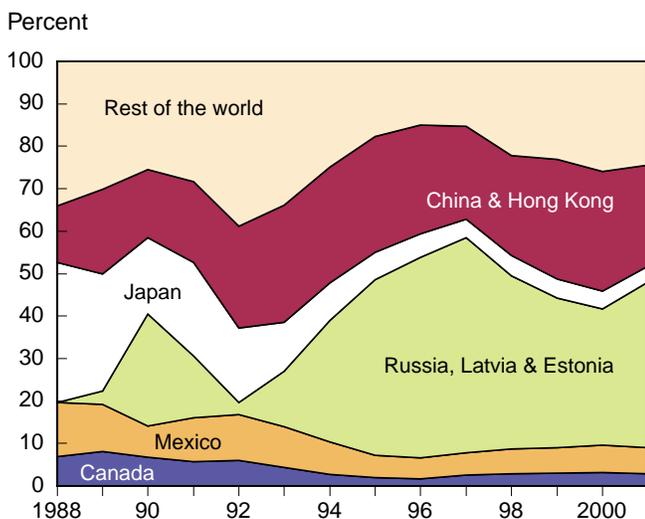
Mexico: World's Third Largest Market for Broiler Exports

Since 1997, eight countries have accounted on average for about 76 percent of total U.S. broiler exports,¹ in volume and value. In terms of volume, Russia, Latvia, and Estonia combined represent the largest market for U.S. broiler exports (fig. 3), followed by China (including Hong Kong), Mexico, Japan, and Canada. In 2001, total broiler exports to Mexico amounted to 381 million pounds, valued at \$119 million, making it the third largest market for U.S. broiler exports by volume. This is an increase of 9 percent in quantity from the previous year and 88 percent more than in 1995, when the North American Free Trade Agreement (NAFTA) went into effect.

U.S. broiler exports to Mexico are concentrated mostly in lower-valued products such as leg quarters, ground chicken, and mechanically deboned meat (MDM). Fresh parts accounted for 44 percent of total broiler meat exported from the United States to Mexico in 2001 (fig. 4). Because fresh meat has a short shelf life, the United States exports fresh broiler meat mainly to nearby markets in the Western Hemisphere.

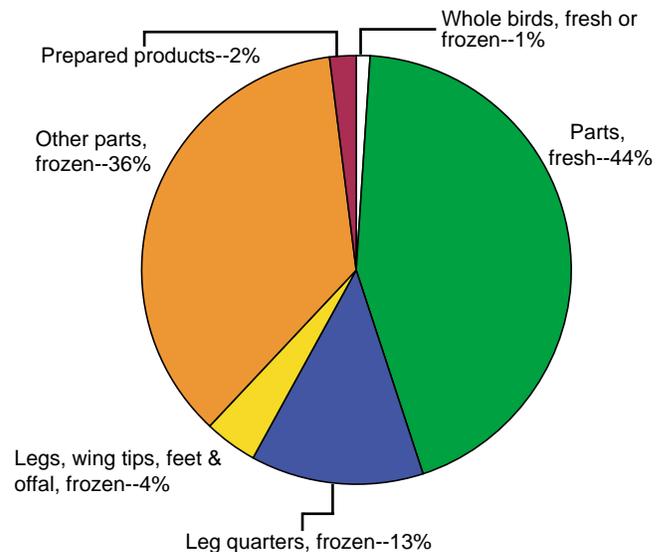
¹ Including chicken feet.

Figure 3
Mexico is the third largest U.S. broiler export market by volume



Source: Economic Research Service, USDA.

Figure 4
Fresh parts accounted for 44 percent of U.S. exports to Mexico, 2001



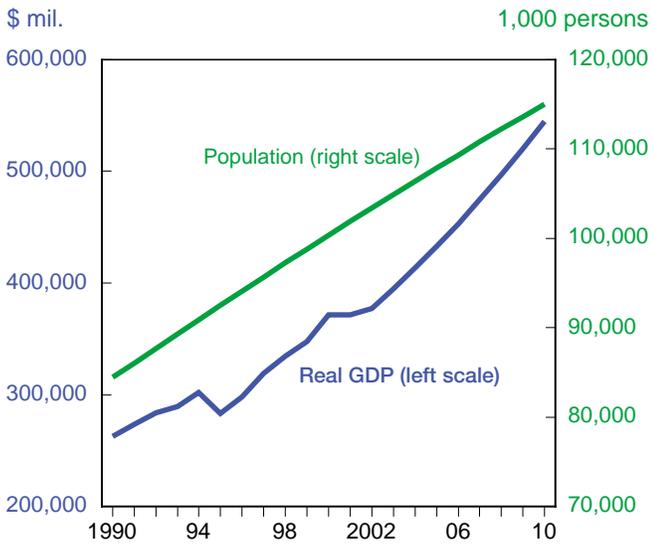
Source: Economic Research Service, USDA.

Mexico's real GDP in 2000 was almost \$372 billion (1990 dollars) and is expected to rise to nearly \$545 billion in 2010 (USDA, 2002). The rate of growth of per capita GDP accelerated from just under 2 percent over the last decade to over 3 percent in 2002. Although Mexico's total population is predicted to reach almost 115 million by 2010, the rate of growth will be slower than in the previous decade (figs. 5 and 6), transforming the age structure of the Mexican population.

In general, as income increases above subsistence levels, consumers diversify their diets and purchase more meat and dairy products along with processed products (USDA, 2001). It is expected that a shift toward a greater proportion of meat protein will occur in Mexican diets as the country's economic development takes place. Mexico shows great potential for further growth in broiler consumption. Geographic location and a liberalization of trade restrictions due to NAFTA, along with strong consumer demand for dark poultry meat products in Mexico, make the Mexican market attractive for U.S. poultry producers.

Figure 5

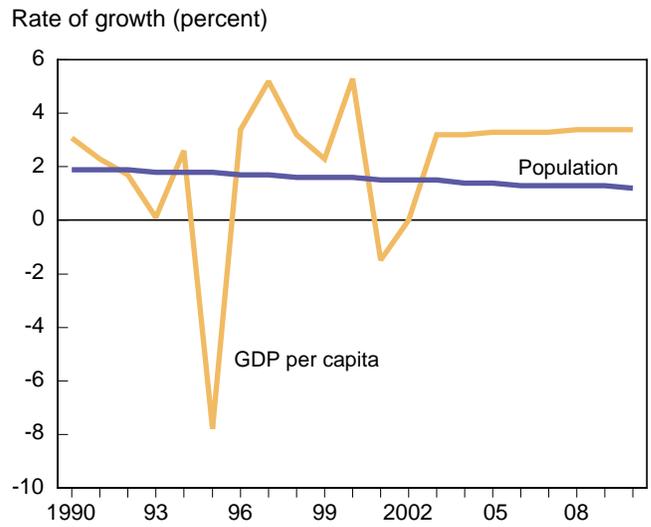
Mexican real GDP is expected to increase by almost 47 percent in the next decade



Source: Economic Research Service, USDA.

Figure 6

Mexico's GDP per capita rebounds while population growth rate decreases



Source: Economic Research Service, USDA.

Economics Underlying U.S.-Mexico Broiler Trade

The profitability of chicken processing depends on the difference between the total sales value of meat products and byproducts and the costs of raising, slaughtering, and processing. The value of white meat parts relative to dark meat parts is not determined only by the supply side of the market; consumer demand ultimately determines the relative value of the parts.

The different poultry preferences in Mexico and the United States can be advantageous to both trading partners. The U.S. market places a much higher premium on white meat. Even if U.S. and Mexican producers could provide whole chickens at the same cost, differences in each country's consumer tastes could complement its poultry production. This would lead to opportunities for profitable trade in chicken parts in both countries. Furthermore, as chicken parts are jointly produced, differences in tastes can drive trade even if there are no differences in overall costs.

Sanitary regulations in the poultry industry are nontariff trade barriers (NTBs) that restrict trade flows of poultry parts and products for health and safety reasons. These rules, regulations, and standards play an important role in determining the poultry trade between the United States and Mexico. After the expi-

ration of the tariff and quota restrictions allowed under NAFTA on December 31, 2002, NTBs to U.S.-Mexican poultry trading will still prevail and affect trade. Since October 1999, Mexico has been eligible to export processed poultry (for example, canned or cooked) to the United States, but not freshly slaughtered poultry products.

At present, Mexico is petitioning USDA's Food Safety and Inspection Service (FSIS) <<http://www.fsis.usda.gov/index.htm>> for certification to export fresh, chilled, and frozen poultry to the United States (USDA, FSIS, International Policy Staff, 2002). In addition, Mexico requested that the Animal and Plant Health Inspection Service (APHIS) <<http://www.aphis.usda.gov/>> consider additional Mexican states to be declared relatively low risk of transmitting exotic Newcastle disease (END) (USDA, APHIS, National Center for Import and Export, 2002). Changes in the eligibility of Mexico poultry exports might result in potentially different trade patterns between the United States and Mexico. This study presents in a nutshell the sanitary requirements and regulations currently governing poultry trade between the United States and Mexico and then analyzes the possible economic impact if Mexico is allowed to ship fresh, chilled, and frozen broiler products to the United States.

United States Sanitary Regulatory Environment

Sanitary and phytosanitary (SPS) measures are impediments to trade, affecting both its flow and magnitude. Therefore, it is crucial to understand the poultry sanitary regulations that govern U.S.-Mexico poultry trade in order to comprehend this unique situation and to assess the economic impacts of changes in trade flows.

The U.S. Department of Agriculture (USDA)² <<http://www.usda.gov>> is responsible for providing the Nation with safe and affordable food. Within this

mission, the agency's responsibilities have been divided, with APHIS responsible for protecting America's animal and plant resources, while FSIS is charged with protecting public health by regulating meat, poultry, and egg products. Broiler trade between the United States and Mexico has been restricted to shipments mainly emanating from the United States. Low production costs for broilers in the United States, high demand for dark poultry meat in Mexico, and animal diseases and food safety regulations in both countries contribute to this one-way flow of goods.

² *The Food and Drug Administration* protects public health and regulates food, medical devices, biologics, animal feed, and drugs, cosmetics, and radiation-emitting products, but is not covered in this study.

Infectious Avian Diseases that Constrain Poultry Trade

The International Organization for Epizootics (OIE) classifies transmissible animal diseases into two lists, A and B. List A contains “the list of transmissible diseases which have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products.”

List B includes “the list of transmissible diseases which are considered to be of socio-economic and/or public health importance within countries and which are significant in the international trade of animals and animal products.”

Newcastle disease (ND) and highly pathogenic avian influenza (HPAI), described below, are two highly infectious diseases that restrict poultry trade.

Newcastle disease is a contagious viral infection, often causing fatal respiratory and nervous disorders in fowl. The virus is readily transmitted by contaminated equipment or clothing and frequently all birds in a flock become infected within 3 to 4 days after exposure. This respiratory disease begins with nasal discharge, breathing difficulty, gasping, and sneezing. In younger birds, these symptoms may be followed by nervous symptoms such as wing and leg paralysis and head and neck twisting. Nervous disorders are rare in older birds, and in turkeys the symptoms are less severe.

Newcastle disease is caused by different strains of a virus. The milder strain causes “mesogenic” Newcastle disease, whereas the most severe strain causes viscerotropic velogenic Newcastle disease, more commonly referred to as “**exotic Newcastle disease (END)**.” According to APHIS, “END is probably one of the most infectious diseases of

poultry in the world.” This disease is so virulent that many birds die without showing any clinical signs. Bird death rate can occur at almost 100 percent in unvaccinated poultry flocks; it can infect and cause death even in vaccinated poultry. There is no treatment for Newcastle disease. However, repeated vaccination of young chickens is the recommended method for preventing its spread. For more information, see the Web sites of the Animal and Plant Health Inspection Service (APHIS) <<http://www.aphis.usda.gov/oa/pubs/avianflu.html>> and the Mississippi State University Extension Service <<http://msucares.com/poultry/diseases/diseases.html>>.

Avian influenza is a virus that can infect all fowl. There are many strains of the virus, which are classified as low pathogenic (LPAI) or highly pathogenic (HPAI) based upon the severity of the illness that they cause. Some LPAI viruses can mutate into highly pathogenic forms under field conditions. HPAI is extremely infectious and often fatal, striking quickly without any early warning signs. Once established, it spreads rapidly. Infected birds show signs of nasal discharge, coughing, sneezing, diarrhea, decreased egg production, lack of energy and appetite, or sudden death without clinical signs.

The disease is spread by direct contact among the birds, as well as from contaminated equipment and clothing. Migratory fowl have often been implicated as carriers of the virus. Thorough cleaning and decontamination of all facilities, equipment, and clothing, as well as quarantine measures, are the recommended means of preventing the spread of this highly contagious disease. For additional information, see the Animal and Plant Health Inspection Service (APHIS) <<http://www.aphis.usda.gov/oa/pubs/avianflu.html>>.

OIE Classification of Poultry Diseases, 2002

List A-major importance in the international trade of animals and animal products	List B-significant in the international trade of animals and animal products
Highly pathogenic avian influenza	Avian infectious bronchitis
Newcastle disease	Avian infectious laryngotracheitis
	Avian tuberculosis
	Duck virus hepatitis
	Duck virus enteritis
	Fowl cholera
	Fowl pox
	Fowl typhoid
	Infectious bursal disease (Gumboro disease)
	Marek's disease
	Avian mycoplasmosis (<i>M. gallisepticum</i>)
	Avian chlamydiosis
	Pullorum disease

Source: International Animal Health Code, 10th edition-2002, International Organization for Epizootics (OIE) <http://www.oie.int/eng/normes/mcode/a_summry.htm>.

APHIS Requirements

To be in compliance with international trade agreements, APHIS has developed standards for protecting the Nation’s animal and plant resources by regulating imports on a regional basis rather than on country-based import restrictions. END,³ the primary poultry disease affecting Mexican exports to the United States, is considered by APHIS to exist in all but 18 regions of the world (table 1).

Any poultry carcasses or products of poultry carcasses that originate in a free-of-END region (table 1), but are processed (cut, packaged, and/or cooked) in a region where END exists, are subject to the restrictions summarized in table 2. Therefore, if at any time in the originating or processing of birds or poultry products are exposed to a disease-existing region, the carcasses are restricted as if they originated from a region not eligible to export fresh meat.

In 1997, APHIS amended its regulations to recognize disease-free regions or zones within a country or to apply restrictions to those zones to mitigate risk from disease transmission. The zones are defined after an evaluation of the risk by APHIS. APHIS has evaluated the Mexican states of Sonora and Sinaloa and consid-

ers the risk from END transmission from these regions to be relatively low. Moreover, APHIS has identified restrictions that are sufficient to mitigate risk from fresh poultry meat (table 3). As can be seen, the rules are specific and confine the rearing of birds destined for the United States, as well as their slaughter, to Sinaloa and Sonora. If those regions comply with APHIS restrictions and Mexico becomes eligible to export fresh poultry to the United States, Mexican processors in these two states can export fresh, chilled, and frozen poultry meat to the United States.

Poultry product shipments from Mexico to the United States are subject to APHIS co-mingling rules. Co-mingling rules require that the processing plants in Sinaloa and Sonora be shut down, cleaned, and disinfected both before and after the processing of any poultry products that originate in other states and are to be shipped to the United States. In addition, any meat sold in the United States must be inspected by FSIS to certify that it meets U.S. safety requirements. Currently, there are five poultry processing plants in Mexico that are certified by the Government of Mexico to export to the United States (fig. 7). These plants can export processed (can or cooked) poultry products only from birds that are either slaughtered in the United States or in another country approved to export slaughtered poultry to the United States.

³ Other import regulations (in either the United States or Mexico) regarding contamination of poultry products with food-borne human pathogens such as *Salmonella enteritidis* and *Salmonella typhimurium* (neither contained in List A or B) are not discussed in this study.

Table 1—Regions declared by APHIS to be free of exotic Newcastle disease (END)

Regions	Disease-free countries
Europe	Denmark, Finland, France, Great Britain (England, Scotland, Wales, and the Isle of Man), Greece, Iceland, Luxembourg, Republic of Ireland, Spain, Sweden, Switzerland.
Others	Australia, Fiji, New Zealand, Canada, Chile, Costa Rica, United States.

All other regions are considered to contain these pathogens.

Source: National Archives of Records Administration, Code of Federal Regulations, Title 9, Vol. 1, Chapter 1, Section 94.6, January 1, 2002.

Table 2—APHIS guidelines for shipment of all poultry and poultry products to the United States: Origin in disease-containing regions or exposure to disease-containing regions

Description	Requirements
Shipment to approved establishments	<p>Shipment of eviscerated game birds with heads and feet removed is allowed.</p> <p>Carcasses or products of poultry and game birds can be shipped to any museums, educational institutions, or other establishments that have demonstrated that they can properly process and disinfect material.</p> <p>Poultry and game bird carcasses, parts, and products can be shipped if sealed in airtight containers and commercially cooked after packing to insure shelf stability without refrigeration.</p> <p>Carcass, parts or products of poultry, game birds or other birds may be imported if thoroughly cooked and if inspected by a USDA representative at the port of arrival.</p> <p>Poultry originating in a Newcastle disease-free area but processed in a disease-existing area can be imported if shipped in sealed containers that show no sign of tampering and are accompanied by an authorized certification.</p> <p>Poultry products can be prepared only in approved establishments.</p>
Handling	<p>Processing facilities in regions where END exists:</p> <ul style="list-style-type: none"> -May not receive or handle live poultry. -Must keep records that are available to USDA inspectors. -May process carcasses or parts if: <ul style="list-style-type: none"> ● All utensils used in processing are cleaned and disinfected between processing poultry from END regions and END-free regions. ● Products destined for the U.S. are kept separate and not co-mingled during processing. ● U.S.-destined exports are packed in clean, new packaging. ● There is proper certification that no cross contamination has occurred.
Cooperative Service Agreement	<p>Whereby operators of processing facilities pay all expenses incurred by APHIS in inspecting the establishment. APHIS anticipates that inspections will occur once a year.</p>
Shipment to the U.S.	<p>Shipments from the region where the product was processed must be in closed containers sealed with serially numbered seals applied by an official of the national government of that region.</p>

Source: National Archives of Records Administration, Code of Federal Regulations, Title 9, Vol. 1, Chapter 1, Section 94.6, January 1, 2002.

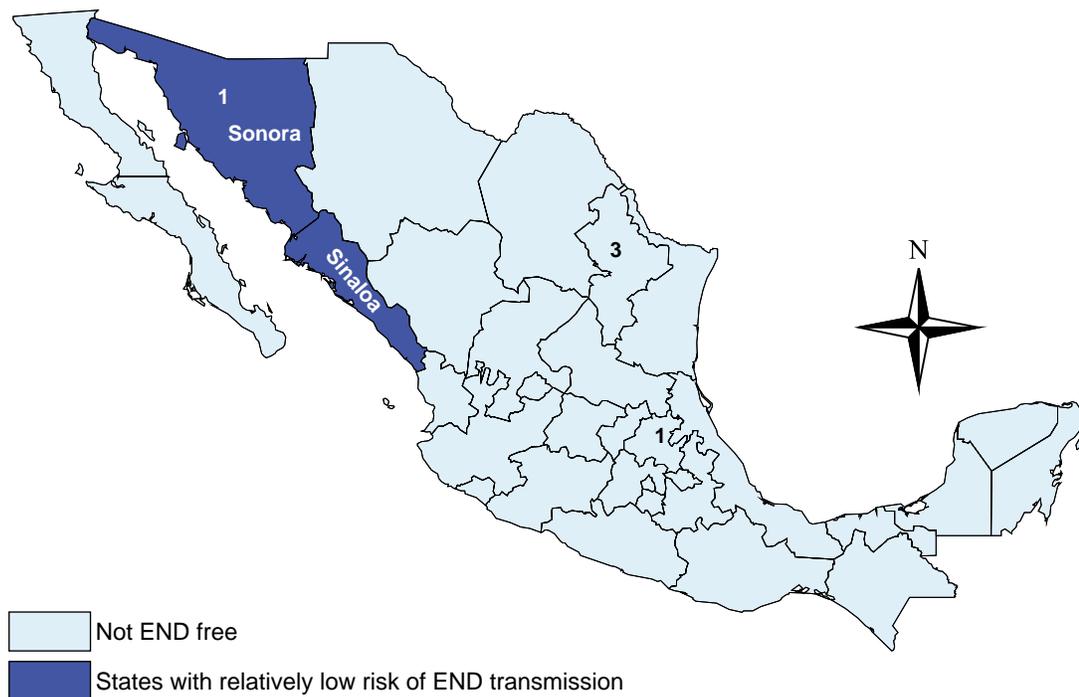
Table 3—APHIS guidelines for importing poultry meat and products from Mexico to the United States

General requirements	Specific requirements
<p>Poultry meat and products must be derived from birds born and raised in Sinaloa or Sonora, Mexico:</p>	<ul style="list-style-type: none"> ● Must be slaughtered, and if processed, in Sinaloa or Sonora, Mexico. ● Slaughter plant must be federally inspected. ● Slaughter must be under supervision of Mexican Government veterinarian. ● Slaughter plant must be approved to export to the United States. ● Poultry products must be processed in federally inspected processing plants in Sinaloa or Sonora, Mexico under the supervision of a full-time salaried Mexican Government veterinarian. ● Poultry meat or products must not have been in contact with poultry from any state in Mexico other than Sinaloa or Sonora. ● Poultry product shipments to the United States shall not pass through any state in Mexico other than Sinaloa or Sonora unless shipping containers bear intact serially numbered seals applied at federally inspected slaughter plant by Mexican Government veterinarian.

Source: National Archives of Records Administration, Code of Federal Regulations, Title 9, Vol. 1, Chapter 1, Section 94.6, January 1, 2002.

Figure 7

Number of poultry plants eligible for export of processed poultry to the United States* and Mexican States with low risk of transmitting exotic Newcastle disease (END)**



*USDA, FSIS--International Policy Staff, Personal Communication, August 26, 2002.

**Code of Federal Regulations, Title 9, Vol. 1, Chap. 1, Section 94.22, January 1, 2002.

Source: Economic Research Service, USDA.

FSIS Requirements

Countries can request eligibility from FSIS to export fresh, chilled, and frozen poultry meat to the United States at any time, but have to meet both FSIS and APHIS requirements. The FSIS equivalence evaluation process to determine eligibility to export (processed or fresh) meat or poultry to the United States involves two steps, a document review and an onsite review (table 4).

The document review assures FSIS that critical points in the five risk areas (sanitation, animal disease,

slaughter, residues, and enforcement) are addressed satisfactorily by the foreign government. If this first step shows the country's system is satisfactory, a technical team from FSIS visits the country to assess first-hand its eligibility to export meat or poultry to the United States. After FSIS determines that the country's inspection system is equivalent to the U.S. inspection program, in the case of fresh, chilled, and frozen poultry meat, a U.S. rule is written and the country is certified as eligible to export fresh poultry meat to the United States.

Table 4—FSIS steps to determine country eligibility to export fresh and cooked meat and poultry to the United States

Steps
1. Countries make a formal written request to the International Policy Staff, FSIS,USDA.
2. Evaluation of a country inspection system: <ul style="list-style-type: none">● Document review: Evaluation of country's laws, regulations, and other written information to assure critical points in the five risk areas (contamination, disease, processing, residues, and compliance and economic fraud) are addressed satisfactorily with respect to standards, activities, and resource allocation.● Onsite review: Technical team from FSIS visits the country to evaluate the five risk areas as well as other aspects of the inspection system, including plant facilities and equipment, laboratories, training programs, and in-plant operations, to assess country's eligibility to export meat or poultry to the United States.● FSIS writes the rules recognizing the country to be eligible to export meat to the United States.
3. FSIS reviews inspection in eligible countries to assure they continue to meet U.S. requirements. Review frequency of each exporting country is a minimum of one per year, but it may be more, based on the country's performance history.

Source: Food Safety and Inspection Service, USDA. *Importing Meat and Poultry to the United States: A Guide for Importers and Brokers*. Online version updated December 1998. Personal communication, International Policy Staff, August 26, 2002.

Mexico Sanitary Regulatory Environment

The sanitary conditions required for exporting whole birds, parts, and processed poultry products from the United States to Mexico are summarized in table 5. The table shows that the Mexican government has instituted a series of specific regulations to insure that poultry meat products entering Mexico are disease free.

An additional special permit (table 6) from the “Dispositivo Nacional de Emergencia en Salud Animal (DINESA)” is required with regard to avian influenza for movement of birds into the interior of Mexico, before a shipment of poultry products and parts is permitted to enter Mexico. Moreover, when entering Mexico, vehicles carrying the imported products must:

- Have their containers securely fastened by means of a steel band if the cargo has to transit regions in which the disease is under control or is in the process of eradication with vaccination.
- The vehicle and its containers must be washed and disinfected in the exterior before entering a disease-free zone or one that is in the process of eradication.

- The steel bands must be removed at the final destination by an officer of the “Secretaría de Agricultura, Ganadería y Desarrollo Rural, Pesca y Alimentación (SAGARPA)” or by a certified veterinarian.

Tables 5 and 6 show that the Mexican government has in place regulations governing the safety of poultry meat products being imported into the country, comprising a set of strict rules and regulations as well as specific guidelines to insure product safety. More information regarding Mexico’s meat and poultry export requirements can be found in the FSIS Library of Export Requirements <<http://www.fsis.usda.gov/OFO/export/explib.htm>>. Producers, processors, and shippers on both sides of the border must work within these regulations set up by the United States and Mexico in order to carry out cross-border poultry commerce that could enhance trade options for both countries.

Table 5—SAGARPA guidelines for importing poultry meat products (whole bird, parts, residuals, or processed birds) from the United States to Mexico

General requirements	Specific requirements
Presentation of an official certificate issued by the U.S. Department of Agriculture that indicates:	<p>Products originated from federally inspected plants inspected before and after slaughter (NOM-005-ZOO-1993).</p> <p>Meat is certified to be free of END (NOM-013-ZOO-1994).</p> <p>Meat is suitable for human consumption.</p> <p>The product originated from a lot in which 35 END serial random samples were withdrawn, resulting in a negative result using the “gel agar precipitation test.”</p> <p>During slaughtering and processing, poultry products were not mixed with birds or meat that were not covered by the previous requirements (NOM-044-ZOO-1995).</p> <p>Poultry products must be packed in cardboard boxes (NOM-044-ZOO-1995).</p> <p>Vehicles and containers must be cleaned and disinfected before shipment (NOM-044-ZOO-1995).</p> <p>Shipments must originate in plants certified by the National Direction of Animal Health, SAGARPA.</p> <p>Personnel from the Animal and Plant Sanitary Inspection Office, in compliance with the NOM-030-ZOO-1995, must inspect shipments in an establishment authorized to export to Mexico.</p>

Source: Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), Secretaría de Agricultura, Ganadería y Desarrollo Rural, Pesca y Alimentación (SAGARPA), Mexico. October 11, 2001.

Table 6—SAGARPA requirements for shipping imported poultry meat products from the United States to or within Mexico

Source/final destination	Permit required
Originated from a region in the process of eradication with vaccination to a disease-free region or a region in the process of eradication.	X
Originated from a region in the process of eradication to a disease-free region or in the process of eradication, but has to go through a region in the process of eradication with vaccination.	X
Originated from a disease-free region to a disease-free region or one in the process of eradication, but has to travel through a region in the process of eradication with vaccination. This is also applicable to land transfers between airplanes or airports.	X

Source: Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), Secretaría de Agricultura, Ganadería y Desarrollo Rural, Pesca y Alimentación (SAGARPA), Mexico. October 11, 2001.

Policy Changes and Trade Implications

What will happen to U.S.-Mexican poultry markets once Mexico is allowed to ship chicken products from its low-risk-of-END-transmission states to the United States? Currently, the United States ships large volumes of poultry meat to Mexico, consisting mostly of MDM and dark meat. Conclusions can be drawn about relative differences in chicken and chicken product prices based on existing trade flows. Given the trade pattern in which products flow from where they are relatively cheap to where they are relatively expensive, one would expect Mexican poultry prices for dark meat to be higher than those in the United States. With relatively high poultry prices, the only fresh, chilled, and frozen poultry meat that Mexico could export to the United States, as long as Mexican plants meet U.S. import standards, would be those that fill special *niche* markets. However, some chicken parts, for instance white meat, may be cheaper in Mexico than in the United States, making them candidates for shipment north.

Since the traded items consist of wholesale chicken and chicken products, the prices to compare are the two countries' wholesale prices. The USDA's Agricultural Marketing Service (AMS) publishes a large number of U.S. wholesale chicken and chicken product prices. AMS also publishes prices obtained from Mexico regarding Mexican wholesale market prices and then transforms these prices from pesos per kilogram to dollars per pound. Mexican prices for whole-birds are generally similar to U.S. whole-bird prices, while the prices of parts tend to be much higher than U.S. prices.

The concept of "wholesale" prices differs between the two countries. U.S. wholesale prices are, for the most part, those paid to the chicken processor. However, the Mexican wholesale market is an actual location where Mexican producers and importers deliver products to be bought by Mexican retailers. Therefore, Mexico's wholesale market prices are further up the marketing chain than the U.S. prices, and, accordingly, could reflect more transport and handling costs.

Mexico imports much more MDM than it produces. The production of MDM in the United States is largely the byproduct of boneless-cut production⁴ and is used in both countries in luncheon meats and sausages, as well as in "ham" in Mexico. The MDM that Mexico imports competes, at best, indirectly with Mexican poultry production. It is expected that allowing Mexican plants to ship fresh, chilled, and frozen poultry to the United States will have negligible effects on the MDM component of U.S.-Mexican poultry trade. The low price of whole chickens in Mexican wholesale markets gives evidence that Mexican poultry producers and processors can compete with the United States in the production of whole birds. It is also apparent that U.S. dark meat and MDM are attractively priced relative to Mexican products.

⁴ U.S. wholesale MDM prices are generally lower than the wholesale chicken part prices, except for back and necks. MDM is produced as a way of recovering value from otherwise unusable parts.

Predicting Broiler Market Impacts: Model and Results

The potential effects of allowing the relatively low-risk-of-END-transmission Mexican states to ship poultry to the United States were evaluated using a product market model of the United States and Mexican poultry industries. The model captures the economics of production and marketing under different trade patterns, and it also incorporates different SPS measures affecting U.S.-Mexico chicken and chicken-product trade. In addition, it can be modified to incorporate changes in sanitary policies.

The model is a mathematical programming model, with a structure similar to the North American Trade Model for Animal Products (NATMAP), (Hahn, 1993) of the North American animal product market.

Products included in the model are whole chickens, white meat, dark meat, and other chicken products, including backs, necks, and MDM. The model maximizes economic surplus⁵ and solves for production, trade flows, and prices for all these products. The cost minimization equation is defined as follows:

$$\text{Minimize Cost} = \sum_{i,j} S_{i,j,k} * TC_{i,j,k} + \sum_i [F_i(L_i) + G_i(W_i, C_i)] - \sum_{l,k} H_{l,k}(X_{l,k}) + \sum_j O_j$$

where:

$S_{i,j,k}$ is the shipment from producing region “i” to consuming region “j” of chicken product (whole birds or cuts) “k”,

$TC_{i,j,k}$ is the cost of shipping chicken product k from region i to region j,

L_i is the number of live birds produced in region i,

$F_i(L_i)$ is a regional cost function for raising live birds in region i,

W_i is the number of birds produced in region i for sale as whole birds,

C_i is the number of birds cut up for parts in region i,

$G_i(W_i, C_i)$ is a regional cost function for bird slaughter and processing,

X_{lk} is country “l” exports (outside the United States and Mexico) of chicken product k,

$H_{l,k}(X_{l,k})$ is a function calculating the net surplus earned from exporting chicken (the net surplus is a benefit and is treated as a cost reduction), and

O_j measures the total effect that chicken-price changes have on the consumer cost of living. Increases in chicken prices increase the cost of living, and decreases in chicken prices decrease it. Increases in the cost of living are costs, and decreases are savings.

As noted, there is a great deal of uncertainty about the relative competitive position of Mexican and U.S. chicken products. A wide range of assumptions about price relationships and other economic variables were incorporated into the model, including a range of assumptions about price relationships and economic parameters. One of the goals of this modeling exercise was to identify critical factors that determine the effects of policy changes. At present, demand preferences in the two countries make poultry markets complementary. However, in the future the two markets might become competitive, given Mexico’s lower production costs.

All scenarios were based on the following assumptions: (1) it is economically feasible to ship dark meat to Mexico, but not whole birds; (2) it would be profitable to ship white meat north to the United States from Sinaloa and Sonora, Mexico, but not whole birds; (3) in the long run, additional states in Mexico are recognized as relatively low risk of END transmission by APHIS; (4) Mexico is certified by FSIS as eligible to export fresh, chilled, and frozen poultry to the United States; and (5) the cost of Mexican plants obtaining FSIS certification is negligible on a per bird basis.

Assumption (1) matches current reality, whereas assumption (2) was added to allow for some impact of relatively low-risk-of-END-transmission state shipments to the United States. Unless some Mexican products are competitive in the United States, the policy change will have no effect on the markets. Assumptions (3) and (4) are based on Mexico’s

⁵ Technically, it minimizes the costs of producing and moving chicken around and between the United States and Mexico subject to a consumer utility constraint. Proofs of the equivalency of these two approaches can be found in Hahn, 1993.

requesting that additional states be recognized by APHIS as relatively low risk of END transmission and be certified by FSIS to export fresh, chilled, and frozen poultry to the United States.

The most important factor driving potential market changes is the difference between U.S. and Mexican chicken product prices. The lower the price of white meat in Mexico relative to the United States, the larger will be the effect on trade flows of allowing low-risk states to ship poultry north. The next most important factor is the chicken production capacity and ability to expand of low-risk-of-END-transmission states.

To determine the economic impact of allowing Sinaloa and Sonora to export fresh, chilled, and frozen poultry to the United States, two scenarios were developed:

- Scenario 1: the baseline, representing current conditions in which Sinaloa and Sonora are recognized as relatively low risk of END transmission but are not certified as eligible to export fresh, chilled, and frozen poultry to the United States.
- Scenario 2: Sinaloa and Sonora are certified to export fresh, chilled, and frozen poultry to the United States.

Total Mexican chicken production is approximately 13 percent of U.S. production. In 2000, Sinaloa and Sonora accounted for about 4 percent of total Mexican broiler production (SAGARPA-SIAP, 2001). Because chicken production in Sinaloa and Sonora is small

compared with that of the United States, allowing these states to export products to the United States will have little effect on the U.S. poultry market (scenario 2). If the two states can greatly expand their production, it would still have little effect on U.S. prices. Shipments of white meat to the United States may have a minor effect on U.S. chicken prices. These small price changes will cause only slight changes in U.S. poultry production (tables 7 and 8).

To analyze the economic impact of having more Mexican states join the low-risk group eligible to ship to the United States, an additional set of four sensitivity scenarios (scenarios 3-6) were incorporated. In these scenarios, two additional assumptions were considered: (1) Mexican poultry production has the capacity to expand greatly (this maximizes the effects of allowing Mexico to export fresh, chilled, and frozen poultry), and (2) Mexico has no real cost advantage in chicken processing over the United States. The scenarios allow different percentages of Mexican production to be shipped from relatively low-risk-of-END-transmission states, as follows:

- Scenario 3: 15 percent of total Mexican production—this quantity is produced in Sinaloa, Sonora, and one of the following states as they are recognized as relatively low risk of END transmission: Veracruz, Jalisco, Puebla, Guanajuato, Querétaro, and Mexico. Each of these states accounts for between 8 to 12 percent of national poultry production.

Table 7—Sensitivity analysis: Predicted wholesale prices with expansion of low-risk-of-END areas of Mexico

Country	Scenarios ¹		Whole birds	White meat	Dark meat	MDM
	----- Dollars per kg -----					
USA	1	BASE	0.88	1.59	0.55	0.35
	2	4%	0.88	1.59	0.55	0.35
	3	15%	0.88	1.59	0.55	0.35
	4	25%	0.88	1.59	0.55	0.35
	5	50%	0.88	1.59	0.55	0.35
	6	96%	0.88	1.59	0.55	0.35
Mexico	1	BASE	0.84	1.40	0.61	0.41
	2	4%	0.85	1.42	0.61	0.41
	3	15%	0.86	1.47	0.58	0.41
	4	25%	0.86	1.48	0.58	0.41
	5	50%	0.86	1.49	0.58	0.41
	6	96%	0.86	1.49	0.58	0.41

¹The "BASE" scenario represents current conditions under which Mexico cannot ship fresh, chilled, or frozen poultry to the United States. The percent scenarios are that portion of Mexican production occurring in relatively low-risk of END transmission states.

- Scenarios 4, 5, and 6: 25, 50, and 96 percent of total Mexican production—these quantities reflect production from additional regions in Mexico as they are gradually recognized as being at relatively low risk of END transmission.

The production of white meat for export to the United States leads to increased production of dark meat in Mexico in all of the scenarios analyzed (table 9). This increase in dark meat production displaces some U.S. exports of dark meat to Mexico. As more Mexican states join the low-risk group (and assuming that Mexico has the capacity to expand its own production), U.S. dark meat exports to Mexico could be entirely displaced. U.S. MDM exports are little affected by changes in the SPS status of Mexican states. There are no significant changes in total U.S. broiler consumption relative to the baseline.

The model results indicate that allowing the relatively low-risk-of-END-transmission states to export fresh

poultry to the United States will largely affect the Mexican broiler market. Higher white meat prices in the United States relative to those in Mexico are expected to increase the total *value* of chickens from low-risk states, leading to an increase in production in these states. Higher prices in the low-risk states will be transmitted to other production regions. U.S. prices for chicken and chicken cuts are not significantly affected by the increase in Mexican imports. In all the scenarios, there were negligible changes in U.S. prices (table 7).

The impacts are negligible because changes in exports to Mexico and imports from Mexico are small compared with U.S. production and consumption. The low U.S. price for dark meat could place a ceiling on Mexican dark meat prices. Mexican dark meat prices may even decline slightly as more dark meat is produced in Mexico as a byproduct of increased production of white meat to be exported to the United States. However, the decrease in domestic whole chickens supplied to the Mexican market will tend to increase

Table 8—Sensitivity analysis: Predicted chicken supply and utilization with expansion of low-risk-of-END areas of Mexico

Country	Scenarios ¹		Production	Imports	Exports	Consumption
USA	1	BASE	14,899	0	2,806	12,093
	2	4%	14,821	33	2,755	12,099
	3	15%	14,760	61	2,717	12,104
	4	25%	14,757	62	2,715	12,104
	5	50%	14,756	63	2,714	12,105
	6	96%	14,756	63	2,714	12,105
Mexico	1	BASE	1,989	173	0	2,162
	2	4%	2,070	120	33	2,157
	3	15%	2,122	87	61	2,148
	4	25%	2,122	87	62	2,147
	5	50%	2,123	87	63	2,147
	6	96%	2,123	87	63	2,147

¹The "BASE" scenario represents current conditions under which Mexico cannot ship fresh, chilled, or frozen poultry to the United States. The percent scenarios are that portion of Mexican production occurring in relatively low-risk of END transmission states.

Table 9—Sensitivity analysis: Predicted chicken trade with expansion of low-risk-of-END areas of Mexico

From	To	Chicken product or part	Scenarios ¹					
			Base	4%	15%	25%	50%	96%
----- 1,000 metric tons -----								
USA	Mexico	Dark meat	81	31	—	—	—	—
USA	Mexico	Backs, necks, MDM	92	89	87	87	87	87
Mexico	USA	White meat	—	33	61	62	63	63

¹The "BASE" scenario represents current conditions under which Mexico cannot ship fresh, chilled, or frozen poultry to the United States. The percent scenarios are that portion of Mexican production occurring in relatively low-risk of END transmission states.

their price in Mexico. Ultimately, these factors are likely to cause higher prices for white meat and whole chickens in Mexico and a decline in Mexican dark meat prices.

The scenarios are all based on the assumption that the Mexican poultry industry in the low-risk states can expand in response to higher prices. If one more major Mexican production state is recognized as relatively low risk of END transmission (representing 15 percent of Mexican total production), then U.S. exports of dark meat could be affected. There is little difference in the expected economic impacts in the United States and Mexico between the scenario that adds 15 percent to Mexican production and scenarios that add higher percentages. Once 15 percent of Mexico's production is eligible for export to the United States, Mexican production will have expanded enough to eliminate dark meat imports, and Mexican breast meat shipments to the United States will not have a significant effect on the U.S. market.

Despite Mexico's importance in poultry trade, elimination of Mexico as an export market for U.S. dark meat would only lower U.S. chicken exports by 3 percent. Total Mexican chicken production would expand at

most by 7 percent, because at that level of production white and dark meat prices equalize in both countries. Increased supplies of white meat from Mexico and decreased exports of dark meat to Mexico lead to slightly lower U.S. broiler production relative to the base, less than 1 percent. U.S. chicken consumption changes little.

An expanding Mexican poultry industry could have a potentially beneficial effect on other U.S. agribusiness industries. Increased broiler production would require an increase in feed grain⁶ demand and much of this grain is expected to come from the United States. In summary, at present the two markets complement each other, and if Mexico could sustain its lower production costs and meet the SPS requirements, it could satisfy its own dark meat demand. Moreover, model results indicate that Mexico may have the potential to develop a significant broiler industry.

⁶ Currently in Mexico, there are tariff-rate quotas (TRQ) on whole kernel corn imports from the United States but none for worked corn (any processed corn such as ground, cracked, or kibbled corn) and sorghum. According to Ensminger (1992), sorghum is a 100-percent substitute for corn in poultry feed rations.

Conclusions and Further Research

U.S.-Mexico poultry trade is influenced by comparative advantage in production and differences in consumer tastes. Another major force driving poultry trade is the impact of sanitary regulations. Currently, poultry processing plants from all regions of Mexico that have been certified to export to the United States can only export processed poultry (e.g., canned or cooked) if they follow strict plant cleaning protocols. At present Mexico is petitioning FSIS for certification to export fresh, chilled, and frozen poultry to the United States. In addition, Mexico requested APHIS to consider additional states to be declared low risk for transmitting END.

Difficulties in comparing U.S. and Mexican “wholesale” prices limit the ability to make any predictions with certainty of trade flows once the relatively low-risk-of-END-transmission states are certified for fresh, chilled, and frozen poultry meat export to the United States. It appears that white meat has a higher price in the United States. If this is the case, and Mexican processing plants could meet SPS standards, it would be to their advantage to ship their white meat north to the United States. Because Sinaloa and Sonora are small producers of chicken, they could greatly expand their production. Export of all their white meat to the United States would have little effect on U.S. poultry prices. Even under the assumption that almost all Mexican states are declared relatively low risk of END transmission and can ship fresh, chilled, and frozen poultry to the United States, the effect on U.S. prices could be very small.

However, if more Mexican states are recognized as relatively low risk of END transmission, then U.S. exports of dark meat to Mexico may be substantially eliminated. It can be expected that expansion of the Mexican poultry industry would lead to increased shipments of U.S. feed grains to Mexico. The model presented in this study only addresses trade between the United States and Mexico. Future analysis could entail a global study to evaluate Mexico’s potential trade position in the world poultry market.

Additional research could address a number of issues related to U.S.-Mexican poultry trade. The model has identified the most important factor driving trade as the differences in wholesale chicken prices. The main priority for further research is to determine at which level in the marketing channel Mexican prices for chicken and chicken products are directly comparable to U.S. wholesale prices. Other research items include: 1) expanded study of the Mexican poultry market to measure the current production of poultry in Mexico, especially the two states with relatively low risk of END transmission and their ability to expand their capacity; 2) comparison of U.S.-Mexico poultry cost structure; 3) analysis of the institutional structure of the wholesale-retail broiler market in Mexico; 4) analysis of potential trade flows and the impact on farmers, processors, and consumers on both sides of the border; and 5) analysis of Mexico’s competitiveness in the world poultry market.

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